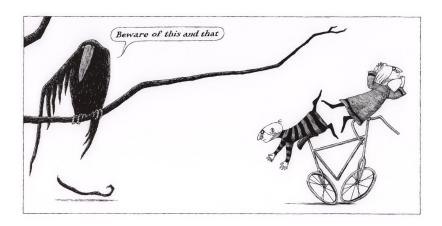**If found, please return to:**

Record of Important Things

Simply, people can no longer remember passwords good enough to reliably defend against dictionary attacks, and are much more secure if they choose a password too complicated to remember and then write it down. We're all good at securing small pieces of paper. I recommend that people write their passwords down on a small piece of paper, and keep it with their other valuable small pieces of paper: in their wallet.

Bruce Schneier CTO, Resilient

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Cryptographically-secure passphrases with Diceware

What is a Diceware passphrase?

A passphrase is a bunch of words and characters that you type in to your computer to let it know for sure that the person typing is you. Passphrases differ from passwords only in length.

Diceware is a method for picking passphrases that uses dice to select words at random from a special list. Each word in the list is preceded by a four digit number. All the digits are between one and six, allowing you to use the outcomes of four dice rolls to select a word from the list.

Directions

1 Decide how many words you want in your passphrase. A four-word passphrase provides a level of security *much* higher than the passwords most people use. For NSA-proof security, use seven.

2 Roll all four dice at once and write the results down, reading from left to right, on a scrap paper. Make as many of these four-digit groups as you want words in your passphrase.

3 Flip to the word list and look up the corresponding word next to each four-digit number.

4 The words that you have found are your new passphrase! If required, capitalize a memorable word, and replace the last word with its four digit number.

5 Come up with a way to remember your phrase. It might be a story, scenario, or sentence that that can remind you of the particular words you chose, in order.

Example

Suppose you want a five-word passphrase. You will need 5×4 or 20 dice rolls. Let's say they come out as:

1, 6, 6, 6, 5, 1, 5, 6, 5, 3, 5, 6, 3, 2, 2, 3, 5, 6, 2, and 6.

Write the results on a scrap of paper in groups of four:

1 6 6 6
5 1 5 6
5 3 5 6
3 2 2 3
5 6 2 6

You then look up each group of five rolls in the Diceware word list by finding the number in the list and writing down the word next to the number:

1666 cognitive
5156 poetic
5356 ribbon
3223 garlic
5626 smelliness

Your passphrase would then be:

cognitive poetic ribbon garlic smelliness

This passphrase is one of the 3,656,158,440,062,976 (about 2^{51}) alternatives that could have been chosen by this method.

1111 acid
1112 acorn
1113 acre
1114 acts
1115 afar
1116 affix
1121 aged
1122 agent
1123 agile
1124 aging
1125 agony
1126 ahead
1131 aide
1132 aids
1133 aim
1134 ajar
1135 alarm
1136 alias
1141 alibi
1142 alien
1143 alike
1144 alive
1145 aloe
1146 aloft
1151 aloha
1152 alone
1153 amend
1154 amino
1155 ample
1156 amuse
1161 angel
1162 anger
1163 angle
1164 ankle
1165 apple
1166 april
1211 apron
1212 aqua
1213 area
1214 arena
1215 argue
1216 arise
1221 armed
1222 armor
1223 army
1224 aroma
1225 array
1226 arson
1231 art
1232 ashen
1233 ashes
1234 atlas
1235 atom
1236 attic
1241 audio
1242 avert
1243 avoid
1244 awake
1245 award
1246 awoke
1251 axis
1252 bacon
1253 badge
1254 bagel
1255 baggy
1256 baked
1261 baker

1262 balmy
1263 banjo
1264 barge
1265 barn
1266 bash
1311 basil
1312 bask
1313 batch
1314 bath
1315 baton
1316 bats
1321 blade
1322 blank
1323 blast
1324 blaze
1325 bleak
1326 blend
1331 bless
1332 blimp
1333 blink
1334 bloat
1335 blob
1336 blog
1341 blot
1342 blunt
1343 blurt
1344 blush
1345 boast
1346 boat
1351 body
1352 boil
1353 bok
1354 bolt
1355 boned
1356 boney
1361 bonus
1362 bony
1363 book
1364 booth
1365 boots
1366 boss
1411 botch
1412 both
1413 boxer
1414 breed
1415 bribe
1416 brick
1421 bride
1422 brim
1423 bring
1424 brink
1425 brisk
1426 broad
1431 broil
1432 broke
1433 brook
1434 broom
1435 brush
1436 buck
1441 bud
1442 buggy
1443 bulge
1444 bulk
1445 bully
1446 bunch
1451 bunny
1452 bunt

