Fun With Research

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Outline

- A bio and some personal "wisdom"
- The differential equations of love
- Mr. Thumbnail

Outline

- A bio and some personal "wisdom"
- Rethinking Passwords (a current stump speech, but with a little research in it)
- Mr. Thumbnail

Rethinking Passwords

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OAG password rules

*   The password must be at least seven characters long and cannot exceed fifty characters.
* The password is case sensitive and must include at least one letter and one numeric digit.
* The password may include punctuation characters but cannot contain spaces or single or double apostrophes.
* The password must be in Roman characters

World of Warcraft
Wizard Rules

*** Your Account Password must contain at least one numeric character and one alphabetic character.**
*** It must differ from your Account Name.**
*** It must be between eight and sixteen characters in length.**
*** It may only contain alphanumeric characters and punctuation such as A-Z, 0-9, or !"#$%.**

United Airlines rules

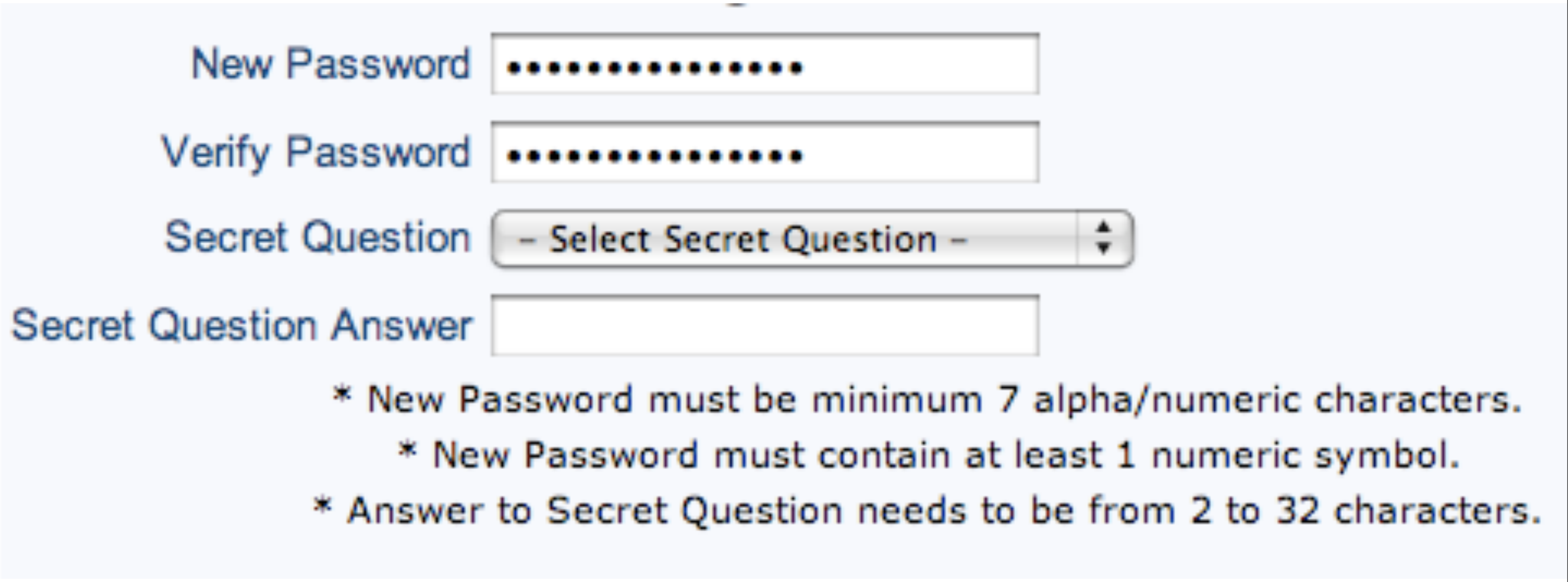
Passwords may be any combination of six (6) characters and are case insensitive.

Your password will grant you access to united.com, as well as other United features such as our wireless flight paging service, EasyAccess.

For security, certain passwords, such as "united" and "password" are not allowed.

Passwords are case insensitive; please remember how it is entered

Minimum password length is six (6) characters and must include characters from at least two (2) of these groups: alpha, number, and special characters.



New Password ••••••••••••••••

Verify Password ••••••••••••••••

Secret Question – Select Secret Question –

Secret Question Answer

* New Password must be minimum 7 alpha/numeric characters.

* New Password must contain at least 1 numeric symbol.

* Answer to Secret Question needs to be from 2 to 32 characters.

Passphrase Rules:

It must be a minimum of 4 words separated by blanks, at least 1 word must be 5 characters or longer.

It is case sensitive and cannot be less than 11 characters or more than 50 characters long including blanks.

It cannot contain single quotes, double quotes or ascii newline characters.

It cannot contain 3 or more consecutive identical characters.

You may NOT reuse any of the last 6 previously used passphrases

- The password may not contain your user name.
- The password must contain a minimum of six characters although eight characters are recommended since future complexity parameters will require an eight-character minimum.
- The password must contain three of the following characteristics:
  - Uppercase alphabet characters (AZ)
  - Lowercase alphabet characters (az)
  - Arabic numerals (09)
  - Non-alphanumeric characters (for example, !,$,#,%)

- Passwords shall not contain any proper noun or the name of any person, pet, child, or fictional character. Passwords shall not contain any employee serial number, Social Security number, birth date, phone number, or any information that could be readily guessed about the creator of the password.
- Passwords shall not contain any simple pattern of letters or numbers, such as "qwerty" or "xyz123".
- Passwords shall not be any word, noun, or name spelled backwards or appended with a single digit or with a two-digit "year" string, such as 98xyz123.
- Pass phrases, if used in addition to or instead of passwords, should follow the same guidelines.
- Passwords shall not be the same as the User ID.

Create a password between 8 to 15 characters.
Your password must contain at least:

- one special character (shift-number)
- one uppercase character
- one lowercase character
- and NOT contain any spaces

Use A Different Password on each Target System

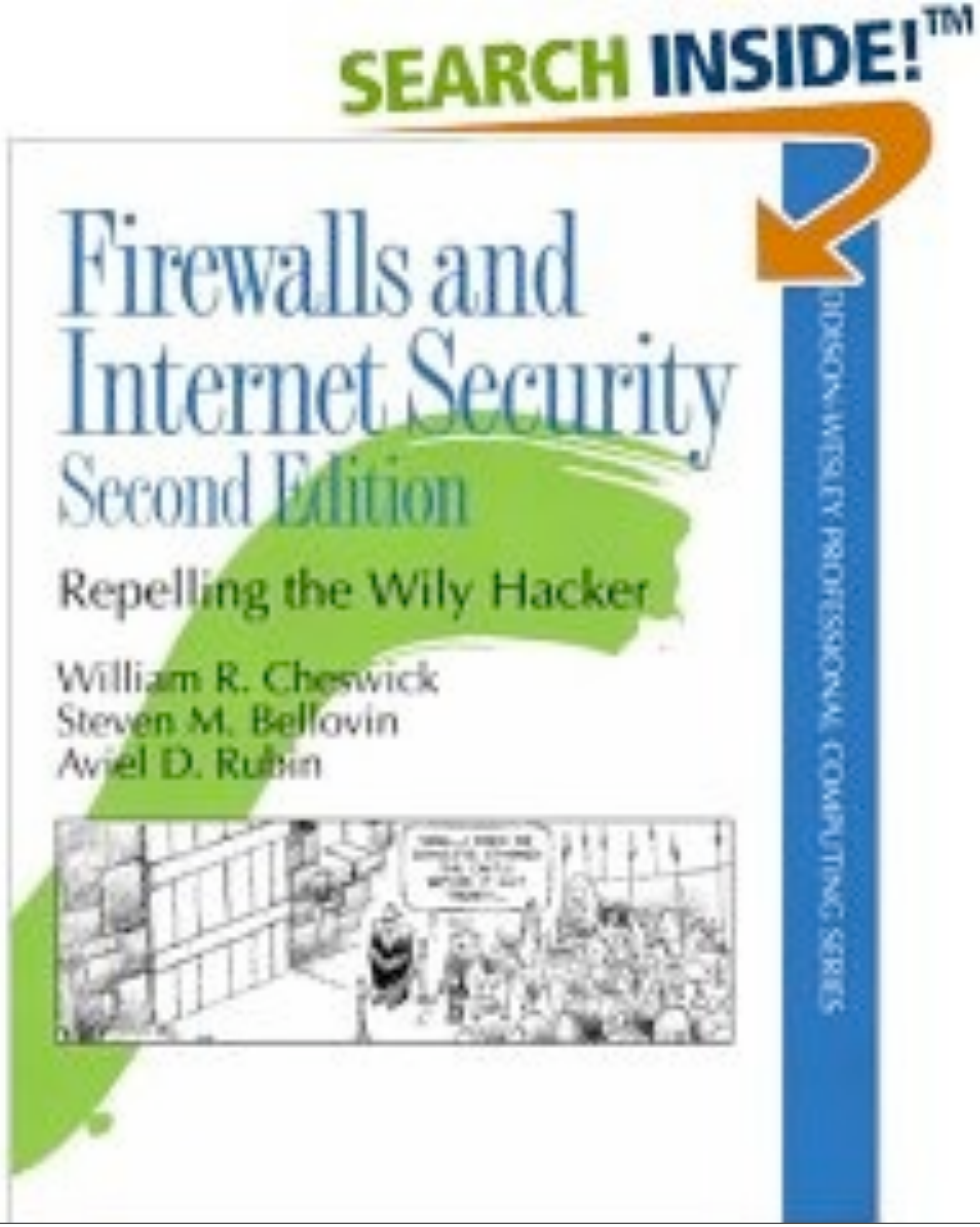
Change Your Password Frequently

Don’t Reuse Passwords

Don’t Write Your Password Down

Who is Responsible For This Eye-Of-Newt Password Fascism?

Well I am a Little


SEARCH INSIDE!™
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Second Edition
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William R. Cheswick
Steven M. Bellovin
Aviel D. Rubin
ADDISON-WESLEY PROFESSIONAL COMPUTING SERIES

What are these rules for?

Dictionary Attacks

How many times can I try to guess your password?

How Many Guesses? History of passwords

- A: a lot
- A: jillions
- A: zillions
- A: three
- A: three, and the correct answer changes each time you try

A: A lot of guesses

- Late 1970s, when Unix passwords were hashed with a salt (Morris and Thompson)
    - That made pre-computation impractical
- Access is mostly timesharing

A: Jillions

- Moore's Law carries on, people don't pick better passwords
- Networked services offer access to password files on misconfigured sites
- WAYWYT?

A: Zillions

- Today
- Multicore computers are perfect for password cracking
- Clouds, botnets, screen savers are all perfect for dictionary attacks
- If brute force doesn’t work, use more.

The Dictionary Attack Arms Race

- Moore's Law: 12 doublings since 1990
- And multi-core CPUs are perfect for password cracking
- Can a human choose and remember a password that a computer can't guess when limited only by computer speed and time available?

Evolution of the bad guys

- academics
- teens without girl friends
- governments
- organized crime, drug lords, terrorists

We Knew People Pick Weak PWs by 1990

- Klein, D. V.; *Foiling the Cracker; A Survey of, and Improvements to Unix Password Security*, Proceedings of the United Kingdom Unix User's Group, London, July 1990.

It is simply poor engineering to expect people to select and remember passwords that are resistant to dictionary attacks

Results

- People violate many of these rules routinely, for usability reasons
- Stringent rules increase use of fall-back systems, which are usually less secure, or more expensive
- The rules don’t make most things more secure in the face of most current threats

A: Three guesses

- Lock the account for a while or forever if there are too many wrong guesses in a row, or too many wrong guesses forever
- A locked account is a pain, but much better than illicit access
- Any non-moronic password can now be used

Non-moronic password rule

- Pick something a friend, colleague won't guess in a few tries.

