

6.1040 · software studio · fall 2022

# user interface design & review

Daniel Jackson & Arvind Satyanarayan

# today's goals

## **criteria for usability**

give you a deeper & broader understanding  
what you're trying to achieve

## **usability heuristics**

rules of thumb you can apply  
a shortcut to expertise

criteria

ease of use

# easy to use



learnable

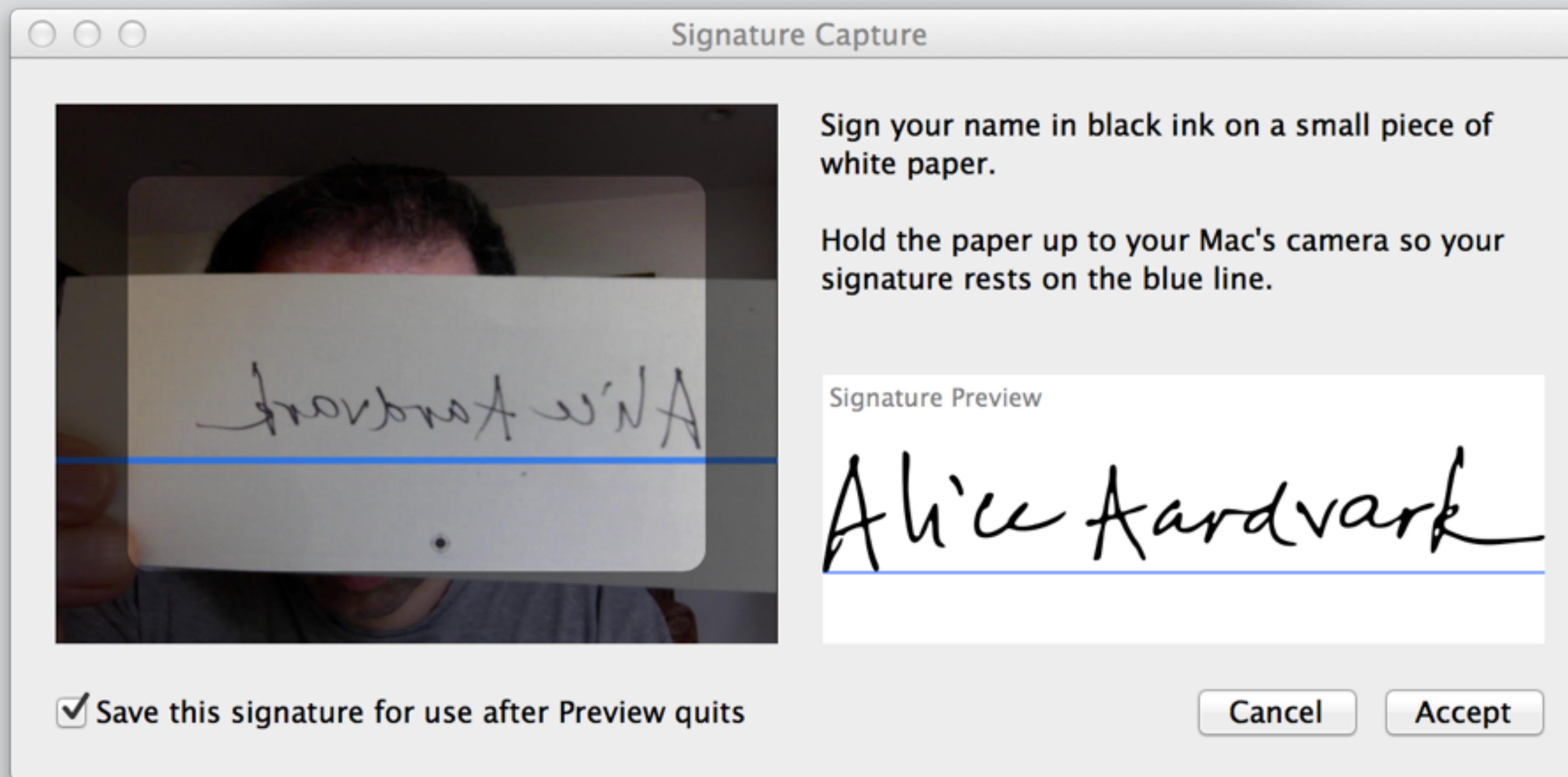


efficient



error-tolerant

# example: signatures in Apple Preview



learnable?

yes, as good as it gets

efficient?

yes, but not very flexible

error-tolerant?

yes, feedback as you position it

# example: car radio presets



learnable?

not really: who would guess?

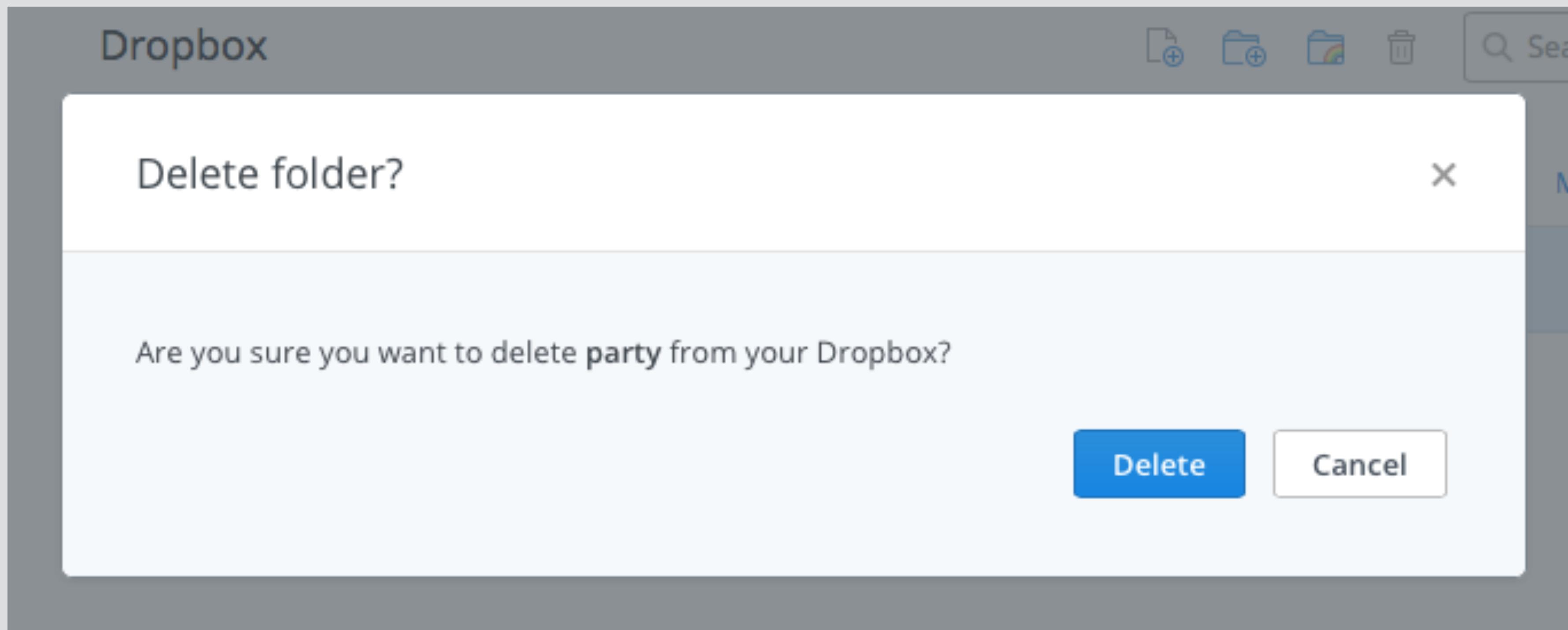
efficient?

yes, perfect

error-tolerant?

unless you lean on a button

# example: dropbox deletion



learnable?

yes, but might not mean what you think

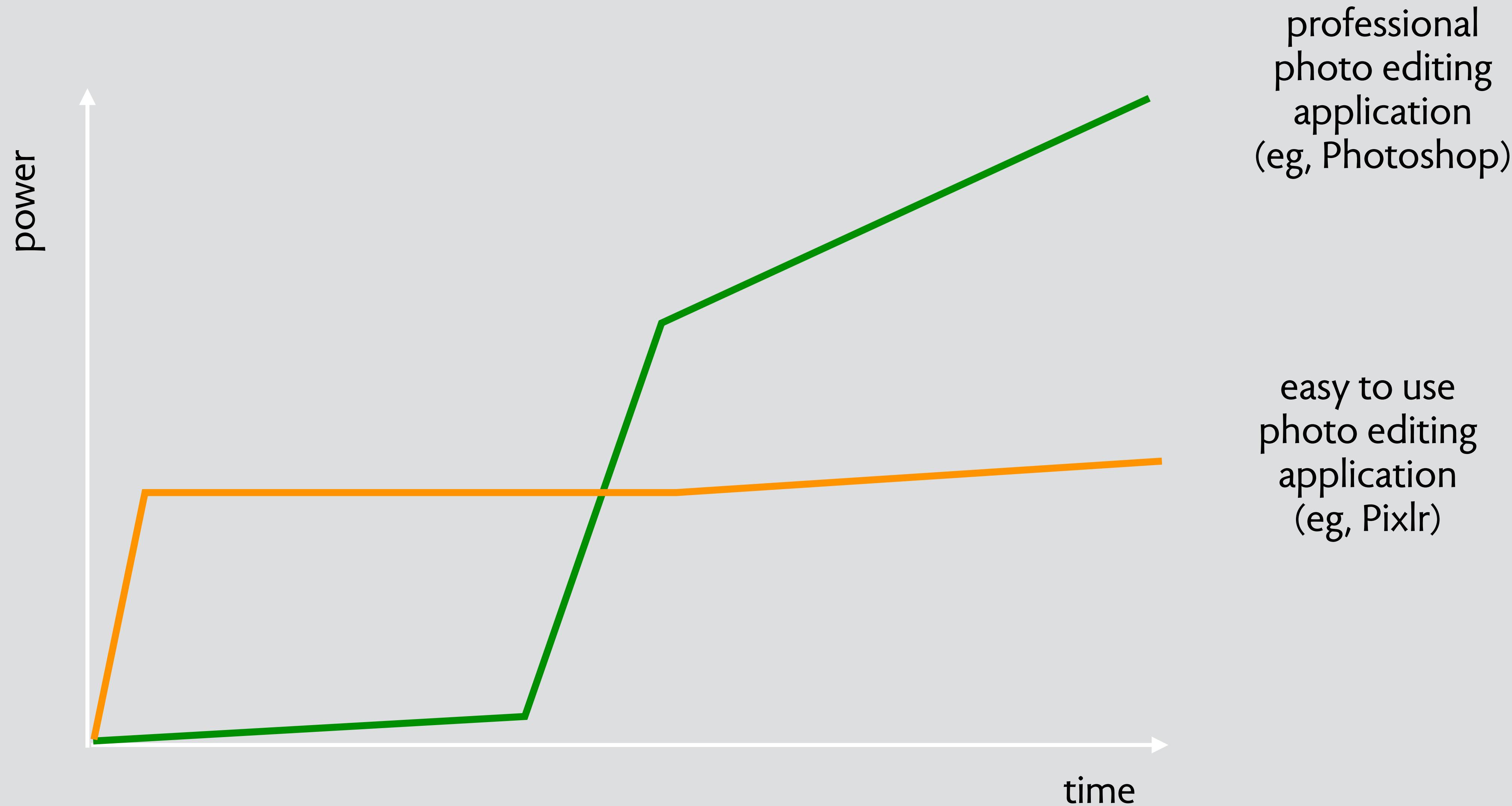
efficient?

yes, just click a button

error-tolerant?

no: deletes other users' copies too!

# learnability vs efficiency



pleasantness

# example: pleasantness in architecture



Ryōan-ji, Kyoto

## example: the light phone



“A credit card-sized cell phone designed to be used as little as possible. The Light Phone is your phone away from phone.”

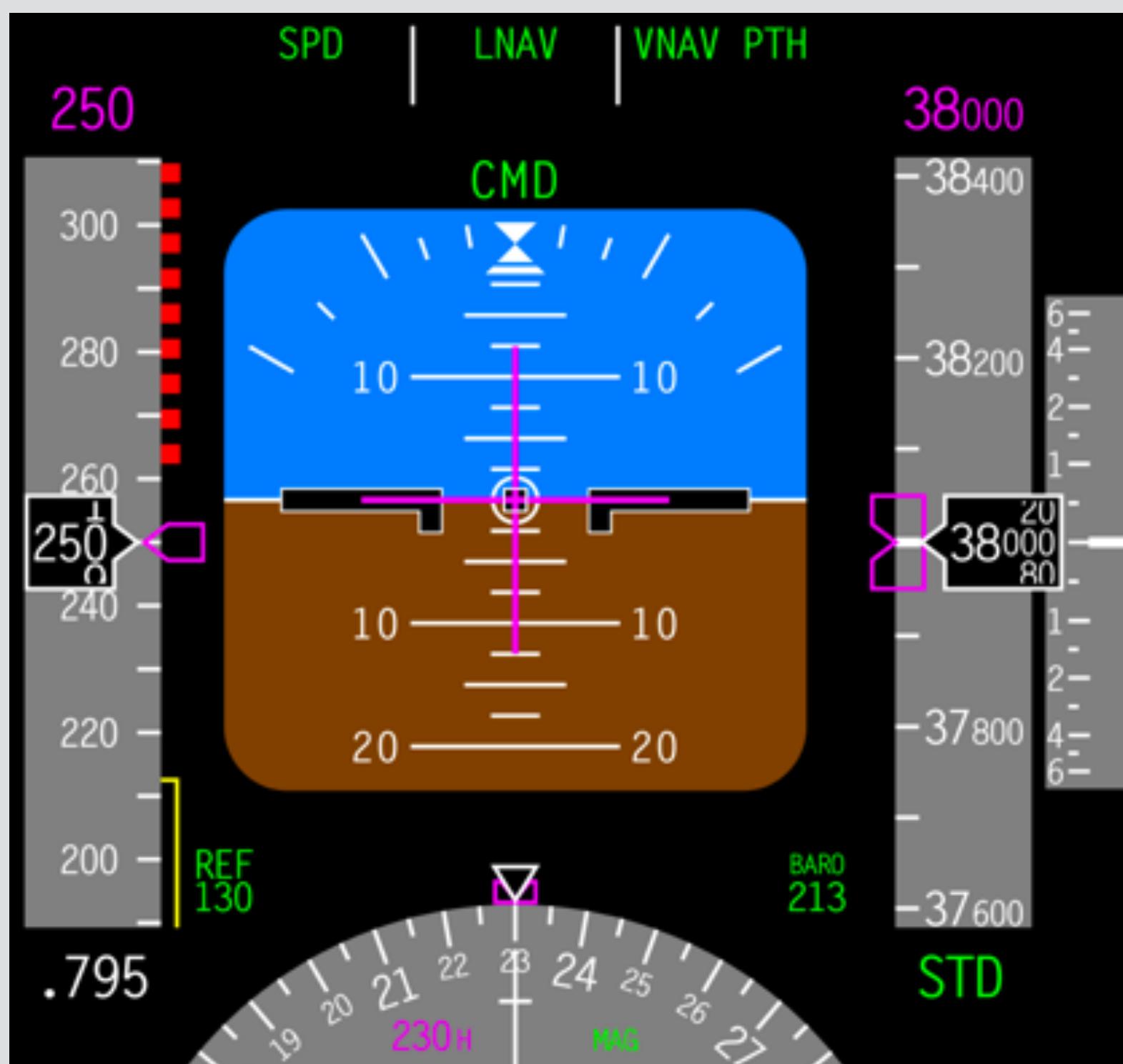
# amber case: calm tech evangelist



require least attention possible  
communicate without noise  
respect social norms  
minimal technology needed  
use the periphery

safety

# what's safety for?



safety-critical products



regular products

interlocks, not just messages



*Armistice Sharks*

Heathrow Airport

# an infusion pump



# an FDA recall

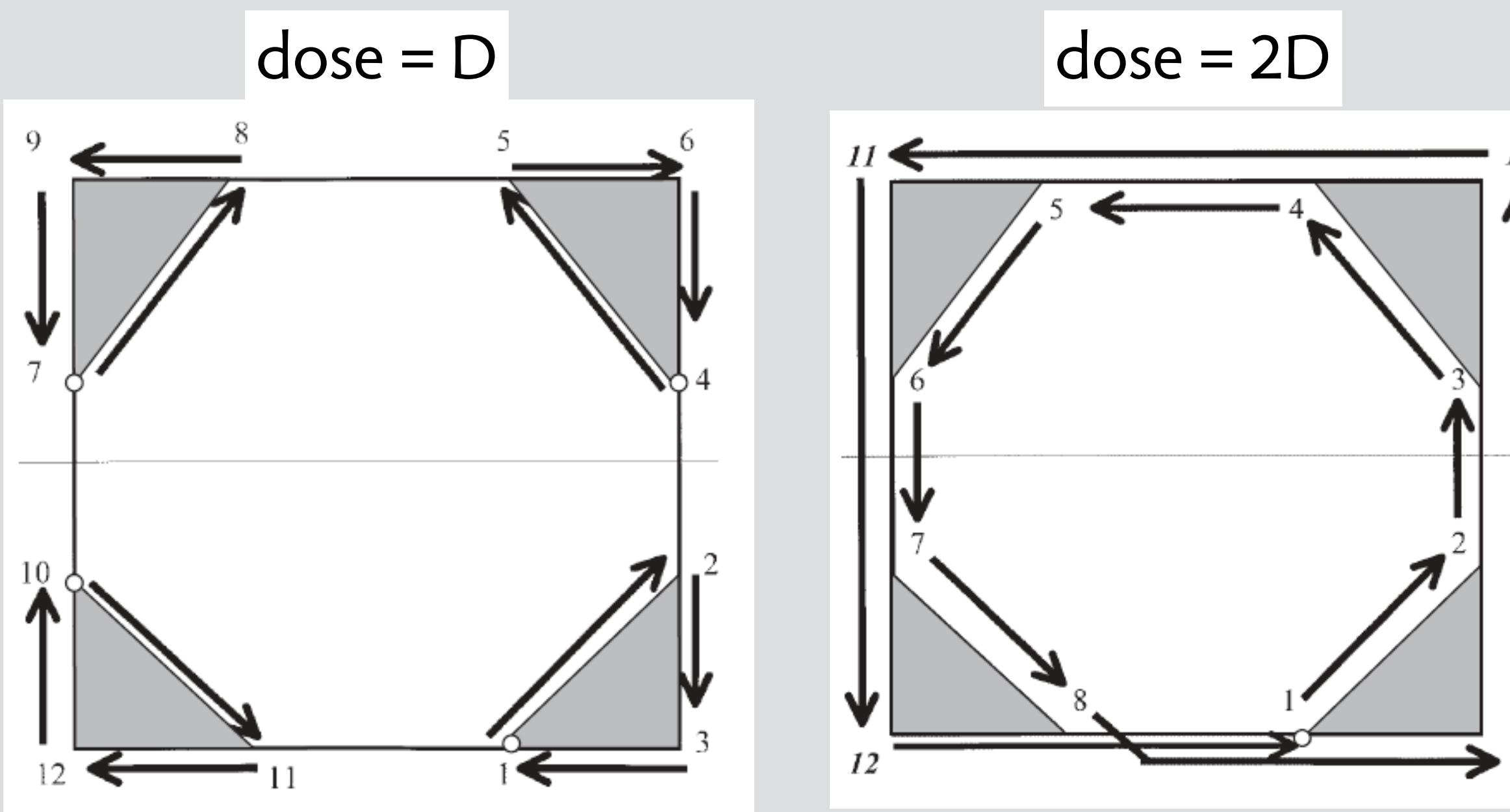
“

Infusion pumps, including the Baxter Colleague models, have been the source of persistent safety problems. In the past five years, the FDA has received more than 56,000 reports of adverse events associated with the use of infusion pumps. Those events have included serious injuries and more than 500 deaths.

