

Interaction Techniques

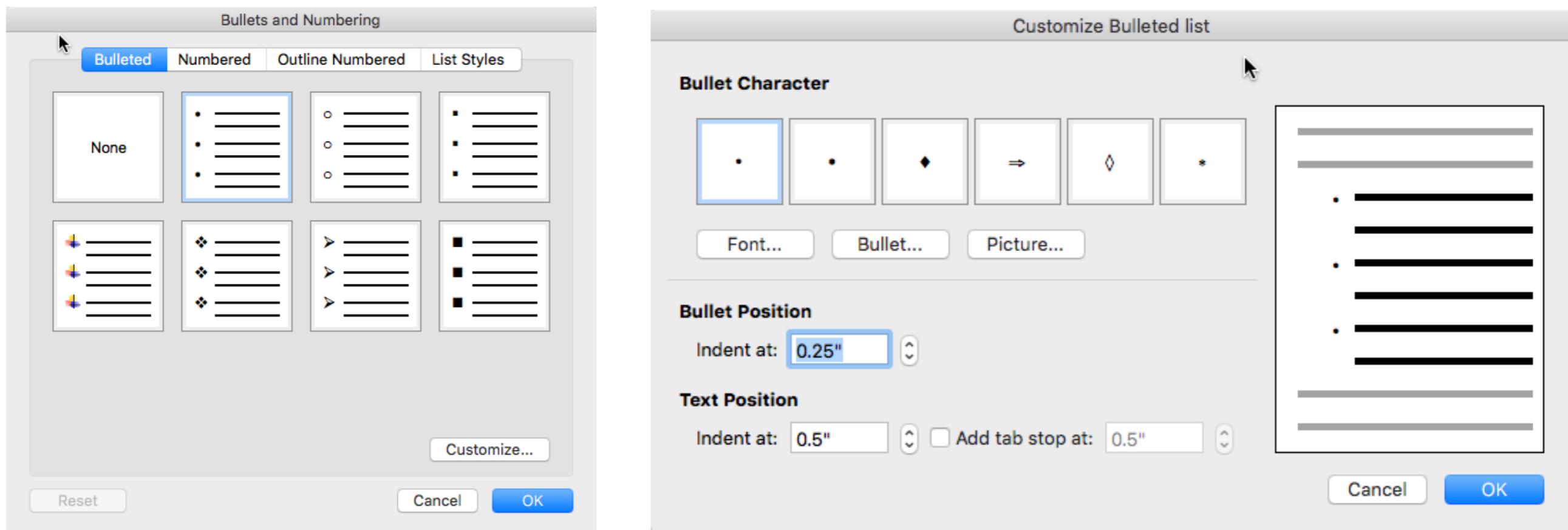
SWE 432, Fall 2019
Web Application Development

Review: Site Design vs Real World

- Challenges (differences from physical world):
 - No spatial sense of scale. 50 pages? 500 pages? 50,000 pages?
 - No sense of direction. Which way did I just go?
 - No sense of location. No spatial anchoring of where I am now and how that relates to where I could go.

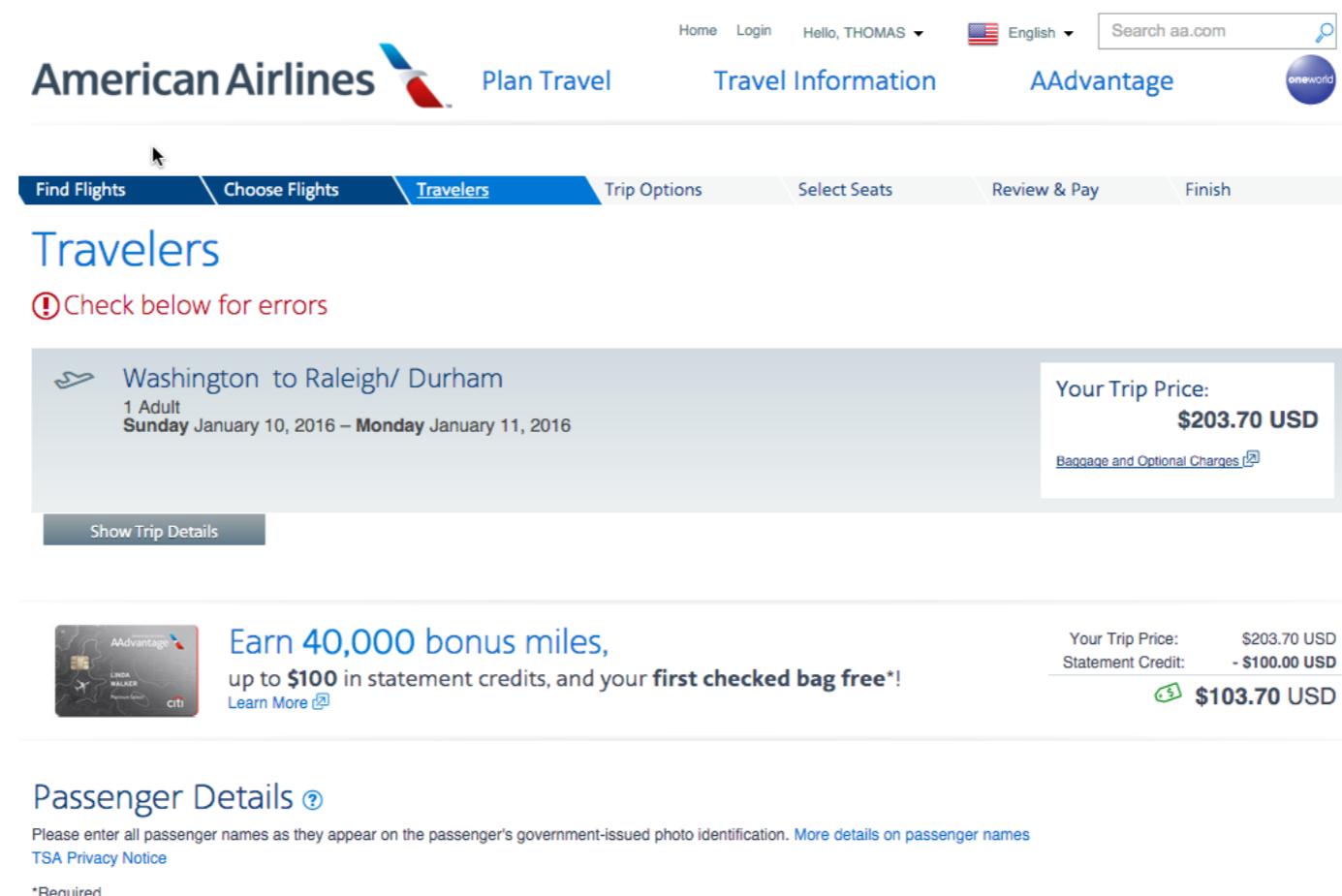
Review: Progressive disclosure

- a.k.a. details on demand
- Separate information & commands into layers
- Present most frequently used information & commands first



Review: Separate long tasks into sequences

- Reduce short term memory demands by having user only work on one aspect of larger task at a time
- Don't interrupt users in the middle with unrelated tasks
- Provide closure of each subtask at the end



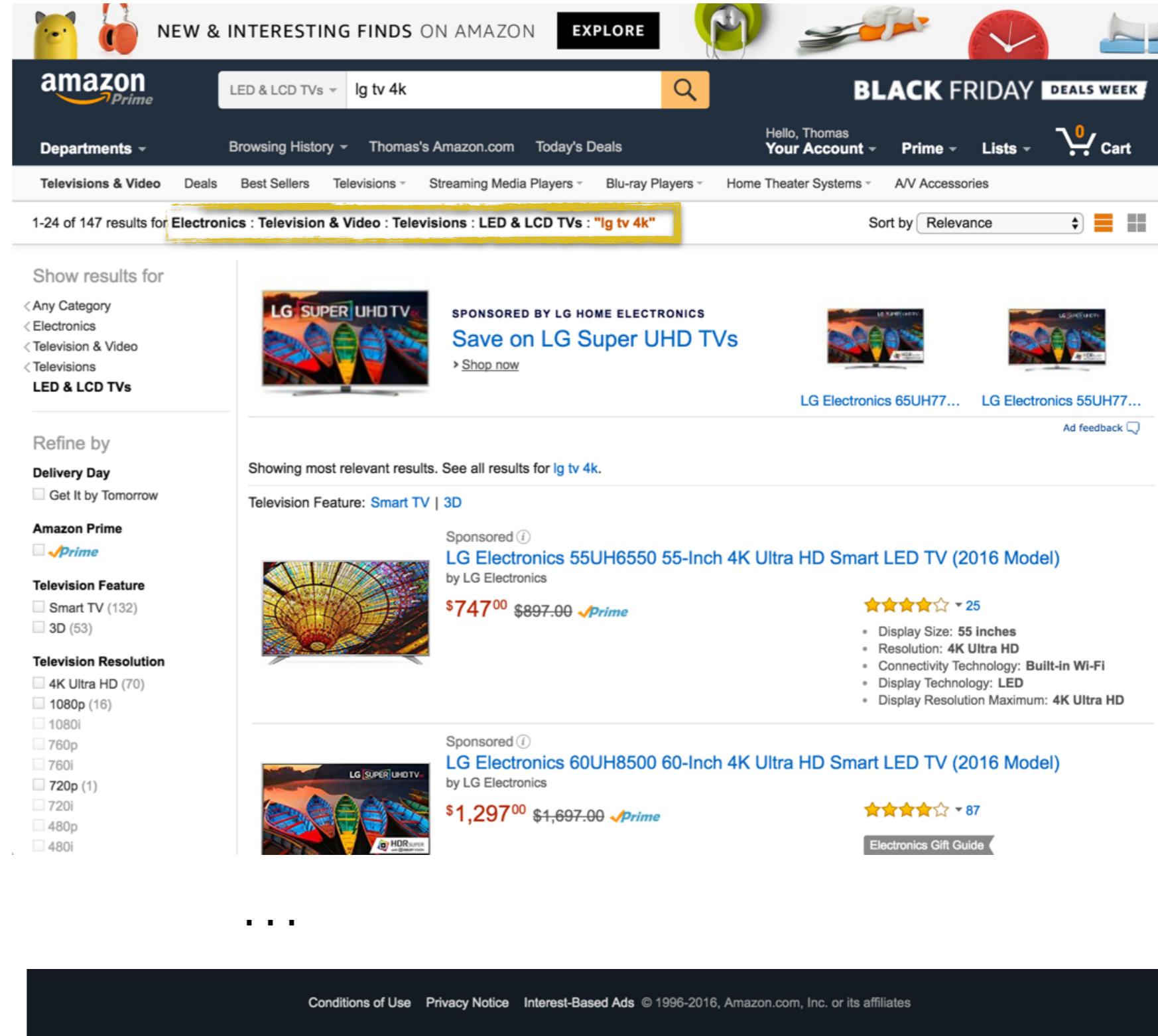
The screenshot shows the American Airlines website's 'Travelers' section. At the top, there's a navigation bar with links for Home, Login, Hello, THOMAS, English, and a search bar. Below the navigation is a breadcrumb trail: Find Flights > Choose Flights > Travelers. The main content area is titled 'Travelers' and includes a note 'Check below for errors'. It displays flight details: 'Washington to Raleigh/ Durham', '1 Adult', 'Sunday January 10, 2016 – Monday January 11, 2016'. To the right, it shows 'Your Trip Price: \$203.70 USD' and a link for 'Baggage and Optional Charges'. A 'Show Trip Details' button is located below the flight info. At the bottom, there's an offer for 'AAdvantage' cardholders: 'Earn 40,000 bonus miles, up to \$100 in statement credits, and your first checked bag free!'. It also shows the final price after a statement credit: 'Your Trip Price: \$203.70 USD', 'Statement Credit: -\$100.00 USD', and a total of '\$103.70 USD'. The 'Passenger Details' section is at the very bottom, with a note to enter passenger names as they appear on photo ID and links for 'TSA Privacy Notice' and an asterisk indicating required fields.

