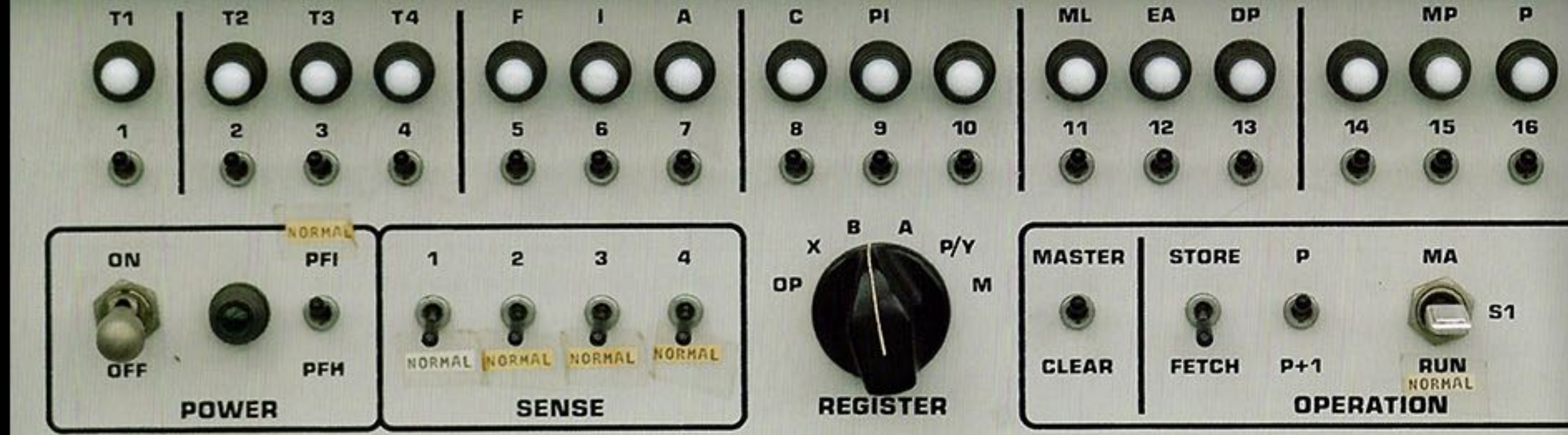


CS160

USER INTERFACE DESIGN

FALL 2018



HEURISTIC EVALUATION

17 SEP 2018

ERIC PAULOS

www.paulos.net

UNIVERSITY OF CALIFORNIA



Berkeley

ANNOUNCEMENTS

PROG 02A — Due 19 SEP

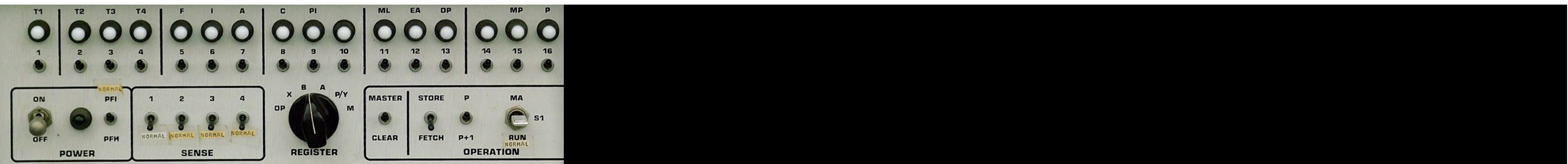
PROG 02B — Due 5 OCT

Required Class — 24 SEP

GROUPS ASSIGNED THIS WEEK

SECTION: APIs + Heuristic Evaluation

DESIGN 02 - Heuristic Evaluation (Due SEP 26)



CONCEPTUAL MODELS

MENTAL REPRESENTATIONS

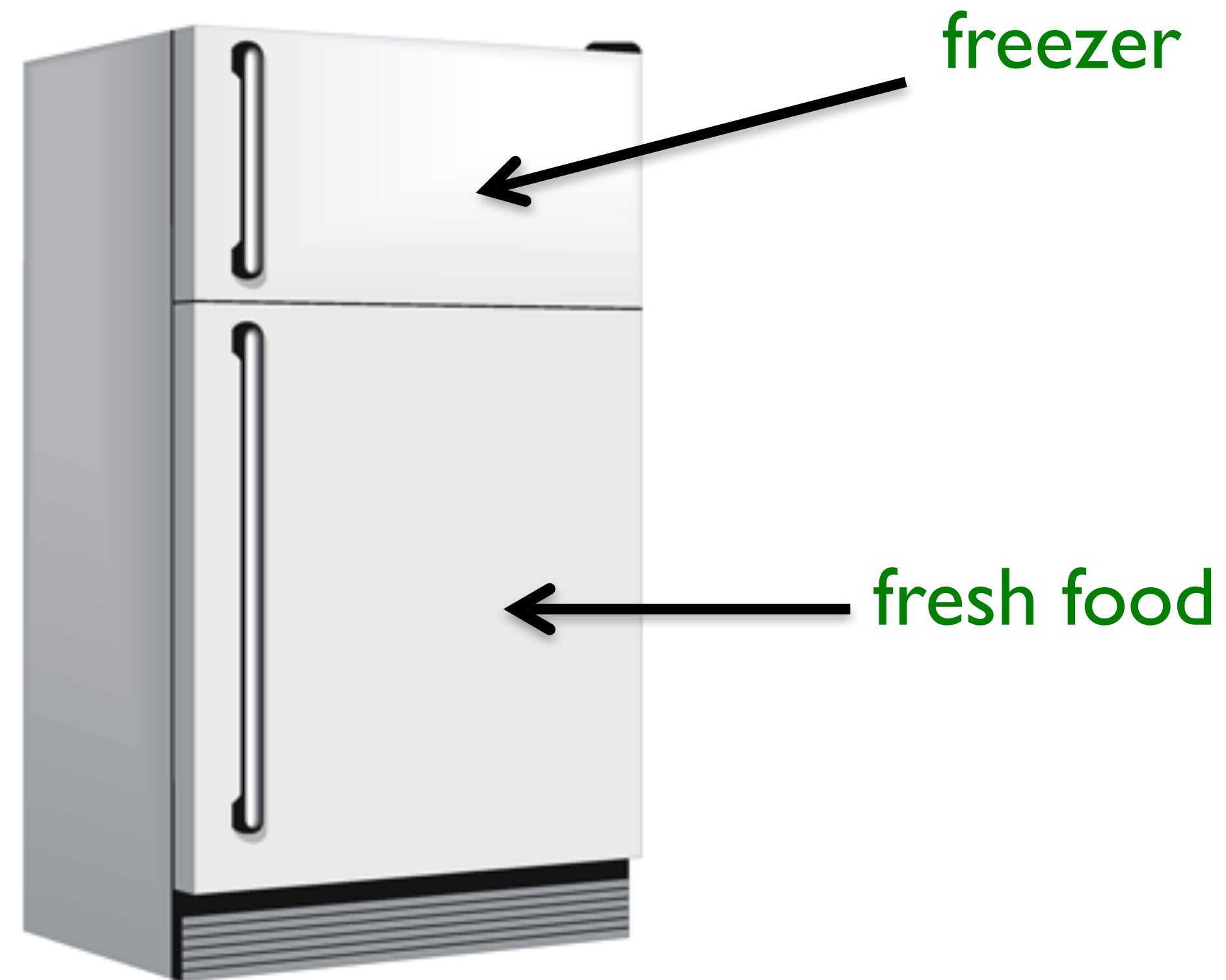
Users' understanding of how interface works

People have preconceived models

Online help / documentation useful (but shouldn't be necessary)

Interfaces Must Communicate Model

REFRIGERATOR



Problem: freezer too cold, but fresh food just right

REFRIGERATOR CONTROLS

Normal Settings	C and 4
Colder Fresh Food	C and 5-6
Coldest Fresh Food	B and 7
Colder Freezer	D and 6-7
Warmer Fresh Food	C and 3-1
OFF (both)	0

A B C D E

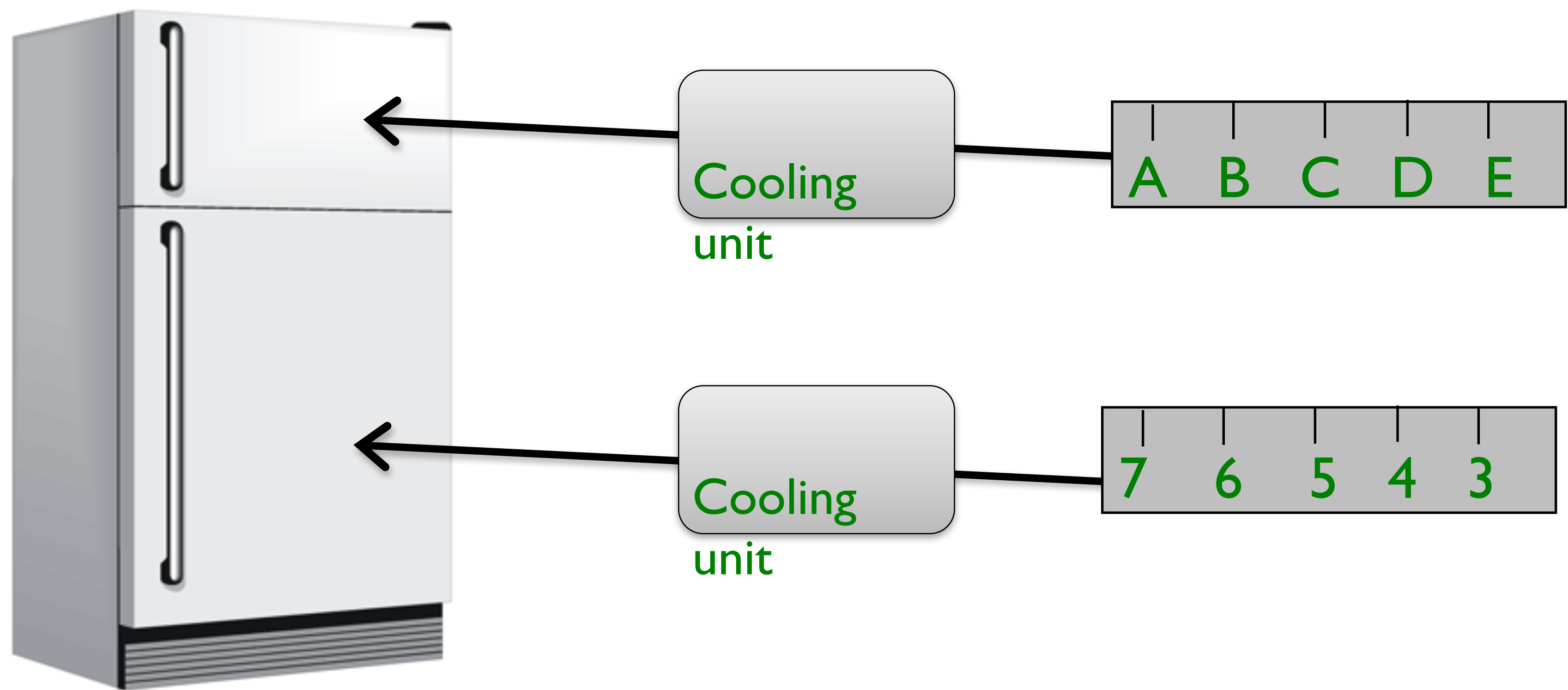
7 6 5 4 3

Freezer

Fresh Food

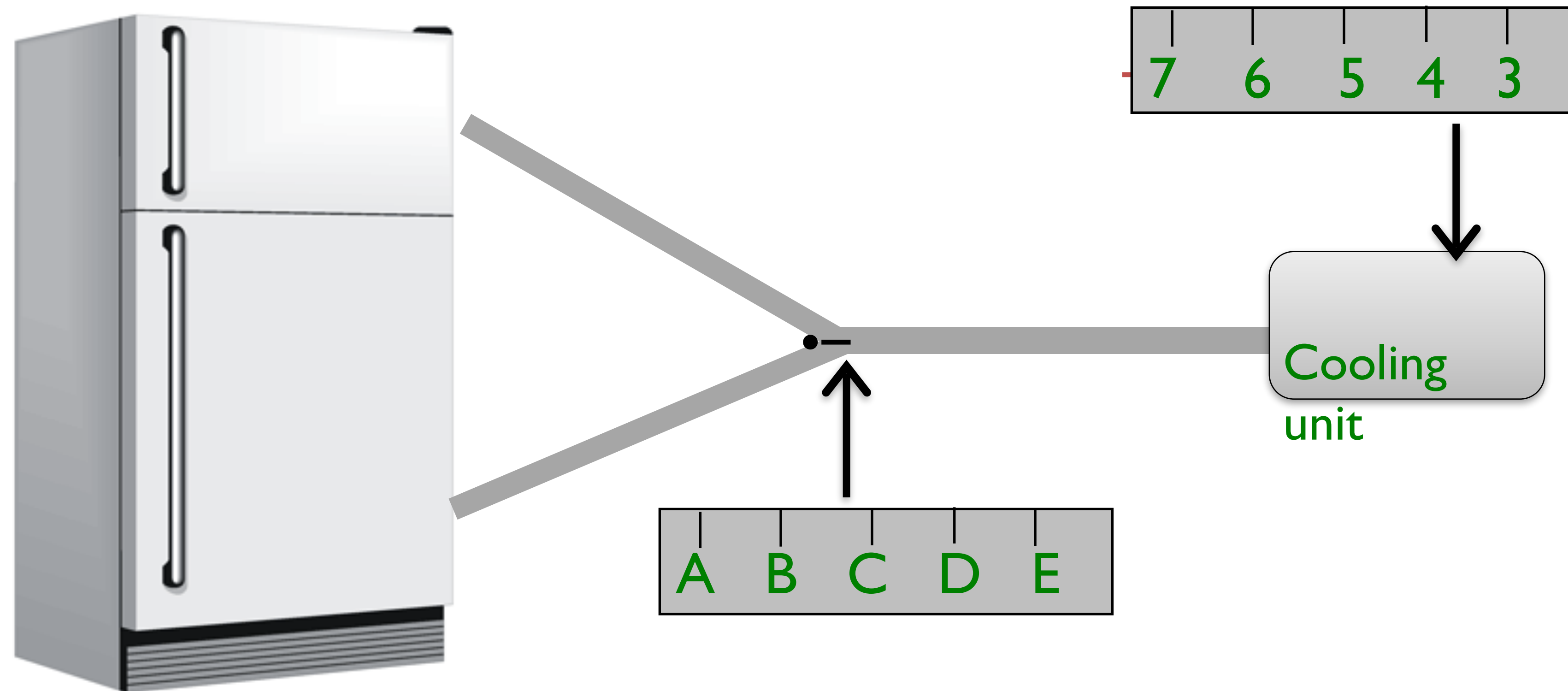
What is your conceptual model?

MOST LIKELY CONCEPTUAL MODEL



Independent controls

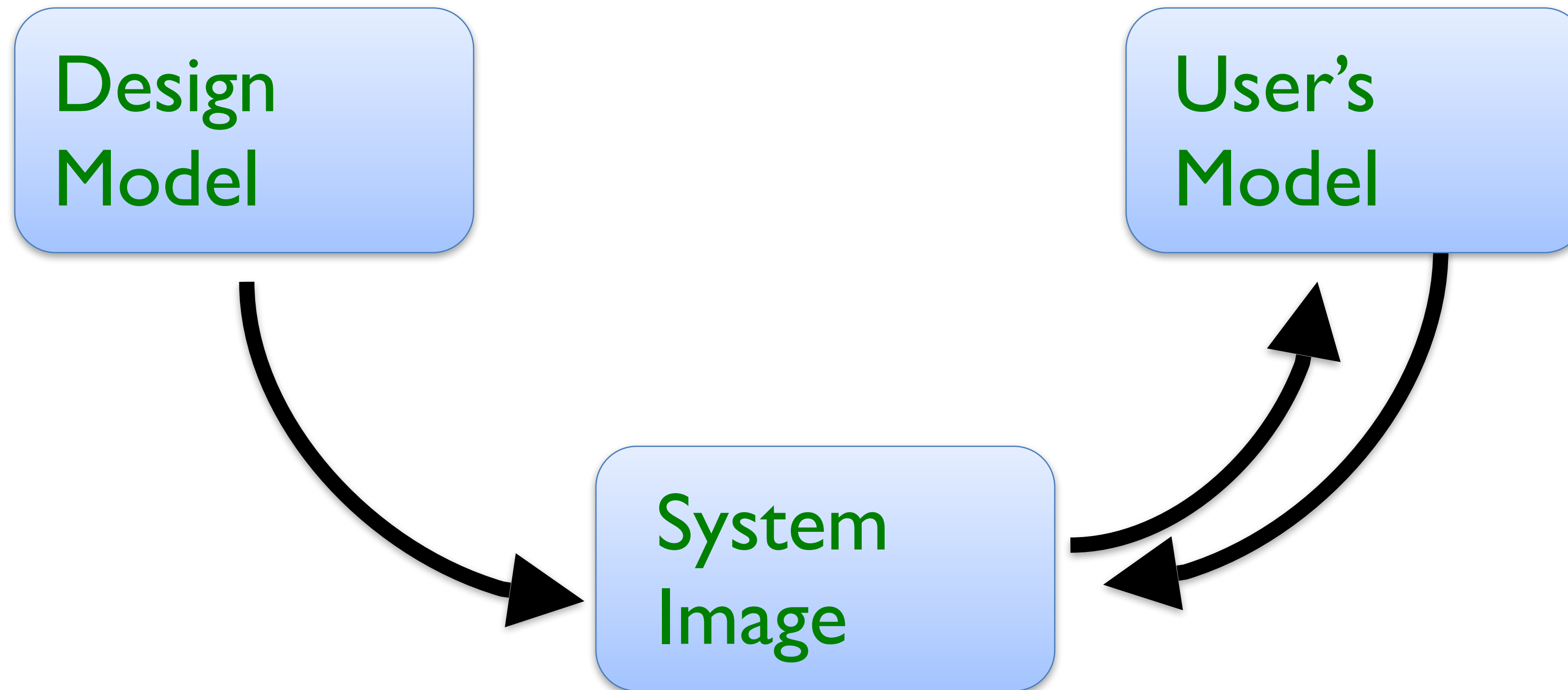
CORRECT CONCEPTUAL MODEL



Possible solutions:

- Make controls map to user's model
- Make controls map to actual system

CONCEPTUAL MODELS

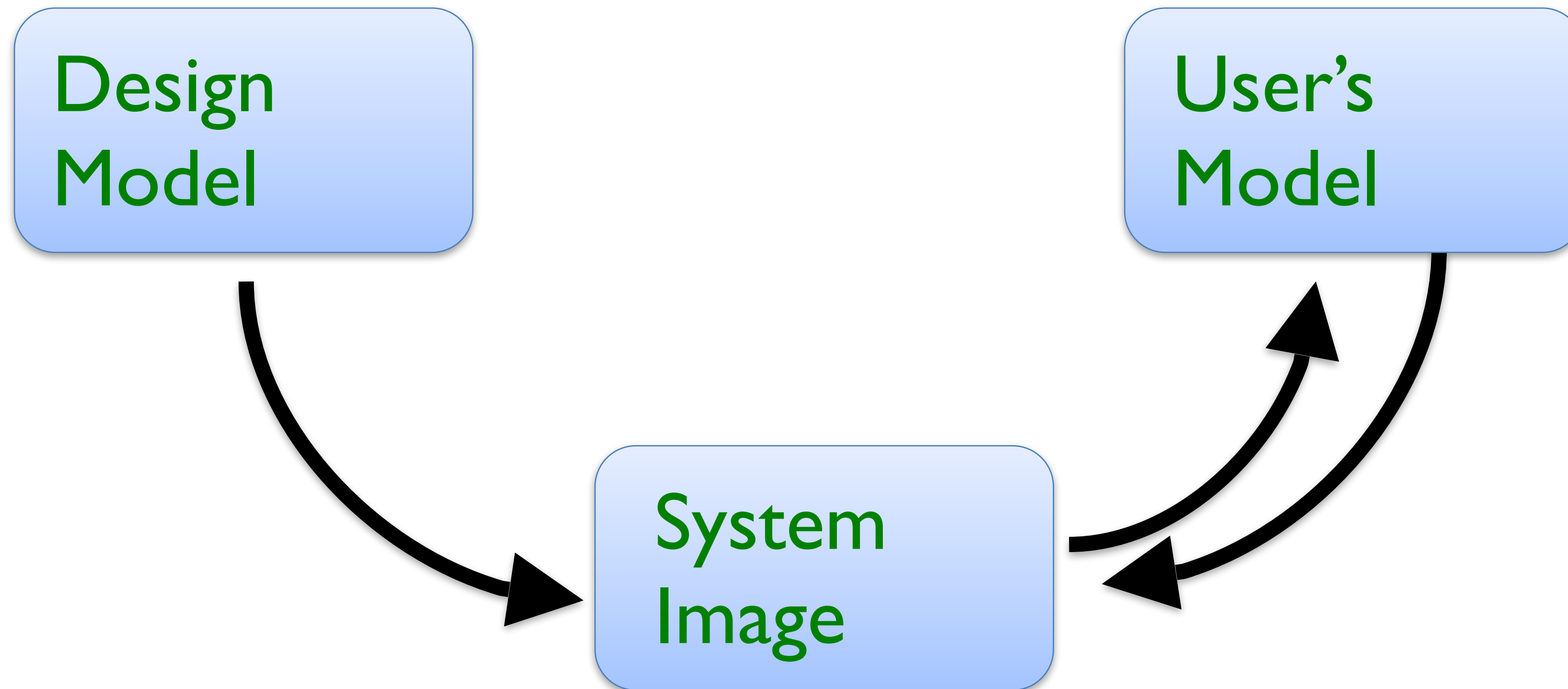


CONCEPTUAL MODELS

Designers model may not match user's model

Users get model from experience & usage

Users only work with system image, not with designer



PRECONCEIVED MODELS

People have preconceived models of how things work

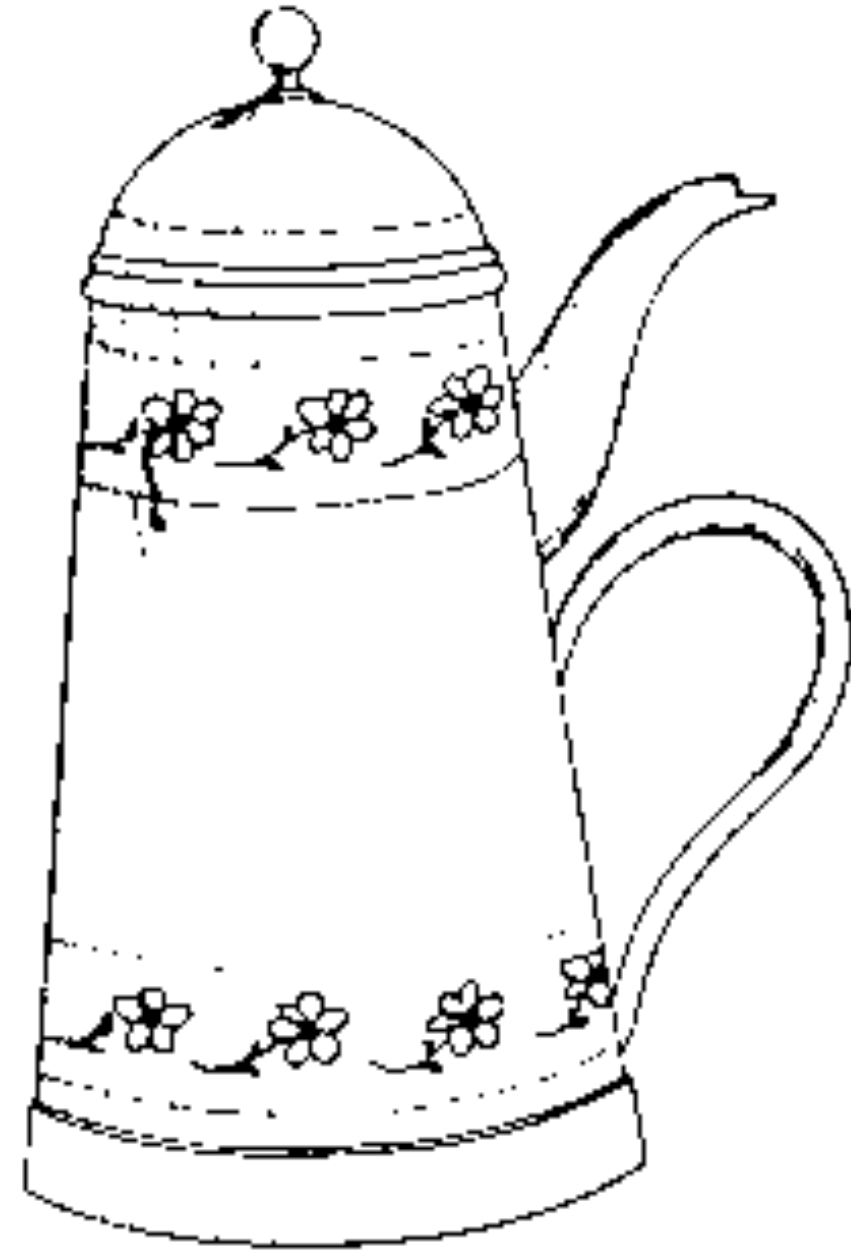
how does your car start?

how does an ATM machine work?

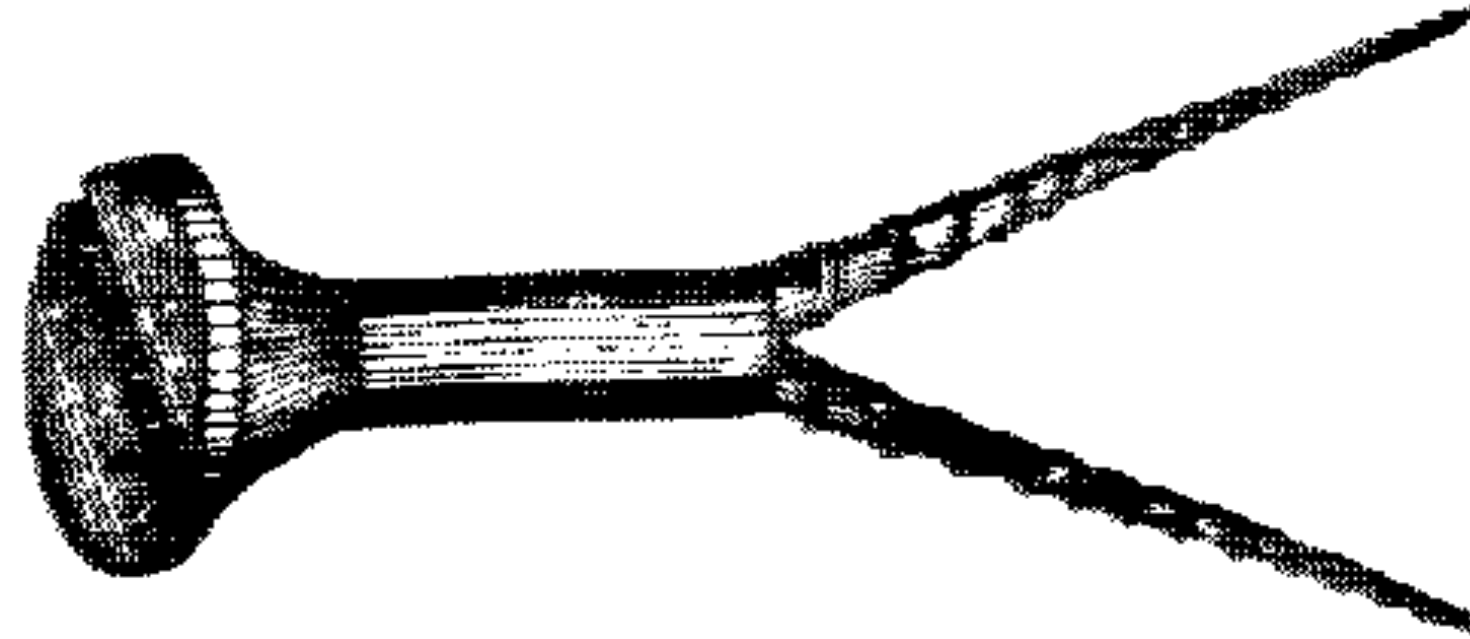
how does your computer boot?

Allow us to predict how things will work or not work

PRECONCEIVED MODELS



Teapot



Screw

PRECONCEIVED MODELS OFTEN WRONG!