1453 bush
1454 bust
1455 busy
1456 buzz
1461 cable
1462 cache
1463 cadet
1464 cage
1465 cake
1466 calm
1511 cameo
1512 canal
1513 candy
1514 cane
1515 canon
1516 cape
1521 card
1522 cargo
1523 carol
1524 carry
1525 carve
1526 case
1531 cash
1532 cause
1533 cedar
1534 chain
1535 chair
1536 chant
1541 chaos
1542 charm
1543 chase
1544 cheek
1545 cheer
1546 chef
1551 chess
1552 chest
1553 chew
1554 chief
1555 chili
1556 chill
1561 chip
1562 chomp
1563 chop
1564 chow
1565 chuck
1566 chump
1611 chunk
1612 churn
1613 chute
1614 cider
1615 cinch
1616 city
1621 civic
1622 civil
1623 clad
1624 claim
1625 clamp
1626 clap
1631 clash
1632 clasp
1633 class
1634 claw
1635 clay
1636 clean
1641 clear
1642 cleat
1643 cleft

1644 clerk
1645 click
1646 cling
1651 clink
1652 clip
1653 cloak
1654 clock
1655 clone
1656 cloth
1661 cloud
1662 clump
1663 coach
1664 coast
1665 coat
1666 cod
2111 coil
2112 coke
2113 cola
2114 cold
2115 colt
2116 coma
2121 come
2122 comic
2123 comma
2124 cone
2125 cope
2126 copy
2131 coral
2132 cork
2133 cost
2134 cot
2135 couch
2136 cough
2141 cover
2142 cozy
2143 craft
2144 cramp
2145 crane
2146 crank
2151 crate
2152 crave
2153 crawl
2154 crazy
2155 creme
2156 crepe
2161 crept
2162 crib
2163 cried
2164 crisp
2165 crook
2166 crop
2211 cross
2212 crowd
2213 crown
2214 crumb
2215 crush
2216 crust
2221 cub
2222 cult
2223 cupid
2224 cure
2225 curl
2226 curry
2231 curse
2232 curve
2233 curvy
2234 cushy

2235 cut
2236 cycle
2241 dab
2242 dad
2243 daily
2244 dairy
2245 daisy
2246 dance
2251 dandy
2252 darn
2253 dart
2254 dash
2255 data
2256 date
2261 dawn
2262 deaf
2263 deal
2264 dean
2265 debit
2266 debt
2311 debug
2312 decaf
2313 decal
2314 decay
2315 deck
2316 decor
2321 decoy
2322 deed
2323 delay
2324 denim
2325 dense
2326 dent
2331 depth
2332 derby
2333 desk
2334 dial
2335 diary
2336 dice
2341 dig
2342 dill
2343 dime
2344 dimly
2345 diner
2346 dingy
2351 disco
2352 dish
2353 disk
2354 ditch
2355 ditzy
2356 dizzy
2361 dock
2362 dodge
2363 doing
2364 doll
2365 dome
2366 donor
2411 donut
2412 dose
2413 dot
2414 dove
2415 down
2416 dowry
2421 doze
2422 drab
2423 drama
2424 drank
2425 draw

