SitePassword

A Different Kind of Password Manager

Alan H. Karp alanhkarp@gmail.com

18 January 2023

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

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Everybody

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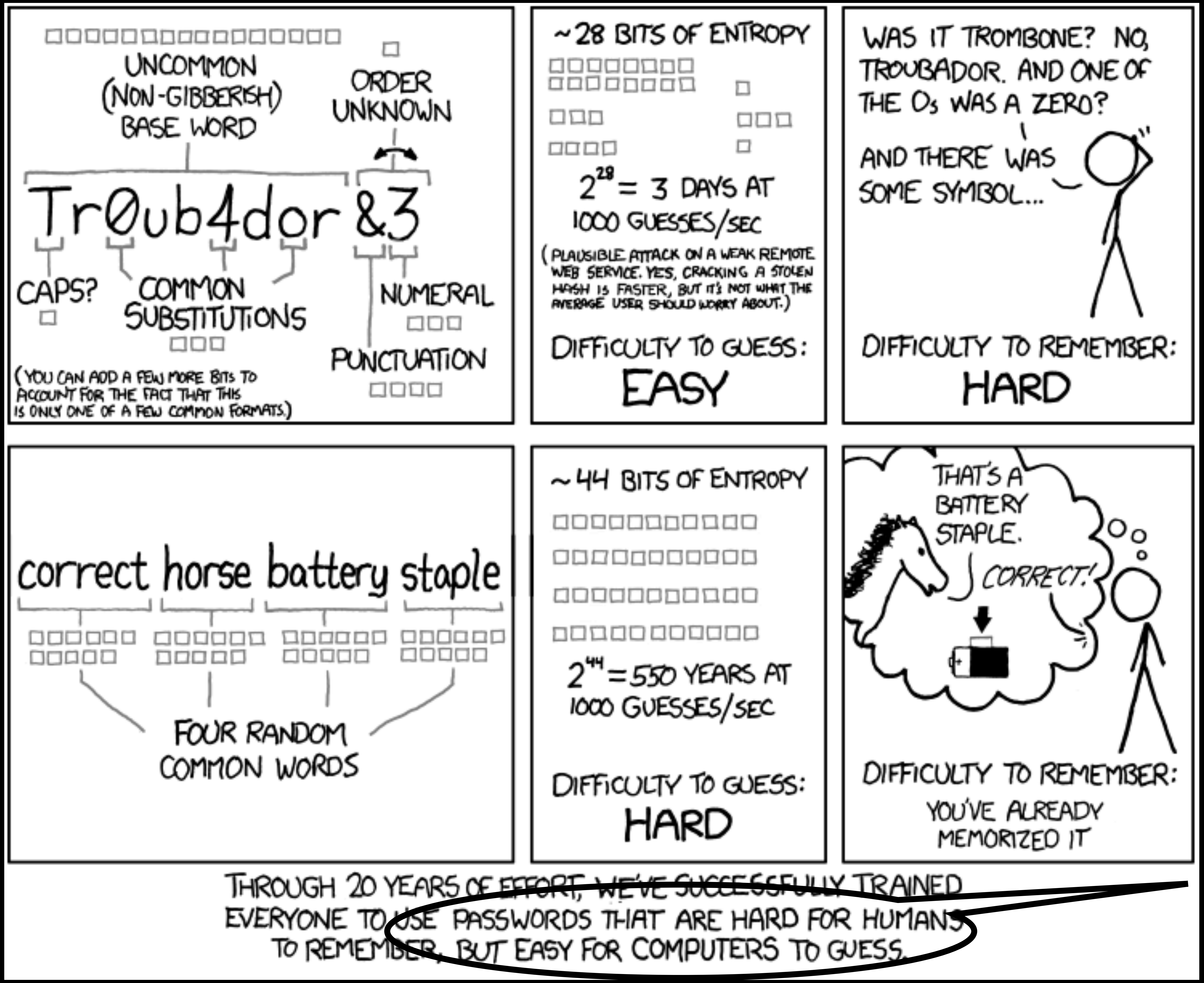
Everybody

2013 2003 1993 1983 1973 1963

What’s So Bad about Passwords?



UNCOMMON (NON-GIBBERISH) BASE WORD
ORDER UNKNOWN
Tr0ub4dor&3
CAPS?
COMMON SUBSTITUTIONS
NUMERAL
PUNCTUATION
(YOU CAN ADD A FEW MORE BITS TO ACCOUNT FOR THE FACT THAT THIS IS ONLY ONE OF A FEW COMMON FORMATS.)
~28 BITS OF ENTROPY
2^28 = 3 DAYS AT 1000 GUESSES/SEC
(PLAUSIBLE ATTACK ON A WEAK REMOTE WEB SERVICE. YES, CRACKING A STOLEN HASH IS FASTER, BUT IT'S NOT WHAT THE AVERAGE USER SHOULD WORRY ABOUT.)
DIFFICULTY TO GUESS: EASY
WAS IT TROMBONE? NO, TROUBADOR. AND ONE OF THE Os WAS A ZERO?
AND THERE WAS SOME SYMBOL...
DIFFICULTY TO REMEMBER: HARD
correct horse battery staple
FOUR RANDOM COMMON WORDS
~44 BITS OF ENTROPY
2^44 = 550 YEARS AT 1000 GUESSES/SEC
DIFFICULTY TO GUESS: HARD
THAT'S A BATTERY STAPLE.
CORRECT!
DIFFICULTY TO REMEMBER: YOU'VE ALREADY MEMORIZED IT
THROUGH 20 YEARS OF EFFORT, WE'VE SUCCESSFULLY TRAINED EVERYONE TO USE PASSWORDS THAT ARE HARD FOR HUMANS TO REMEMBER, BUT EASY FOR COMPUTERS TO GUESS.

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

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)
- 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
  - Secure
  - Use from anywhere

- Other desirable features
  - Strong passwords
  - Different for every site
  - Easy to change (Ask me why that’s bad)

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

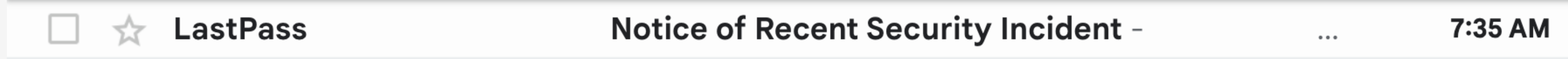
A password manager is an app on your phone, tablet, or computer that **stores** your passwords, so you don't have to remember them. — ncsc.gov

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



□ ☆ LastPass Notice of Recent Security Incident - ... 7:35 AM

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.**

A Different Approach

A Different Kind of Password Manager

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.

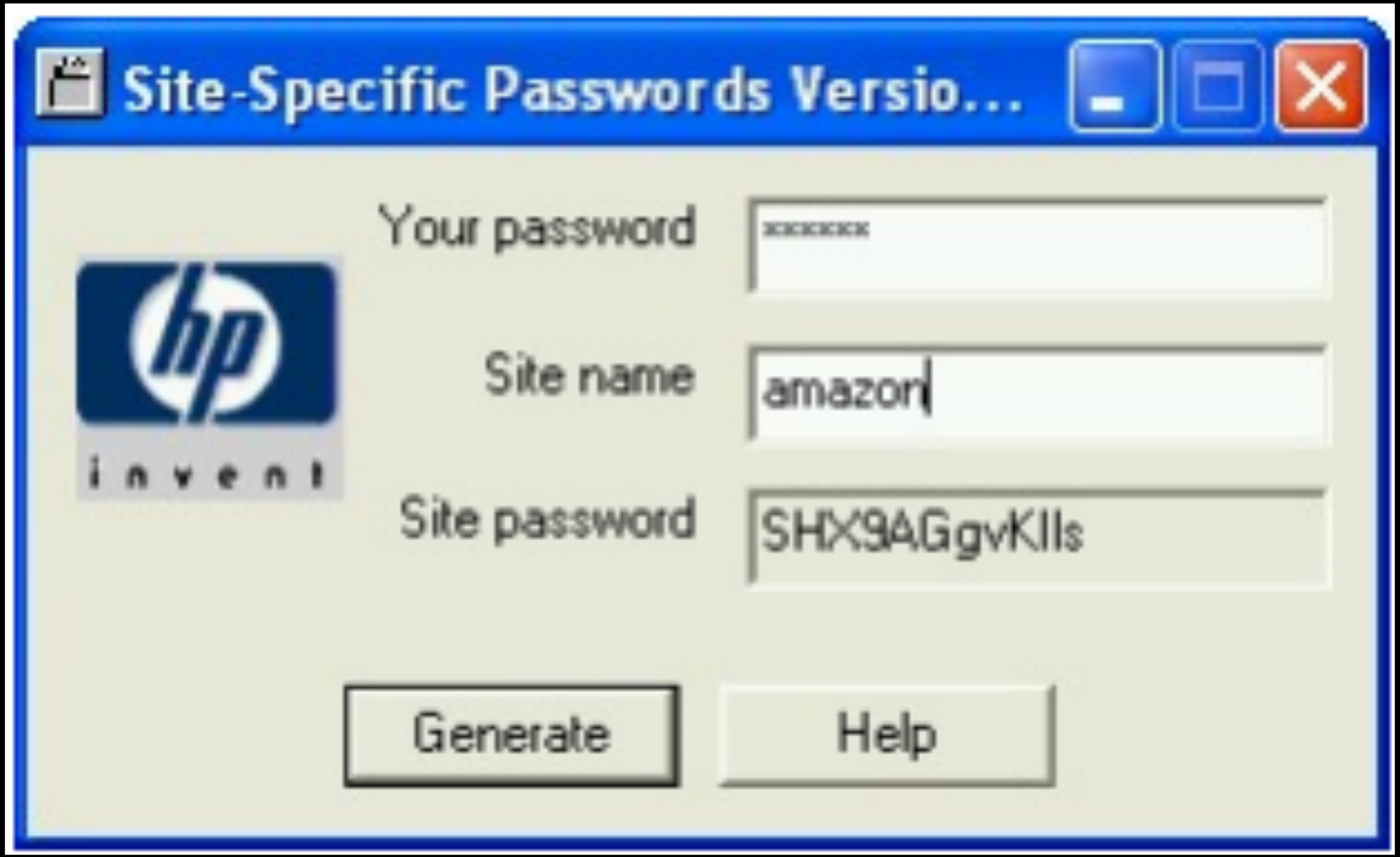
A Brief History of SitePassword

The Earliest Days

2003

The Earliest Days

2003



Site-Specific Passwords Versio...

Your password xxxxxx

Site name amazon

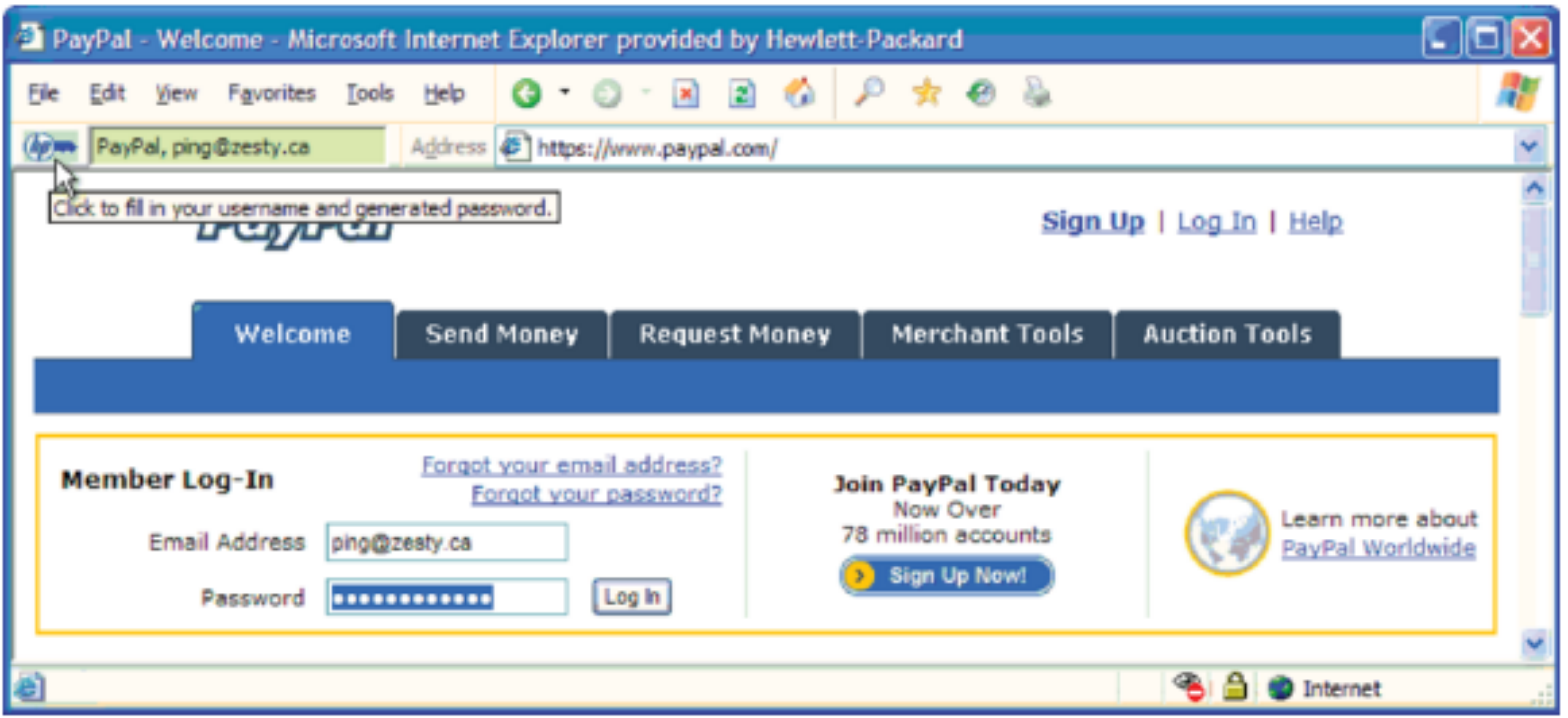
Site password SHX9AGgvKIls

HP Anti-Phishing Toolbar for IE

2005

HP Anti-Phishing Toolbar for IE

2005



PayPal - Welcome - Microsoft Internet Explorer provided by Hewlett-Packard

PayPal, ping@zesty.ca

Address https://www.paypal.com/

Click to fill in your username and generated password.