Summary solution

- Limited guesses and lock the account
- Non-moronic passwords

The Problem: the threat model has changed

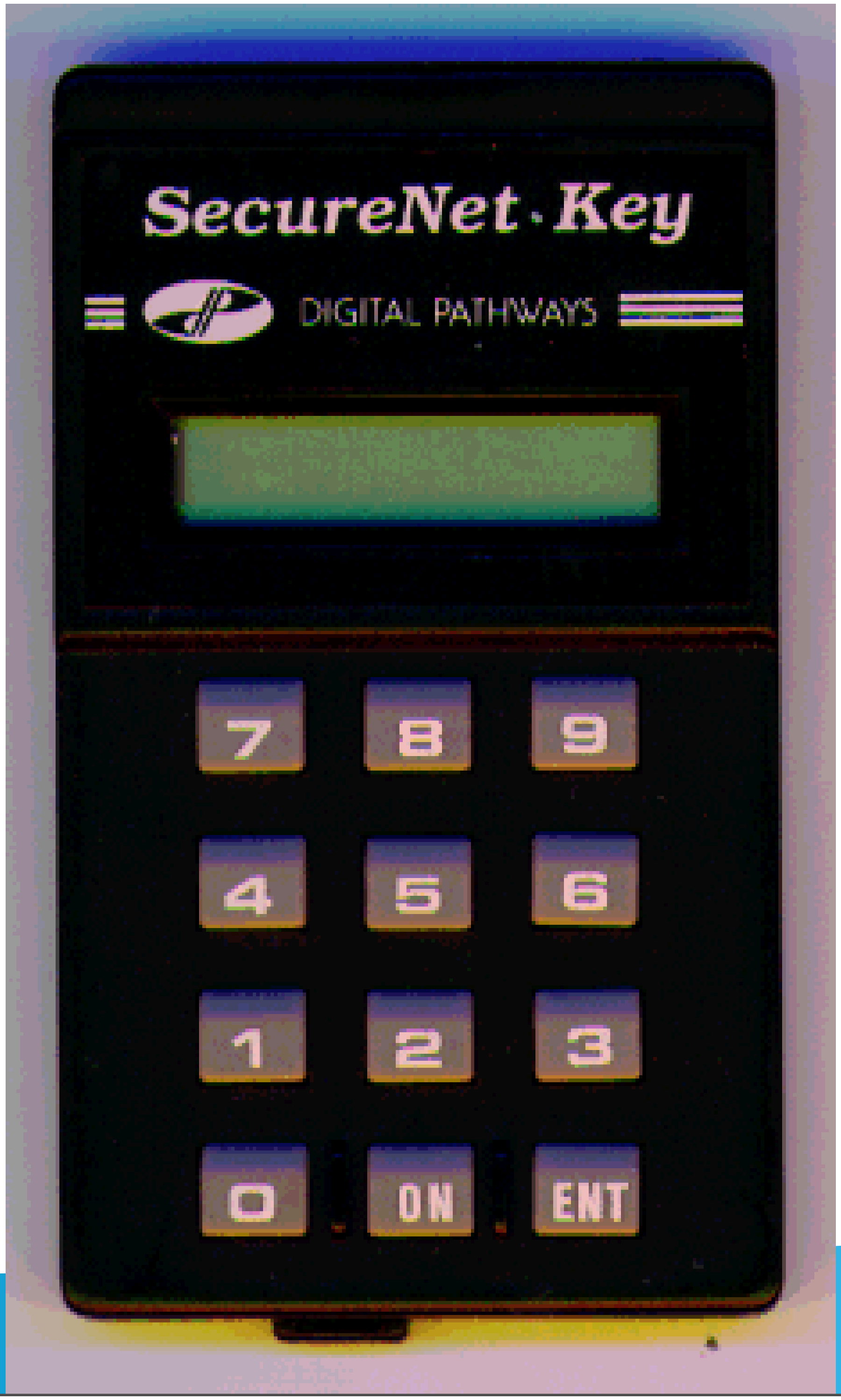
- Dictionary attacks are not used very much any more
- Keystroke loggers and *phishing* beat any strong password
- If I watch (or listen!) to you type, I can get the full password regardless of complexity!

A: three, and the correct answer changes

- This is done with one-time passwords
- The answer is based either on the time, or the response to a changing challenge
- Usually requires hardware, or a piece of paper (but see below)

SecureID

SecureNet Key
SNK-004



at&t

A login from my distant past

```
RISC/os (inet)

Authentication Server.

Id? ches
Enter response code for 70202: 04432234


Destination? cetus
$
```

Challenge/Response passwords

- Gets us out of the game
- Sniffing is not useful
- Man-in-the-middle can still be used
- Pretty much nothing to forget
- A PIN is helpful to make two-factor
- Surprisingly cheap

Why aren't these ubiquitous?

- Cheap devices available before 1990
- People hate:
  - Having to carry the device
  - Entering the challenge (why SNK lost)
  - Entering the response
  - Carrying multiple devices

Further password criteria?

- Text-only is most general
  - The web isn't the only place we need these solutions
  - But maybe iPhone-like interfaces will be ubiquitous enough
- Memorability? Shoulder-surfing?

Password Properties

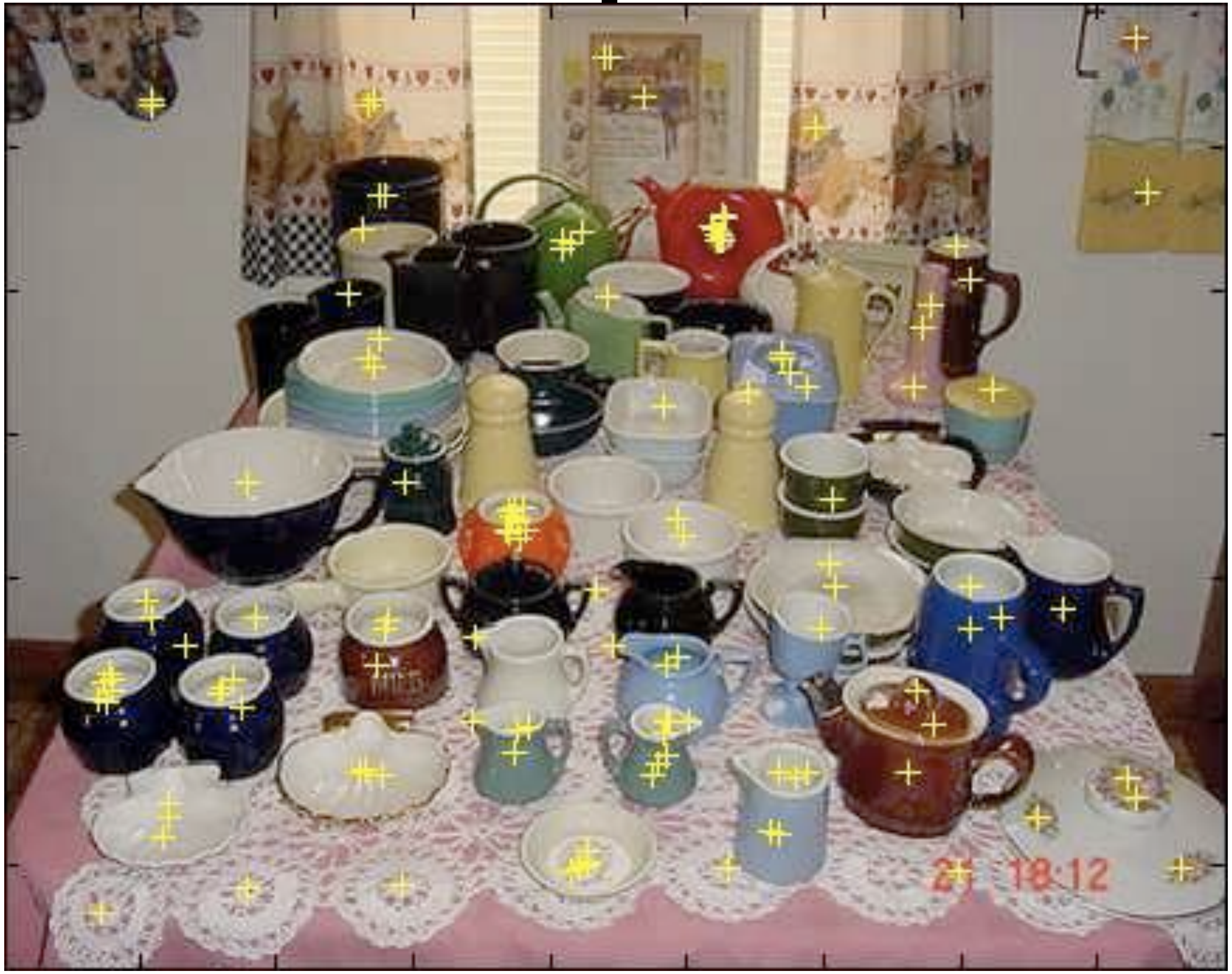
- Memorable?
  - Daily, monthly, yearly?
  - Cost if forgotten
- Hardware needed?
- Training steps needed
- User selected?

Text

- Single use?
- Changeable?
- Easy to write down?
- Easy to describe or transmit?
- Authentication speed
- Text, graphical, bio, other

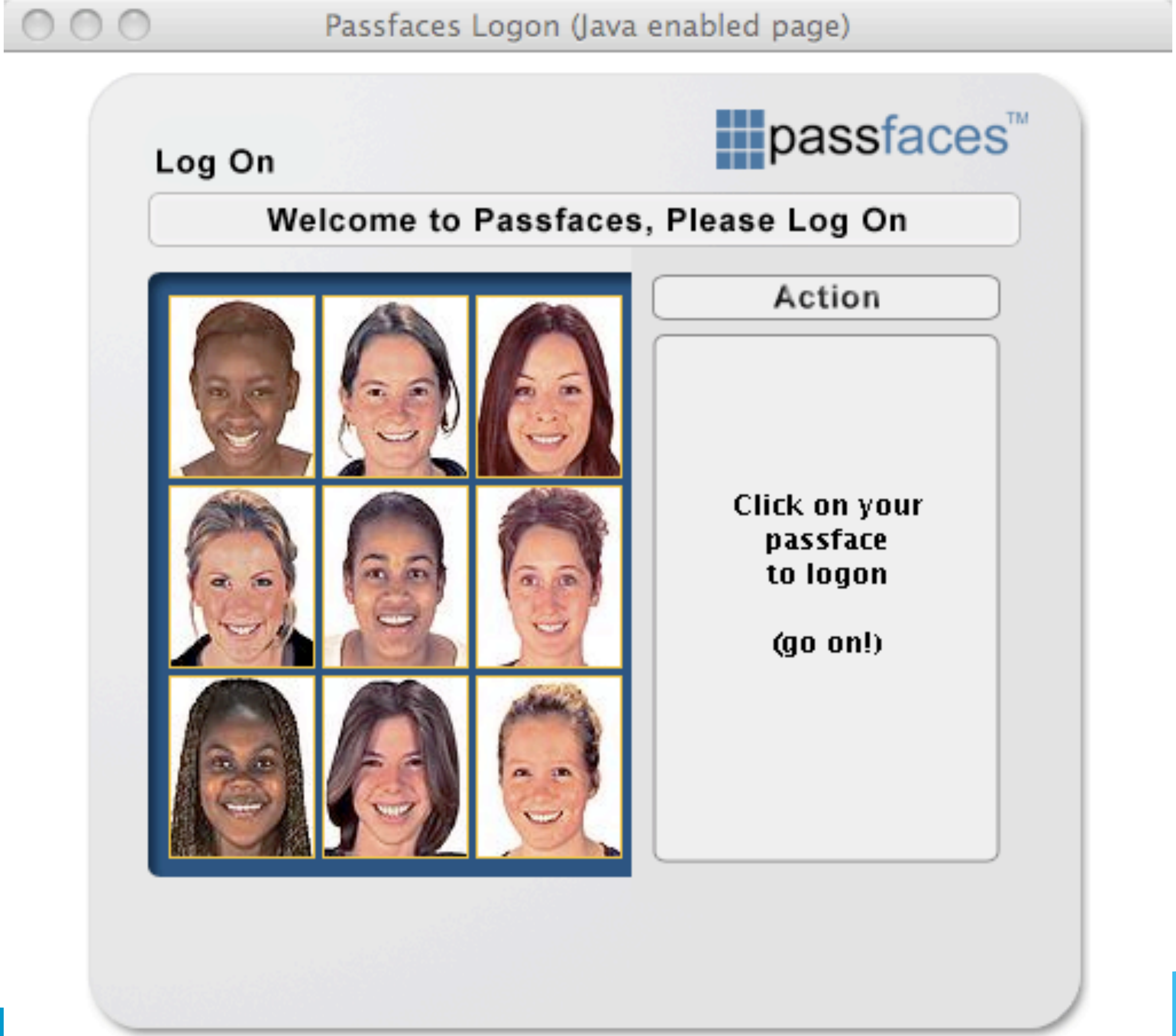
Some Password Ideas

Passpoints



from *Dirik, Memon, Birget*; SOUPS 2007

Passfaces



Passfaces Logon (Java enabled page)

