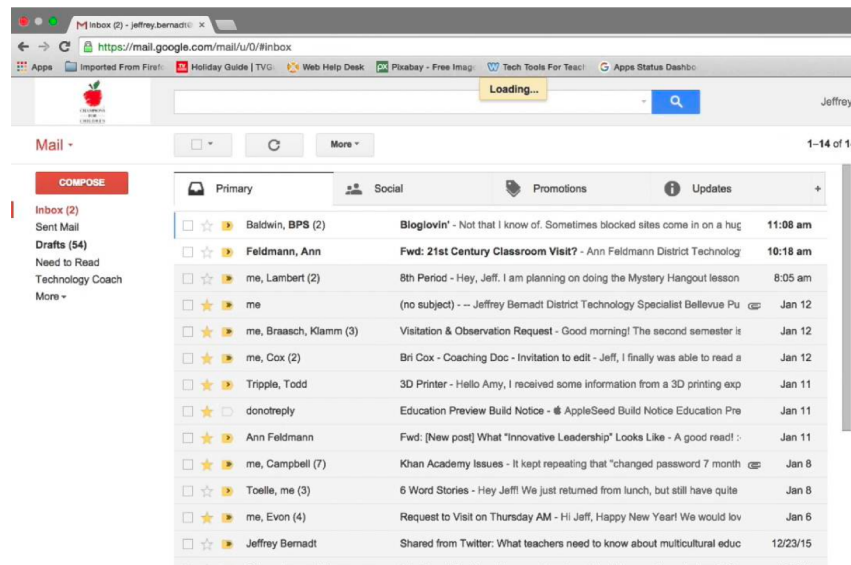




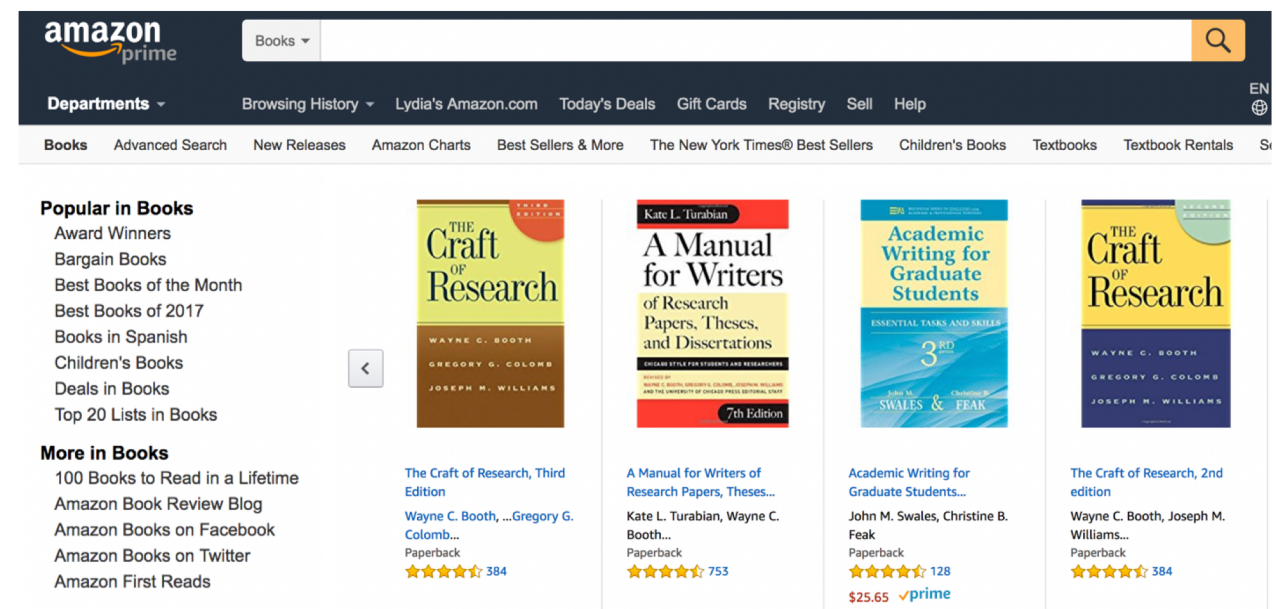
Direct Manipulation

Prof. Lydia Chilton
COMS 4170
12 February 2025

Users interact with a system to accomplish a goal

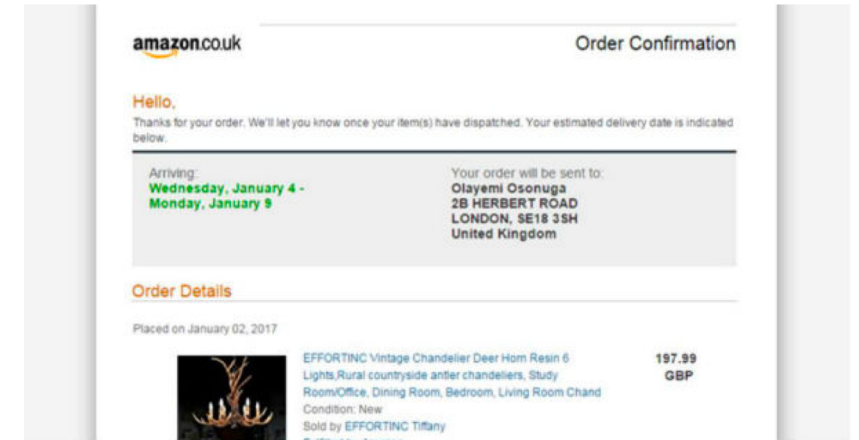