”

FDA Recall notice (2010)  
[http://www.fda.gov/NewsEvents/  
Newsroom/PressAnnouncements/  
ucm210664.htm](http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm210664.htm)

# more designs that killed people



Panama City Hospital, 2001  
Multidata therapy planning system kills 18 patients



PLUGR, Afghanistan 2001

# blaming the user

USS Yorktown, 1997



Managers are now aware of the problem of entering zero into database fields and are trained to bypass a bad data field and change the value... ships do go dead in the water... People sometimes make mistakes and systems break. The trick is we have trained our crew...

— Commanding Officer, USS Yorktown

security

# anecdote: my bad password

**From:** "TIG" <[help@MIT.EDU](mailto:help@MIT.EDU)>  
**Date:** October 13, 2008 11:04:08 AM EDT  
**To:** "'Daniel Jackson'" <[dnj@csail.mit.edu](mailto:dnj@csail.mit.edu)>  
**Subject:** your password

We recently ran a password checker to evaluate  
passwords of all CSAIL users, and your password was  
readily broken. Please choose a new password ASAP...

my password:

sergeantpepper1967

8 character UNIX limit: truncated after this

# a common password policy

## ACTION REQUIRED TO RETAIN ACCESS TO APPLICATIONS VIA THE INTERNET SUCH AS EMAIL, WEB SITES AND REMOTE DIAL UP

Company provides the ability to access various applications via a Company ID and password. Your password expires every 75 days.

**This reminder is being sent as it has been 60 days since your last password change.**

**If you do not change your password within the next 15 days, your password will expire and you will lose access to company applications.**

is this a good policy?

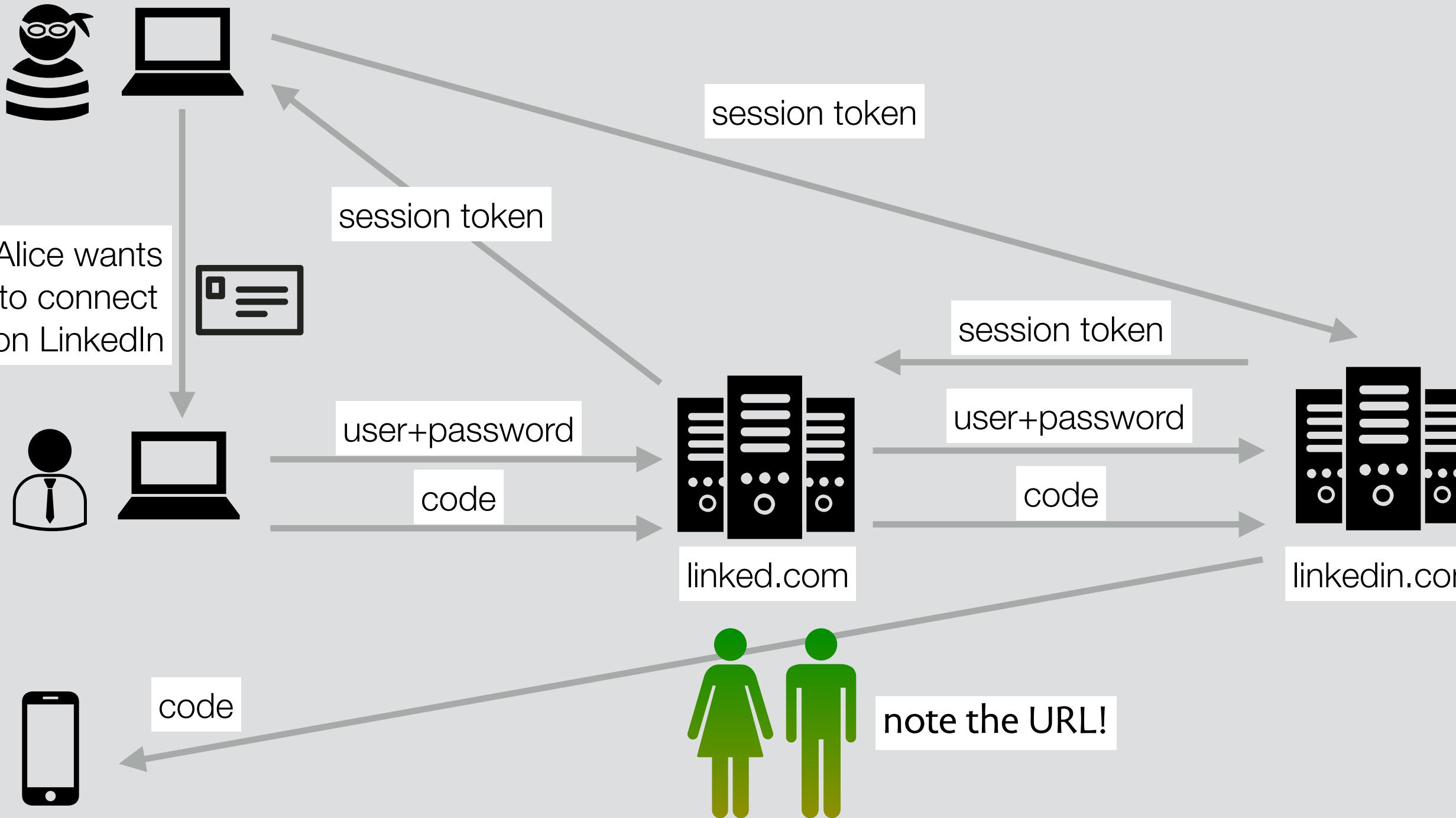
**From: [admin@company.com](mailto:admin@company.com)**  
**Sent: Friday, January 09, 2011 4:43 PM**  
**To: [consultants](#)**  
**Subject: your passwords**

**I have updated all the passwords for you.**

**New Password: Company1**  
**IDs affected: jackson, smith, doe**

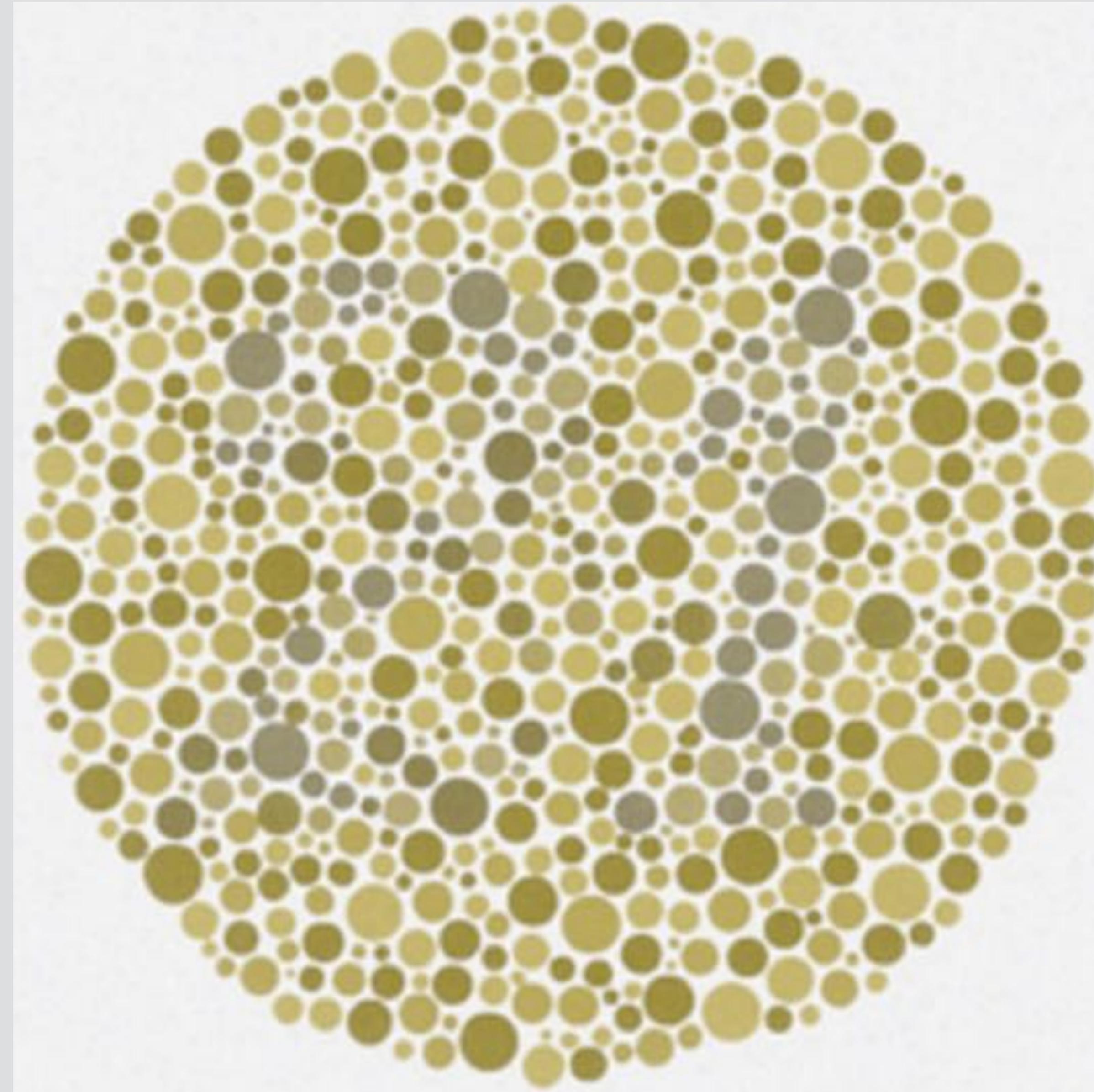
how the company worked around it

# almost all security attacks begin with social engineering



accessibility

# red-green colorblindness



affects 8% of men

# example: colorblindness

**Transport select committee warns drivers of fake websites**



SHARE [TWITTER](#) [LINKEDIN](#) [FACEBOOK](#) [GOOGLE+](#) [@](#)

**Promoted Content**

**Innovation at work**  
Want to find out how to unleash innovation in your organisation? Whether you're keen to learn more about hotdesking, laser printing, connectivity, mobility, security or more, check out our...

◀ ⏪ ⏴ ⏵ ⏹ ▶

**Latest in Strategy**

 Apple Music faces antitrust investigation

simulated with SEE Chrome plugin

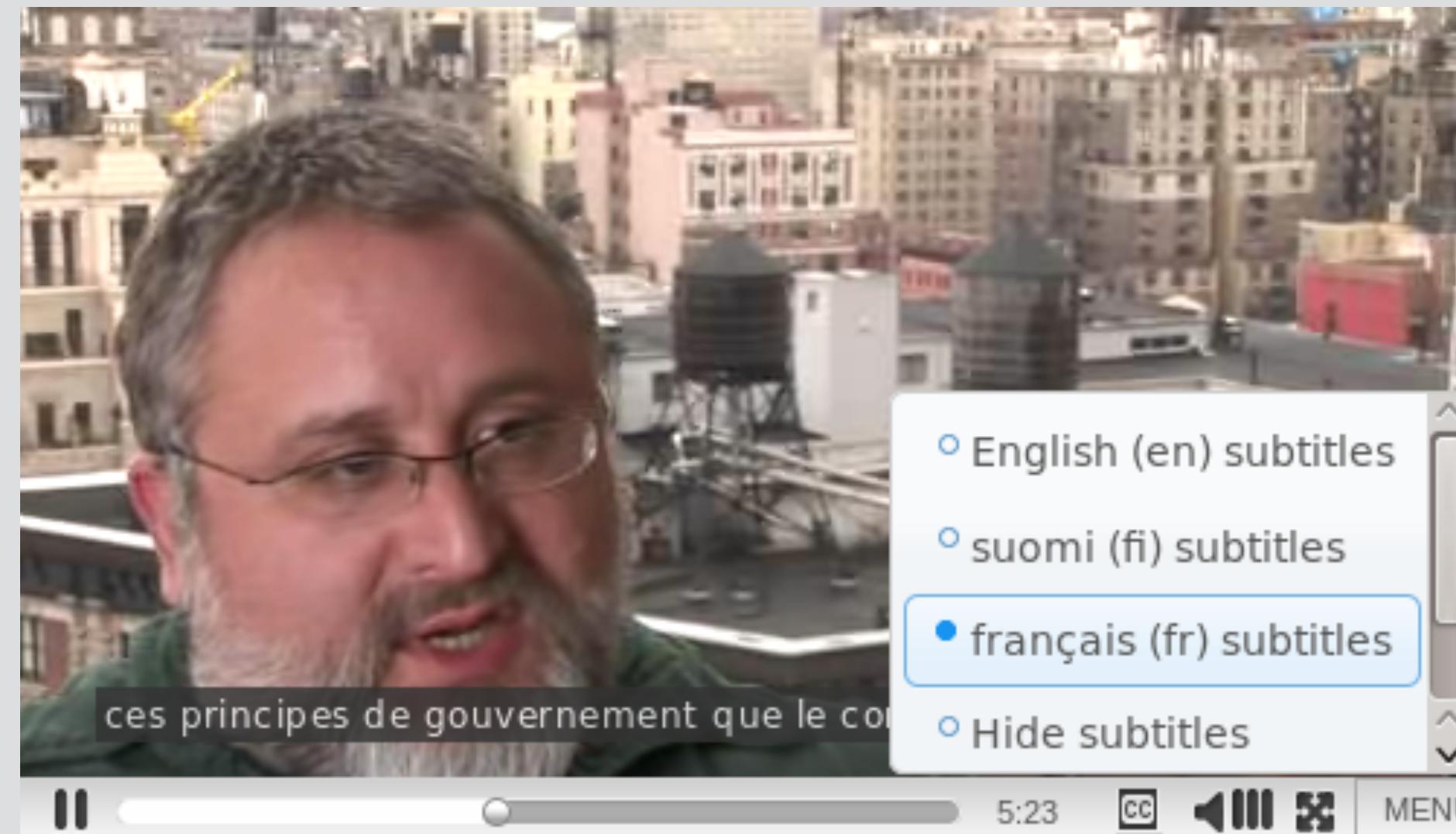
# web accessibility guidelines



provide text alternatives to images

A screenshot of the webAIM website. At the top, there is a navigation bar with links for "skip to main content", "webAIM", "services", "articles", "resources", and "community". Below the navigation is a search bar and a sidebar with links for "Introduction to Web Accessibility" and "WebAIM Training". The main content area features a photograph of a woman sitting on a bench reading a book. The page title is "Keyboard Accessibility" with the subtitle "Home &gt; Articles &gt; Keyboard Accessibility". The "Article Contents" section includes a table of contents with three pages: "Page 1: Keyboard Accessibility" (with sections for "Introduction", "Potential Problems", and "Keyboard Testing"), "Page 2: Tabindex", and "Page 3: Accesskey". A "Related Resources" sidebar on the right lists topics like "Motor Disabilities", "Accessible JavaScript", "Accessibility of AJAX Applications", and "Accessibility of Rich Internet Applications".

keyboard accessible



offer captioning of video content

# lessons

**ease of use:** conflicting goals

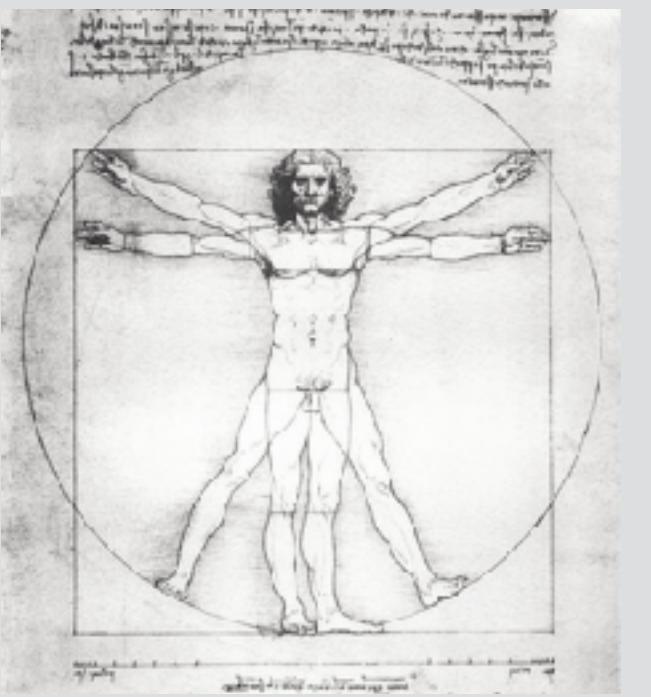
**pleasantness:** we're not machines

**safety:** usability means constraints

**security** from usability & usable security

**accessibility:** important & beneficial to all

# levels of UX design



physical

concrete



linguistic



conceptual

abstract

physical  
level

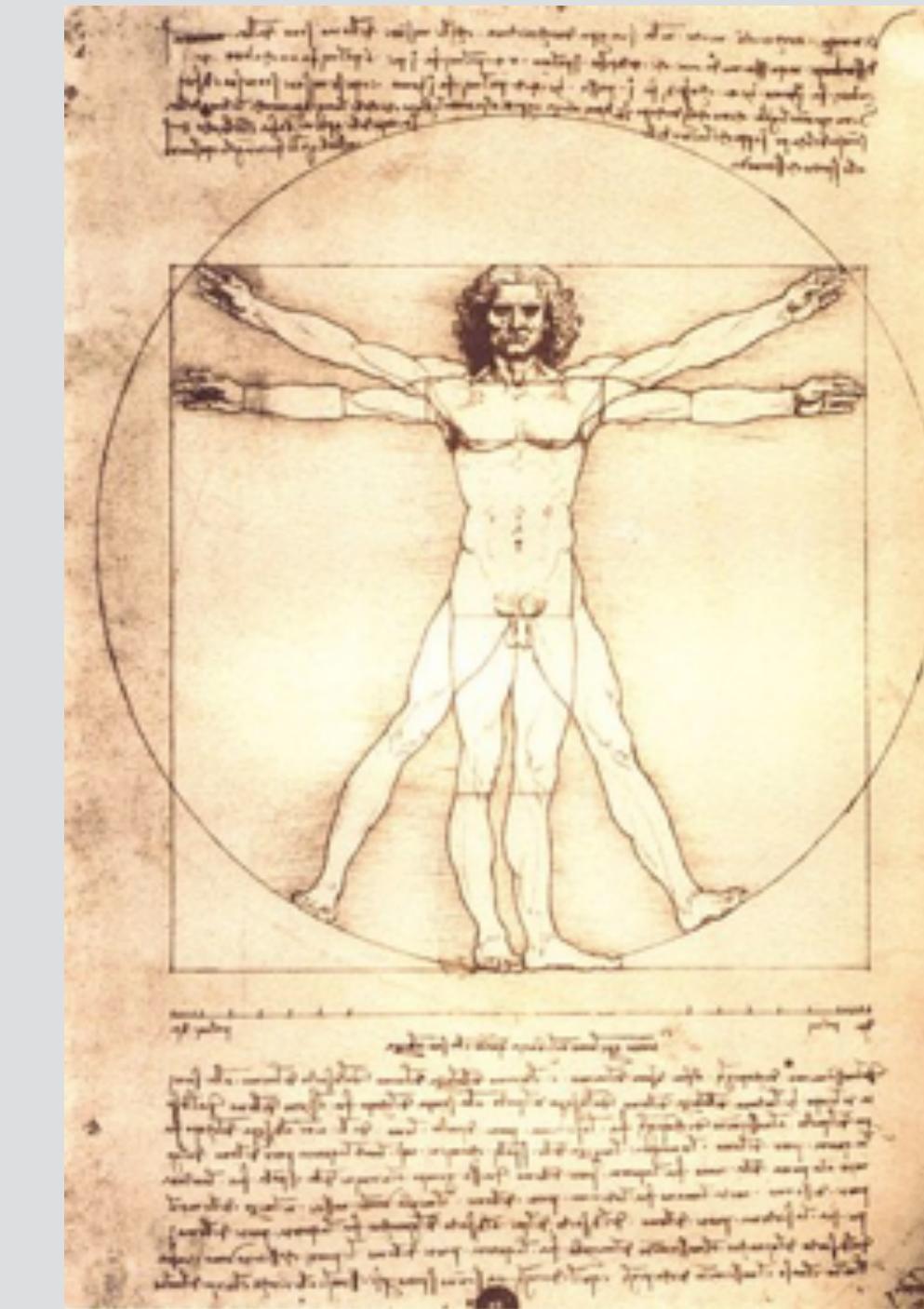
# concerns of the physical level



## design of interface

where to put buttons  
when to show progress bar  
what colors to use  
when to rely on recall