Review: Idioms

- A consistent mental model of how something works
 - e.g., Files: open / close / save / save as
- Offers intuitive understanding of affordances & interactions
- Provides consistent vocabulary for describing interactions
- Only have to learn it **once**
- Might have originated in real world, but thought of in terms of mental model for UI interactions

Review: Breadcrumbs

- Offer trail of where the user has been and how they got there
- Shows hierarchy of information space
- Shows current location



The screenshot shows the Amazon search results for "lg tv 4k". The search bar at the top contains "lg tv 4k". The breadcrumb navigation path is highlighted with a yellow box: "1-24 of 147 results for Electronics : Television & Video : Televisions : LED & LCD TVs : "lg tv 4k"".

On the left, there is a sidebar with "Show results for" and "Refine by" sections. The "Refine by" section includes filters for Delivery Day (Get It by Tomorrow), Amazon Prime (Prime), Television Feature (Smart TV, 3D), and Television Resolution (4K Ultra HD, 1080p, 1080i, 760p, 760i, 720p, 720i, 480p, 480i).

The main content area displays sponsored and non-sponsored product listings. The first listing is for an LG Super UHD TV, followed by the LG Electronics 55UH6550 55-Inch 4K Ultra HD Smart LED TV (2016 Model) and the LG Electronics 60UH8500 60-Inch 4K Ultra HD Smart LED TV (2016 Model). Each listing includes the product image, price, original price, Prime status, and a star rating.

At the bottom of the page, there are links for Conditions of Use, Privacy Notice, Interest-Based Ads, and a copyright notice: "© 1996-2016, Amazon.com, Inc. or its affiliates".

Today

- What principles guide the design of usable interaction techniques?
 - How can interaction designs help support making plans, taking action, and interpreting feedback?
 - How does a direct manipulation interface make complex tasks easier?

HW5: User Experience Design

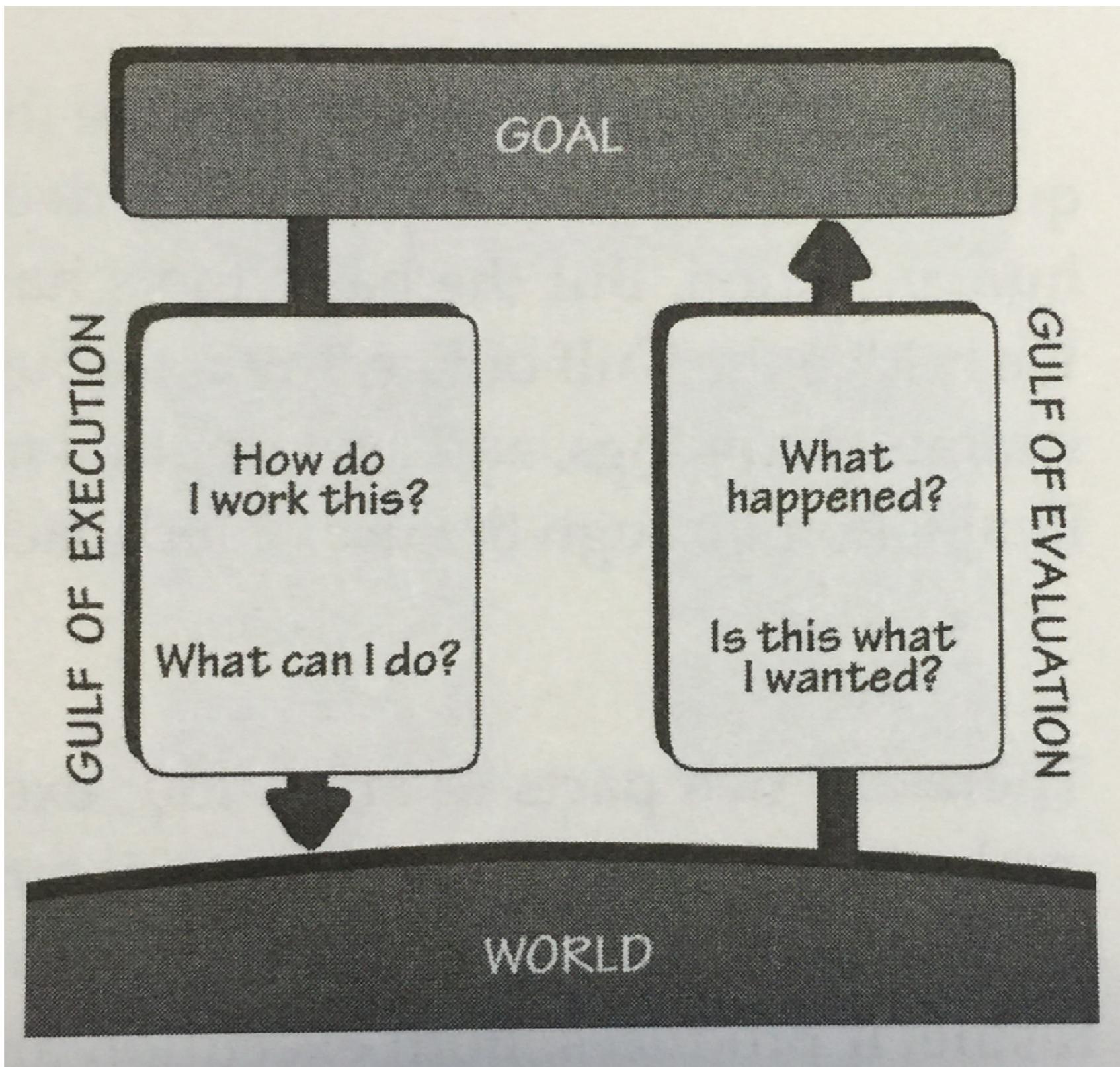
Interaction technique

- A method by which a user can perform an action or sequence of actions with a computer.
- Might encompass **software** (e.g., accelerators on a menu) and/or specialized **hardware** (momentum scrolling on iOS)
- What makes a good interaction technique?
 - Usability: task performance, discoverability, learnability, ...

Example: Filtering

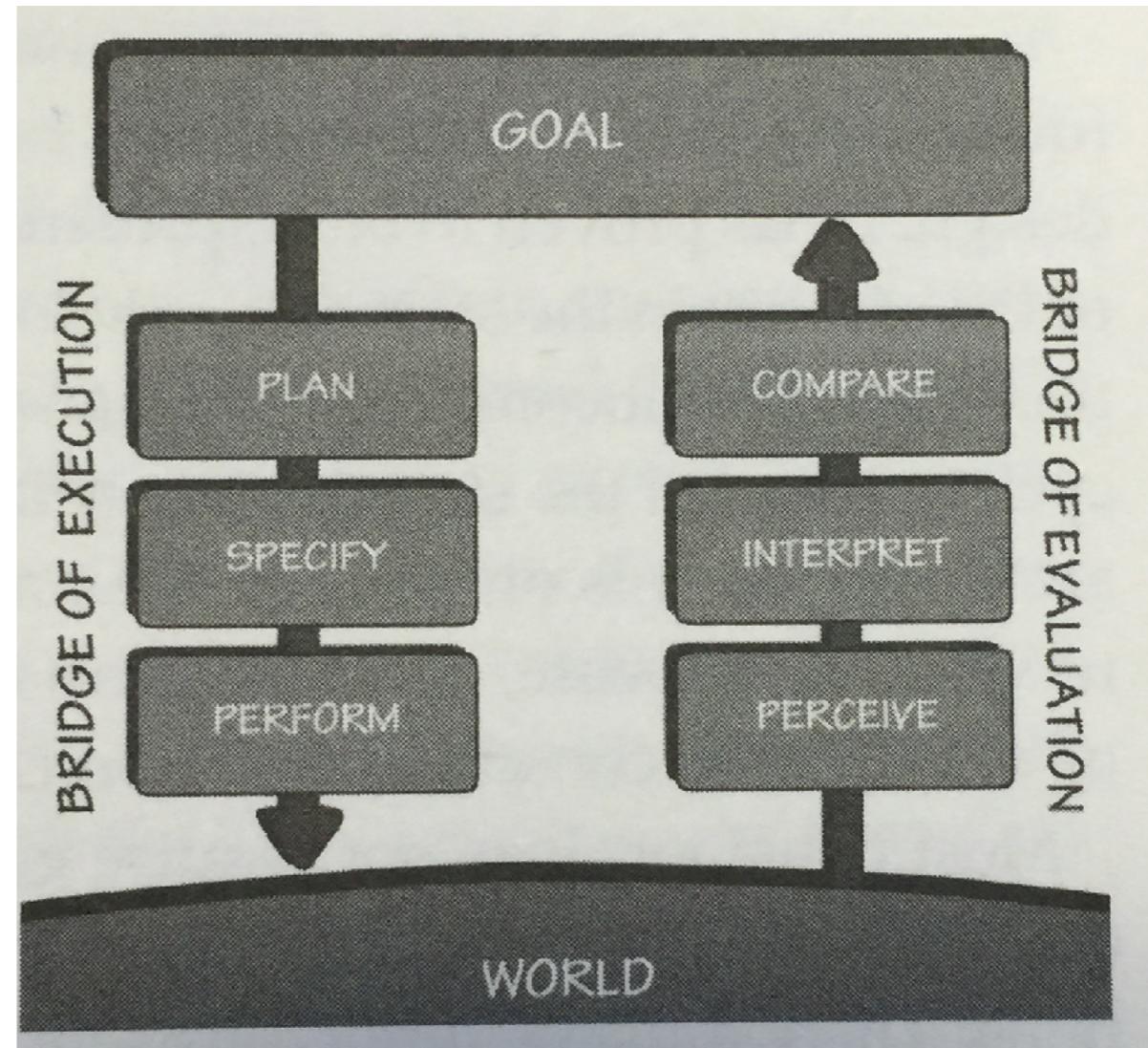
- www.target.com

Gulfs of execution and evaluation



Norman's 7 stages of action

1. Goal (form the goal)
2. Plan (the action)
3. Specify (action sequence)
4. Perform (action sequence)
5. Perceive (the state of the world)
6. Interpret (the perception)
7. Compare (outcome w/ goal)



Signifiers

- a.k.a “cognitive affordances” [Hartson & Pyla]
- Goals
 - Show which UI elements can be manipulated
 - Show how they can be manipulated
 - Help users get started
 - Guide data entry
 - Suggest default choices
 - Support error recovery

Hinting

- Indicate which UI elements can be interacted with
- Possible visual indicators
 - Static hinting - distinctive look & feel
 - Dynamic hinting - rollover highlights
 - Response hinting - change visual design with click
 - Cursor hinting - change cursor display

Help users predict outcome of actions

- What does this do?
- Should I click it?