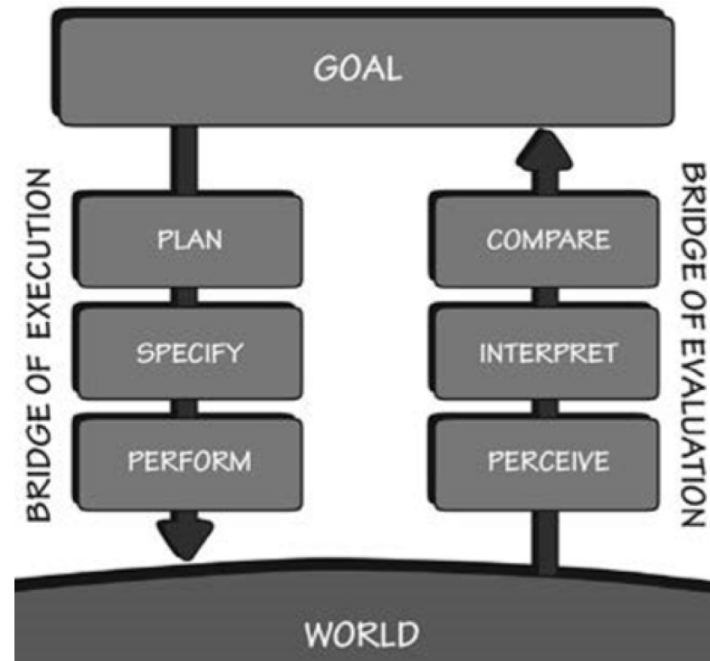
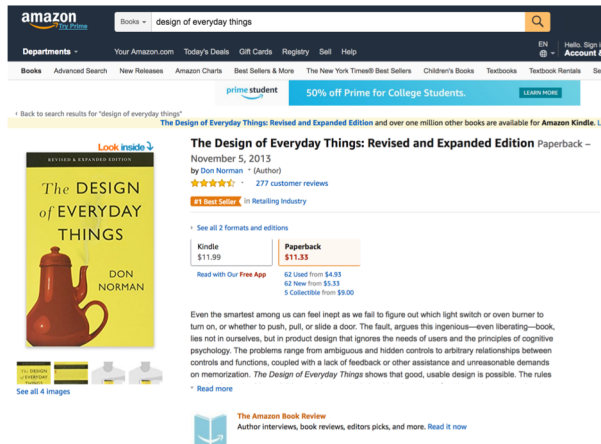


To read and respond to all email.



To buy a book

To accomplish a **goal**,
users must **execute** an operation
and **evaluate** the result