2426 dress	2621 fade	3212 gala	3363 harm	3554 keg
2431 dried	2622 fall	3213 game	3364 hash	3555 kept
2432 drift	2623 false	3214 gap	3365 hasty	3556 kick
2433 drill	2624 fancy	3215 gas	3366 hatch	3561 kilt
2434 drive	2625 fang	3216 gave	3411 hate	3562 king
2435 drone	2626 fax	3221 gear	3412 haven	3563 kite
2436 droop	2631 feast	3222 gecko	3413 hazel	3564 kitty
2441 drove	2632 feed	3223 geek	3414 hazy	3565 kiwi
2442 drown	2633 femur	3224 gem	3415 heap	3566 knee
2443 drum	2634 fence	3225 genre	3416 heat	3611 knelt
2444 dry	2635 fend	3226 gift	3421 heave	3612 koala
2445 duck	2636 ferry	3231 gig	3422 hedge	3613 kung
2446 duct	2641 fetal	3232 gills	3423 hefty	3614 ladle
2451 dude	2642 fetch	3233 given	3424 help	3615 lady
2452 dug	2643 fever	3234 giver	3425 herbs	3616 lair
2453 duke	2644 fiber	3235 glad	3426 hers	3621 lake
2454 duo	2645 fifth	3236 glass	3431 hub	3622 lance
2455 dusk	2646 fifty	3241 glide	3432 hug	3623 land
2456 dust	2651 film	3242 gloss	3433 hula	3624 lapel
2461 duty	2652 filth	3243 glove	3434 hull	3625 large
2462 dwarf	2653 final	3244 glow	3435 human	3626 lash
2463 dwell	2654 finch	3245 glue	3436 humid	3631 lasso
2464 eagle	2655 fit	3246 goal	3441 hump	3632 last
2465 early	2656 five	3251 going	3442 hung	3633 latch
2466 earth	2661 flag	3252 golf	3443 hunk	3634 late
2511 easel	2662 flaky	3253 gong	3444 hunt	3635 lazy
2512 east	2663 flame	3254 good	3445 hurry	3636 left
2513 eaten	2664 flap	3255 gooey	3446 hurt	3641 legal
2514 eats	2665 flask	3256 goofy	3451 hush	3642 lemon
2515 ebay	2666 fled	3261 gore	3452 hut	3643 lend
2516 ebony	3111 flick	3262 gown	3453 ice	3644 lens
2521 ebook	3112 fling	3263 grab	3454 icing	3645 lent
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5521 slum	5656 stem	6235 task	6414 twice	6553 width
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5523 slush	5662 stew	6241 tasty	6416 twins	6555 wifi
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5525 smash	5664 sting	6243 thank	6422 twist	6561 wimp
5526 smell	5665 stir	6244 thaw	6423 uncle	6562 wind
5531 smile	5666 stock	6245 theft	6424 uncut	6563 wing
5532 smirk	6111 stole	6246 theme	6425 undo	6564 wink
5533 smog	6112 stomp	6251 thigh	6426 unify	6565 wipe
5534 snack	6113 stony	6252 thing	6431 union	6566 wired
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5541 snarl	6116 stoop	6255 thorn	6434 upon	6613 wish
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5546 snort	6125 straw	6264 thump	6443 usher	6622 wool
5551 snout	6126 stray	6265 thus	6444 utter	6623 woozy
5552 snowy	6131 strut	6266 tiara	6445 value	6624 word
5553 snub	6132 stuck	6311 tidal	6446 vapor	6625 work
5554 snuff	6133 stud	6312 tidy	6451 vegan	6626 worry
5555 speak	6134 stuff	6313 tiger	6452 venue	6631 wound
5556 speed	6135 stump	6314 tile	6453 verse	6632 woven
5561 spend	6136 stung	6315 tilt	6454 vest	6633 wrath
5562 spent	6141 stunt	6316 tint	6455 veto	6634 wreck
5563 spew	6142 suds	6321 tiny	6456 vice	6635 wrist
5564 spied	6143 sugar	6322 trace	6461 video	6636 xerox
5565 spill	6144 sulk	6323 track	6462 view	6641 yahoo
5566 spiny	6145 surf	6324 trade	6463 viral	6642 yam
5611 spoil	6146 sushi	6325 train	6464 virus	6643 yard
5612 spoke	6151 swab	6326 trait	6465 visa	6644 year
5613 spoof	6152 swan	6331 trap	6466 visor	6645 yeast
5614 spool	6153 swarm	6332 trash	6511 vixen	6646 yelp
5615 spoon	6154 sway	6333 tray	6512 vocal	6651 yield
5616 sport	6155 swear	6334 treat	6513 voice	6652 yo-yo
5621 spot	6156 sweat	6335 tree	6514 void	6653 yodel
5622 spout	6161 sweep	6336 trek	6515 volt	6654 yoga
5623 spray	6162 swell	6341 trend	6516 voter	6655 yoyo
5624 spree	6163 swept	6342 trial	6521 vowel	6656 yummy
5625 spur	6164 swim	6343 tribe	6522 wad	6661 zebra
5626 squad	6165 swing	6344 trick	6523 wafer	6662 zero
5631 squat	6166 swipe	6345 trio	6524 wager	6663 zesty
5632 squid	6211 swirl	6346 trout	6525 wages	6664 zippy
5633 stack	6212 swoop	6351 truce	6526 wagon	6665 zone
5634 staff	6213 swore	6352 truck	6531 wake	6666 zoom
5635 stage	6214 syrup	6353 trump	6532 walk	
5636 stain	6215 tacky	6354 trunk	6533 wand	
5641 stall	6216 taco	6355 try	6534 wasp	
5642 stamp	6221 tag	6356 tug	6535 watch	

Questions & answers regarding online security

Shouldn't I never write my password down?

In today's world, major corporations are hacked every week, and distributed cracking networks can break complex passwords in record time. It's safest to use a strong, unique password for each account you hold, but this makes memorization impractical.