Email Address ping@zesty.ca

Password ●●●●●●●●●●●●●

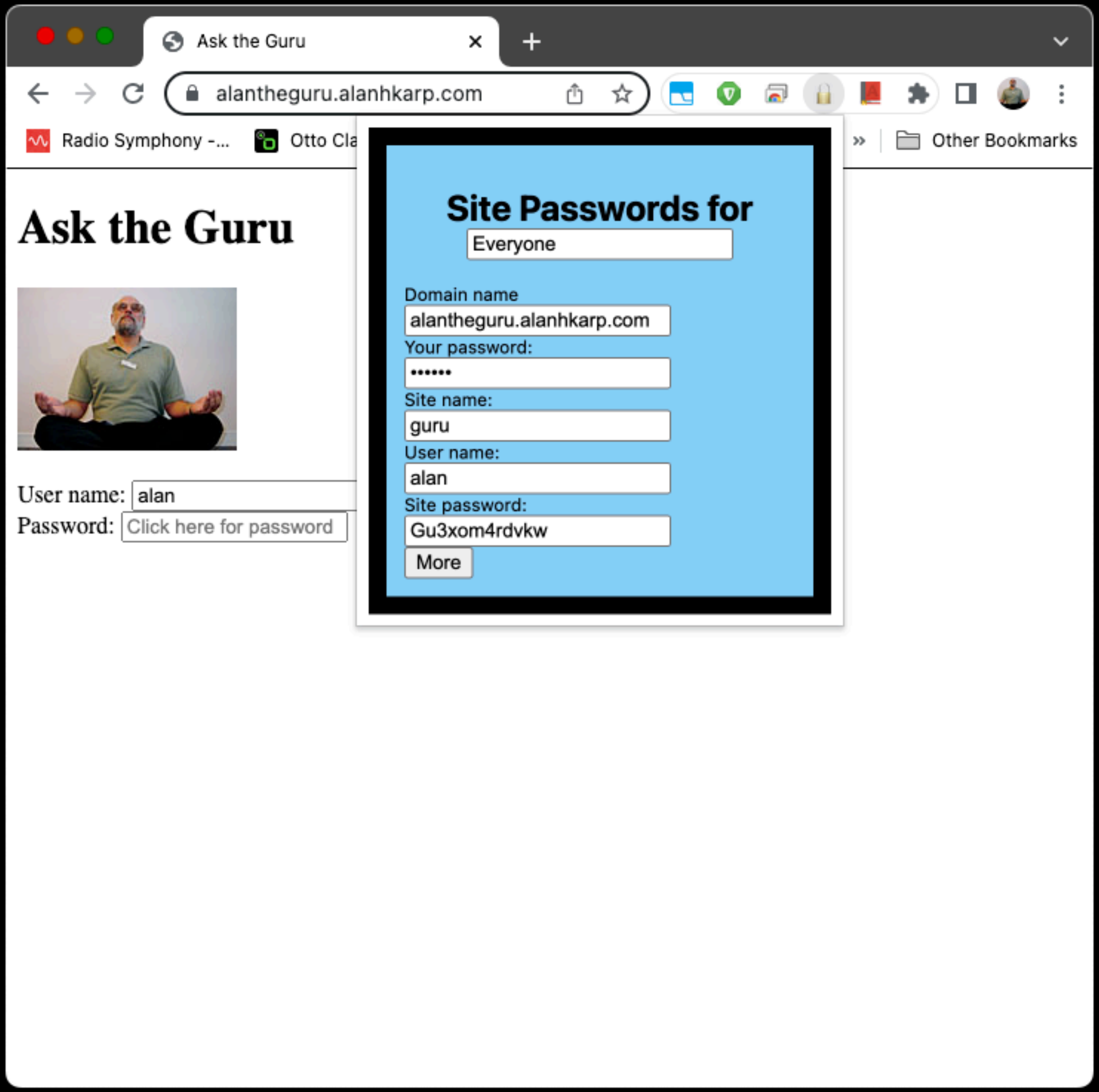
Chrome Extension

2012

Chrome Extension

2012

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



Ask the Guru

User name: alan
Password: Click here for password

Site Passwords for
Everyone

Domain name
alantheguru.alanhkarp.com
Your password:
••••••
Site name:
guru
User name:
alan
Site password:
Gu3xom4rdvkw

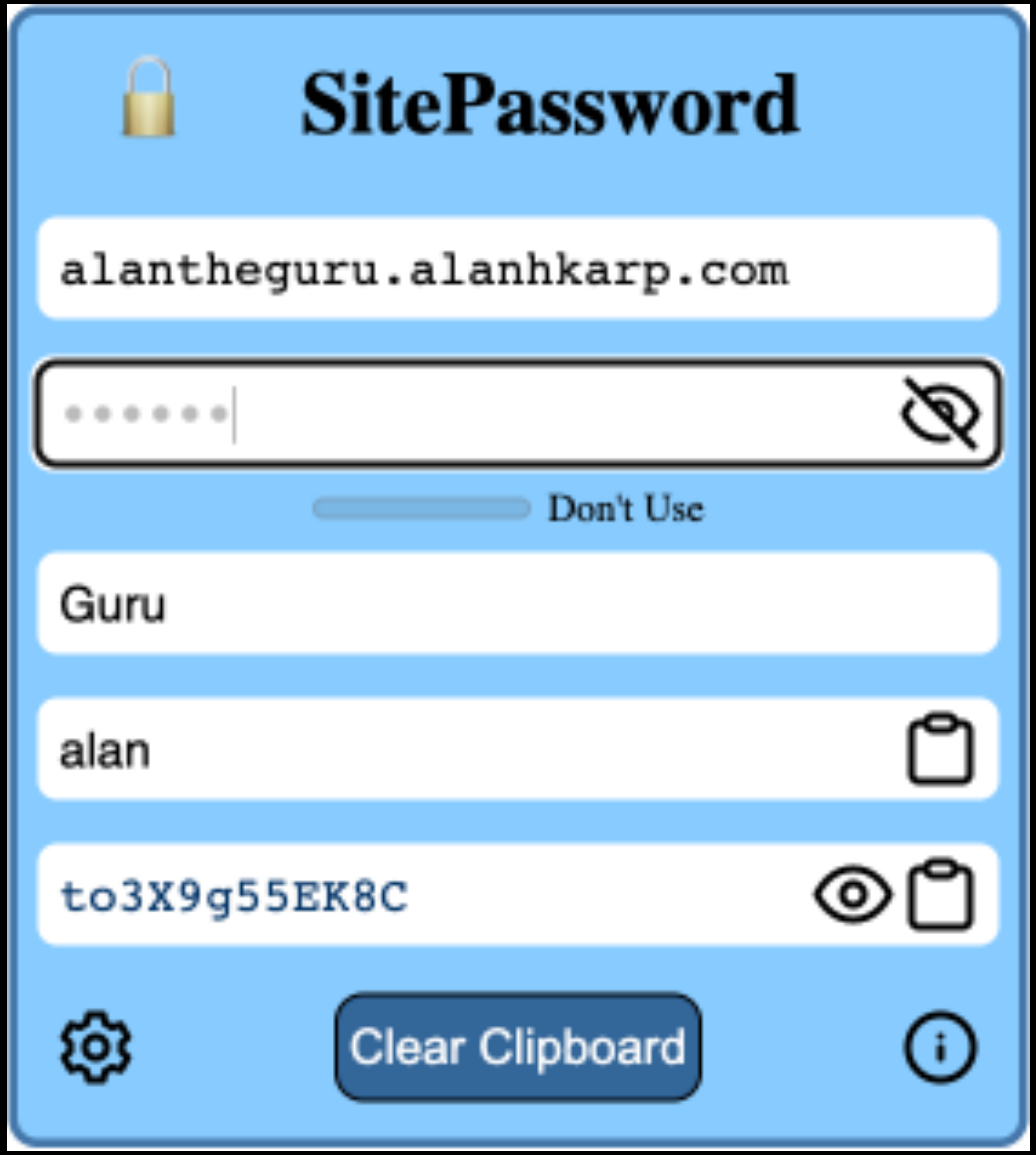
And Then

2021

- Google says I have to update it.
- “No problem,” I say to myself. “It’ll only take a week or so.”
- A year 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



SitePassword

alantheguru.alanhkarp.com

••••••

Don't Use

Guru

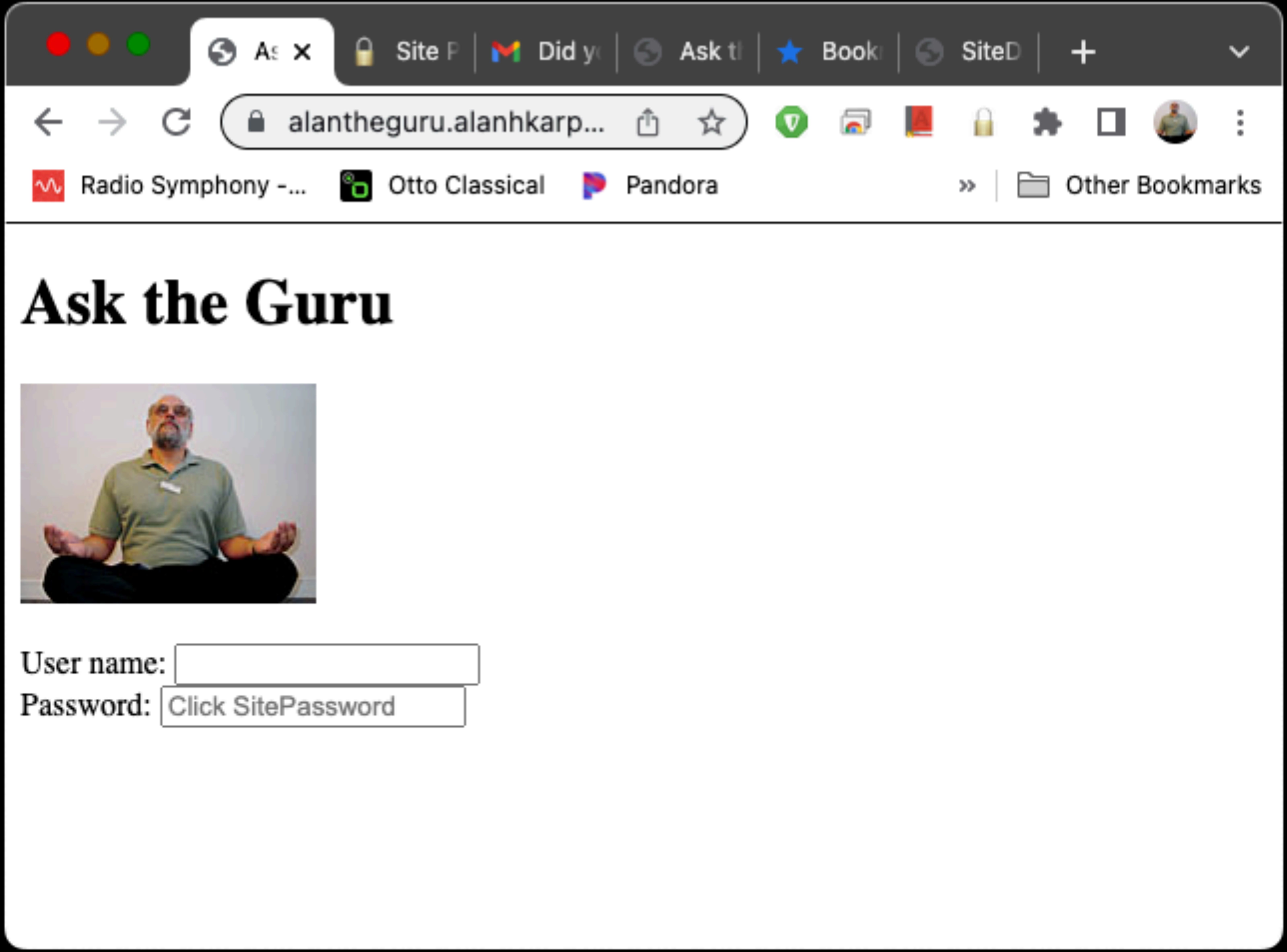
alan

to3X9g55EK8C

Let Google Do the Heavy Lifting

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

A Taste of SitePassword



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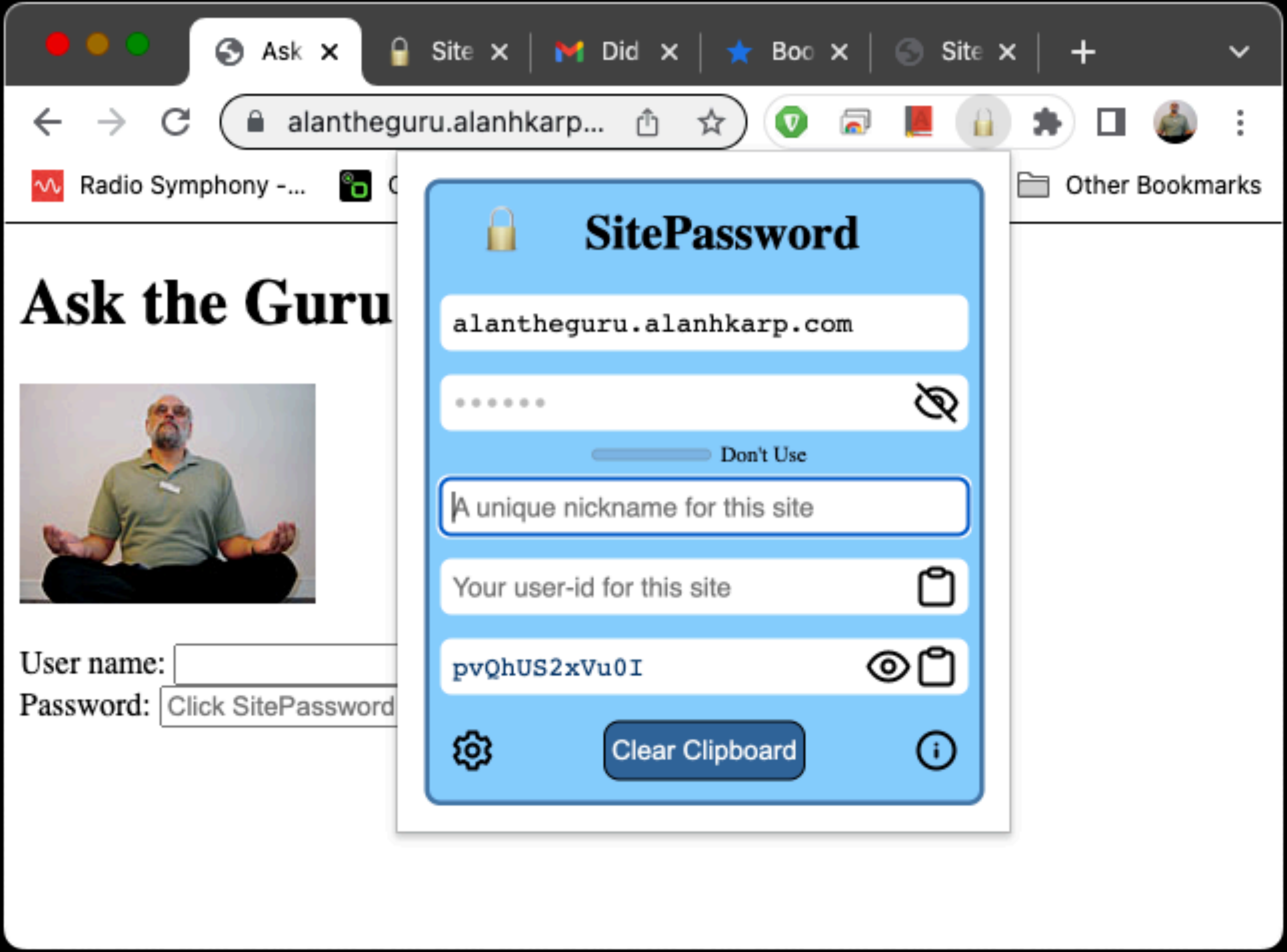
User name:

Password: Click SitePassword



Ask the Guru

User name:

Password: Click SitePassword

SitePassword

alantheguru.alanhkarp.com

••••••

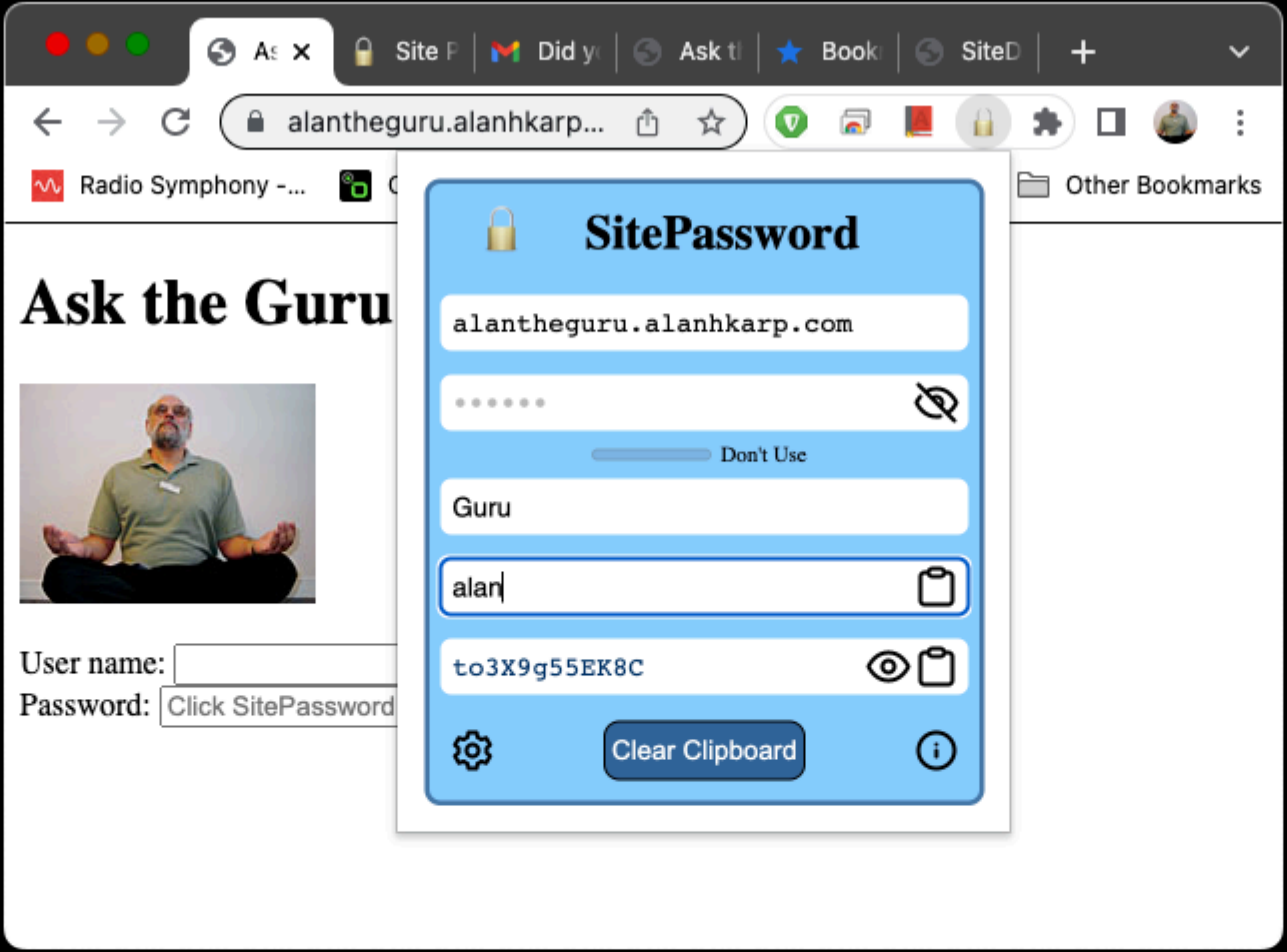
Don't Use

A unique nickname for this site

Your user-id for this site

pvQhUS2xVu0I

Clear Clipboard



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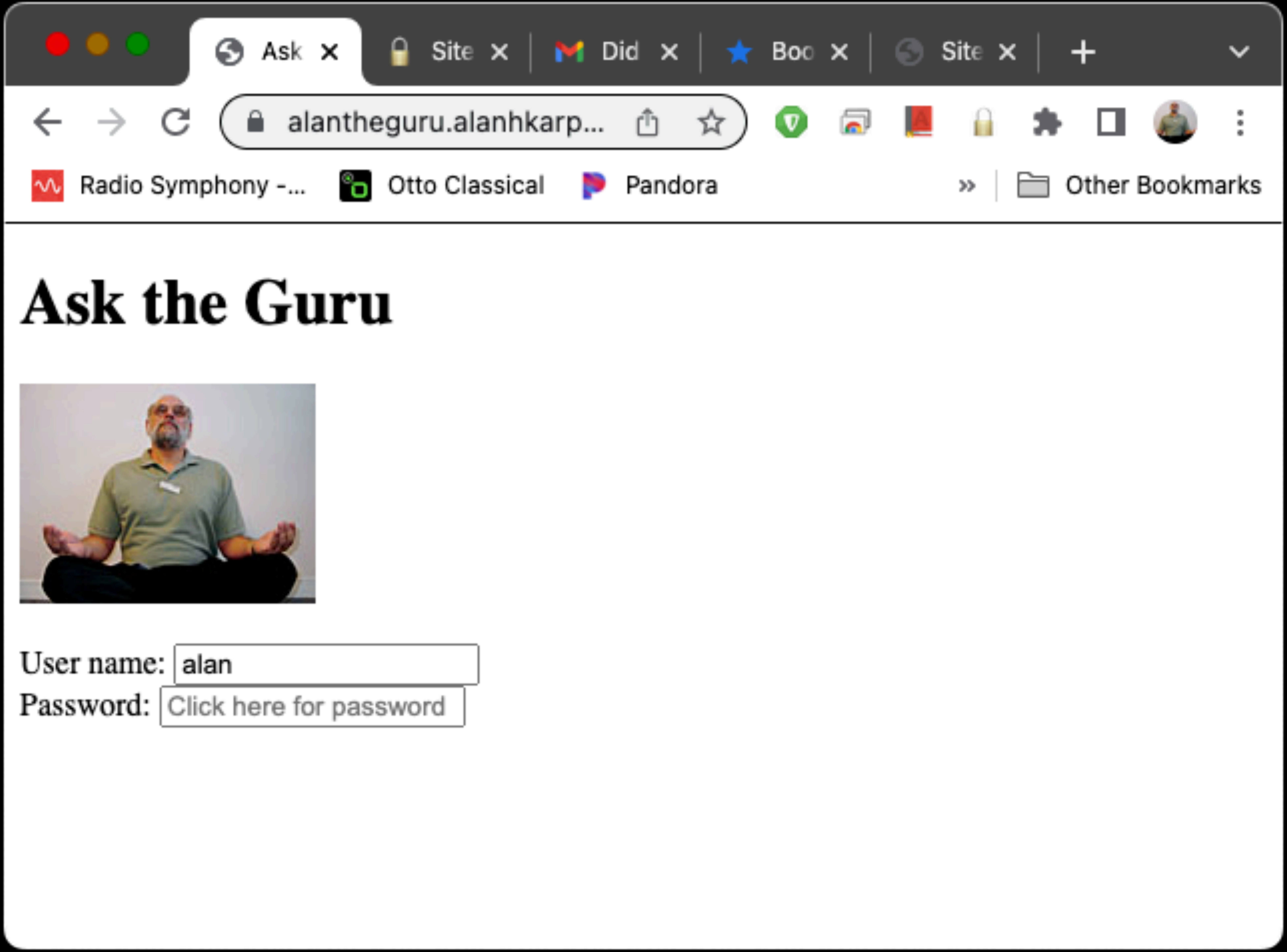

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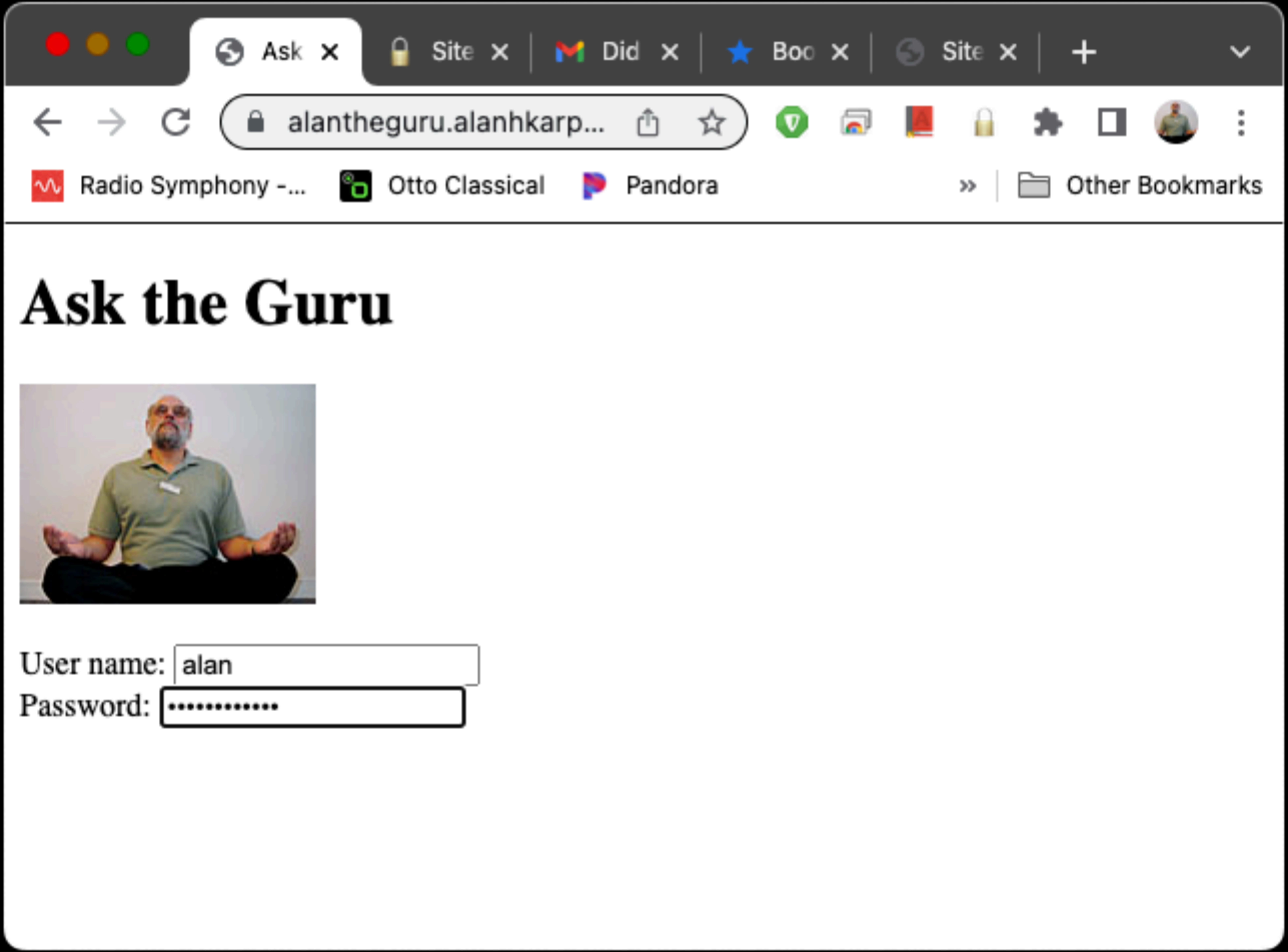

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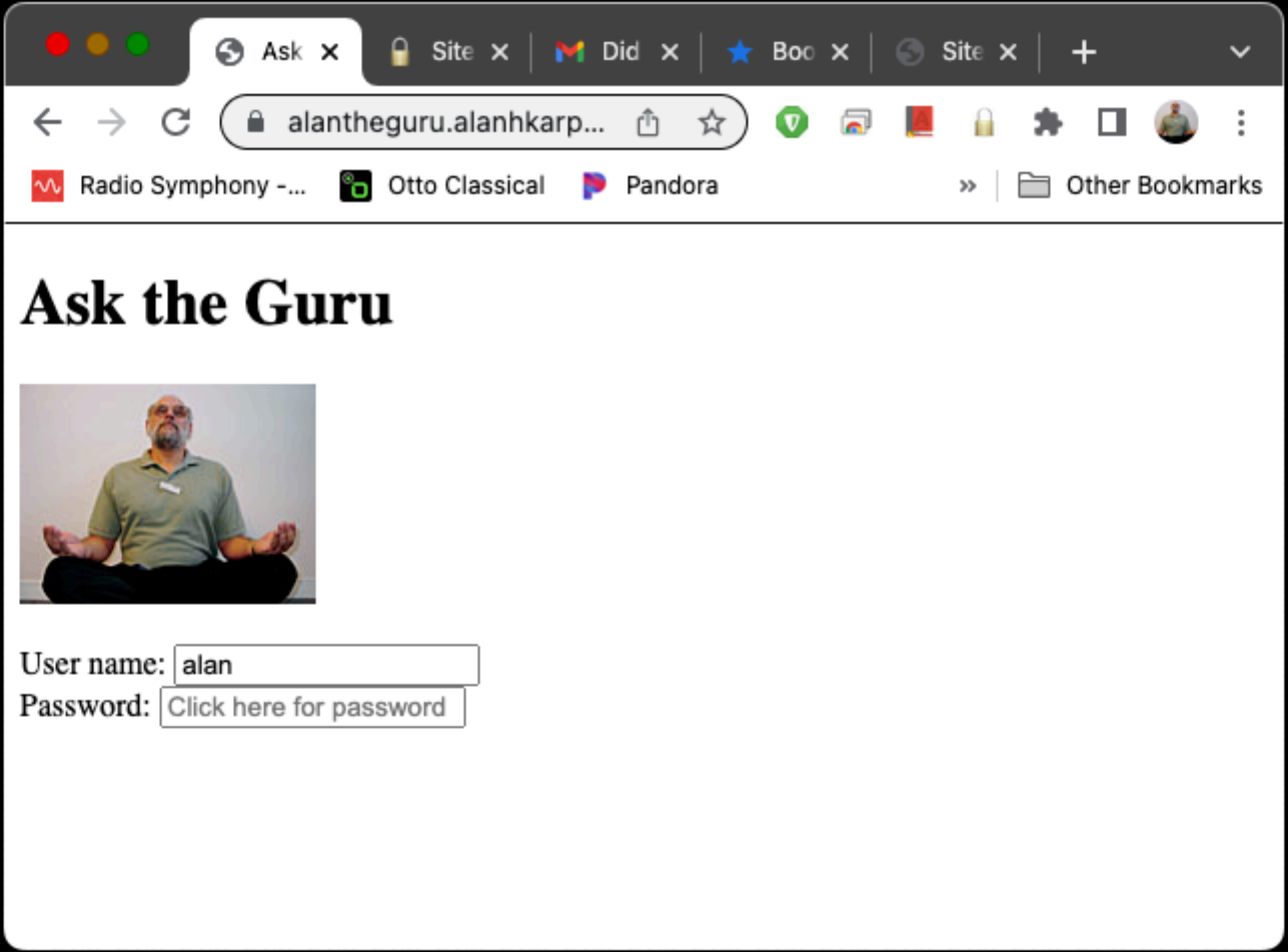

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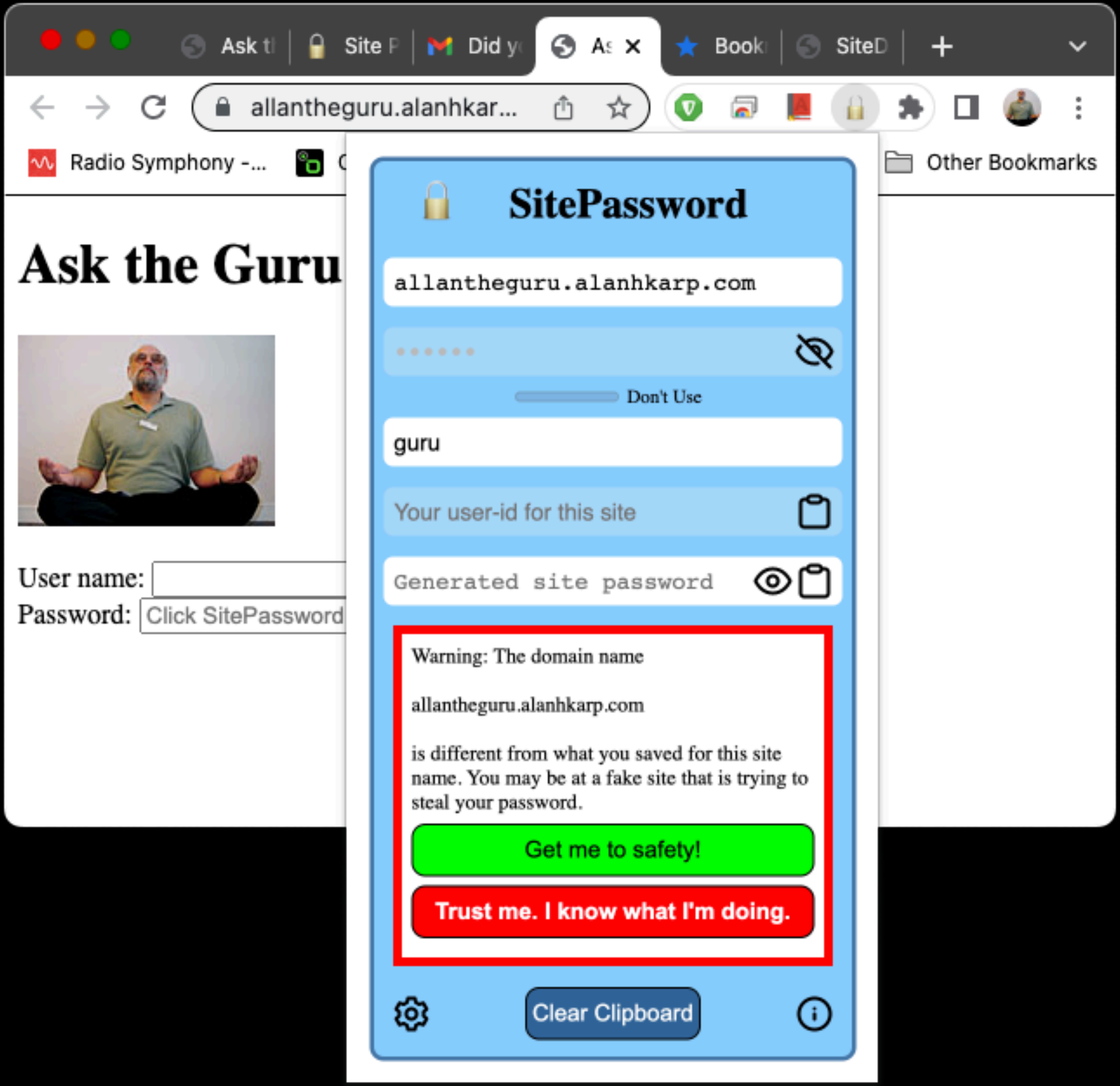