Clarity of wording (Example)

- Design for clarity & precision

Implement Function Behavior (10 Pts) 

Implement a behavior for this function

Back Dispute this test Inspect code Run Tests

STATUS failed

DESCRIPTION it should throw an exception if the parameters are invalid

EXECUTION TIME 6ms

MESSAGE expected 4 to equal 3

DIFF 3 - 4

CODE

```
1  expect(calculate('+',[1,2])).to.equal(3);
```

Function Editor

```
11  * @return {Number}
12  */
13 function calculate(command,numbers){
14  if( ['*','/','+','-'].indexOf(command) == -1 )
15      throw 'command not recognized'
16
17  if( !(numbers instanceof Array) || numbers.length === 0)
18      throw 'numbers not valid';
19
20  switch( command ){
21      case '+':
22          var res = sum(numbers[0],numbers[1]);
23          return res; sum(numbers[0],numbers[1]) X
24          case '*':
25              var res = prod
26              return res;
27          default:
28      }
```

1. Line 15: Missing semicolon.

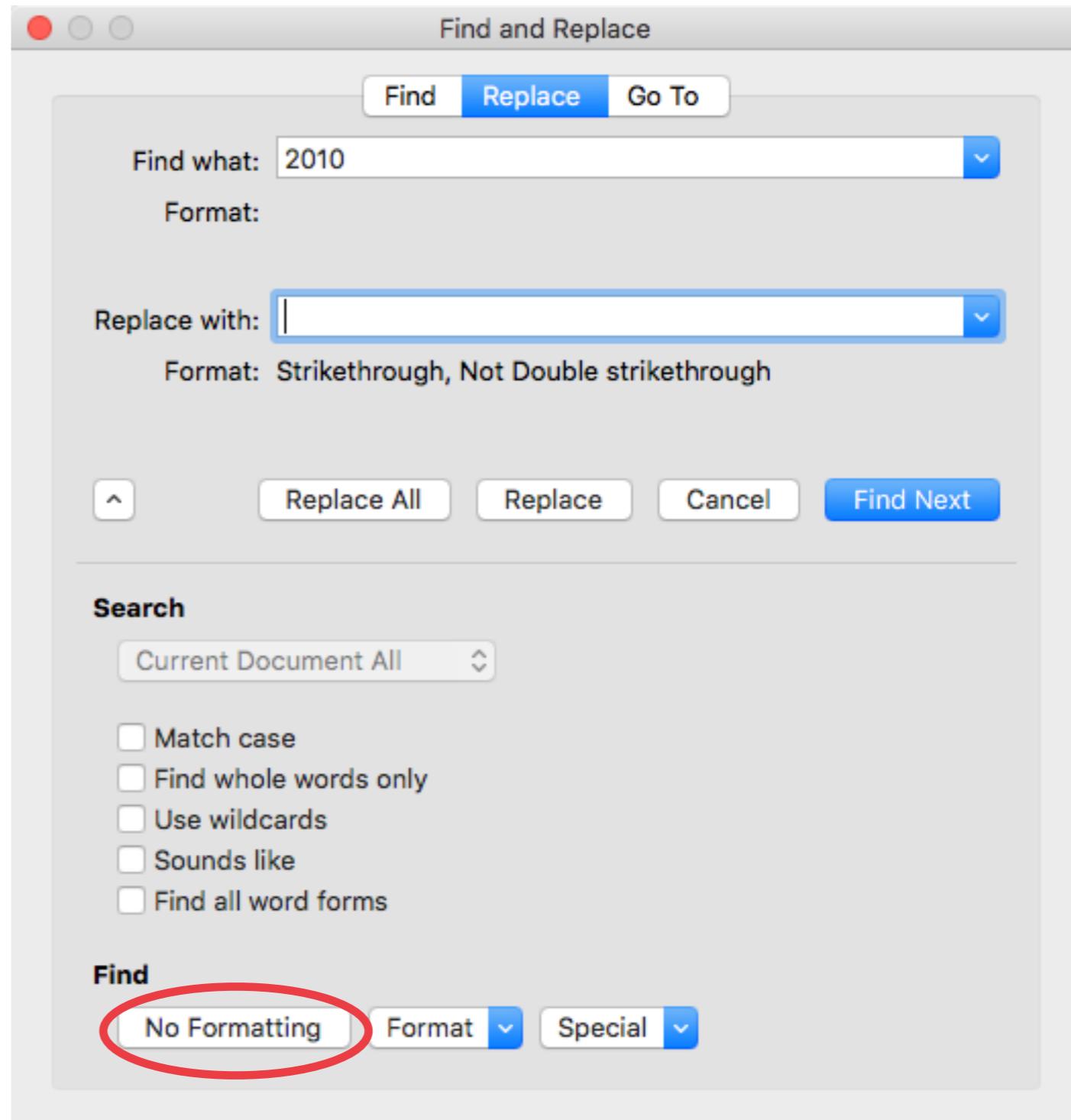


Clarity of wording

- Choose words carefully
- Speak the user's language
- Avoid vague, ambiguous terms
- Be as specific as possible
- Clearly represent domain concepts

Consistency

- In use of **terms**
 - e.g., do not use “revise” and “edit” interchangeably
- In how commands **map** to UI interactions



Likely & useful defaults

- Default text, if relevant (e.g., date)
- Default cursor position
- Avoid requirements to retype & re-enter data

Avoid using modes

- Modes create inconsistent mapping
 - E.g., control S sometimes saves, sometimes sends email
 - Especially dangerous for frequent interactions that become highly automatic actions
- Avoid when possible
- Clearly distinguish if necessary

Physical actions

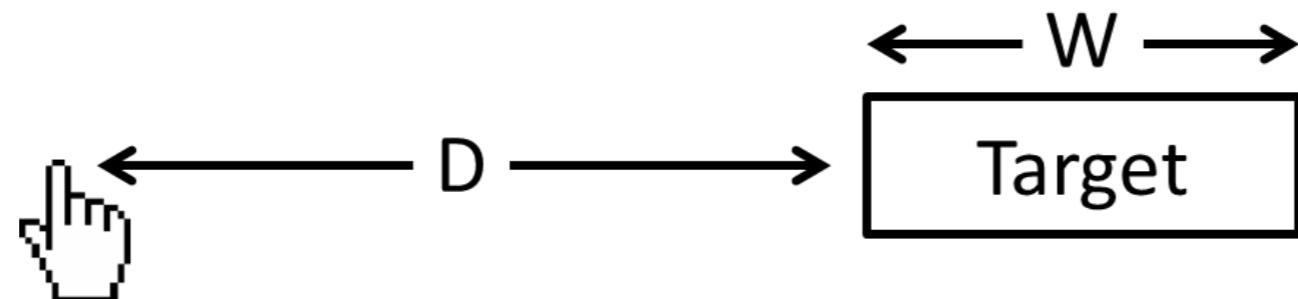
Provide intermediate feedback during interactions

- As user is interacting with objects, provide feedback on interactions
- Examples
 - While dragging object, show new position
 - As selecting text, show selection
 - While clicking on button, show button changing

Avoid physical awkwardness

- Switching between input devices takes time
- Avoid forcing user to constantly switch between input devices (e.g., keyboard & mouse)
 - e.g., Effective tab order between fields
- Avoid awkward keyboard combinations

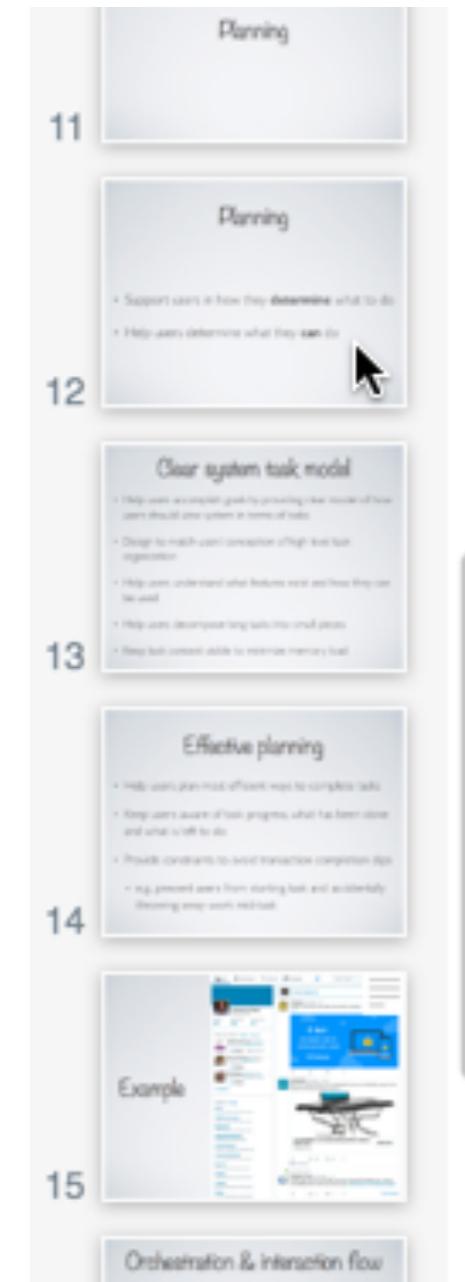
Fitt's law



- Time required to move to a target **decreases** with target **size** & **increases** with **distance** to the target
- Movements typically consist of
 - one large quick movement to target (**ballistic** movement)
 - fine-adjustment movement (**homing** movements)
- Homing movements generally responsible for most of movement time & errors
- Applies to rapid pointing movements, not slow continuous movements