touch, sight, sound

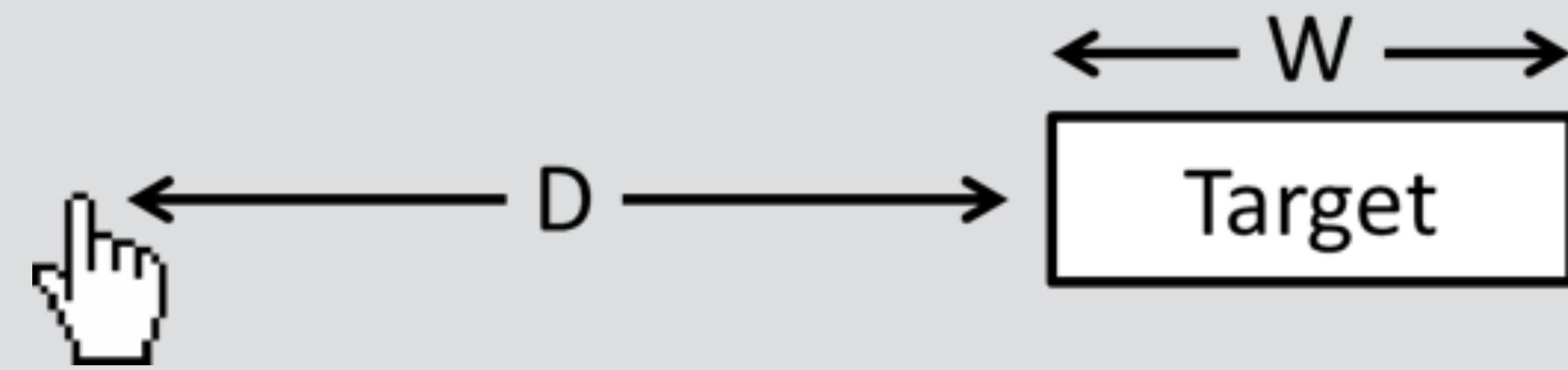


## human characteristics

time to move mouse?  
perception of delay?  
sensitivity of the eye?  
memory capacity?

# fitts's law

*heuristic*  
make features  
close & large

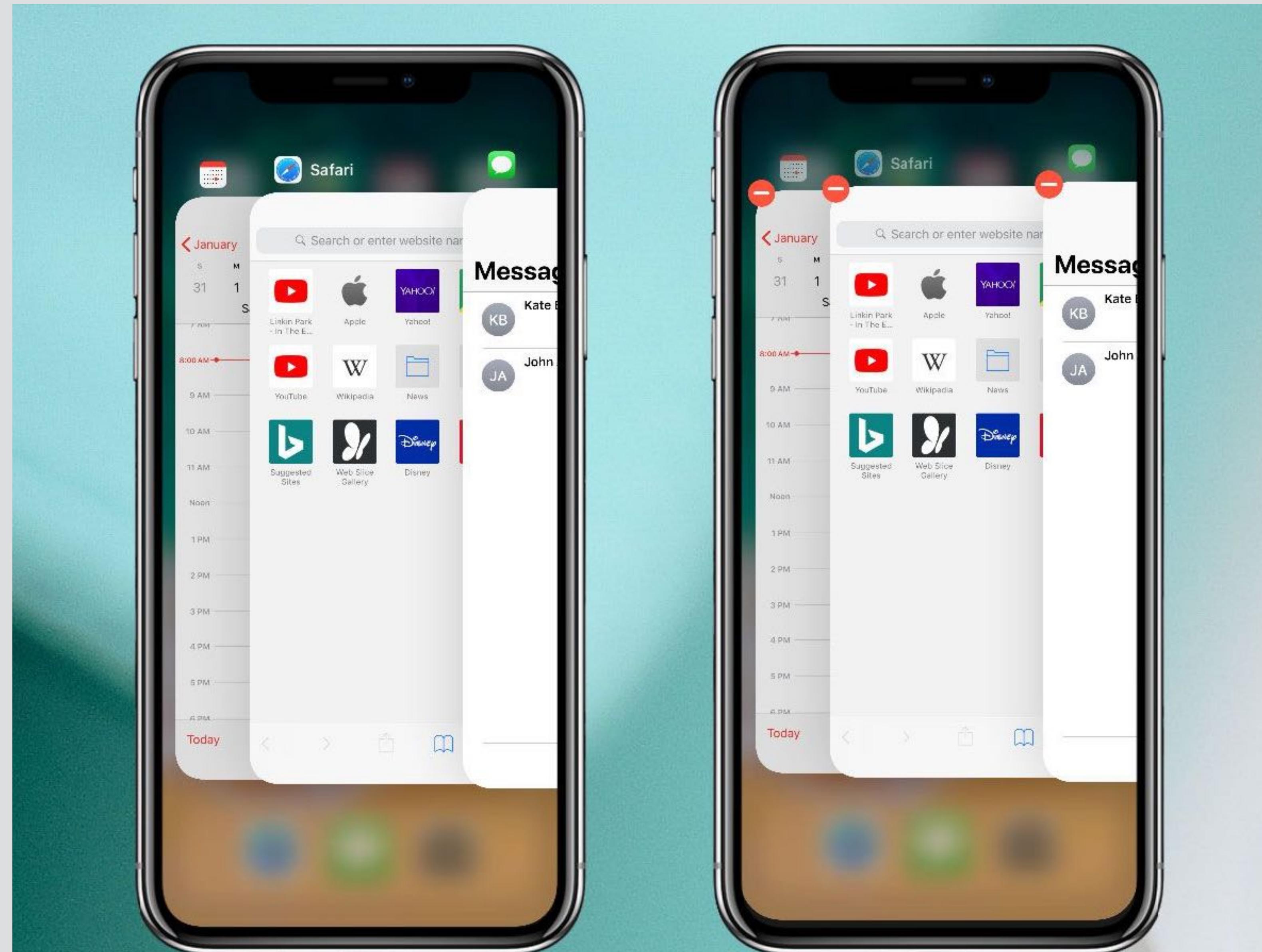


time to move to target  $T = a + b \cdot \log(D/W + 1)$

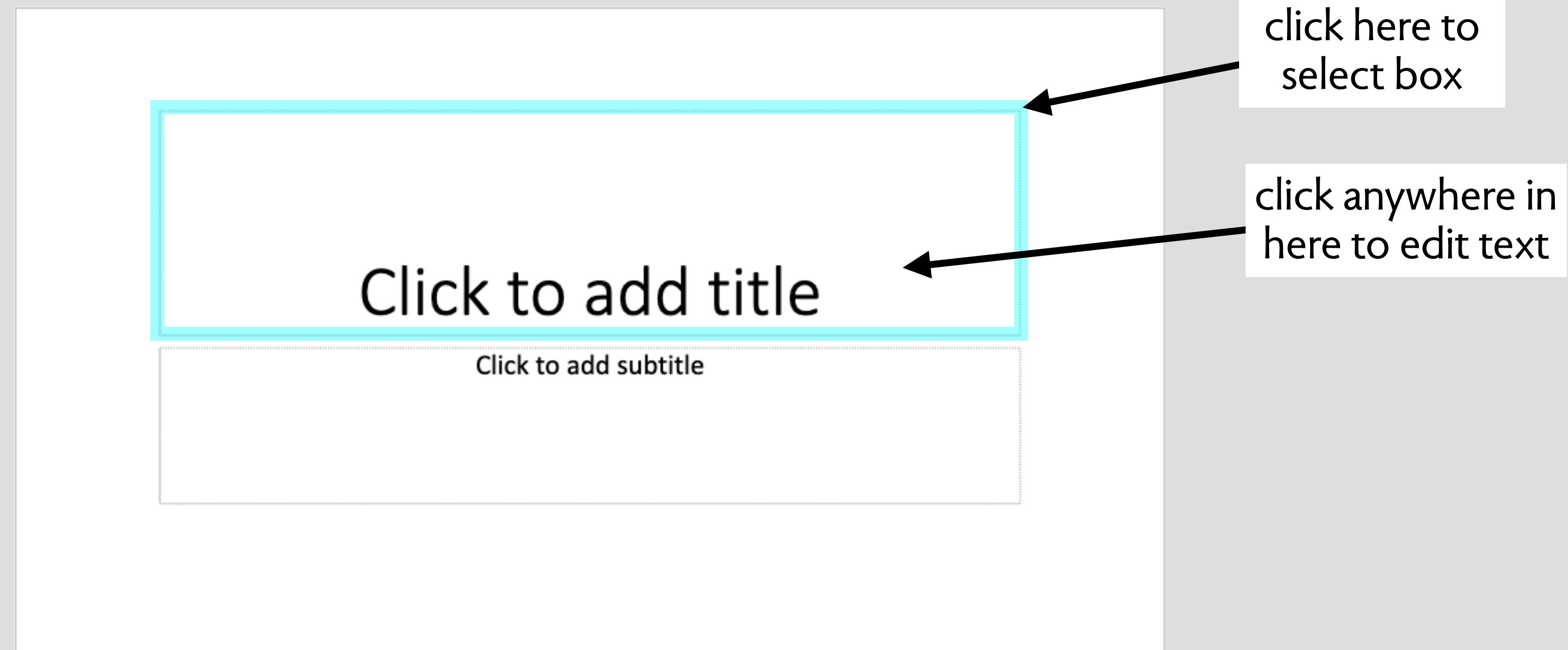
reaction time a is fixed

moving time depends on 'index of difficulty'  $D/W$

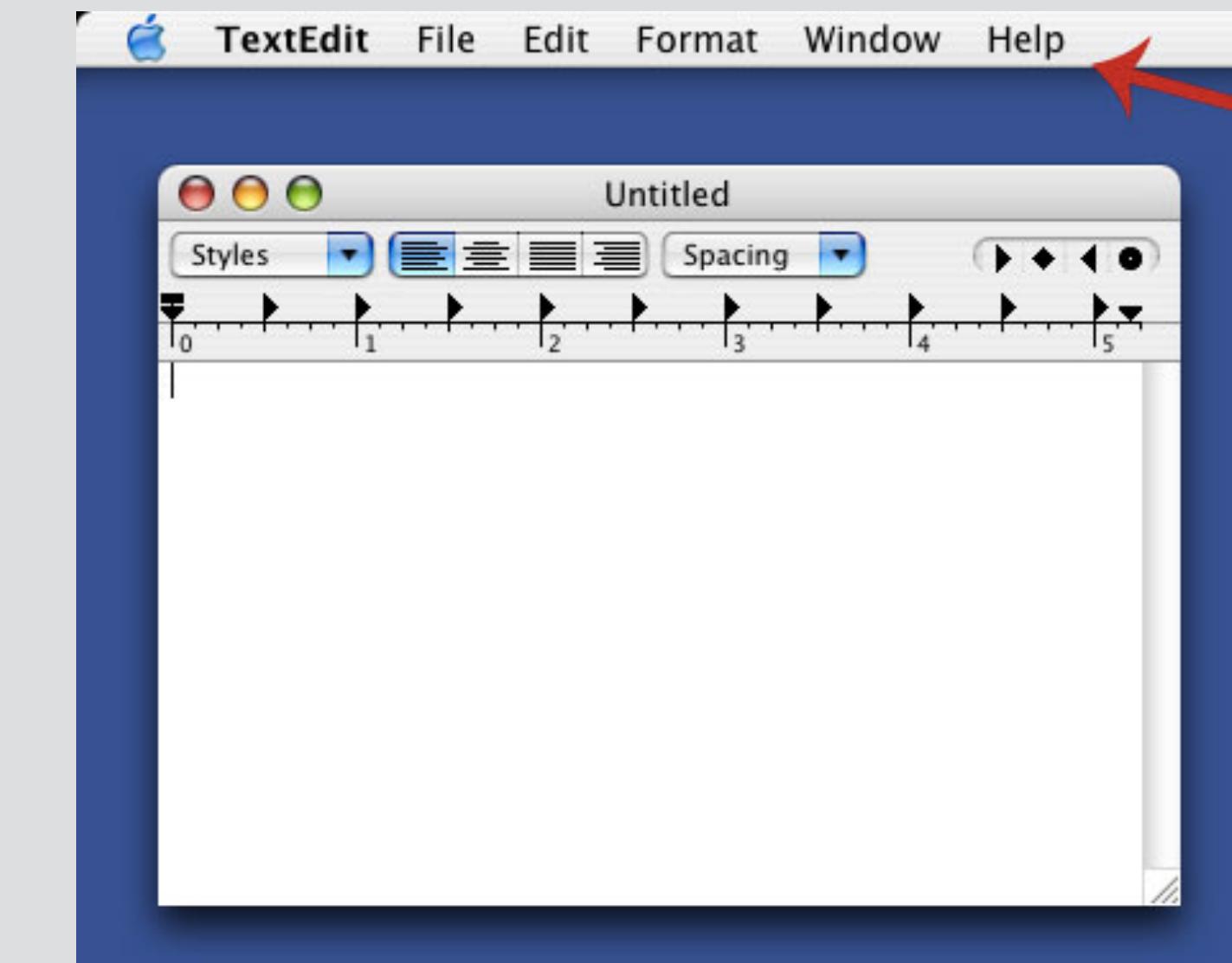
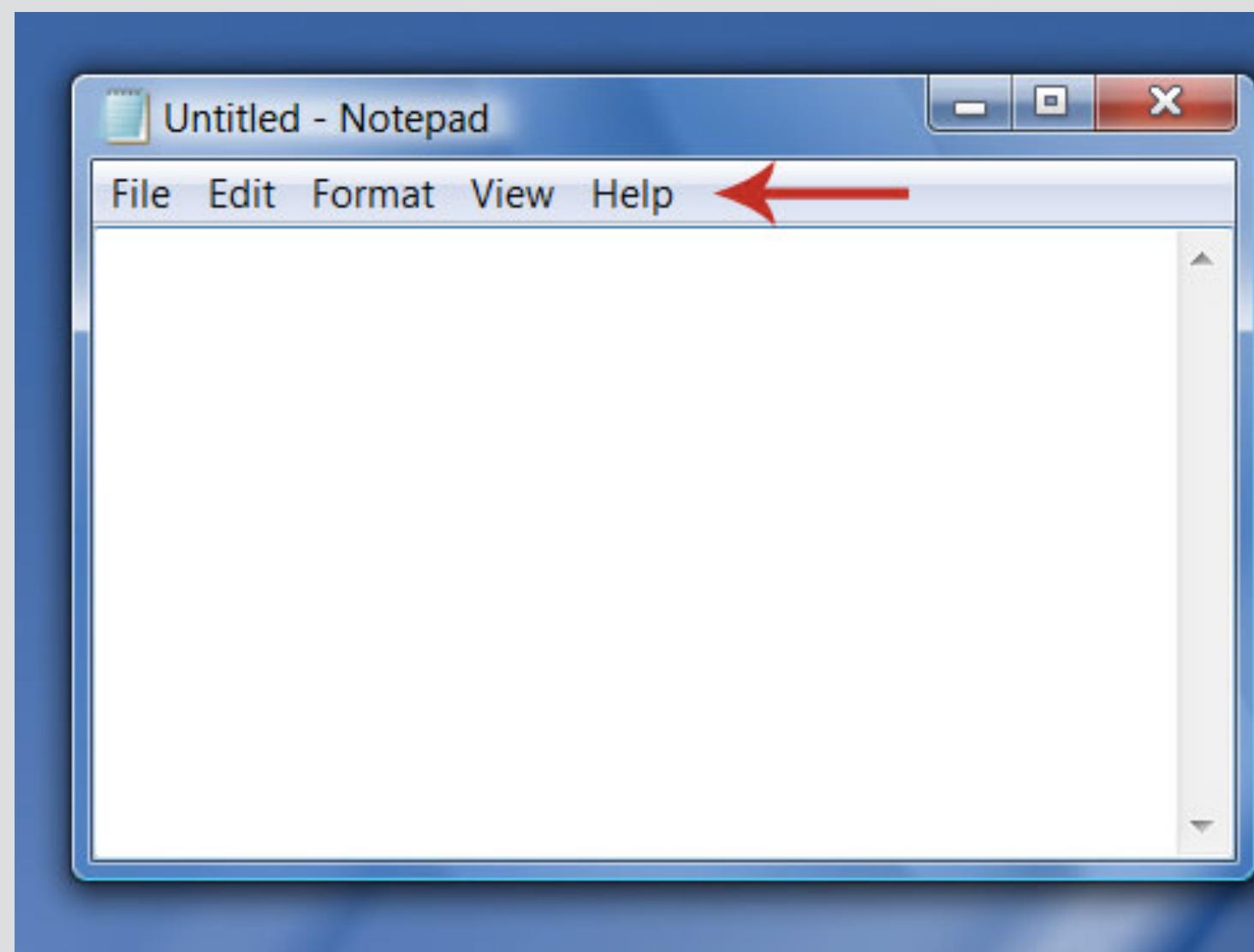
# example: closing app on iPhone



# example: powerpoint selection



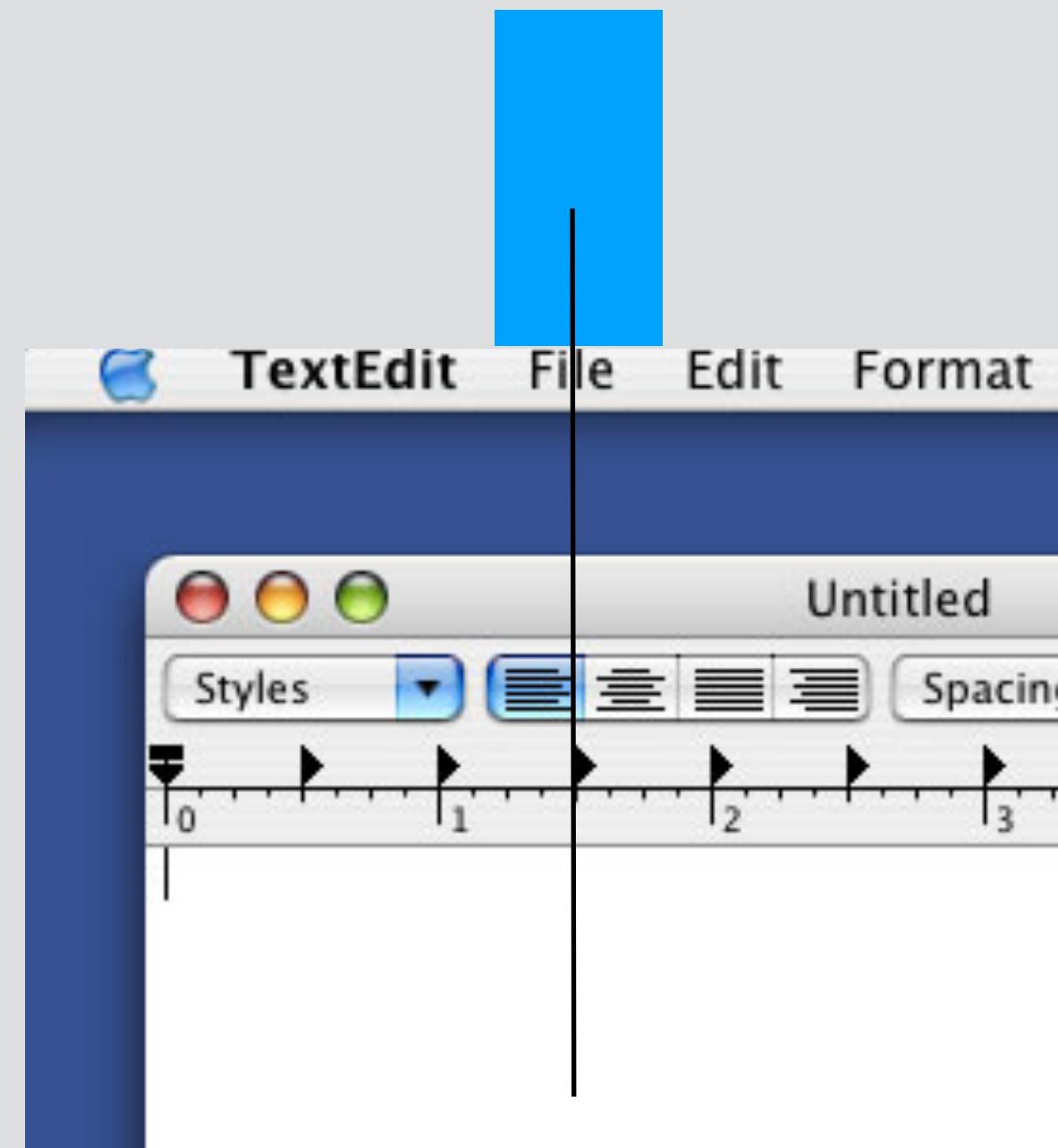
# discussion: windows vs mac



"On Windows the menu bar is right there, no need to move your eye to another part of the screen."