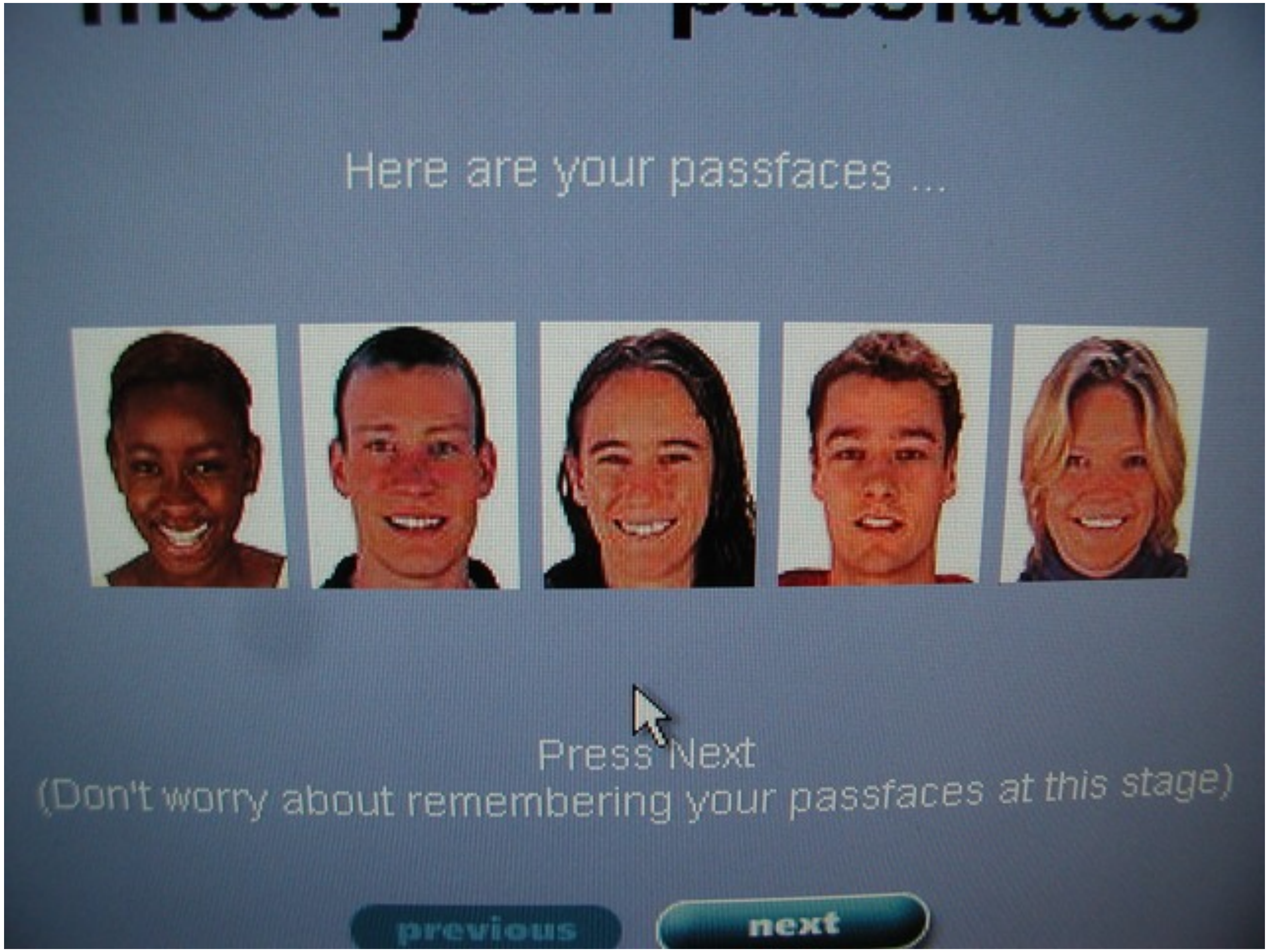
Log On

Welcome to Passfaces, Please Log On

Click on your passface to logon

(go on!)

Passfaces

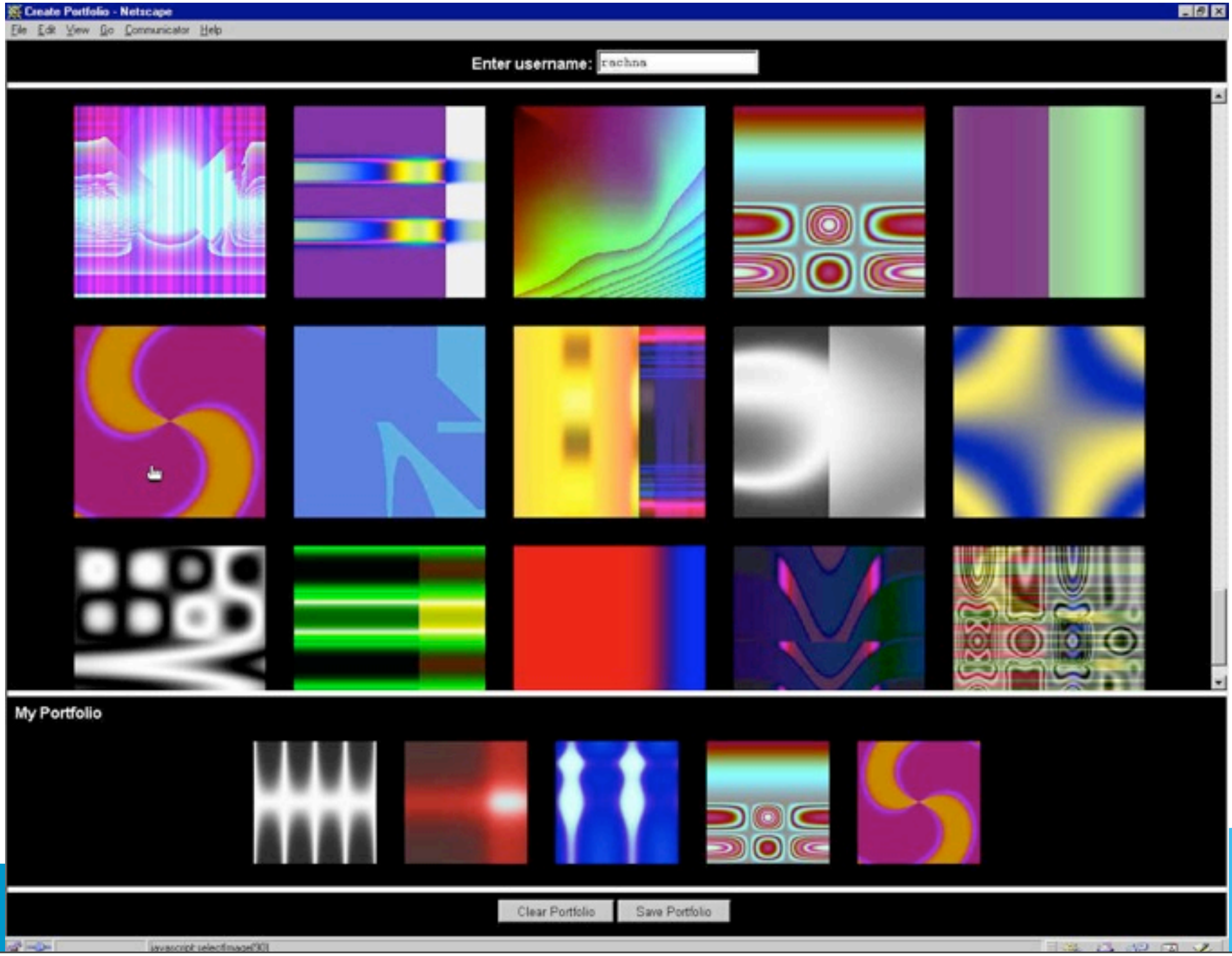


meet your passfaces

Here are your passfaces ...

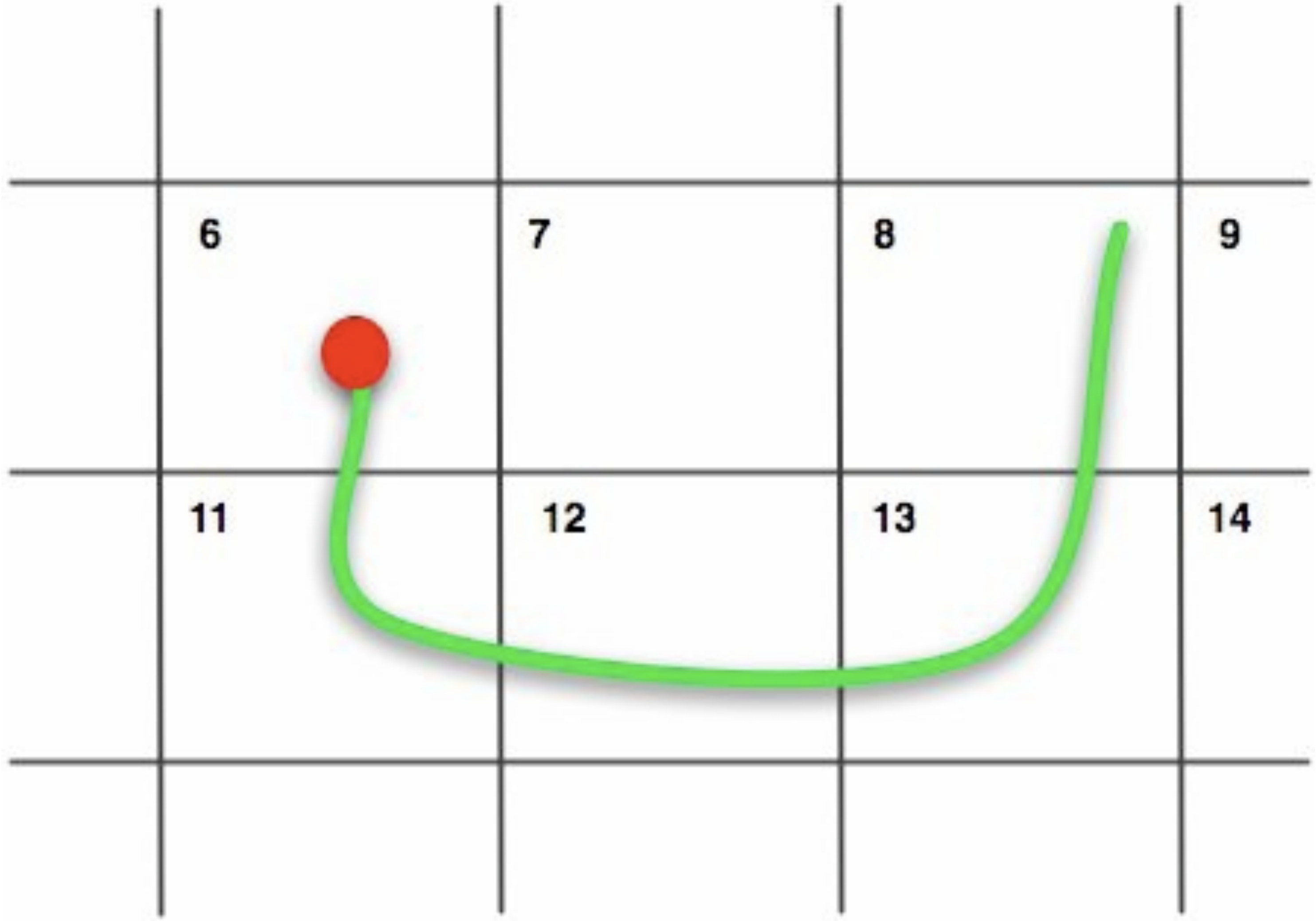
Press Next
(Don't worry about remembering your passfaces at this stage)