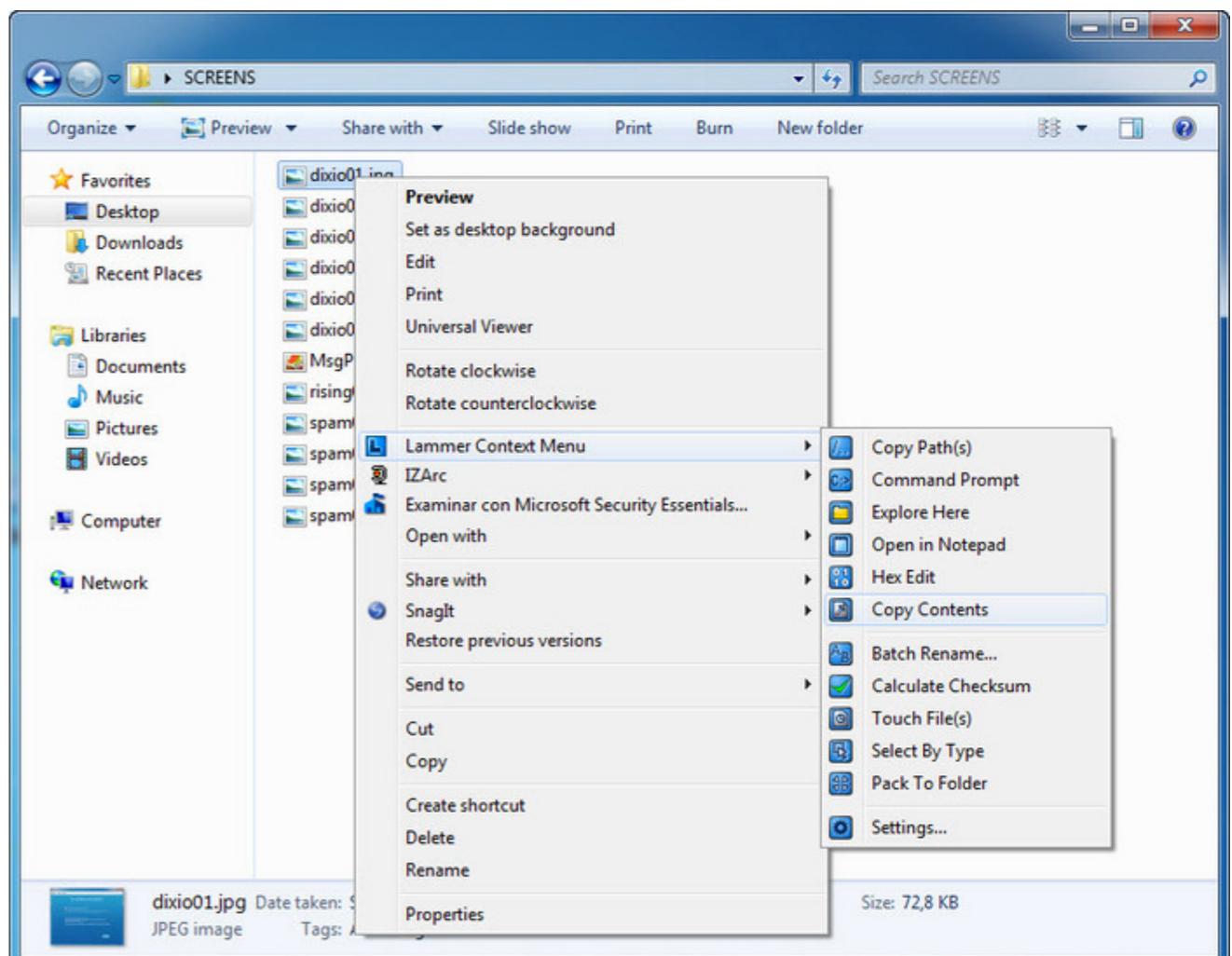
Design implications of Fitt's law

- **Constraining** movement to one dimension dramatically increases speed of actions
 - e.g., scroll bars are 1D



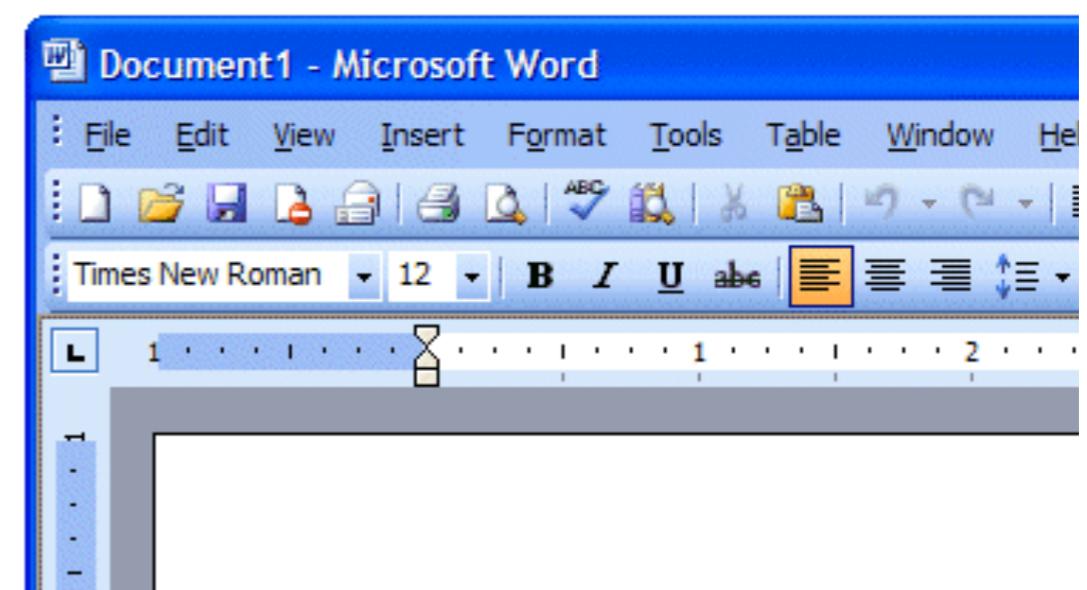
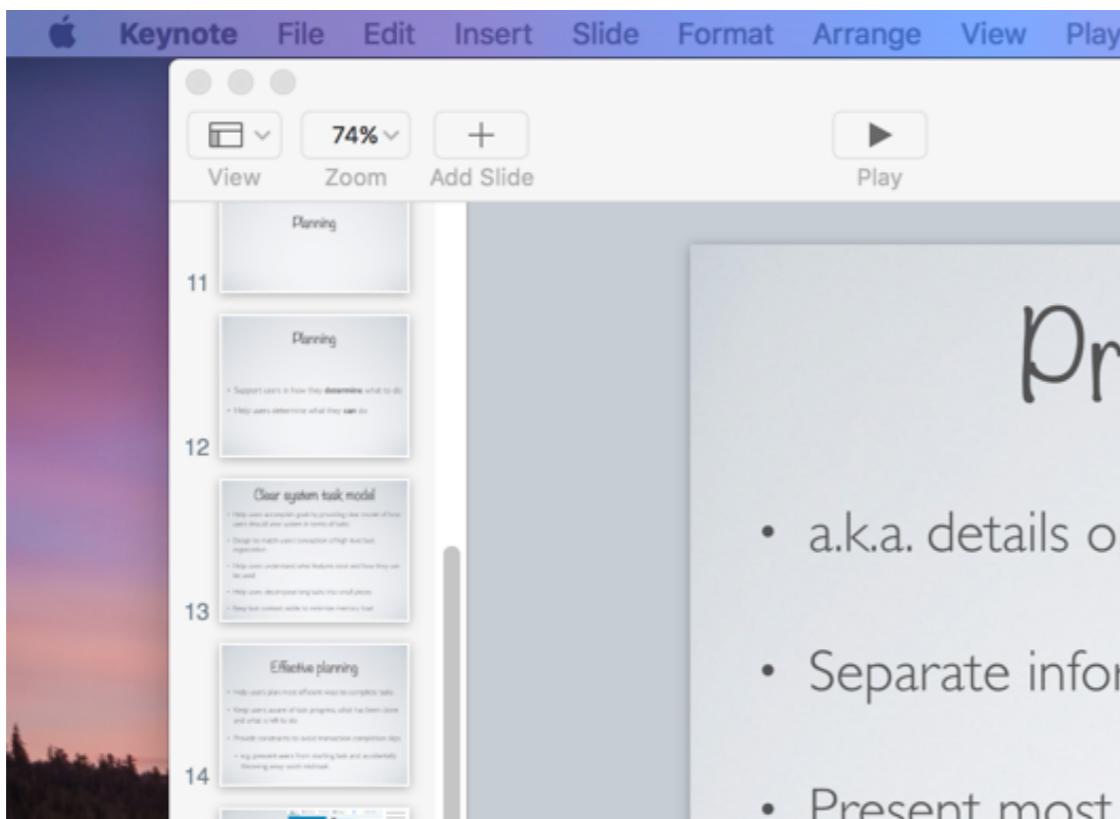
Design implications of Fitt's law

- Making controls **larger** reduces time to invoke actions
- Locating controls closer to user **cursor** reduces time
 - e.g., context menus



Design implications of Fitt's law

- Positioning button or control along **edge** of screen acts as barrier to movement, substantially reducing homing time & errors

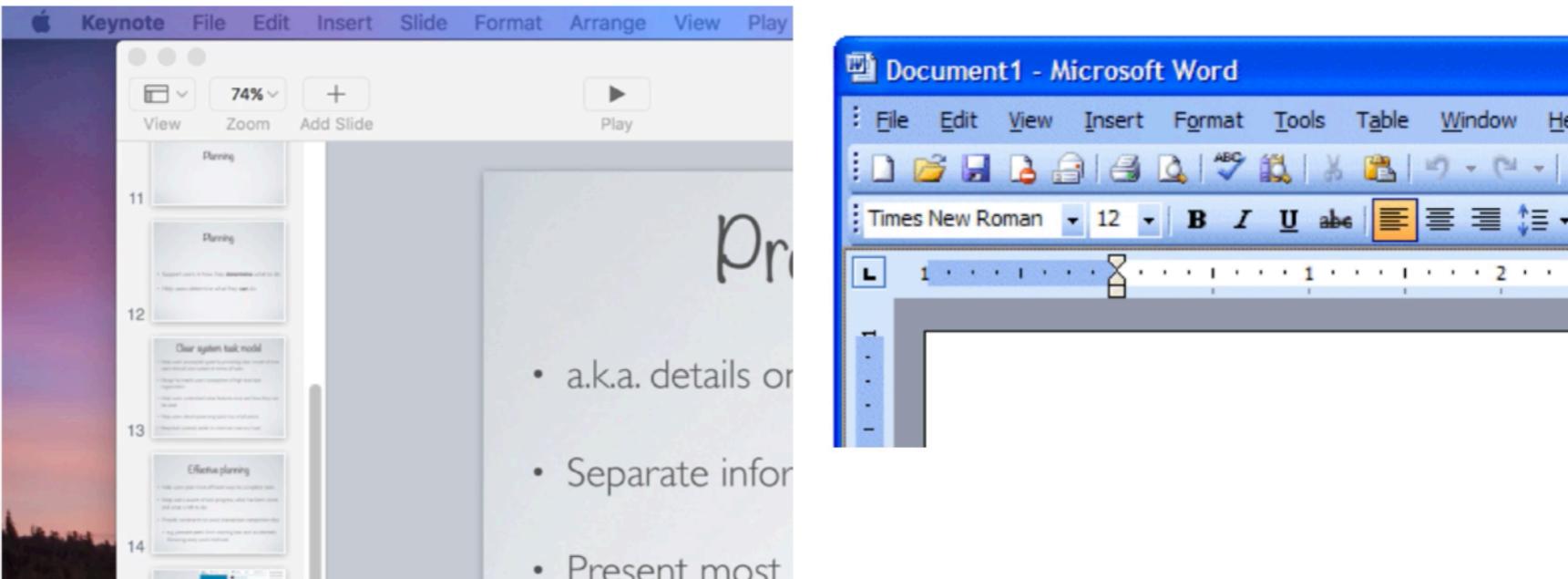


- a.k.a. details or...
- Separate information
- Present most...