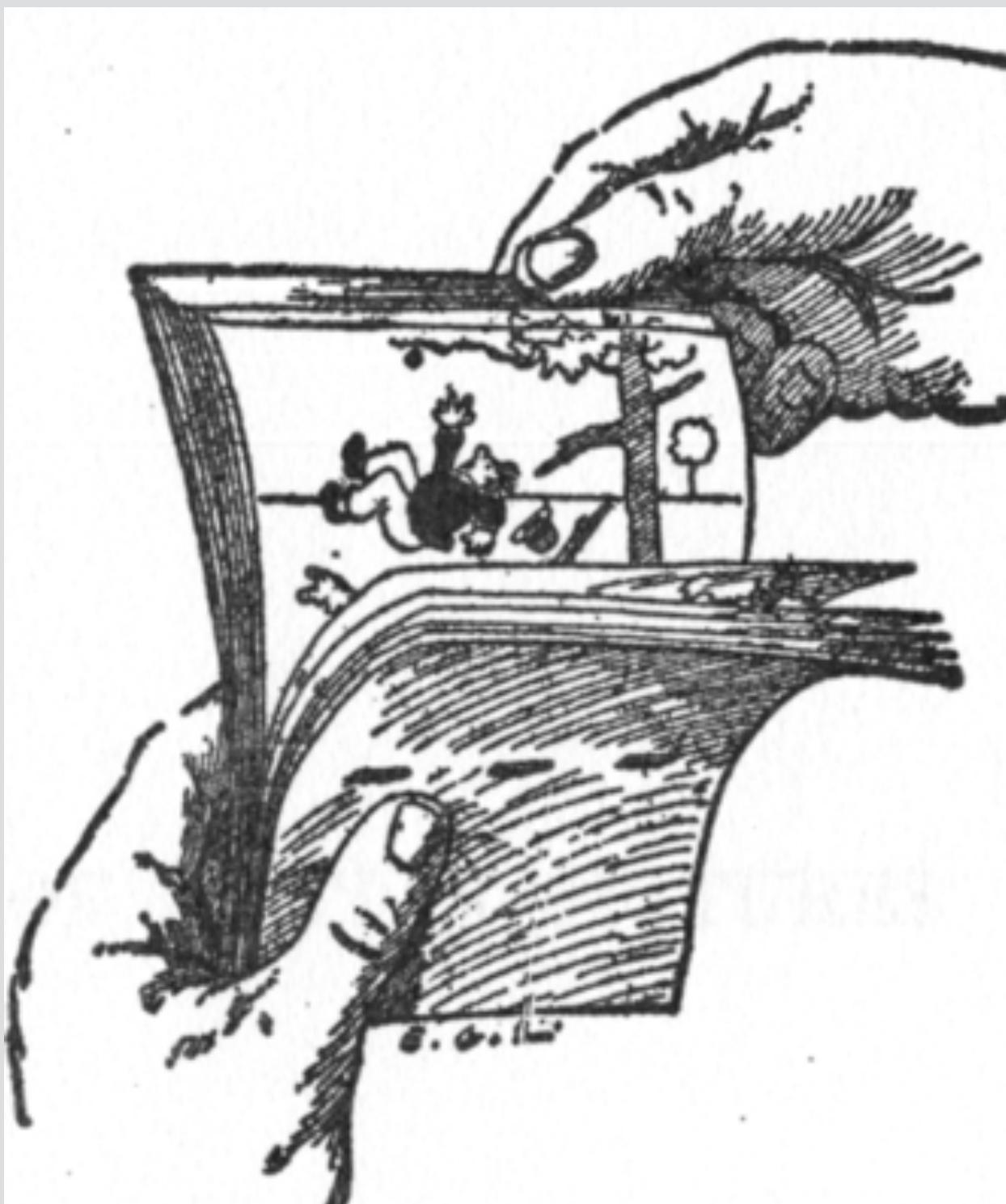
An online argument. Is he right? What does Fitts's Law say?

# applying fitt: windows vs mac



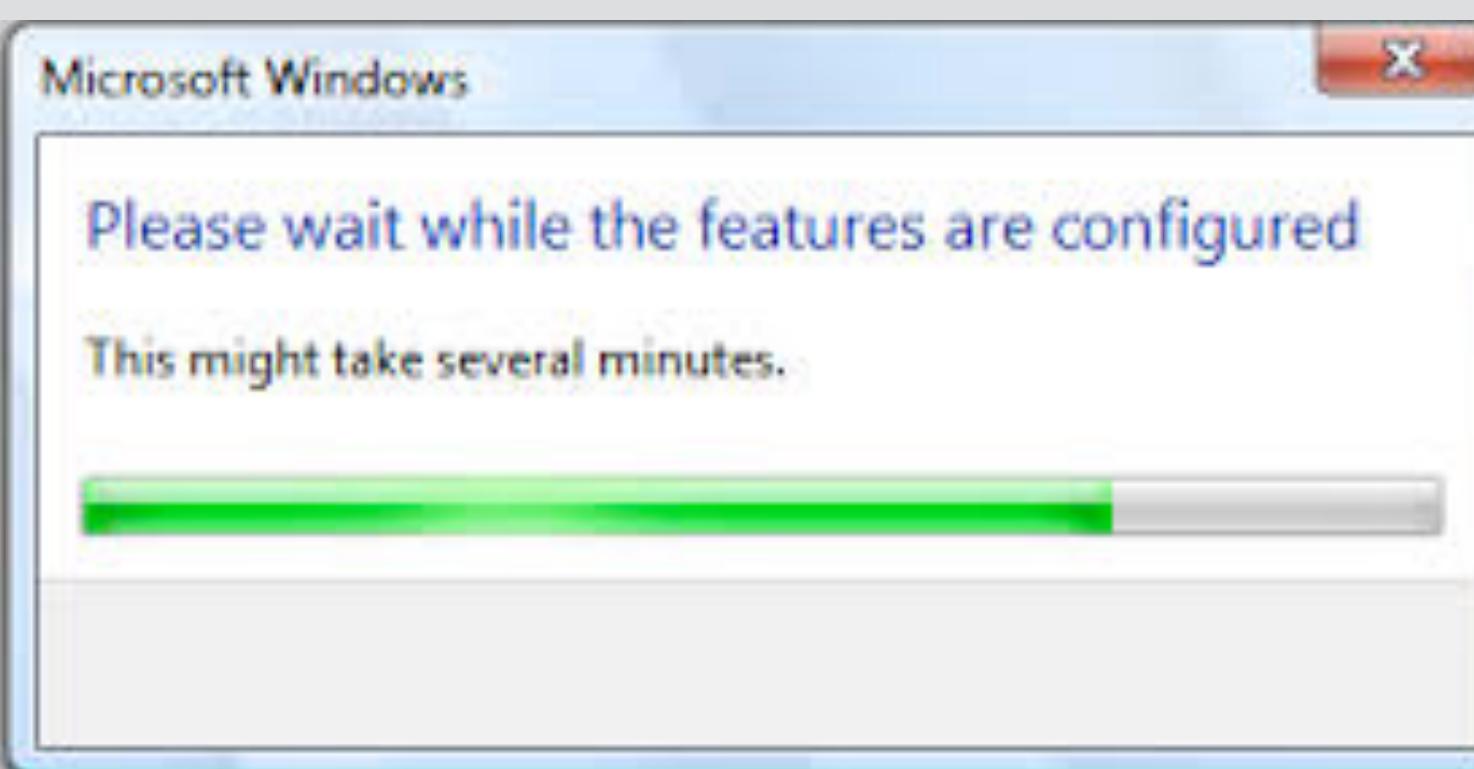
the Mac menu is a bit further away,  
but it effectively has **infinite size**, so  
it's much quicker to locate

# perceptual fusion



THE KINEOGRAPH.

an early flipbook



progress bar

*heuristics*  
avoid delays  $> 0.1\text{s}$   
for longer, show progress

# gestalt principles of grouping

username

password

USER

password

username

password

*heuristic*  
use visual layout  
to convey structure

# example: Massachusetts tax payments site

<https://mtc.dor.state.ma.us>

## 🛡 Taxpayer Identification

Individual Name

ID Type

ID \*

Confirm ID \*

Phone Number \*

SSN

Required

Required

Required

A screenshot of a web form titled "Taxpayer Identification". It contains fields for "Individual Name", "ID Type" (dropdown menu), "ID" (text input with a red asterisk), "Confirm ID" (text input with a red asterisk), and "Phone Number" (text input with a red asterisk). To the right of the "ID" field is a dropdown menu set to "SSN". Below each required field is the word "Required" in a smaller, gray font.

# example: aggregate actions in Google groups

The screenshot shows the Google Groups interface for the 'alloytools' group. The left sidebar includes links for 'My groups', 'Home', 'Starred', 'Favorites' (with a note to add stars), and 'Recently viewed' (listing 'Alloy Board', 'alloytools', 'tlaplus', 'Mongoose Node.JS ODM', and 'microsoft.public.mac.office.word'). The main content area shows the 'alloytools' group details: 'Shared privately', '14 of 14 topics (11 unread) ★'. Below this is a welcome message: 'Welcome to the Alloytools discussion group. The purpose of this group is to discuss Alloy development and promoting Alloy.' A thumbnail image for the group shows the word 'alloy' over a dark background. At the bottom, there are buttons for 'Edit welcome message' and 'Clear welcome message', and a list of recent topics with checkboxes next to them:

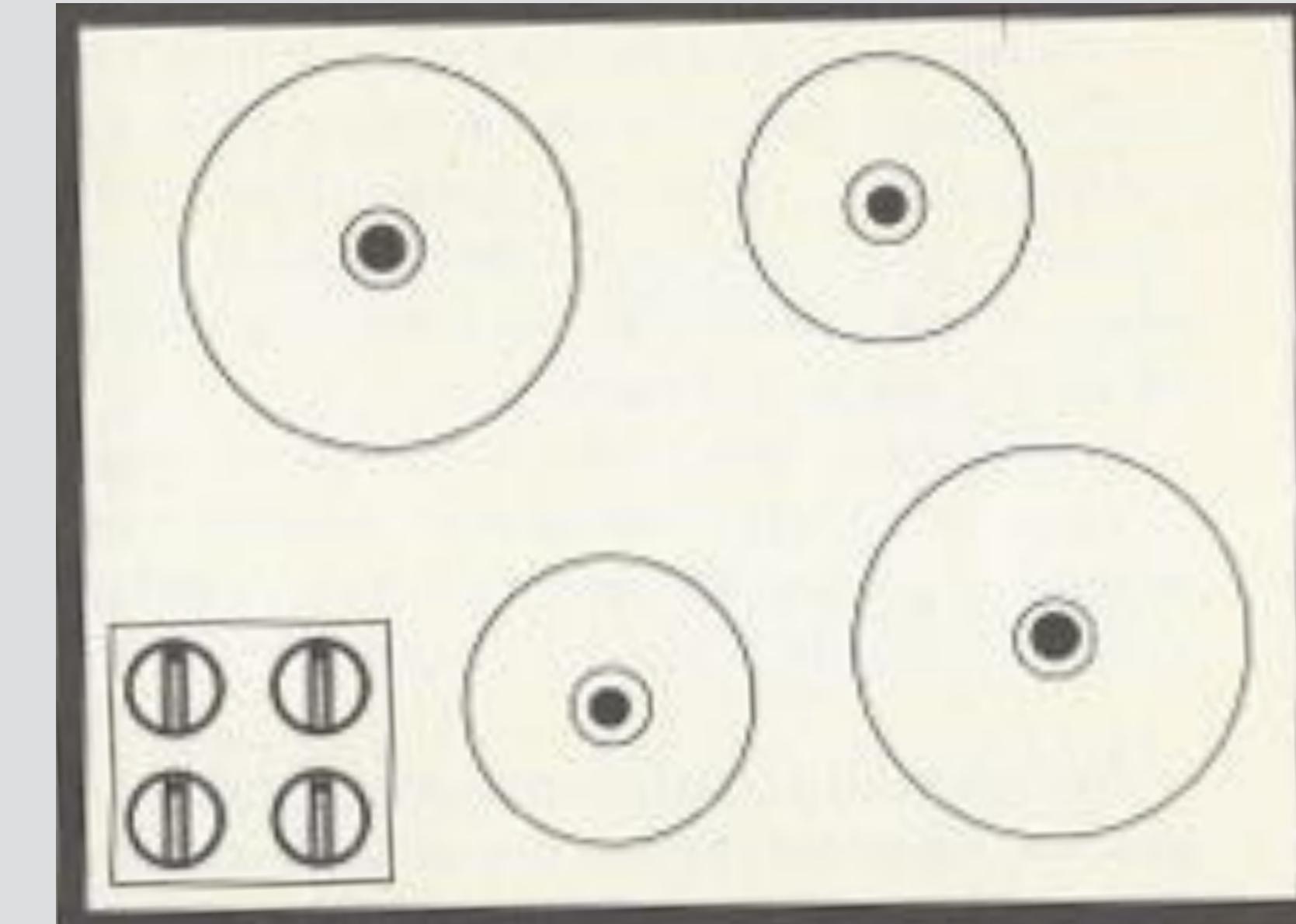
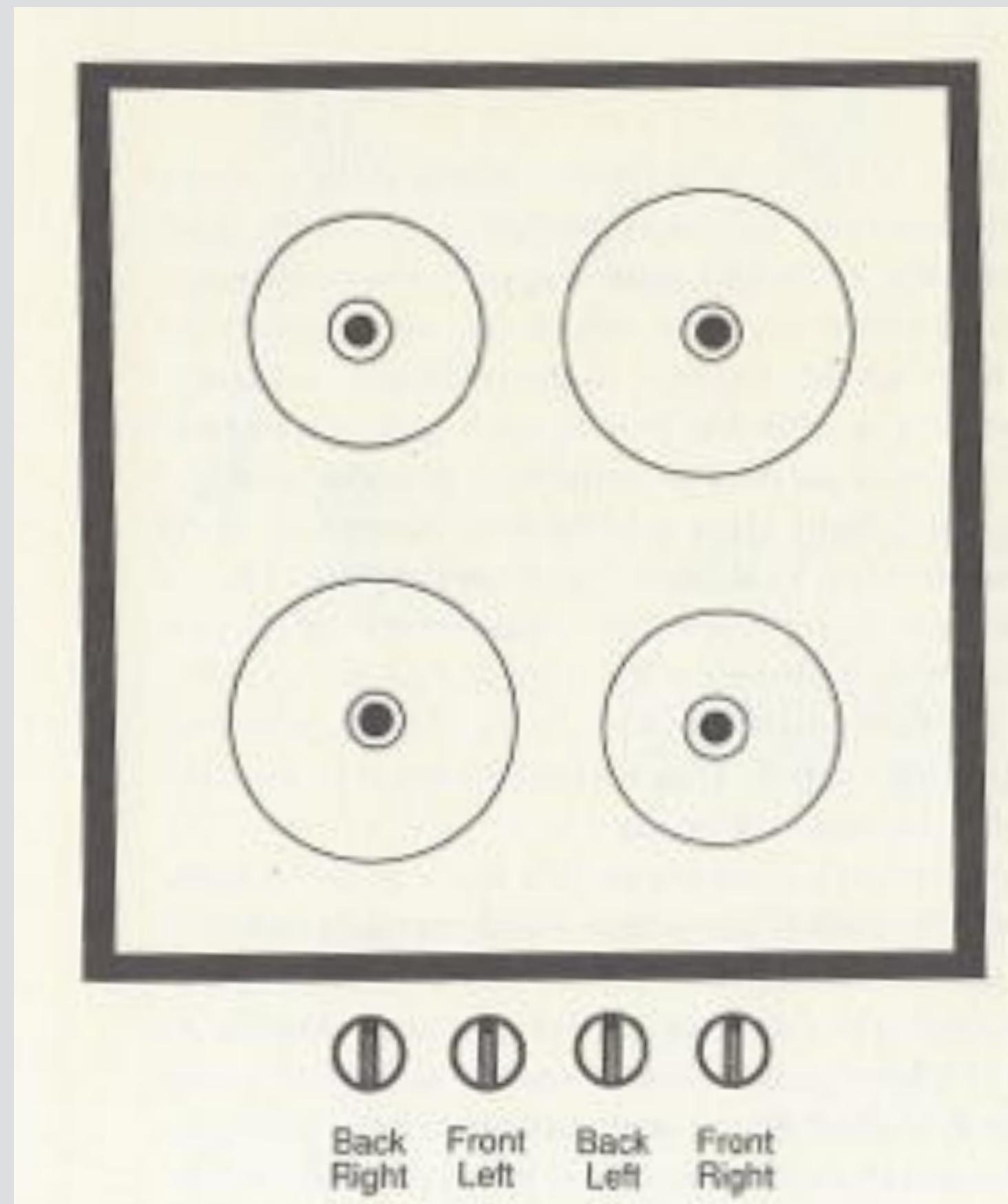
- ★ 📢 What is a deterministic state machine? (4)
- ★ 📢 ABZ 2018 call for contributions (1)
- ★ 📢 Alloy grammar (4)
- ★ 📢 When, What, Why of Alloy models (1)

A blue circle highlights the 'Actions' button in the top right, and another blue circle highlights the checkbox for the first topic in the list.

