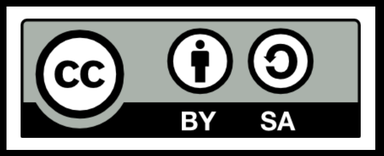
SitePassword

A Hybrid Password Manager

Alan H. Karp alanhkarp@gmail.com

25 October 2023



“Passwords are terrible, and we won’t be using them in 10 years.”

“Passwords are terrible, and we won’t be using them in 10 years.”

Everybody

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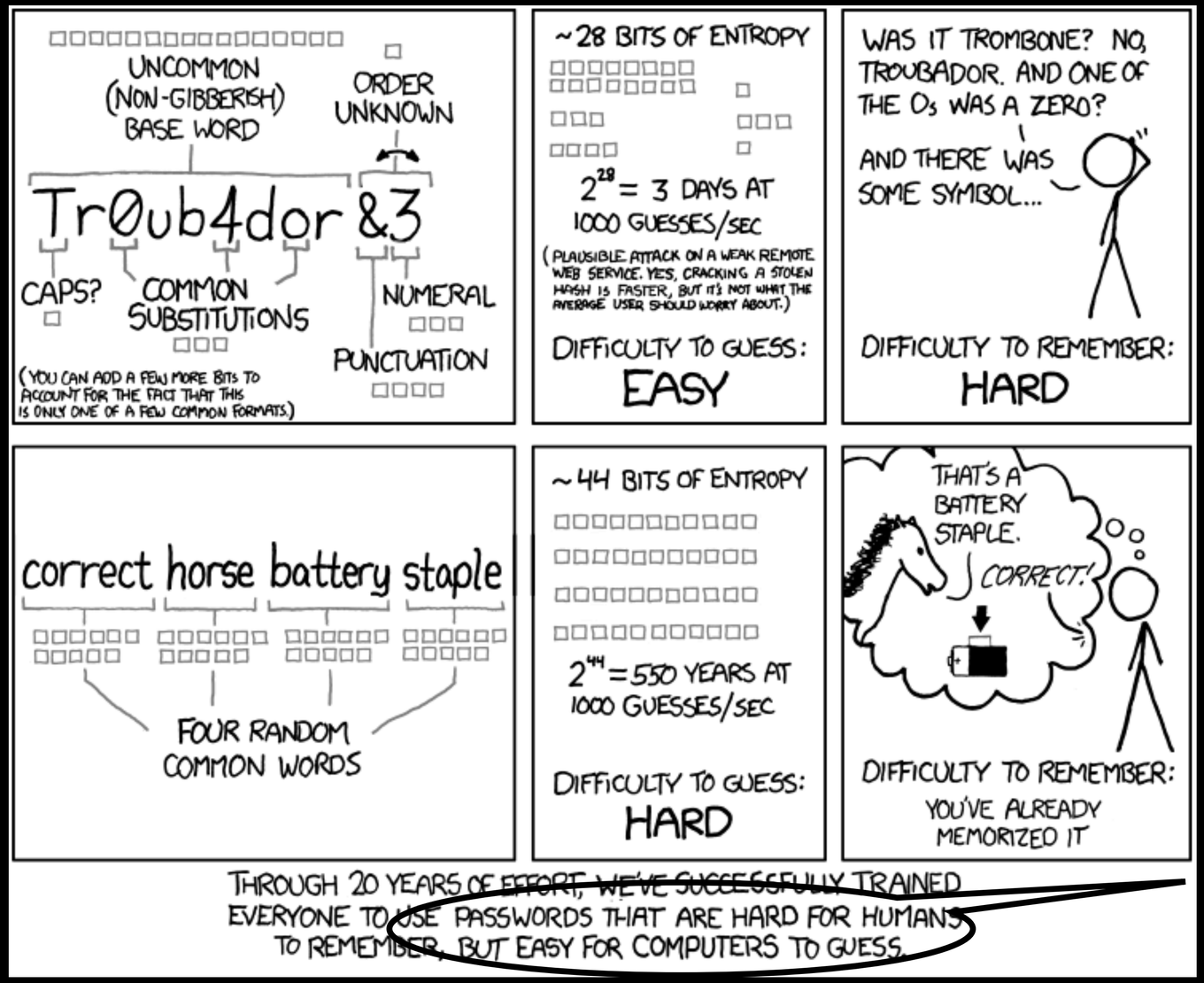
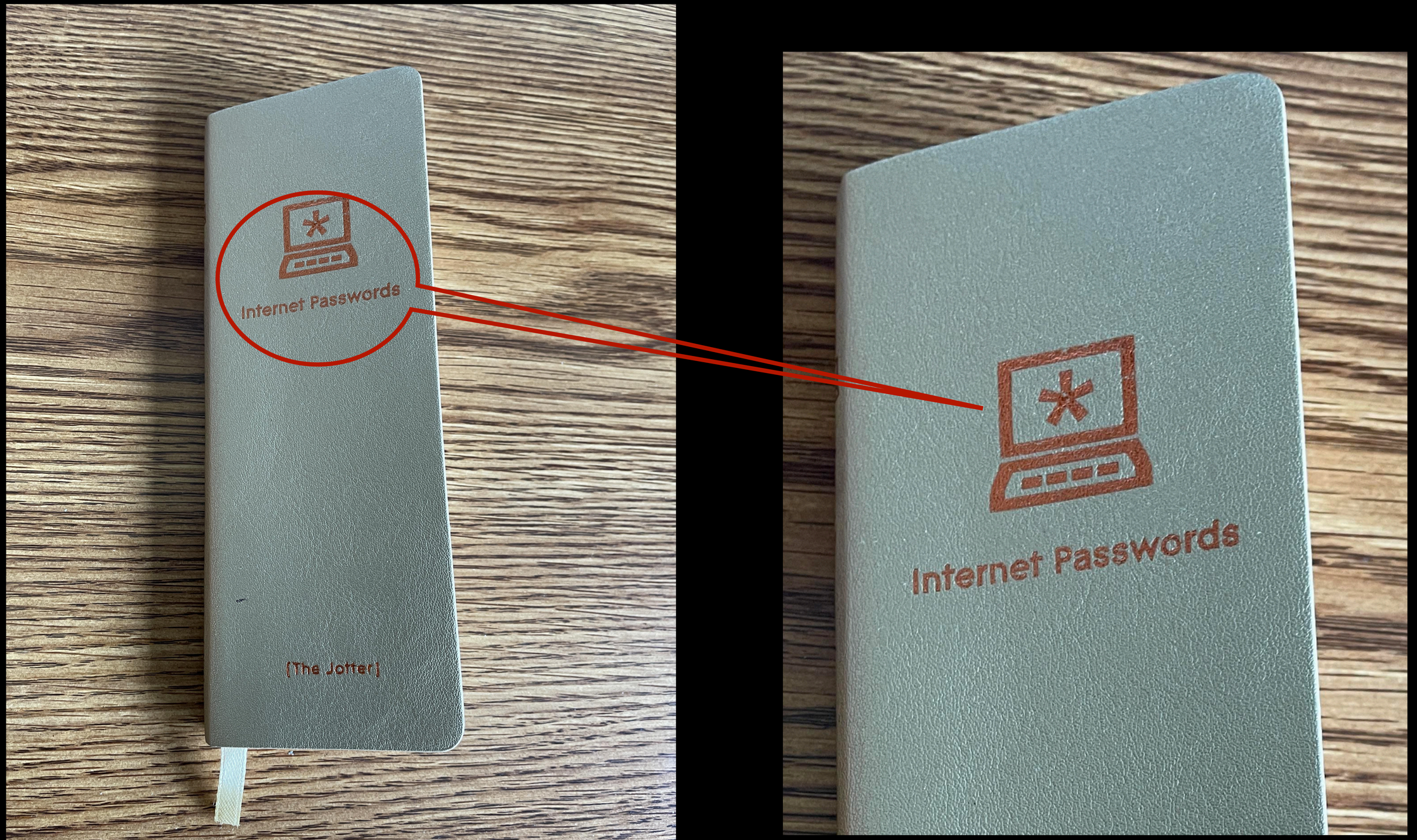
Everybody