Once, people were told not to write passwords down, ever, but the consensus among security professionals has evolved. You're better at protecting this book than corporations are at securing their password databases.

Can I just pick my own words from the word list?

No. Humans are terrible at being unpredictable, and hackers are great at exploiting predictability. The primary reason that Diceware creates secure passwords is that you have no agency in the process.

Should I leave spaces between the words?

Yes. It makes your passphrase more secure, *and* easier to type on a mobile phone.

How many words should I use in my passphrase?

The most important accounts, such as e-mail, e-commerce and financial sites, should use at least five words.

Encrypted drives storing sensitive personal and financial documents should use seven words.

Less important accounts, like social media, can use three words, provided each password is used only once.

My passphrase is rejected because it is too long, or because it lacks capitalization and numbers.

You may shorten words to no less than three letters without affecting the security of your passphrase, provided the shortened version remains unique within the word list. You may also replace words with their associated 4 digit number. You may *not* choose different words.

Capitalization adds a very small amount of security; if required, pick a memorable word to capitalize.

What if I lose this book?

The real purpose of this book is to provide you with the tools to generate strong, memorable passwords that are unbreakable by the world's most powerful computers. It need not be the only place that you record them.

Are password manager apps like 1Password safe?

Yes, as long as the master password is strong & secure. For example, if Google Chrome is configured to store your password, make sure that you have a strong Google password, and don't leave your account logged on computers or mobile devices that are not physically secure. The same is true of Safari and iCloud, Internet Explorer and Windows Live, etc.

Who invented Diceware?

Diceware was invented by Arnold G. Reinhold, a computer scientist in Cambridge, MA. It was first published to Usenet's *sci.crypt.research* on August 1st, 1995. For more information, visit `http://world.std.com/~reinhold/diceware.html`.

This book implements a simplified version developed by the Electronic Frontier Foundation (EFF) in 2016, which uses only four dice.

What is the danger in re-using a password?

Imagine that you used the same password for an online clothing store, and your e-mail provider. Months later, the clothing store is hacked and your password is stolen. The hackers login to your email and find correspondence from your bank. They use the bank website to reset your online banking password, and intercept the confirmation email. Next, they use the bank website to order checks in your name, initiate transfers, etc.

This story illustrates why the security of your e-mail ranks above others in importance: for hackers, it is the gateway to all your accounts.

How can I find out if my password has been stolen?

Visit https://haveibeenpwned.com/ or a similar site, and type in your e-mail address. They track the data leaks released by hackers, and can identify which e-mail addresses were hacked, and how much data was released.

If your e-mail tests positive, immediately change the password for the sites listed *and* any sites that might have used the same password.

What is two-factor authentication?

Two-factor authentication enhances your password by sending a code to your phone or another device, which you then have to type in order to be authorized. This ensures that even if someone has your password, they also need to have your phone.

It's a good idea to set up two-factor authentication on any account linked to your bank account or credit cards.

The US Government no longer recommends SMS for two-factor authentication, due to the ease with which text messages can be intercepted. Mobile apps such as Google Authenticator are more secure.

What is phishing?

Phishing is when a hacker sends you an email that appears to be from an organization you have a relationship with, but is actually a trap to get you to give up your password.

Phishing e-mails typically warn you that something is wrong with your account, and urge you to log in via a link. They can be very realistic and insidious.

Always check the URL in any e-mailed links you click, and make sure that they take you to the site you expect. Better yet, ignore links in e-mails and go directly to the website for the organization.

What is social engineering?

Social engineering is when a hacker contacts a company you do business with and pretends to be you. Often this means telling customer service that you have lost your password, and trying to convince the representative to change it or otherwise unlock your account.

The best protection against social engineering is to avoid using easily-guessed security questions, such as your mother's maiden name. When offered an opportunity to enter such security questions, generate a Diceware password instead.

How can I stay safe online?

Above all, practice good operational security (*opsec*). Be suspicious and careful online.

Minimize the number of accounts you open, and always choose the best account security available.

Keep track of the accounts you open, close unused accounts, and change passwords on active accounts regularly.

Prefer to shop with businesses that have strong online safeguards, and take advantage of identity protection and online shopping protection services offered by *reputable* financial services.

What to do if I've been hacked?

The resources at `www.crashoverridenetwork.com` and `staysafeonline.org` are a good starting point. They provide tools that help determine whether you have been hacked and can help regain control over your online accounts.

Record of Important Things
Compiled & edited by Wade Brainerd

XKCD comic from:
`https://xkcd.com/936/`

The LATEX source code for this book is located at:
`https://github.com/wadetb/dicebook`