Extracted from fragmentary evidence

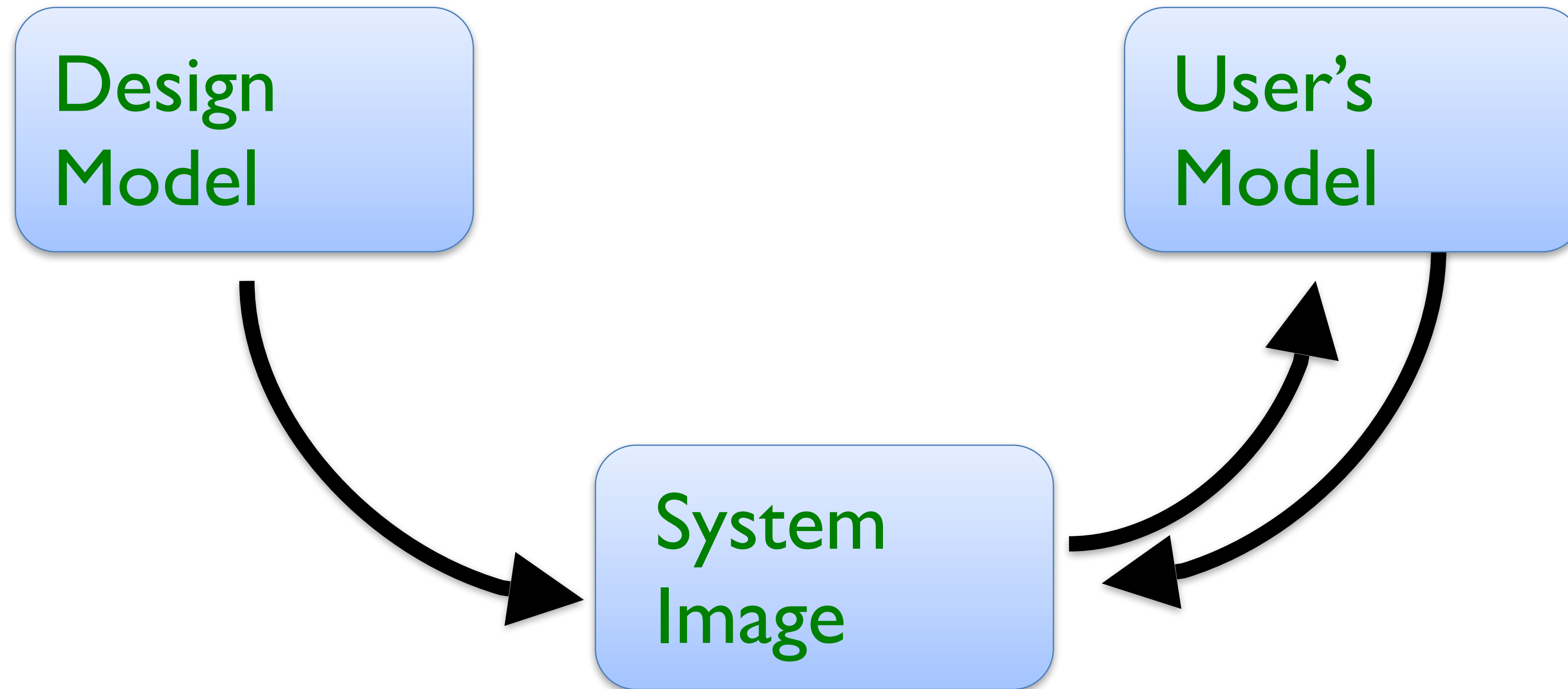
People find ways to explain things

Certain you're driving on the correct road

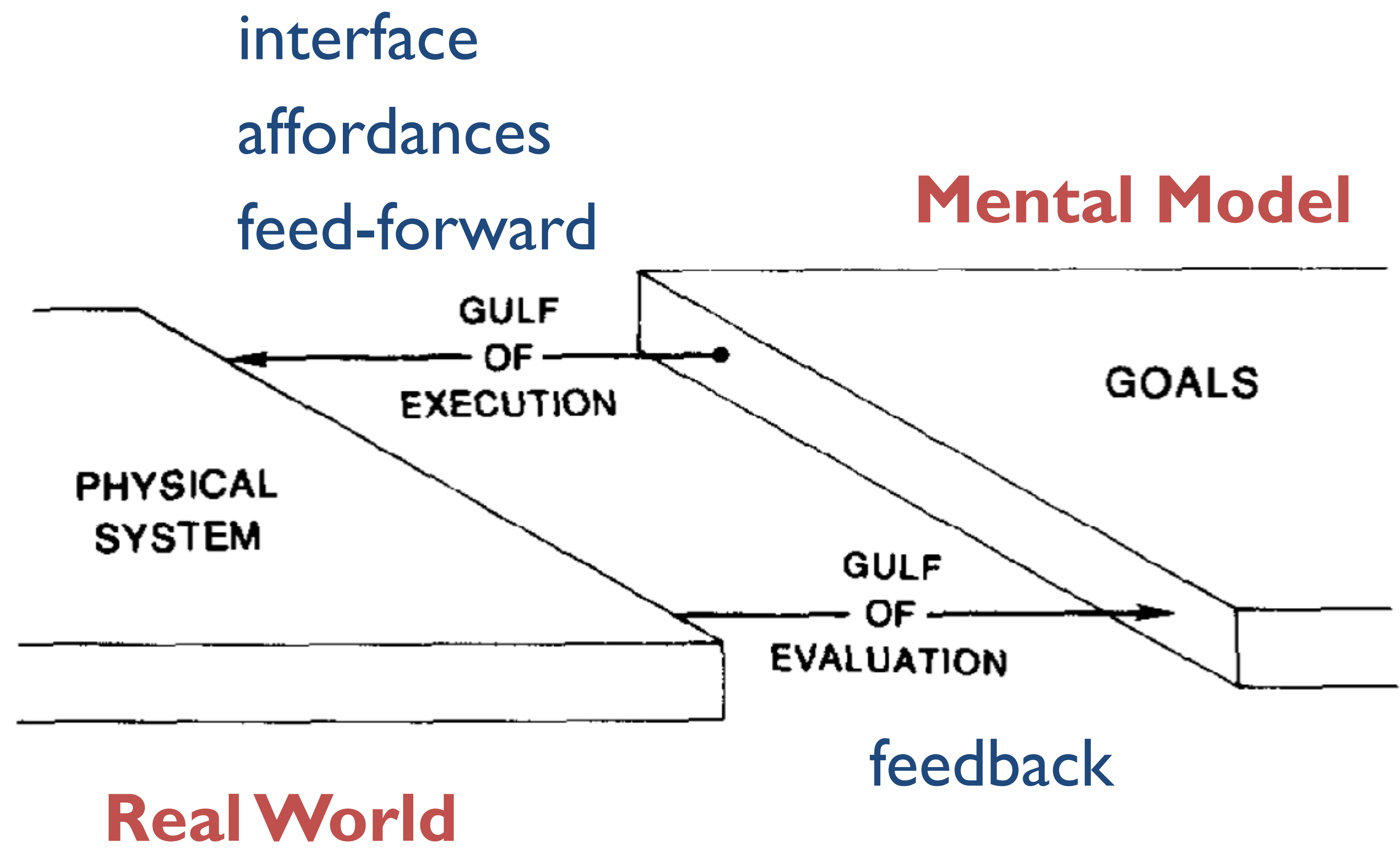


THE ACTION CYCLE

CONCEPTUAL MODELS



GULFS OF EXECUTION & EVALUATION



GULF OF EXECUTION

Real world

Gulf

Mental model:
Draw a rectangle

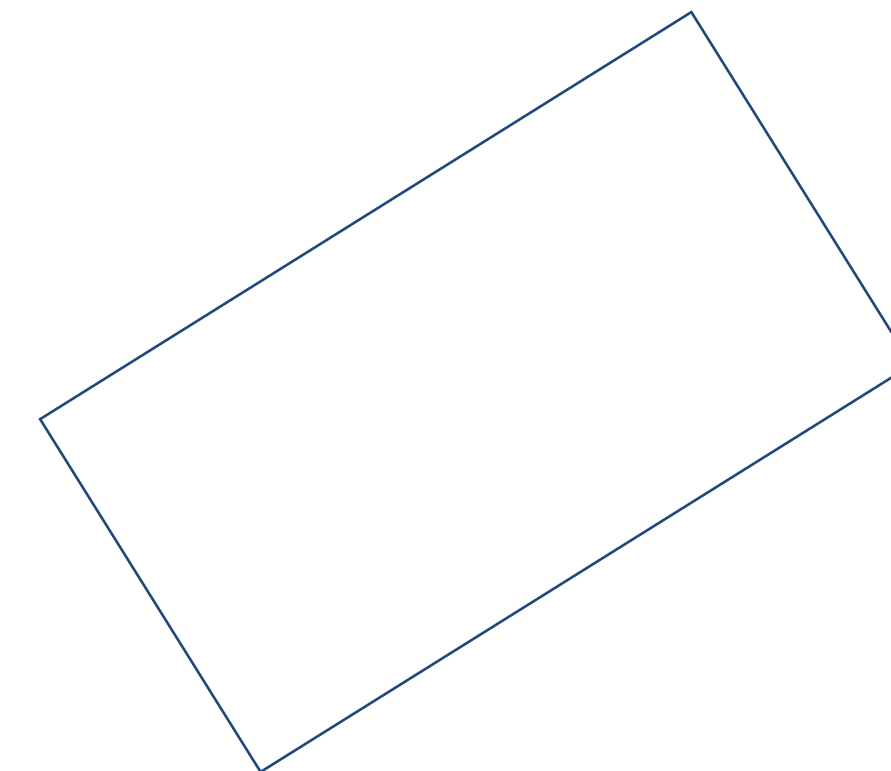


Move 90 30

Rotate 35

Pen down

...



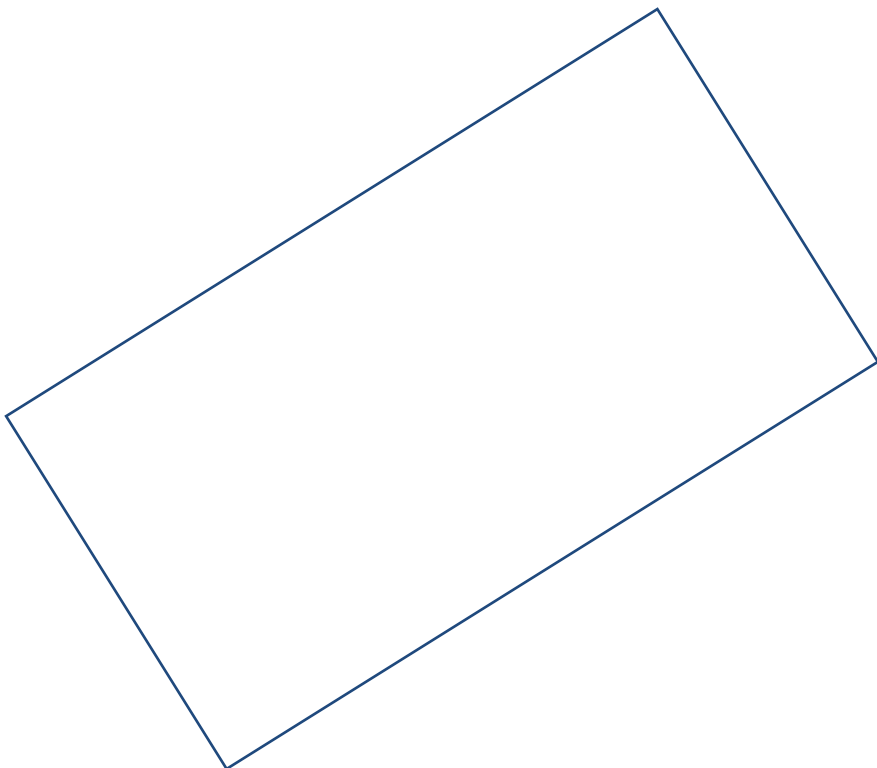
GULF OF EXECUTION

Real world

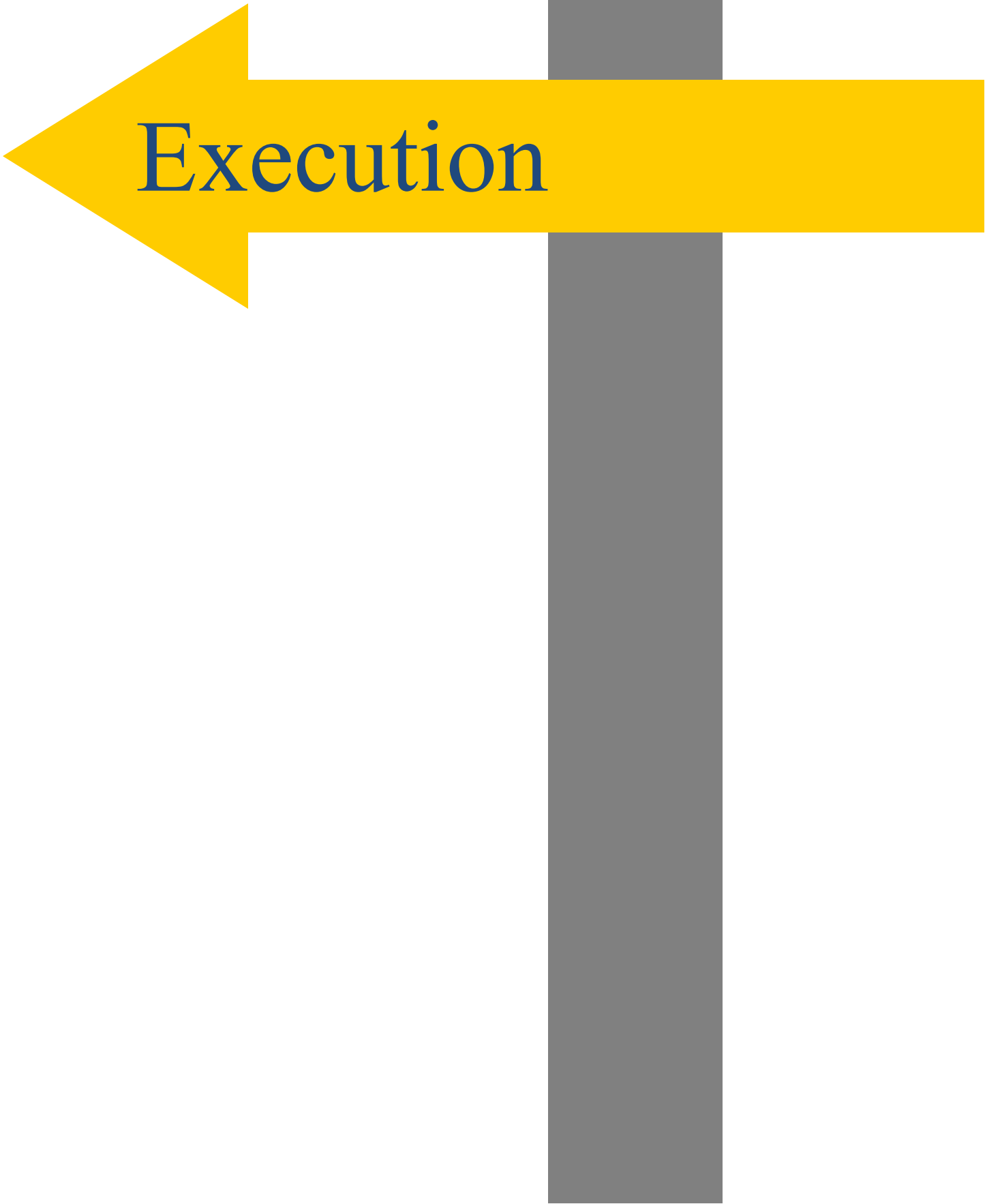
1. Draw a rectangle



2. Rotate the shape

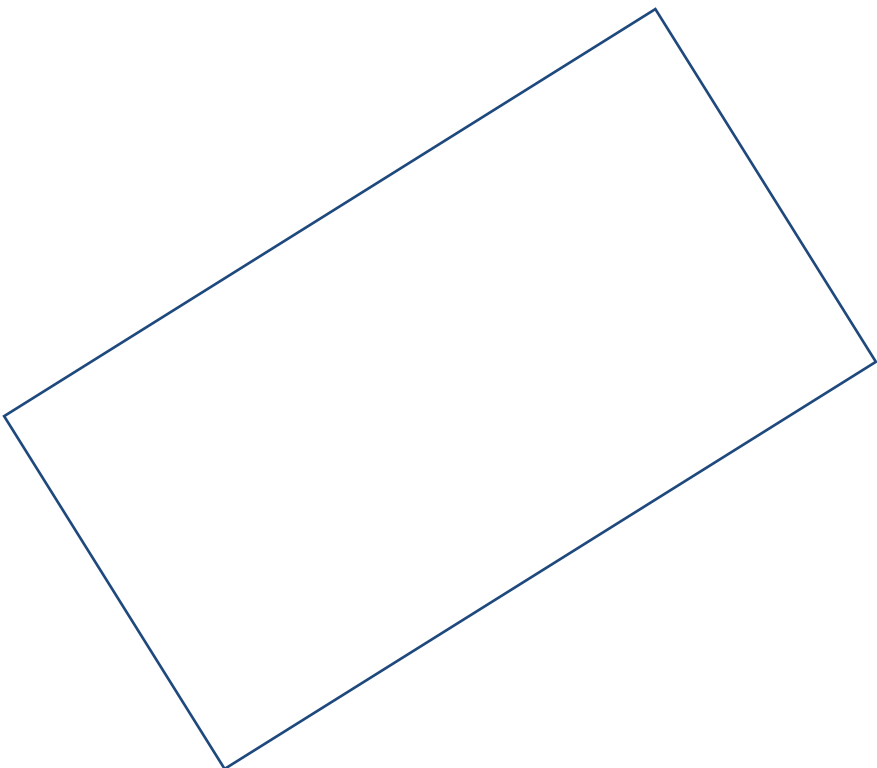


Gulf



Mental model:

Draw a rectangle



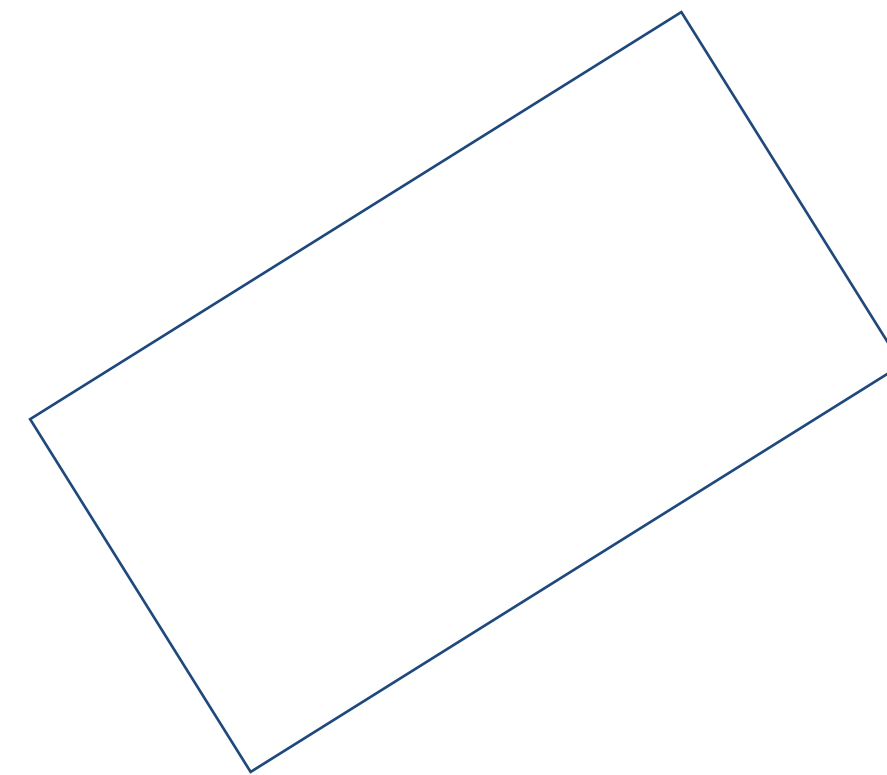
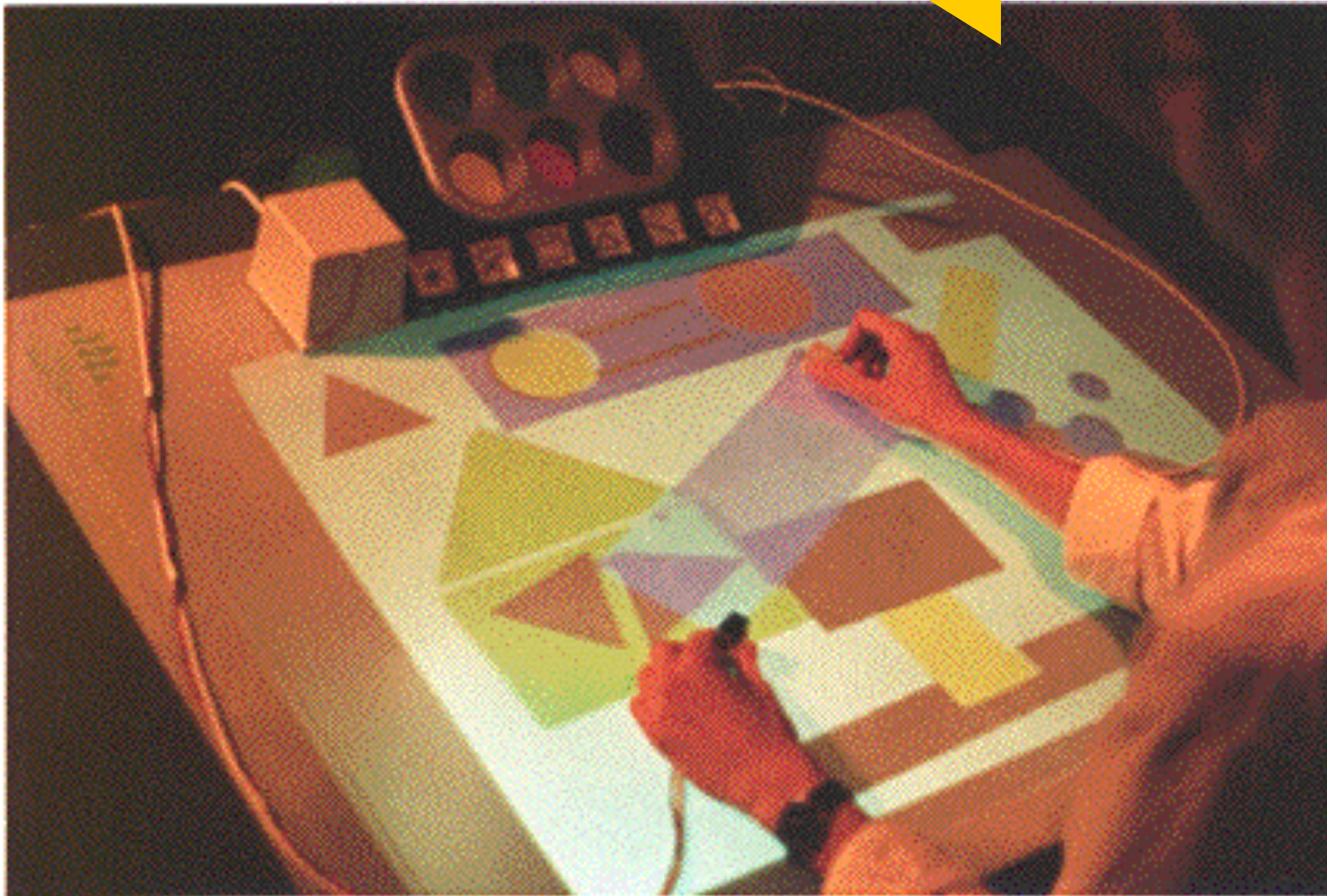
GULF OF EXECUTION

Real world

Gulf

Mental model:
Draw a rectangle

Execution



GULF OF EVALUATION

Gulf

Real world:

x	y
0.67	0.79
0.32	0.63
0.39	0.72
0.27	0.85
0.71	0.43
0.63	0.09
0.03	0.03
0.20	0.54
0.51	0.38
0.11	0.33
0.46	0.46

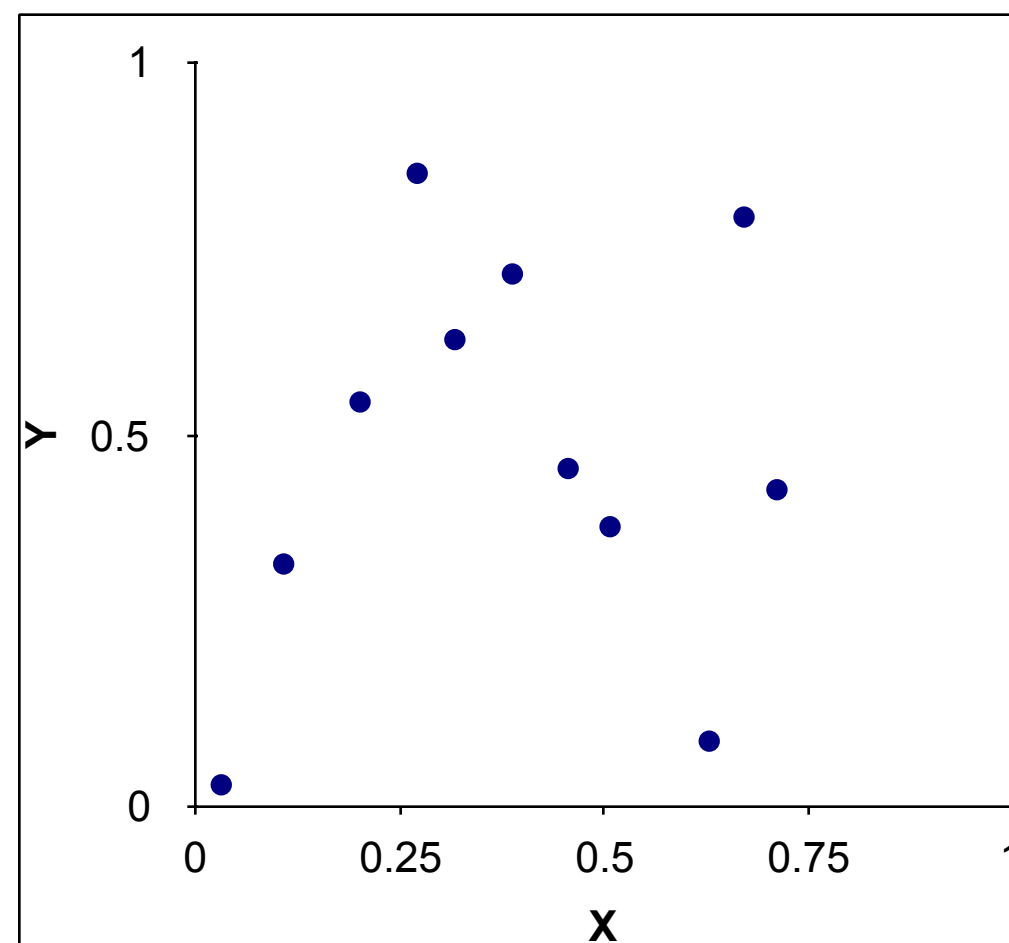
Mental model:
x,y correlated?

Evaluation

GULF OF EVALUATION

Gulf

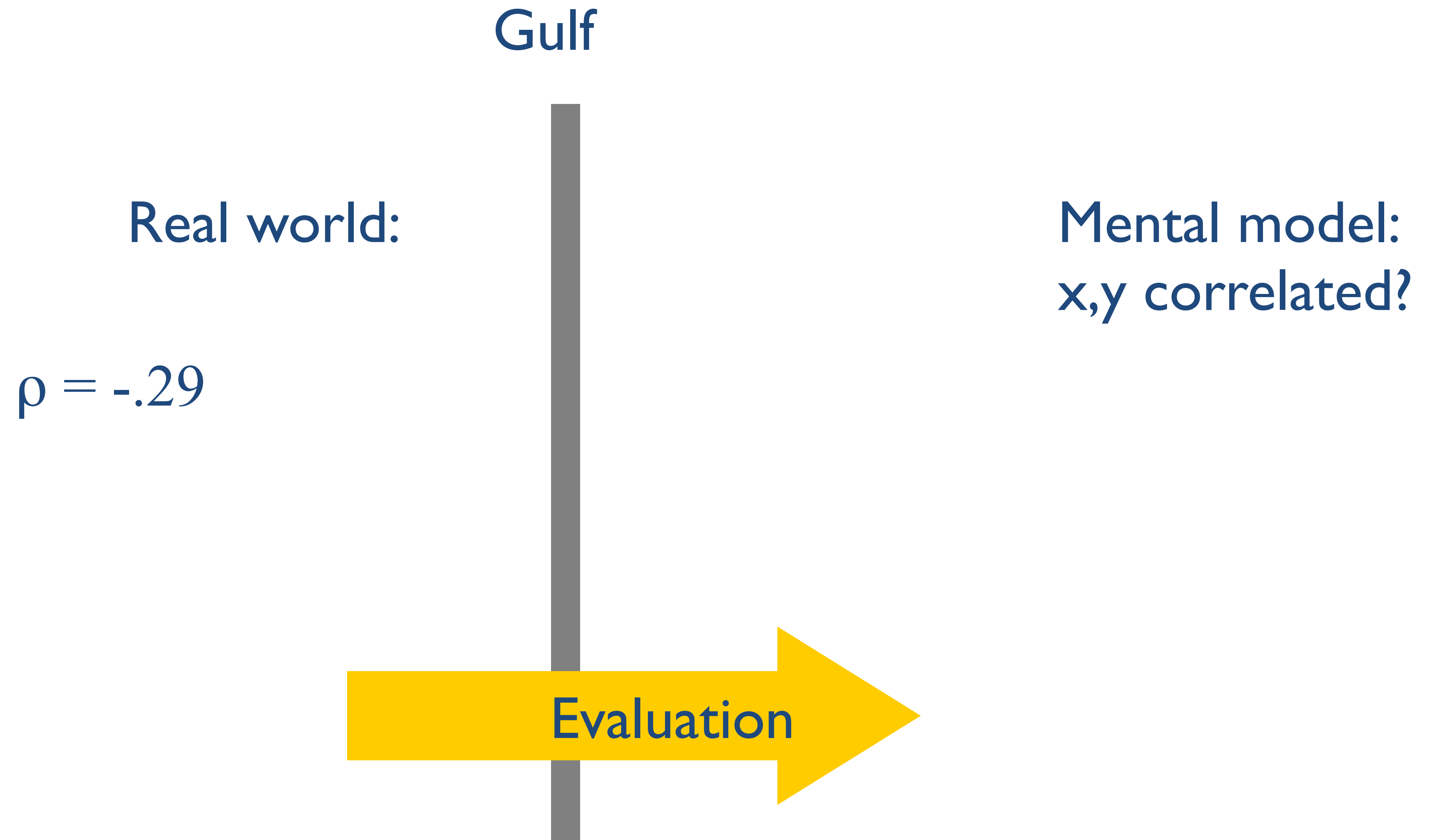
Real world:



Mental model:
x,y correlated?