2023 2013 2003 1993 1983 1973 1963

What's So Bad about Passwords?



Passwords are hard for people to remember and easy for computers to guess.


Internet Passwords
[The Jotter]
Internet Passwords

Theorem

Any password algorithm you can hold in your head is easy to guess.

Proof

Well, duh!

The human brain is simply not wired for this problem.

Do You Use a Password Manager?

One of the top recommended security practices but only 40% use them

Do You Use a Password Manager?

One of the top recommended security practices but only 40% use them

- 1Password ($36)
- LastPass ($36)
- DashLane ($60)
- Keeper ($35)
- ZohoVault (Free or $54)
- Avira ($32)
- RememBear (Shutting down)
- PassBolt (Free if you host)
- Bitwarden (Free or $40)
- LogMeOnce ($48)
- NordPass (Free or $36)
- PasswordBoss (Free?)
- RoboForm ($24)
- Your Browser (Free)

Password Manager Characteristics

- Requirements
  - Easy to use
  - Engenders trust
  - Use from anywhere
- Other desirable features
  - Secure
  - Strong passwords
  - Different for every site
  - Handle password changes

What is a Password Manager?

A software application designed to **store** and manage online credentials. It also generates passwords. Usually, the passwords are stored in an encrypted database locked behind a master password. — malwarebytes.com

A password manager is an app on your phone, tablet, or computer that **stores** your passwords, so you don't have to remember them. — ncsc.gov

A password manager is a service that helps you generate and **store** long, unique passwords for all your online accounts. — consumerreports.org

So What's So Bad about That?

- Where are your passwords stored?
  - On your machine?
  - In the cloud? Who's cloud?
- How are they stored?
- It costs money
    - To manage your account
    - To pay for the cloud resources

And then There’s This to Worry About

We recently detected unusual activity within a third-party cloud storage service, …

We have determined that an unauthorized party, …was able to gain access to certain elements of our customers’ information. **Our customers’ passwords remain safely encrypted due to LastPass's Zero Knowledge architecture**.

Reports of cryptocurrency seed phrases being stolen

A Different Approach

Don’t Remember Your Passwords, Calculate Them

- It can be free
  - No accounts to manage
  - No password storage needed
- Can even be used without network access
- **You are in control**
  - Carry a piece of paper with everything you need to get your passwords.
  - It’s not great if you lose it, but it isn’t terrible either.