Deja Vu (Recognition-based)


Create Portfolio - Netscape
File Edit View Go Communicator Help
My Portfolio
Clear Portfolio
Save Portfolio
javascript:selectImage(90)

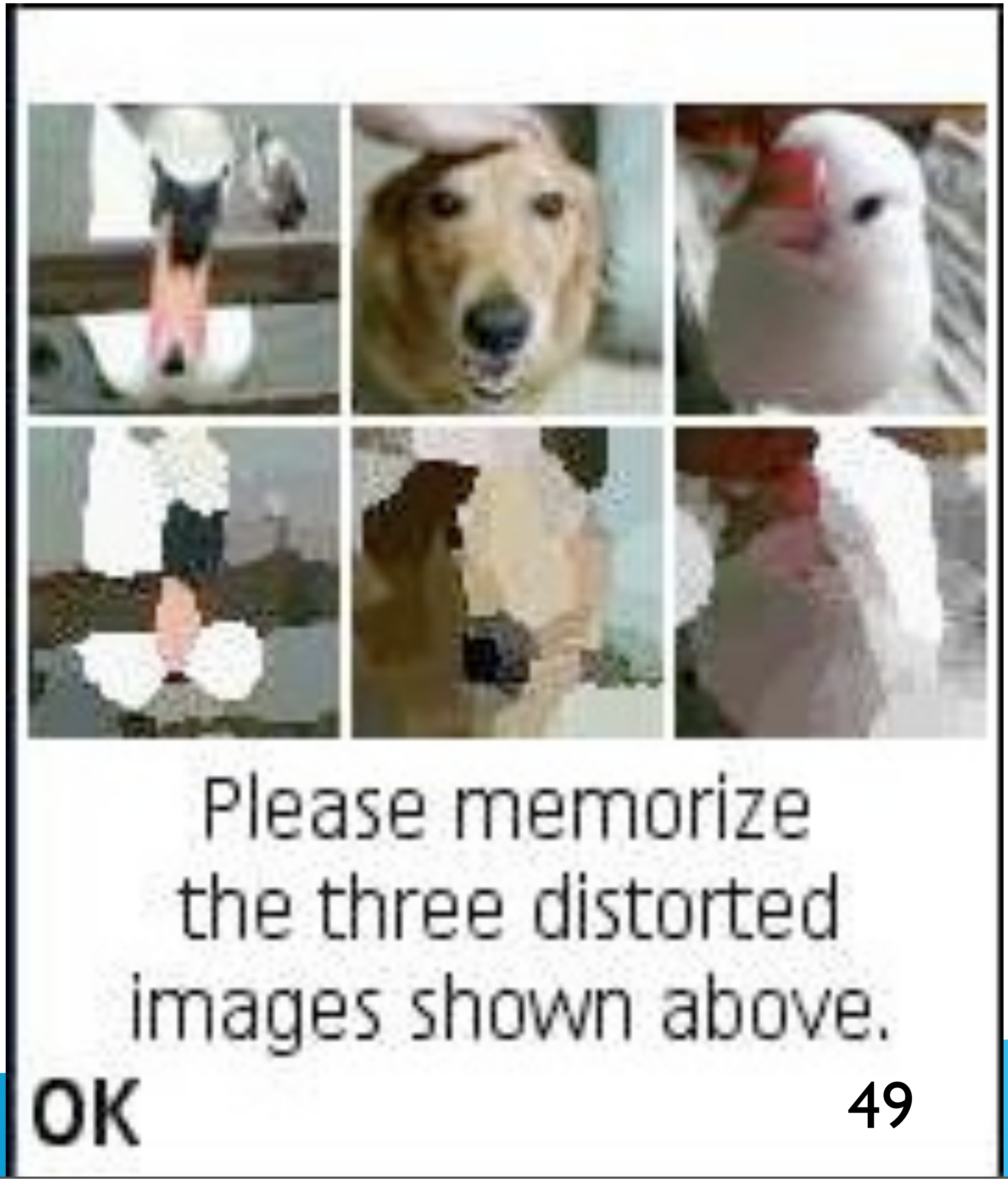
Enter username: rachna

Draw a Secret



Lin, Dunphy, *et al.* SOUPS 2007

Use Your Illusion (SOUPS 2008)

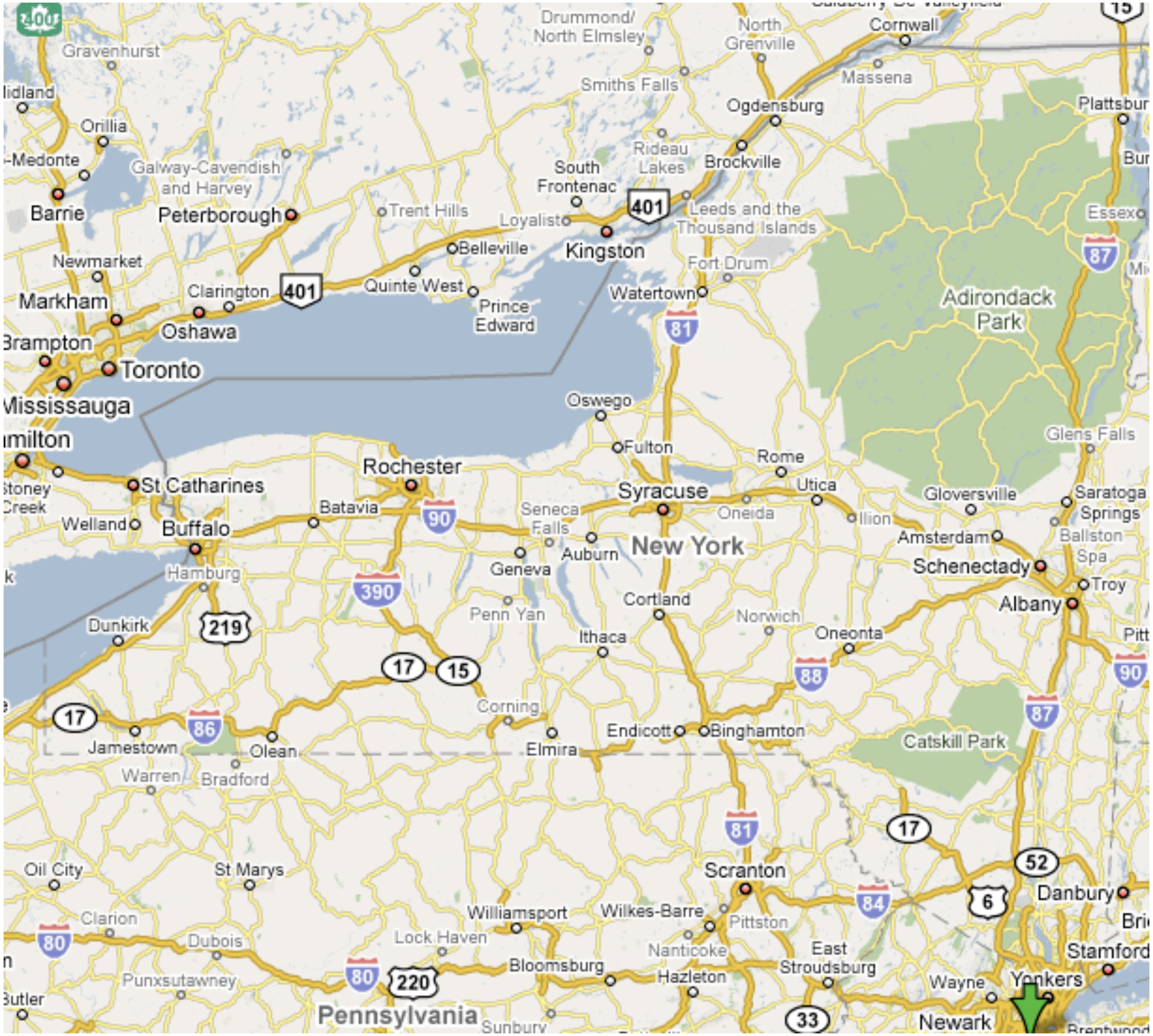


Please memorize the three distorted images shown above.