Evaluation

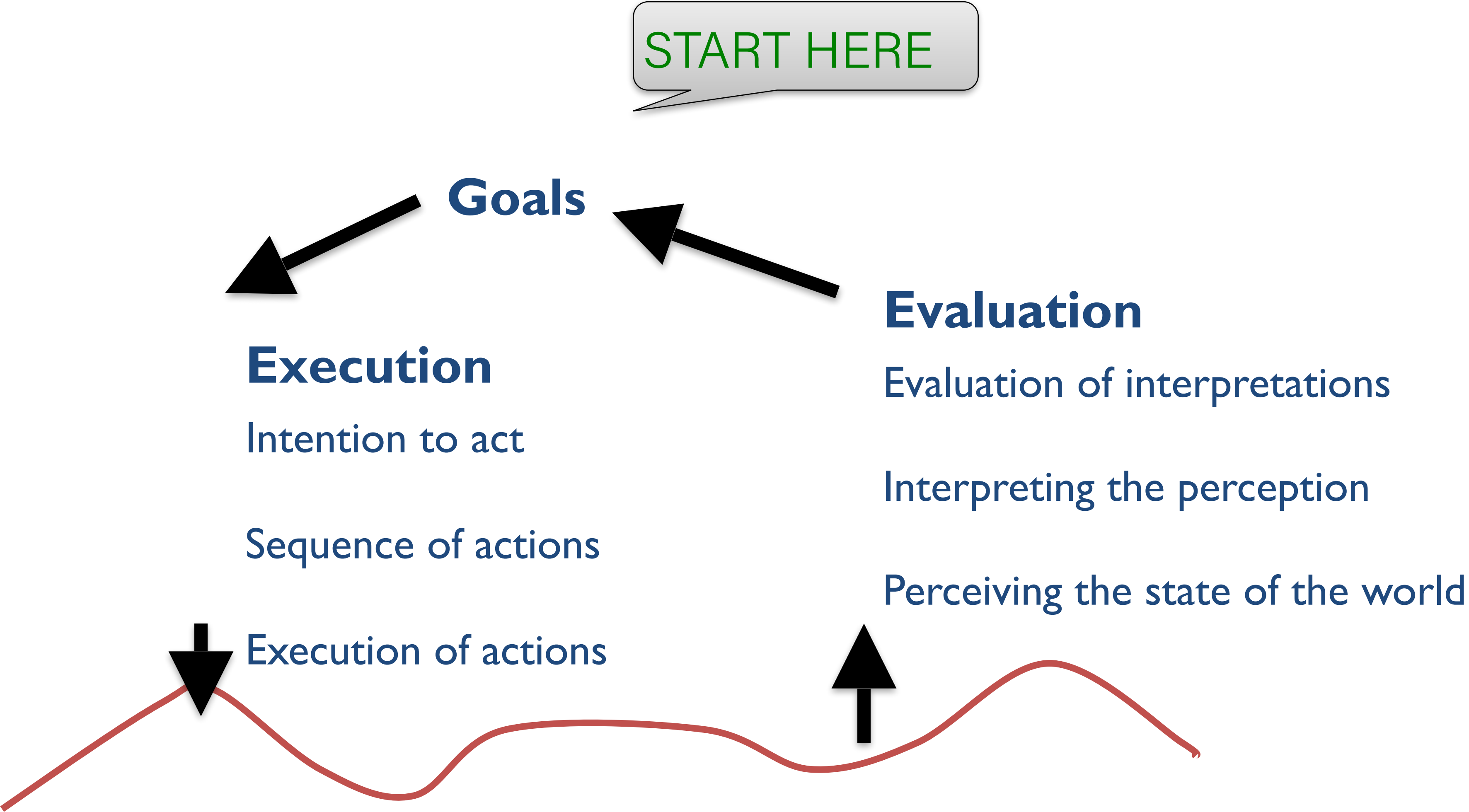
GULF OF EVALUATION

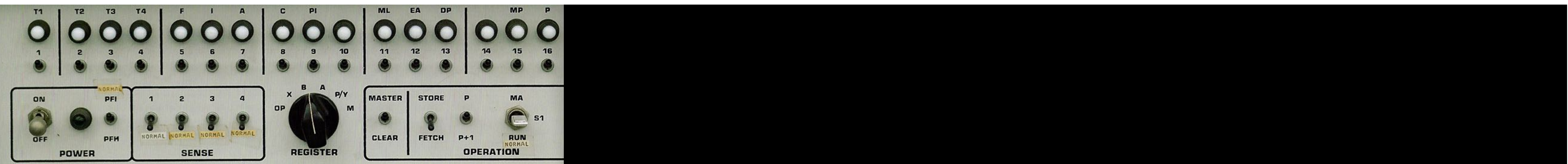


ACTION CYCLE



ACTION CYCLE





DIRECT MANIPULATION

DIRECT MANIPULATION

An interface that behaves as though the interaction was with a real-world object rather than with an abstract system

Central ideas

Visibility of the objects of interest

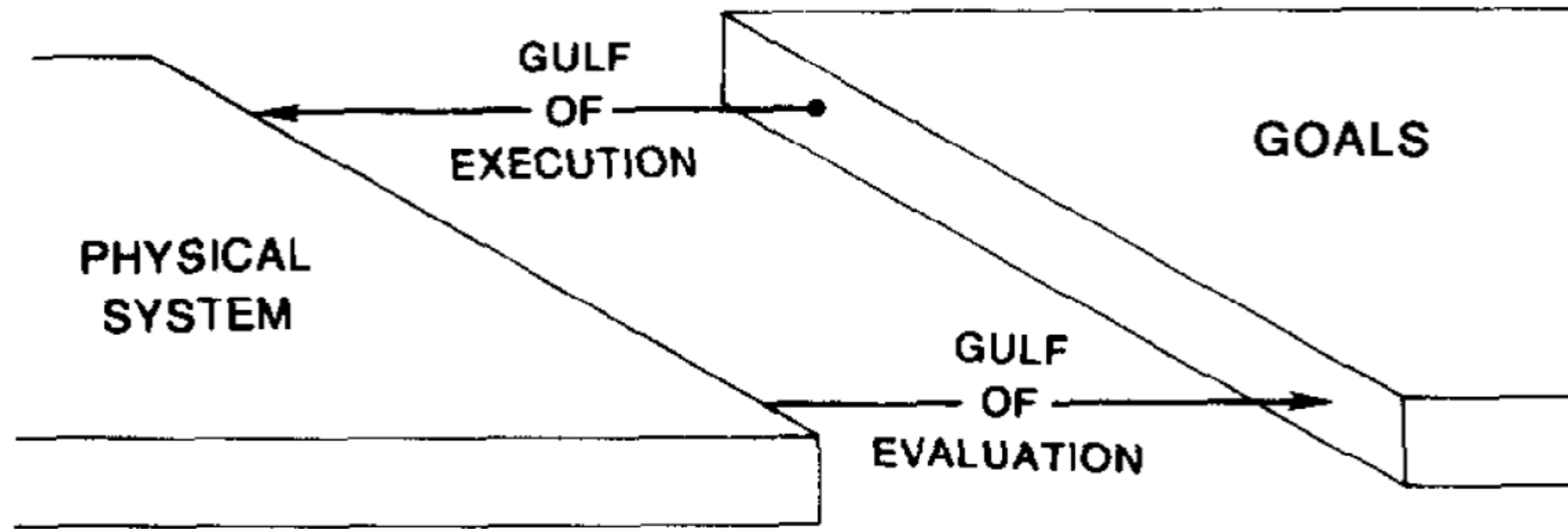
Rapid, reversible, incremental actions

Manipulation by pointing and moving

Immediate and continuous display of results

REDUCE DISTANCE

Decrease gulfs



KEY POINTS

Direct Engagement

The feeling of working directly on the task

Direct Manipulation

An interface that behaves as though the interaction was with a real-world object rather than with an abstract system

Central ideas

Visibility of the objects of interest

Rapid, reversible, incremental actions

Manipulation by pointing and moving

Immediate and continuous display of results

Almost always based on a metaphor

Mapped onto some facet of the real world task semantics

THE METAPHOR

Computer objects as visible, moveable objects

Consequences

Items represented as icons

Items can be “picked up” and “moved” on a surface

Items can be “thrown out”

Items can be “copied”

Do we really want to have to drag them to a photocopier?

How much is too much?

VISUAL REPRESENTATION

To manipulate an object it must be visible

September 2018						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
26	27	28	29	30	31	Sep 1
Molly out of t... Help Jill Mov...	Kids Start Sc... • CS160 4 more...	Kevin in Boston • Onboarding b... 15 more...	• CS160 10 more...	• Eric Lab Rese... 4 more...	• Argo orthodo... 3 more...	• Jill studio
2	3	4	5	6	7	8
Kevin in Bost...	• SCULPT Full... • CHI Reading...	• Camille • Invention Lab... 10 more...	• CITRIS Leade... • CS160 11 more...	• Leave for Air... • Critical Practi... 6 more...	Eric in OC to visit Mom Visit Mom SoCal	2 more...
9	10	11	12	13	14	15
Eric in OC to visit Mom Visit Mom So... • Workshop @...	• SCULPT Full... 9 more...	• Barnaby nails... • Invention Lab 5 more...	Drop Deadline Christie bday! 9 more...	Scott Carter... Darlene Robe... 12 more...	• Youtong • Lunch Meetin... 4 more...	• SCULPT Full... • Cal Football v...
16	17	18	19	20	21	22
Paxton Haircut • SCULPT Full... • Workshop @...	King Picture... IMWUT Revi... 7 more...	• Yali + Lab eve... • Yali's Grand... 8 more...	• CS160 • Hybrid Ecolo... 4 more...	• Eric Lab Rese... • Eric Lab Rese... 3 more...	• Miracullum fa... • CHI Deadline... 3 more...	• jill and eric pa...
23	24	25	26	27	28	29
Jill's bday • Workshop @... • Meet Jimmy f...	• CS160 • EECS Faculty... • Field Notes -...	NSF Due to... Jill Miller's 35... 5 more...	• CS160 • Vedant prese... 7 more...	• Eric Lab Rese... • Eric Lab Rese... 4 more...	• Art Faculty M... • Eric Dentist • Niloufar Sale...	• Trackers (Pax...
30	Oct 1	2	3	4	5	6
Google Facul... • Workshop @... • Post-CHI visit...	• CS160 • EECS Faculty... 6 more...	Molly out of town (Missouri) NSF Medium... 7 more...	TEI Reviews... 7 more...	• Eric Lab Rese... 5 more...	• Highlights Yol... • Shankar + Cl...	Fleet week b...

September 17, 2018

Monday

all-day	King Picture Day	
	IMWUT Reviews Due	
10 AM		
11 AM	10:30 AM CS160	
Noon	12 PM EECS Faculty Lunch	12 PM Welcome lunch for Robe...
1 PM	1 PM BCNM	
2 PM		
3 PM	2:30 PM CHI Paper	2:30 PM HeeSoo
4 PM	4 PM Field Notes	
5 PM	5 PM Janet L? (King)	
6 PM		
7 PM		
8 PM		
9 PM	8:15 PM Meet Bradley Smith	

ISSUES

Some Disadvantages

Repetitive operations (may still be best via script)

Tasks that require high accuracy (positioning)

Ill-suited for abstract operations

- Spell-checker?

- Search database by scrolling or by query?

- May desire to trade off directness for generality

Solution: Combine direct manipulation & abstractions

Word processor:

- WYSIWYG document (direct manipulation)

- Buttons, menus, dialog boxes (abstractions, but direct manipulation "in the small")

If we only restrict ourselves to direct manipulation we miss the most exciting potential of new technology – to enable new ways to think and interact

SUMMARY

Conceptual model is the user's mental model of how the interface works

Perceived affordances help users form this model

Designers must provide clues in system to make conceptual model clear

- Make controls visible

- Make sure mapping is clear

- Provide feedback

Gulfs of Execution and Evaluation

Action cycle involves bridging gulfs between user & system

If we only restrict ourselves to direct manipulation we miss the most exciting potential of new technology – to enable new ways to think and interact



DESIGN PRINCIPLES

1. MAKE CONTROLS VISIBLE



POOR VISIBILITY (BMW'S IDRIVE)





How do you put someone on hold?



How do you set the alarm?





ON/OFF



MP3
CD CHANGER COMPATIBLE





TOO MUCH VISIBILITY?

6 remote controls for “modest” home theater



2. MAKE SURE MAPPING IS CLEAR

Mapping: Relationship between controls and their result

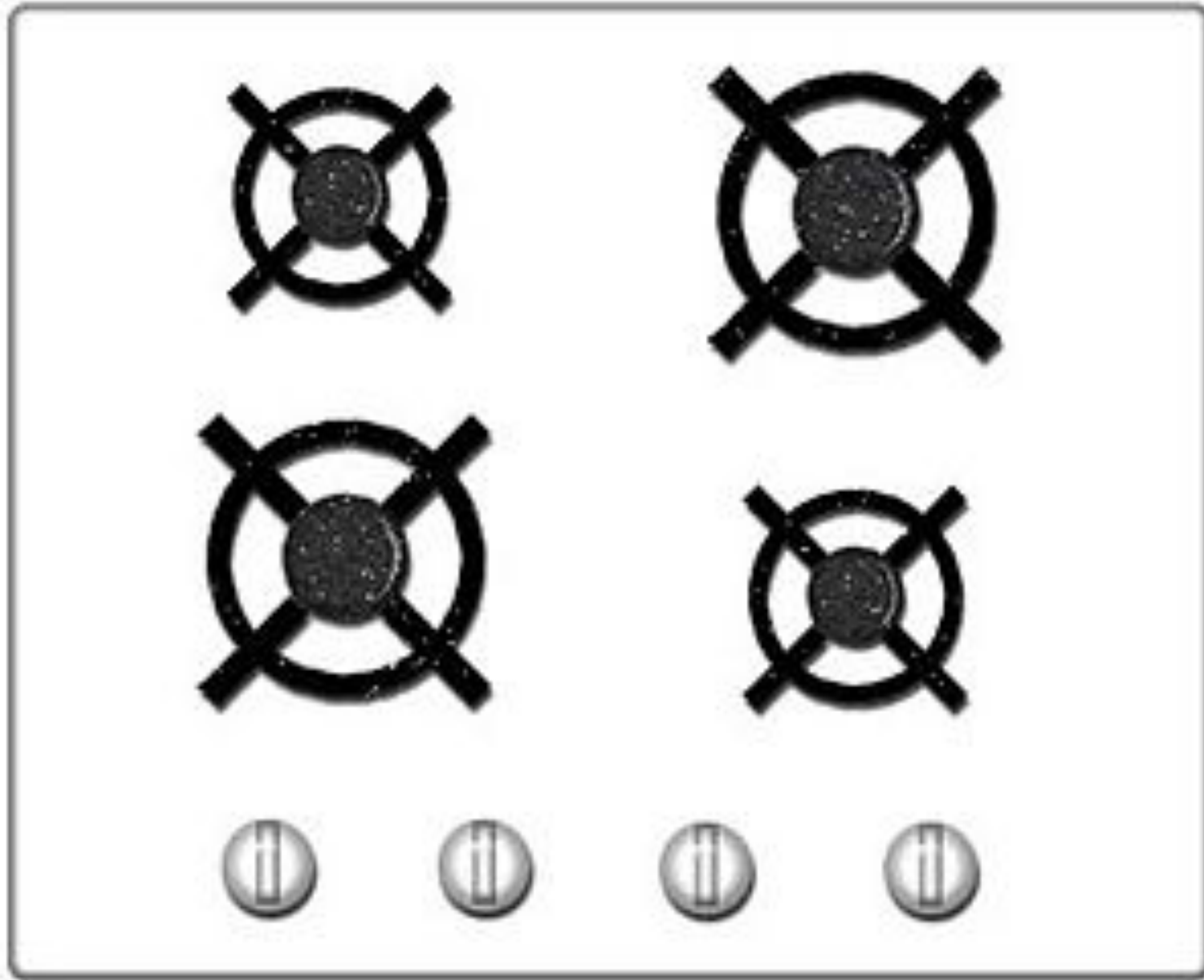




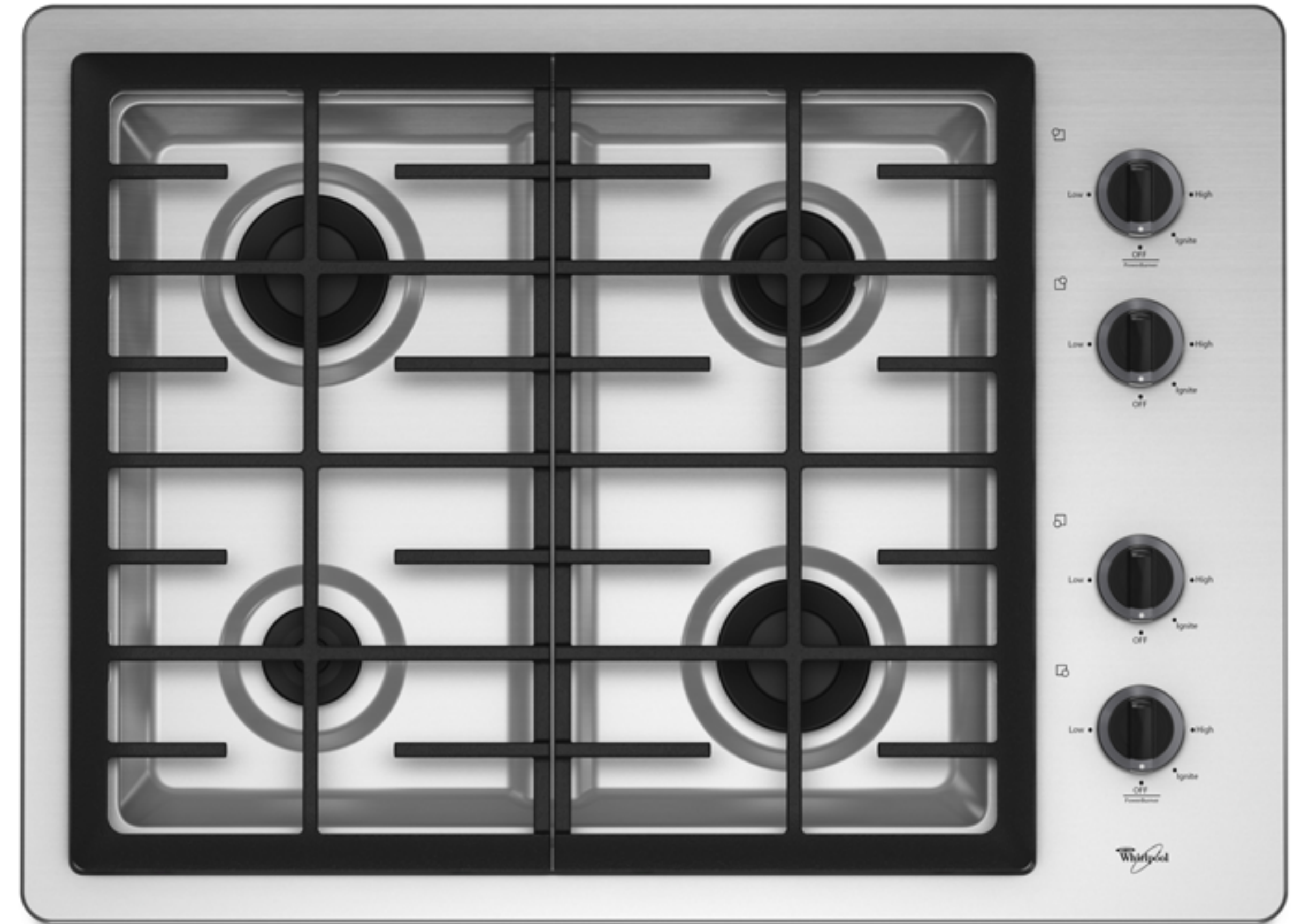
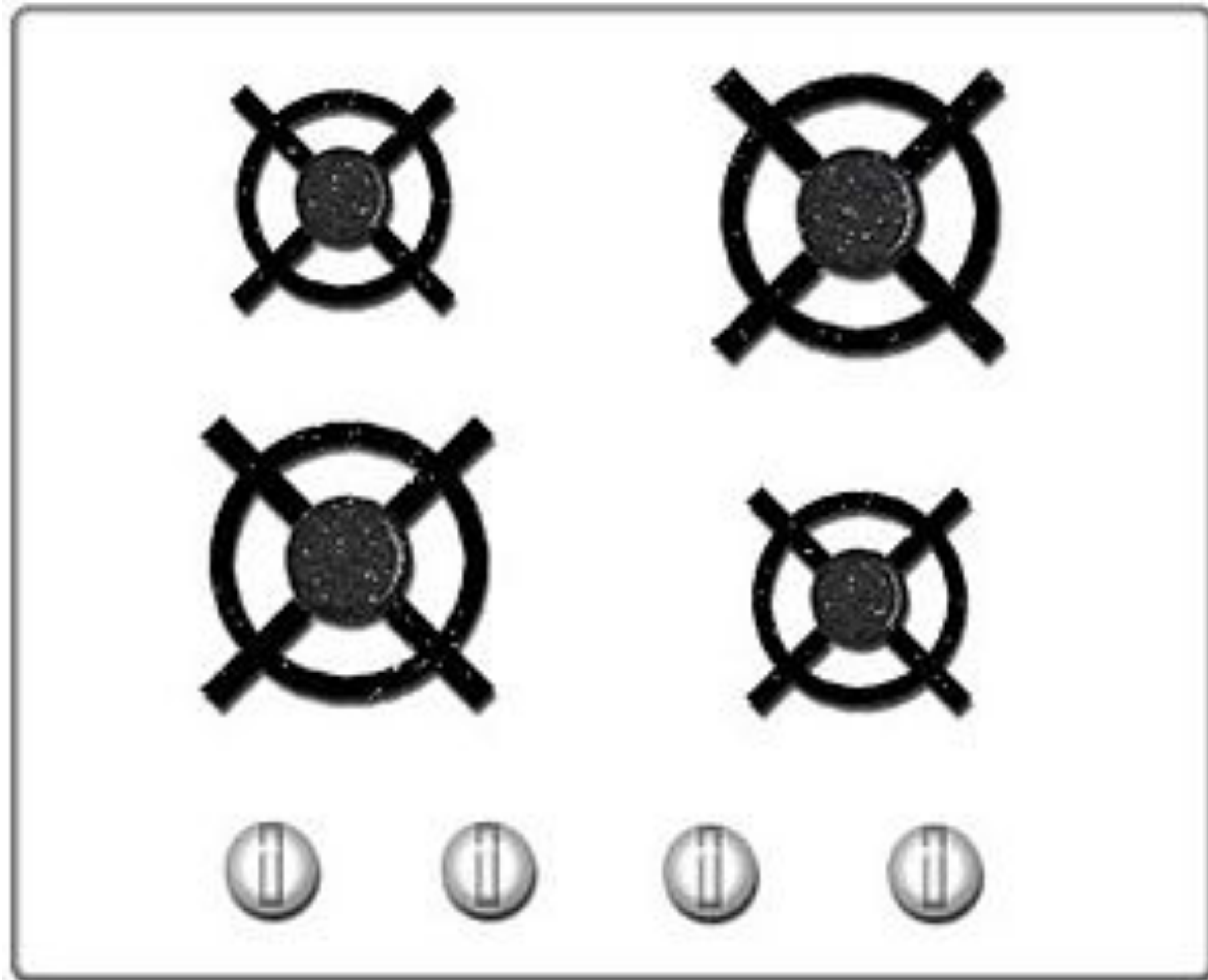


Which way will the sound be moved when you turn this knob?

STOVETOP CONTROLS



STOVETOP CONTROLS



Whirlpool®

30-inch Gas Cooktop with two 12,500 BTU Power™ Burners

Model #: W5CG3024XS

STOVETOP CONTROLS



Products Owners Every day, care.®



Contact Us Chat Account



Whirlpool Brand U.S.A. | Kitchen Appliances | Cooking Appliances | Cooktops | 4 Burner Cooktops | W5CG3024XS



30-inch Gas Cooktop with two 12,500 BTU Power™ Burners

★★★★★ 4.5 (159) [Write a review](#)

Color: Stainless Steel - W5CG3024XS

MSRP

\$649.00

- 30" Porcelain-on-Steel Cooktop
- Right Front: 12,500 BTU Power™ Burner ⓘ
- Left Rear: 12,500 BTU Power™ Burner ⓘ

