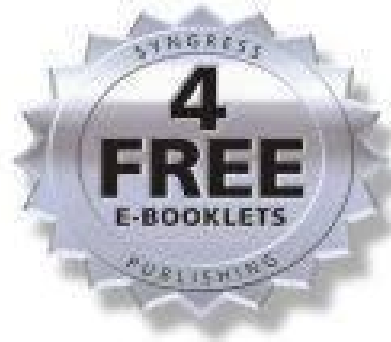


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Perfect Passwords: Selection, Protection, Authentication

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Chapter 1

Passwords: The Basics and Beyond

...alighting from his beast, he tied it up to a tree, and going to the entrance, pronounced the word which he had not forgotten, "*Open, Sesame!*" Hereat, as was its wont, the door flew open, and entering thereby he saw the goods and hoard of gold and silver untouched and lying as he had left them.

—*Arabian Nights, The Forty Thieves*

The Beginning

My fascination with security began perhaps a decade ago when I took my first job with the official title of software developer. I had written code casually for years, but this was the first time someone paid me to do it. I was a corporate employee. I wrote code all day. I had a network account that I logged in to every morning. Like almost everyone else at the company, I had a weak password that I swapped every three months with another weak password.

I had been interested in various aspects of security for a long time, but information at that time was scarce. Back then, you couldn't just search on Google for something; you found the good information by navigating an endless pathway of hyperlinks from one Web site to the next. The information that I did find was often obsolete, unreliable, or limited in context; thus, I was left unsatisfied.

Nevertheless, I studied everything I could find during any spare minute I had. After I read and reread stacks of printouts, they slowly started to make sense to me. Although I was merely a beginner, I learned a few tricks that enabled me to gain already some rank as the office hacker.

Then one morning I got my calling. A friend of mine who was one of the company executives pulled me into his office, explained a predicament the company faced, and told me that the company needed my help. The senior network administrator had been in a heated argument with the company vice president earlier that morning. In the middle of the argument, the network administrator slammed his keys on the table, cleared out his desk, and left the company. Now, the company management wanted me to break in to all the systems and recover all the administrator's passwords because the vice president was too scorned to call the admin asking for the passwords. I knew that I didn't have the experience to take on such a task, but still I couldn't help being seduced by the challenge. I told him I would do it.

But once I sat down at my desk, reality set in; I was enormously intimidated by this undertaking. Sure, I knew a few tricks, but presuming that I could actually accomplish this task was absurd. I thought that perhaps I should have admitted to my friend that I wasn't as skilled as he thought. Had I gone too far? Had my own hubris clouded my judgment? As inconsequential as this incident might sound, it was my defining moment.

I could have failed. I would have failed that day if I had not discovered this remarkable truth about hackers: their superhuman skills don't make them successful; rather, everyone else fails so much at security that hackers just make it look easy. I discovered that people don't have strong passwords. Moreover, we use the same passwords repeatedly, never straying far from a few core passwords. When it comes to passwords, we just aren't that clever.

I obtained the administrator's Microsoft Access password and then his e-mail password. Next, I got his Windows NT administrator password. One password at a time his security fell—*superman1*, *superman23*, *superman95*, *Wonderwoman*.

I didn't do anything special that day except discover this decisive weakness of human security—that is, that humans are horribly predictable. Late that night I e-mailed the list of passwords to my friend. I went home, buzzing from the thrill of what I had just accomplished.

The next morning I just happened to approach the office building at the same time as the company president and vice president. They both turned, and as if they had rehearsed it beforehand, opened the front door and bowed before me. I was confused at first, but then realized that they had already heard about the passwords I had collected. I walked through the doorway feeling happy for the recognition from the top of the company. I loved the attention, but from that point on, I was infatuated—almost obsessed—with security, passwords, and the character of human behavior.

Our Passwords

Passwords, in some form or another, have long been associated with security. We see it in literature all the time: to unlock a door, to pass a guard, or to distinguish friend from enemy. These ambiguous words or phrases are the keys to magical spells or the secret codes to identify one spy to another.

Secret codes are an indispensable part of our modern lives. We use them to check our e-mail and voice mailboxes. We need them to withdraw money from an ATM or to connect to our online banking account. We use them to authorize financial transactions and to buy and sell items on the Internet. We use them to limit access to wireless Internet connections and to encrypt our most sensitive private data. You may even find yourself needing a password to order pizza, purchase flowers, rent a DVD, or get a car wash. We are a world of secrets.

Whether they are referred to as passwords, PINs, passcodes, or some other name, they are all secret keys that we hold to gain access to the protected portions of our lives.

Passwords are more than just a key. They serve several purposes. They *authenticate* us to a machine to prove our identity—a secret that only we should know. They ensure our *privacy*, keeping our sensitive information secure. They also enforce *nonrepudiation*, preventing us from later rejecting the validity of transactions authenticated with our passwords. Our username identifies us; the password validates us.