about 115

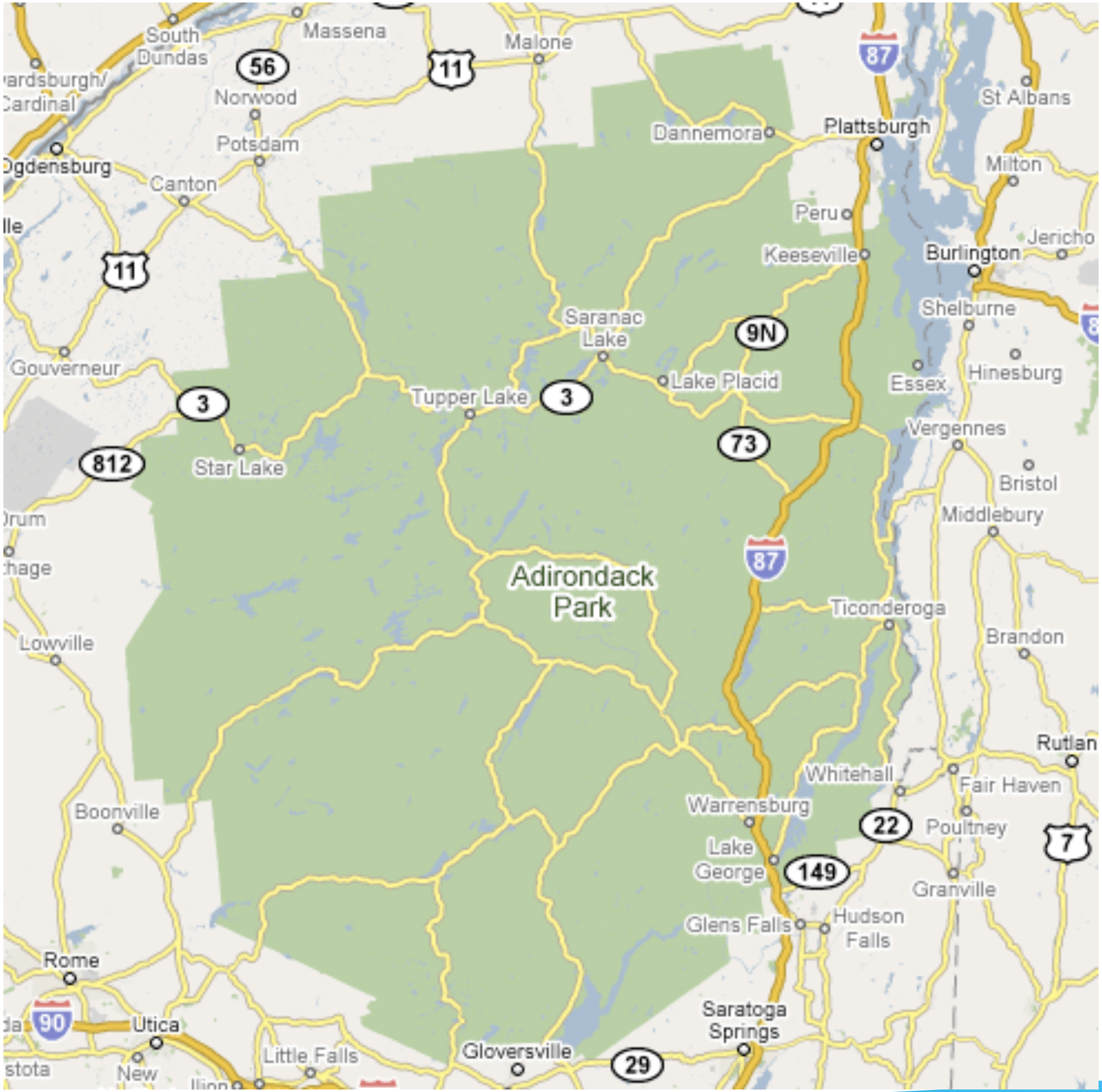
Some Whacko Ches Ideas

Passmaps



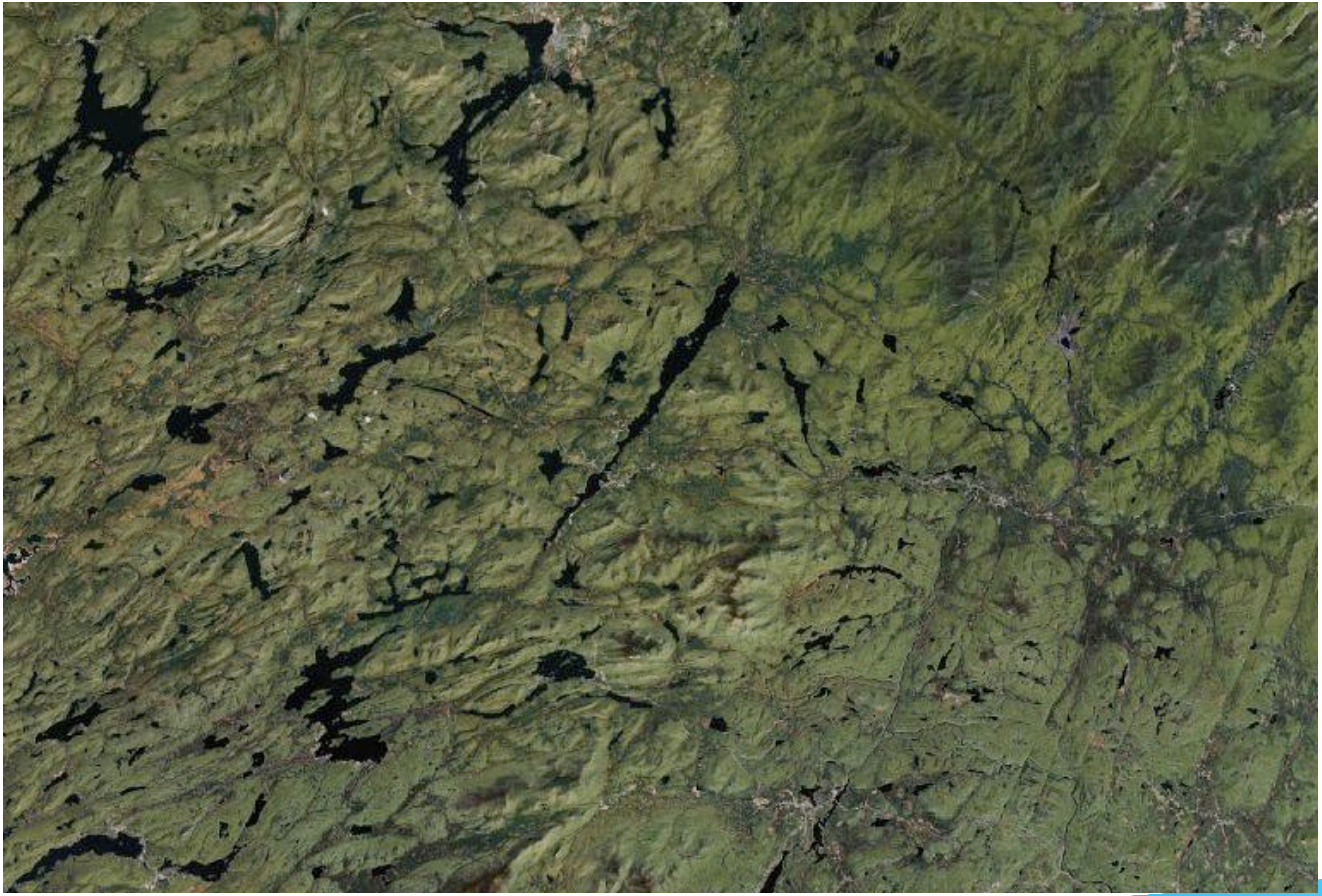
TODO: Find a point in New York State

Adirondacks are nice



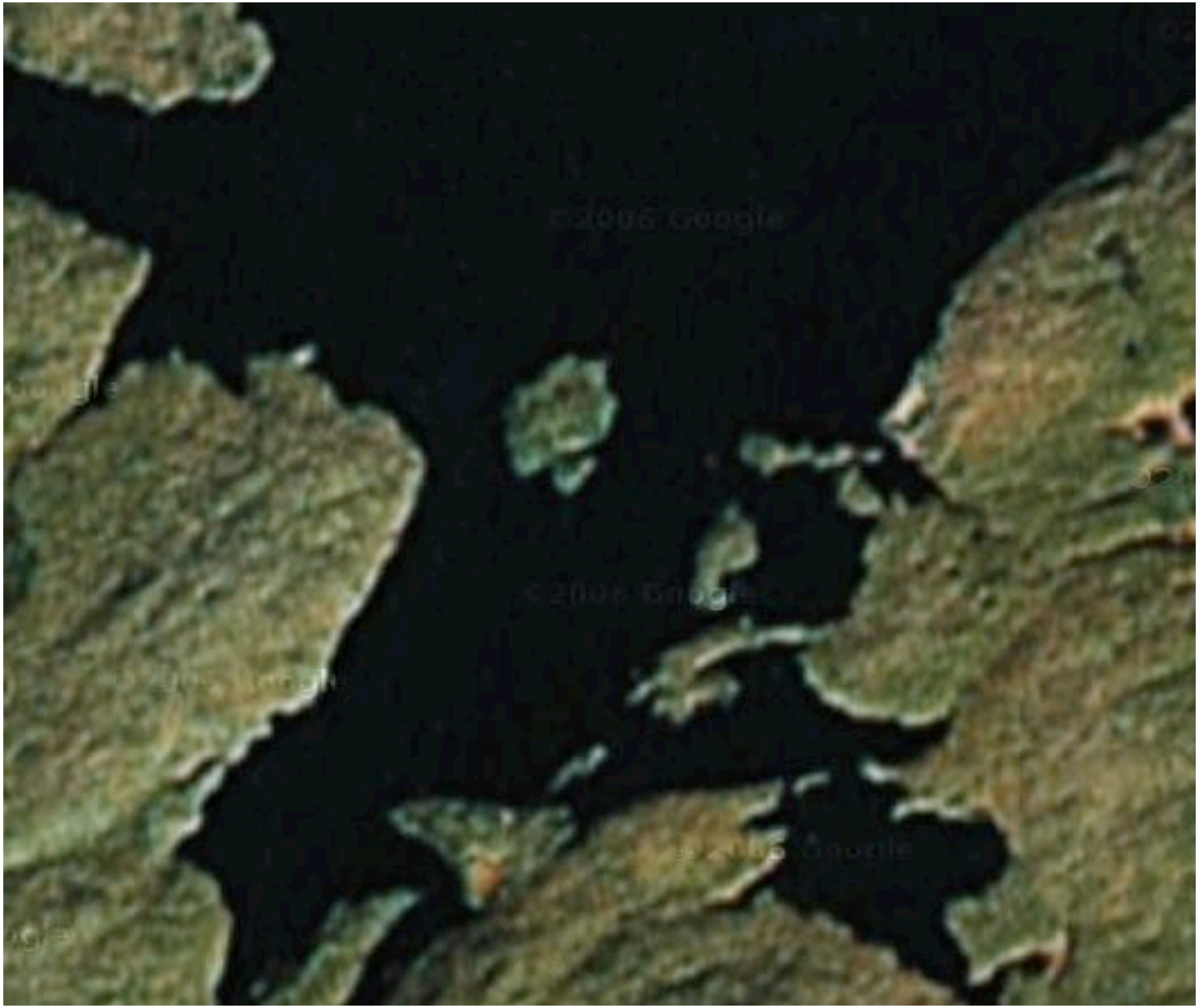
52 of about 90

Lakes have interesting shapes,
let’s zoom in on the middle



Upside down dog in the upper left