Ask the Guru

User name:

Password: Click SitePassword

SitePassword

allantheguru.alanhkarp.com

••••••

Don't Use

guru

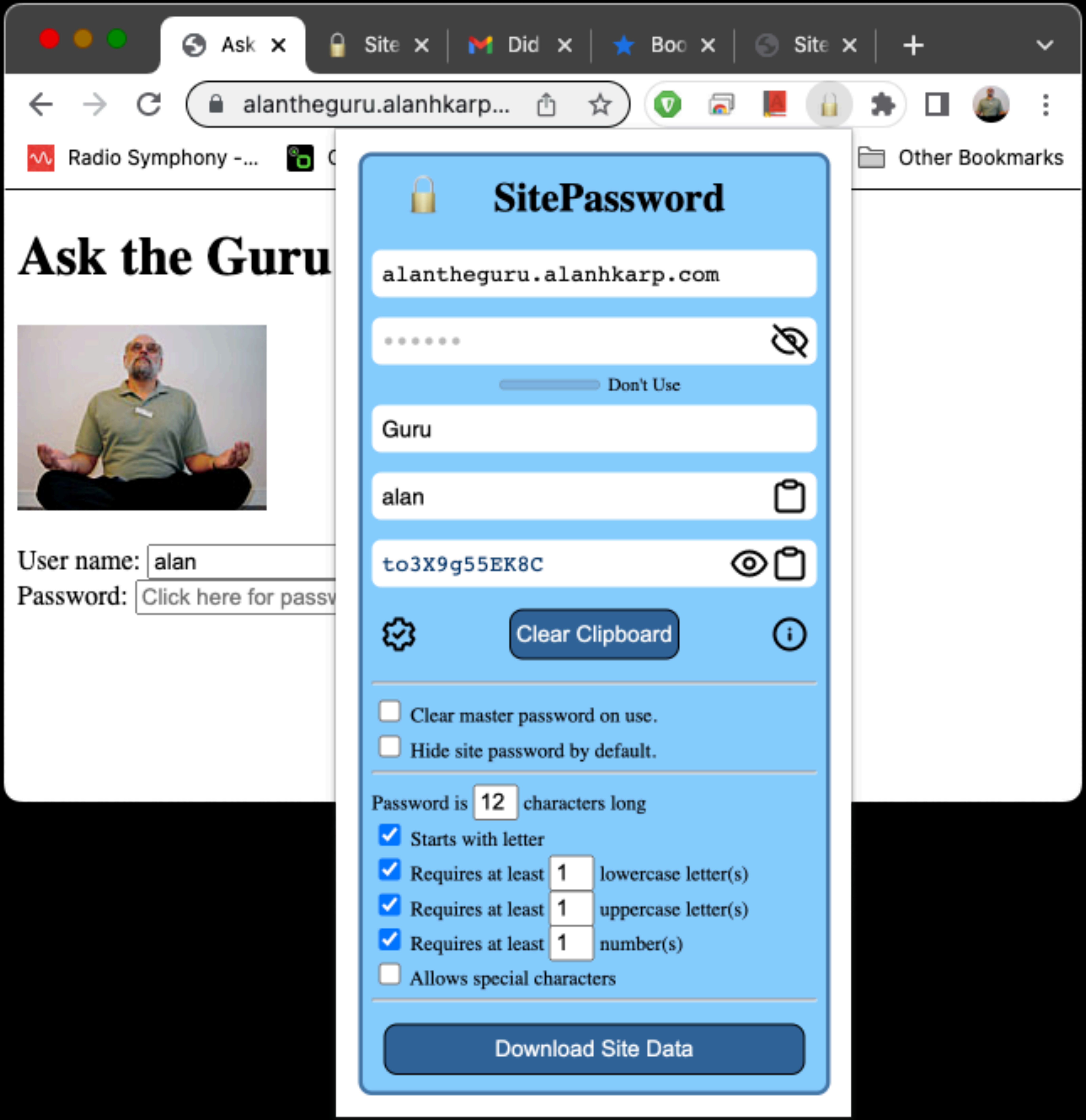
Your user-id for this site

Generated site password

Warning: The domain name

allantheguru.alanhkarp.com

is different from what you saved for this site name. You may be at a fake site that is trying to steal your password.



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□ Clear master password on use.

□ Hide site password by default.

Password is 12 characters long

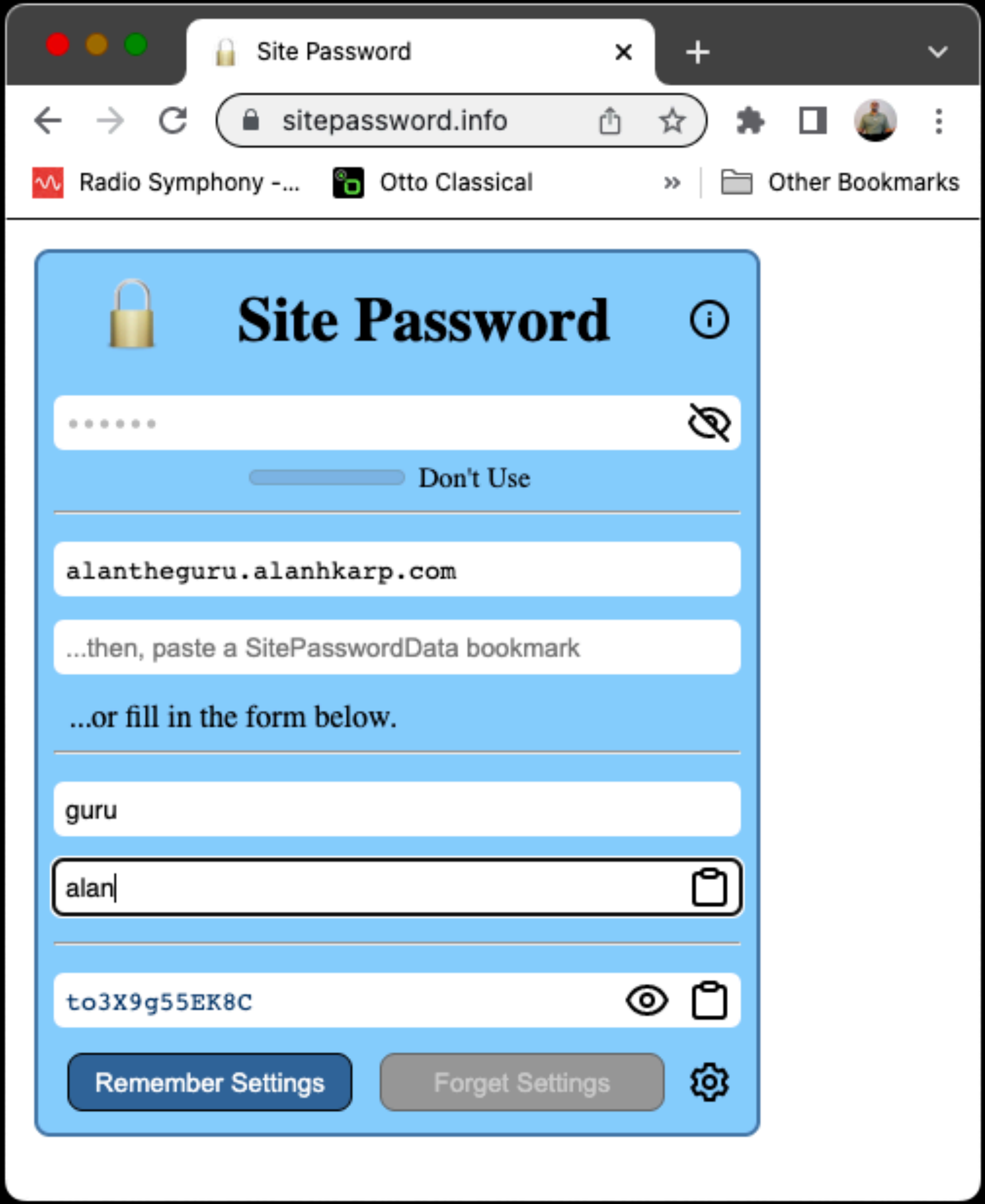
☑ Starts with letter

☑ Requires at least 1 lowercase letter(s)

☑ Requires at least 1 uppercase letter(s)

☑ Requires at least 1 number(s)

□ Allows special characters



Site Password

••••••

Don't Use

alantheguru.alanhkarp.com

...then, paste a SitePasswordData bookmark

...or fill in the form below.

guru

alan

to3X9g55EK8C

Usable Security

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 master password
  - Use clipboard only when needed and warn after use
- Choose a readable font, particularly for site password
- Focus the field the user will be needing next

My User Experience Goals

Where I failed

- Can’t always make “Click here for password” show up
    - Resorted to tooltip, but it takes a second or so to appear
- Forgetting settings for a domain
    - Delete the corresponding bookmark
- Closing the popup

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 password field
- Minuses
  - Not as secure
  - Some don’t generate passwords, only store them
  - Many don’t consider the password policy

As Bad as it Gets

1. Autofills with no user action

    Make it easy to steal passwords

2. Can’t customize generated password

    Might not be able to use password generator

3. Has an option to show existing passwords

    Encourages password reuse

4. Uses same password for smile.amazon.com and amazon.com but not amazon.co.uk

    Getting this right is really hard

Plus it warns on weak passwords too late

It’s More than Just Passwords Strength

- Autofill
  - Put the password into a form controlled by an attacker
- Storage Security
  - Stolen, didn’t get the passwords but got the metadata
- User Communication
  - Allows weak/reused passwords
  - Generated passwords sometimes weak (oMMMMMMT?m*m)

It’s More than Just the Passwords

- Avoid using clipboard but sometimes the only viable backup
- Phishing sites and phishing the password manager password
- Domain name errors - google.evil.com vs google.com
- Accessibility features
- Code size - one password manager is over 200,000 lines of code
    - SitePassword 1,500 lines of JavaScript, 750 HTML, 250 CSS
- Worst of all - Not using a password manager due to lack of trust

Related Attacks

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

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

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 passwords by default
- Doesn’t handle dartmouth.edu/~alanhkarp

The Ugly

An Offline attack against master password

1. You create an account at a bad guy’s site
2. Bad guy knows site password and username and can guess site name
3. Bad guy starts guessing master passwords

- Mitigations
  - Strong master password
  - Hash a minimum of 100 times to get site password
  - Any guesses that produce the known site password must be tried online
- Defeated by a hard to invert hash function that produces lots of collisions

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
- Make password field visible only after you click a button
- Add CSS at runtime that makes password field visible

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

- Many password managers use the same algorithm
  - 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 - myacm.acm.org
- Unnecessary dependencies
  - Many use jQuery on their login pages

How Bad Is It?

One password manager has special cases for over 200 sites.

Summary

Future Work

- User studies
- Other browsers
  - Brave, Edge, Opera - Works
  - Firefox - Should work but doesn’t
  - Safari - Need to figure out how to use Xcode properly
- IoS and Android apps
  - Monitoring a serious security issue