A Brief History of SitePassword

The Earliest Days

2003

The Earliest Days

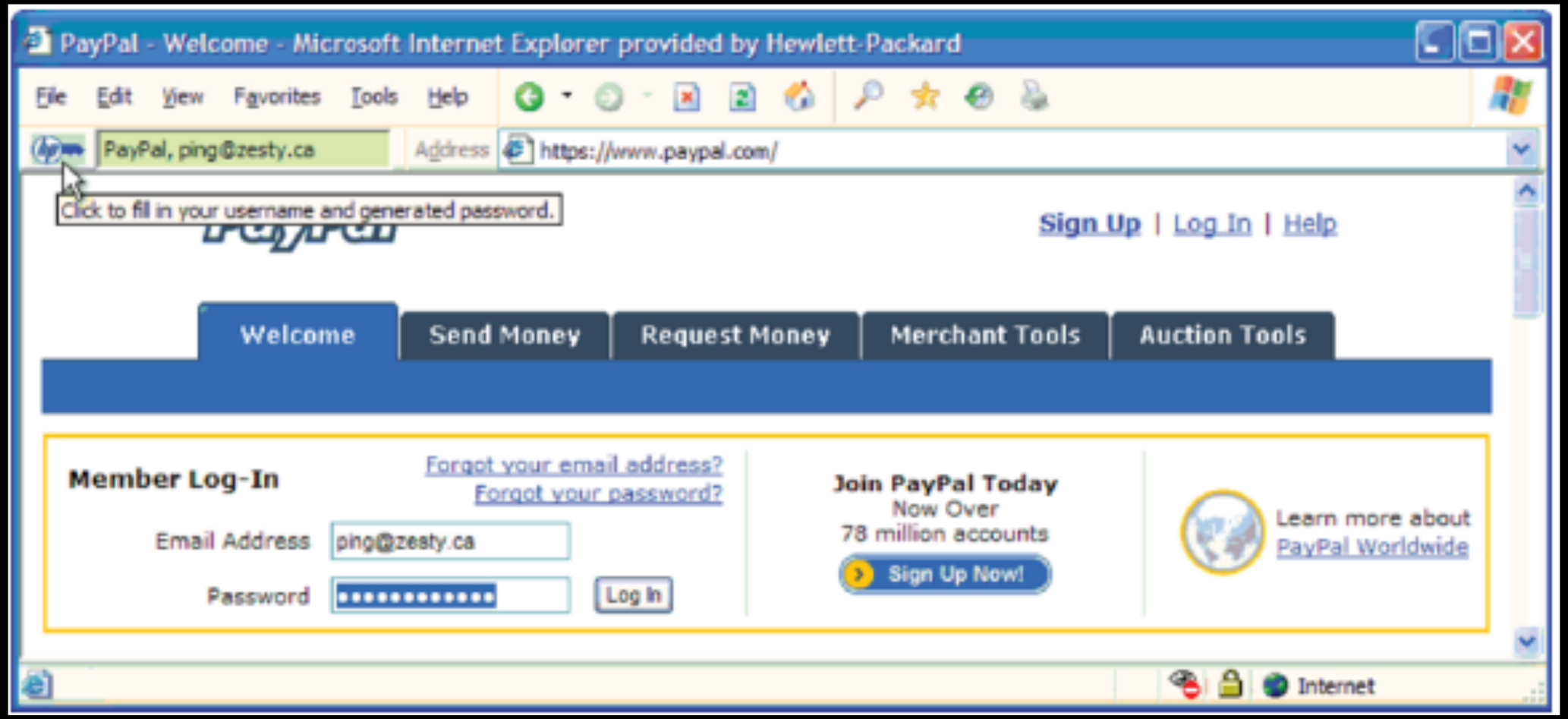
2003

HP Anti-Phishing Toolbar for IE

2005

HP Anti-Phishing Toolbar for IE

2005



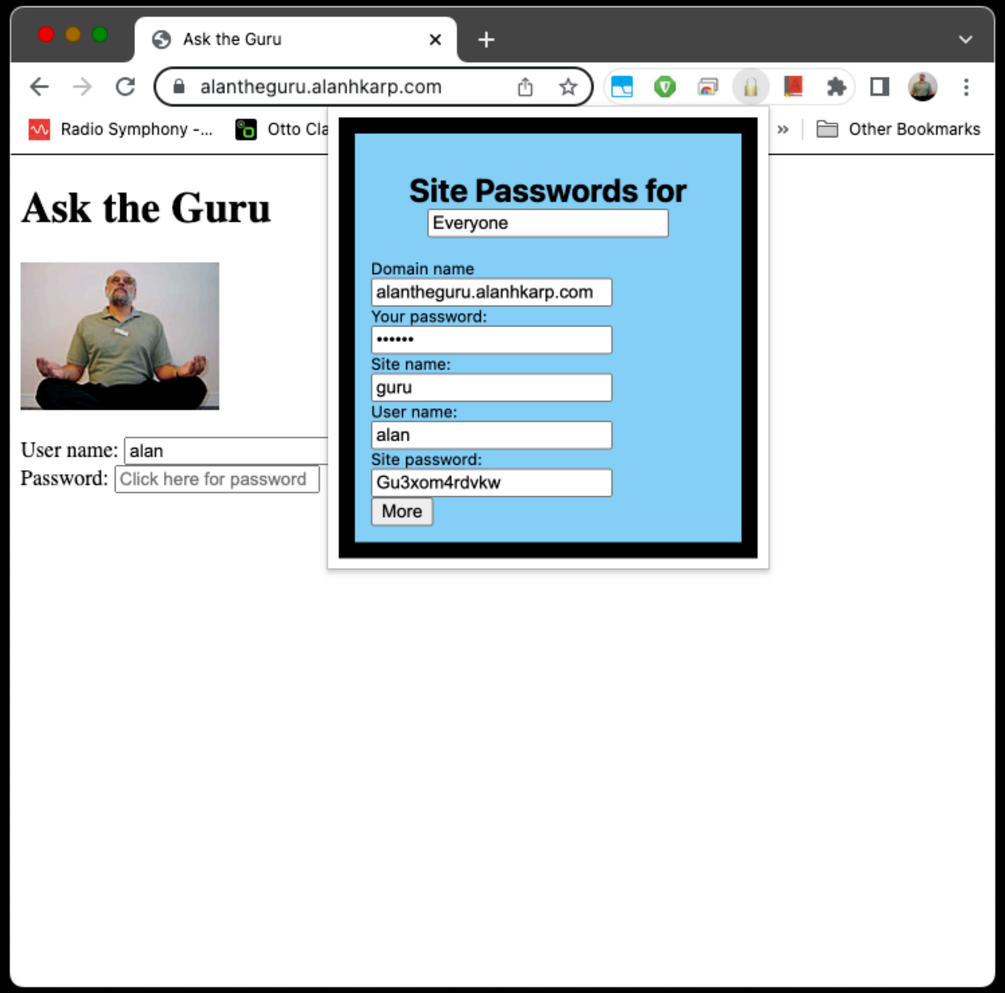
Chrome Extension

2012

Chrome Extension

2012

- Some Problems
  - No sync across machines
  - Only finds 60% of password fields
  - Unhappy with personas
- Only available for testers
- Only I used it for the next 10 years



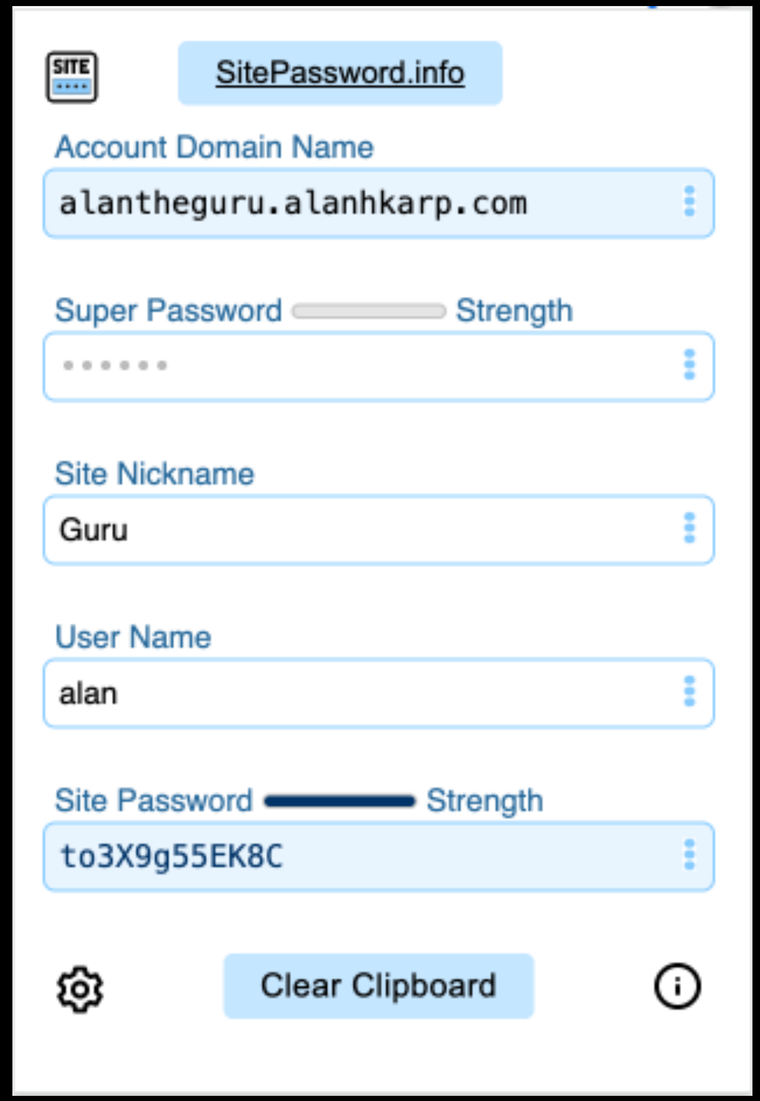
And Then

2021

- Google says I have to update it.
- “No problem,” I say to myself. “It’ll only take a week or so.”
- Almost two years later …….