Dogs bark, check out the voice box



PW is lat/long of the center island

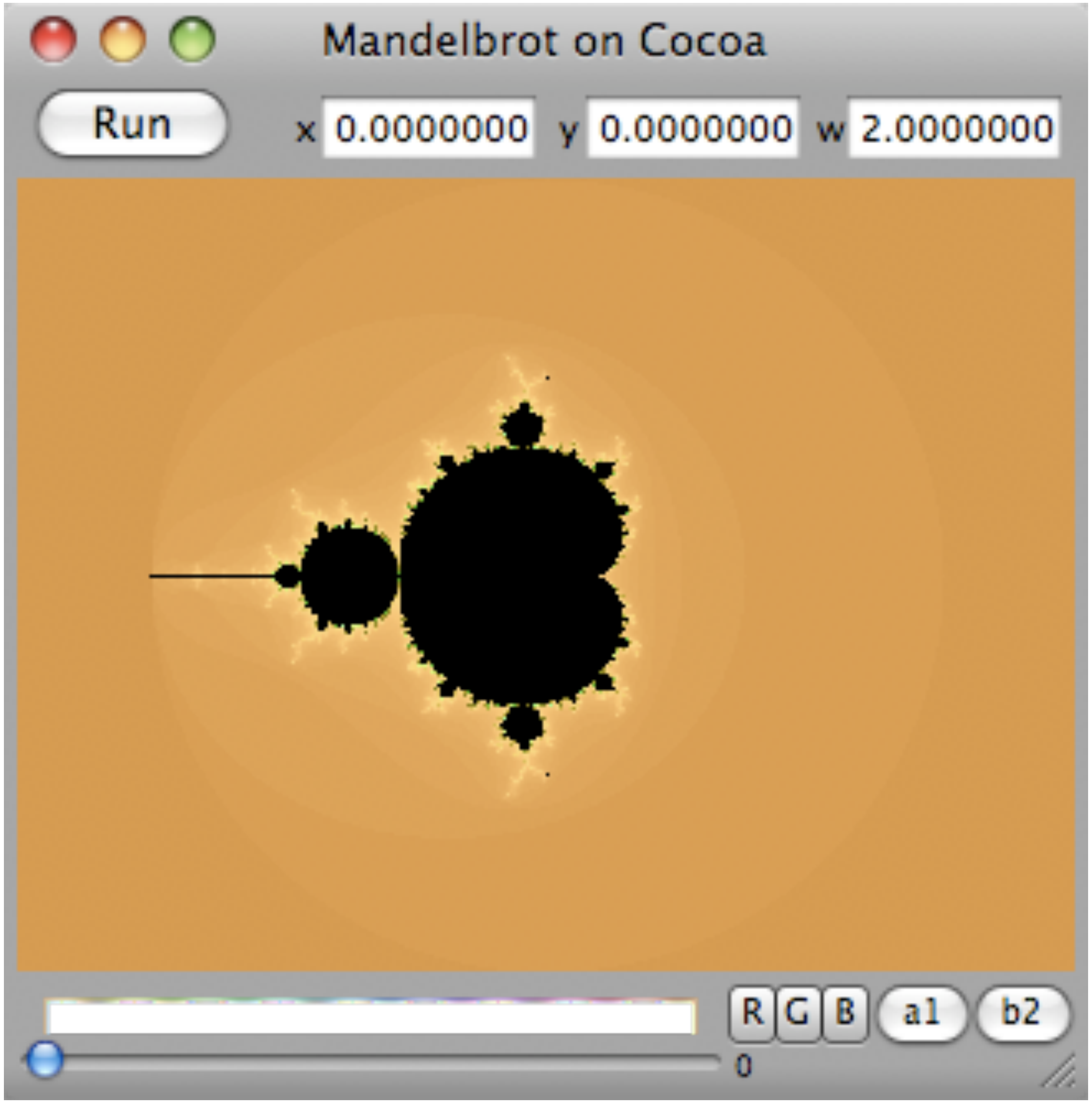
Passmaps?

- Reproducibly zoom in on a remembered set of map features?
- Lots of bits
- Maybe hard to shoulder surf
- Not challenge/response
- memorable over a year?

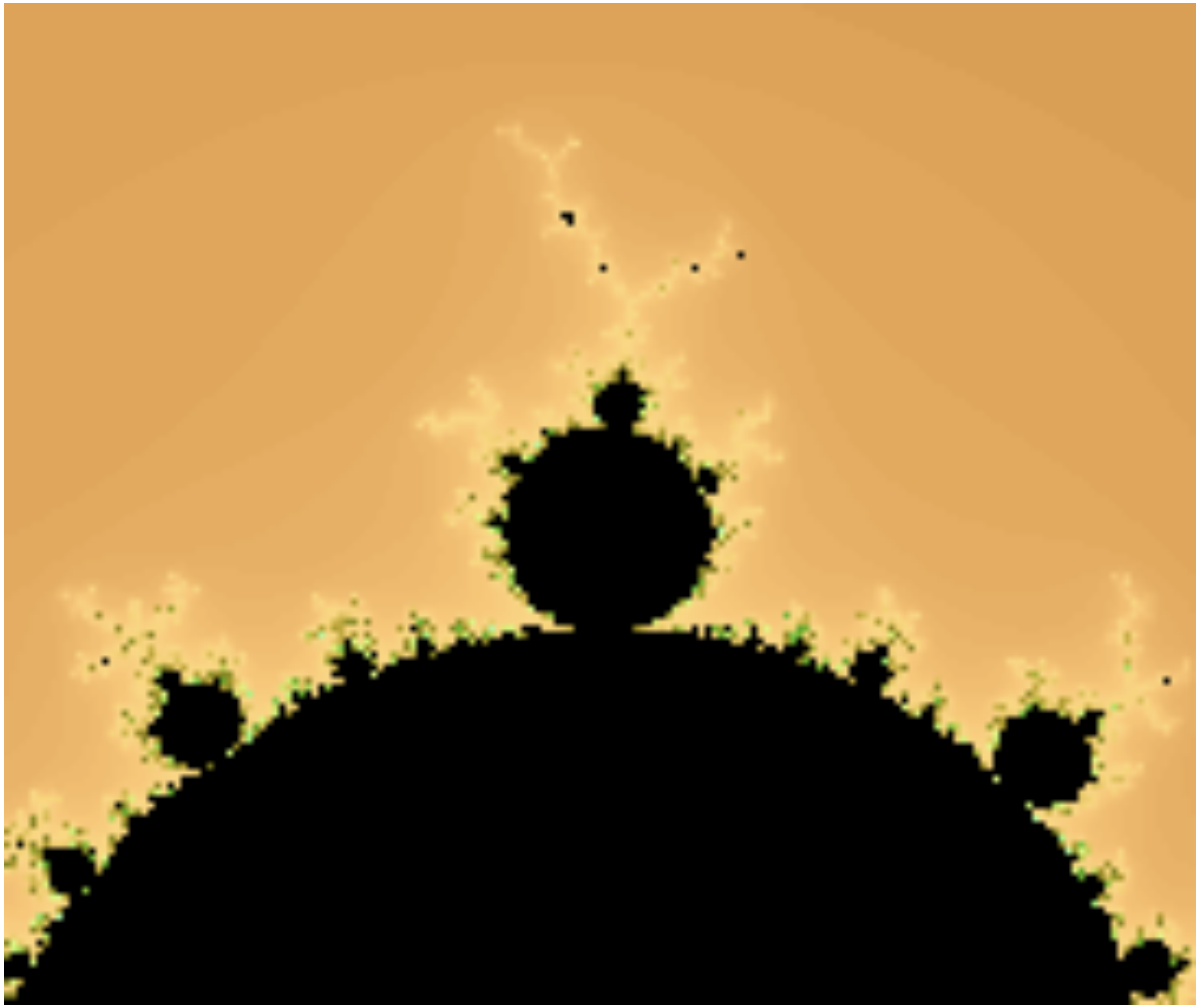
- Nice for a touch screen?