References

Slides at https://github.com/alanhkarp/SitePassword

- 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

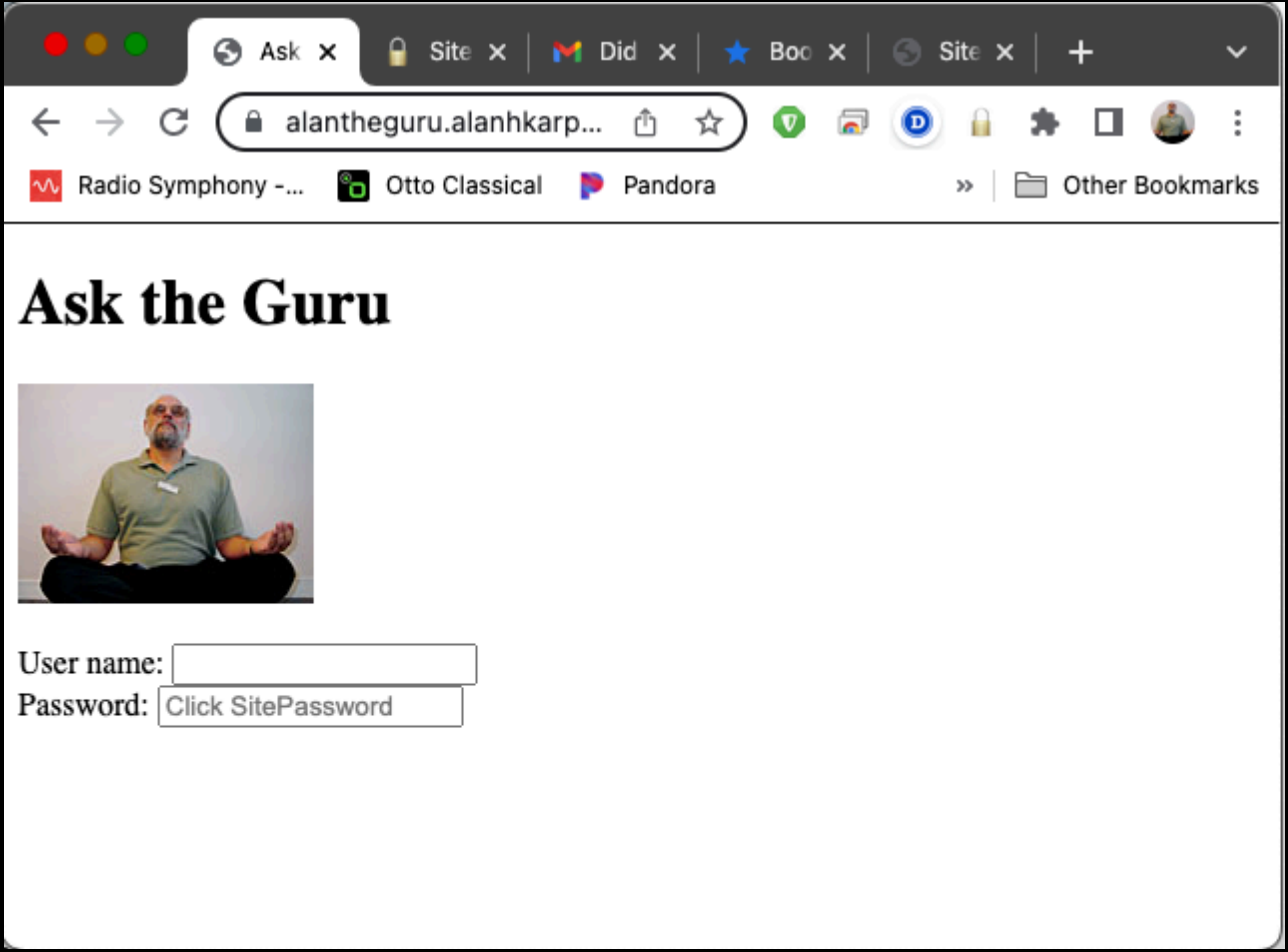
Takeaways

- 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

Demo



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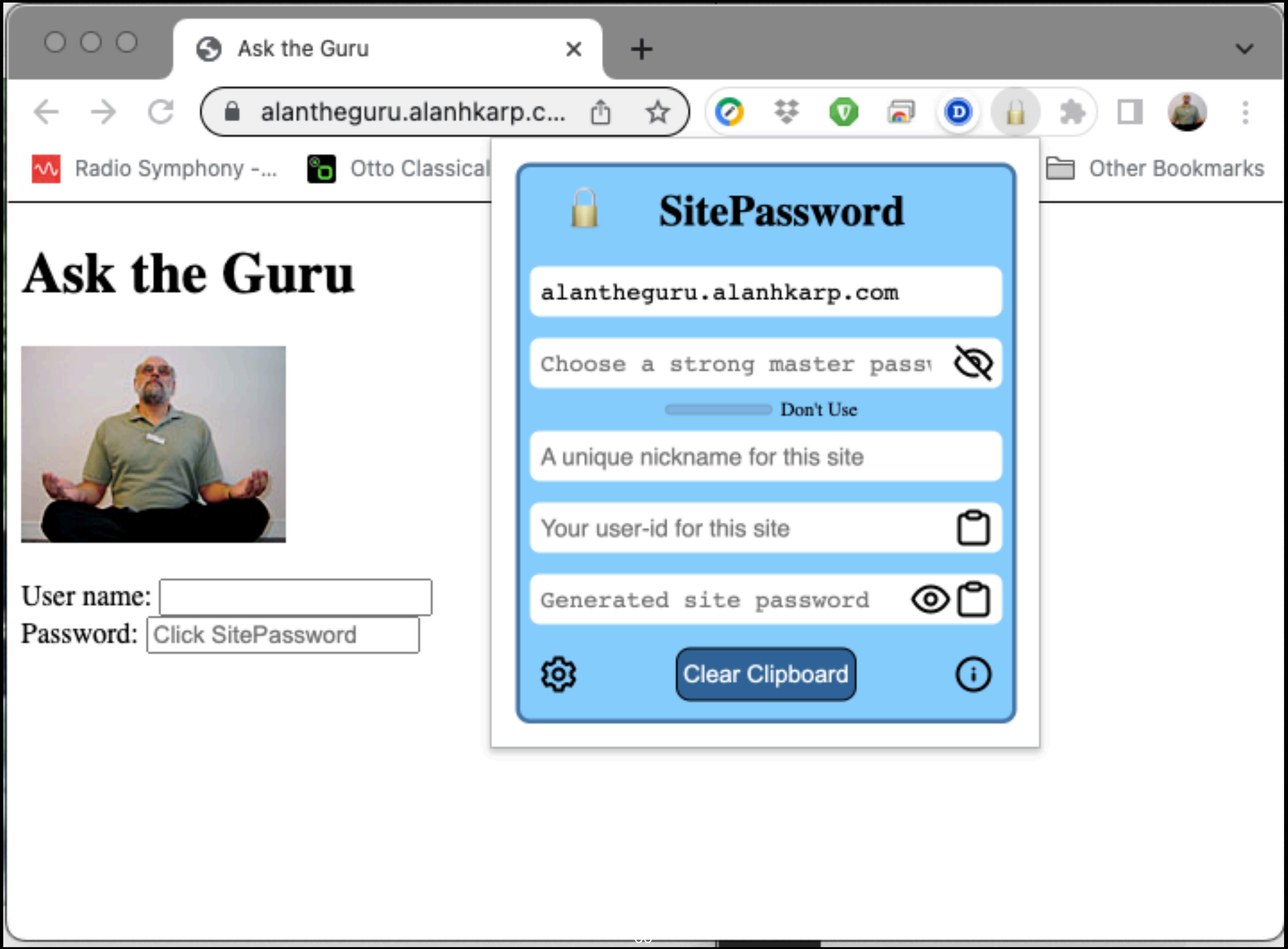
Password: Click SitePassword



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SitePassword

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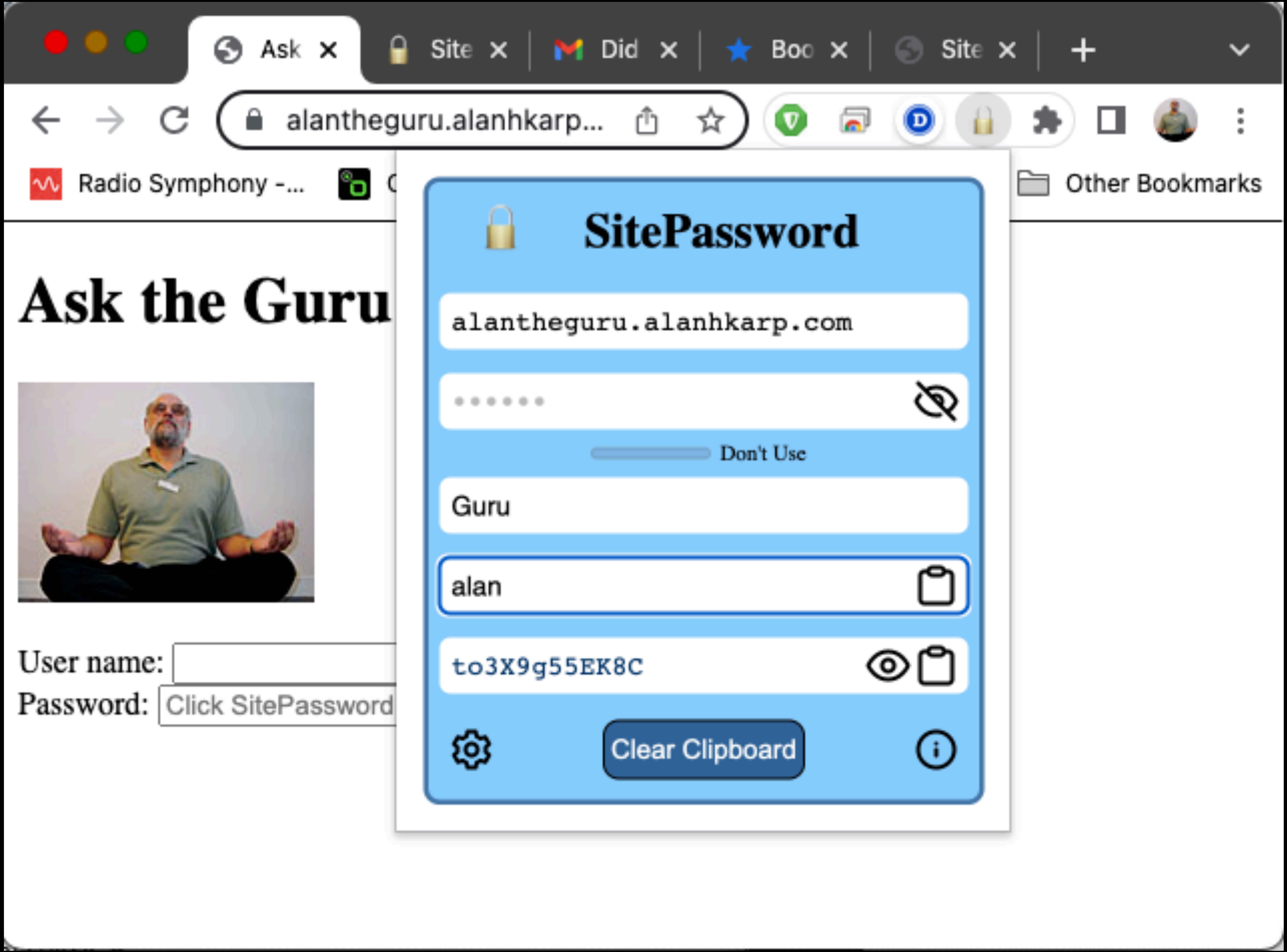
Choose a strong master passw

Don't Use

A unique nickname for this site

Your user-id for this site

Generated site password



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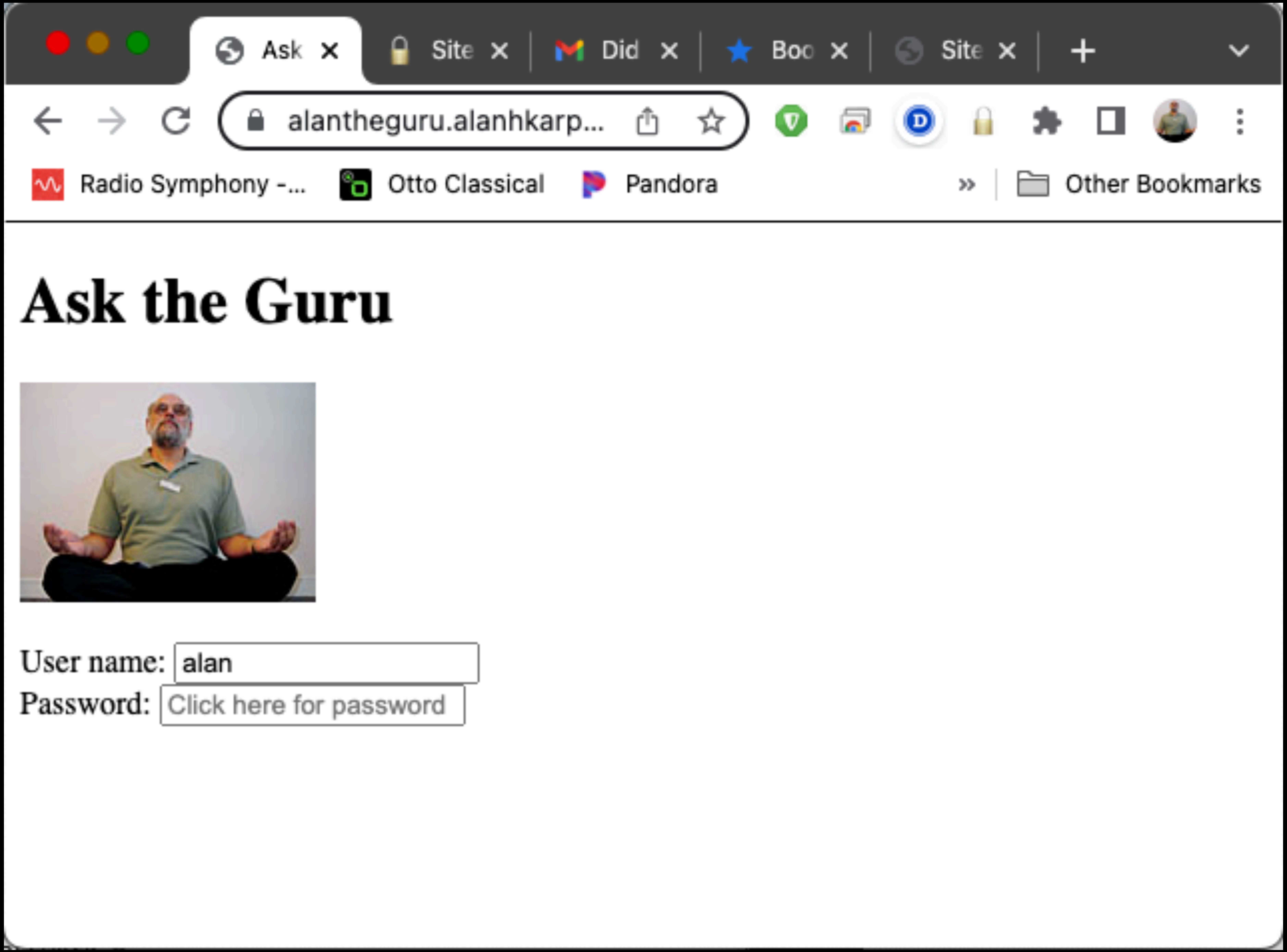

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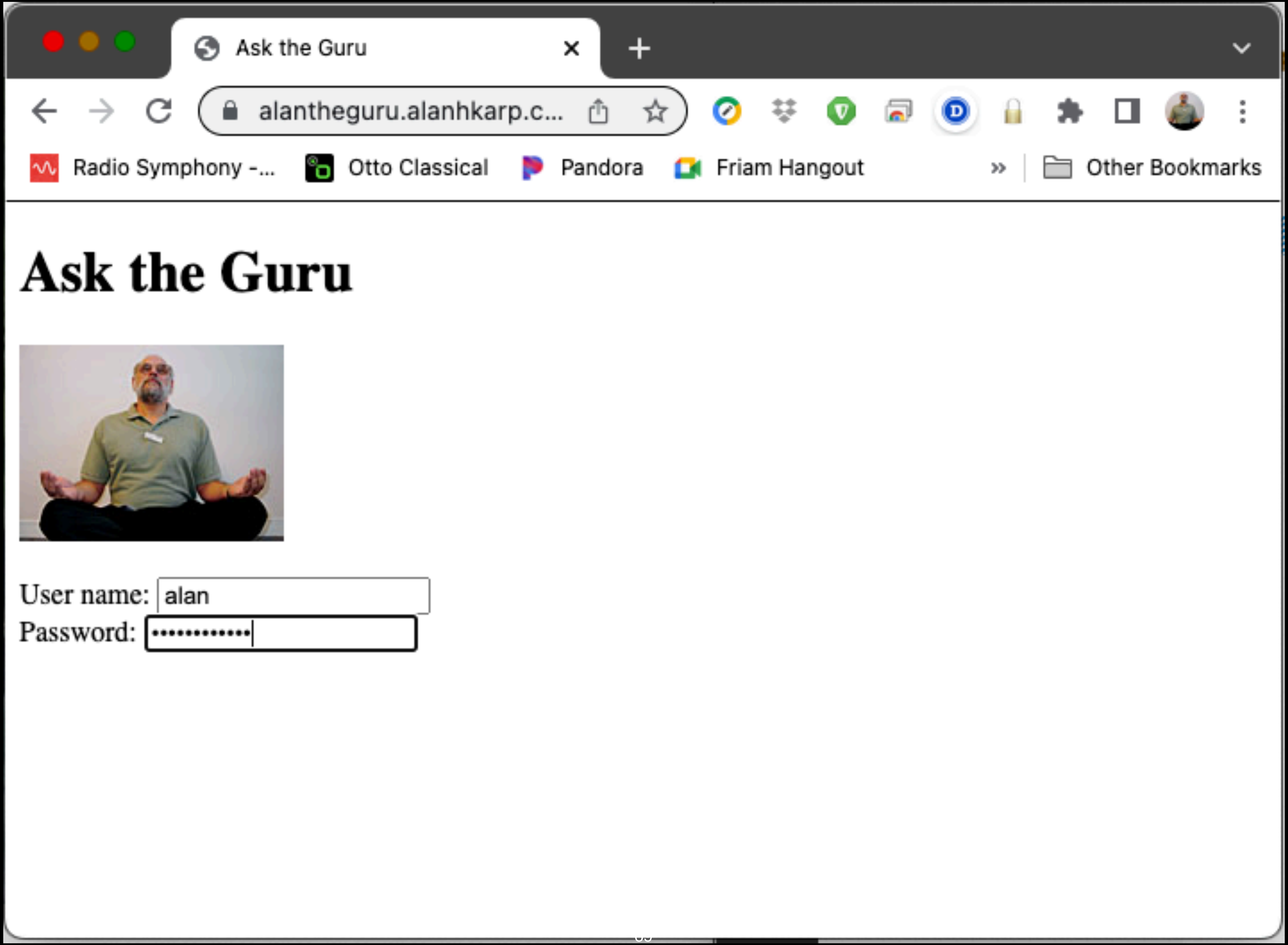