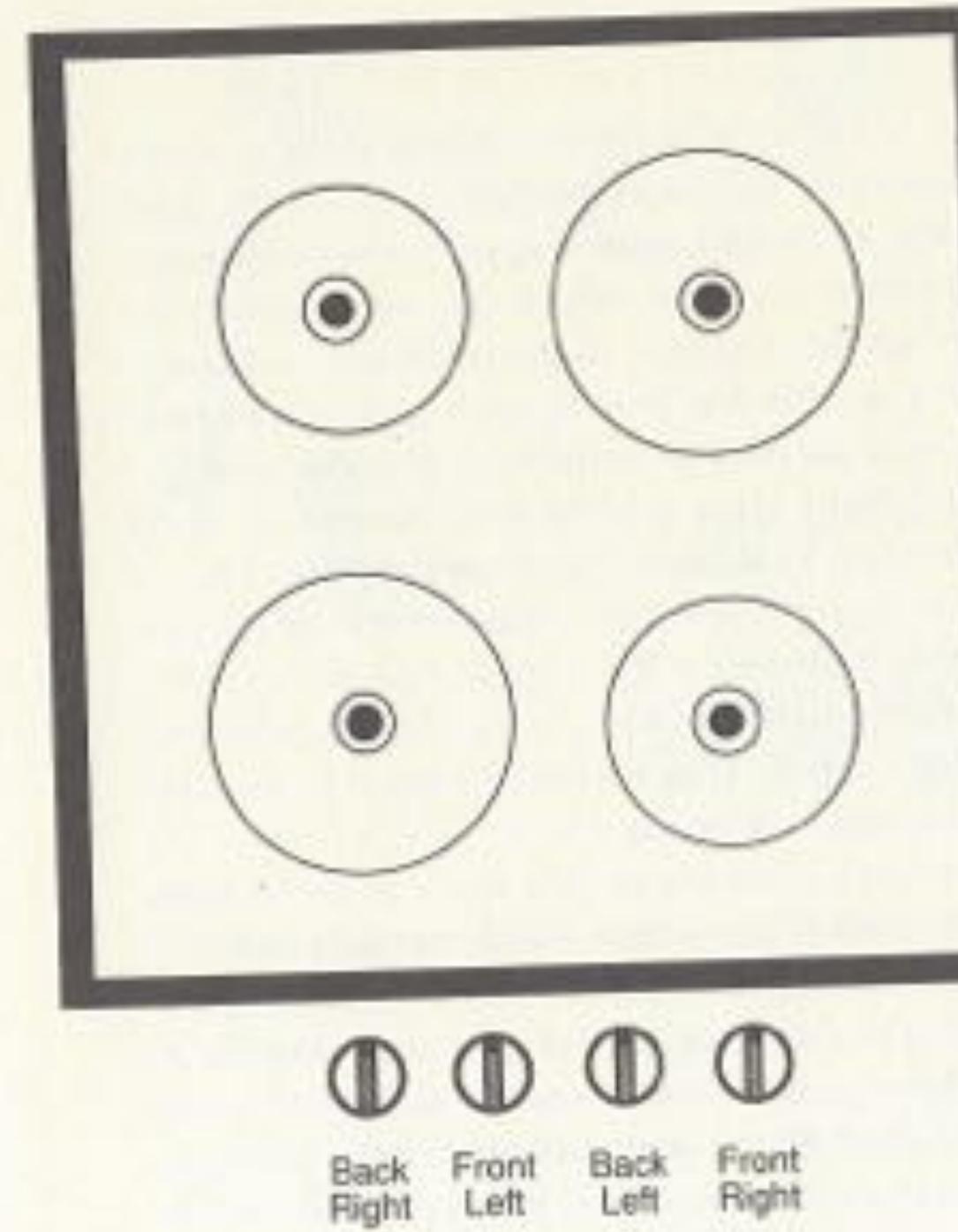
# mapping

*heuristic*

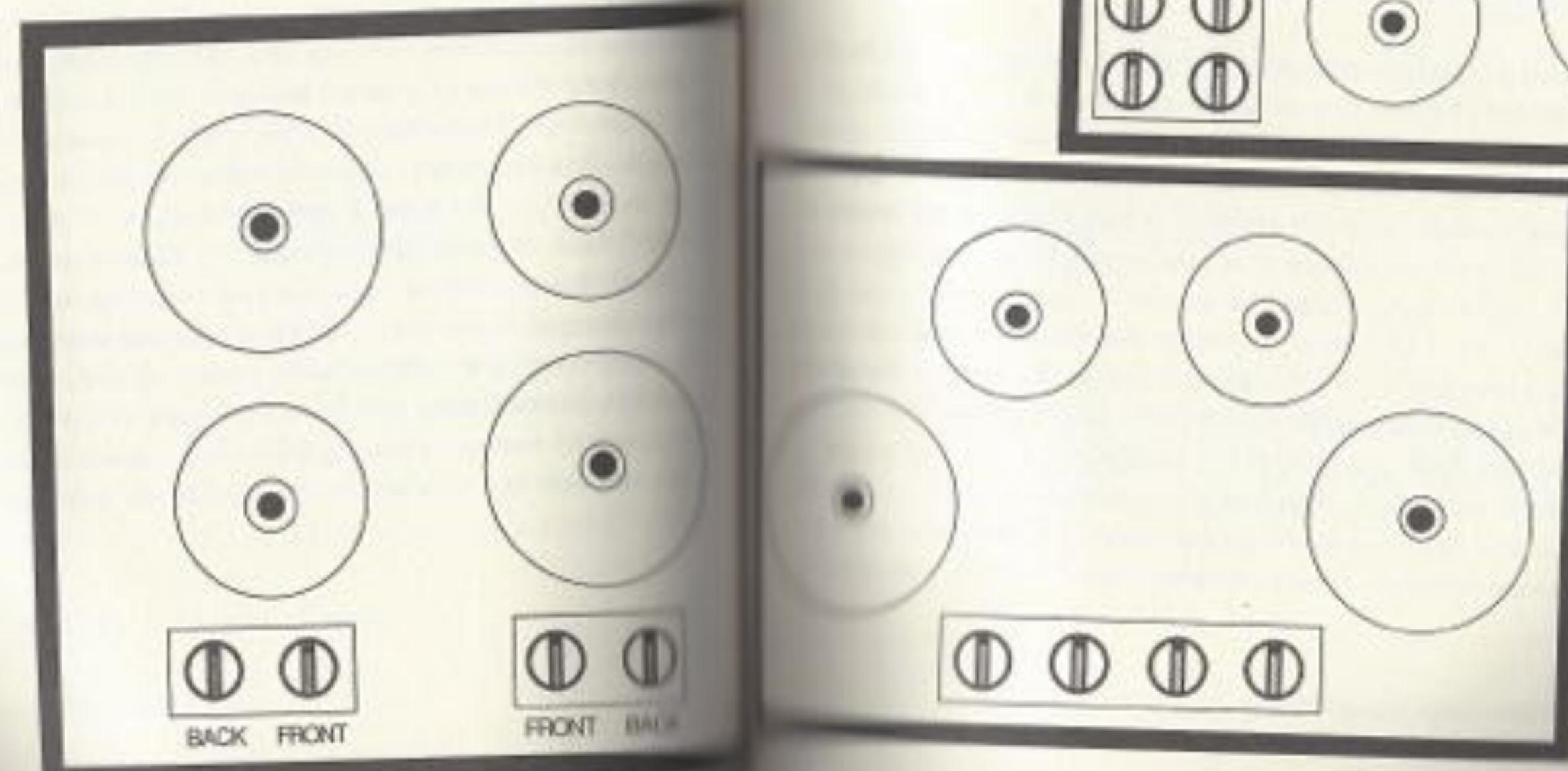
make layout consistent  
with function



from: Donald Norman, The Design of Everyday Things



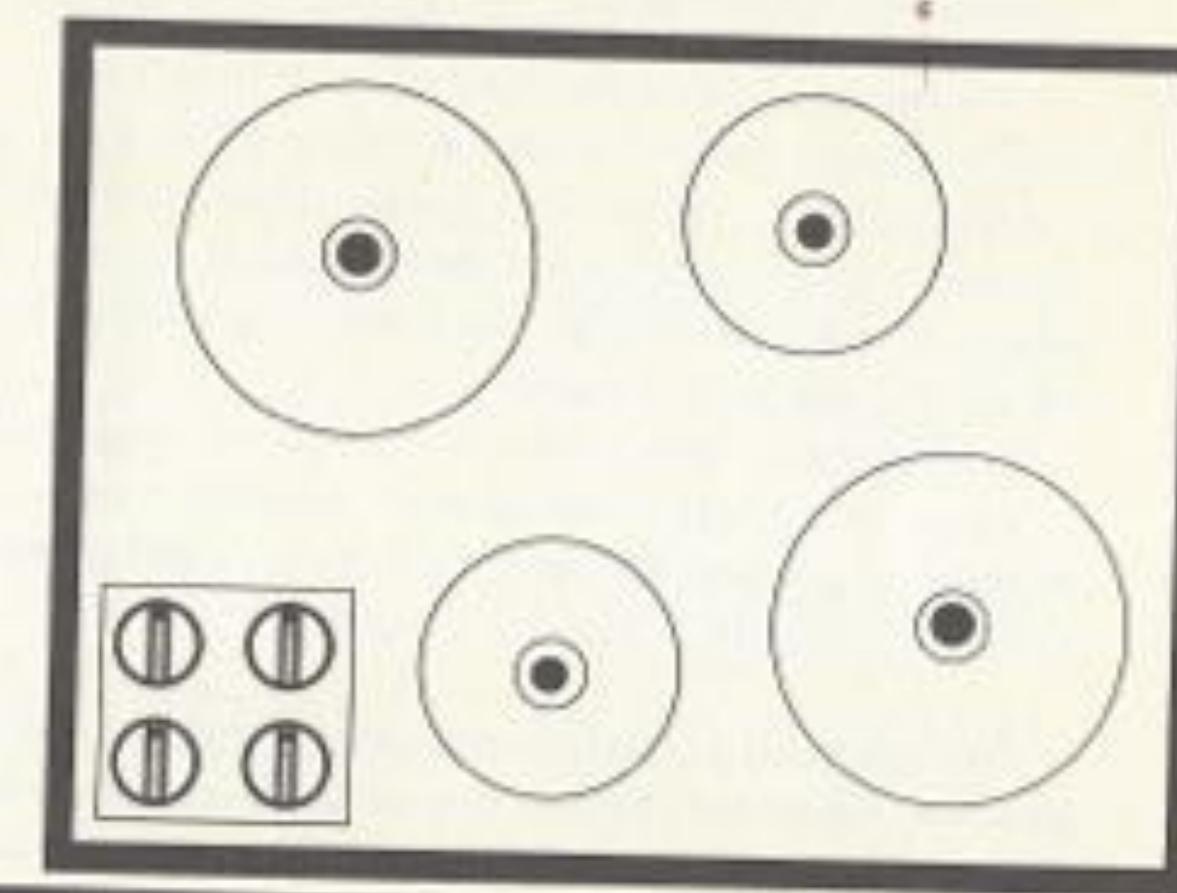
Back Right    Front Left    Back Left    Front Right



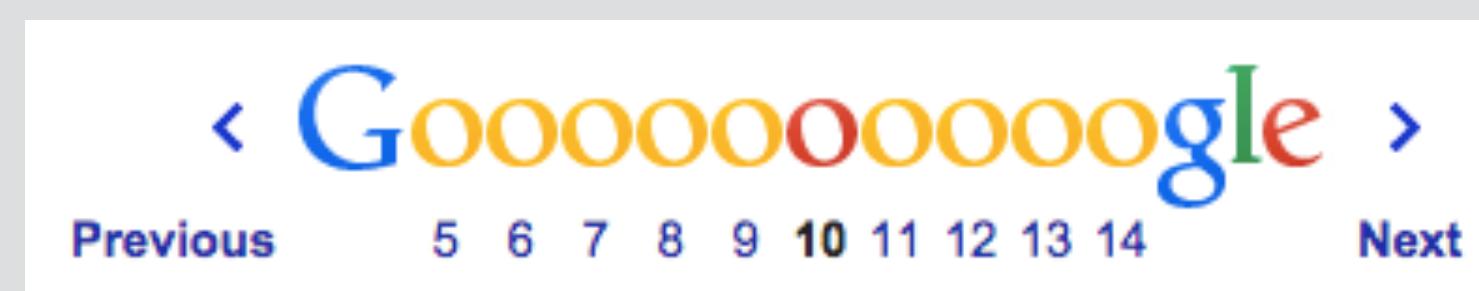
3-3 Arbitrary Arrangement of Stove Controls (top of opposite page). Couple the usual rectangular arrangement of burners with this arbitrary row of controls, and there is trouble: which control goes with which burner? You don't know unless the controls are labeled. The memory load for this arrangement is high: there are twenty-four possible arrangements, and you have to remember which of the twenty-four this one is. Fortunately, the controls are seldom arranged quite this arbitrarily.

3-4 Paired Stove Controls (bottom of opposite page). This is the type of partial mapping of controls to burners in common use today. The two controls on the left work the left burners, and the two controls on the right work the right burners. Now there are only four possible arrangements (two for each side). Even so, confusion is possible (and, I can assure you, it occurs often).

3-5 Full Natural Mapping of Controls and Burners (below). Two of the Possible Ways. There is no ambiguity, no need for learning or remembering, no need for labels. Why can't all stoves be like these?



# situational context



*heuristic*  
make user's location  
(and state) visible

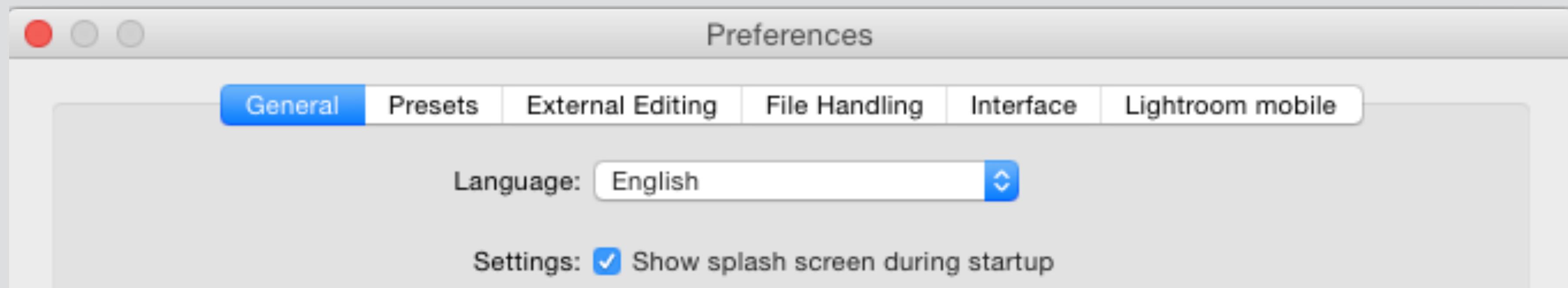
pagination

[Library of Congress](#) > [Collections](#) > [Fine Prints](#)