Where to Buy

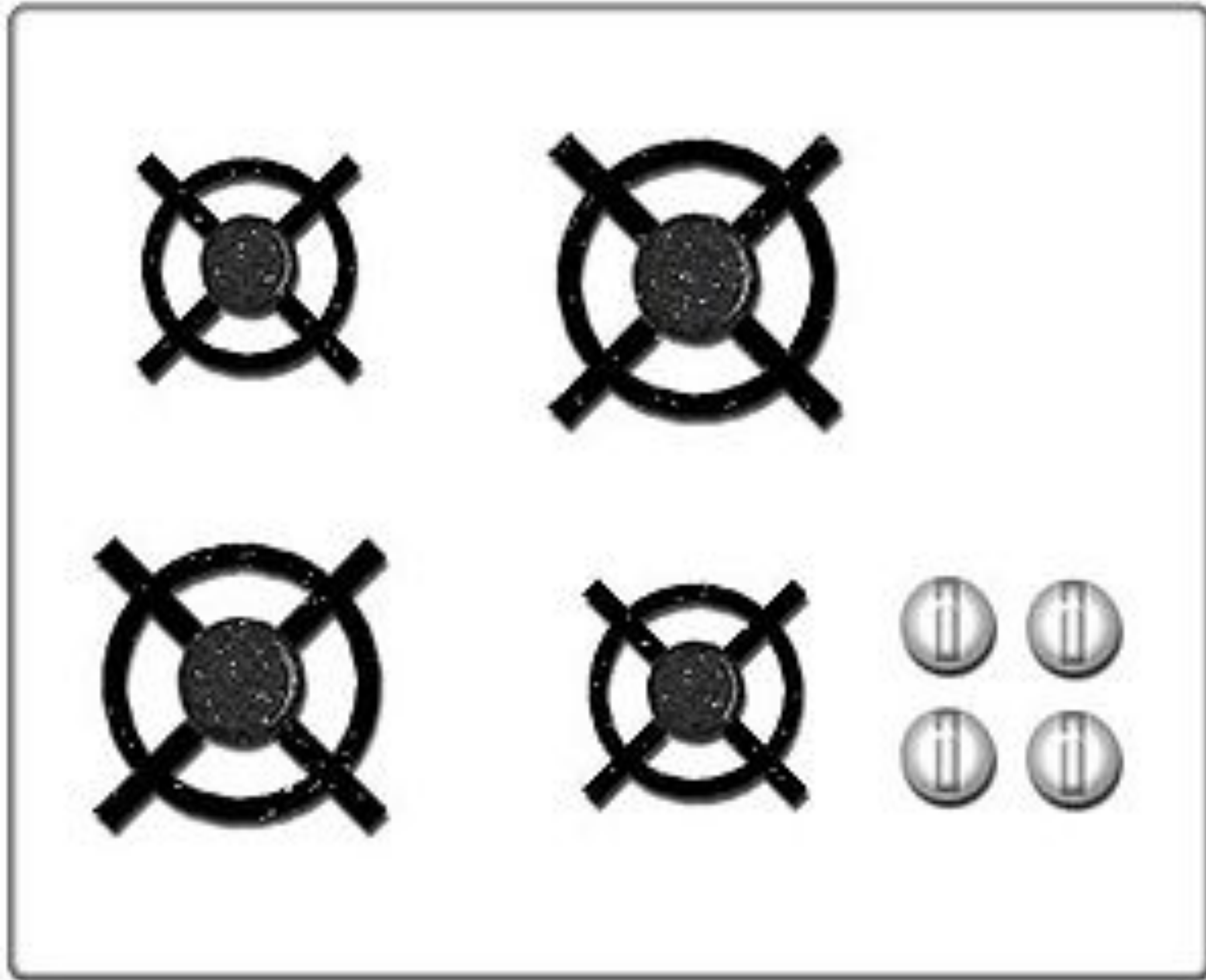
Sign in to Save

Compare

Share

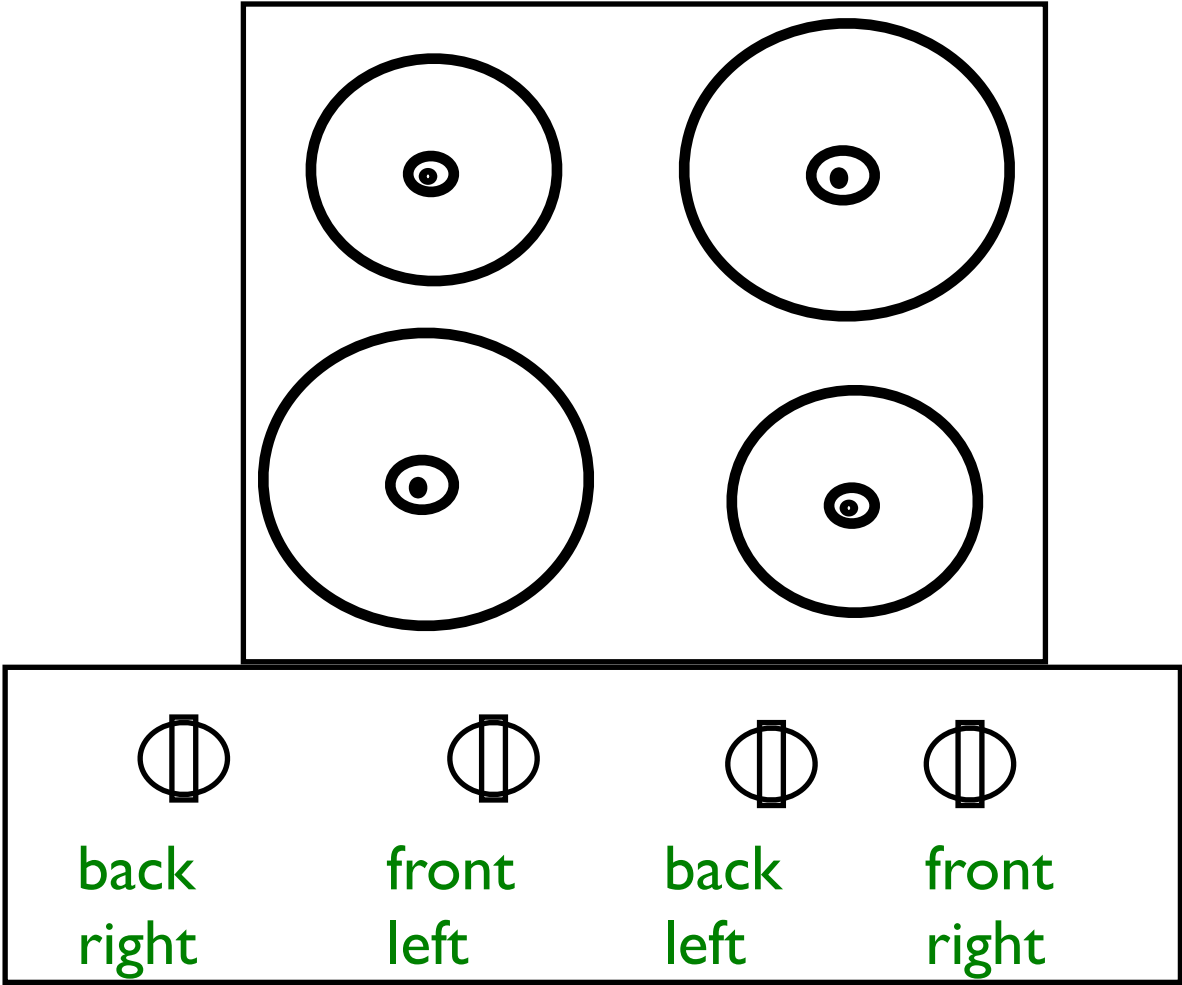
Print

STOVETOP CONTROLS



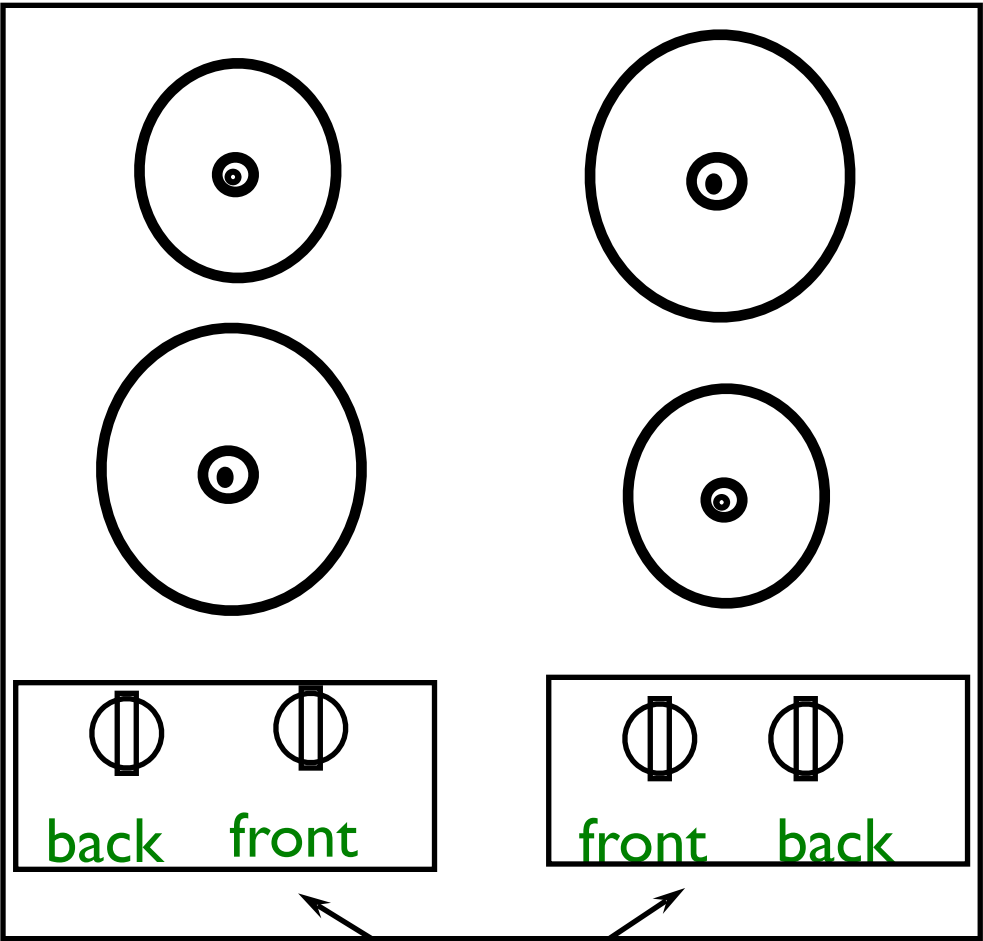
STOVETOP CONTROLS

arbitrary



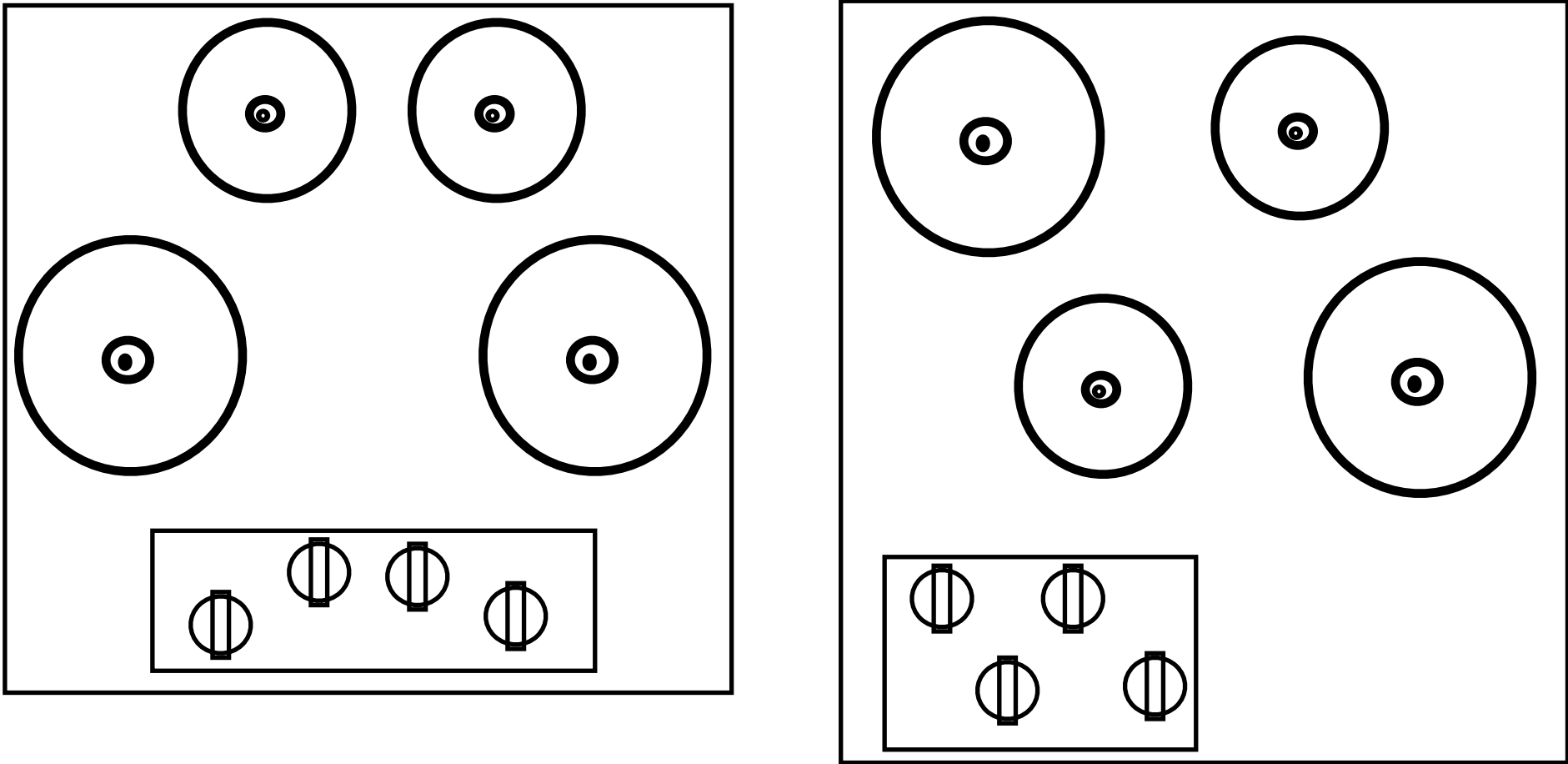
24 possibilities, requires:
visible labels
memory

paired



2 possibilities per side
=4 total possibilities

full mapping



MAPPING

Re-sort results by:

Date Placed

--Select--

Sort

Photo		Price
	☐ Add To Saved Auto	Call For Price
1931 FORD MODEL A, Stock # 4588 - Chromed out small block, 350		
Chew V-8 2 speed powerslide transmission 9 inch rear (201) 259.5955		

MAPPING

Re-sort results by:

Date Placed

--Select--

Sort

Photo		Price
	☐ Add To Saved Auto	Call For Price
1931 FORD MODEL A, Stock # 4588 - Chromed out small block, 350		
Chew V-8 2 speed powerslide transmission 9 inch rear (201) 259.5955		

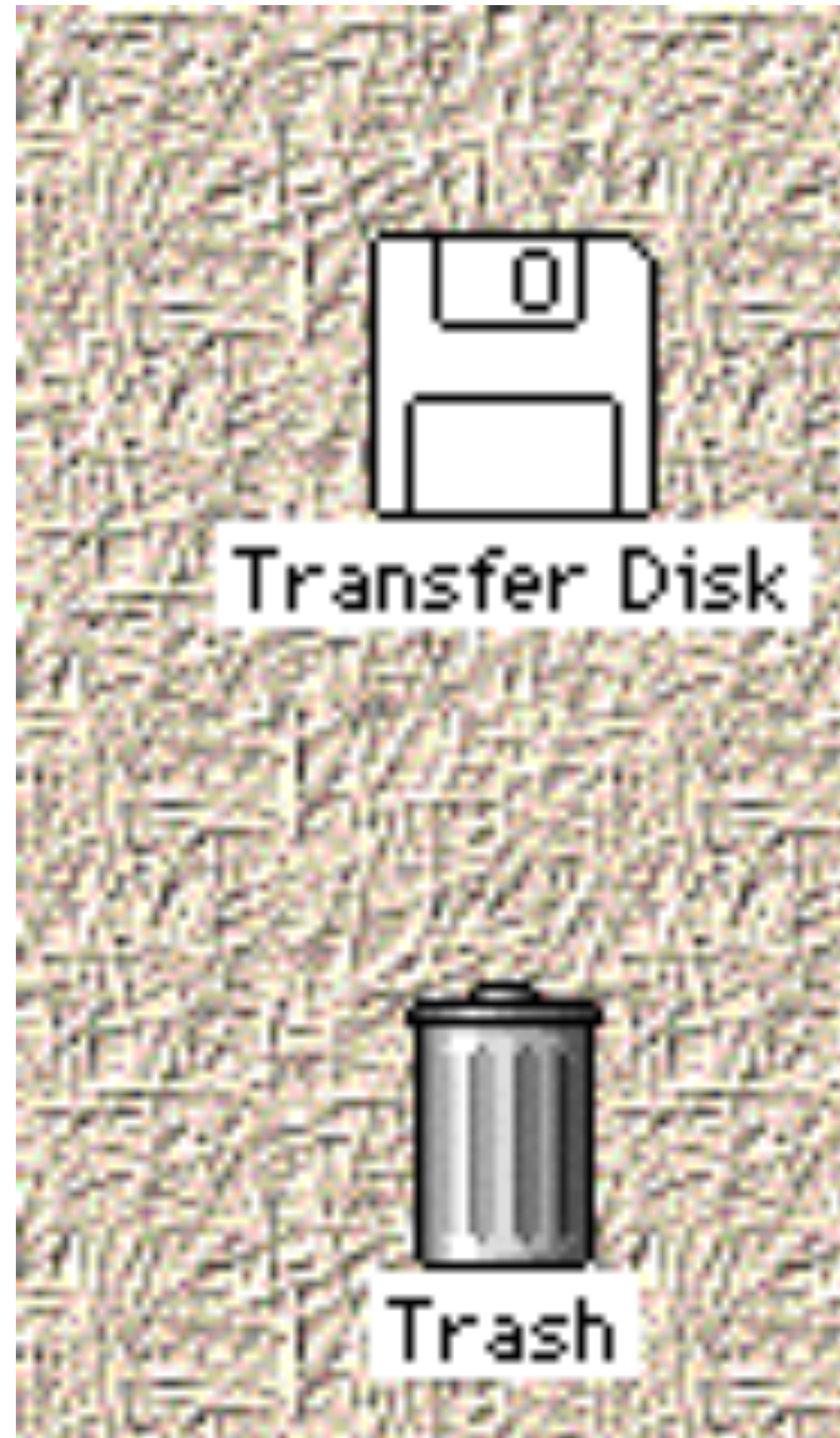
TRANSFER EXPECTATIONS

From known objects to similar new ones

Positive: previous experience applies to new situation

Negative: previous experience conflicts with new situation





What happens when disk is dragged onto trash can?



Crown in
Apple Watch

3. PROVIDE FEEDBACK

People press >> 1 time

Unclear if system has registered the button press

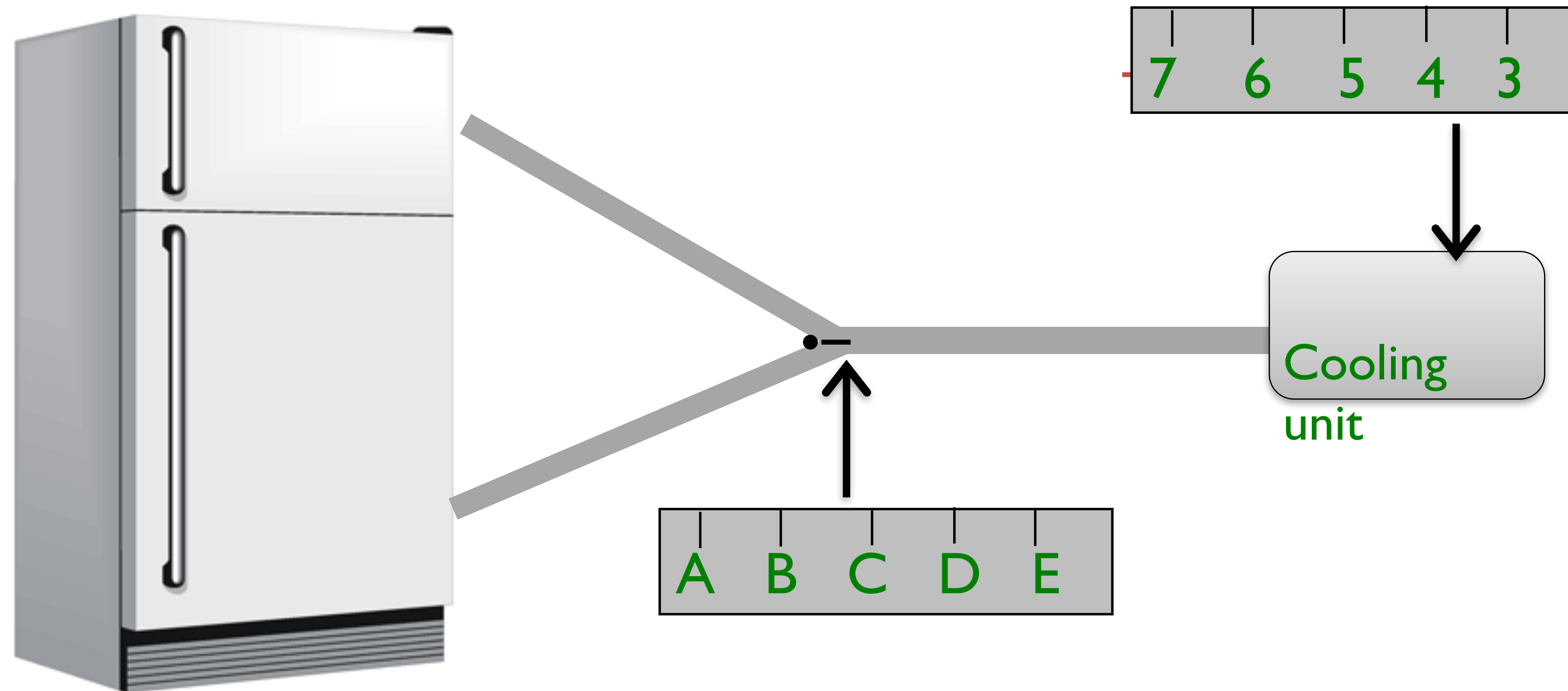


ELEVATORS

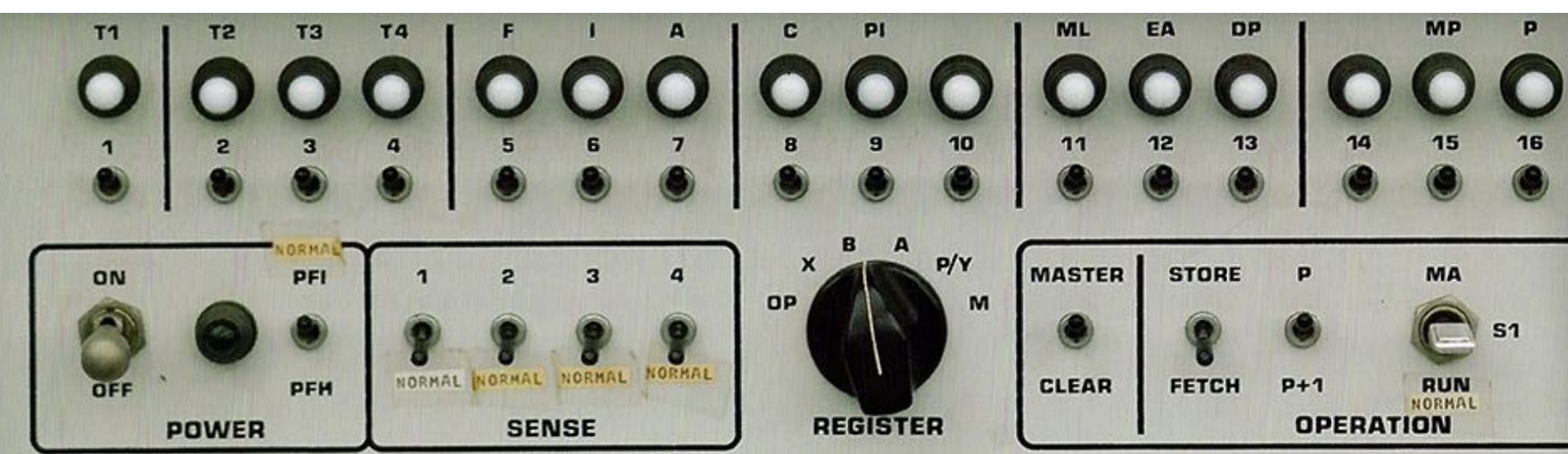
Elevator buttons light up
...reduces multiple presses



POOR FEEDBACK



Took a day for refrigerator to adjust to new settings



HEURISTIC EVALUATION

USABILITY HEURISTICS

“Rules of thumb” describing features of usable systems

Can be used as design principles

Can be used to evaluate a design

Example: Minimize users' memory load

HEURISTIC EVALUATION

Developed by Jakob Nielsen (1994)

Can be performed on working UI or on sketches

Small set (3-5) of evaluators (experts) examine UI

Evaluators check compliance with usability heuristics

Different evaluators will find different problems

Evaluators only communicate afterwards to aggregate findings

Designers use violations to redesign/fix problems



NIELSEN'S TEN HEURISTICS

H1: Visibility of system status

H2: Match system and real world

H3: User control and freedom

H4: Consistency and standards

H5: Error prevention

H6: Recognition rather than recall

H7: Flexibility and efficiency of use

H8: Aesthetic and minimalist design

H9: Help users recognize, diagnose, recover from errors

H10: Help and documentation

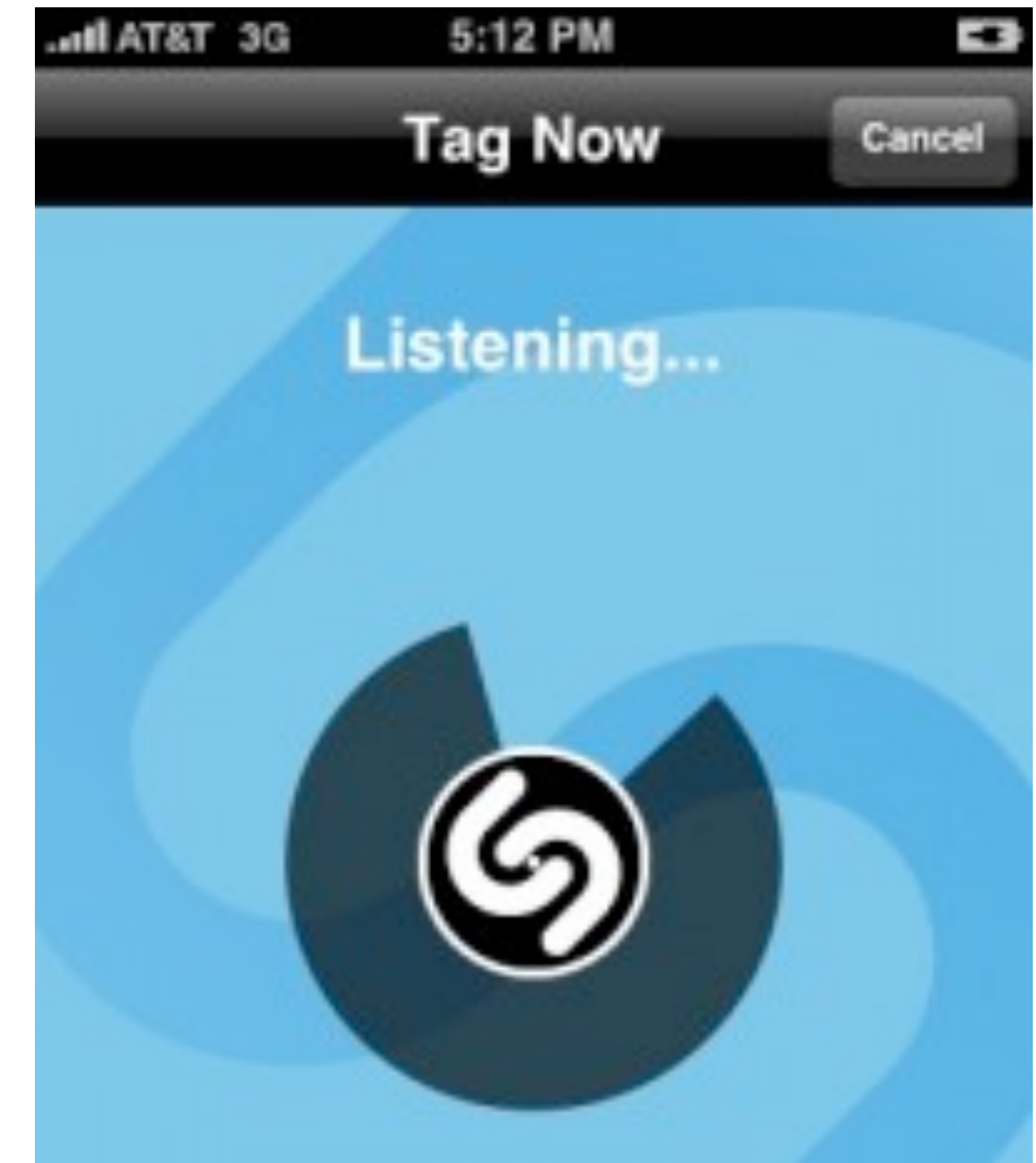
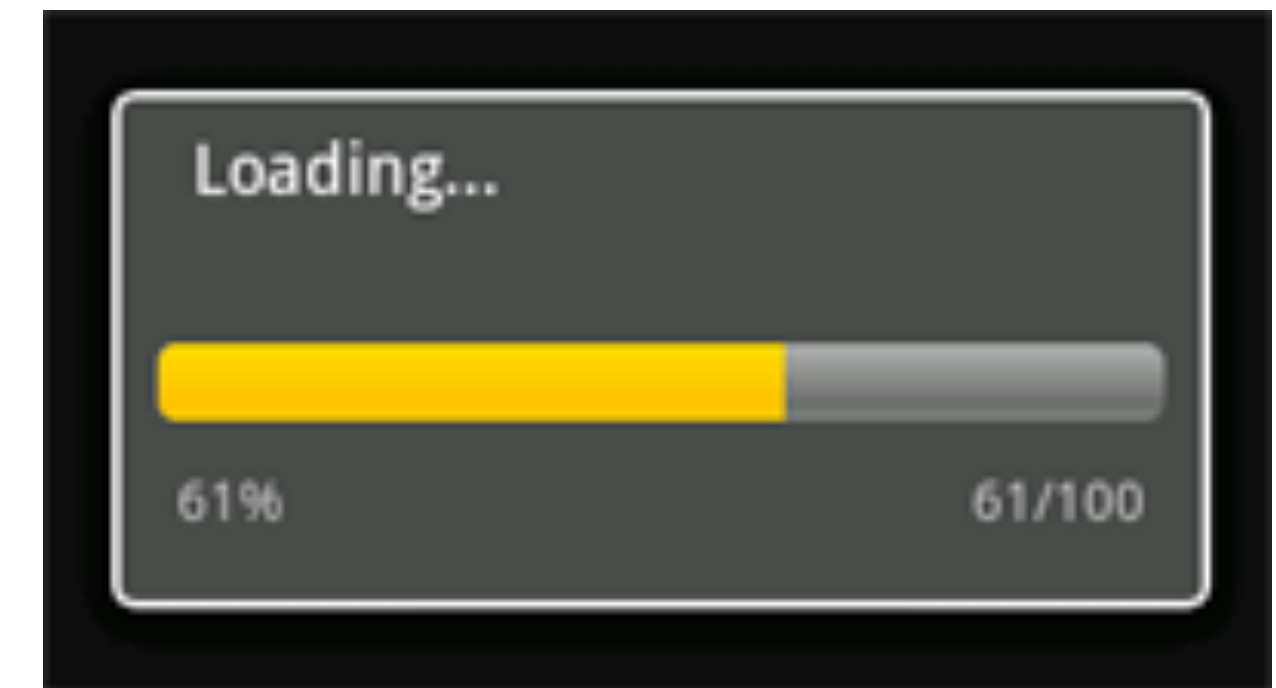
H-1: VISIBILITY OF SYSTEM STATUS

Keep users informed about what is going on.