Why It Took So Long

- Google’s changes
  - From a persistent background page to a transient service worker
  - Everything is async
- Fixed what I didn’t like
  - Always(?) finds password field
  - Synchronizes across machines
  - Handles different personas



Let Google Do the Heavy Lifting

- Store settings in bookmarks
  - Every browser syncs bookmarks
  - But Google doesn’t merge duplicates
- Supporting personas with Profiles
  - Switch Profile without logging out
  - Each Profile has its own bookmarks

A Taste of SitePassword

Ask the Guru

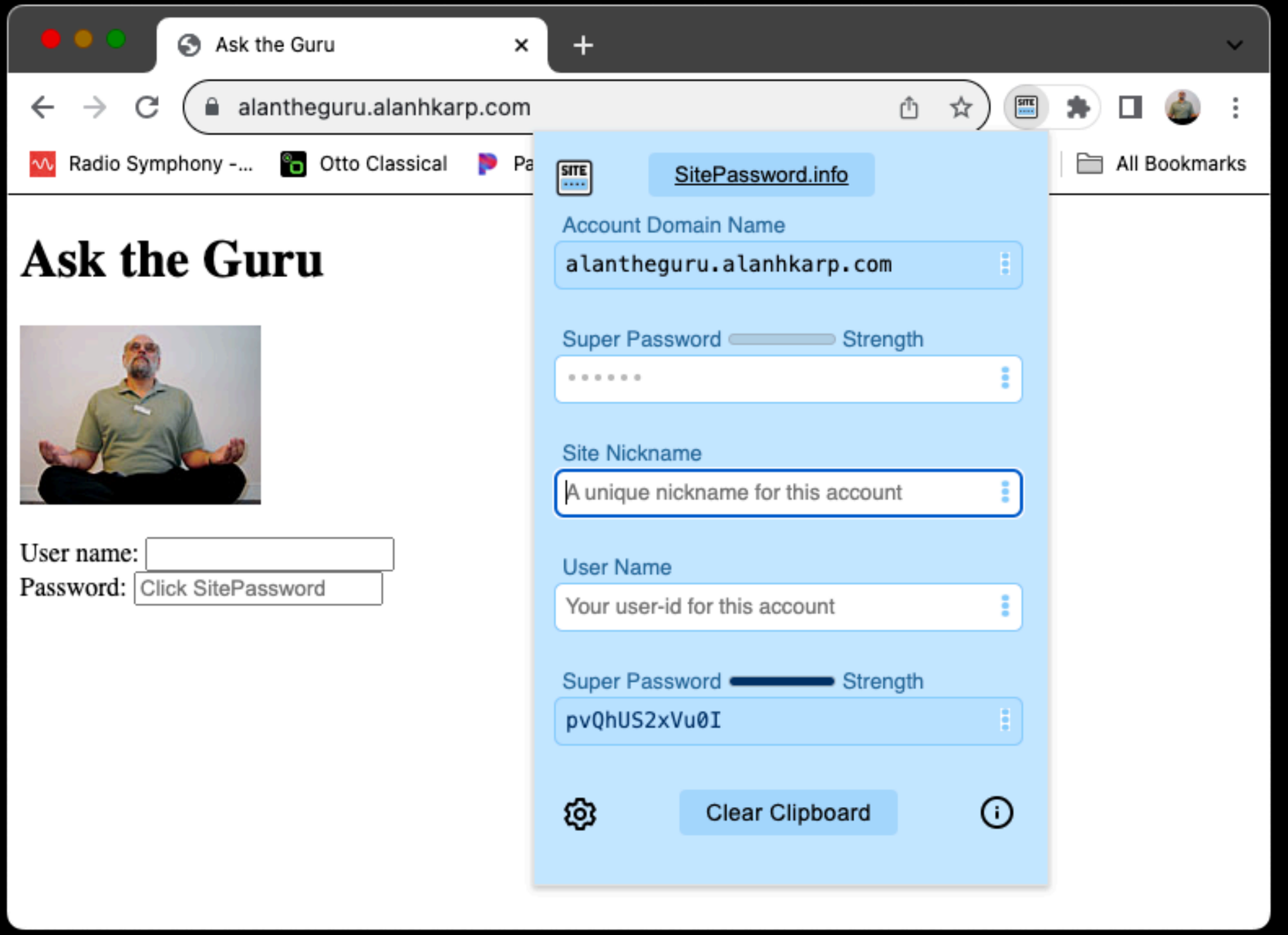
alantheguru.alanhkarp.com

Radio Symphony -... Otto Classical Pandora Friam Hangout All Bookmarks

Ask the Guru

User name:

Password: Click SitePassword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All Bookmarks
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Password:
Click SitePassword
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Account Domain Name
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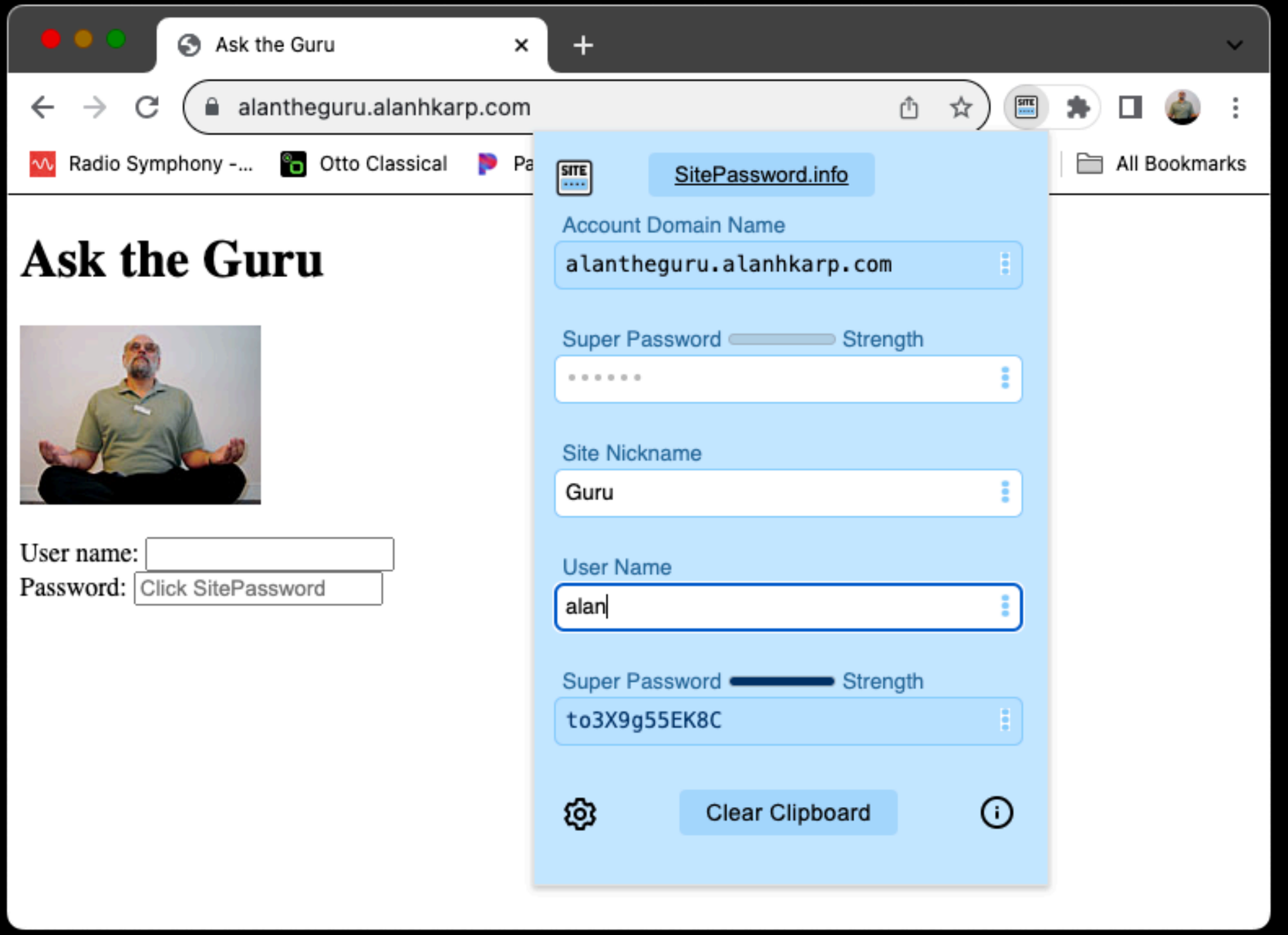
Super Password Strength
Site Nickname
A unique nickname for this account
User Name
Your user-id for this account
Super Password Strength
pvQhUS2xVu0I
Clear Clipboard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Super Password Strength
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Guru
User Name
alan
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to3X9g55EK8C
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Ask the Guru