Design implications of Fitt's Law

- Problem: How to benefit from both having menu near the mouse at all times AND have the barriers?

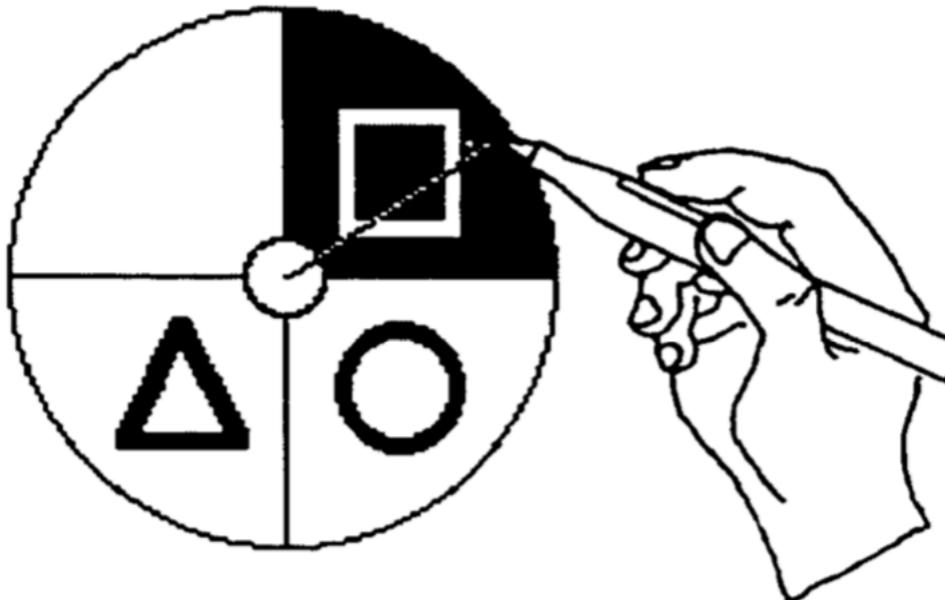
- Positioning button or control along **edge** of screen acts as barrier to movement, substantially reducing homing time & errors



The image contains two screenshots of software interfaces. The left screenshot shows a Keynote presentation slide with a sidebar containing numbered items 11 through 14. The right screenshot shows a Microsoft Word document with a ribbon menu at the top and a toolbar below it.

Alternatives: Pie menu

- Only angle matters, not distance
- Advantages:
 - Faster to select angle than distance
 - Fixed distance to travel
 - Scale independent
- Disadvantages:
 - Angle varies with number of items (can't always have shared items in same place)
 - Large?

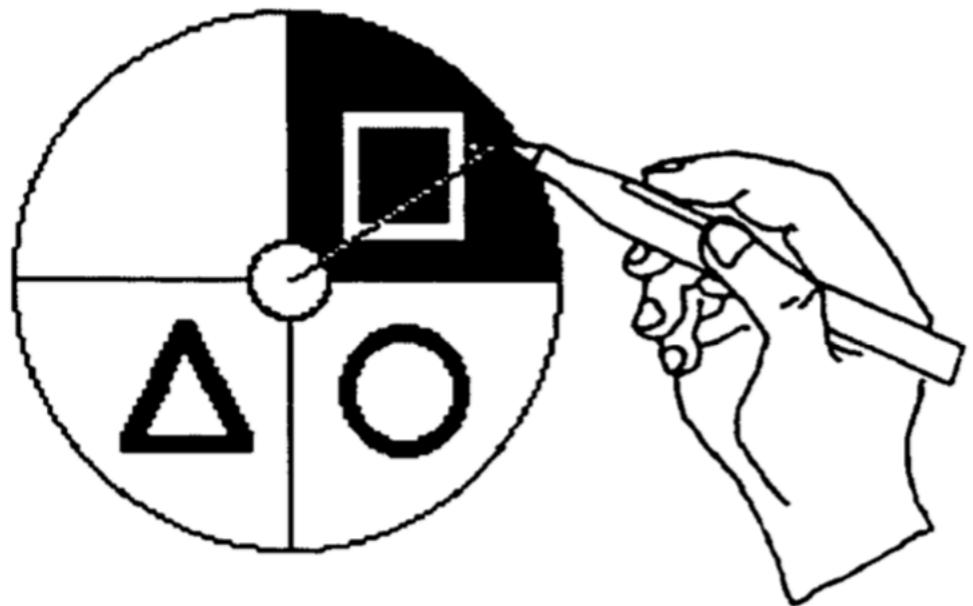


Kurtenbach '93

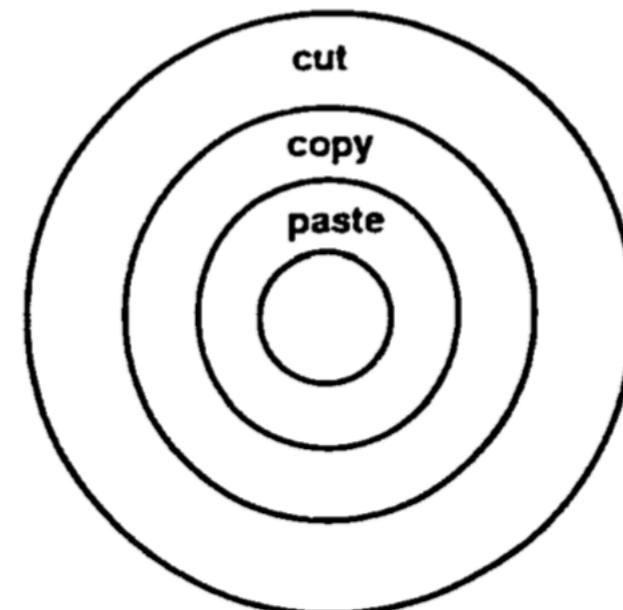
More: <https://medium.com/@donhopkins/the-design-and-implementation-of-pie-menus-80db1e1b5293>

Alternatives: Bullseye

- Only distance matters, not angle
- Scale dependent

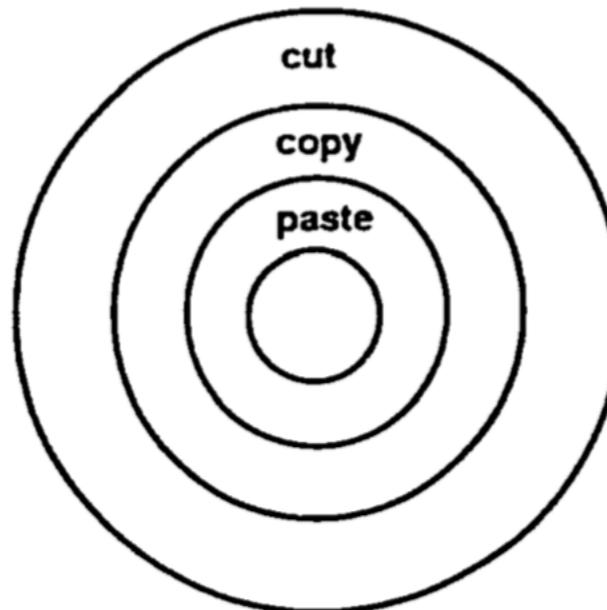
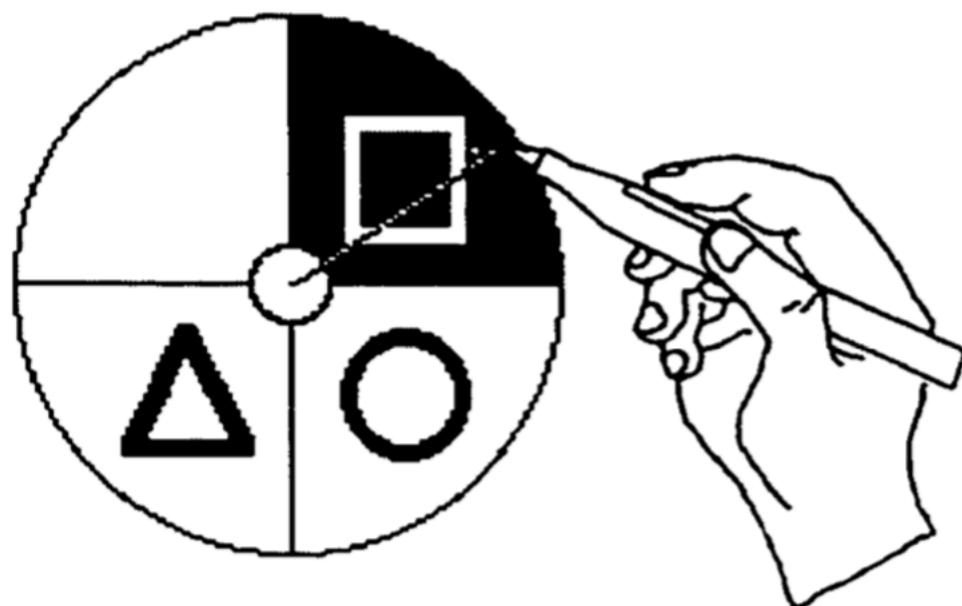