a breadcrumb from <http://www.loc.gov>

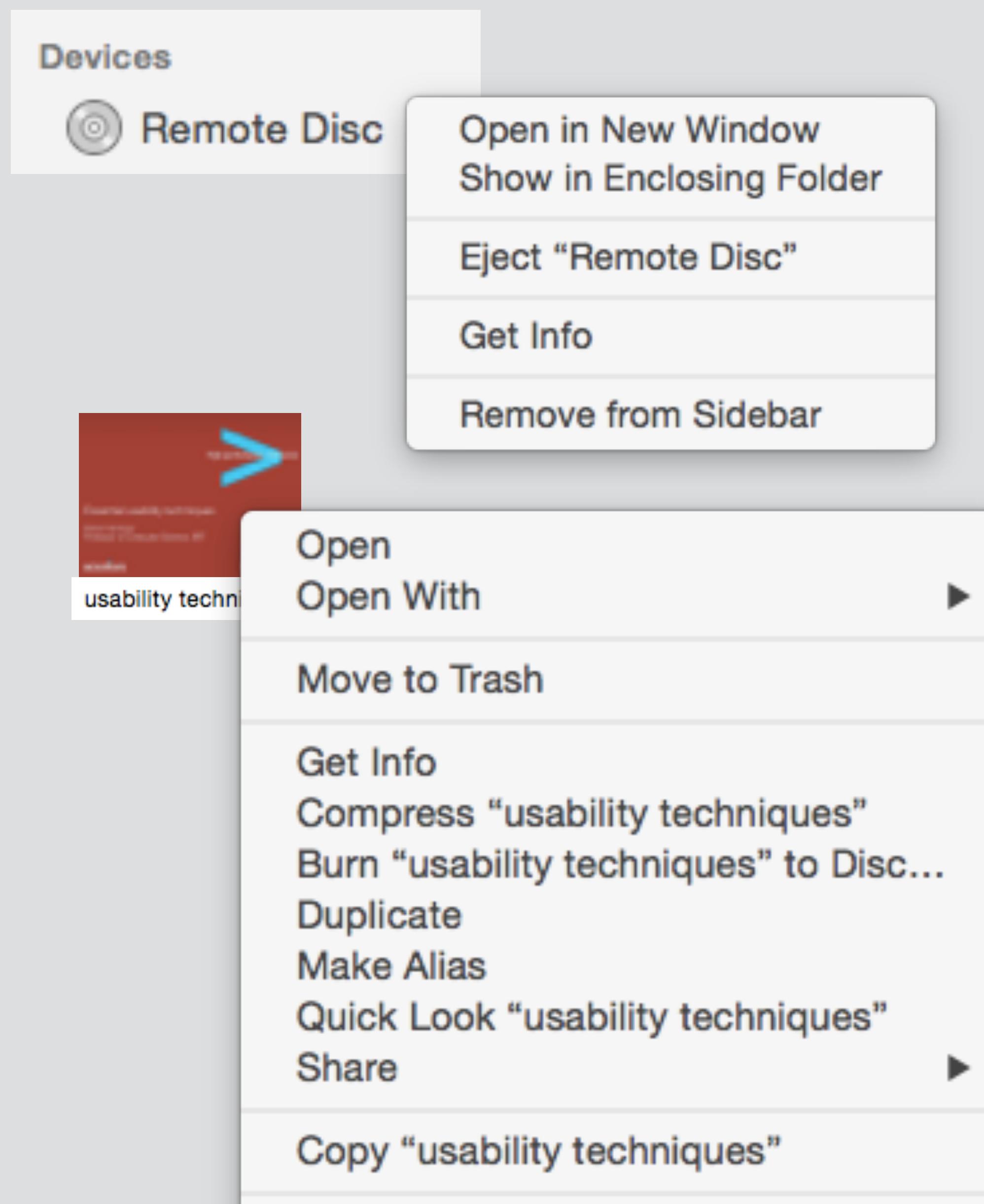


filters from <http://www.loc.gov>



tabs from Adobe Lightroom

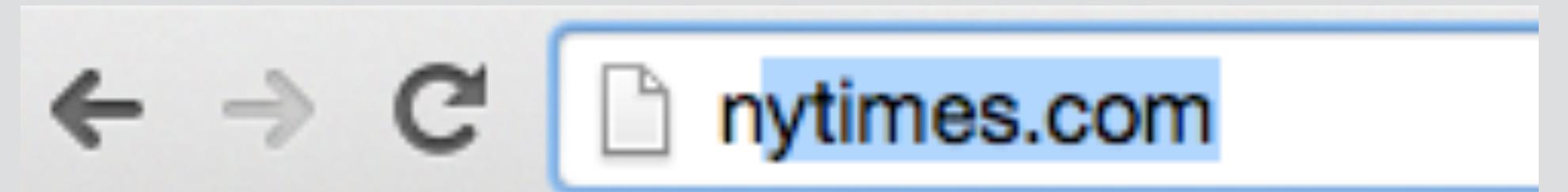
# anticipation & context



*heuristic*

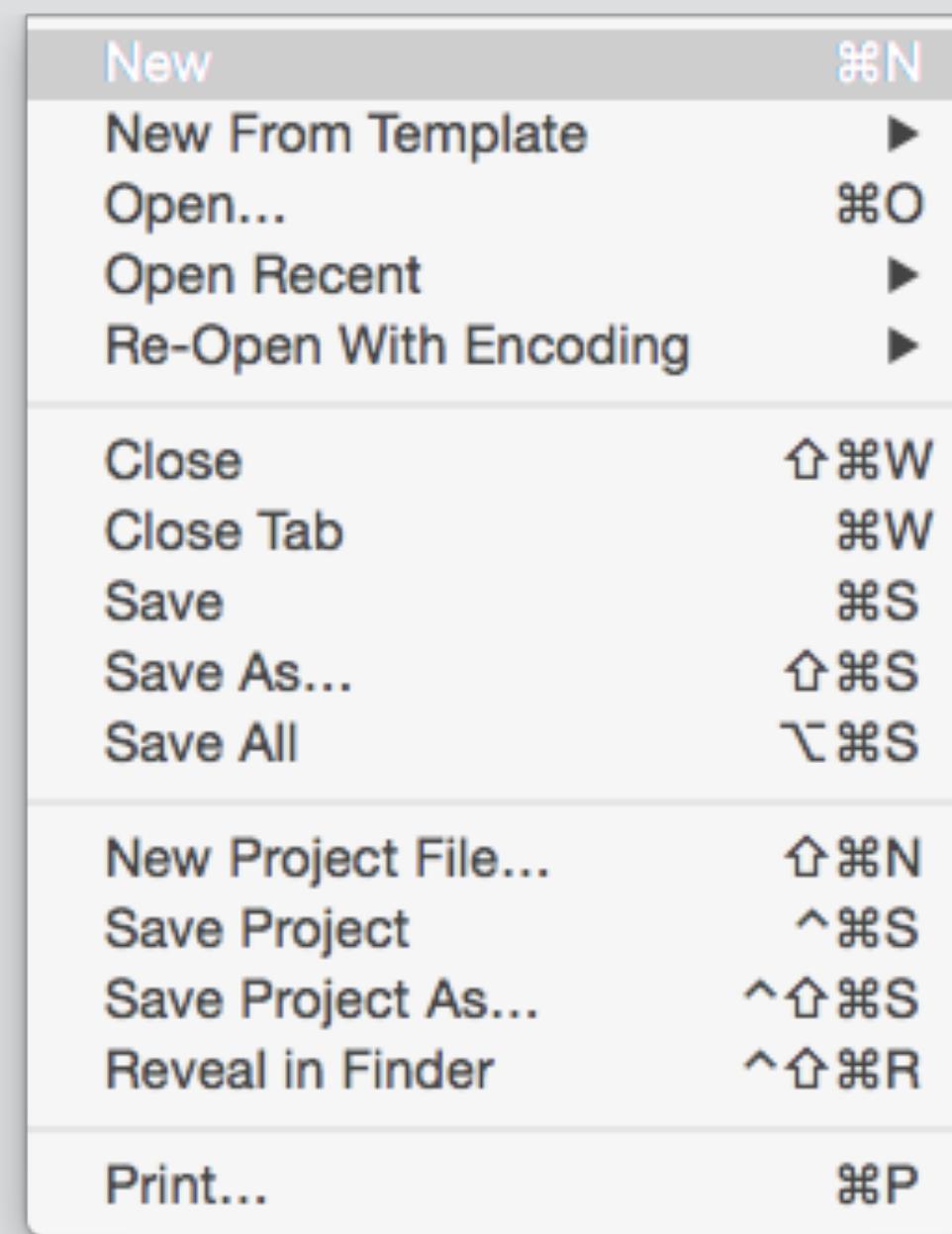
put items together that user is  
expected to need; make  
available actions appropriate for  
context

# accelerators

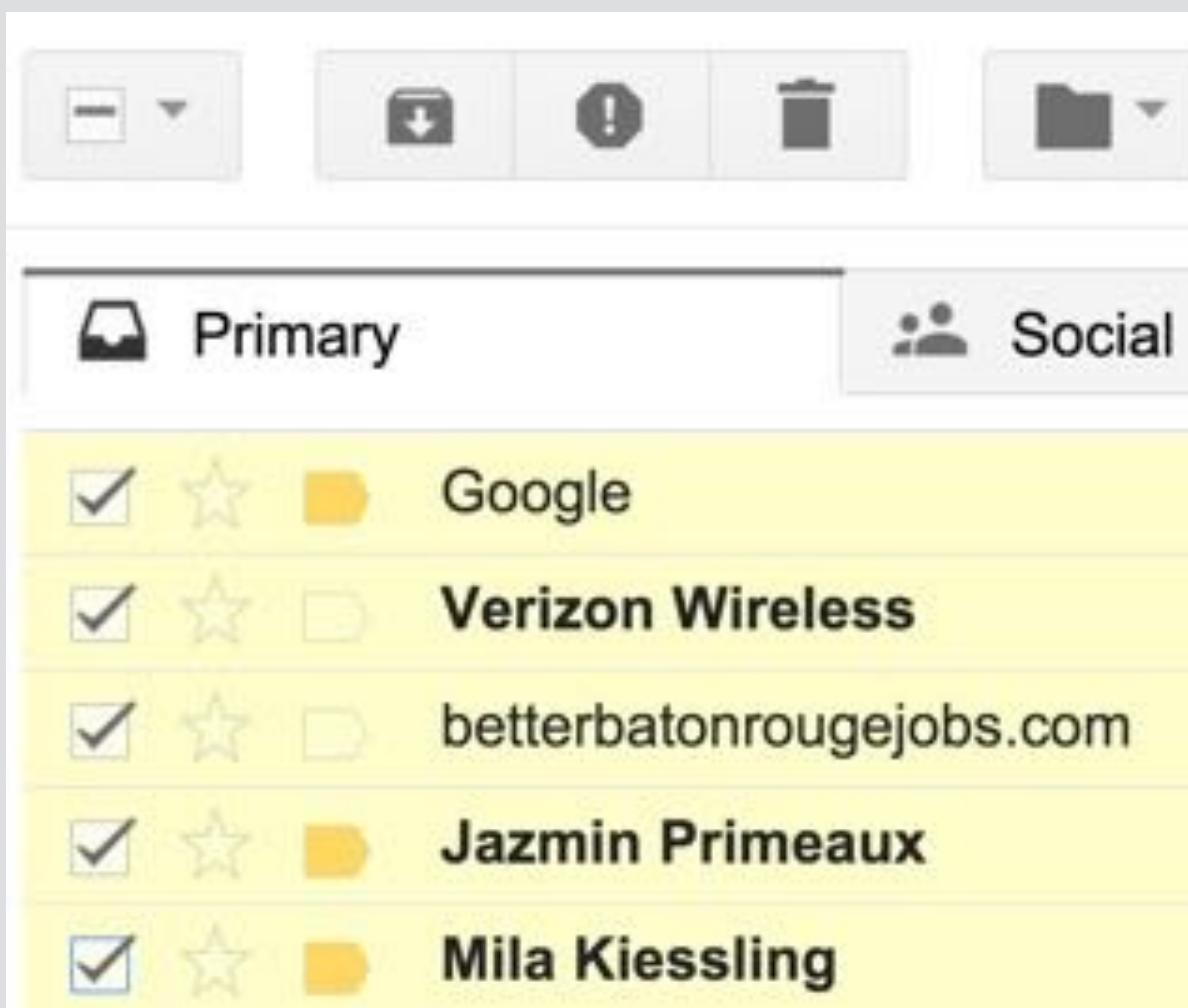


Google search bar autocomplete

*heuristic*  
provide accelerators for  
expert users



Textmate shortcuts



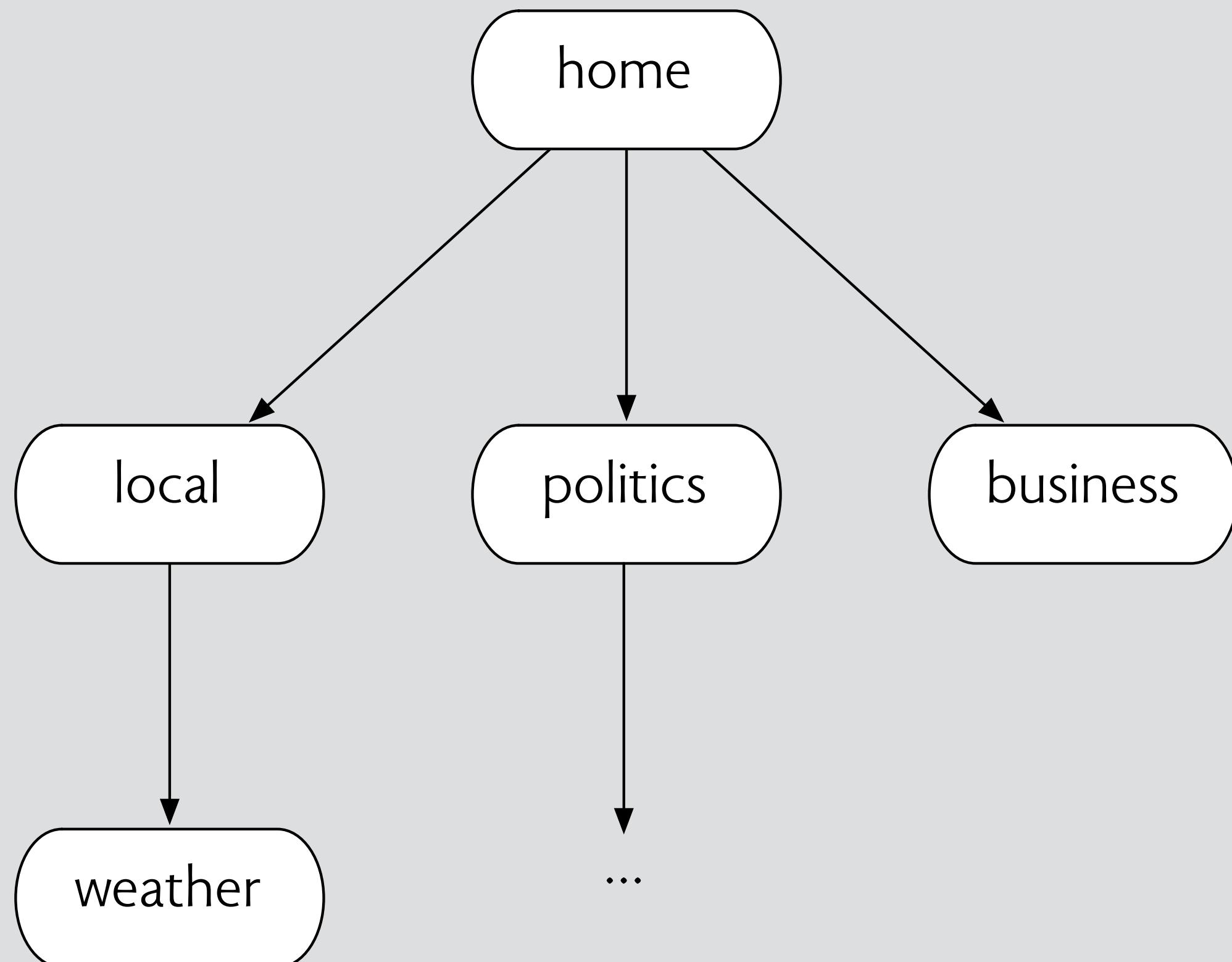
Gmail aggregation

# discussion: accelerators

**what other accelerators have you used?  
which work well? which are learnable?**



# short paths



*heuristic*  
minimize steps to reach  
common functions

The New York Times

Monday, October 19, 2020

U.S. INTERNATIONAL CANADA ESPAÑOL 中文 PLAY THE CROSSWORD Account Today's Paper

World U.S. Politics N.Y. Business Opinion Tech Science Health Sports Arts Books Style Food Travel Magazine T Magazine Real Estate Video

**The Morning**  
Make sense of the news, every day, with David Leonhardt.

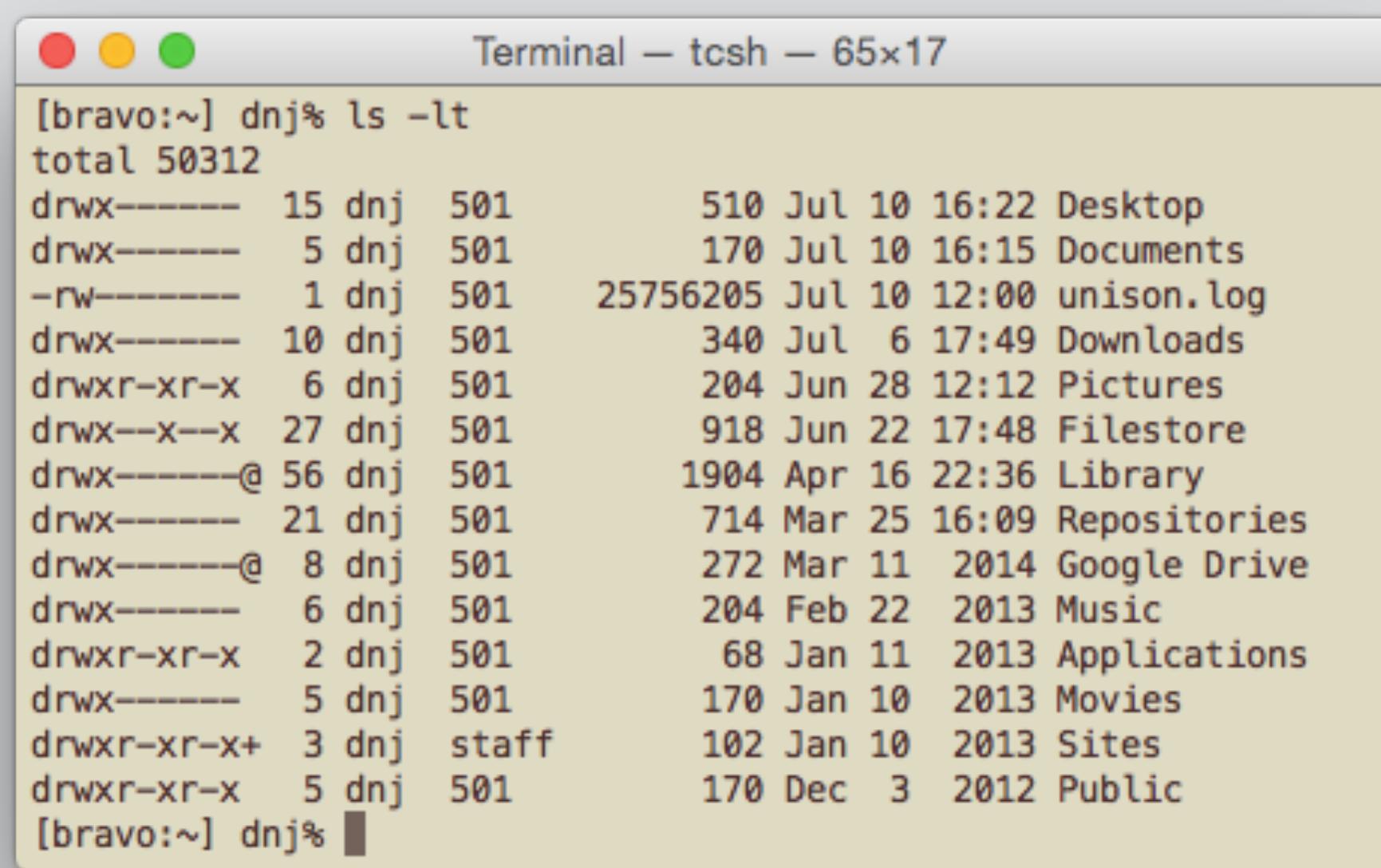
Listen to 'The Field'  
A divided Latino vote in Arizona.

Neediest Cases Fund  
The pandemic brought loss, and now they're behind on rent.

56°F 63° 49°  
Newtonville, MA

New York Times: weather on front page

# recognition vs. recall

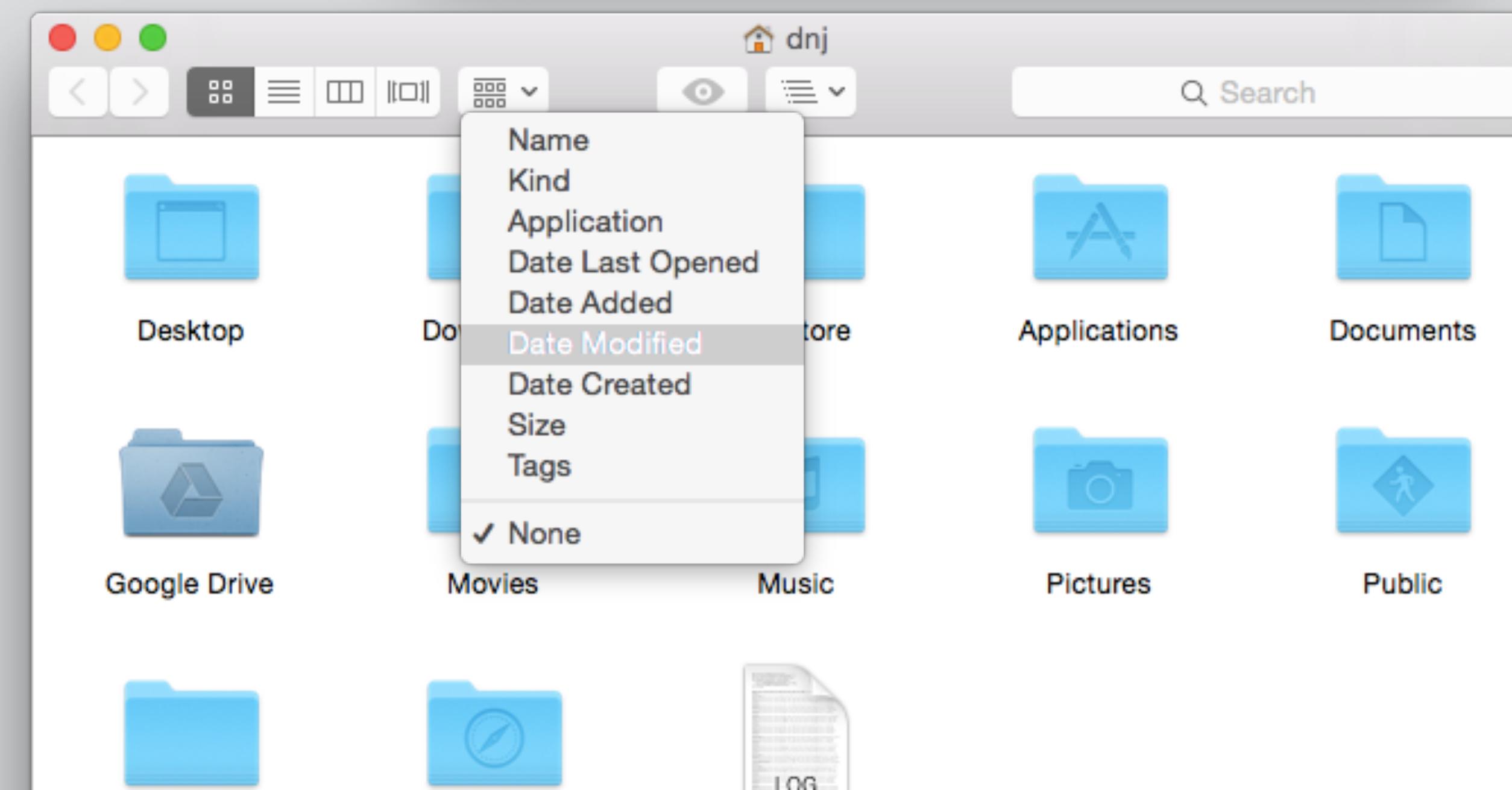


```
Terminal — tcsh — 65x17
[bravo:~] dnj% ls -lt
total 50312
drwx----- 15 dnj 501      510 Jul 10 16:22 Desktop
drwx----- 5 dnj 501       170 Jul 10 16:15 Documents
-rw----- 1 dnj 501 25756205 Jul 10 12:00 unison.log
drwx----- 10 dnj 501      340 Jul  6 17:49 Downloads
drwxr-xr-x  6 dnj 501      204 Jun 28 12:12 Pictures
drwx--x--x 27 dnj 501      918 Jun 22 17:48 Filestore
drwx-----@ 56 dnj 501     1904 Apr 16 22:36 Library
drwx----- 21 dnj 501      714 Mar 25 16:09 Repositories
drwx-----@ 8 dnj 501      272 Mar 11 2014 Google Drive
drwx----- 6 dnj 501      204 Feb 22 2013 Music
drwxr-xr-x  2 dnj 501      68 Jan 11 2013 Applications
drwx----- 5 dnj 501      170 Jan 10 2013 Movies
drwxr-xr-x+ 3 dnj staff   102 Jan 10 2013 Sites
drwxr-xr-x  5 dnj 501      170 Dec  3 2012 Public
[bravo:~] dnj%
```

*heuristic*

let the user recognize  
not have to remember!