But passwords have some weaknesses: more than one person can possess knowledge of the secret any one time. Unlike a physical key that only one person can hold at a time, you have no guarantee that someone else hasn't somehow obtained your password, with or without your knowledge. Moreover, there is a constant threat of losing your password to someone else with malicious intent. Password thefts can and do happen on a daily basis—by the thousands. Your only defense is to build a strong password, protect it carefully, and change it regularly.

The other weakness with passwords is human behavior. Human nature is such that we do not fear threats that we do not perceive. We cannot imagine why someone would want to gain access to our e-mail or network accounts. We feel reasonably safe with the passwords that we select.

That one day at work, I walked past the company president and vice president, passed through the entrance, walked down the hall, and sat down at my desk. I logged in to my network account with my own weak password and was suddenly struck with the knowledge of my own weakness. I realized that my own security was just as fragile as the security system that I had broken the day before. Just seeing my last two passwords, someone could easily guess my current password and probably the next one after that. At least one other coworker already knew my password because I shared it with him one day when I was out sick so that he could access my files. I decided that day to change my attitude about passwords.

A number of years ago, I sat in an audience and watched a performance of the amazing Kreskin, a self-proclaimed mentalist. I watched as he consistently predicted and manipulated the human behavior of the audience. During his tricks, he explained that he didn't have any special powers, just an extraordinary understanding of human behavior.

He consistently guessed secrets selected by the audience and related facts about the personal lives of many audience members, facts such as their social security numbers or dates of birth. He is not alone. Psychics, fortune-tellers, mediums, magicians, and others often depend on human predictability for the success of their crafts. Undoubtedly, people just behave the same.

If you ask someone to name a vegetable, 98 percent of the time, that person will tell you a carrot. Tell someone to pick an even number between 50 and 100, where both digits are different, most commonly people will pick the number 68. Think of a card. The most common choices predictably are nine of diamonds, ace of spades, queen of hearts, or the six of clubs.

You might even find yourself with exceptional skills at predicting human nature, anticipating the behavior of others, for example, or guessing the ends of movies. Remarkably, as poor as we are at avoiding predictability, we are exceptionally capable of detecting predictability in others.

Consider the list of random passwords shown in Table 1.1. If you study the list for a few minutes, you will start to see simple and predictable patterns emerge.

bmw66	fuzzy1	trisha
Jessica1	Steven	123456
sa1856	Alexis	gregory2
843520	xmen94	brutus1
0214866	link11	lakers7
m9153p	1nani1	lamacod1
cyril87	Bubba1	pariz2
7082382	856899	letmein
100265	grady6	tiger69
jimmyd2	mpick1	cats999
wes333	mjordan2	supra1
053092	sti2000	bearcub
40belix	usa123	wargame6
6Bueler	Lieve27	dan1028
Franc1	3089172	13crow
Nicole3	Roswell	ncc1701
elin97	67bird	jun0214
toyota4	rat22	password

Table 1.1 Random Passwords

The amazing thing is that this small list accurately represents the nature of human passwords. You could give you a list of a thousand or even a million passwords, and you would learn little more about passwords than you could from this small list.

I know because I have actually done it. Over the years I have collected real passwords from every source I could find. I have collected almost 4 million passwords, and my list continues to grow through an automated set of tools that scour the Internet for passwords, often using nothing more than ordinary search engines such as Google. I collected these passwords to gain a better understanding of how people select passwords. For five years I collected, researched, and stared at passwords—thousands of *QWERTY*s, thousands of *12345*s.

The most amazing discovery I made was absolutely nothing. Having more passwords did not change any of my password statistics; the choices of characters remained the same. The top 500 passwords were mostly the same. Password length, complexity, and lack of creativity—all unchanged.

In fact, my numbers were pretty close to other password studies conducted decades ago. Passwords were—and still are—predictably the same over and over: a number or two at the end, a couple numbers at the beginning, all numbers, names of loved ones, dates, vehicles, sports teams, pop culture references, and the ever-present *letmein* and *password*. I could collect another four million passwords and would probably get the same results.

If anything frustrates me about passwords, it is that so many people think they are being clever and unique, but they just aren't. If you could see a million passwords, you would probably be surprised to find that your password looks a lot like everyone else's. If you have ever gone on a long flight across the continental United States, you might have noticed that there is not a lot to see but thousands of square miles of empty space. Occasionally, you pass over a cluster of civilization, but then it's right back to empty land.

That is very much what I see when I look at passwords. So many possibilities remain untouched while thousands cluster around the same few passwords.

Over the years, I began to categorize passwords by their patterns. Here are some of the most common categories of password-writing patterns. These are examples of what you should *not* do and never follow these patterns.