Kurtenbach '93



Alternatives: Dart Board

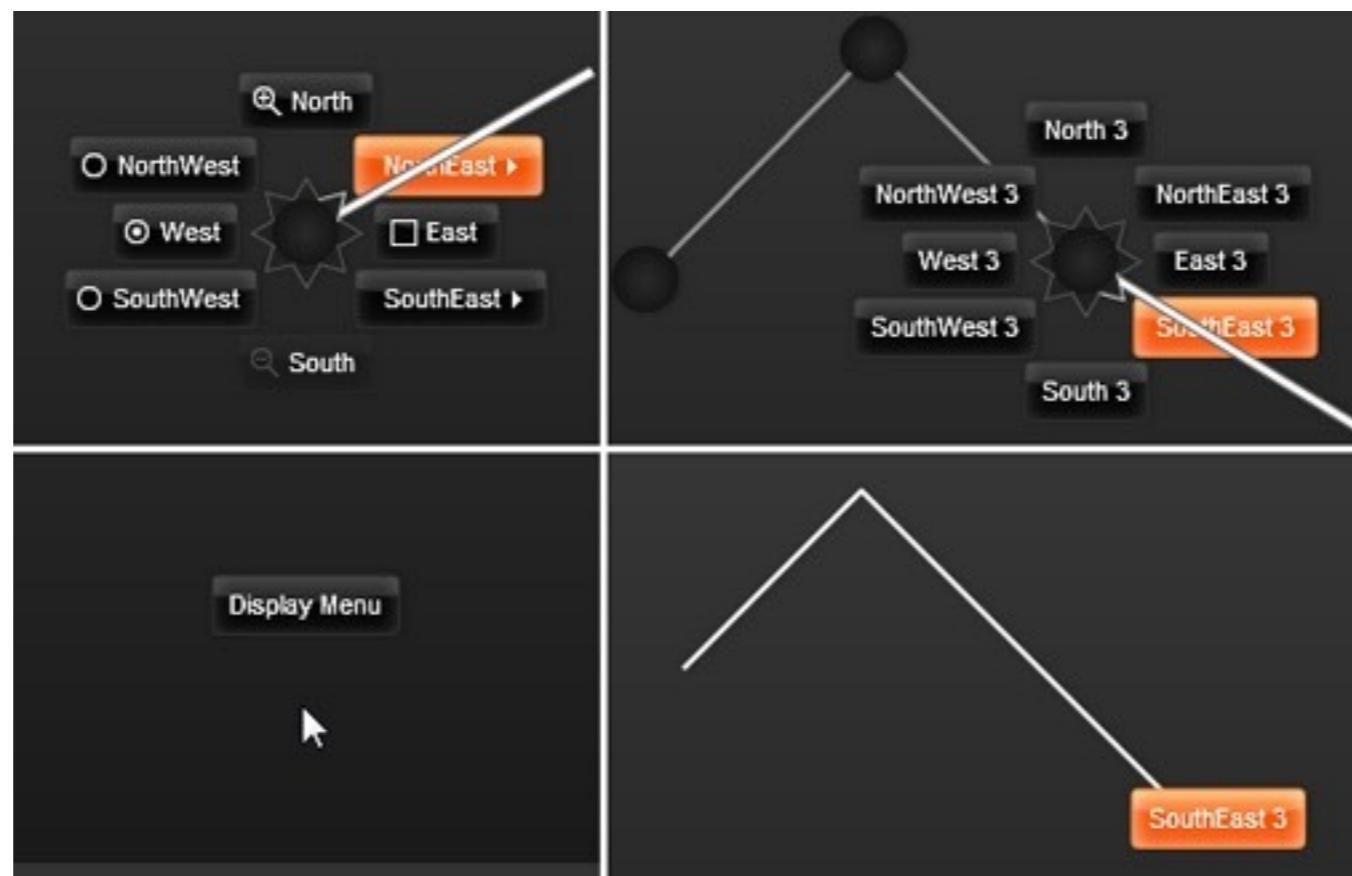
- Angle + Distance



Kurtenbach '93

Accelerating Menus - Marking Menus

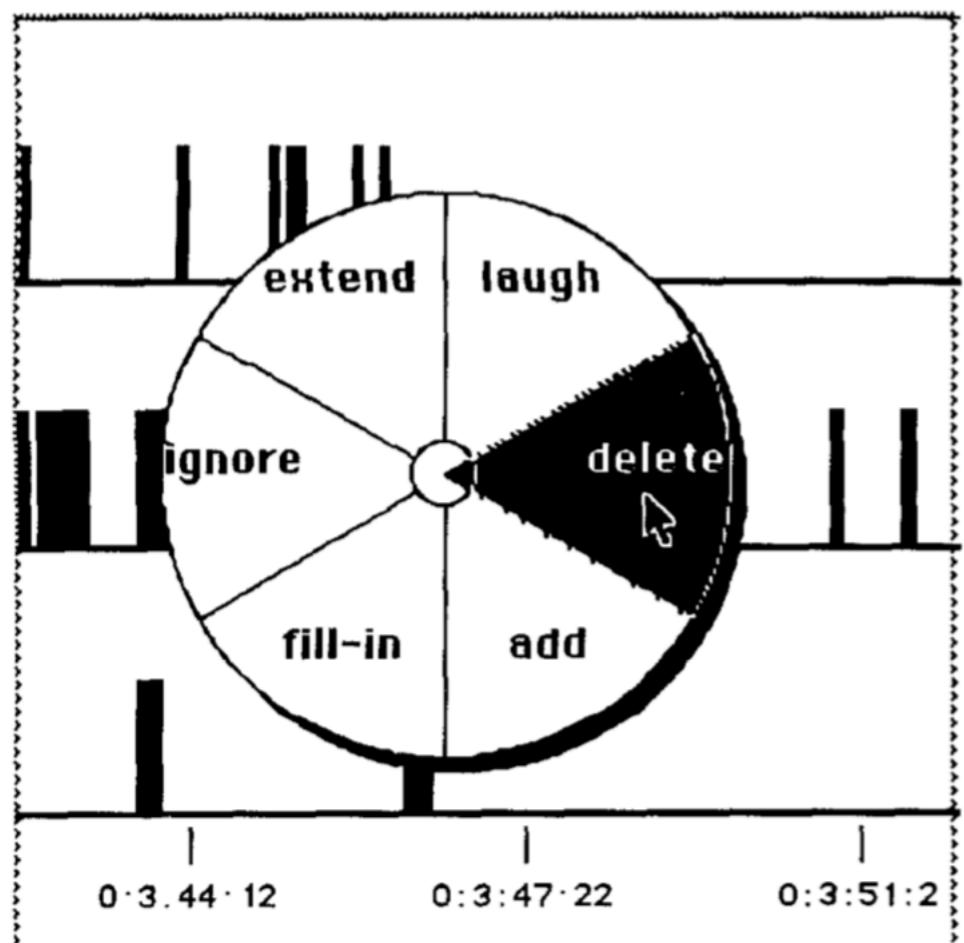
- Idea: focus on the **movement** and not just the visual properties
- Just like the pie, but if you hold mouse and draw, the system interprets as a gesture
- <https://www.youtube.com/watch?v=dtH9GdFSQaw>



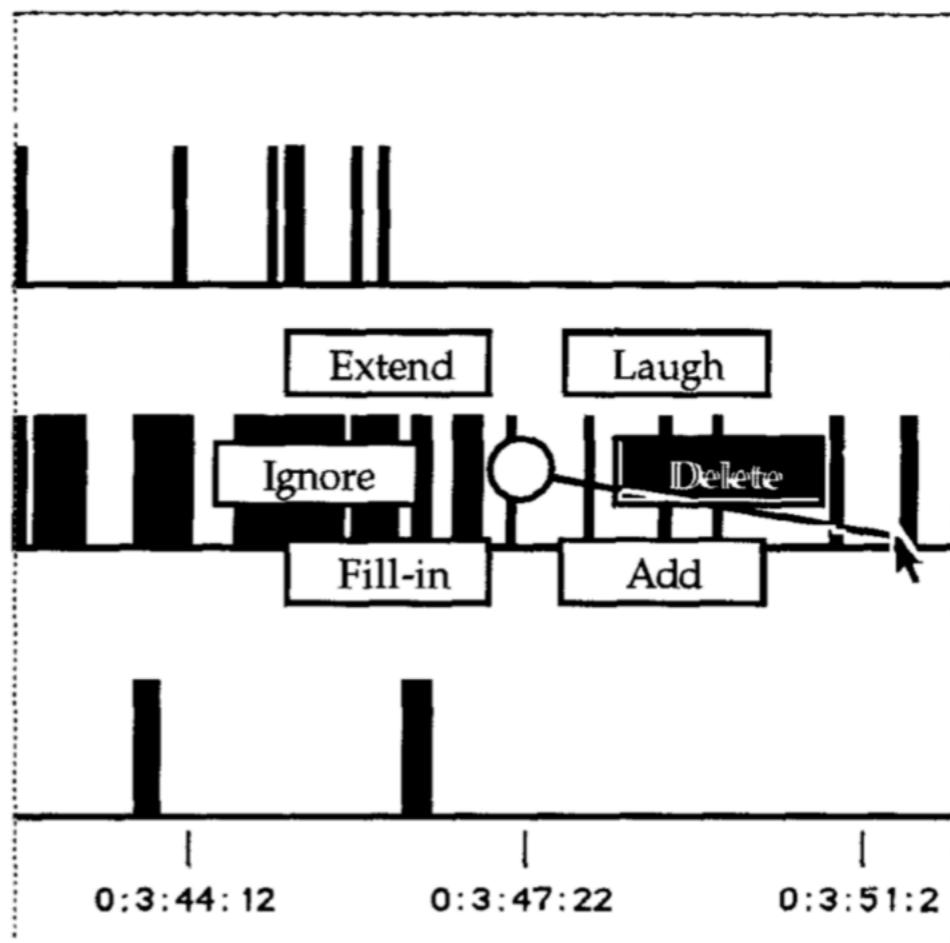
Kurtenbach and Buxton '93

Design Details - Marking Menus

- Principle: Should help user maintain visual context
- Problem: Pies take up space
- Refinement: show only labels



Traditional pies



Labels only

Tapia & Kurtenbach '95

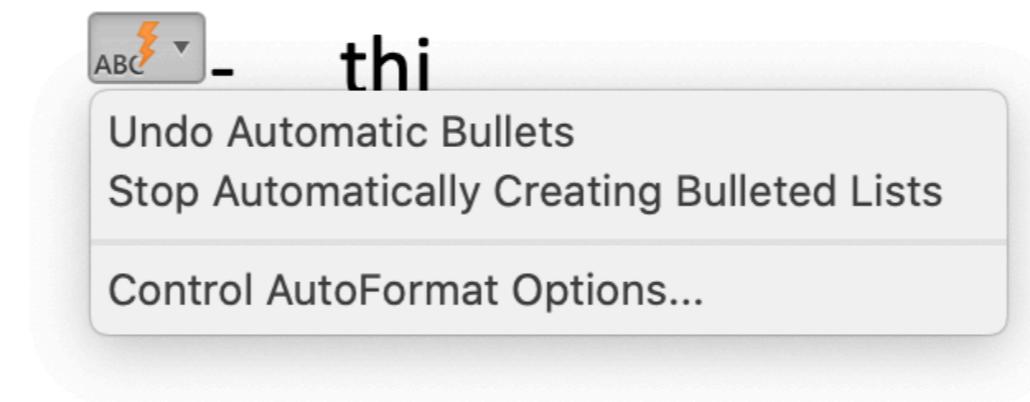
System feedback

System response times

- 0.1 second - reacting **instantaneously**
 - requiring no special feedback except displaying result
 - limit for direct manipulation of objects in UI
- 1.0 second - **freely** navigating commands
 - noticeable delay, limit for keeping user's flow of thought uninterrupted
- 10 seconds - keeping users **attention**
 - limit for keeping user's attention focus in UI
 - longer delays create task breaks
- [Nielsen, Usability Engineering, 1993]

Automation

- Keep user in control at highest task levels
- Take control from user when need is obvious & user is busy
- Provide visibility of automation & opportunities to correct when necessary