Unix shell: have to recall command and options to list directory by modification date



Mac finder: just have to recognize symbol for organize, and then recognize selector for modification date

linguistic  
level

# names matter

## MY MEETINGS



### My Personal Meeting

Meeting ID: 973 8730 4444

### CSAIL Seminar

Host: Daniela Rus

Meeting ID: 973 1234 0095

## MY UPCOMING EVENTS



**Wed, Oct 12**

### Meeting with Arvind

8:00 PM - 8:30 PM

Host: Arvind Satyanarayan

Meeting ID: 973 8730 6219

### 6.1040 Lecture

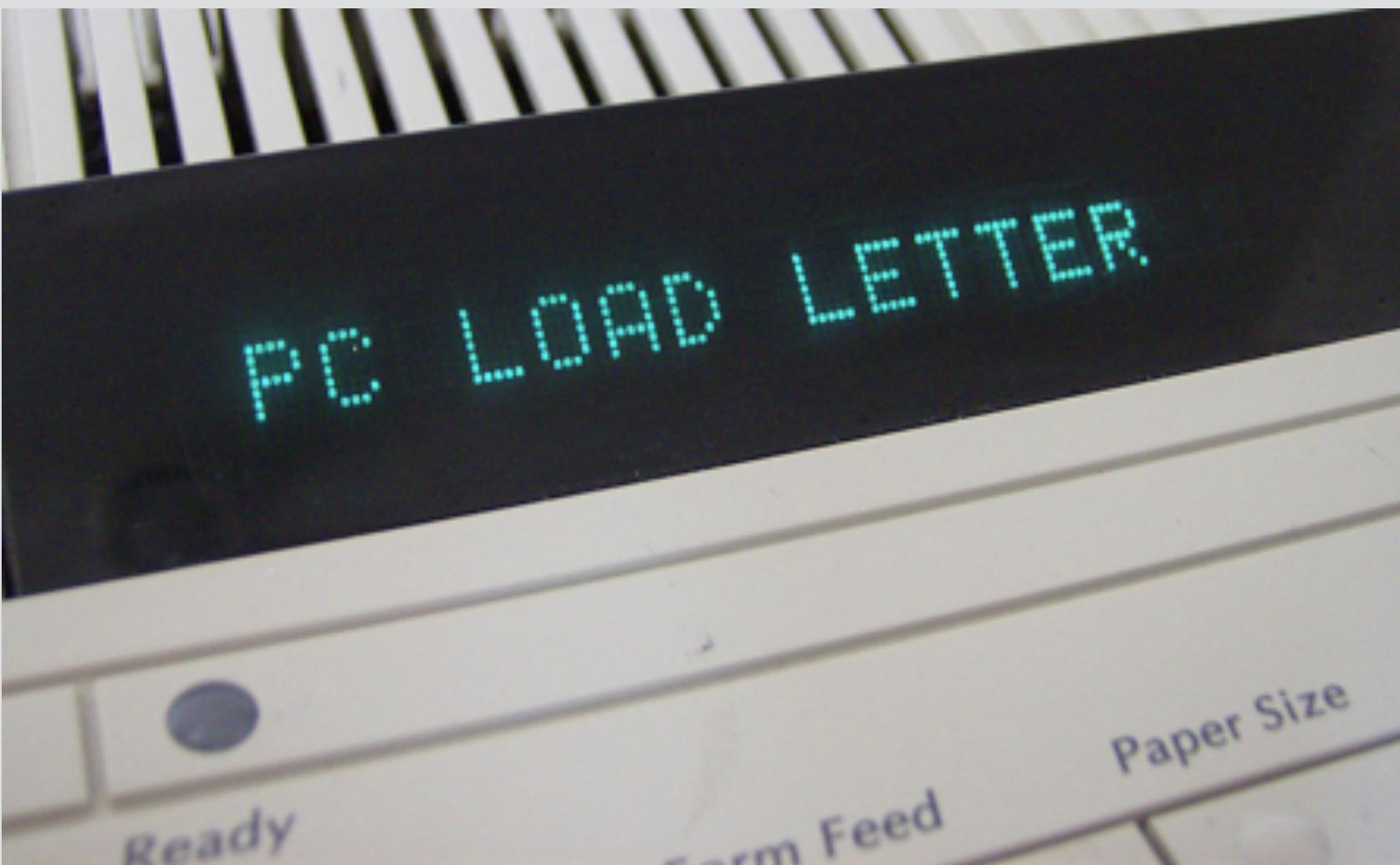
2:30 PM - 4:00 PM

Host: Daniel Jackson

Meeting ID: 973 8730 6220

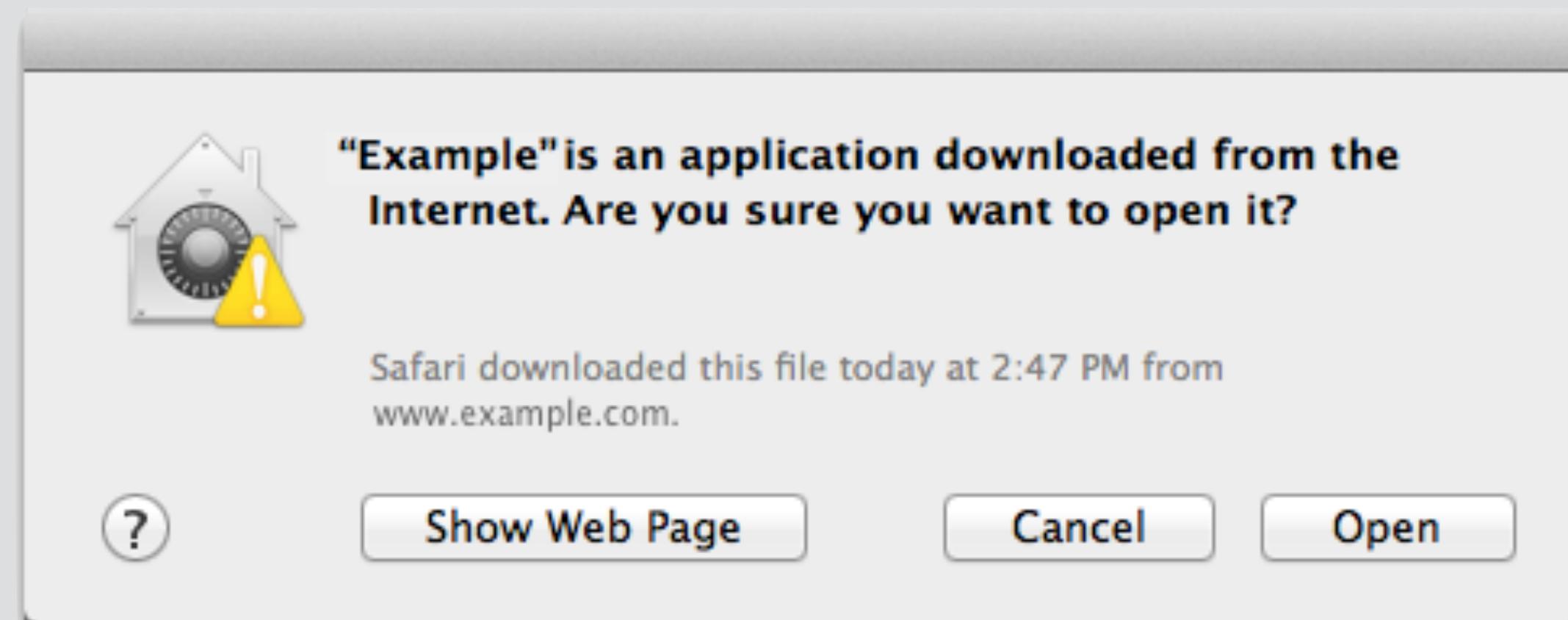
*heuristics*  
pick names for concepts  
& actions carefully!

# speak the user's language



infamous HP printer error

*heuristics*  
use simple terms  
word very carefully  
never blame the user



a helpful and informative message

# crash messages

Software Failure. Press left mouse button to continue.  
Guru Meditation #00000004.0000AAC0

Commodore Amiga crash



Your PC ran into a problem and needs to restart. We're just collecting some error info, and then we'll restart for you. (0% complete)

If you'd like to know more, you can search online later for this error: HAL\_INITIALIZATION\_FAILED

Windows blue screen of death

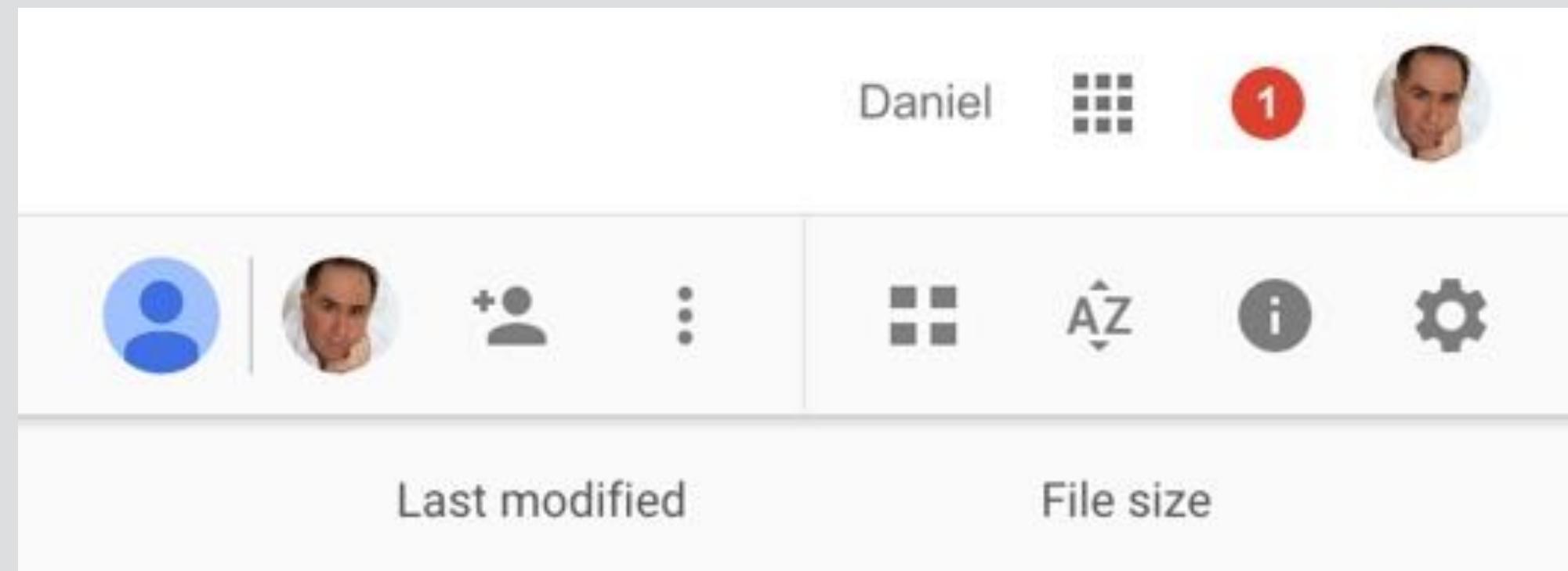


Sorry, a system error occurred.

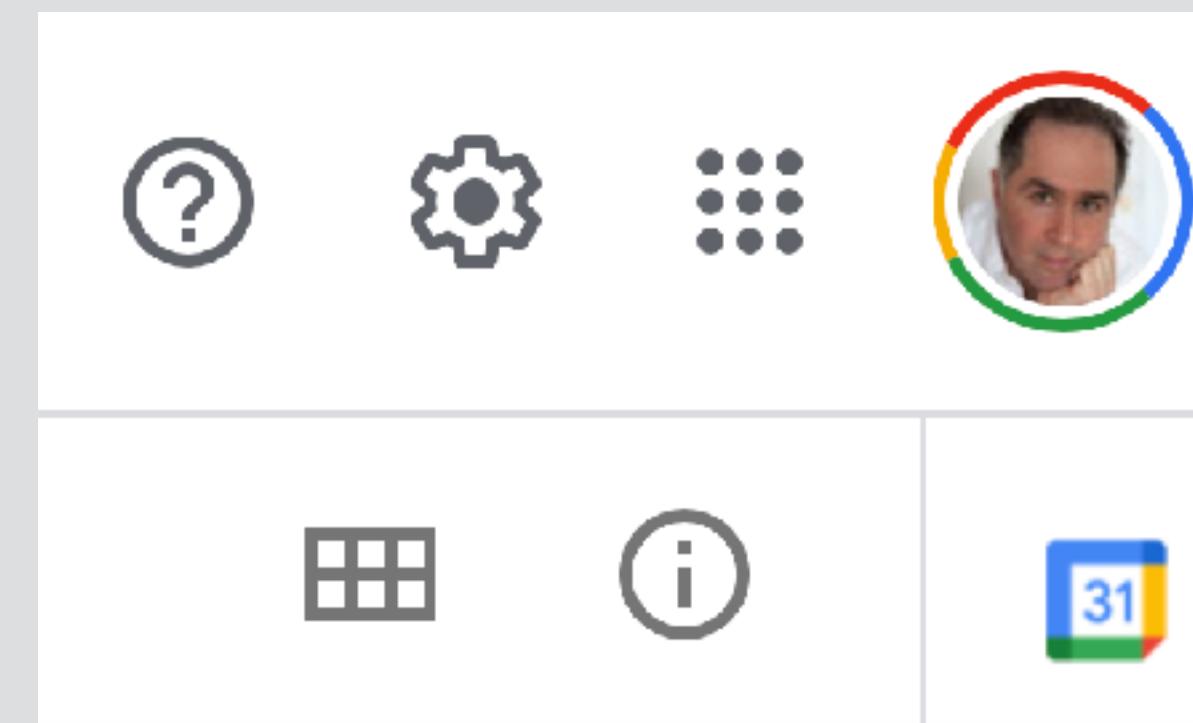
Restart

early Apple Macintosh crash

# consistent naming & icons

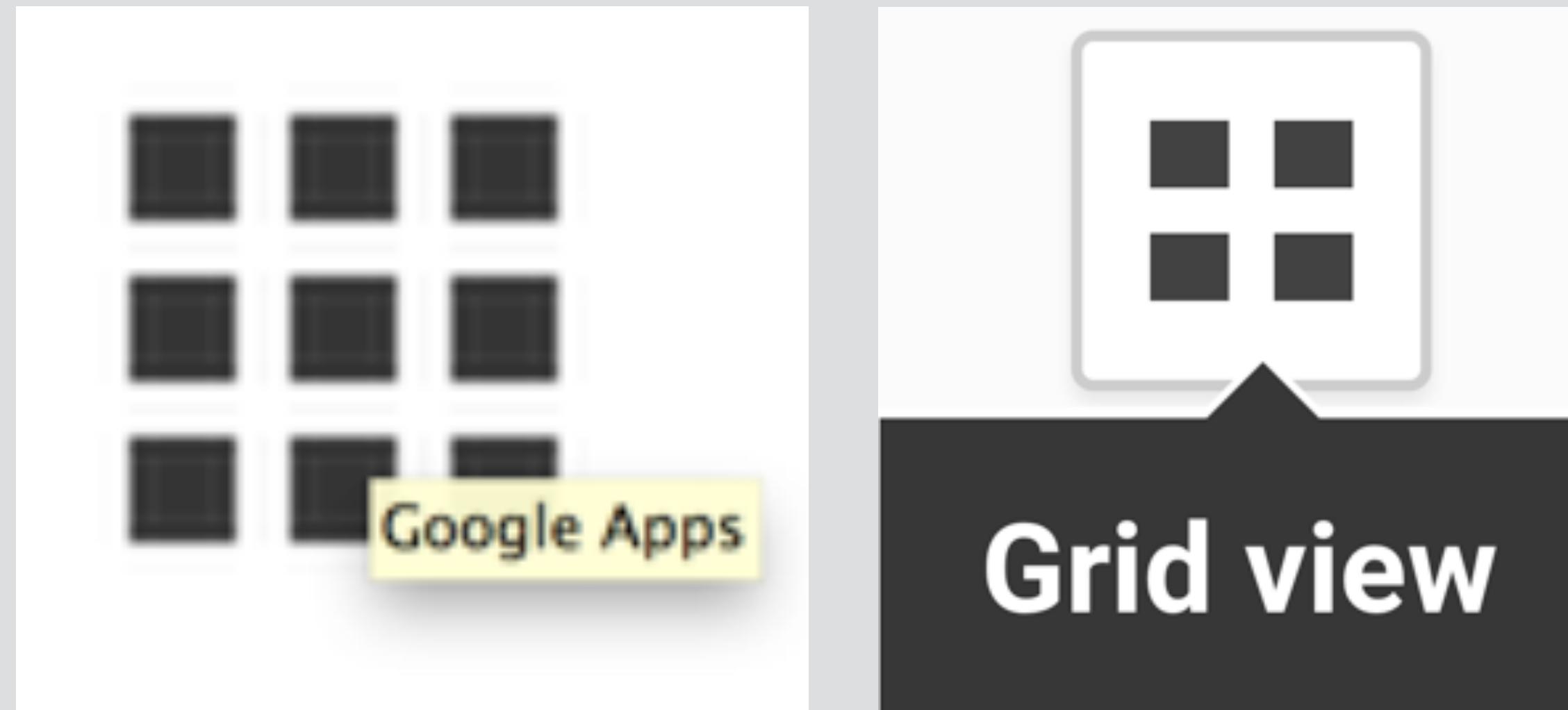


icons shown in Google Drive, c. 2020



2022

*heuristic*  
be consistent;  
same name or symbol for a  
concept or action



consistency  
across  
**application,**  
**platform,**  
**domain**

Chrome

About

*lesson*

beware of violating  
conventions

History

Extensions

Settings

About



Google Chrome

A web browser built for speed, simplicity, and security

[Get help with using Chrome](#)

[Report an issue](#)

Version 43.0.2357.130 (64-bit)



Nearly up-to-date! Relaunch Google Chrome to finish updating.

[Set Up Automatic Updates for All Users](#)

[Relaunch](#)

why is 'History' greyed out?