Response time examples:

- 0.1 sec: no special indicators needed
- 1.0 sec: user tends to lose track of data
- 10 sec: max. duration if user to stay focused on action
- Short delays: Hourglass
- Long delays: Use percent-done progress bars

Overestimate usually better

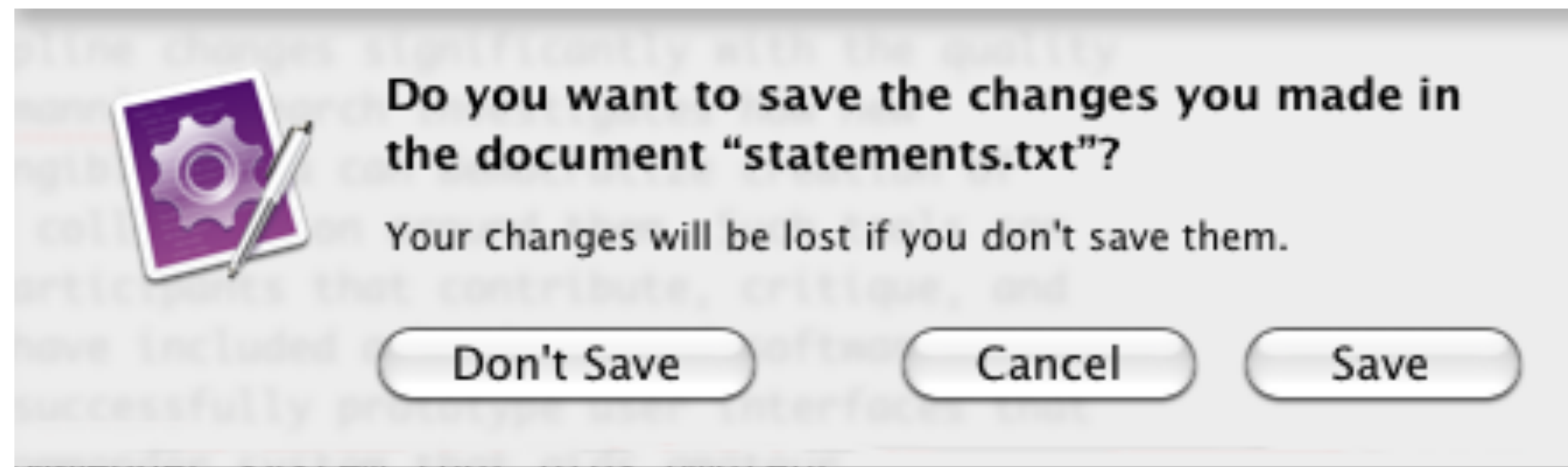


H-1: VISIBILITY OF SYSTEM STATUS

Users should always be aware of what is going on

So that they can make informed decision

Provide redundant information



H-2: MATCH SYSTEM & WORLD

Speak the users' language
Follow real world conventions
Pay attention to metaphors

Bad example: Mac desktop



H2-2: MATCH SYSTEM & WORLD



H-3: USER CONTROL & FREEDOM

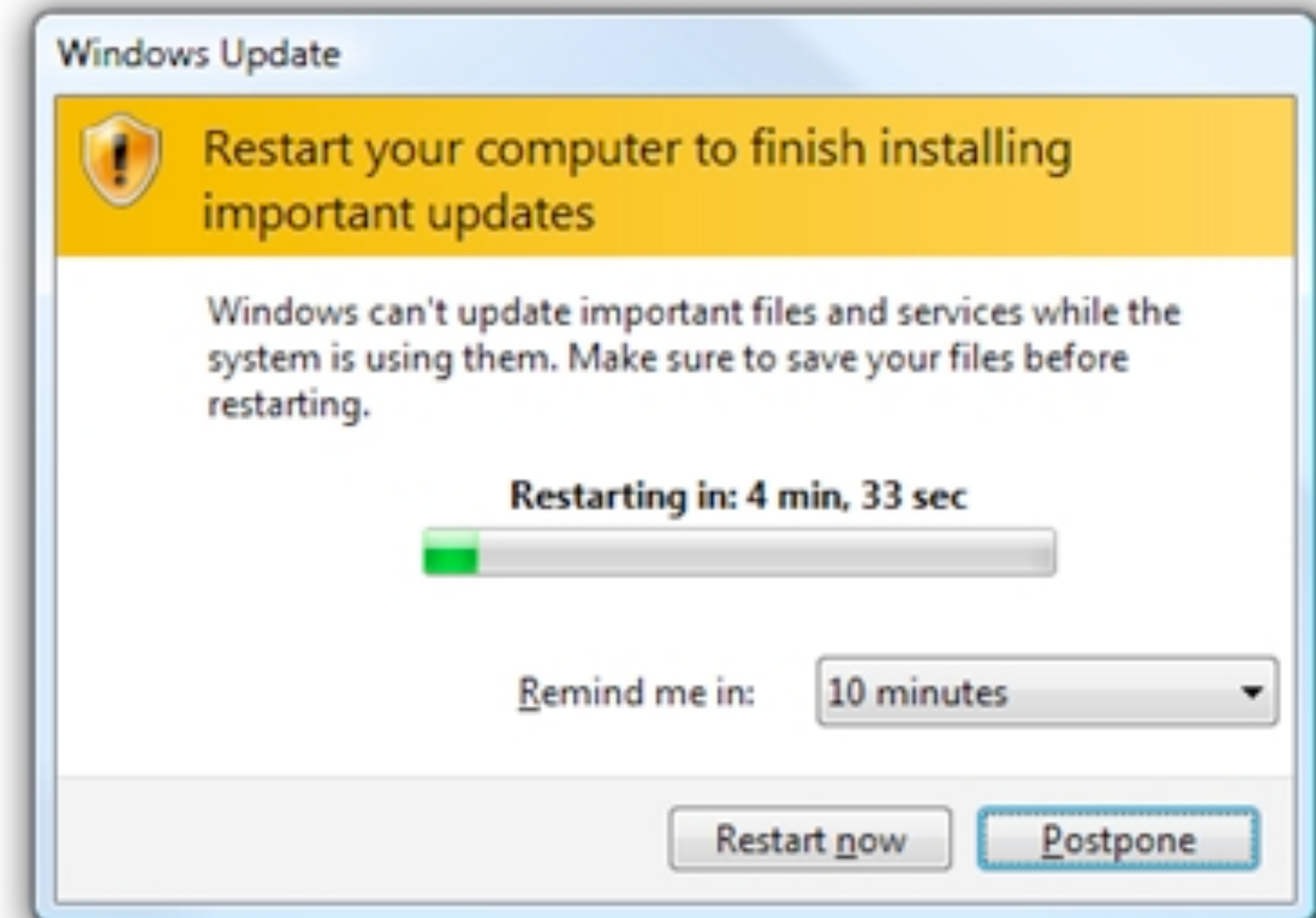
Users don't like to be trapped!

Strategies

Cancel button
(or Esc key) for dialog

Make the cancel button responsive!

Universal undo



H-3: USER CONTROL & FREEDOM

Offer “Exits” for mistaken choices, undo, redo

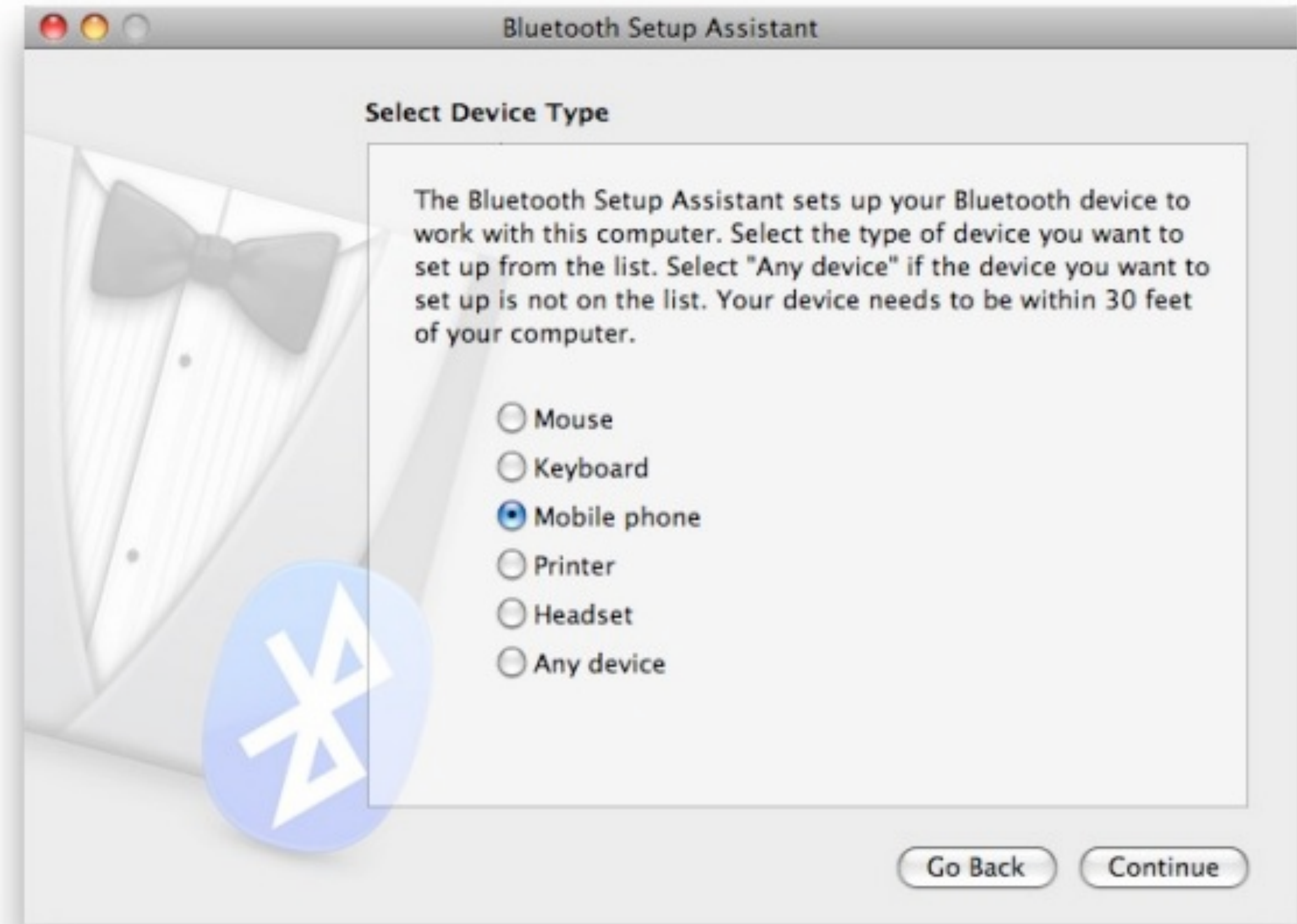
Don't force the user down fixed paths

Wizards

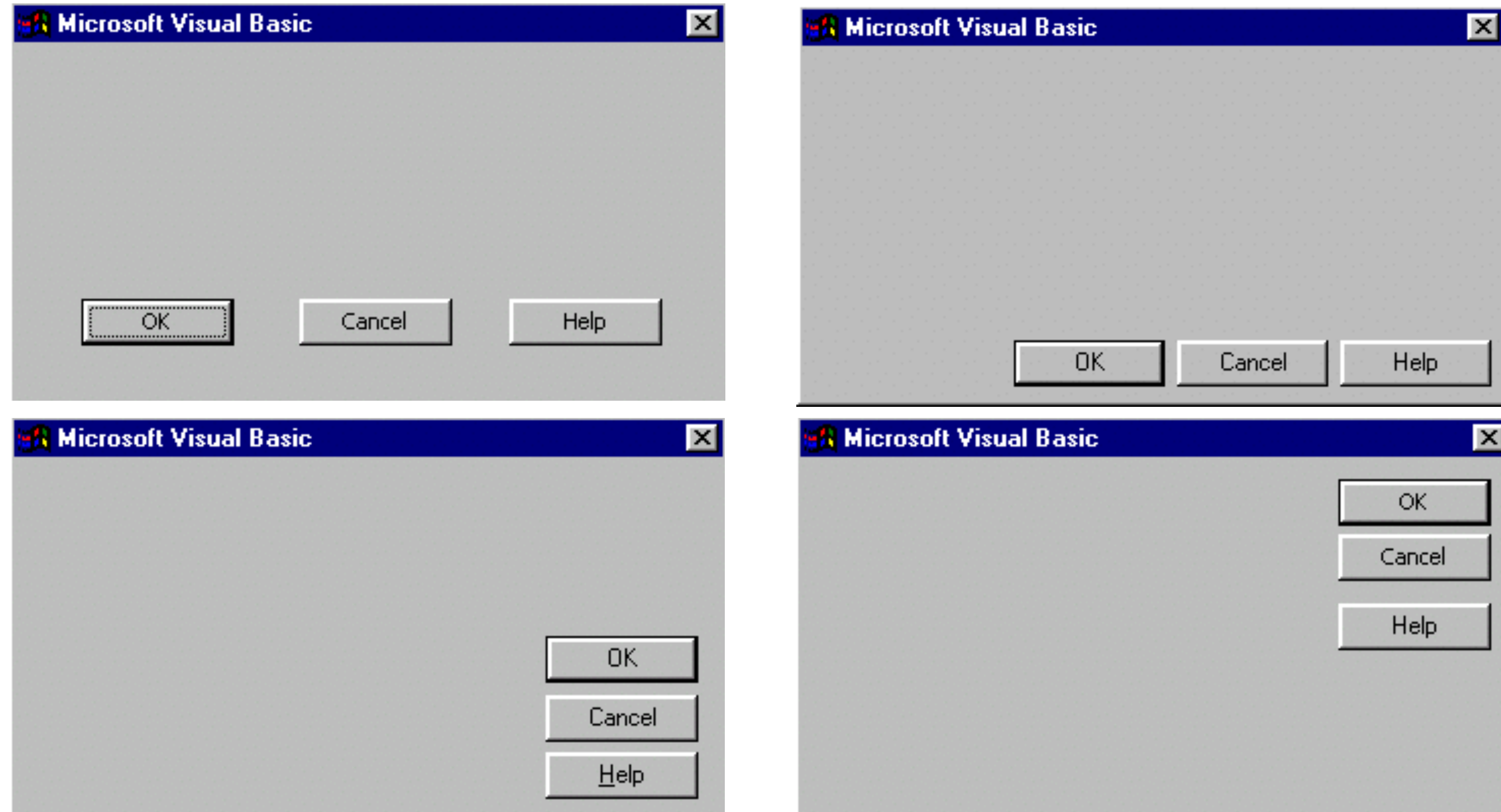
Must respond to question before going to next step

Good for infrequent tasks (e.g., network setup) & beginners

Not good for common tasks (zip/unzip)

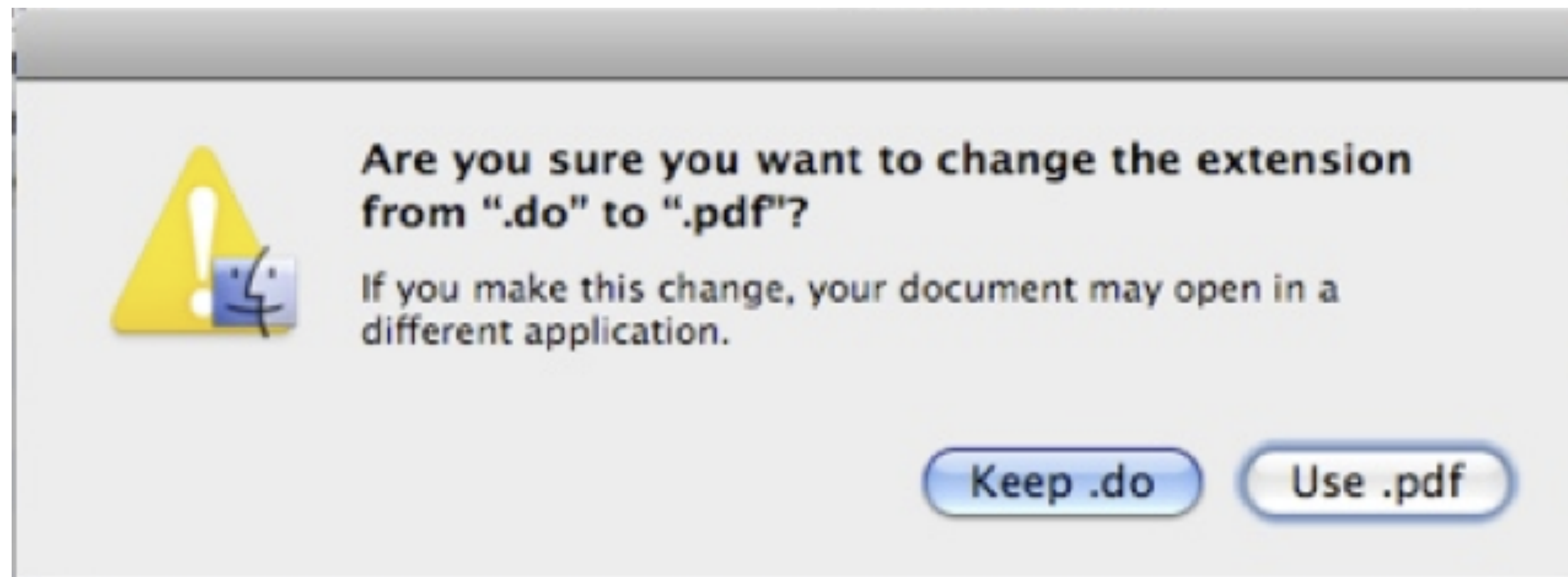


H-4: CONSISTENCY AND STANDARDS



H-5: ERROR PREVENTION

Eliminate error-prone conditions or check for them and ask for confirmation



H-5: ERROR PREVENTION

Aid users with specifying correct input

Trip information:

Find hotels near:

What city?

Check-in:

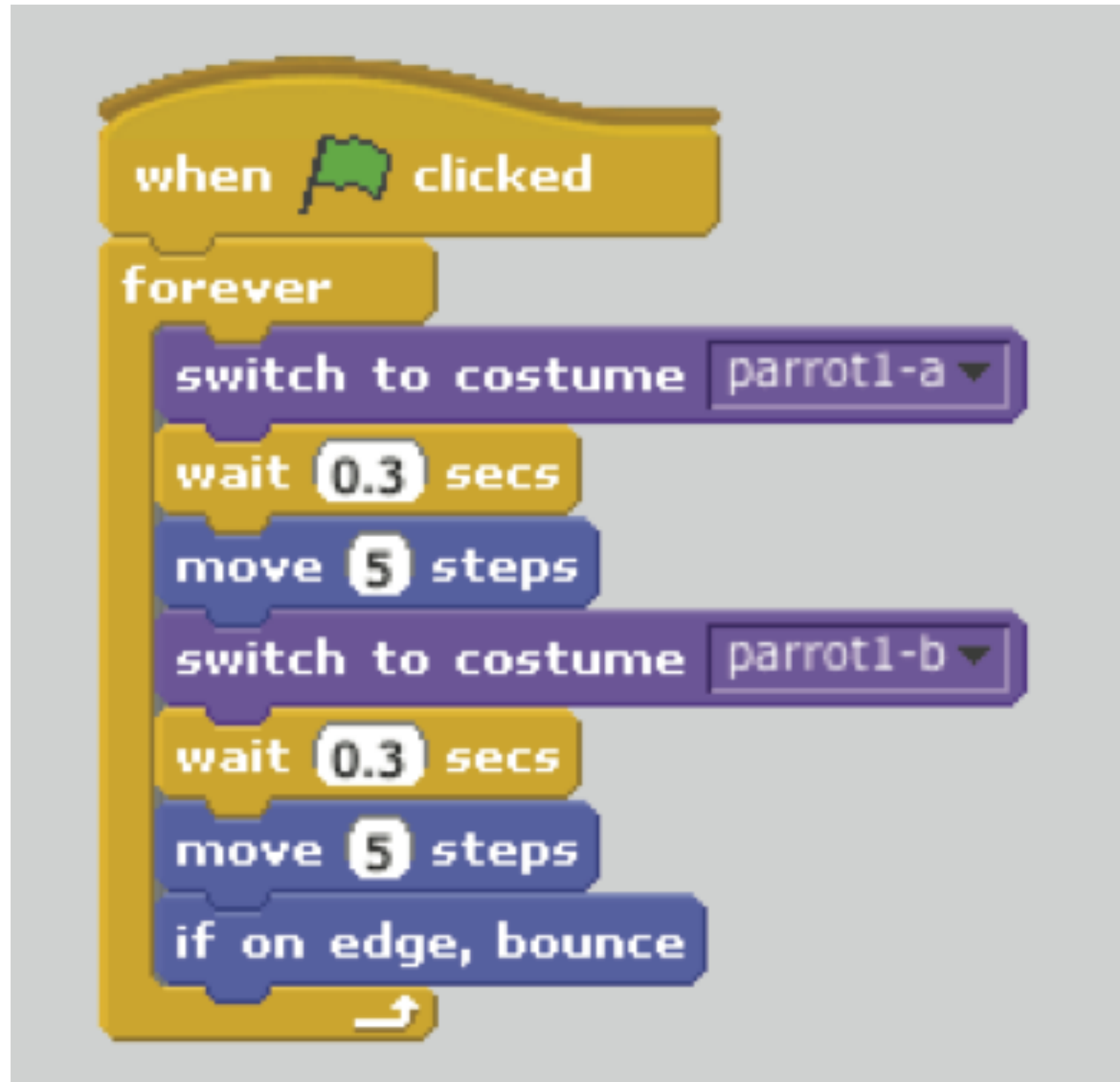
Check-out:

◀ April 2010 ▶ May 2010 ▶

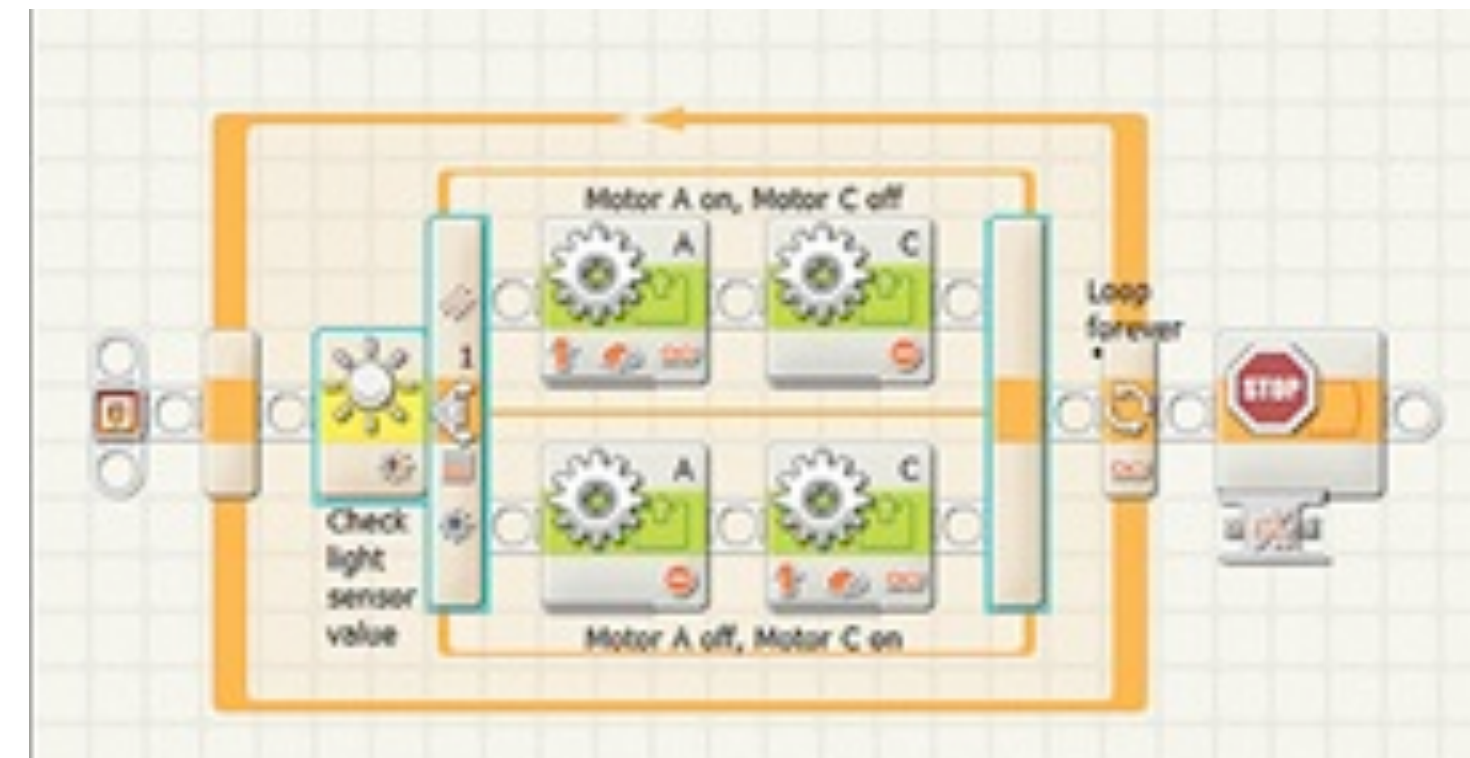
S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2	3							1
4	5	6	7	8	9	10	2	3	4	5	6	7	8
11	12	13	14	15	16	17	9	10	11	12	13	14	15
18	19	20	21	22	23	24	16	17	18	19	20	21	22
25	26	27	28	29	30		23	24	25	26	27	28	29
							30	31					