User name: alan

Password: Click here for password

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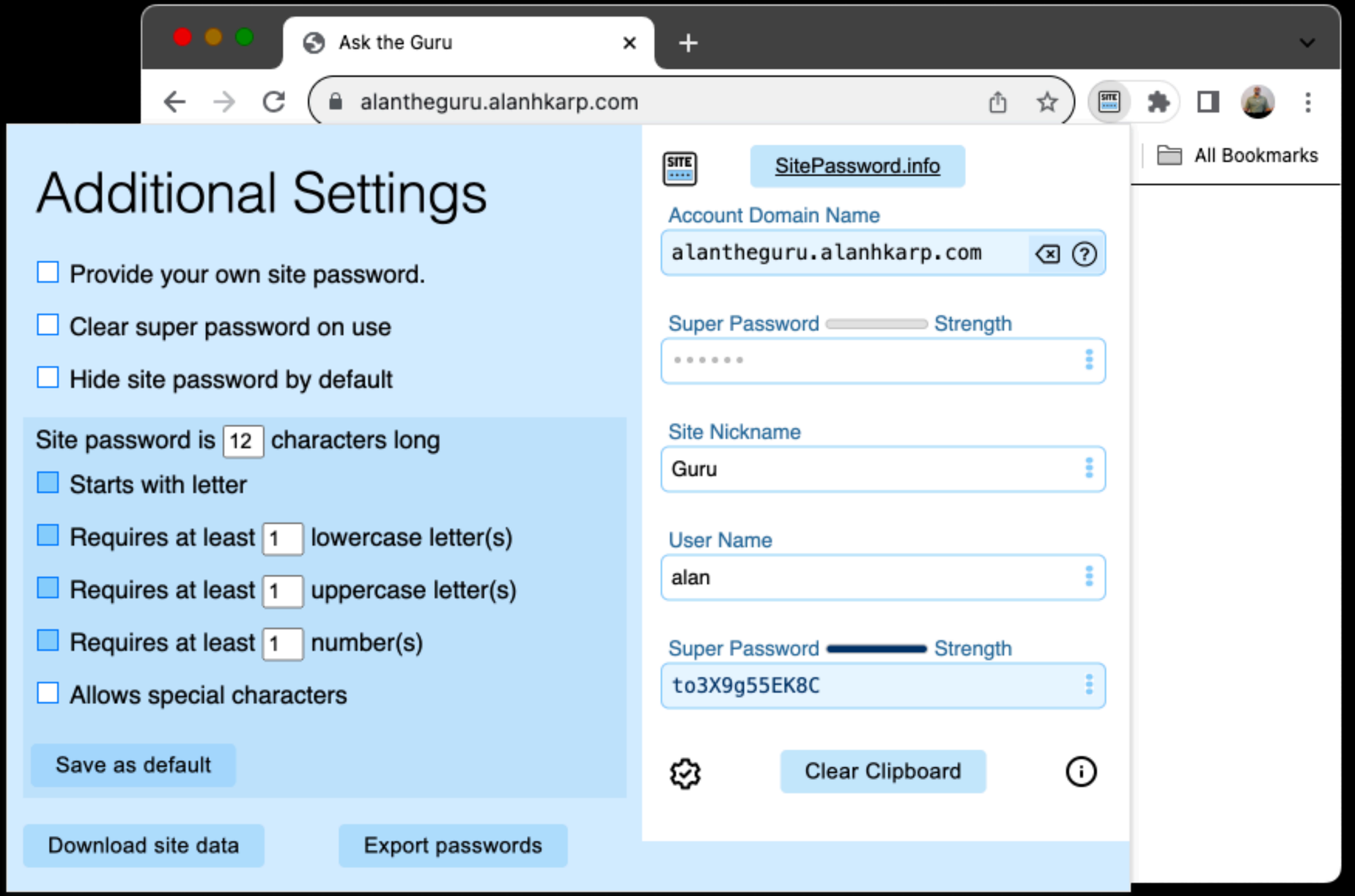
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All Bookmarks
Additional Settings
Provide your own site password.
Clear super password on use
Hide site password by default
Site password is 12 characters long
Starts with letter
Requires at least 1 lowercase letter(s)
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Save as default
Download site data
Export passwords
SitePassword.info
Account Domain Name
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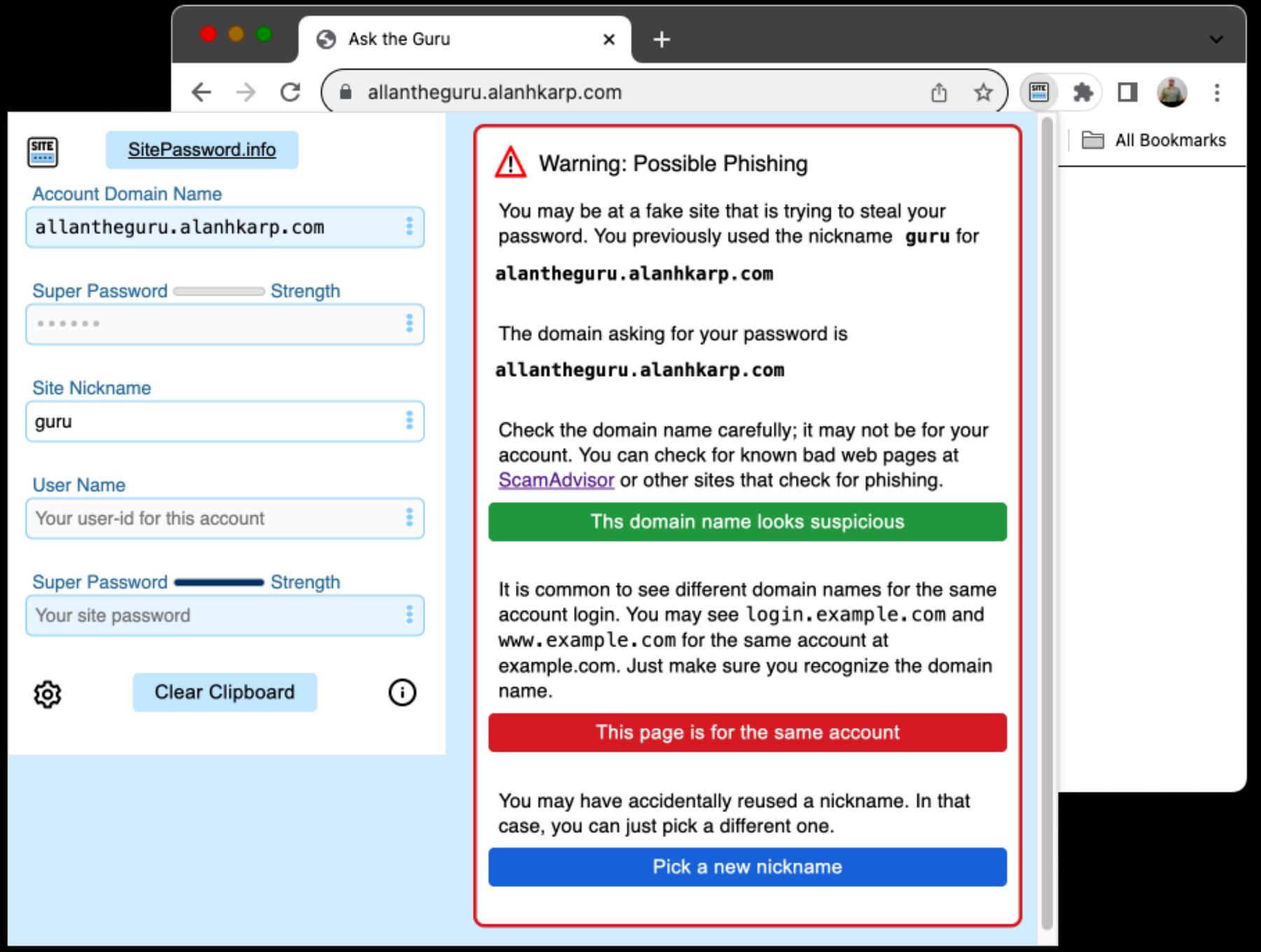
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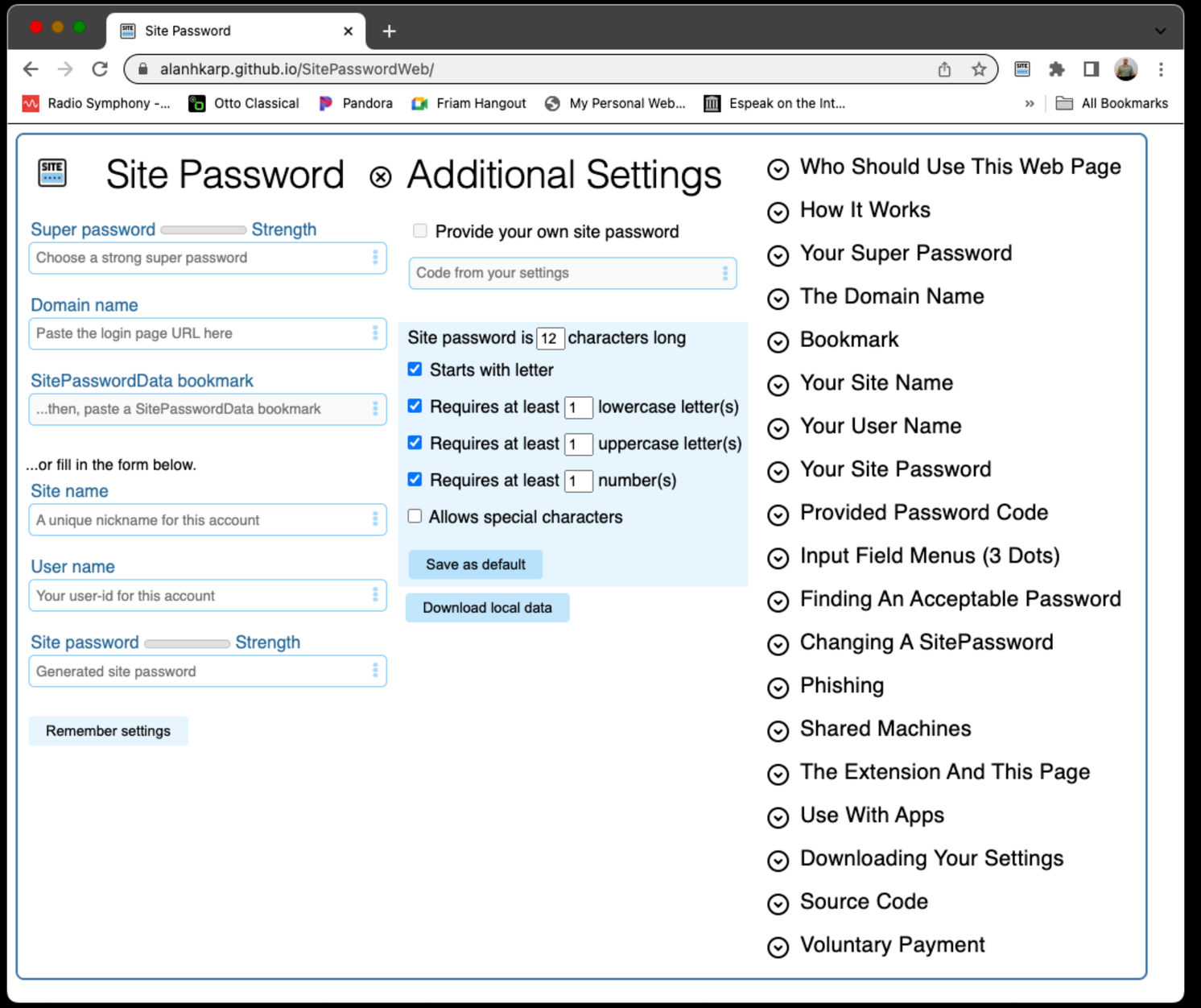
Site Nickname
guru
User Name
Your user-id for this account
Super Password Strength
Your site password
Clear Clipboard
Warning: Possible Phishing
You may be at a fake site that is trying to steal your password. You previously used the nickname guru for
alantheguru.alanhkarp.com
The domain asking for your password is
allantheguru.alanhkarp.com
Check the domain name carefully; it may not be for your account. You can check for known bad web pages at ScamAdvisor or other sites that check for phishing.
Ths domain name looks suspicious
It is common to see different domain names for the same account login. You may see login.example.com and www.example.com for the same account at example.com. Just make sure you recognize the domain name.
This page is for the same account