# Settings

Search settings

You and Google

Autofill

Privacy and security

Appearance

Search engine

Default browser

On startup

Languages

Downloads

Accessibility

System

Reset settings

Extensions

About Chrome

## Appearance

### Theme

Open Chrome Web Store

### Show home button

Disabled

### Show bookmarks bar

### Font size

Medium (Recommended)

### Customize fonts

### Page zoom

100%

Pressing Tab on a webpage highlights links, as well as form fields

Show warning before quitting with ⌘Q

# parts of speech

The screenshot shows a Google Groups interface. At the top left is the Google logo. To its right is a search bar with the placeholder "Search for". Below the search bar, the word "Groups" is displayed in red. Underneath "Groups", the name of the group, "alloytools", is shown in bold black text. A vertical sidebar on the left contains the following menu items:

- ▼ Members
  - All members
  - Invite members
  - Direct add members
  - Outstanding invites
  - Join requests

*heuristic*  
use verbs/nouns for  
actions/queries, and  
be consistent

# information scent

## Award Winners

- [Caldecott Medal \(107\)](#)
- [Man Booker Prize \(54\)](#)
- [National Book Award \(49\)](#)
- [Newbery Medal \(84\)](#)
- [The Pulitzer Prize \(46\)](#)
- [Hugo & Nebula Awards \(25\)](#)
- [Eisner Award \(39\)](#)

## Packaging Option

- [Frustration-Free Packaging \(9\)](#)

## Promotion

- [Bargain Books \(142,908\)](#)

## Avg. Customer Review

-  & Up (2,903,157)
-  & Up (3,274,714)
-  & Up (3,378,179)
-  & Up (3,481,555)

# books

## what's new

- [new releases](#)
- [pre-orders](#)
- [NY Times bestsellers](#)
- [Target Club Picks](#)
- [Only at Target](#)

## featured categories

- [book deals](#)
- [Rosetta Stone](#)
- [John Green](#)
- [Dr. Seuss](#)
- [signed books](#)

## kids' books

- [baby-3 years](#)
- [4-8 years](#)
- [9-12 years](#)
- [teen](#)
- [Common Core State Standards](#)
- [all kids' books](#)

*heuristic*  
use 'scent' to aid  
information 'foraging'

has Apple  
gone rogue?

# invisible controls

★ **Daniel Jackson <dnj@mit.edu>** 

To: Daniel Jackson <dnj@csail.mit.edu>  
remember to print this

---

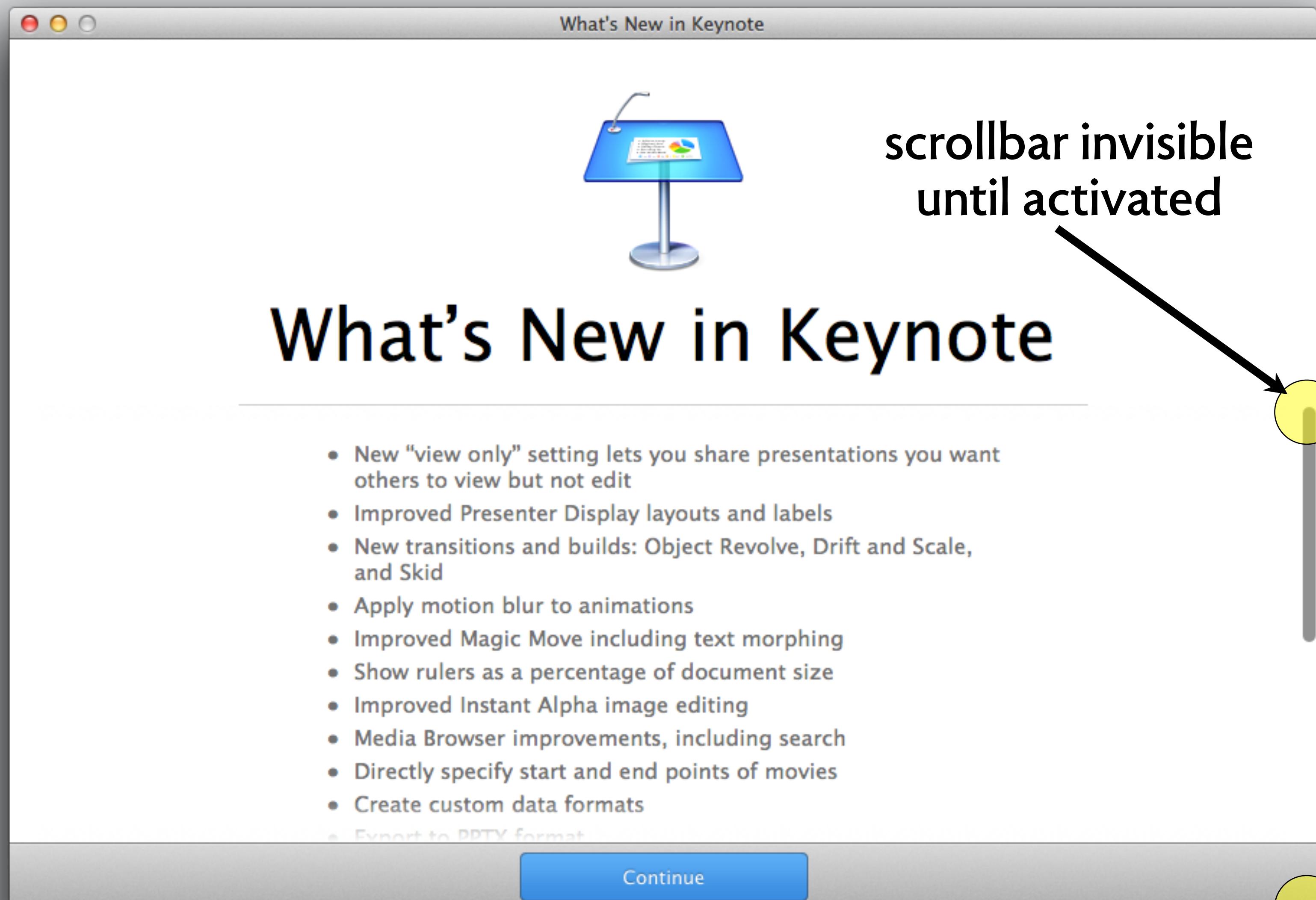
     1 ▾

  
In the Beginning was the  
Command Line.pdf

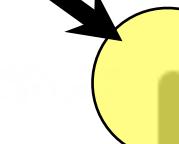
Save All (967 KB)...  
 In the Beginning was the Command Line.pdf  
Quick Look

April 11, 2014 5:39 PM [Hide Details](#)

about about



Scrollbar invisible  
until activated



window size  
cannot be adjusted

# ambivalent scrollbars

The screenshot shows a Mac OS X desktop environment with a window for The New York Times website open in a browser. The window title is "In 'Lost Kingdoms,' Nation...". The URL in the address bar is [www.nytimes.com/2014/04/11/arts/design/in-lost-kingdoms-national-treasures-from-asian-countries.html?ref=arts](http://www.nytimes.com/2014/04/11/arts/design/in-lost-kingdoms-national-treasures-from-asian-countries.html?ref=arts). The page content includes a "CNN go there" banner, an article about "Gathering of Gods From Places Long Forgotten", and other news items. A vertical scrollbar is visible on the right side of the browser window.

ART & DESIGN | ART REVIEW

## Gathering of Gods From Places Long Forgotten

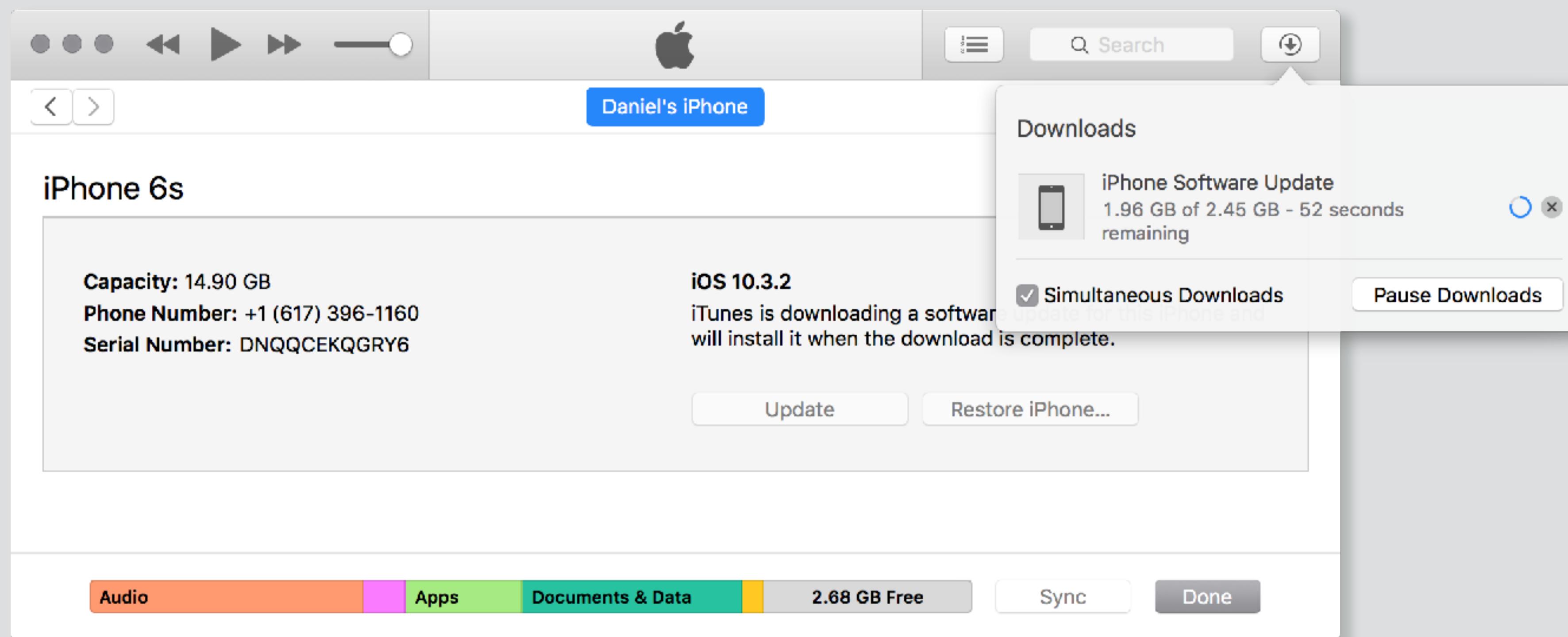
In 'Lost Kingdoms,' National Treasures From Asian Countries

By HOLLAND COTTER APRIL 10, 2014

A large, rectangular image of a stone relief sculpture depicting multiple figures, possibly deities or historical figures, in a dark setting. The sculpture is the central focus of the article.

A black rectangular banner with the "CNN go there" logo in white, located below the main article content.

# what are you waiting for?



11.10.15

# How Apple Is Giving Design A Bad Name

For years, Apple followed user-centered design principles. Then something went wrong.



BY DON NORMAN AND BRUCE TOGNAZZINI LONG READ

<https://www.fastcodesign.com/3053406/how-apple-is-giving-design-a-bad-name>

let's evaluate  
some websites!

Home  
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Pause animations

This website exists as an ongoing collaborative experiment in digital publishing and information sharing. Because this website functions as a wiki, all members of the School of Art community—graduate students, faculty, staff, and alums—have the ability to add new content and pages, and to edit most of the site's existing content.

Content is the property of its various authors. When you contribute to this site, you agree to abide by Yale University academic and network use policy, and to act as a responsible member of our community.

Visitor: Log in

Edit this page

Page history

# YALE SCHOOL OF ART

The Yale School of Art is a **graduate school** that confers MFAs in Graphic Design, Painting/Printmaking, Photography, and Sculpture; and offers undergraduate-level art courses to Yale College students. Our website exists as an **ongoing collaborative experiment** in digital publishing and information sharing. It functions as a wiki—all members of the School of Art community have the ability to add new, and edit most existing content.

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## HAPPENING AT SOA

Fall 2022 Visiting Artist lectures are underway! **[Find the schedule + posters here >](#)**



Research

People

News

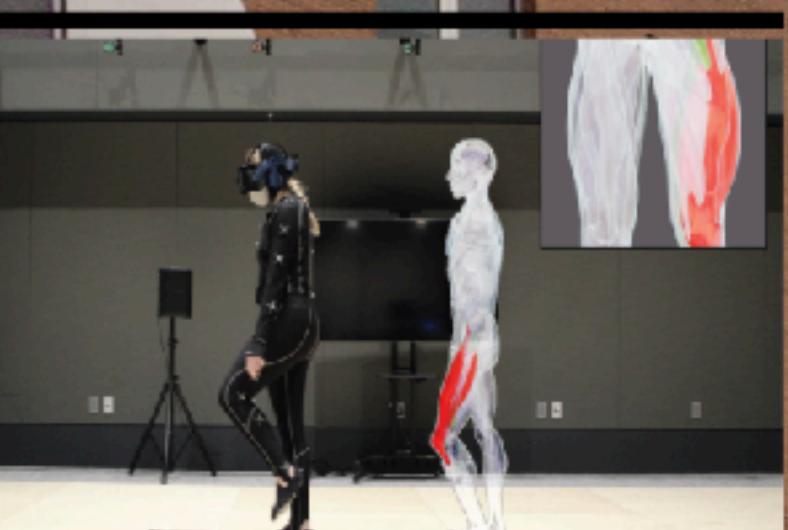
Events

About

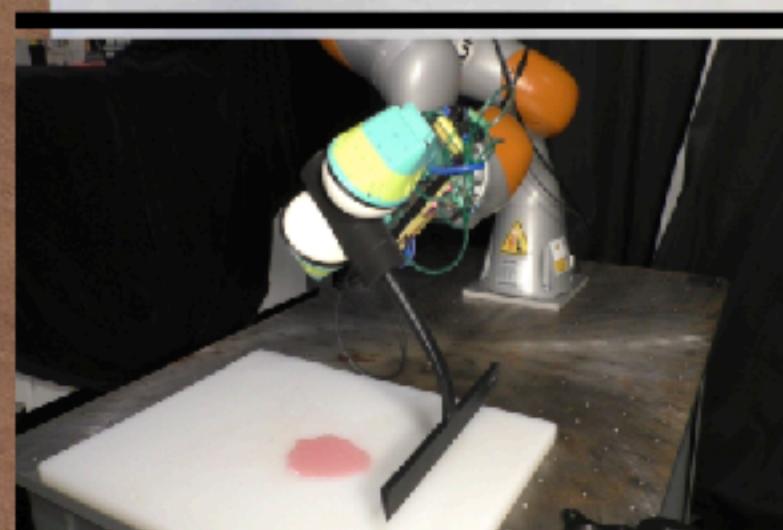


## Robotics

40 People, 54 Projects, 9 Groups



MIT system “sees” the inner structure of the body during physical rehab



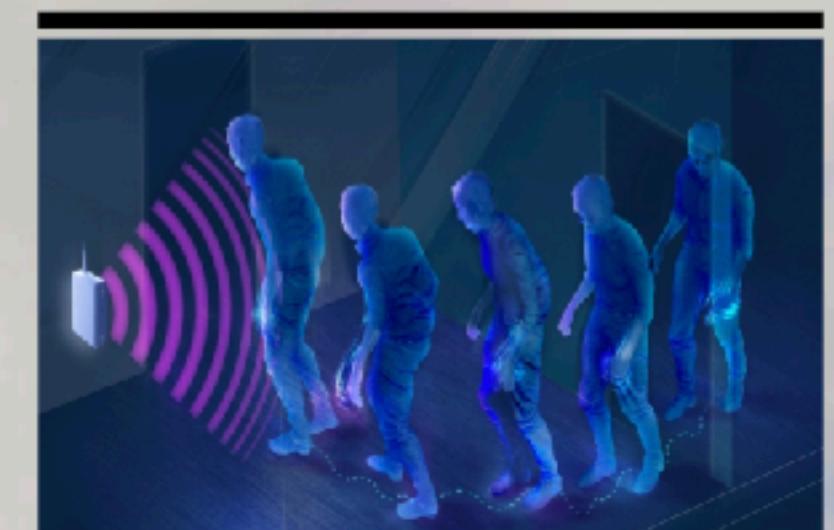
Soft robots that grip with the right amount of force

## AI & ML

122 People, 68 Projects, 24 Groups



AI system makes models like DALL-E 2 more creative



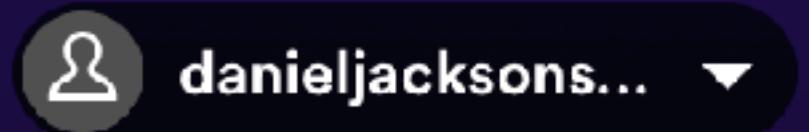
In-home wireless device tracks disease progression in Parkinson’s patients

FEATURED

Videoarchive

TEDxMIT: Computing the Future

**csail.mit.edu**



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My Playlist #5

Serenade in B-Flat Major, K. 361 "Gran Partita": I. ...

Mozart Cmoll messa

This Is Keith Jarrett

Daniel Playlist Classical

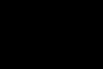
Daniel Playlist

Bach Cello Suites - Queyras & Maisky

This Is Handel

This Is Ed Sheeran

Jackson-Marbach Fam Playlist



Exam Study Classical Music Orchestra – Exam St...

THE SCHOOL FOR GOOD AND EVIL

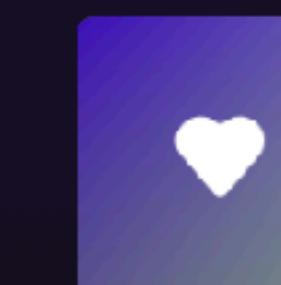
Enchanting Music for Evers and Nevers.

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# Good morning



Liked Songs



This Is Keith Jarrett



97 — Richard Rogers' Reith Lecture — Cities for a Sm...



518. Are Personal Finance Gurus Giving You Bad...



Jewish Voices In The New World



How to Change Your Mind

## Your shows

SEE ALL



not  
just  
GUILS!

which criteria and principles are violated here?

```
$ ls  
a b d  
$ mv d c  
$ ls  
a b c
```

*mv = rename*

```
$ mv a b  
$ ls  
b c
```

*mv = clobber*

```
$ mv b c  
$ ls  
c  
$ ls c  
b
```

*mv = move*

```
$ ls  
f1.c f2.c ... f1.o f2.o ...  
$ rm * >0  
$ ls
```

*look at where > is on keyboard*

```
$ ls  
a b c d  
$ mv a *  
$ ls  
* b c d  
$ rm *  
$ ls
```

*file called \**

*See: The Unix Hater's Handbook*

# takeaways

**heuristics offer**  
codification of knowledge  
basis for critique  
a systematic approach

**but remember**  
no rules are perfect  
must be applied thoughtfully  
surprises always possible!

cheatsheet for heuristic evaluation of user interfaces / 61040, software studio

criteria	physical	linguistic
<b>learnability</b> can users learn quickly and easily?	<b>fitt's law</b> how quick to point?	<b>speak user's language</b> not developer's language
<b>efficiency</b> can experts work fast and efficiently?	<b>perceptual fusion</b> respect human perception of time	<b>consistency</b> are names, icons etc consistent?
<b>error tolerance</b> are user errors mitigated?	<b>gestalt principles</b> convey structure by visual layout	<b>recognition vs. recall</b> reduce recall burden on user
<b>pleasantness</b> is the app pleasant to use?	<b>mapping</b> layout interface to match function	<b>information scent</b> provide hints for navigation
<b>safety</b> is it safe?	<b>situational context</b> provide features appropriate to context	
<b>security</b> are privacy and integrity ensured?	<b>accelerators</b> allow quick access to common features	
<b>accessibility</b> usable by everyone?	<b>typography</b> readable text, accessible & effective color	