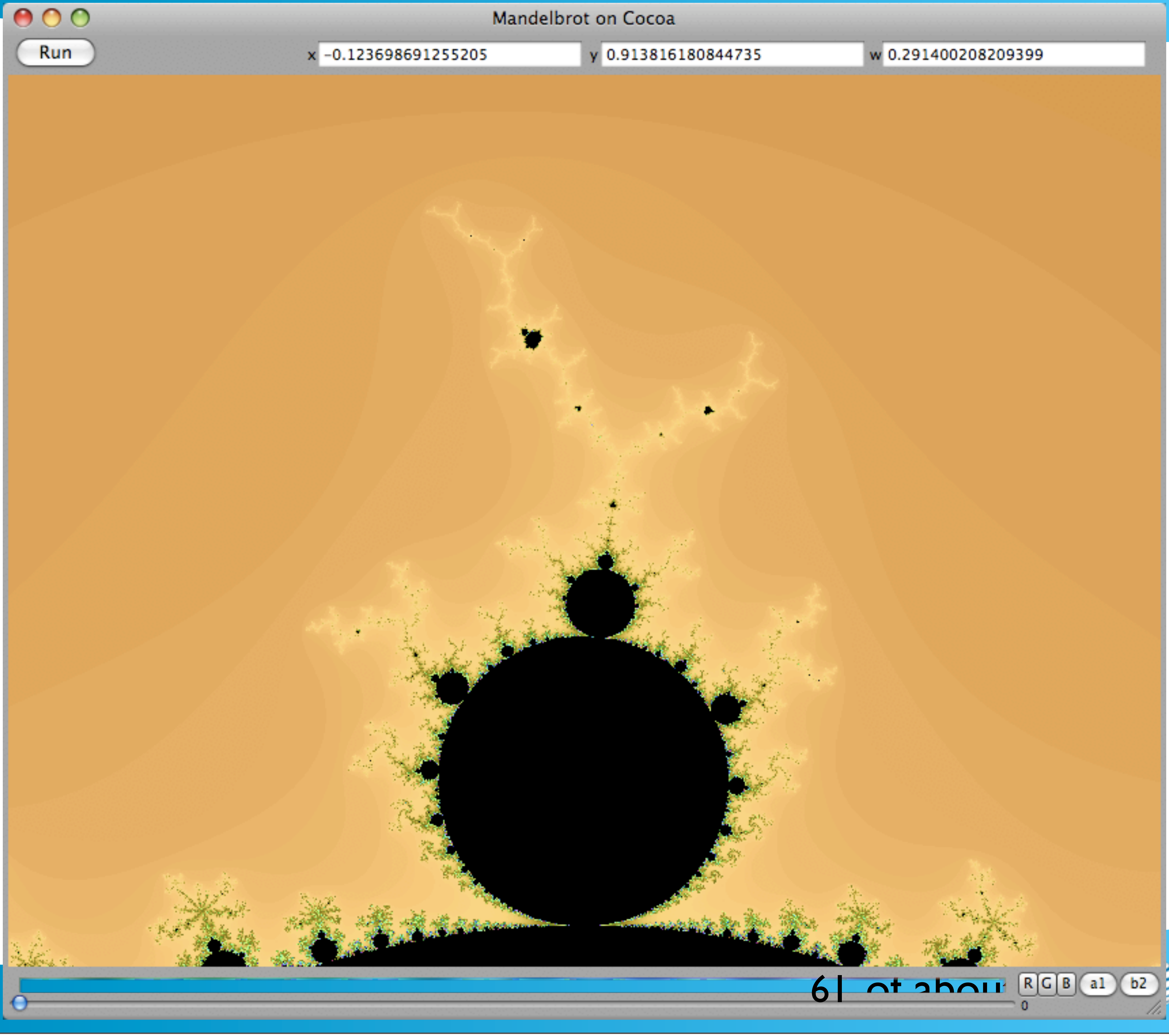
Some Whacko Ches Ideas

How about passgraphs? Get Google out of the loop



Mandelbrot on Cocoa
Run
x 0.0000000
y 0.0000000
w 2.0000000
R
G
B
a1
b2
0



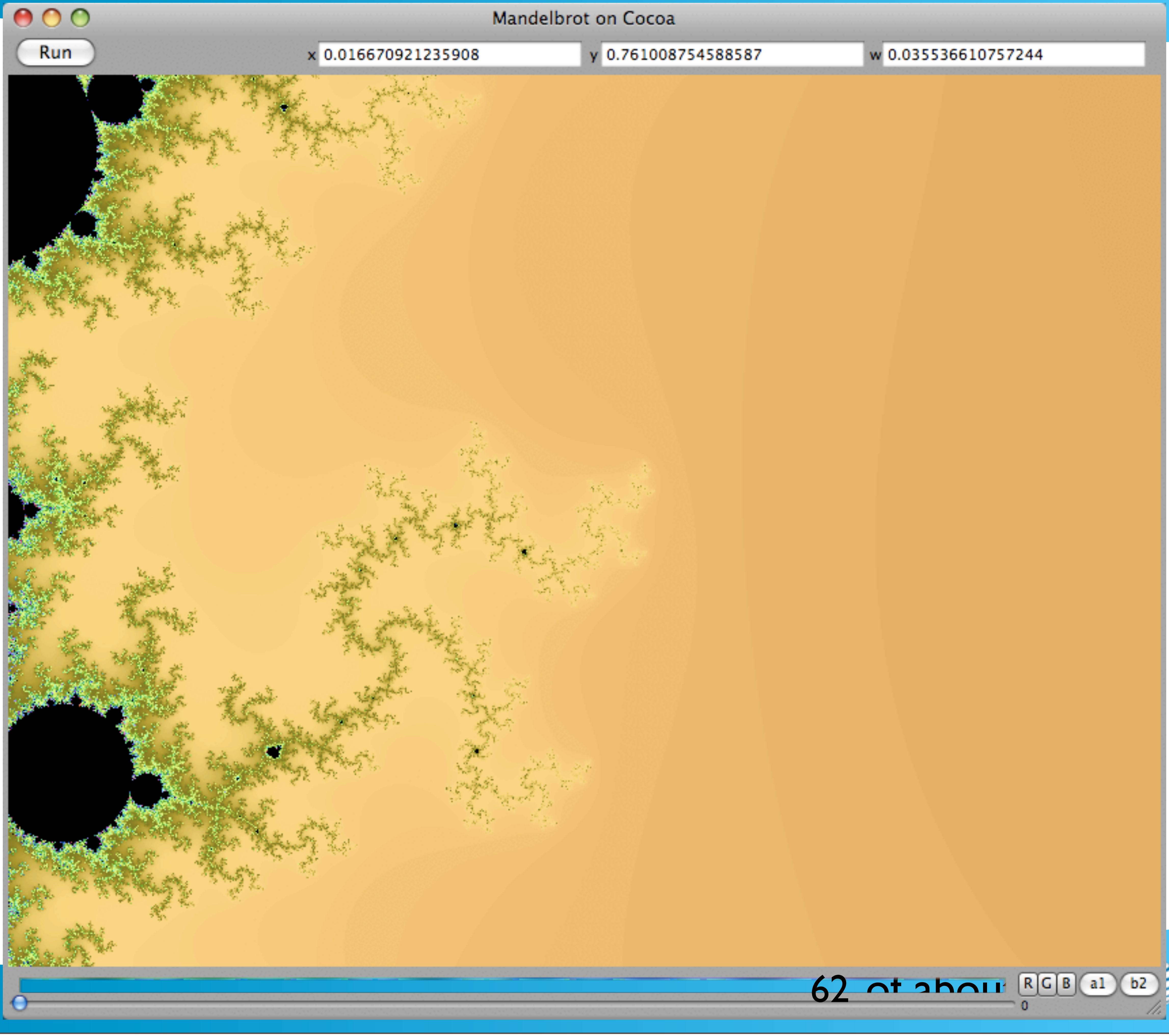


Mandelbrot on Cocoa

x -0.123698691255205

y 0.913816180844735

w 0.291400208209399

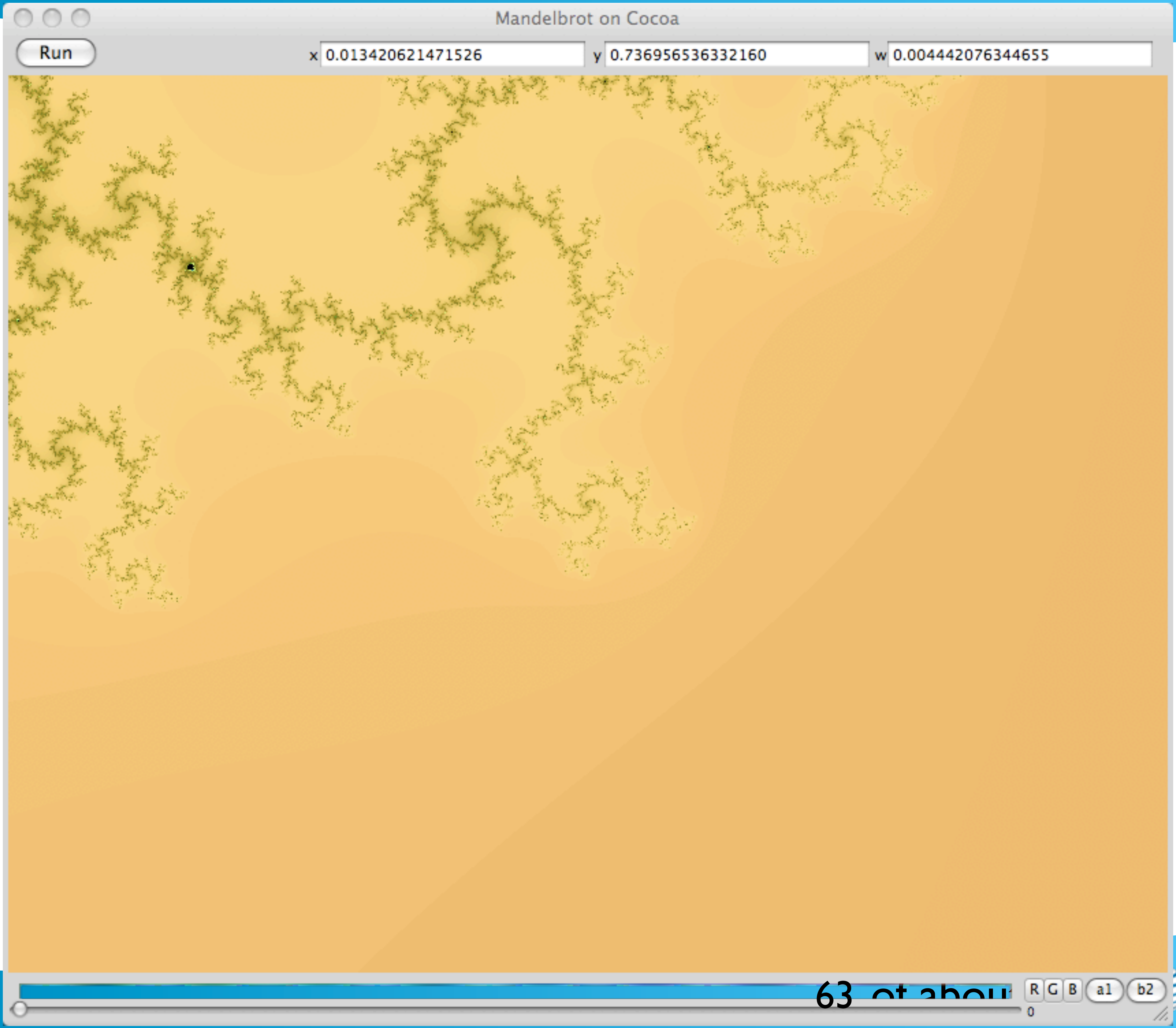


x 0.016670921235908

y 0.761008754588587

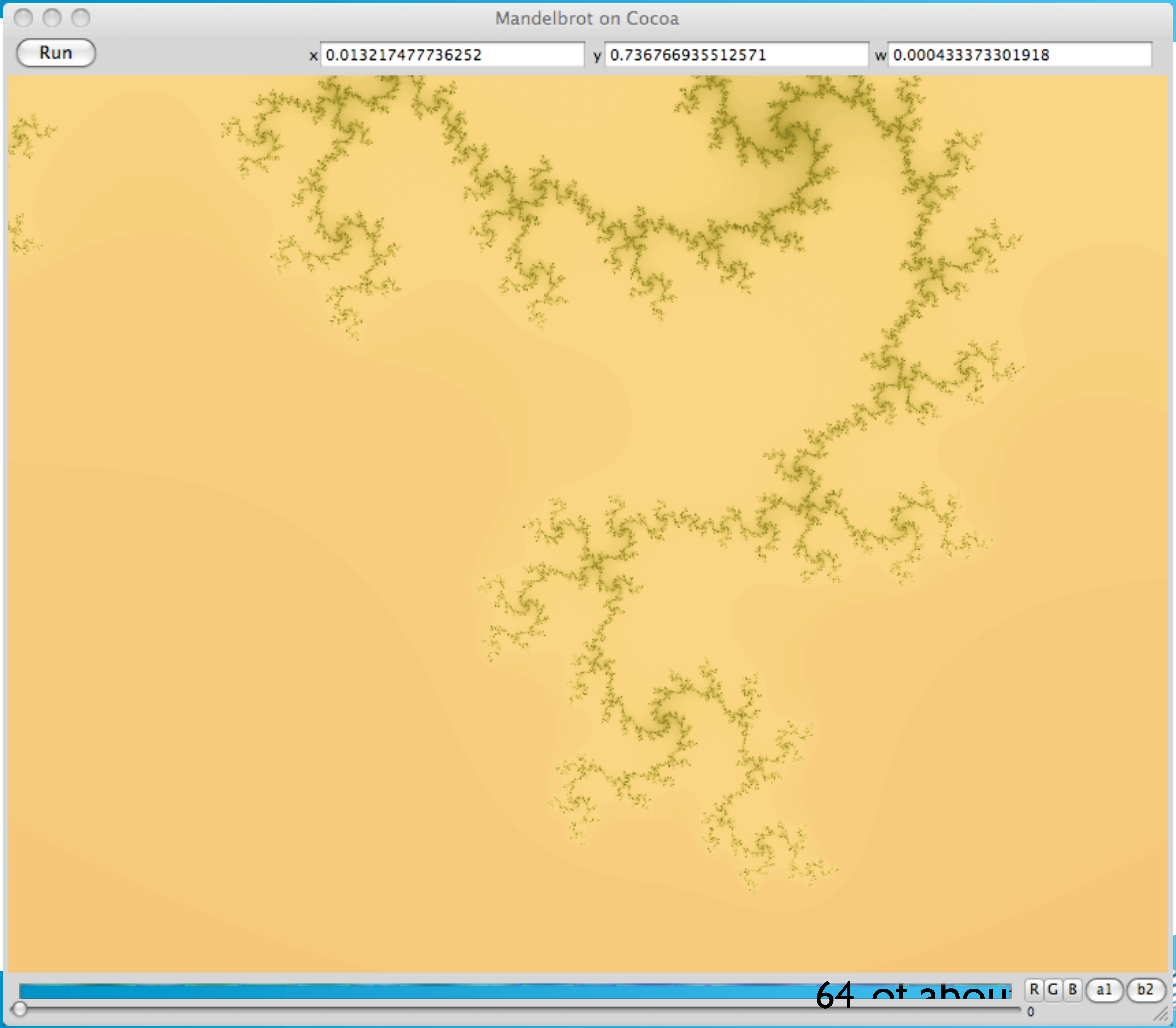
w 0.035536610757244

62 of abou



x 0.013420621471526
y 0.736956536332160
w 0.004442076344655

63 of abou



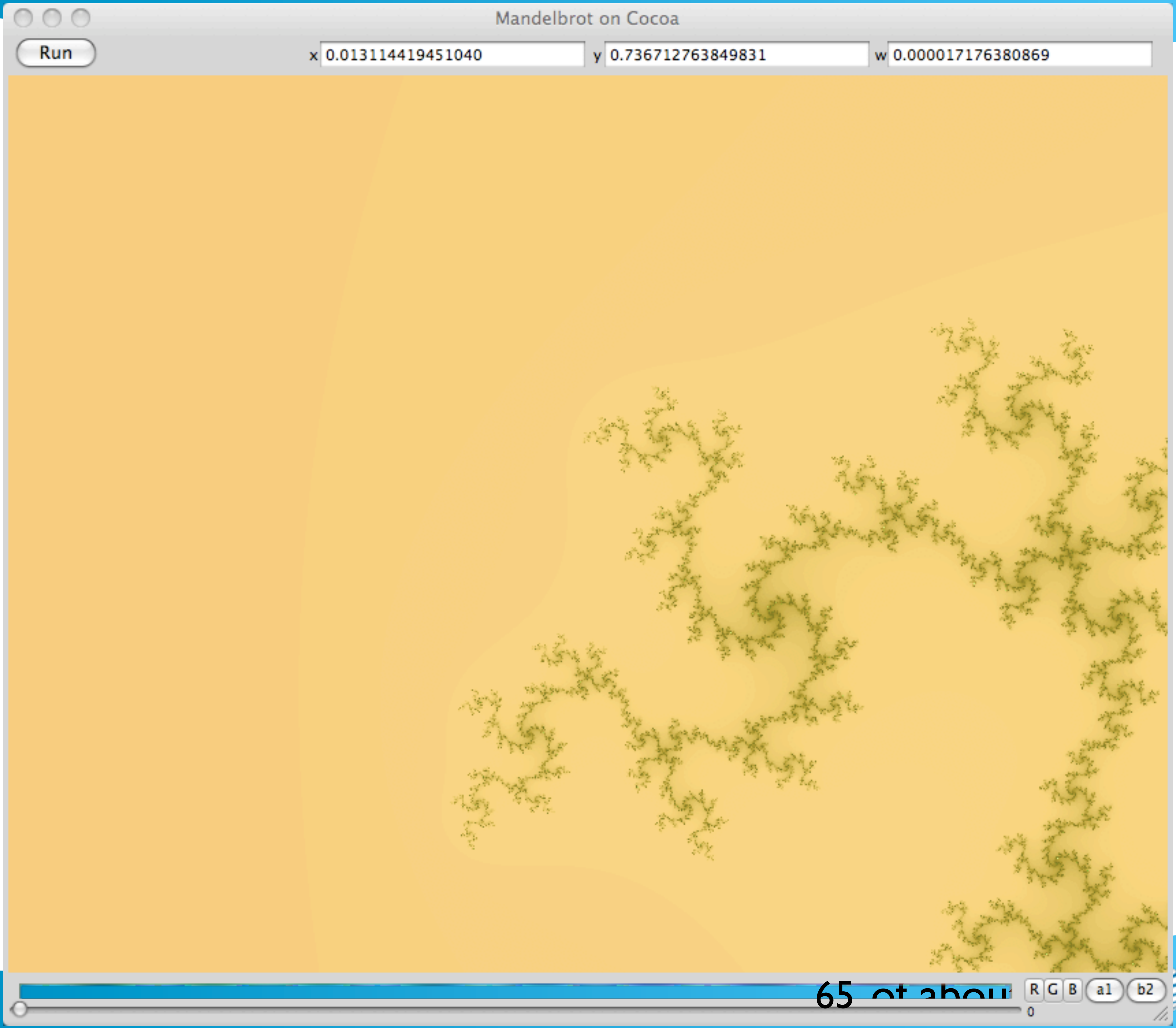
Mandelbrot on Cocoa

x 0.013217477736252

y 0.736766935512571

w 0.000433373301918

64 of abou



x 0.013114419451040

y 0.736712763849831

w 0.000017176380869

Passgraphs?

- Similar to passmaps, but Google is out of the equation
- Maps can have a personal meaning
  - Is this a good thing, or a bad thing?

Some Whacko Ches Ideas

Obfuscated human-computed challenge response

Problem

- One-time passwords solve a lot of password problems
- One-time passwords (usually challenge/response) require something you have
- Equipment can be expensive, and it may be necessary to authenticate when equipment is not available

210
210
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NIA INSURA

Baseball players

- Under a lot of stress
- Information is often vital to the game
- Not always the sharpest knife in the drawer
  - Babe Ruth forgot the signs five steps out on the field

Key insight?

- Humans can't compute well, but perhaps they can obfuscate well enough

Proposed approach

- Use human-computed responses to computer challenges for authentication
- Though the computation is easy, much of the challenge and response is ignored
- Obfuscation and lack of samples complicate the attacker’s job beyond utility

```
Challenge:                            Response:

ches 00319 Thu Dec 20 15:32:22 2001   23456bcd;f.k
root 00294 Fri Dec 21 16:47:39 2001   nj3kdi2jh3yd6fh:/
ches 00311 Fri Dec 21 16:48:50 2001   /ldh3g7fgl
ches 00360 Thu Jan 3 12:52:29 2002    jdi38kfj934hdy;dkf7
ches 00416 Fri Jan 4 09:02:02 2002    jf/l3kf.l2cxn. y
ches 00301 Fri Jan 4 13:29:12 2002    j2mdjudurut2jdnch2hdtg3kdjf;s'/s
ches 00301 Fri Jan 4 13:29:30 2002    j2mdgfj./m3hd'k4hfz
ches 00308 Tue Jan 8 09:35:26 2002    /l6k3jdq,
ches 84588 Thu Jan 10 09:24:18 2002   jf010fk;.j
ches 84588 Thu Jan 10 09:24:35 2002   heu212jdg431j/
ches 00306 Thu Jan 17 10:46:00 2002   jfg.bv,vj/,1
ches 00309 Fri Jan 18 09:37:09 2002   no way 1 way is best!/1
ches 00309 Fri Jan 18 09:37:36 2002   jzw                          * no *
ches 00368 Tue Jan 22 09:51:41 2002   84137405jgf/
ches 77074 Tue Feb 19 09:02:52 2002   d                            * no *
ches 77074 Tue Feb 19 09:02:57 2002   hbcg3]'d/
ches 00163 Mon Feb 25 09:24:30 2002   d                            * no *
ches 00163 Mon Feb 25 09:24:35 2002   ozhdkf0ey2k/.,vk0l
ches 00156 Tue Mar 12 12:41:12 2002   3+4=7 but not 10 or 4/2
ches 00161 Fri Mar 15 09:41:20 2002   /.,kl9djfir
ches 00161 Fri Mar 15 09:41:36 2002   3                            * no *
ches 00160 Mon Mar 25 08:52:59 2002   222
ches 00160 Mon Mar 25 08:53:09 2002   2272645
ches 29709 Mon Apr 1 11:36:34 2002    4
ches 41424 Mon Apr 8 09:49:09 2002    ab3kdhf
ches 85039 Tue Apr 9 09:46:06 2002    04
ches 00161 Thu Apr 18 10:49:14 2002   898for/dklf7d
```

Pass-authentication

- Literature goes back to 1967
- A variety of names used: *reconstructed passwords*, *pass-algorithms*, *human-computer cryptography*, *HumanAut*, *secure human-computer identification*, *cognitive trapdoor games*, *human interactive proofs*

Possible uses

- emergency holographic logins ("passwords of last resort")
- use from insecure terminals, when single session eavesdropping is probably not a problem
- if a solution is found: daily logins
- home run: online transactions: banking

Problems

- Can Joe Sixpack do this?
  - Math is hard
  - Procedural *vs* informational knowledge

Current Threats and Some Revised Advice

Disclaimer

- These are all guidelines, suggestions, thoughts for your own risk/benefits analysis
- Every security person I've discussed this with has a somewhat different take
- Rethink and reengineer these systems, when appropriate

Threats to casual targets

- Password capture by phishing
- Password capture by keystroke logging
- *Not* dictionary attacks
    - Most online systems limit password guessing
- Most attacks are wholesale, not targeted

Dictionary attacks still a concern

- For standard Unix logins
- For ssh password logins
- Against captured oracle streams, like PGP and ssh key files, cleartext challenge/response fields in protocols
- These are not mainstream attacks these days. Stolen laptops/iPhones a concern

Recommendations for users

- Use three levels of passwords based on importance:
  - No importance: NY Times, etc.
  - Inconvenient if stolen: Amazon
  - Major problem if abused: bank access, medical records(?)

For users (cont.)

- Write down the rare ones if you must
- Don’t write down the password, write a reminder of the password
- Use variations to meet “strong” password requirements.
- Do note required variations (i.e. lower case, no spaces)

Save your passwords with Firefox?

- Little difference against keystroke logging
- Key-ring protection mechanisms subject to dictionary attacks
- If stolen, you have given away an authentication factor

If you must, here are at least 60 random bits

- value part Peter sense some computer
- anxiety materials preparation sample experimental
- bliss rubbery uncial Irish
- 2e3059156c9e378

If you must

- not user-chosen, but user can veto, waiting for a "good one"
- User-chosen phrases have *much* lower entropy
- they are going to write it down, for a while
- for daily use: who's going to remember this over a year?

Words are better than eye-of-newt

- much easier to type
- spelling checking (iPhone) is your friend, not enemy

Entropy, >41 bits per line

You grim-faced pipe of pleuritic snipe sweat
You dire chiffonier of foul miniature poodle squirt
You teratic theca of pathogenic moth dingleberry
You worrying pan broiler of bilious puff adder slobber
You vile wok of tumorigenic aphid leftovers
You baneful reliquary of pneumonic miller stumps
You atrocious terrine of harmful Virginia deer vomition
You excruciating pony of septic redstart eccrisis
You blotted kibble of unhygenic wild sheep spittle
You hard-featured fistula of podagric macaque flux

Uncial

uncial |ˈən sh əl; -sēəl| *adjective*

1 of or written in a majuscule script with rounded unjoined letters that is found in European manuscripts of the 4th–8th centuries and from which modern capital letters are derived.

2 *rare* of or relating to an inch or an ounce.

noun

an uncial letter or script.

iPhone-friendly passwords?

- grade likes jokes guess
- goes joke gold gods rode fire rows
- votes mines bored alike yard
- what knit bomb unit star grow
- actor agent above angel abuse
- honey learn least lemon links

19	goes	bird fled flew view core cows gods goes fire toes tide tied ties hide blew bore boss hire code
18	joke	mood joke mild mile mind mine none hold hole home nine bold kind bond bone blow bike bile
18	gold	food cold come cope file gold golf told good time tips hold hole home hope bold bike bile
18	gods	bird fled flew view core gods goes fire toes tide tied ties hide blew bore boss hire code
17	rose	fled flew toes does dose tide tied ties died dies road rode rose rows ride else rise
17	rode	fled flew fire toes does dose tide tied ties died dies rode rose rice ride else rise
17	fire	vote view core gods goes fire toes does tide tied ties died dies rode ride cuts code
17	dose	fled flew side cows does size dose died dies road rode rose rows ride else rise code
17	does	fled flew core side cows fire does dose died dies rode rose rows ride else rise code
16	time	fond guns tune file find fine gold gone told tone tons rule runs time role fund
16	file	food cold come cope duke file gold told good door rule time tips role rope cups
16	died	core side cows fire does dose died dies rode disc rose rows ride sure rise code
16	date	dare date days rage ears rare rate rats safe cage fate card care cars cats says
15	good	food cold cope file gold golf told good tips hold hole hope bold bike bile
15	fine	fond tube come guns tune duke find fine gone tone tons done runs time fund
15	find	fond tube come guns tune duke find fine gone tone tons done runs time fund
15	dies	core side cows fire does dose died dies rode rose rows ride sure rise code
15	bike	guns joke gold gone good none hold hole home nine bold bond bone bike bile
14	toes	fled flew gods goes fire toes tide tied ties rode rose rows ride rise
14	rows	fled flew toes does dose tied ties died dies road rose rows else rise

Easy words?

a
m
v
at
by
cm
ft
ii
la
my
act
aha
all
arm
ask
bed
cup
erm

inch
iron
isle
item
keen
keep
kept
knit
know
lamb
lamp
left
lend
loch
main
many
mark
meal

adapt
admit
adopt
adult
again
agent
ahead
alarm
album
alive
alpha
angel
anger
angle
apart
apply
argue
array

charm
chart
cheap
check
cheek
choir
civil
claim
clear
clerk
clock
coach
coast
could
crack
crime
cruel
curve

fruit
fully
funny
giant
gifts
given
grant
graph
group
habit
happy
harsh
heart
heels
hello
hence
honey
hotel

media
meets
mercy
minus
model
money
month
moral
motor
mouth
movie
mummy
music
nails
nasty
naval
nerve
never

relax
reply
rings
rival
round
rural
salad
scale
scene
scope
serve
seven
shall
shape
sharp
shelf
shell
shock

thick
think
throw
toxic
track
trail
trees
trial
trips
truly
twice
uncle
under
union
units
unity
until
upset

Rethinking Passwords

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