You may have accidentally reused a nickname. In that case, you can just pick a different one.
Pick a new nickname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Radio Symphony -...
Otto Classical
Pandora
Friam Hangout
My Personal Web...
Espeak on the Int...
All Bookmarks
Site Password ⊗ Additional Settings
Super password Strength
Choose a strong super password
Domain name
Paste the login page URL here
SitePasswordData bookmark
...then, paste a SitePasswordData bookmark
...or fill in the form below.
Site name
A unique nickname for this account
User name
Your user-id for this account
Site password Strength
Generated site password
Remember settings
Provide your own site password
Code from your settings
Site password is 12 characters long
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Requires at least 1 number(s)
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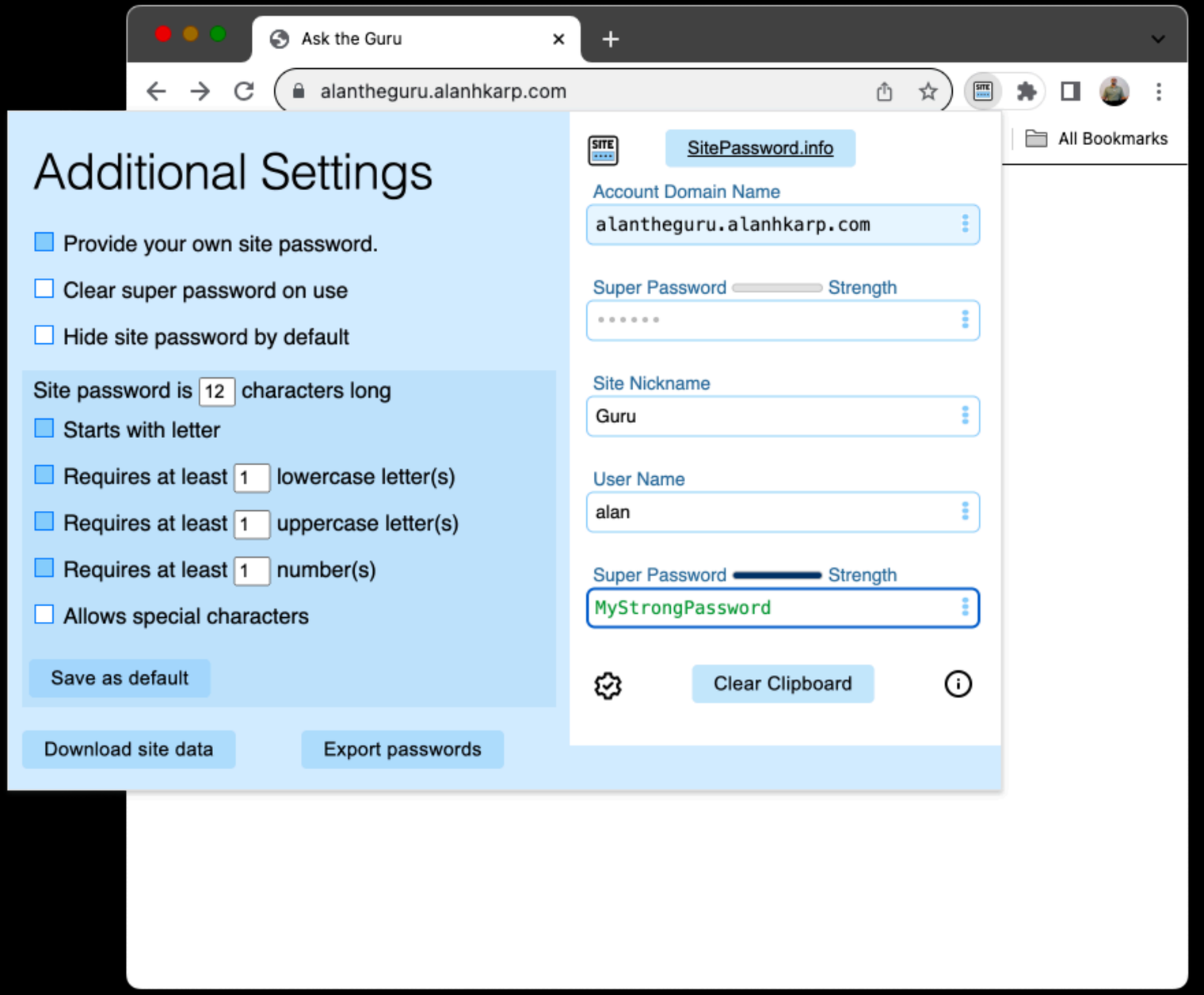
Save as default
Download local data
Who Should Use This Web Page
How It Works
Your Super Password
The Domain Name
Bookmark
Your Site Name
Your User Name
Your Site Password
Provided Password Code
Input Field Menus (3 Dots)
Finding An Acceptable Password
Changing A SitePassword
Phishing
Shared Machines
The Extension And This Page
Use With Apps
Downloading Your Settings
Source Code
Voluntary Payment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SitePassword.info
Account Domain Name
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Super Password Strength
Site Nickname
Guru
User Name
alan
Super Password Strength
MyStrongPassword
Clear Clipboard