Close

H2-5: ERROR PREVENTION



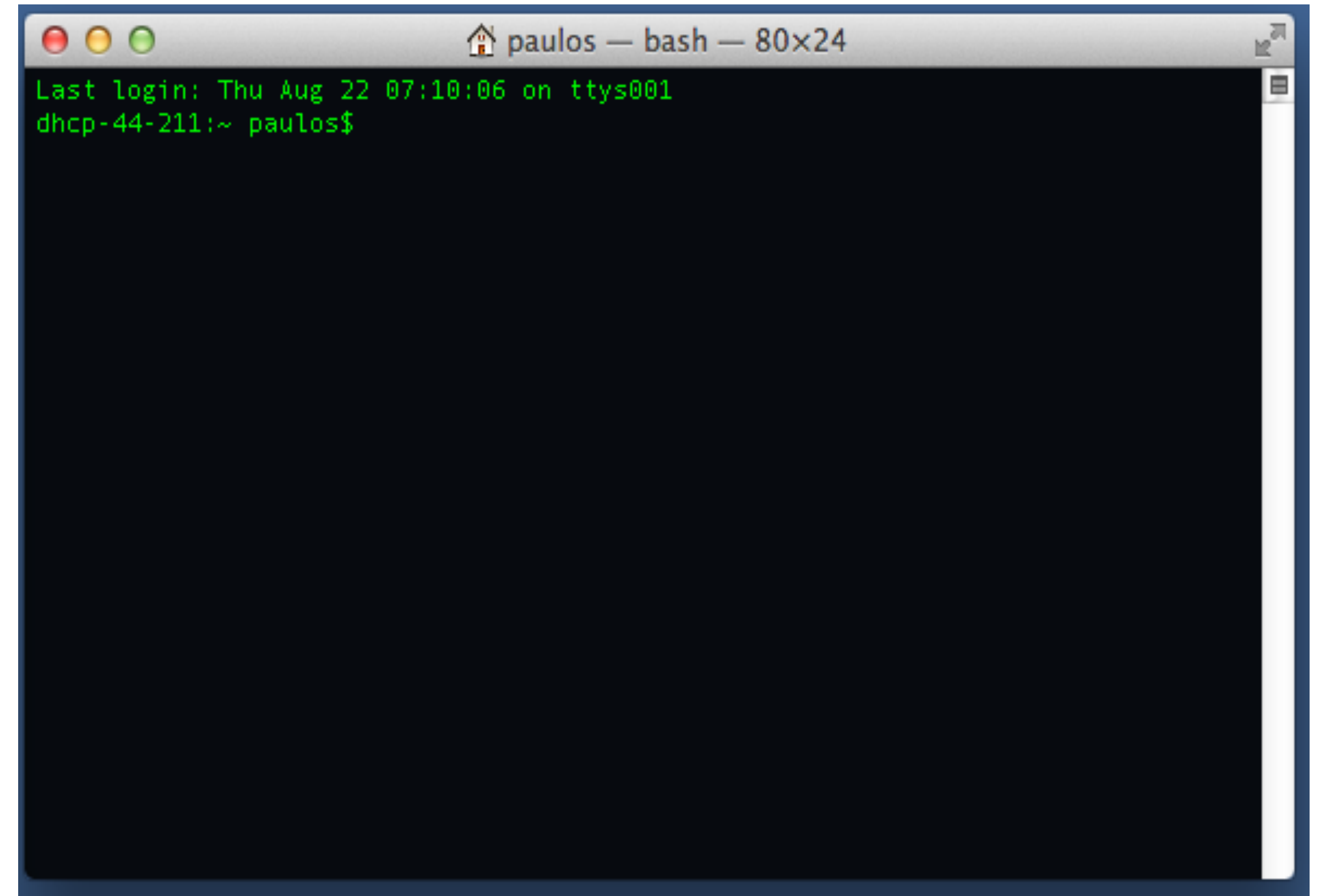
MIT Scratch



Lego Mindstorms

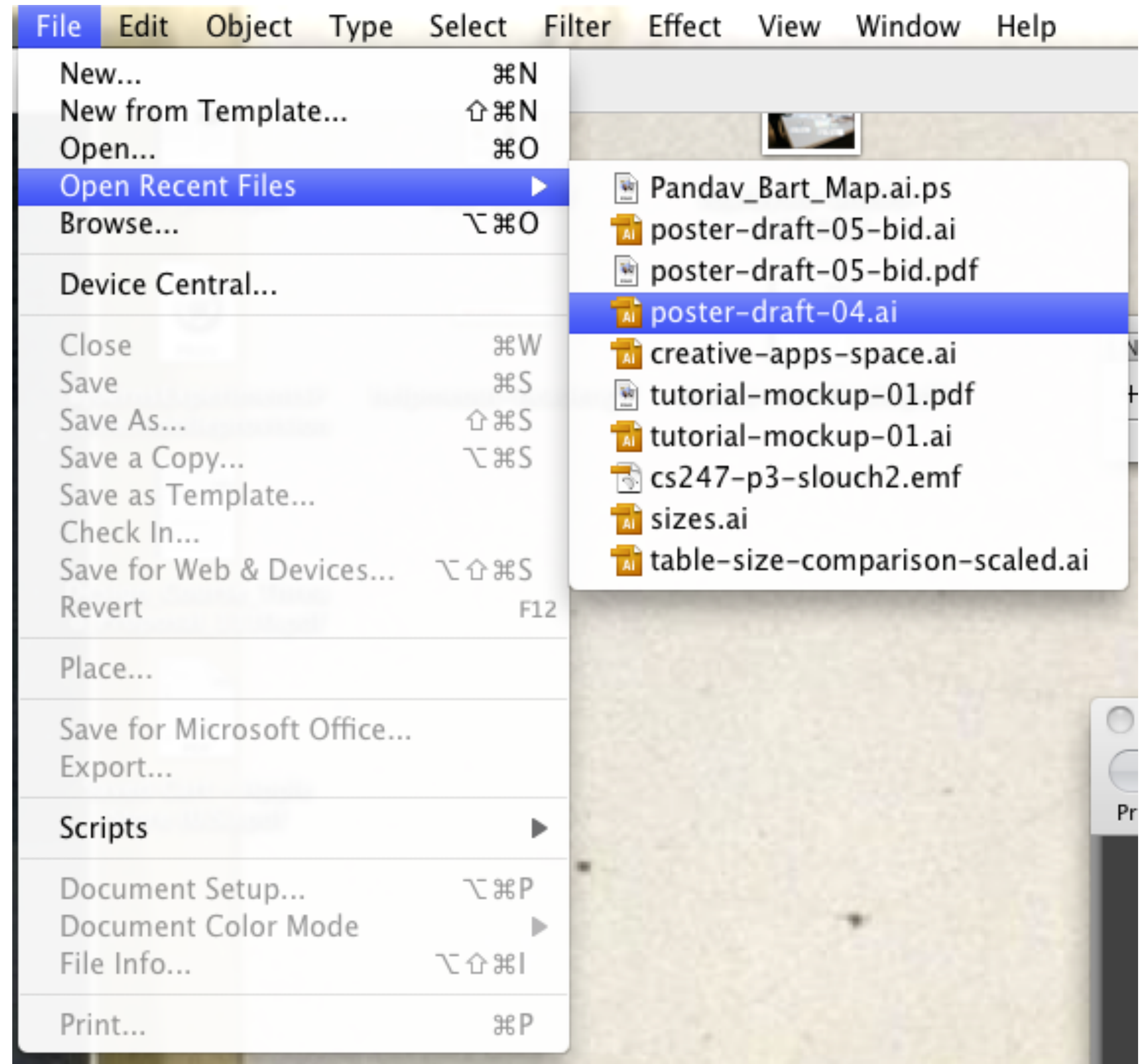
Don't allow
incorrect input

H-6: RECOGNITION OVER RECALL

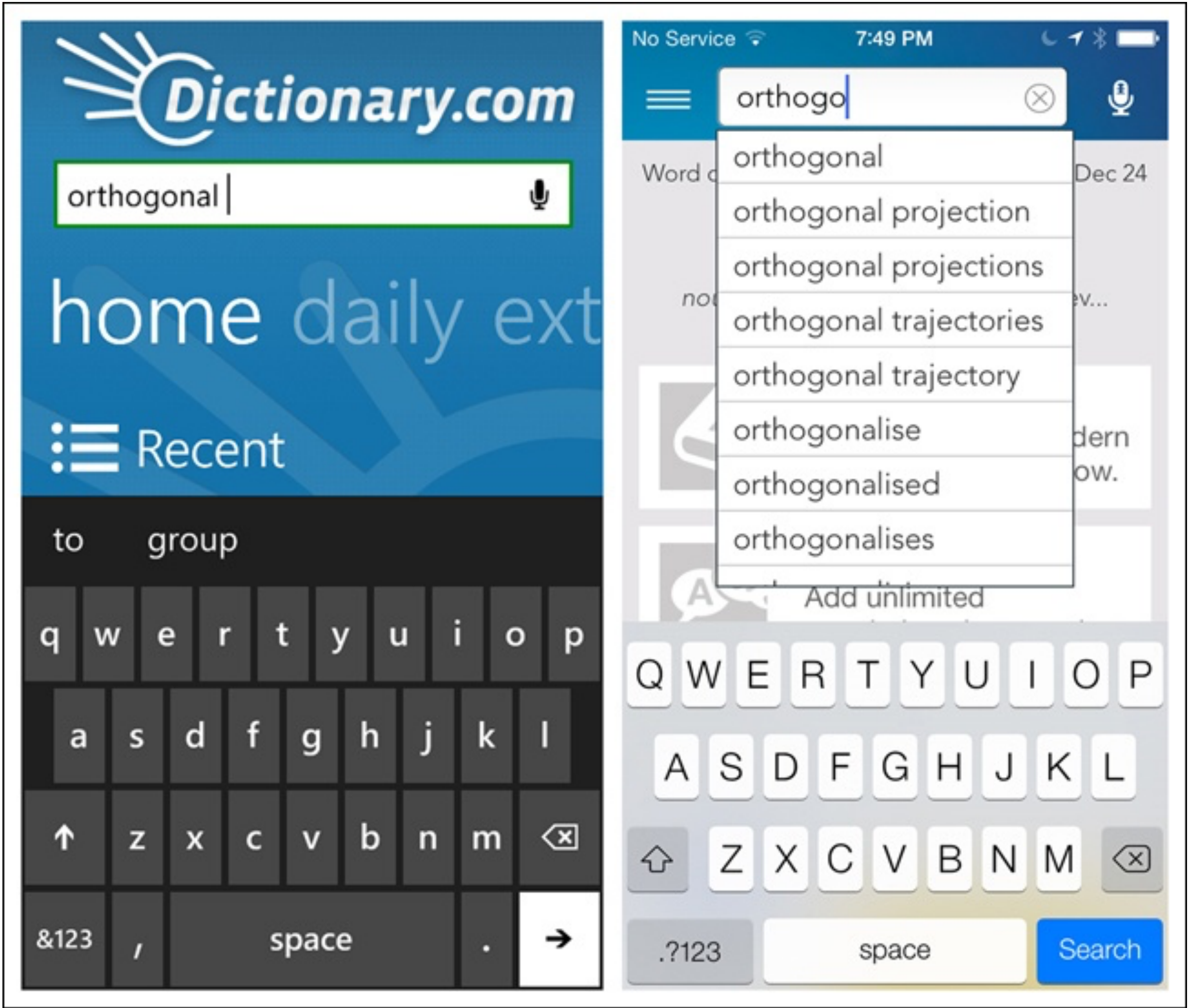
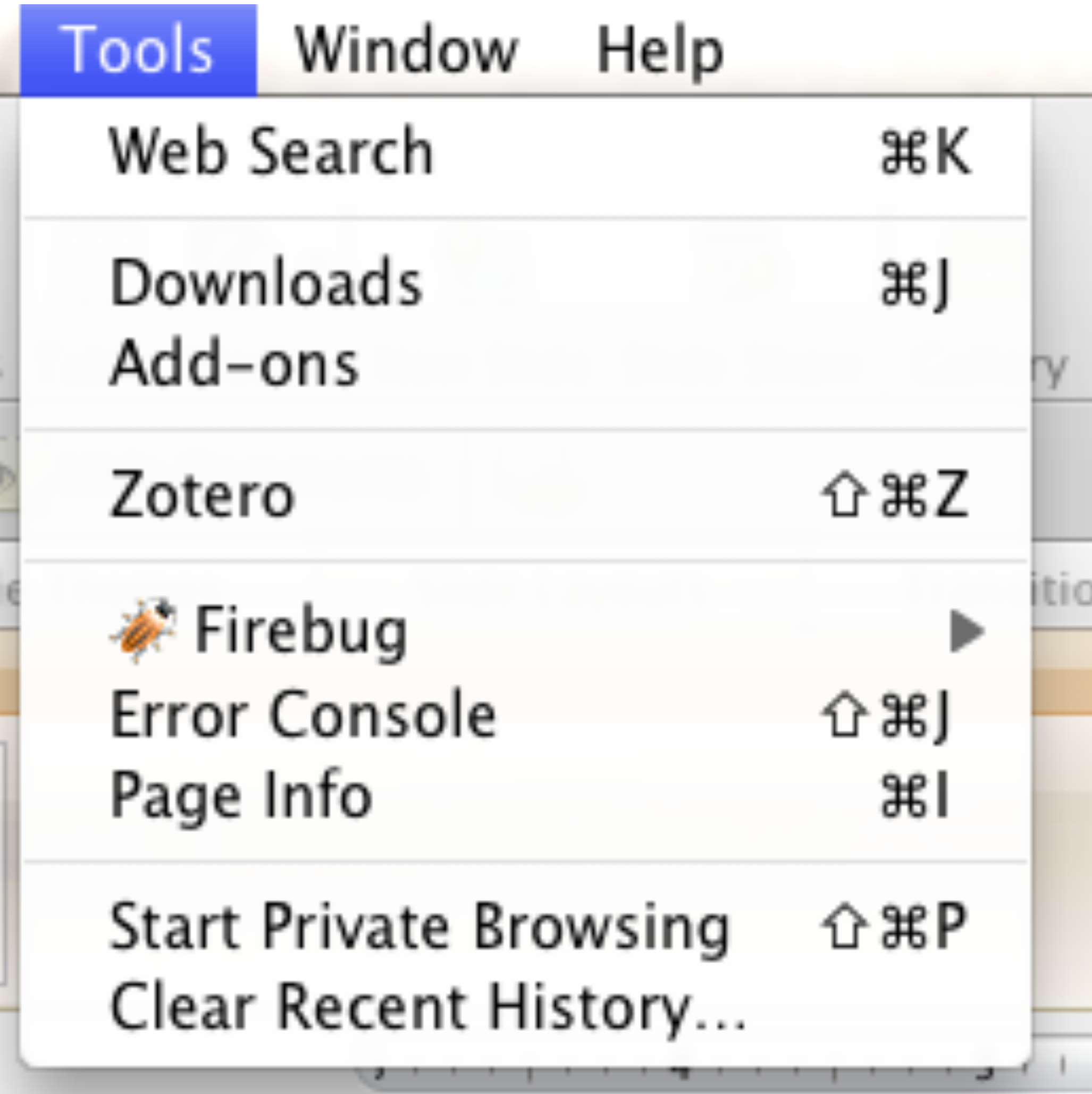


H-6: RECOGNITION OVER RECALL

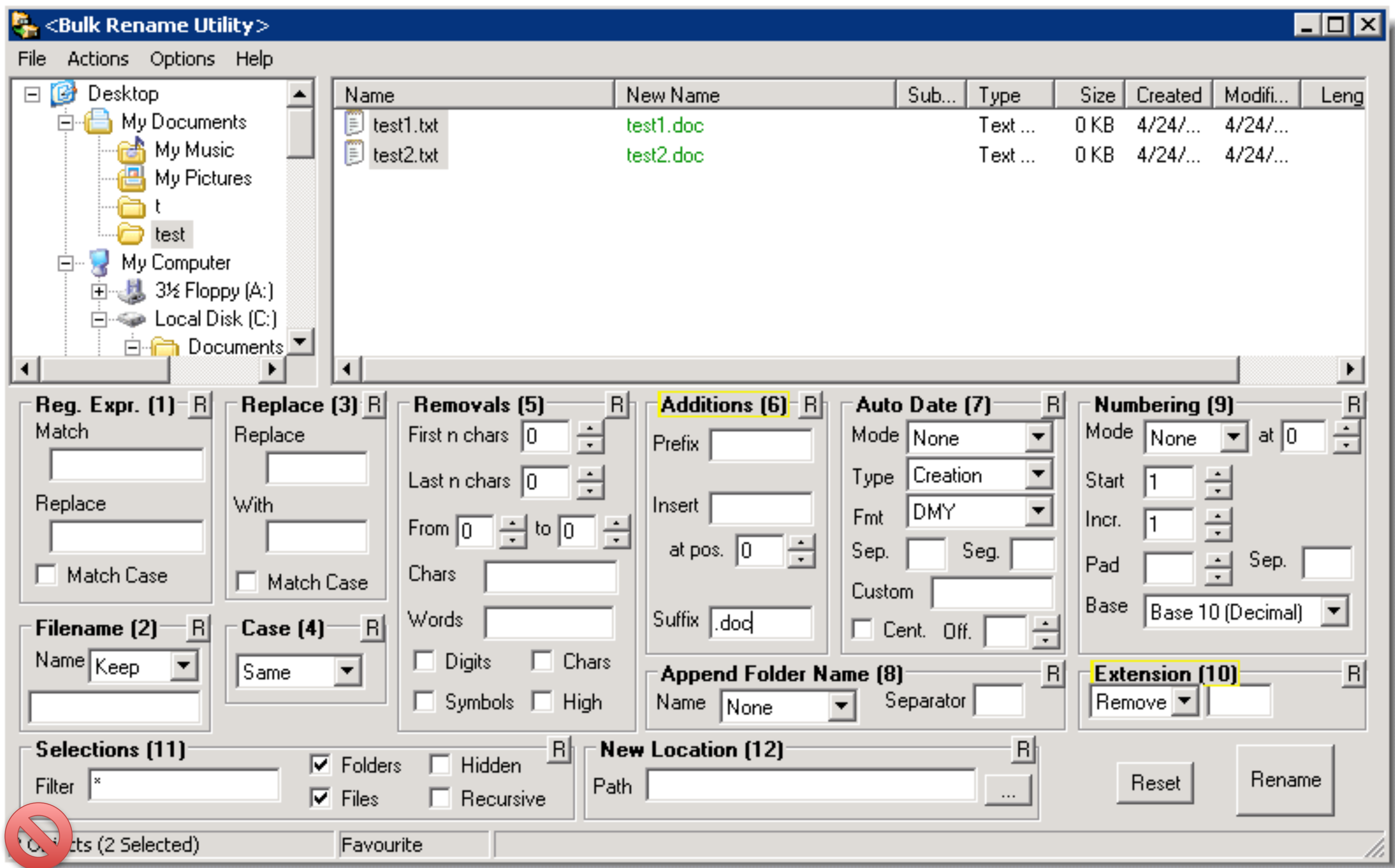
Minimize the user's memory load by making objects, actions, and options visible.



H2-7: FLEXIBILITY AND EFFICIENCY OF USE



H-8: AESTHETIC AND MINIMALIST DESIGN



H-8: AESTHETIC AND MINIMALIST DESIGN

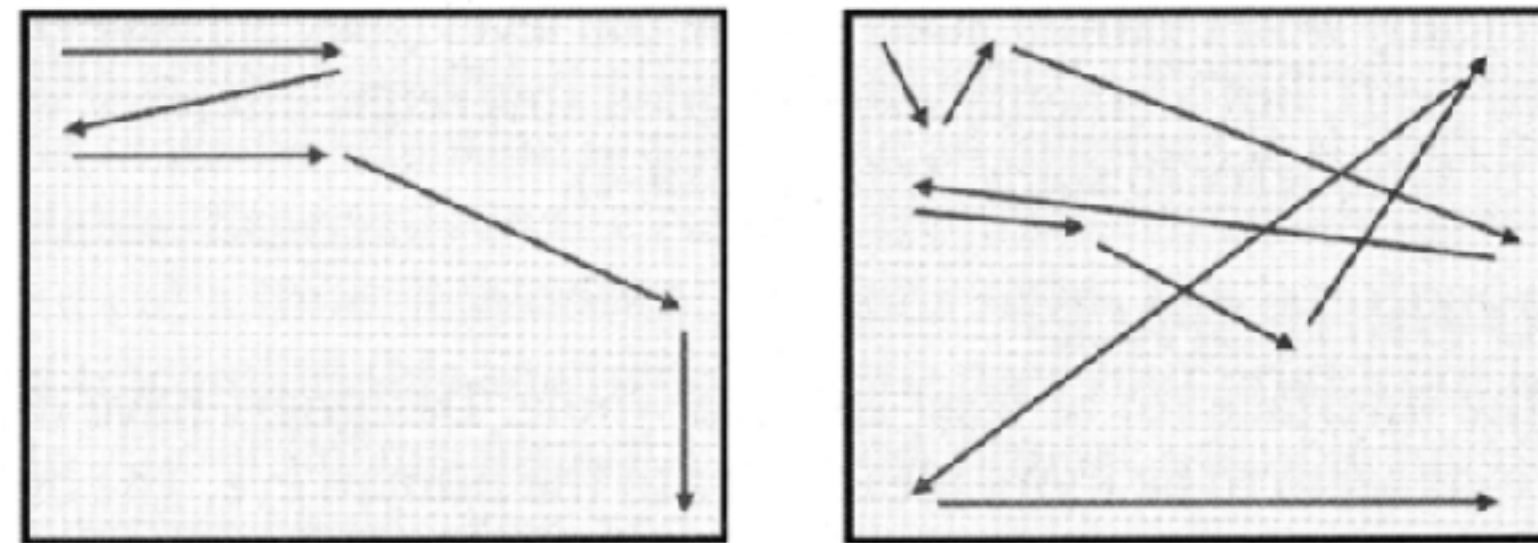
No irrelevant information in dialogues

Form Title -- (appears above URL in most browsers and is used by W/W/W search)		Background Color:
Q&D Software Development Order Desk		FFFBF0
Form Heading -- (appears at top of Web page in bold type)		Text Color:
Q&D Software Development Order Desk		000080
E-Mail responses to (will not appear on	Alternate (for mailto forms only)	Background Graphic
dversch@q-d.com		
Text to appear in Submit button	Text to appear in Reset button	☐ Mailto
Send Order	Clear Form	☒ CGI
Scrolling Status Bar Message (max length = 200 characters)		
WebMania 1.5b with Image Map Wizard is here!		
<< Prev Tab		Next Tab >>



H-8: AESTHETIC AND MINIMALIST DESIGN

Present information in natural order



From Cooper's "About face 2.0"

Occam's razor

Remove or hide irrelevant or rarely needed information –
They compete with important information on screen

Pro: Palm Pilot

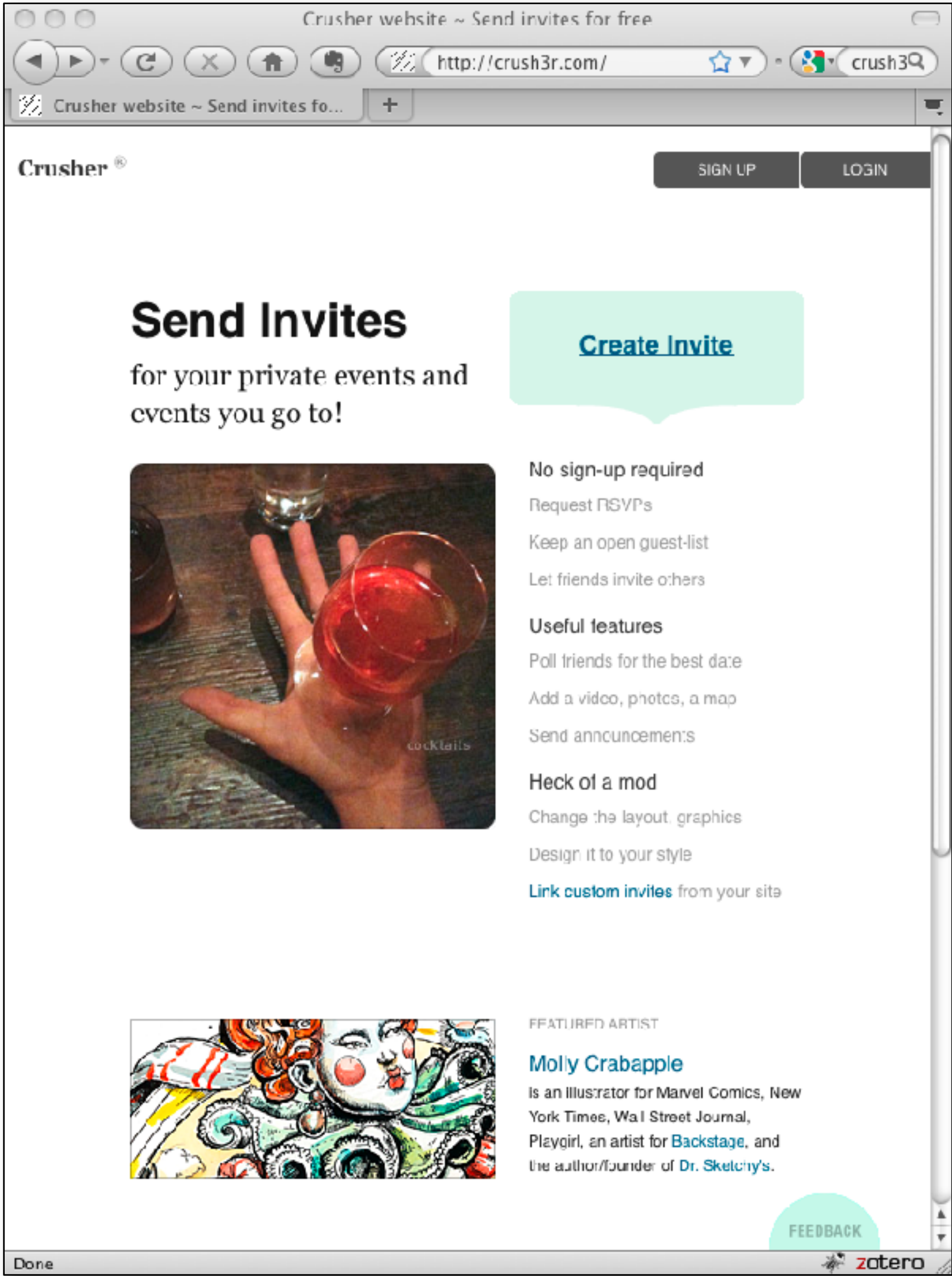
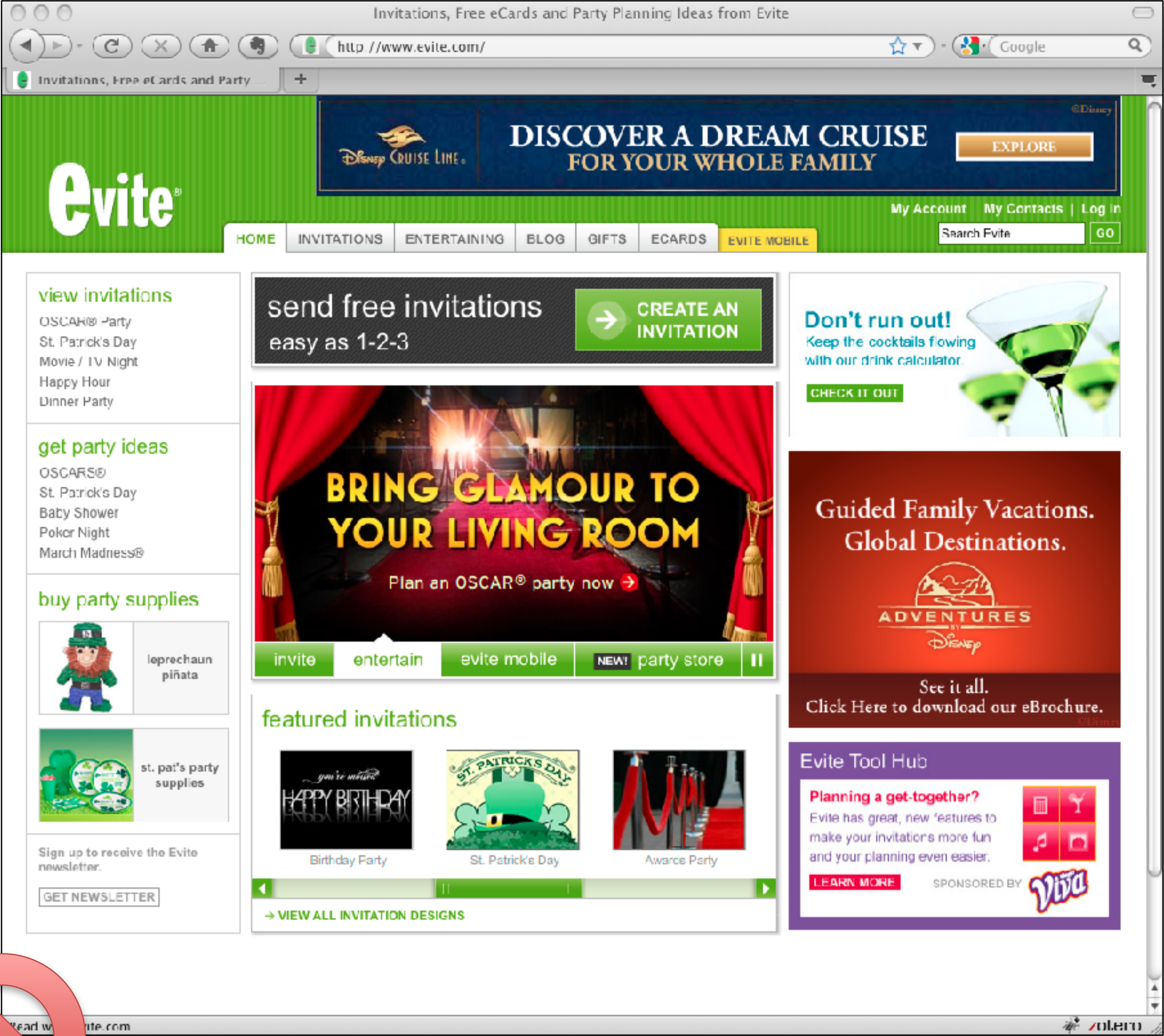
Against: Dynamic menus