Provide feedback for all user actions

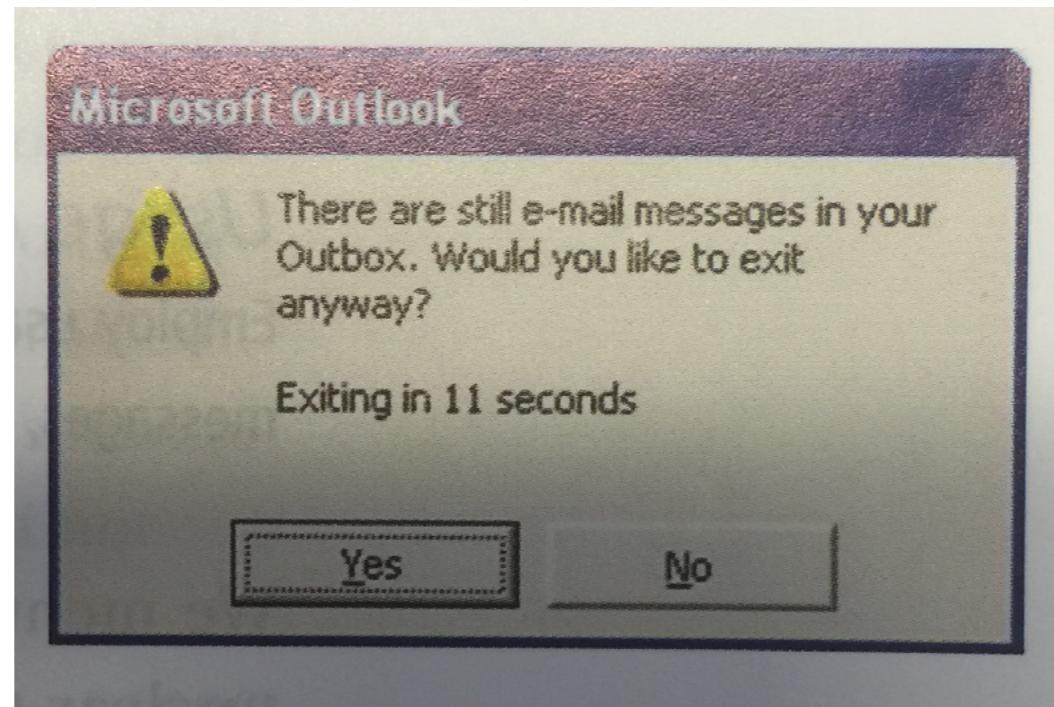
- Feedback helps keep users on track in accomplishing goals
- Request confirmation to prevent costly errors (but use sparingly)
- Make feedback visible, noticeable, legible, located w/ in users focus of attention
- Provide feedback early
- Provide feedback consistently

Tone of feedback

- Establishes relationship with user
- Important not to take user feel “stupid”
- Make the system take blame for errors
- Be positive, to encourage
- Provide helpful messages, not cute messages
- Avoid violent, negative, demeaning, threatening terms (e.g., illegal, invalid)

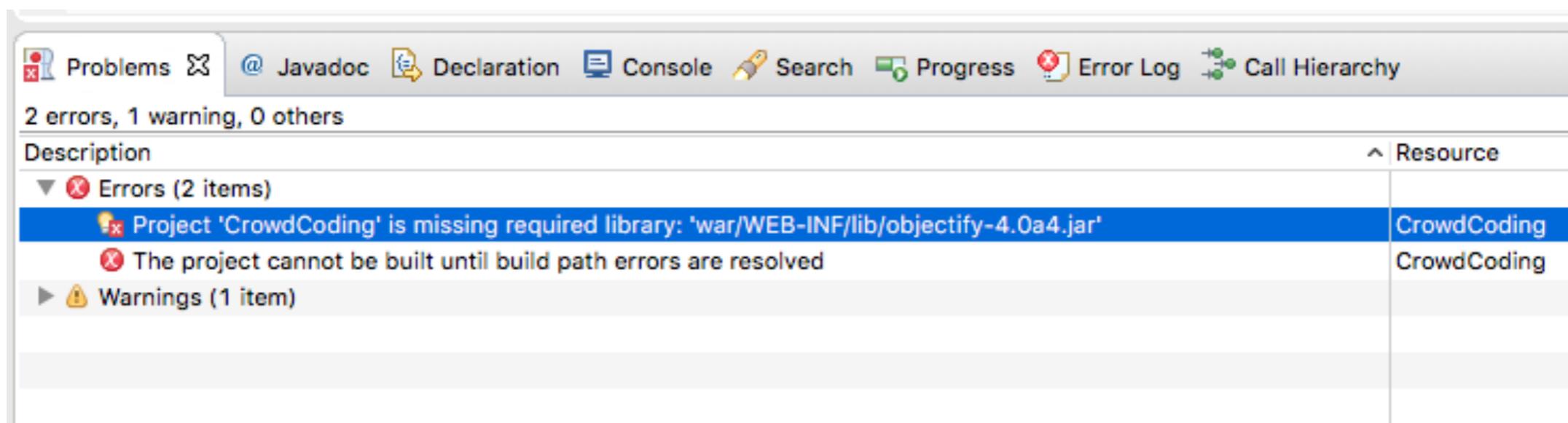
Crafting feedback text

- Clarity - support clear understanding of outcome
- Precise wording
- Completeness - include enough information to fully understand outcomes



Show users how to fix errors

- Good: detecting user errors
- Better: directly showing how errors can be fixed
- (Best: using constraints to prevent errors from ever occurring)



Avoid anthropomorphism (in most contexts)

- Anthropomorphism - the attribution of human characteristics to non-human objects
 - e.g., “Sorry, but I cannot find the file you need”
- Provides a false mental model
 - leads to user thinking they can interact with system as person
 - can be over promising & condescending
 - May work in spoken interaction settings, where system does match user’s mental model

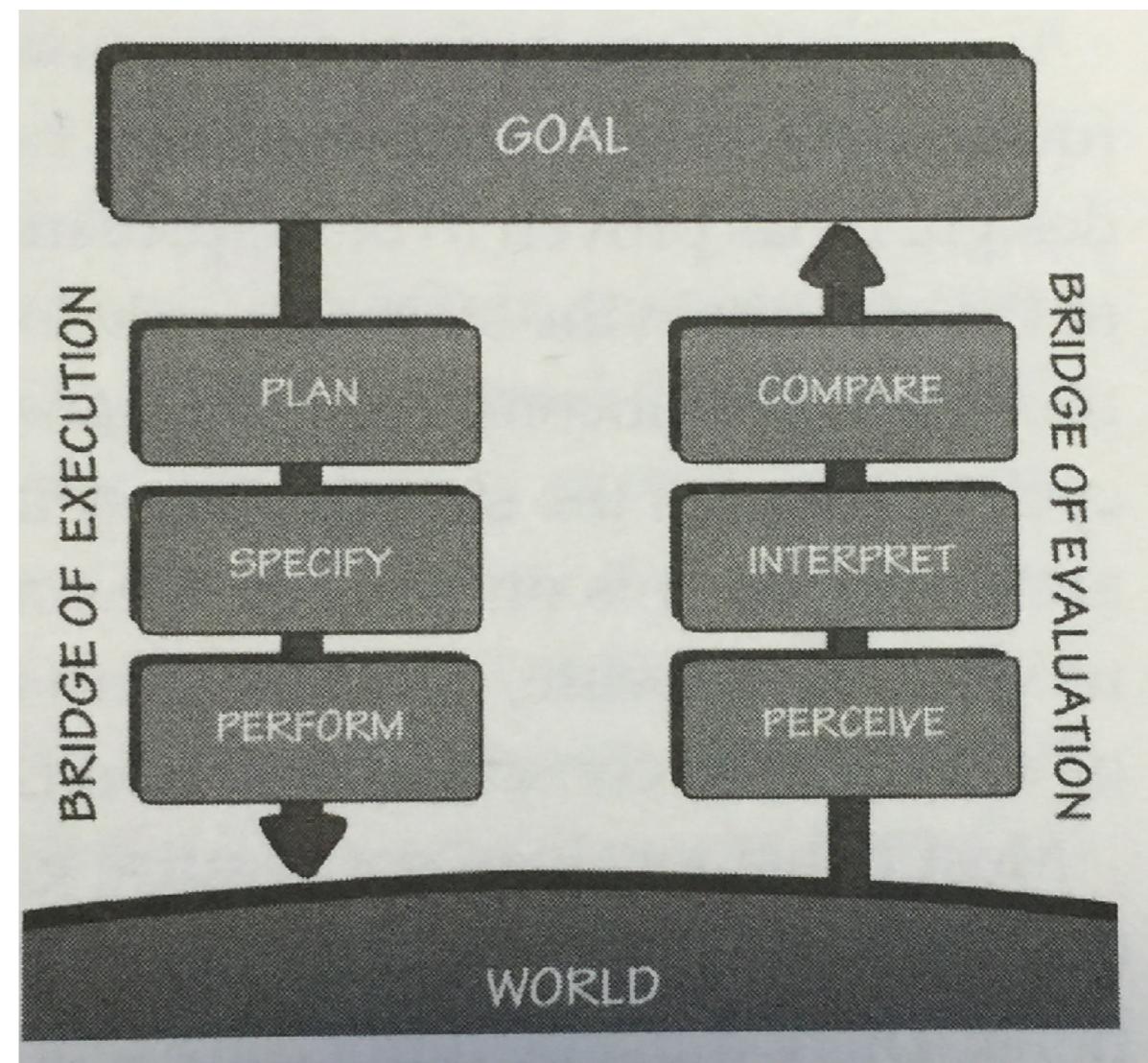
In Class Activity

- In groups of 2 or 3:
 - Identify at least 3 separate usability issues of a web application that violates one of the interaction design principles in this lecture
 - For each issue, brainstorm ways that this usability issue might be addressed.