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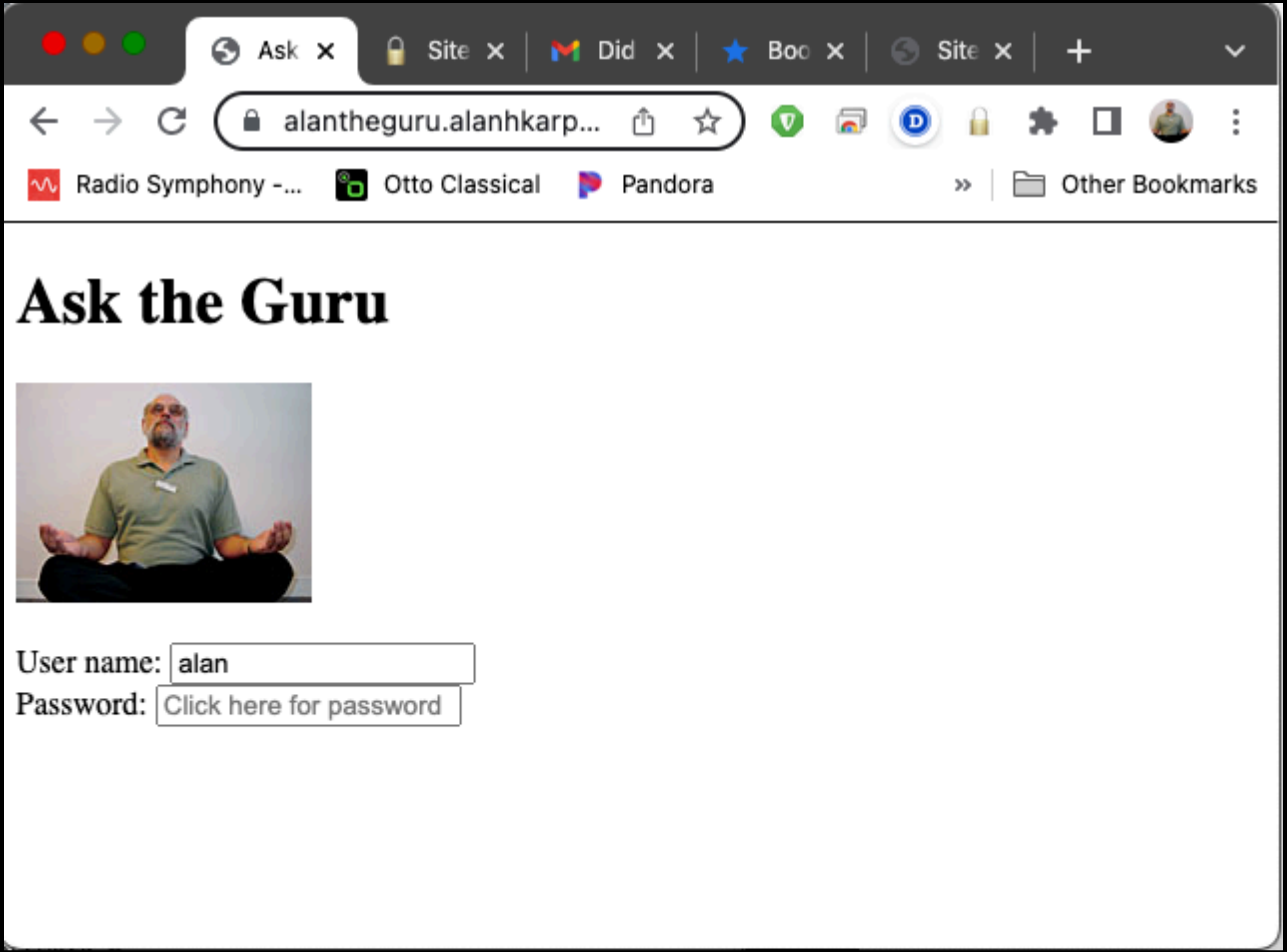

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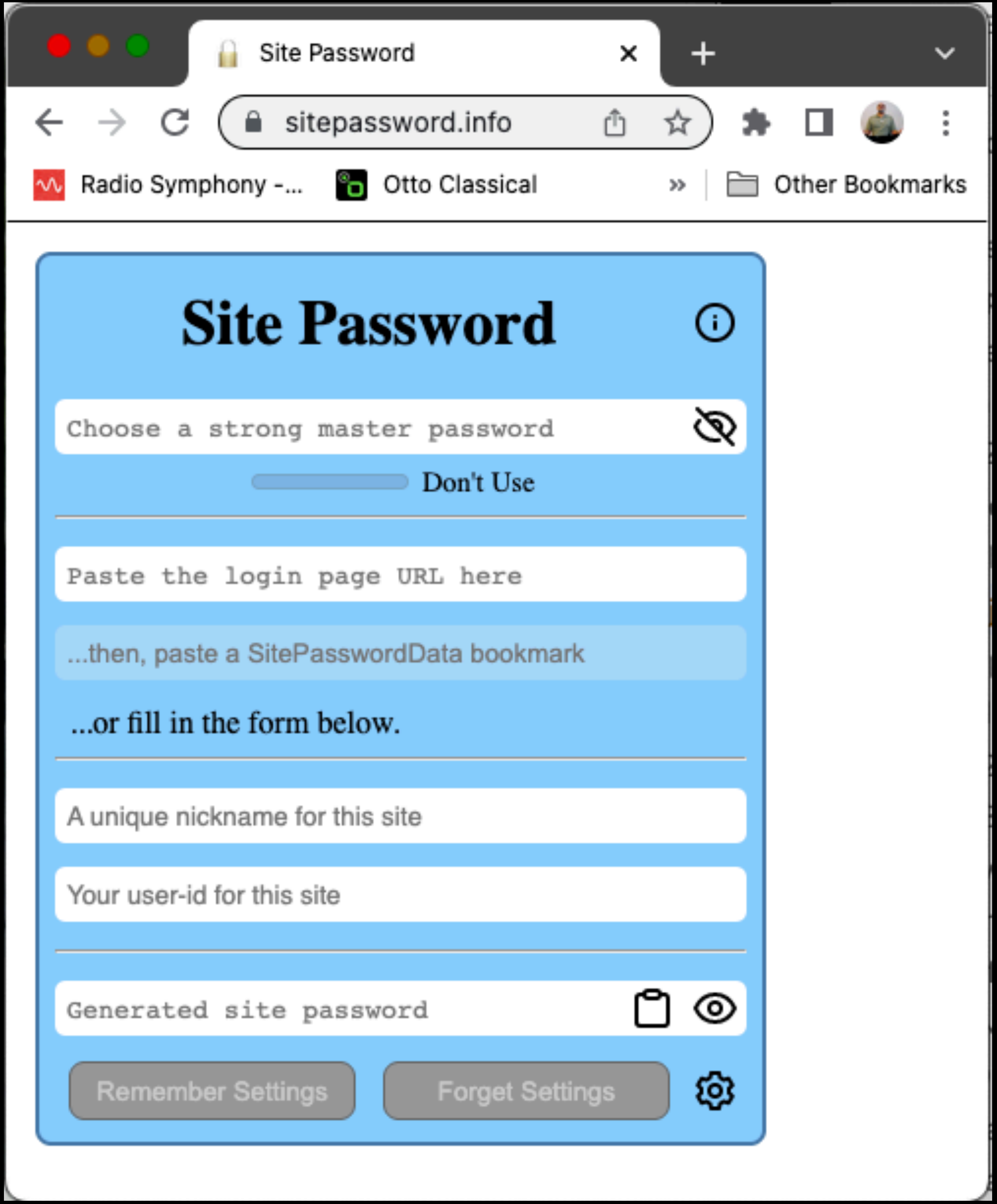


Site Password

Choose a strong master password

Don't Use

Paste the login page URL here

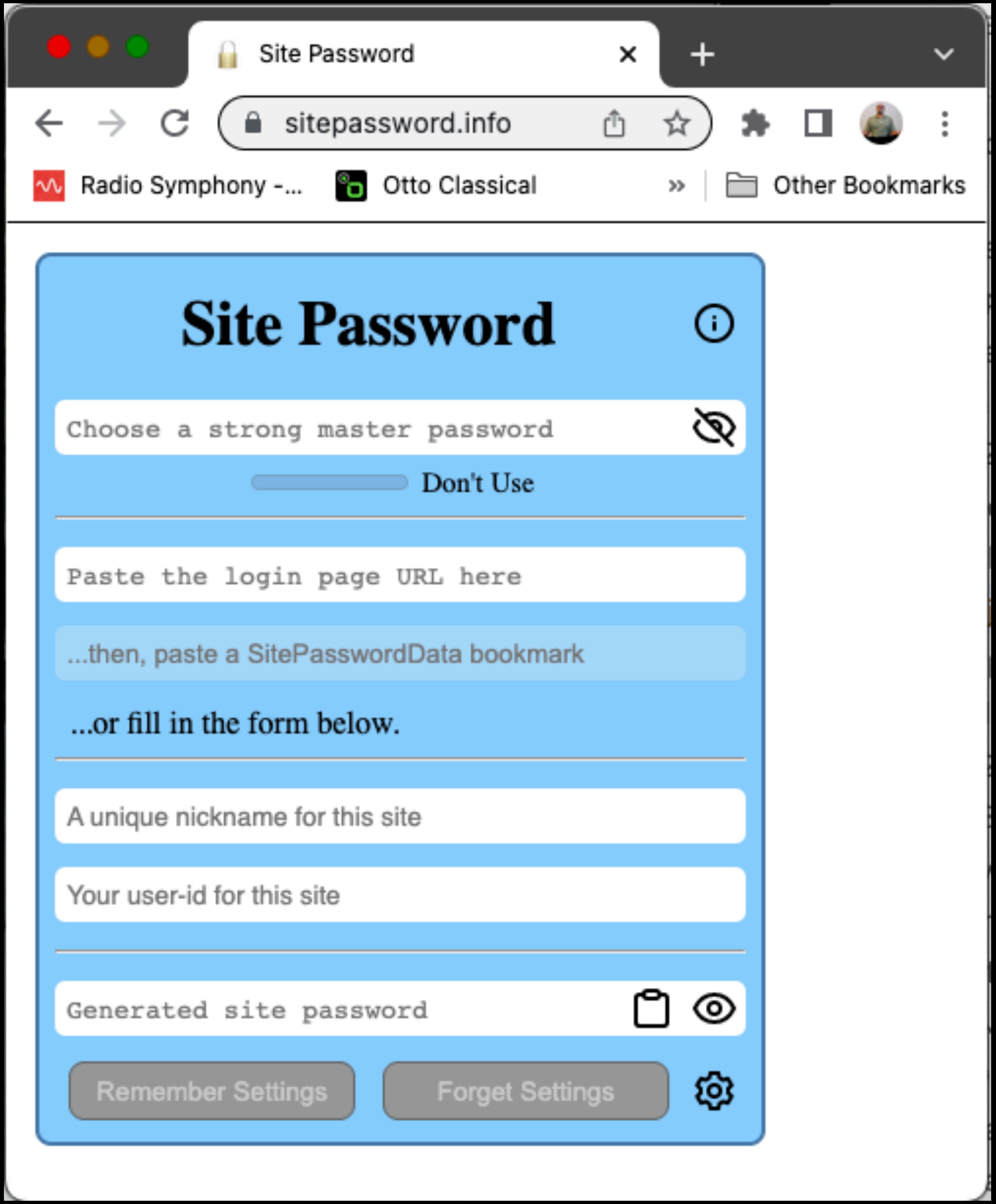
...then, paste a SitePasswordData bookmark

...or fill in the form below.

A unique nickname for this site

Your user-id for this site

Generated site password



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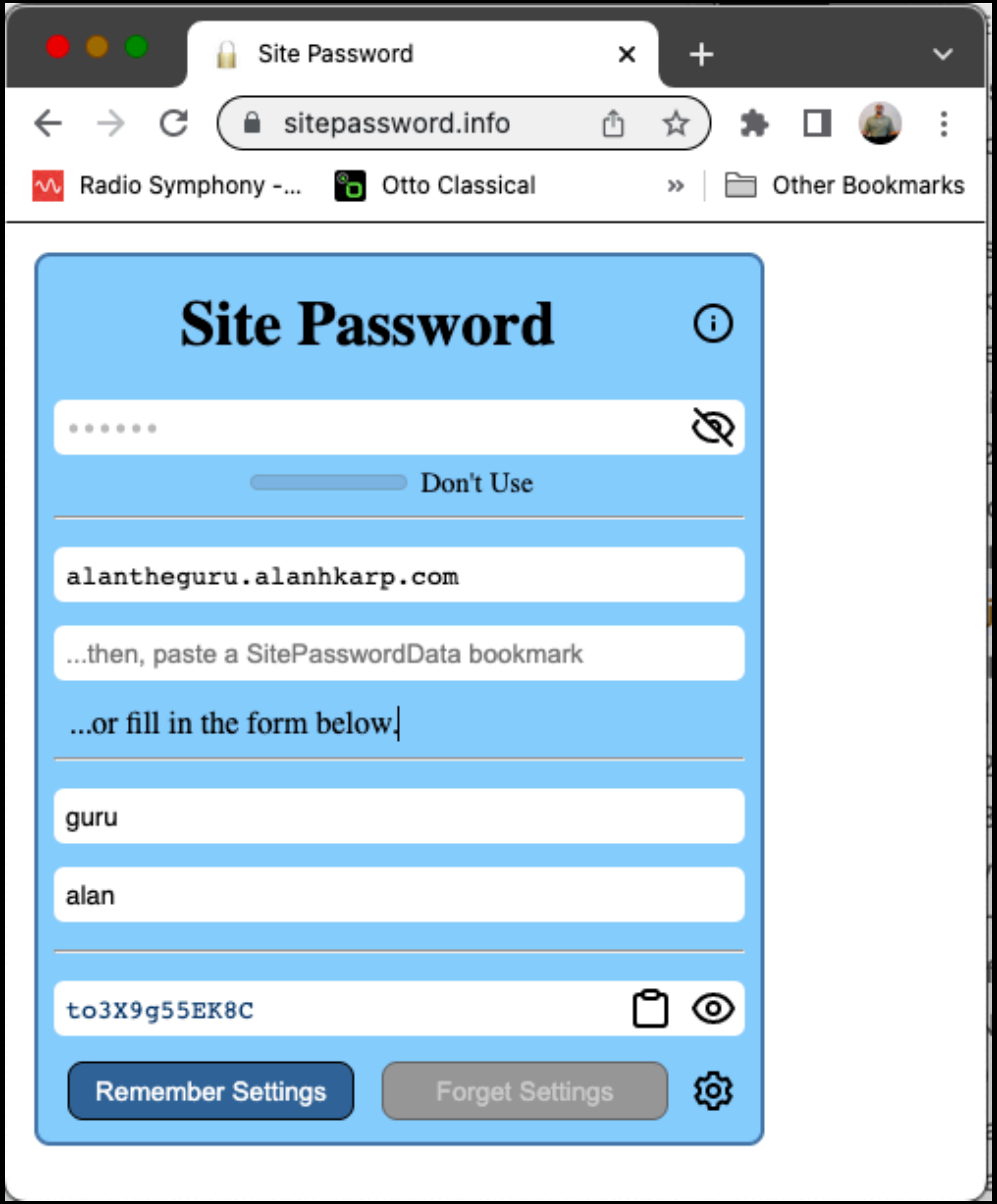

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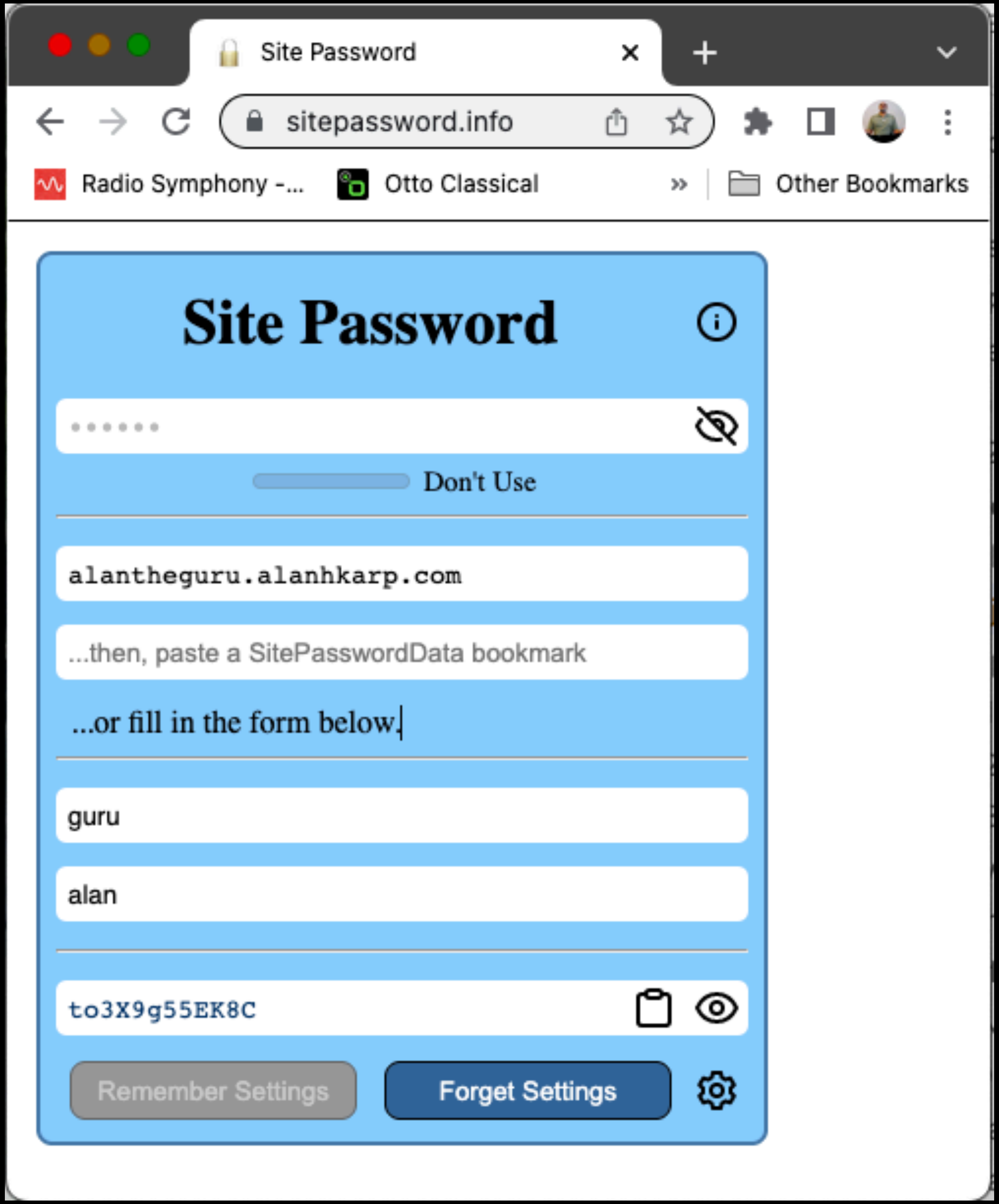