Use windows frugally

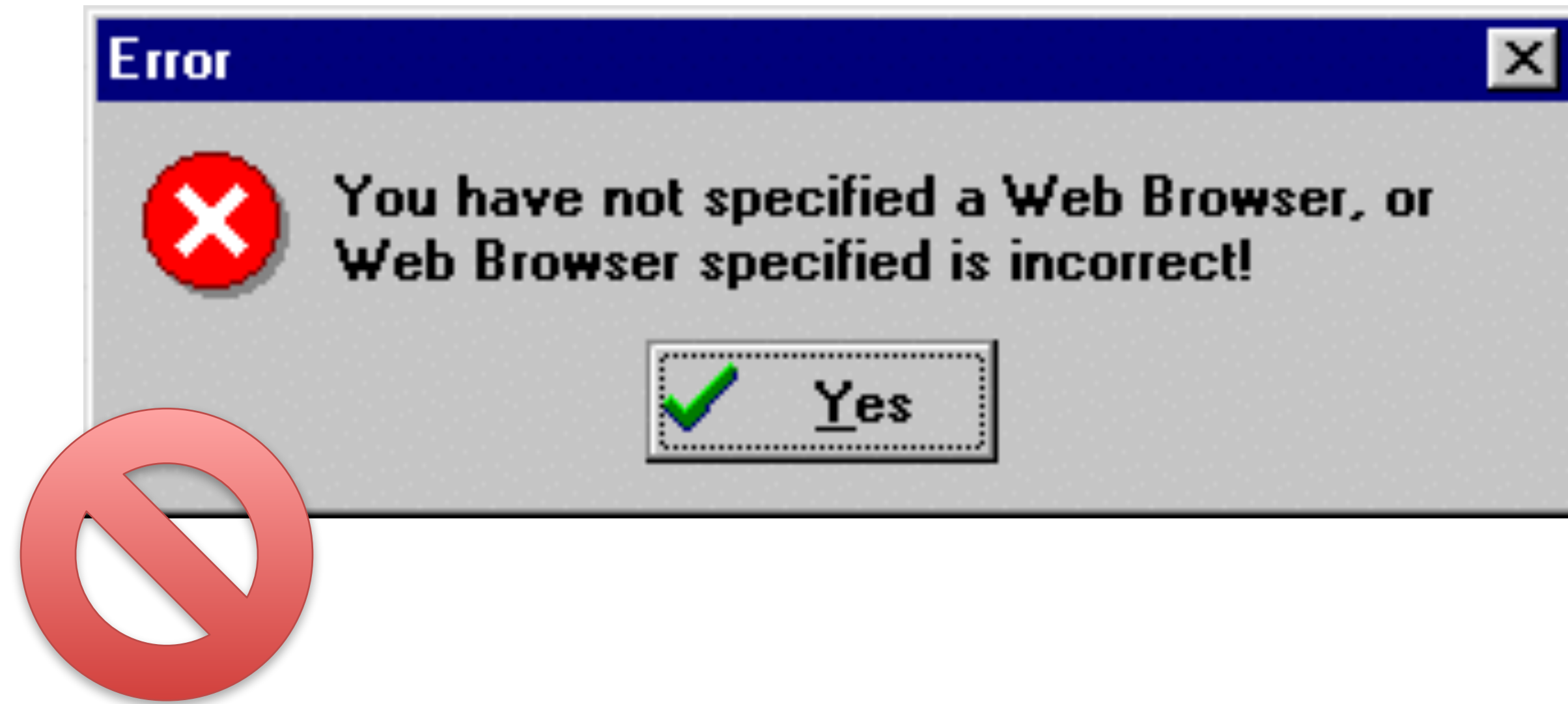
Avoid complex window management



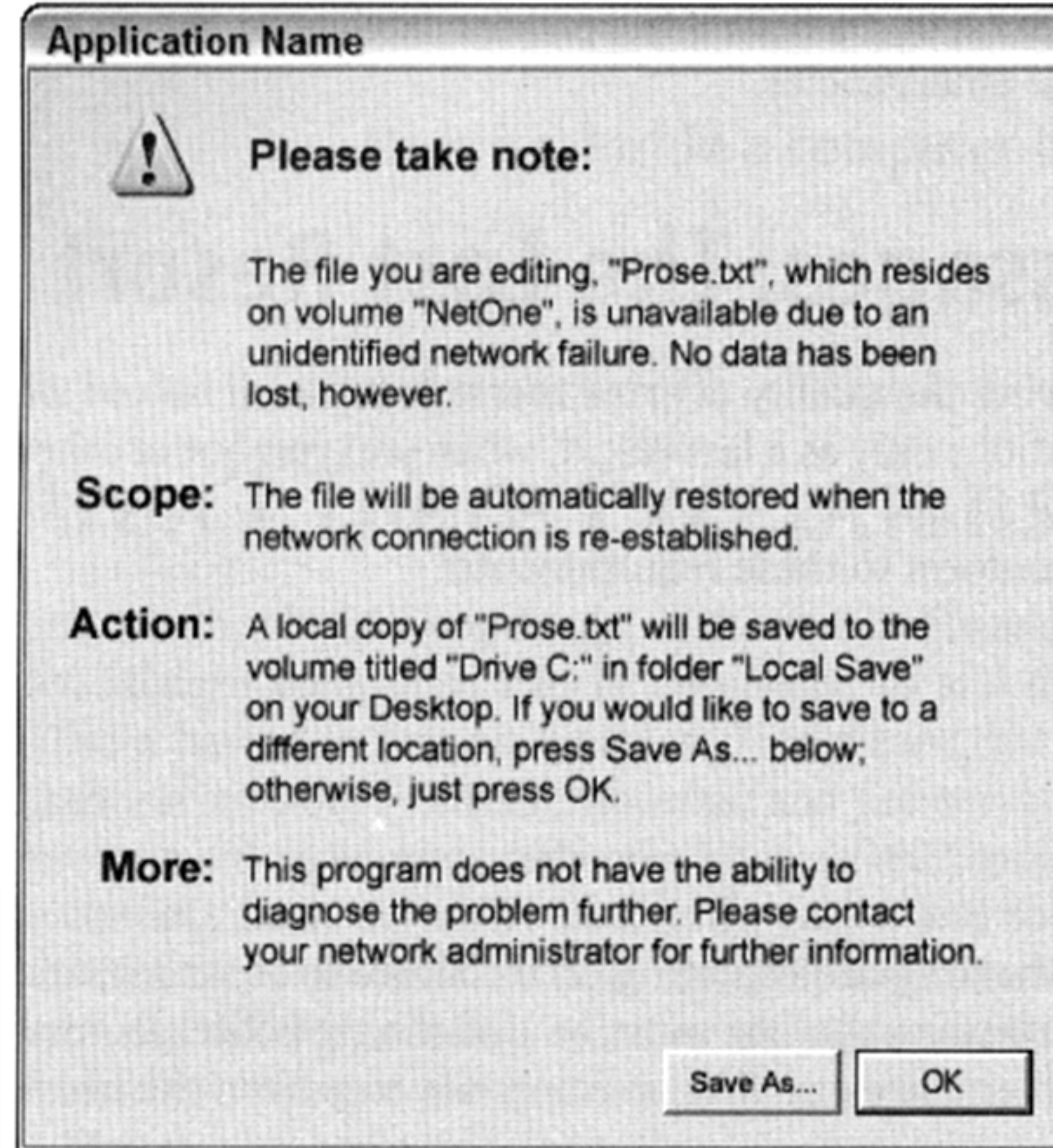
H-8: AESTHETIC AND MINIMALIST DESIGN



H-9: HELP USERS RECOGNIZE, DIAGNOSE, AND RECOVER FROM ERRORS

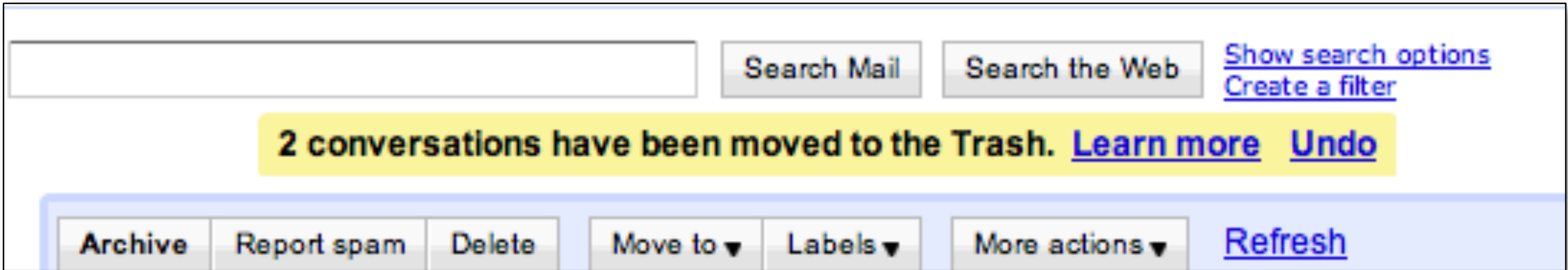


BETTER ERROR MESSAGES

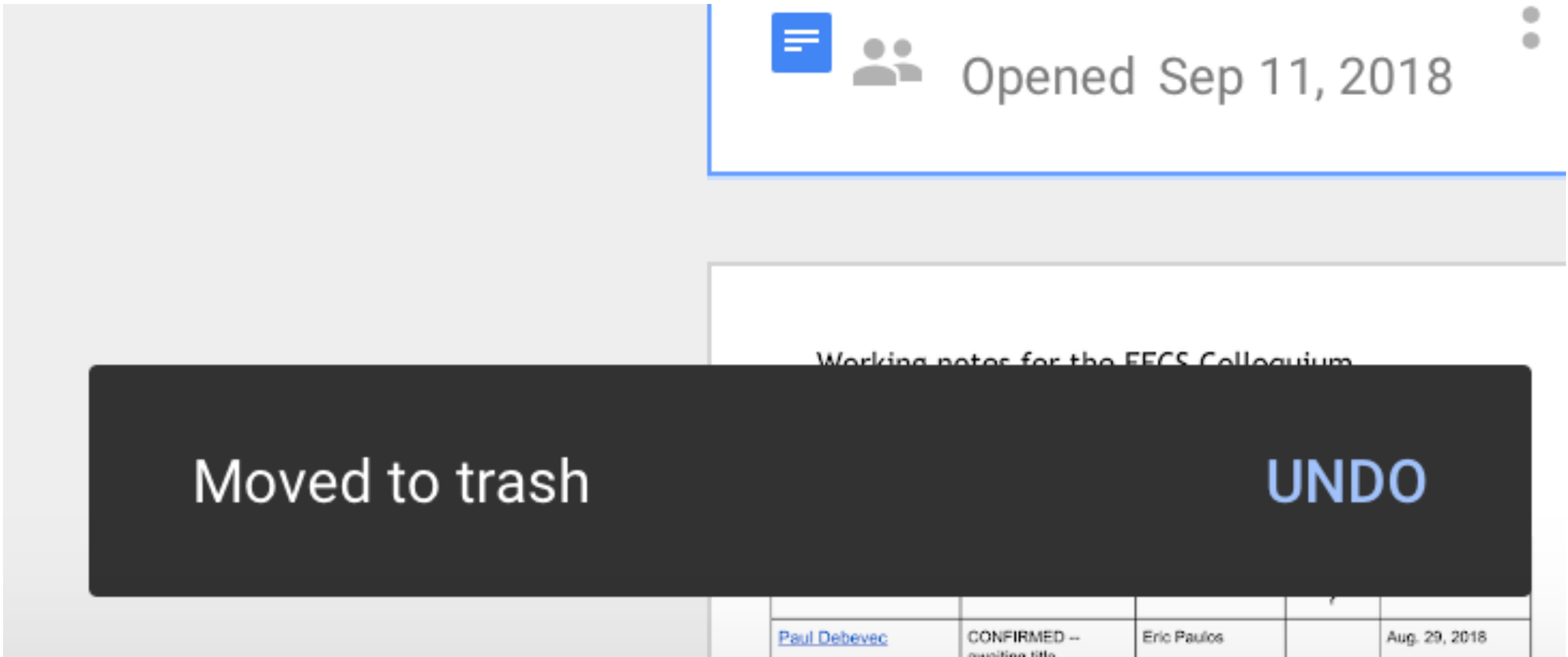


From Cooper's "About Face 2.0"

H2-9: HELP USERS RECOGNIZE, DIAGNOSE, AND RECOVER FROM ERRORS



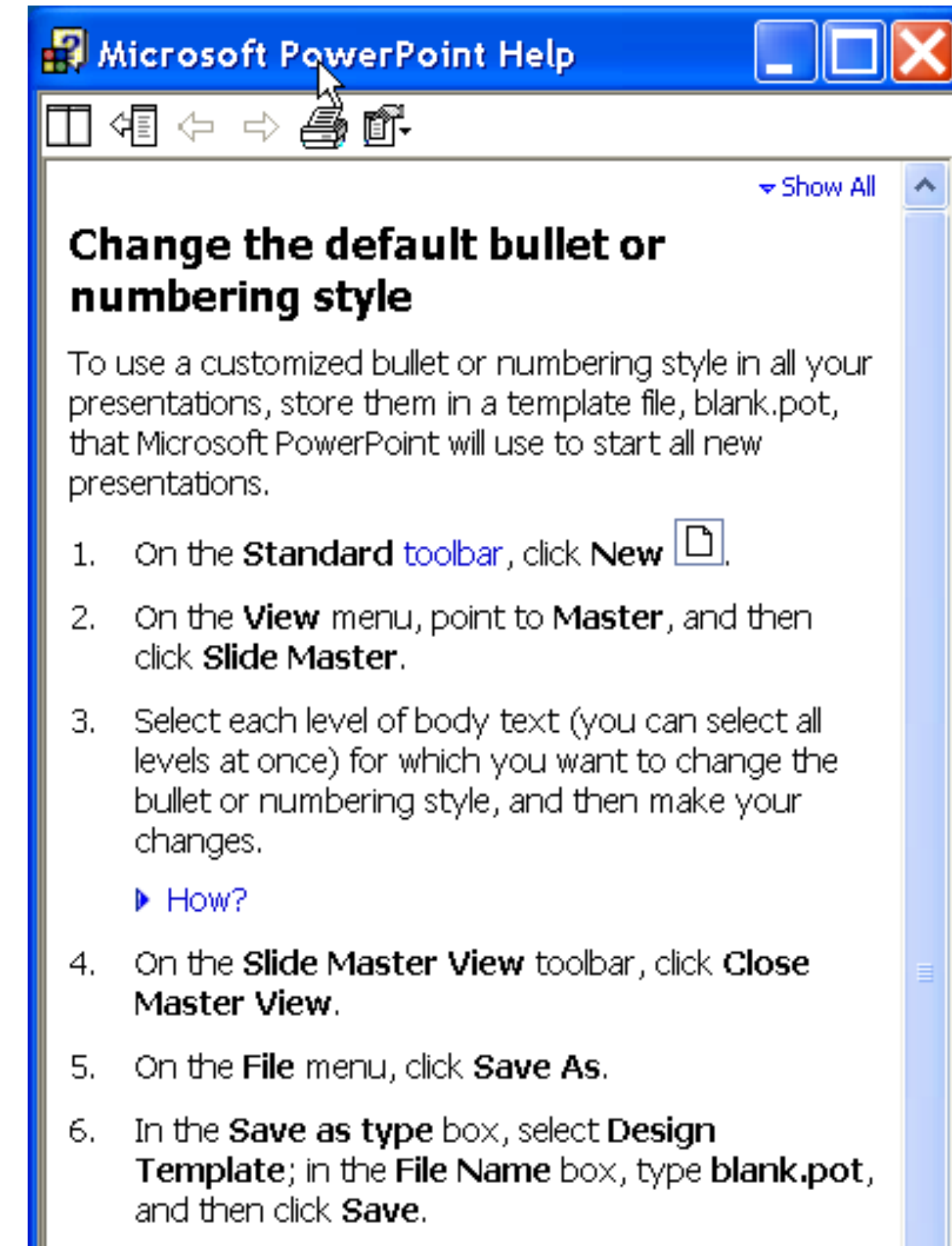
H2-9: HELP USERS RECOGNIZE, DIAGNOSE, AND RECOVER FROM ERRORS



H-10: HELP AND DOCUMENTATION

Help should be:

- Easy to search
- Focused on the user's task
- List concrete steps to carry out
- Not too long



TYPES OF HELP

Tutorial and/or getting started manuals

Presents the system conceptual model

Basis for successful explorations

Provides on-line tours and demos

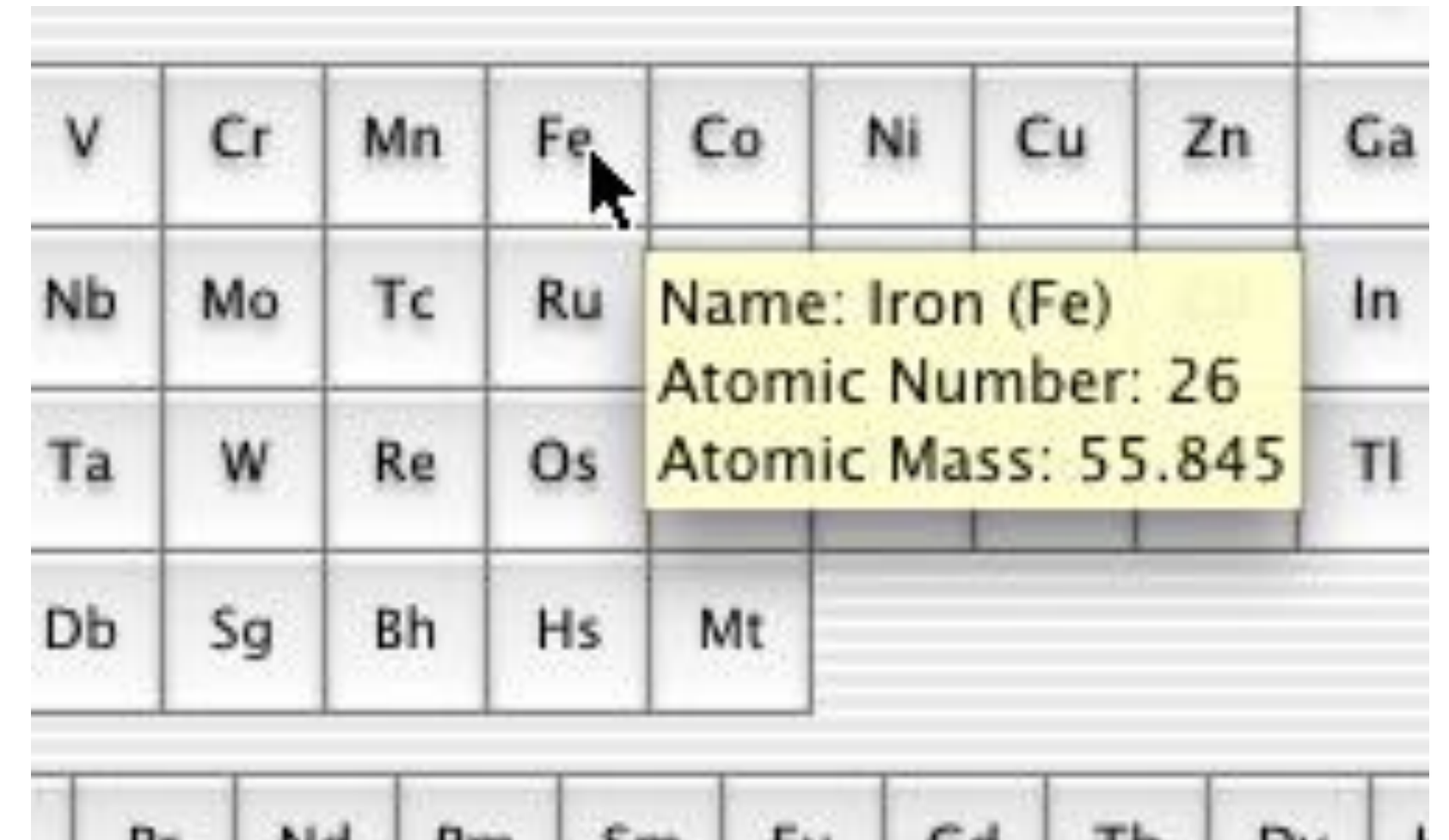
Demonstrates basic features

Reference manuals

Designed with experts in mind

Reminders

Short reference cards, keyboard templates, tooltips...

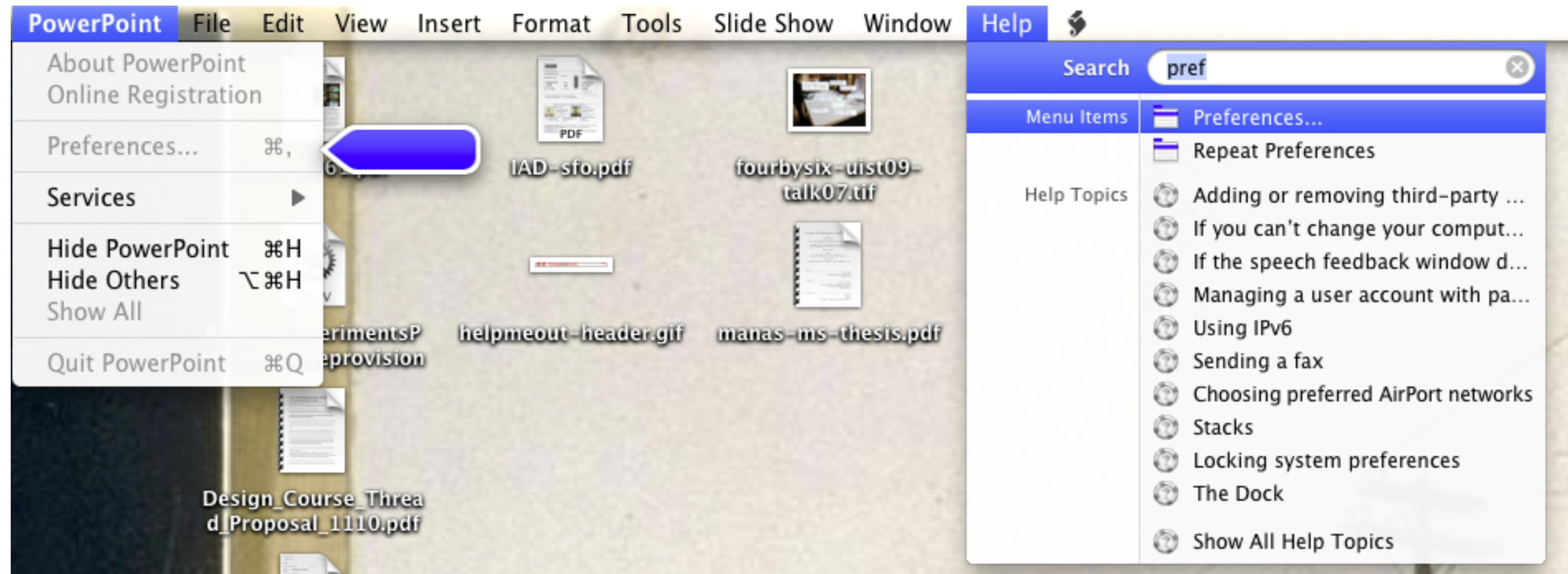
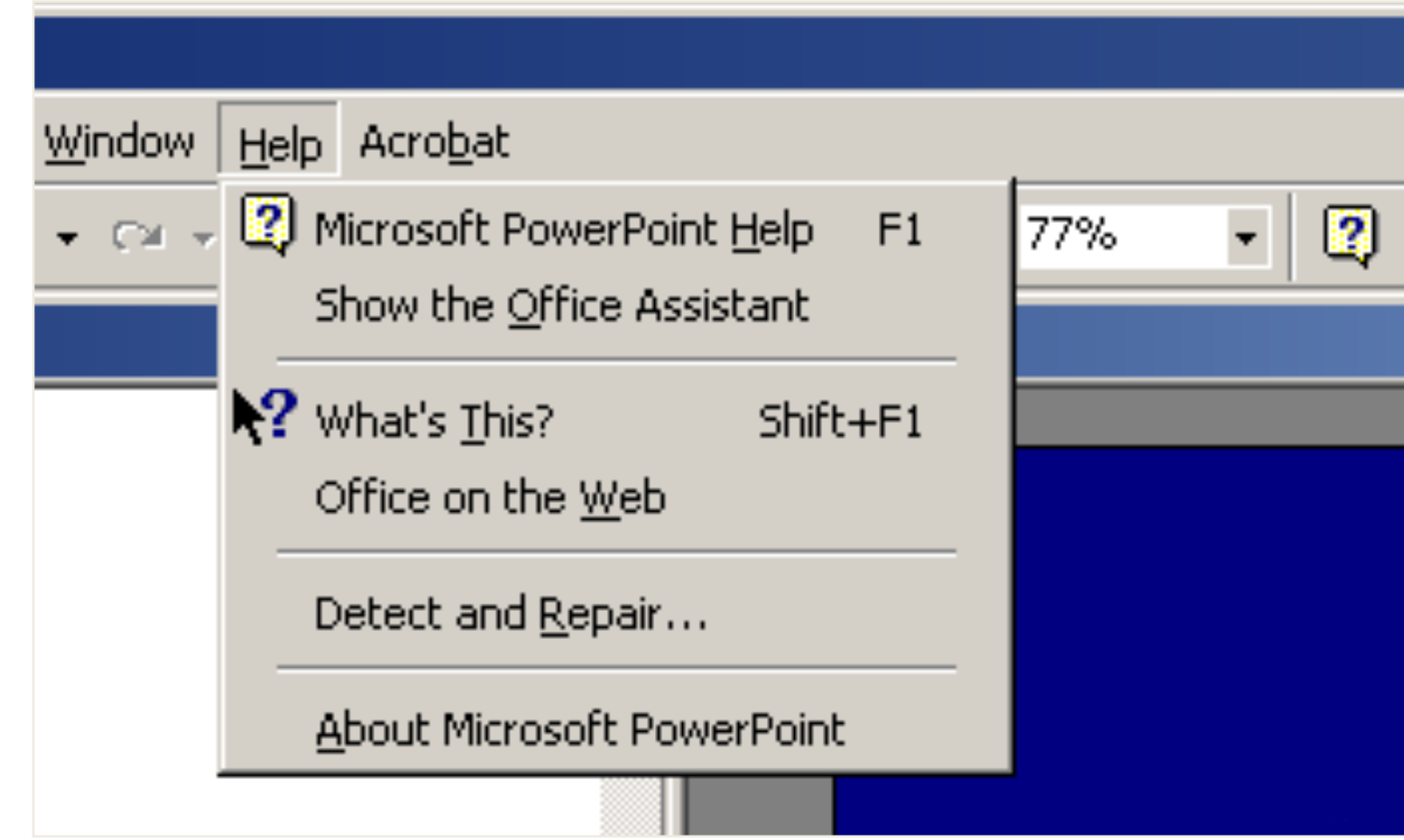


V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga
Nb	Mo	Tc	Ru	Name: Iron (Fe) Atomic Number: 26 Atomic Mass: 55.845				In
Ta	W	Re	Os					Tl
Db	Sg	Bh	Hs	Mt				

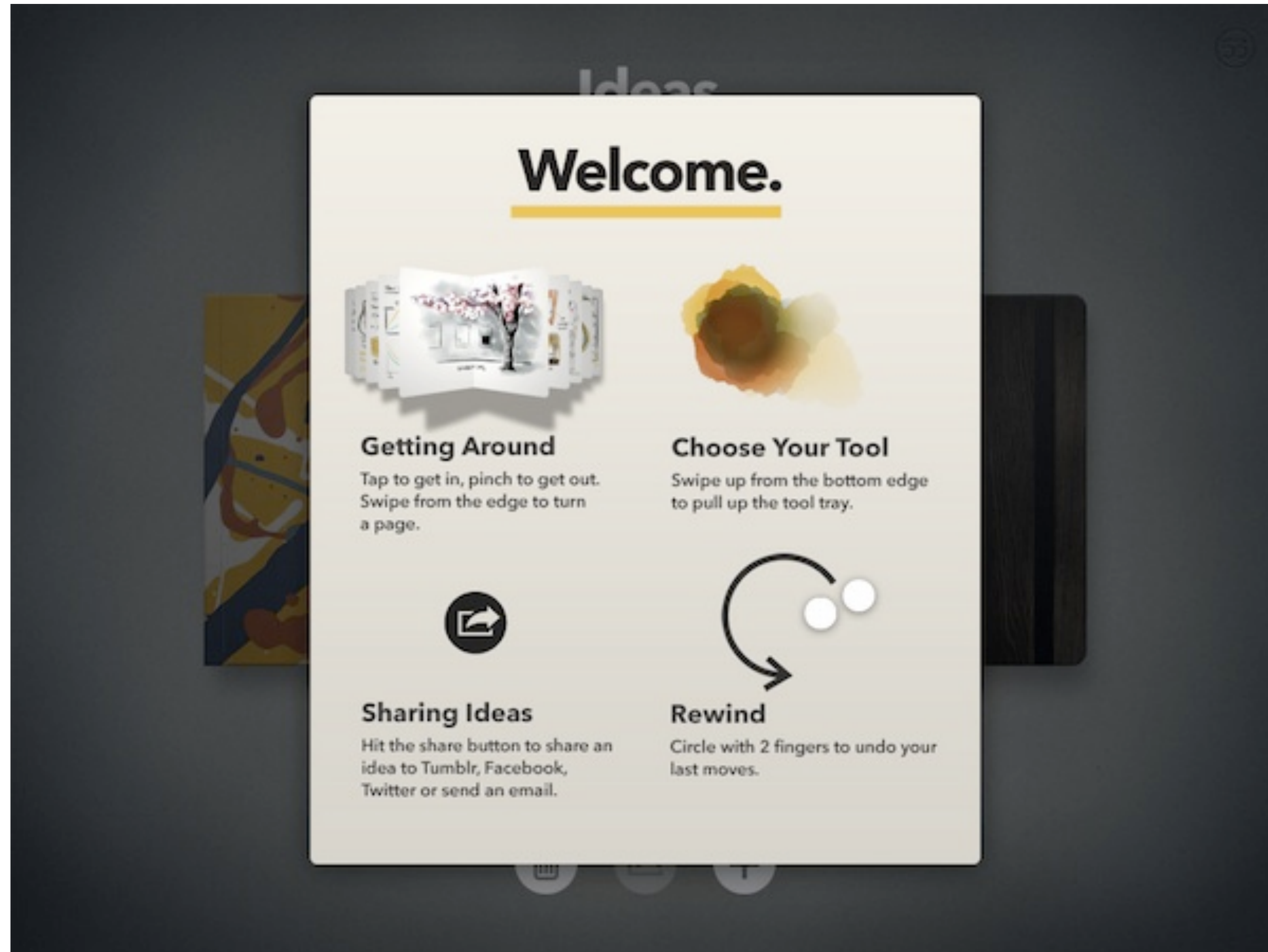
TYPES OF HELP

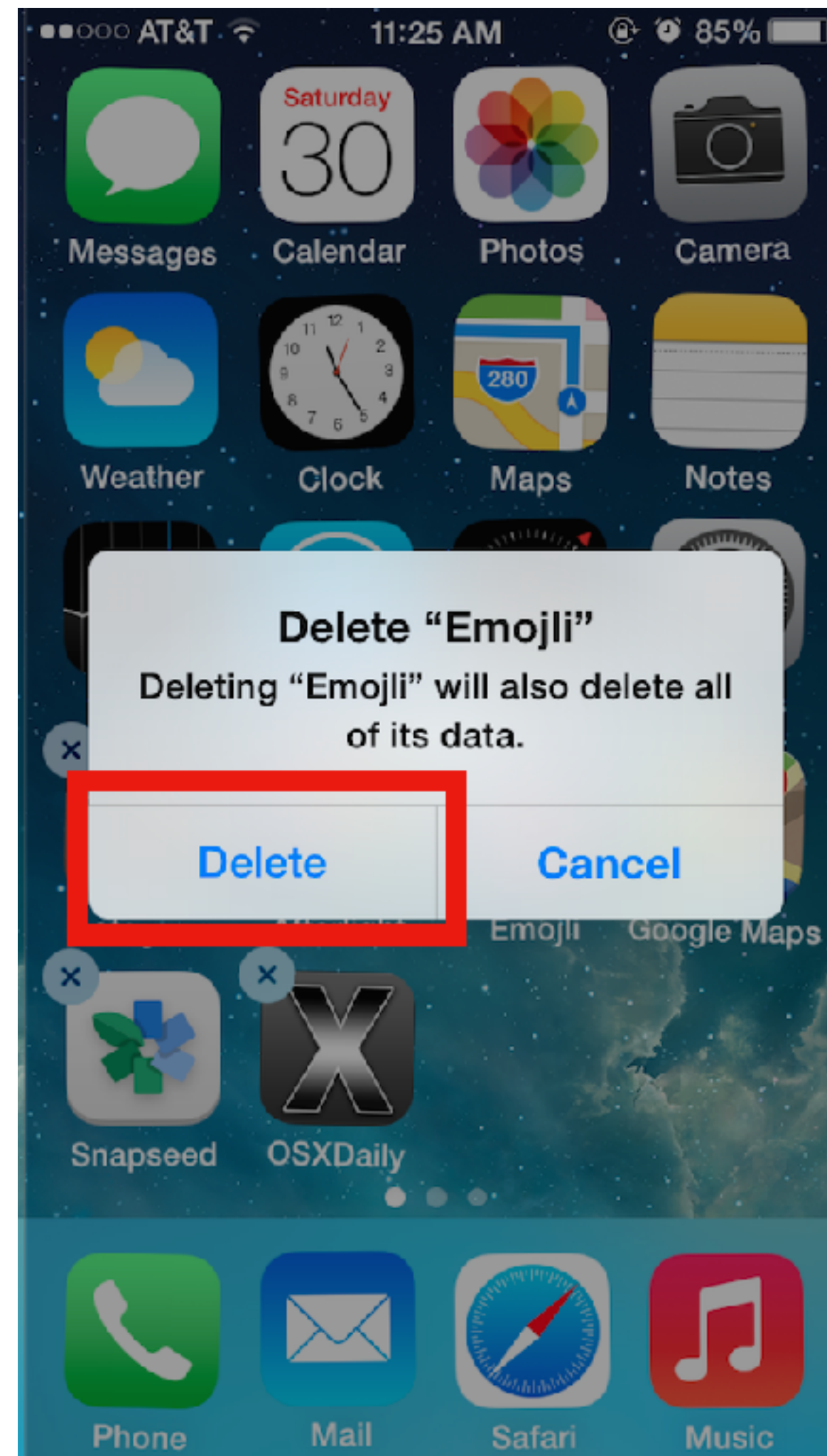
Context sensitive help

Search



NEW USER GUIDES





Suggestions just for you.