Direct manipulation

Motivation

- User is trying to do a task, manipulating some [model] of world
- Hard to plan out long sequence of actions in advance
- Gulf of execution: hard to know if took correct action
- Gulf of evaluation: hard to understand if successfully manipulated world
- Hard to compare hidden world to desired world



Direct manipulation

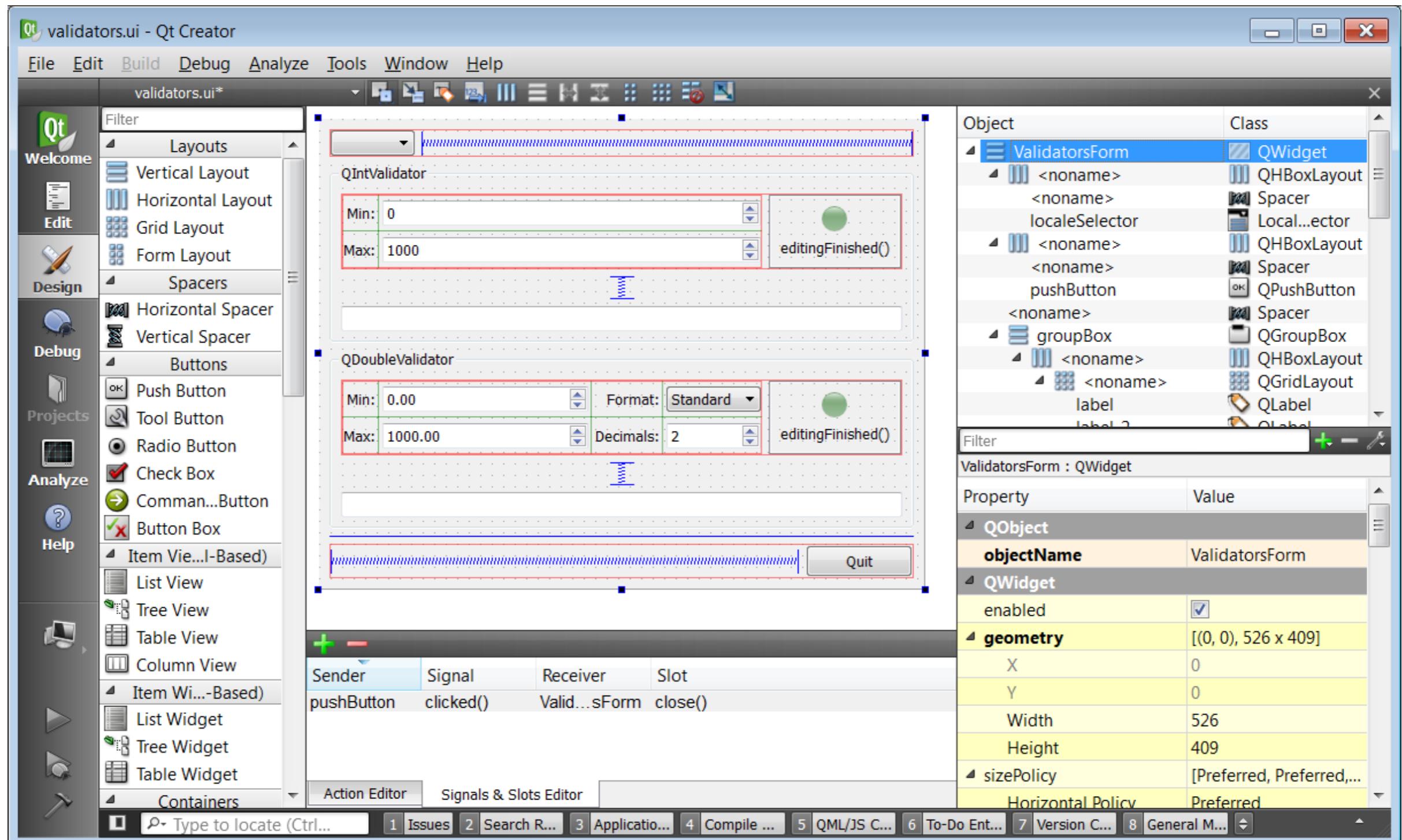
- “Rapid incremental reversible operations whose impact on the objects of interest is immediately visible” (Shneiderman, 1982)



Benefits

- Supports exploration
 - Don't plan long sequence of actions: pick an action, try it, can change mind if want to do something else instead
- Provides immediate feedback
 - Can quickly see what outcome of actions are in manipulating the world
 - Easy to compare desired state of the world to actual state of the world

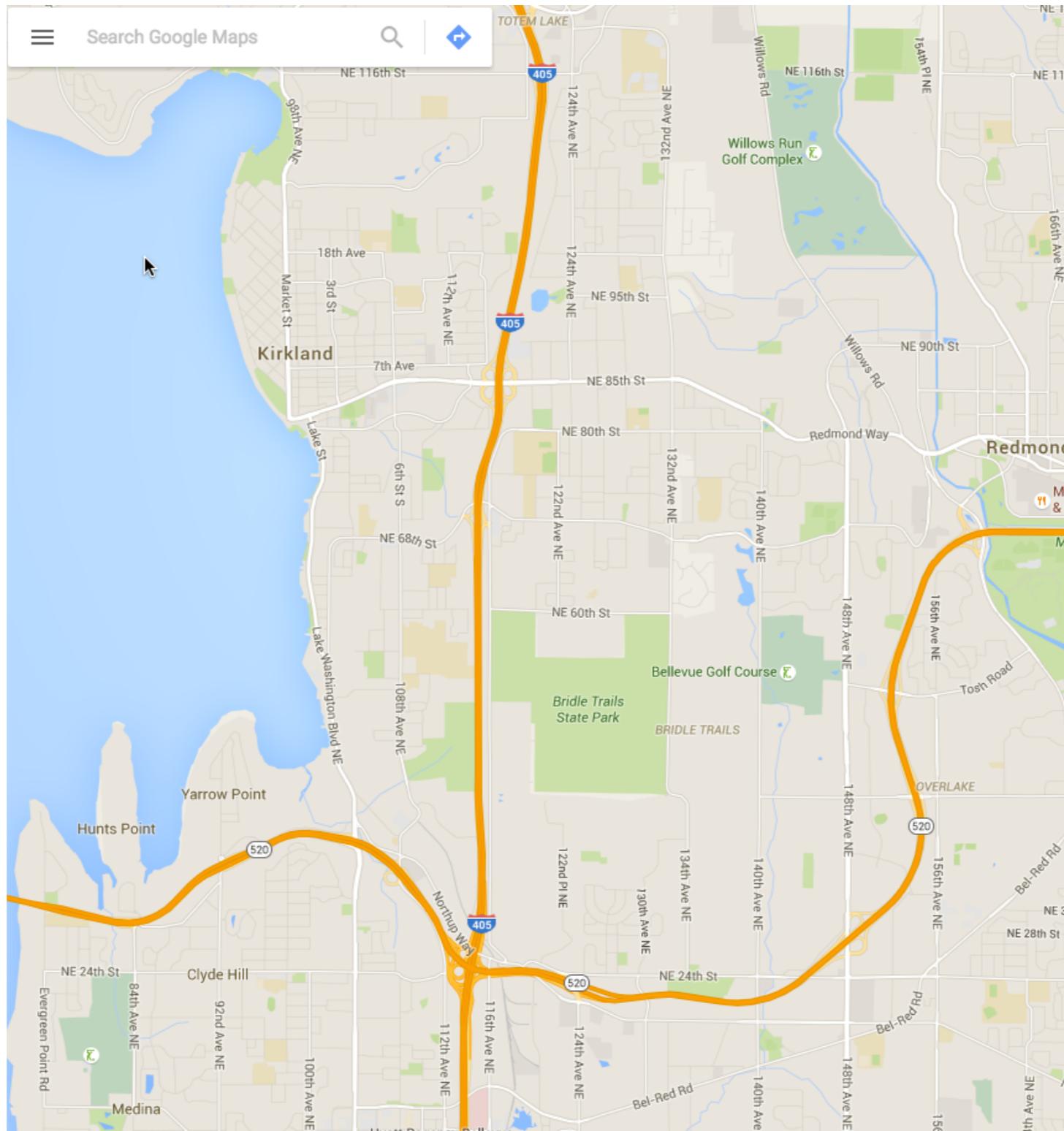
Example - GUI builder



Example - Spreadsheets

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	788	355	564	399	413	897	444	523	413							
2	800	923	233	307	864	355	90	877	864							
3	657	788	755	444	455	478	432	405	455							
4	599	866	233	201	413	361	455	233	413	Sep	Oct	Nov	Dec			
5	899	755	673	311	780	400	614	754	780	2005	2005	2005	2005	Jan	Feb	
6	334	953	888	214	644	789	361	978						2006	2006	
7	233	644	766	446	231	977	577	453	847	455	507	690	700		788	
8	577	533	968	897	541	977	475	358	975	355	478	361	400		800	
9										742	267	599	700		564	
10	Bryant Park	965	365	233	708	564	344	78	359	997	352	215	836		399	
11	Keokuk	670	607	233	846	980	544	613	523	877	405	233	754		413	
12	Westport	855	732	908	556	352	315	635	413	864	455	413	780		355	
13	Temple	607	244	641	908	561	555	314	467	900	378	729	382		444	
14	Lockhart	222	645	999	182	388	905	814	444	190	432	455	614		523	
15	Stonington	344	756	600	481	339	489	144	399	307	444	201	311		877	
16															413	
17	Subtotal	5455	4380	5088	5002	4521	4866	4084	4342	5687	3718	3890	5477		4796	
18															5313	
19	U.K. Factories															
20																
21	Clacton	855	315	908	556	352	556	635	413	864	455	413	780		980	
22	Penge	506	605	860	222	459	222	521	897	355	478	361	400		670	
23	Runcom	670	544	233	846	980	846	613	523	877	405	233	754		2242	
24	Worcester Park	344	489	600	481	339	481	144	399	307	444	201	311		1543	
25	Wapping	855	315	908	556	352	556	635	413	864	455	413	780		600	
26	Tooting Bec	506	605	860	222	459	222	521	897	355	478	361	400		670	
27	Balham	222	905	999	182	388	182	814	444	90	432	455	614		797	
28	Wigan	670	544	233	846	980	846	613	523	877	405	233	754		668	
29	Ashby de la Zouche	855	315	908	556	352	556	635	413	864	455	413	780		800	
30	Bude	607	555	641	908	561	908	314	467	900	378	729	382		413	
31	Looe	344	489	600	481	339	481	144	399	307	444	201	311		400	
32	Scunthorpe	674	677	790	650	666	679	677	566	756	567	685	433		614	
33																
34	Subtotal	5073	4761	5982	5078	4750	5078	4433	4478	5441	3896	3233	5086		7167	
35															7021	
36	Canadian Factories															
37																
38	Deception Bay	344	489	600	600	481	339	521	897	355	478	361	233		846	
39	Mississauga	855	315	908	600	481	339	481	855	315	908	556	352		613	
40	WIG														144	

Example - Google Maps



Example - Kayak

Advice: **BUY** Learn more [i](#)

Create a price alert

Stops [Show all](#)

<input checked="" type="checkbox"/> nonstop	\$127
<input type="checkbox"/> 1 stop	\$145
<input type="checkbox"/> 2+ stops	\$303

Times [Show all](#)

Take-off Washington (DCA)
Fri 2:41p – 10:30p

Take-off Chicago (CHI)
Mon 5:30a – 10:00p

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Depart/Return same

Washington	
<input checked="" type="checkbox"/> DCA: Reagan-Nati...	\$127
<input type="checkbox"/> BWI: Baltimore/Wa...	\$207

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In Class Activity: Direct Manipulation Programming Interactions

- In groups of 2
 - Design a GUI building for creating React apps through direct manipulation
 - Create sketches showing key screens
 - Should support
 - Nesting one component inside another component
 - Hooking up components to events that occur
 - Should make it easier to get feedback on if program works