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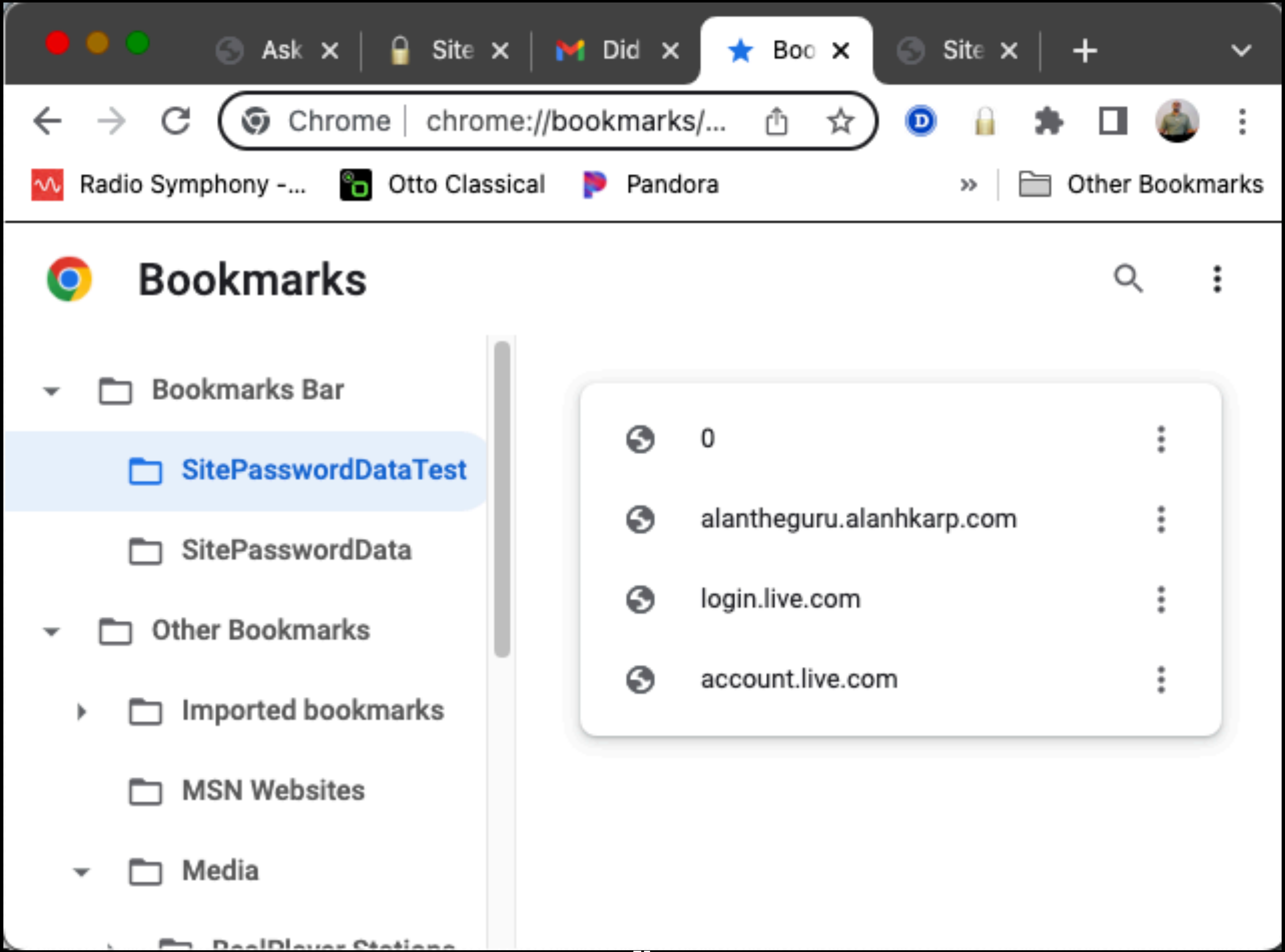


Bookmarks

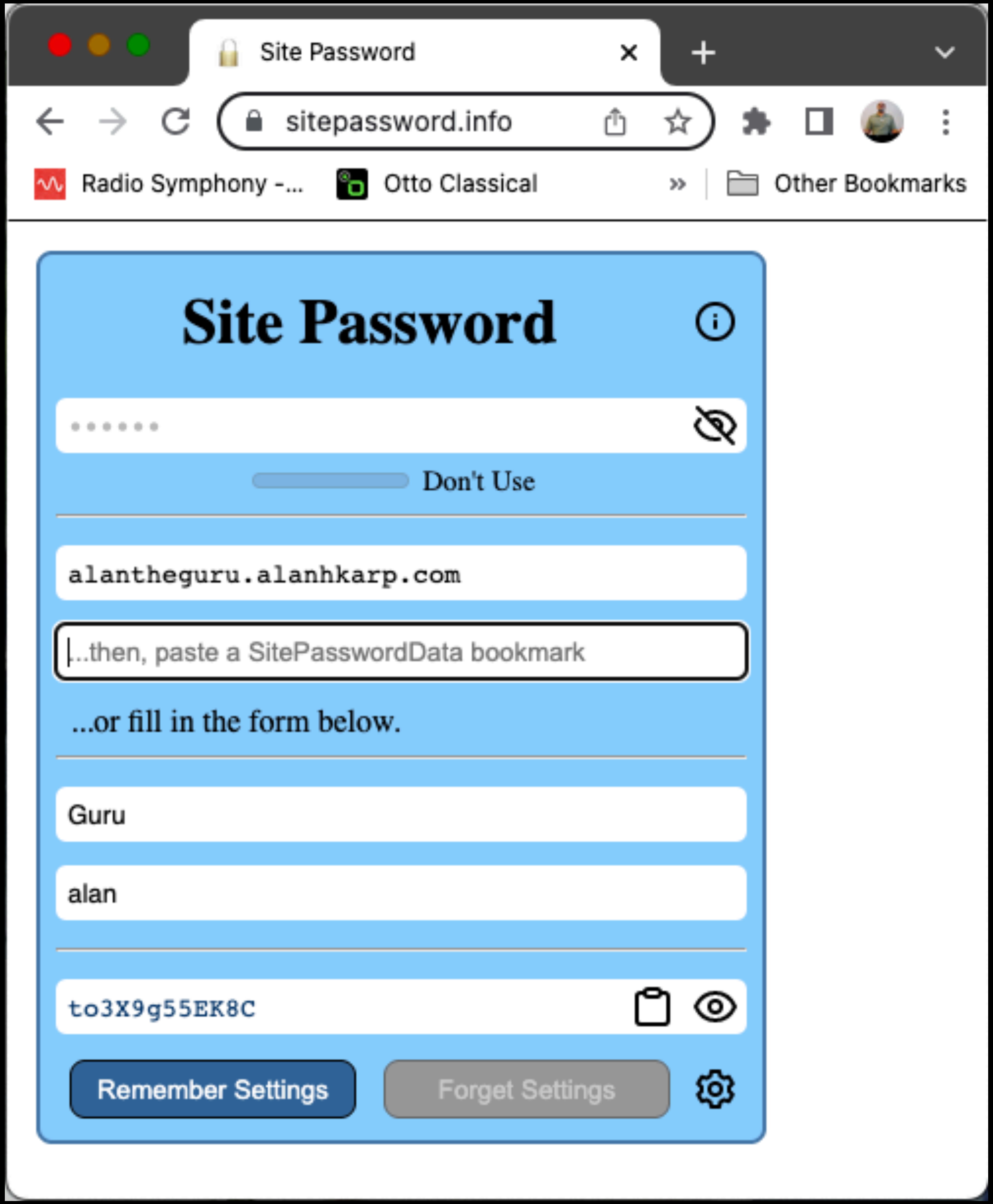
- Bookmarks Bar
  - SitePasswordDataTest
  - SitePasswordData
- Other Bookmarks
  - Imported bookmarks
  - MSN Websites
  - Media
    - RealPlayer Stations

0

alantheguru.alanhkarp.com

login.live.com

account.live.com



Site Password

••••••

Don't Use

alantheguru.alanhkarp.com

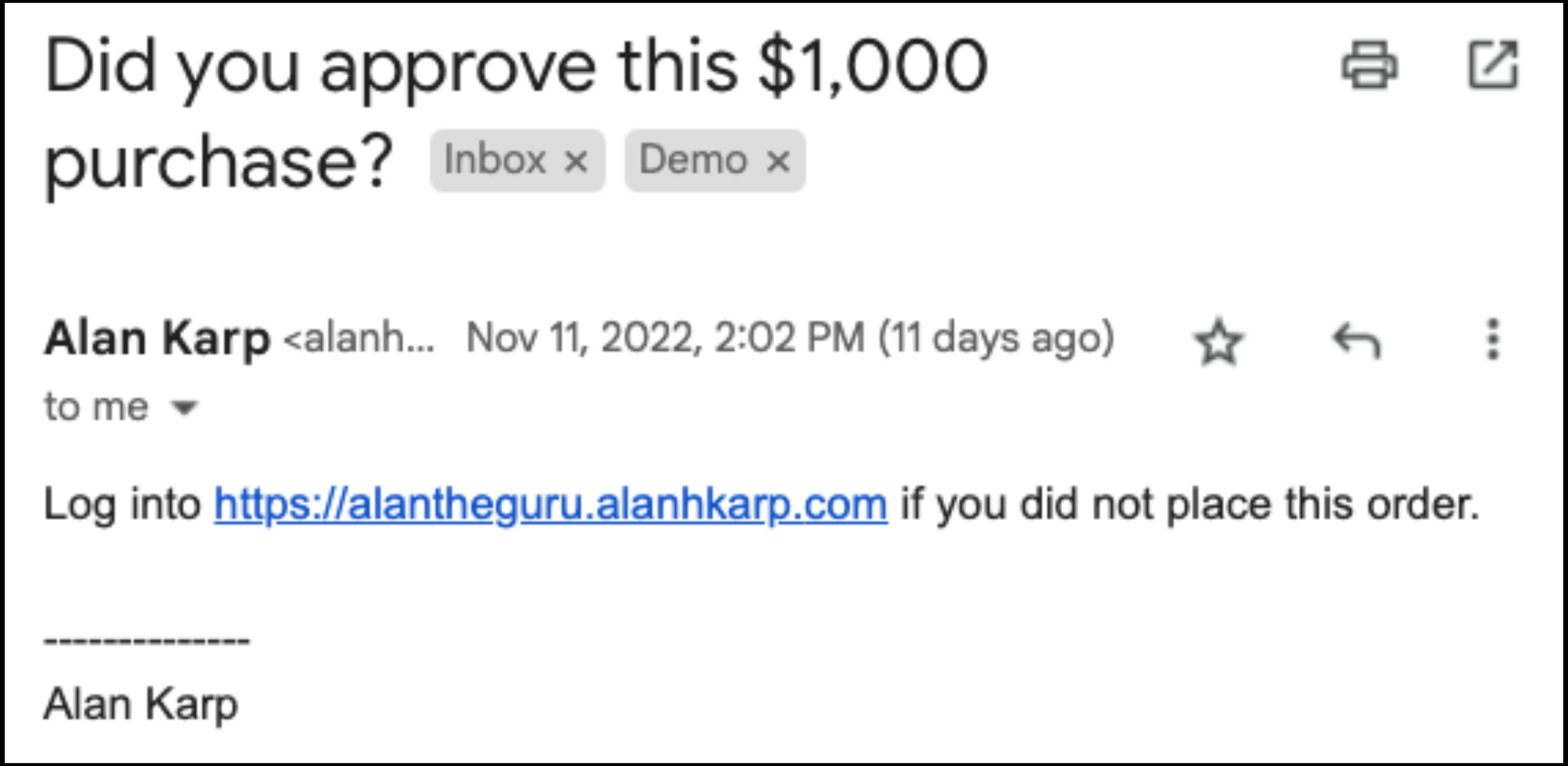
...then, paste a SitePasswordData bookmark

...or fill in the form below.

Guru

alan

to3X9g55EK8C



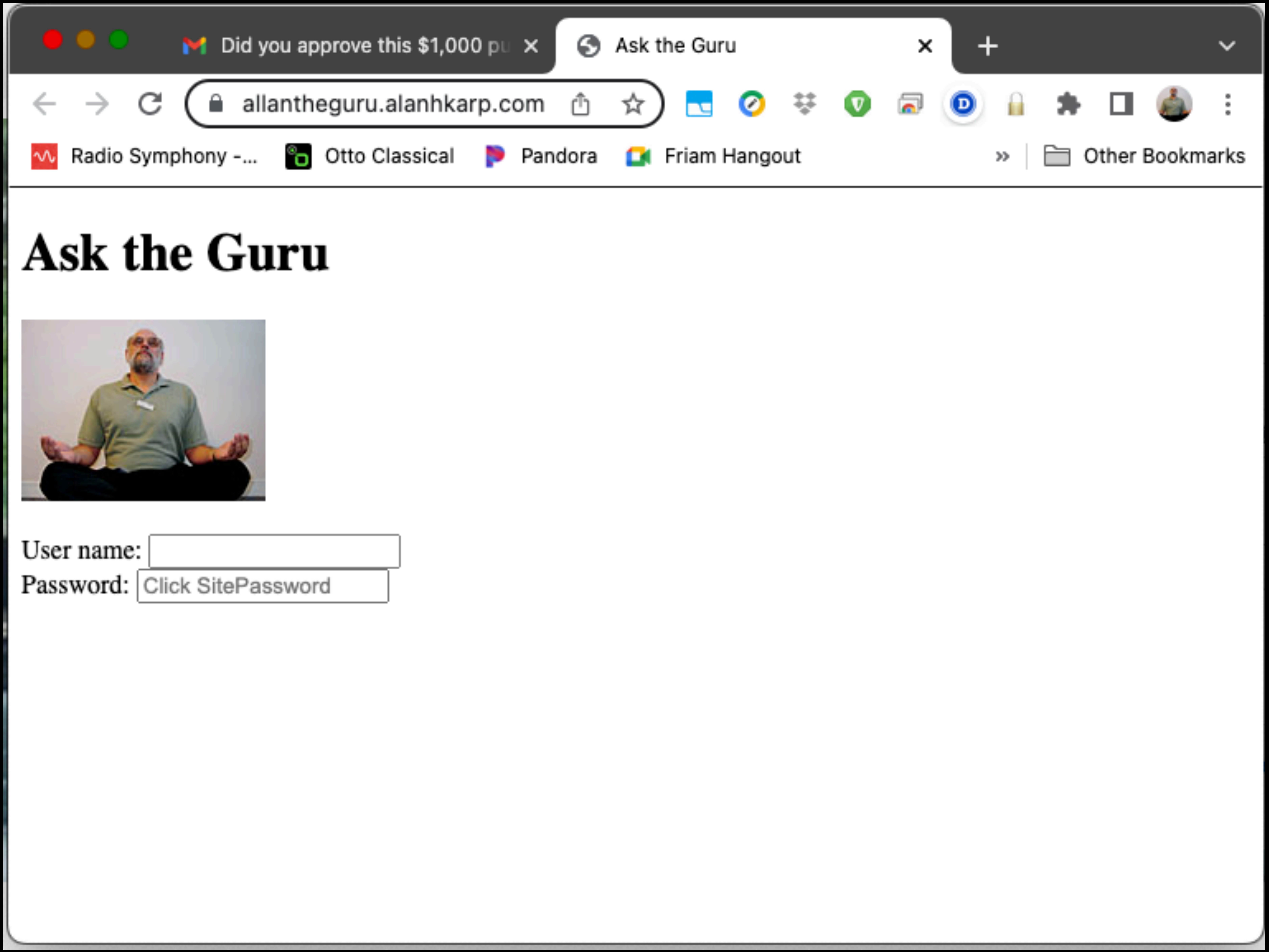
Did you approve this $1,000 purchase?