Based on your choices, here are some suggestions for you.
We recommend [following](#) all of them!

Follow 38 & continue

Suggestions for you



John Gruber @gruber · Aug 28

"She's like a drunk older woman on a cruise."

📍 The Las Vegas Strip, Paradise



Walt Mossberg @waltmossberg · Aug 29

Apple Built iOS 8, Developers Are Coming on.recode.net/1rylLYI via
[@InaFried](#) & [@DawnC331](#)



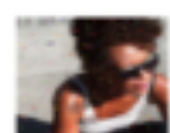
Danny Sullivan @dannysullivan · 20h

I can confirm saying "Xbox load Battlefield no wait scratch that load Titanfall" works. I found that pretty impressive.



Om Malik @om · 1h

Because I am missing Paris and my Parisian friends! [#latergram](#)
[#endofsummer](#) instagram.com/p/sVVRUUqThF/



△ **Jenna Wortham** △ @jennydeluxe · 24h

Some thoughts on Instagram's Hyperlapse, and Fast-Forwarding to the Future nyti.ms/1pqQfcZ



dick costolo @dickc · Aug 26

Snapchat at \$10b not absurd. Crazy growth, clear monetization path, & one of the best social product thinkers out there. Long (figuratively)



Laughing Squid @LaughingSquid · 1h

Iris the Tiny Piglet Bounds Through the Grass, Gets a Belly Rub and Goes for a Walk Around the Neighborhood laughingsquid.com/iris-the-tiny-...

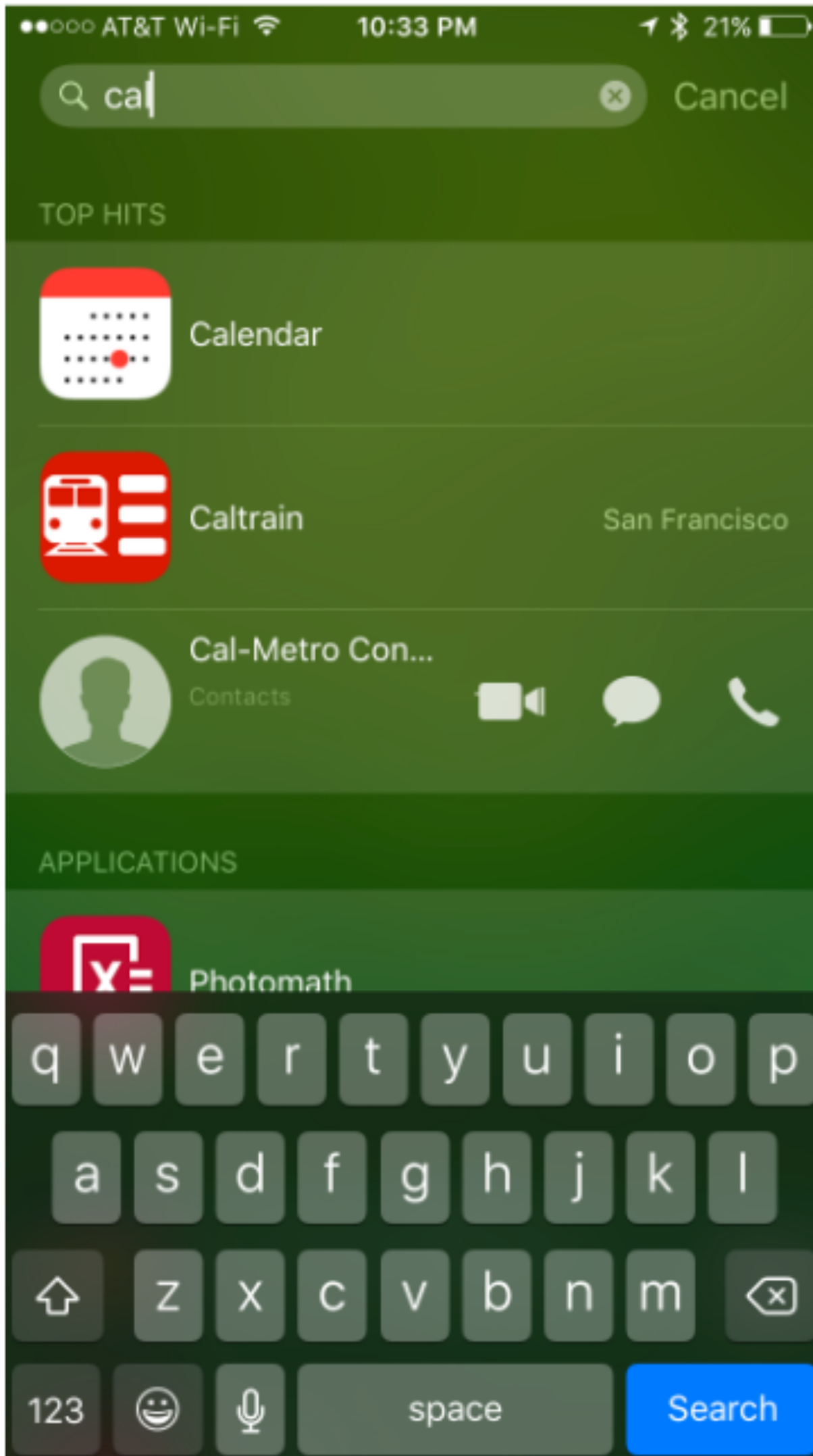


Cult of Mac @cultofmac · 22m

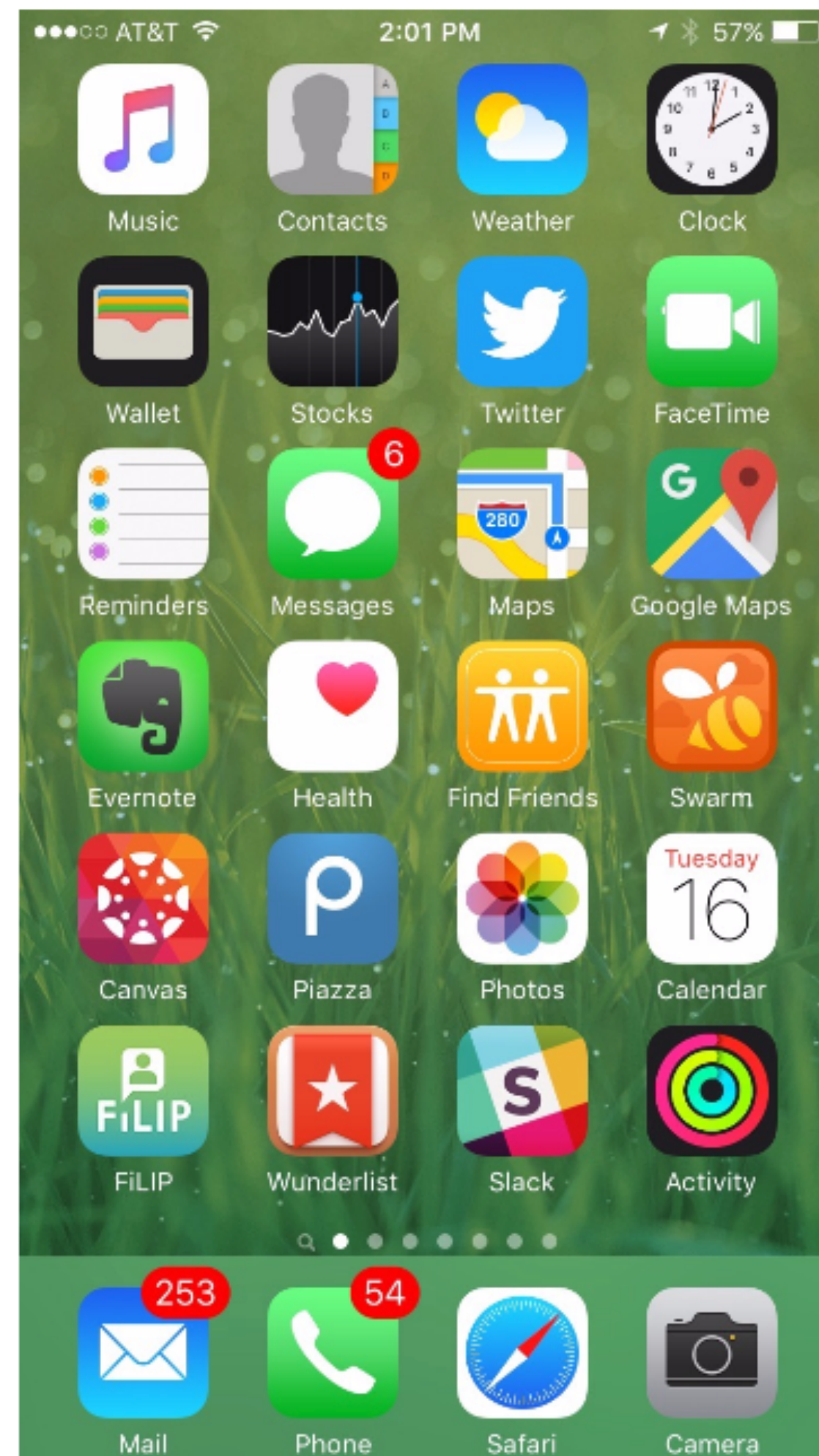
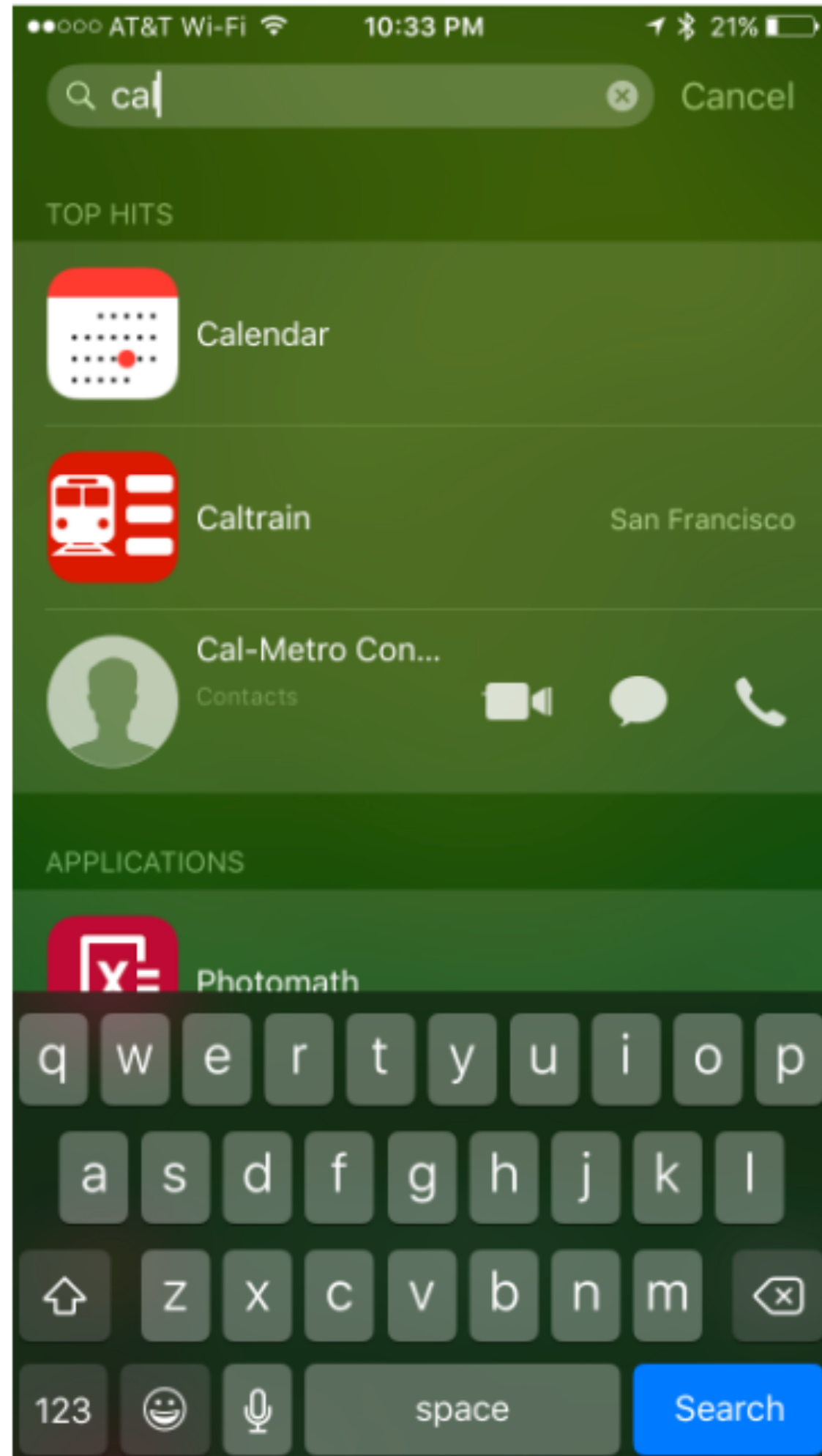
31. When you talk to Siri, the voice assistant that is part of Apple's iOS, it renders an animation of the sound levels as shown below. What HCI Heuristic is being used? (2 points)

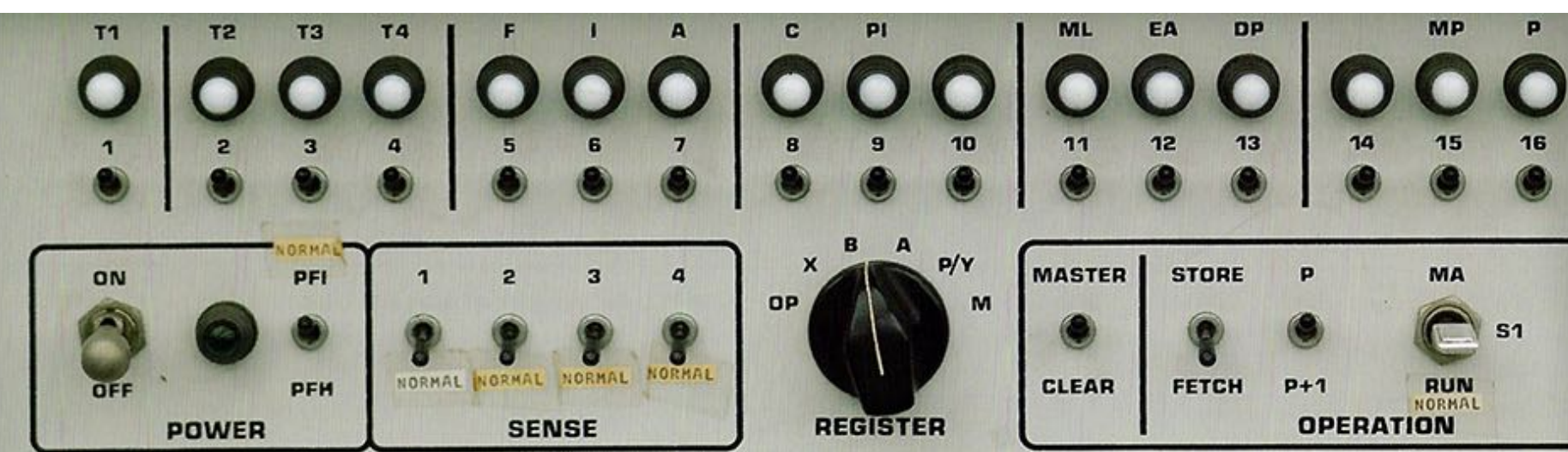


33. In Apple's iOS a user can type part of what they are looking for with suggestions dynamically appearing below. The example below shows a user trying to locate the Calendar App. Which HCI Heuristic is being used? (2 points)



34. Later a user is using the same iOS device from question 33 to locate the Calendar App using the main app view (see image below). Which HCI Heuristic is being violated here with respect to what is also shown in question 33. (2 points)





THE PROCESS OF HEURISTIC EVALUATION

PHASES OF HEURISTIC EVAL. (1-2)

1) Pre-evaluation training

Provide the evaluator with domain knowledge if needed

2) Evaluation

Individuals evaluate interface then aggregate results

Compare interface elements with heuristics

Work in 2 passes

First pass: get a feel for flow and scope

Second pass: focus on specific elements

Each evaluator produces list of problems

Explain why with reference to heuristic or other information

Be specific and list each problem separately

PHASES OF HEURISTIC EVAL. (3-4)

3) Severity rating

Establishes a ranking between problems

Cosmetic, minor, major and catastrophic

First rate individually, then as a group

4) Debriefing

Discuss outcome with design team

Suggest potential solutions

Assess how hard things are to fix

EXAMPLES

Typography uses mix of upper/lower case formats and fonts

Violates “Consistency and standards” (H-4)

Slows users down

Fix: pick a single format for entire interface

Probably wouldn't be found by user testing

LEVELS OF SEVERITY

- 0 - don't agree that this is a usability problem
- 1 - cosmetic problem
- 2 - minor usability problem
- 3 - major usability problem; important to fix
- 4 - usability catastrophe; imperative to fix

SEVERITY RATINGS EXAMPLE

1. [H-4 Consistency] [Severity 3]

The interface used the string "Save" on the first screen for saving the user's file, but used the string "Write file" on the second screen. Users may be confused by this different terminology for the same function.

DEBRIEFING

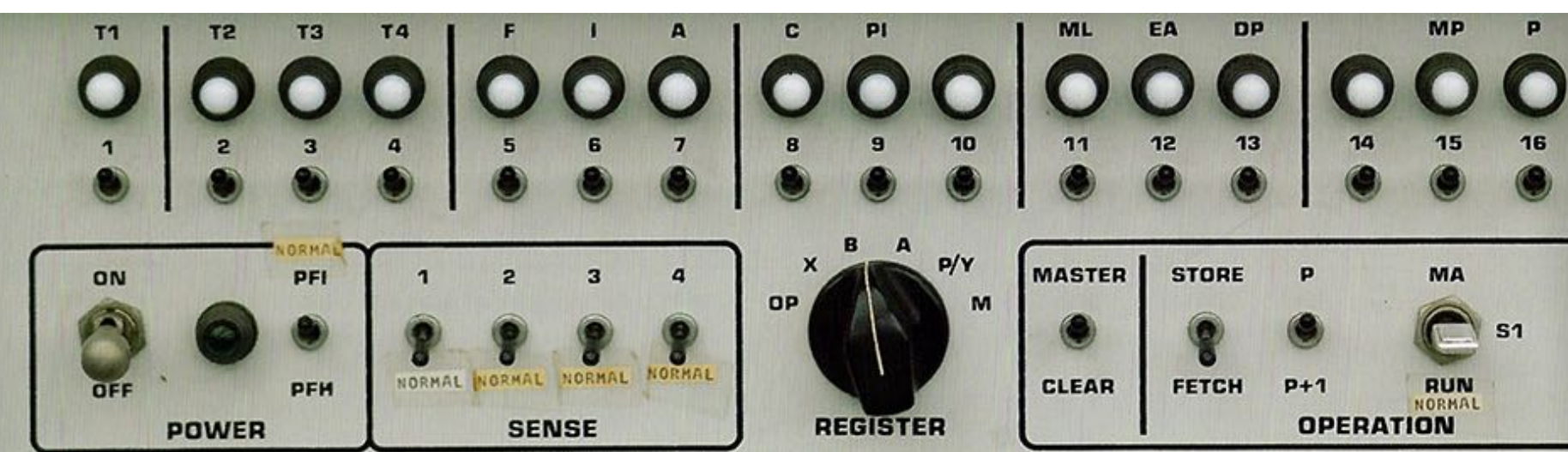
Conduct with evaluators, observers, and development team members

Discuss general characteristics of UI

Suggest improvements to address major usability problems

Development team rates how hard things are to fix

Make it a brainstorming session



PROS AND CONS OF HEURISTIC EVALUATION

HE VS. USER TESTING

HE is much faster

1-2 hours each evaluator vs. days-weeks

HE doesn't require interpreting user's actions

User testing is far more accurate

Takes into account actual users and tasks

HE may miss problems & find "false positives"

Good to alternate between HE & user-based testing

Find different problems

Don't waste participants

NUMBER OF EVALUATORS

Single evaluator achieves poor results

Only finds 35% of usability problems

5 evaluators find ~ 75% of usability problems

Why not more evaluators???? 10? 20?

Adding evaluators costs more

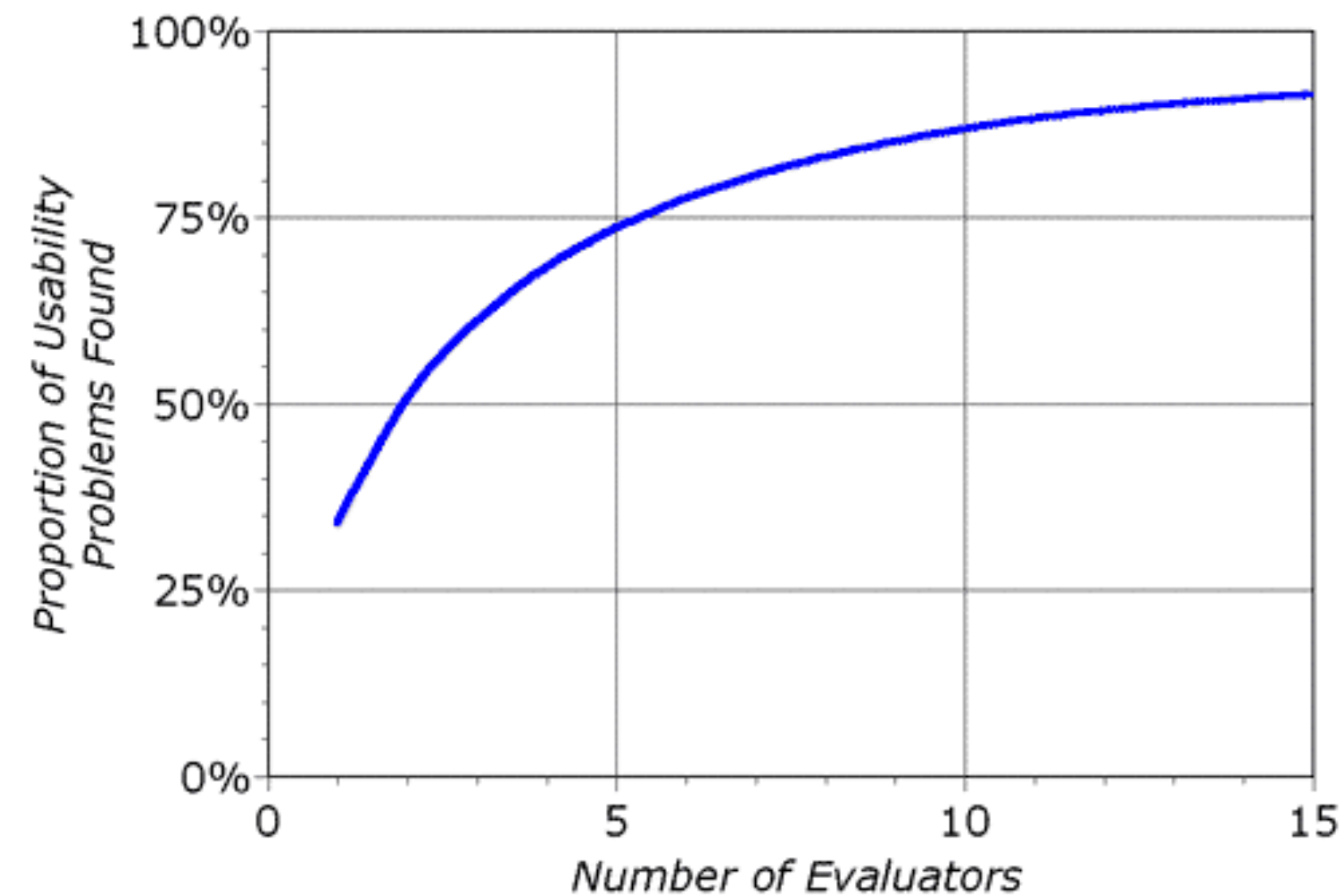
Many evaluators won't find many more problems

But always depends on market for product:

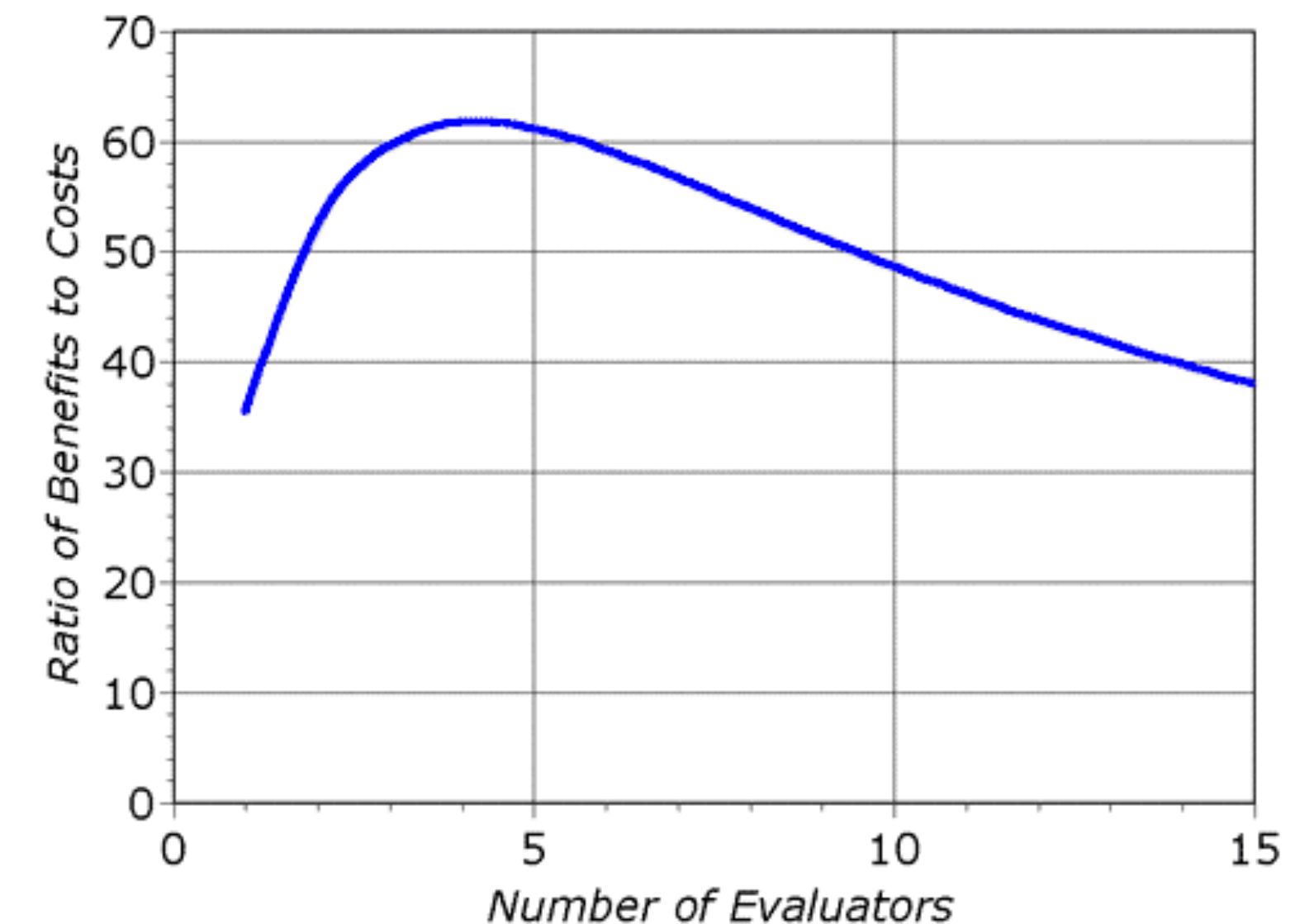
popular products → high support cost for small bugs

DECREASING RETURNS

Problems Found



Benefits / Cost



Caveat: graphs are for one specific example!

SUMMARY

Heuristic evaluation is a discount method

Have evaluators go through the UI twice

Ask them to see if it complies with heuristics

Note where it doesn't and say why

Have evaluators independently rate severity

Combine the findings from 3 to 5 evaluators

Discuss problems with design team

Cheaper alternative to user testing

Finds different problems, so good to alternate