Usability

War Stories

Password Manager Security

Mobile Devices

Situation is Really Bad

- Too easy to spoof app identity
- iframes inside Android WebView can spoof messages
- One password manager pulled their app

Built into the Browser

- Pluses
  - Better than not using a password manager
  - Never resorts to the clipboard
  - Always finds userid field
- Minuses
  - Not as secure
  - Some don’t generate passwords, only store them
  - Many don’t consider the password policy

Chrome Browser Password Manager

As Bad as it Gets

- Autofills with no user action
- Passwords not encrypted by default
- Warns on weak passwords, but only after you look
- Assumes any field of type “password” holds a password
- Can’t customize generated password to fit site’s password rules
- Uses same password for smile.amazon.com and amazon.com, but not amazon.co.uk

It’s More than Just Passwords Strength

- Autofill must require user action
  - Or you might put the password into a form controlled by an attacker
  - But where you click matters
- Storage Security
  - Only protection is strength of your password manager password
- User Communication
  - Inform on weak/reused passwords
  - Generated passwords sometimes weak (oMMMMMMMT?m*m)

It’s More than Just the Passwords

- Phishing sites and phishing the password manager password
- Domain name errors — google.evil.com vs google.com
- Accessibility features
- jQuery on the login page
- Code size - one password manager is over 250,000 lines of code
  - SitePassword is about 2,500 lines with no external dependencies
- Worst of all - Not using a password manager due to lack of trust

How to Inject a Password Field

- HTTP login page - submits forms with HTTPS
  - Doesn’t happen much now but (Schwab, eBay)
- Broken HTTPS
  - Usually an expired certificate (HP Labs internal)
- HTTPS with active content fetched over HTTP
- XSS (Cross Site Scripting) on any page at the victim site

The Evil Coffee Shop Attack

Autofill with no user action

1. The user sets up several sites with a password manager.
2. User connects to a rogue router in a coffee shop.

   The attacker can inject, block, and change network packets.
3. Attacker directs user’s browser to a vulnerable page at the target site.
4. Attacker injects login form into the vulnerable page by modifying packets.
5. Your password manager fills it in.
6. Repeats for another site with a vulnerable page.

SitePassword Security

The Good

- Require click on password field
- Callback registered only on visible password fields
- Use iframe domain name if its password field clicked
- Use zxcvbn() from Dropbox for password strength meter
- Site name and user name act as salt to defeat pre-computation attacks
- Warn if password might still be on the clipboard
- XOR provided passwords with computed one(?)

The Not So Good

But for Good Reasons

- Settings in bookmarks
  - Settings not encrypted
  - Stored on disk and in Google cloud
- Site password visible by default
  - Gives you a sense of how random looking the site passwords are
  - Don’t often open the popup
- 12-character site passwords by default

The Ugly

An offline attack against super password

1. You create an account at evil.com
2. Bad guy knows site password and username and can guess site name
3. Bad guy starts guessing super passwords

- Mitigations
  - Strong super password
  - Hash a minimum of 100 times to get site password
  - Multiple super passwords
  - 2-factor for super password

A Crypto Mitigation

- SitePassword uses SHA-256
  - Produces 44 characters
  - Default site password is 12 characters
  - Roughly 3 or 4 guesses produce the same site password
  - Must be checked online
- What I want
  - Hard to invert hash function with 1M collisions in 256-bit space

Summary

Future Work

- User studies
- Security review
- Other browsers
  - Works on Chromium browsers, e.g., Brave, Chrome, Edge
  - Needs more testing on Firefox
  - Proof of concept on Safari
- IoS and Android apps — Monitoring security issues

References

Slides at https://alanhkarp.github.io/SitePassword/SitePasswordTalk.pdf

- Ping's 10 Principles - http://zesty.ca/pubs/icics-2002-uidss.pdf
- Oesch Thesis - https://trace.tennessee.edu/cgi/viewcontent.cgi?article=7785&context=utk_graddiss
- Oesch Paper - https://www.usenix.org/system/files/sec20-oesch_0.pdf
- https://eprints.whiterose.ac.uk/158056/8/Revisiting_Security_Vulnerabilities_in_Commercial_Password_Managers_2.pdf
- https://www.usenix.org/system/files/soups2019-pearman.pdf
- https://crypto.stanford.edu/~dabo/pubs/papers/pwdmgrBrowser.pdf

Takeaways

- Use a password manager - a bad one is better than none at all
- Turn off any setting that fills in the password without a user action
- Prepare for the worst - Some have gone out of business
- Use it wisely - use strong passwords even if you don’t have to

OR

Take control and use SitePassword

Backup Slides

Usability

Usable Security

No system can be secure if users don’t understand the implications of their actions.

Ping's 10 Princples for a Secure UX

1. Path of Least Resistance: Make the easy way the secure way.
2. Appropriate Boundaries: Make distinctions matter to the user.
3. Explicit Authorization: Authorize only by explicit user action.
4. Visibility: All security related decisions must be viewable.
5. Revocability: Make it easy to revoke granted permissions.
6. Expected Ability: Don't make user think the tool will do what it can't
7. Trusted Path: It should not be possible to spoof the UI.
8. Identifiability: Give each object an identifer that the user understands.
9. Expressiveness: Allow users to express policies that they want.
10. Clarity. Make effects of actions apparent to the user before acting.

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My User Experience Goals

Make it as easy to use as Candy Crush

- Can’t break anything by experimenting
- A Help button is a crutch for developers
- Encourage good practices
  - Warn on weak super/site password
- Choose a readable font, particularly for site password
- Focus the field the user will be needing next

My User Experience Goals

Where I failed

- Getting started
  - Not as obvious as I would like
- Can’t always make “Click here for password” show up
  - Resorted to tooltip, but it takes a second or so to appear
- Closing the popup

How Bad Is It?

One password manager has special cases for over 200 sites.

War Stories

Finding the Password Field

Websites do some weird #%^@

- Put password field in an iframe with a different domain name than page
- Add password field dynamically
- Add password field with type=text and change to type=password
- Many password fields on page but only one visible
- Some sites add CSS at runtime that make the password field visible
- Make password field visible only after you click a button

Finding the Password Field

Websites do some weird #%^@

- Change contents of page based on the fragment
- Password field in a shadow root (shadow DOM)
- Clears the field after I set it (Who the %#^@ knows why)
- Don’t want to update password field at sitepassword.info

Is the Password Field Visible?

Harder to figure out than you may think.

- Does window.computedStyle(element) say it’s visible?
  - Correct most of the time but not always
- Is parent visible?
  - offsetParent != null if position != ‘fixed’
- One clickjacking trick
  - element.style.opacity = “0” reported visible

Finding the UserID Field

Heuristic Used by Many Password Managers

- UserID field is the one immediately before the password field
  - Except when it’s not
- Sometimes to the left
  - Arabic, Hebrew to the right?
- Sometimes intervening fields
  - Some of them not visible

Crazy #%^@

Done by big companies with professional programmers

- Multiple domain names for the same login form
- Login form at a completely different domain
- Username and password fields have the same id
- A bunch of errors when the page loads
  - Took 30 seconds to time out on 4 bad GETs