Alan Karp <alanh... Nov 11, 2022, 2:02 PM (11 days ago)

to me

Log into https://alantheguru.alanhkarp.com if you did not place this order.

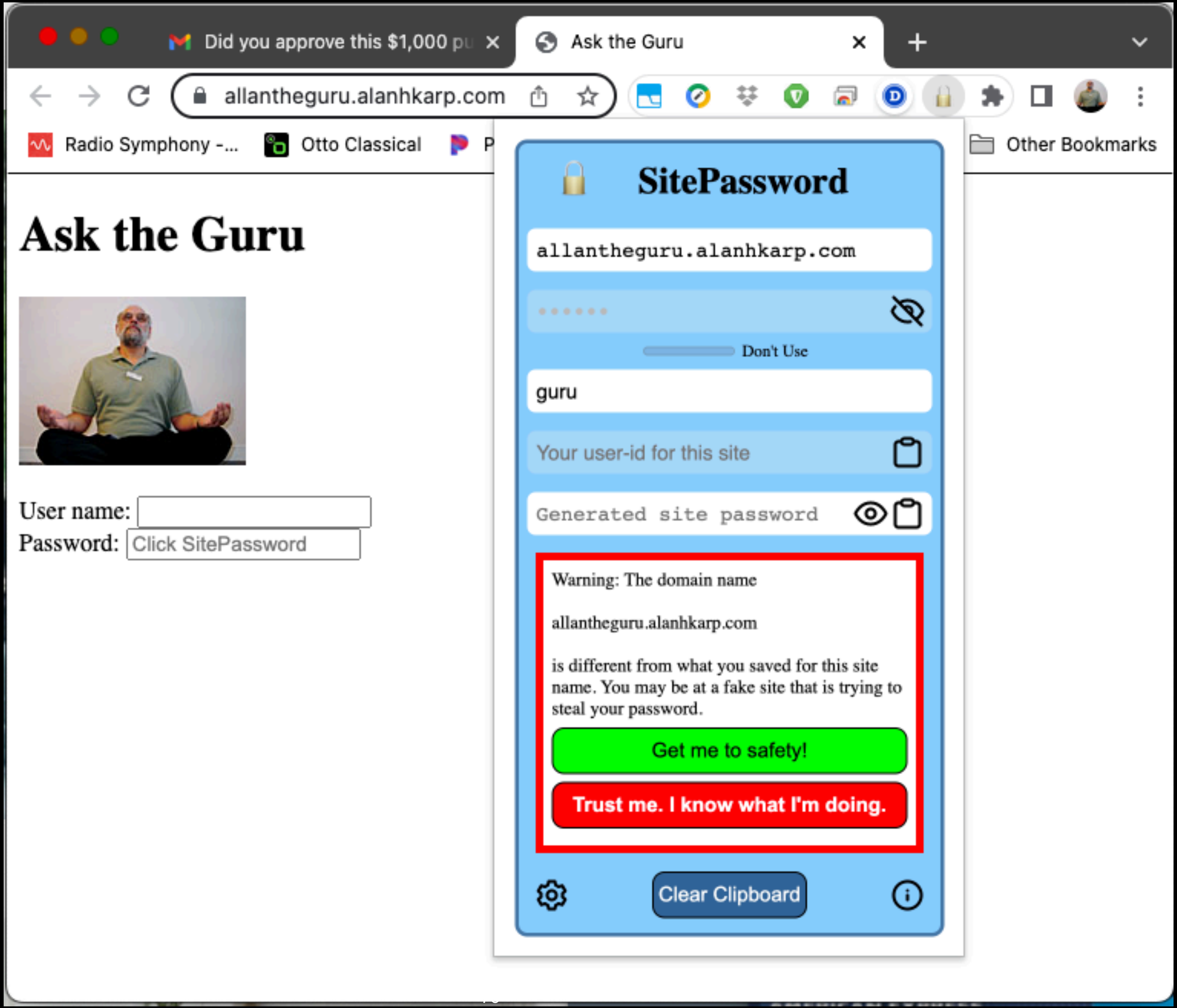
Alan Karp



Ask the Guru

User name:

Password: Click SitePassword



Ask the Guru

User name:
Password: Click SitePassword

SitePassword

allantheguru.alanhkarp.com

••••••

Don't Use

guru

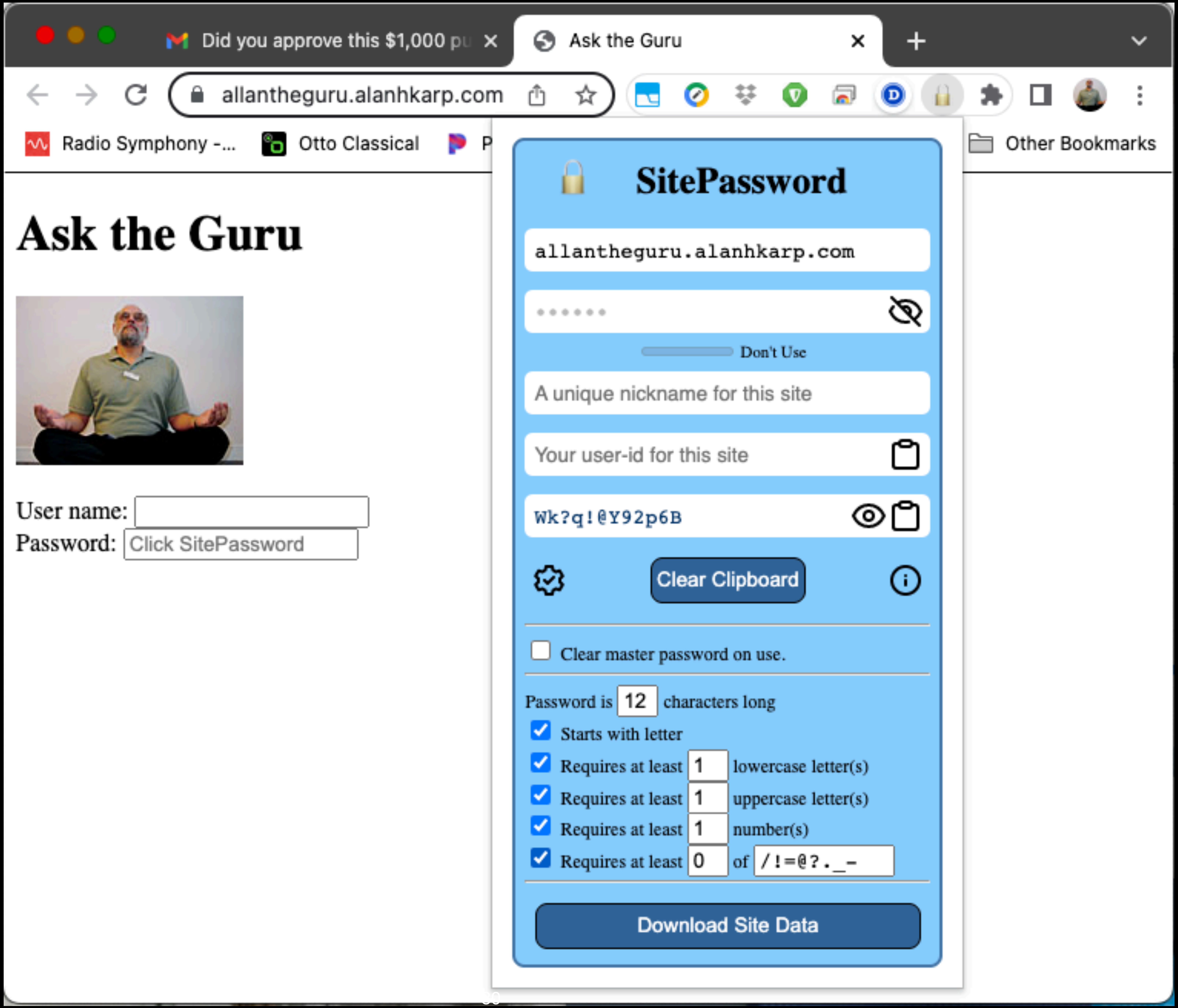
Your user-id for this site

Generated site password

Warning: The domain name

allantheguru.alanhkarp.com

is different from what you saved for this site name. You may be at a fake site that is trying to steal your password.



Ask the Guru

User name:

Password: Click SitePassword

SitePassword

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••••••

Don't Use

A unique nickname for this site

Your user-id for this site

Wk?q!@Y92p6B

□ Clear master password on use.

Password is 12 characters long

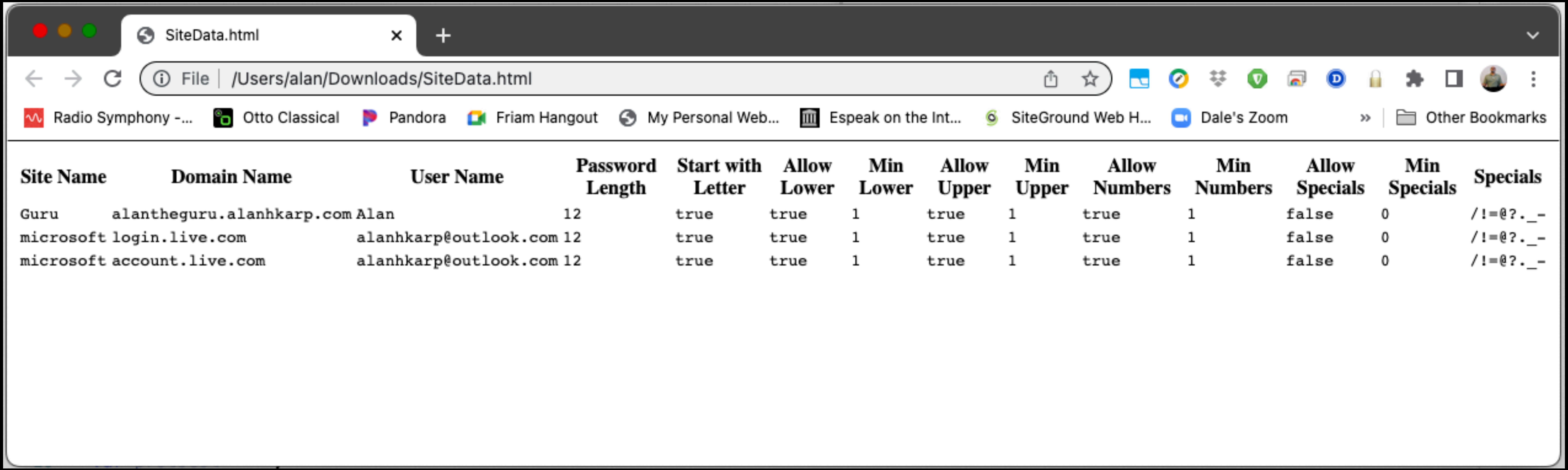
☑ Starts with letter

☑ Requires at least 1 lowercase letter(s)

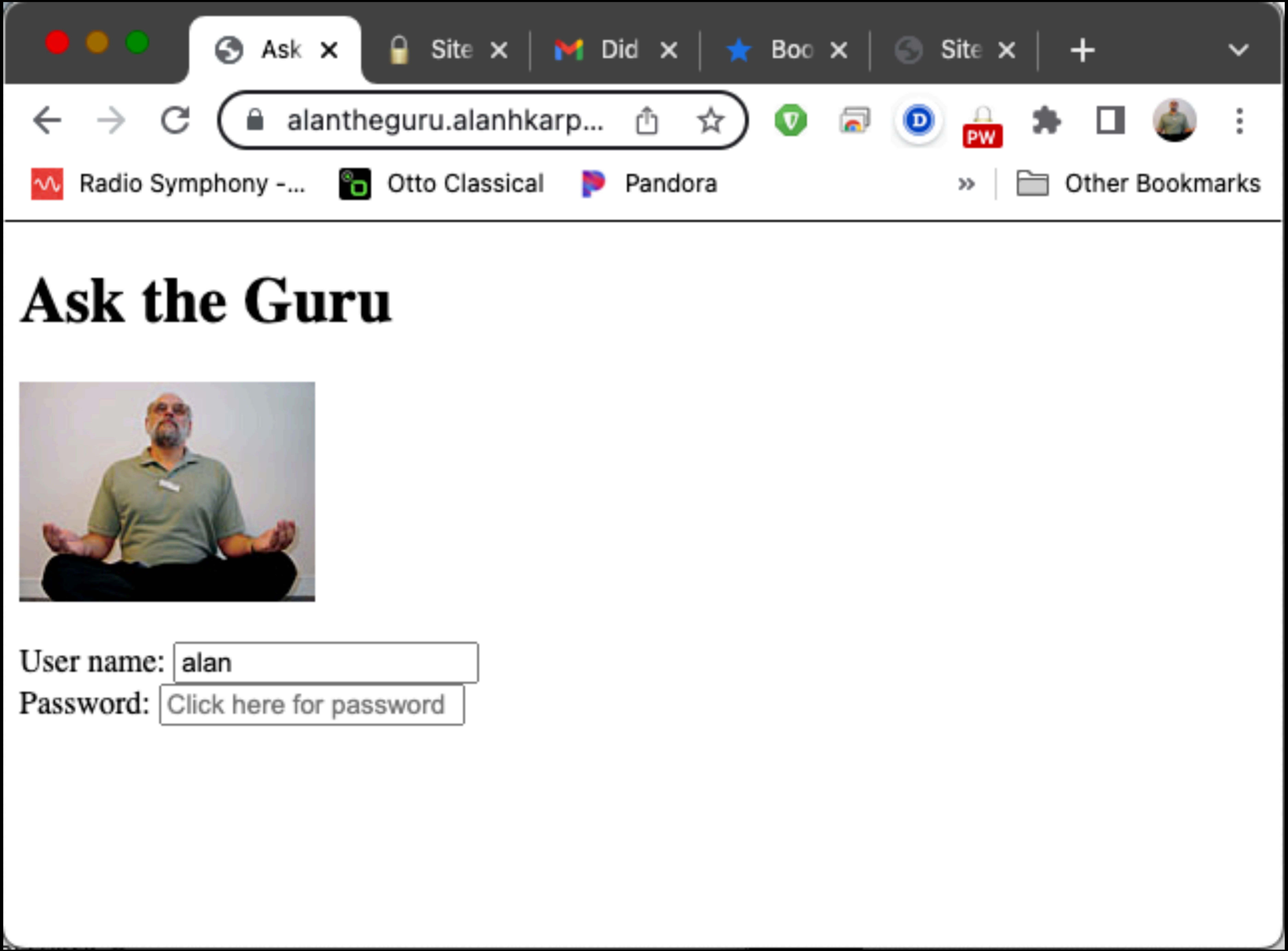
☑ Requires at least 1 uppercase letter(s)

☑ Requires at least 1 number(s)

☑ Requires at least 0 of /!=@?._-



Site Name	Domain Name	User Name	Password Length	Start with Letter	Allow Lower	Min Lower	Allow Upper	Min Upper	Allow Numbers	Min Numbers	Allow Specials	Min Specials	Specials
Guru	alantheguru.alanhkarp.com	Alan	12	true	true	1	true	1	true	1	false	0	/!=@?._-
microsoft	login.live.com	alanhkarp@outlook.com	12	true	true	1	true	1	true	1	false	0	/!=@?._-
microsoft	account.live.com	alanhkarp@outlook.com	12	true	true	1	true	1	true	1	false	0	/!=@?._-



Ask the Guru

User name: alan

Password: Click here for password

Backup Slides

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.