Weak Wordlist Words

This category includes dictionary words, your first or last name, a common password, or a simple phrase that you are likely to find on some wordlist somewhere. These passwords are the worst because they are so vulnerable to dictionary attacks as explained in the next chapter.

- cupcake
- auto
- badger
- letmein
- Jonathon
- Red Sox
- dirty dog

Weak Wordlist Words with Numbers

Only trivially stronger than a simple wordlist word, these passwords include numbers that people add to the front or end of a password in attempt at security or to meet specific policy requirements. Here are some examples:

- deer2000
- atlanta33
- dana55
- fred1234
- 99skip

Weak Wordlist Words with Simple Obfuscation

Again, these passwords are only slightly stronger than a simple wordlist word. These passwords usually have some simple character replacements or deliberate misspellings. Here are a few examples:

- B0ngh
- g0ldf1sh
- j@ke

License Plate Passwords

These passwords include some short phrase that makes use of abbreviations, numbers, or other techniques. These passwords certainly are stronger than a wordlist word, but they are by no means unique. They often read like license plates. Here are some examples:

- sk8ordie
- just4fun
- dabomb
- kissme
- laterpeeps

Weak Wordlist Words Doubled

Most password-cracking tools will check for this simple pattern. Here are some examples:

- crabcrab
- patpat
- joejoe

Garbled Randomness

These passwords are technically more secure because they are random and less predictable, but as you will read in this book, having a password that is easy to remember and easy to type is also essential for security. Here are some examples:

- 9uxg\$t5C
- Bn2#sz63j
- &fM3tc8b

Patterns or Sequences

These passwords could fall into the category of wordlist words because they are so common. The passwords include some pattern or sequence that is based on the appearance or shape of letters or on the location of the keys on the keyboard.

- QWERTY
- 123456
- xcvb
- abc123
- typewriter (all letters on the same keyboard row)

Summary

The single most important aspect of information security is strong passwords. Likewise, the single greatest security failure is weak passwords. Network administrators blame users for selecting such poor passwords, and users blame network administrators for the inconvenience of their draconian password policies.

Further complicating the problem are hundreds of thousands of software and hardware products that have been and continue to be sold with default passwords that users never get around to changing (see defaultpassword.com to understand how big this problem really is).

People select poor passwords and do little to protect them. They share their passwords with others and use the same passwords repeatedly on multiple systems. At the same time, computing power has increased along with the number and quality of tools available to hackers.

Consequently, many have predicted that passwords, at least by themselves, will someday become obsolete. I hear people talk about retina or fingerprint scanners, but at some point, security will still involve some secret, some password.

The good news is that passwords don't have to be obsolete. In this book, I describe techniques for how you can build very strong passwords and explain how to protect your password from attack. All we need to do is follow some simple rules, use some basic common sense, and treat our passwords like real secrets. By implementing these practices, we can extend the life of this simple method of authentication.

The age of the password is not over yet.

Chapter 2

Meet Your Opponent

The Cracker

Password cracking is the method of employing various techniques and tools to guess, methodical determine, or otherwise obtain a password to gain unauthorized access to a protected resource. Password cracking is sometimes used to legitimately recover a lost password, and sometimes a system administrator will use password cracking to test user passwords. But, for the most part, password cracking is used to steal passwords.

Some call it a game; others, a crime. But whatever it is called, both the most talented computer professionals and the novice use it. As one hacker told me, “[Password cracking] is power... the power to compel a system to yield its knowledge.”

I met that hacker in an IRC room. Well known in the hacking underground for his specialized password-cracking software, this hacker agreed to speak with me on conditions of anonymity—no mention even a reference to his pseudonym. “I’m not a hacker or an exploiter. I just crack passwords,” he told me, “but still everyone calls me a hacker. Hacker, cracker; it’s all the same.”

Why does he do it? “For trading, selling, sharing,” he told me. “It gets me respect, and, hey, it’s fun and addicting,” he explained, “and I’m not the only one doing this; it goes on all the time.”

This is the reality. There are people who steal passwords for some form of gain, and it happens all the time.

Why *My* Password?

Perhaps the most common question I hear when it comes to security is, why would one individual have anything tantalizing enough for a hacker to steal his or her passwords? One reason for hacker attacks might be to disguise their identities for purposes such as sending spam, or the attack might be just one jump in the process of leapfrogging toward bigger targets. The attack might be to perform financial transactions to defraud others, or it might be to gain access to one of your subscribed services. The fact is that you cannot even comprehend the ways in which your password would be useful to another.

Password theft is a huge problem. Some Web sites are obviously more attractive targets, but no target, no matter how small, is exempt from this problem.

Password Cracking

Password cracking, once a specialized skill, is now available to just about anyone using widely available tools with names like L0phtcrack, John the Ripper, and Cain & Abel. However, before learning about password-cracking techniques, it is important to understand how a system stores your password.

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