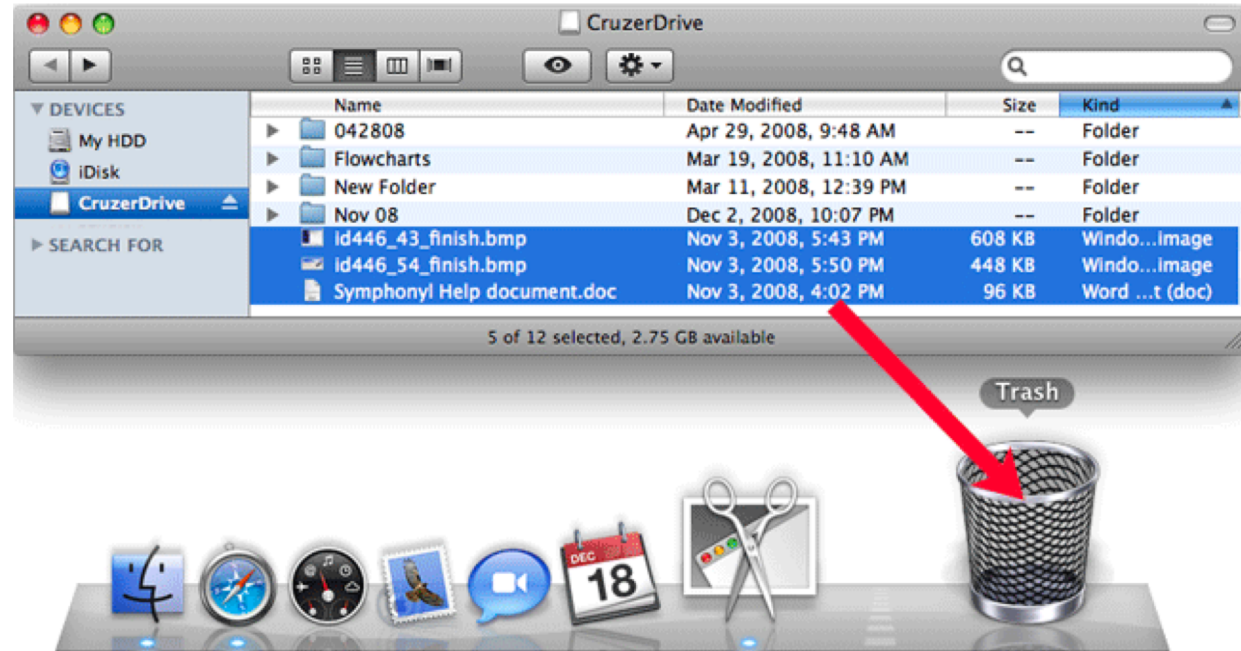


The designer must know the users' goals
and create interactions to help them execute and evaluate it.

Then:
Text commands

```
Last login: Fri May 25 17:23:20 on ttys000
Mac:~ usman$ rm /Users/usman/Desktop/test\ image.jpg
Mac:~ usman$
```

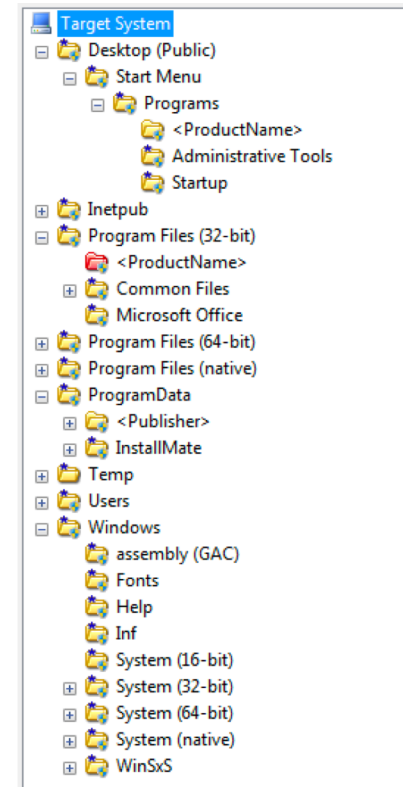
Now:
Graphical User Interfaces



Graphical interfaces have a lot of advantages

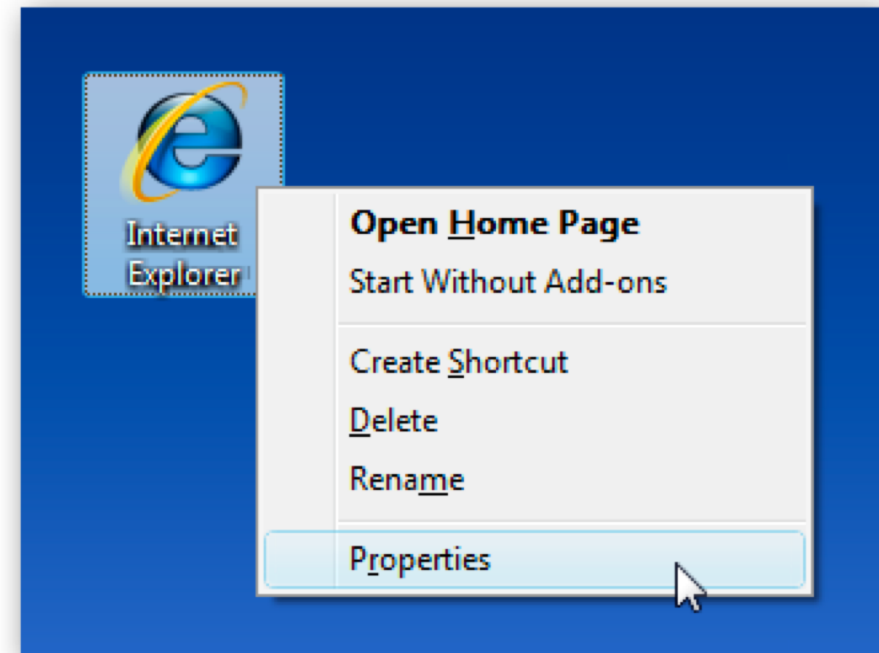
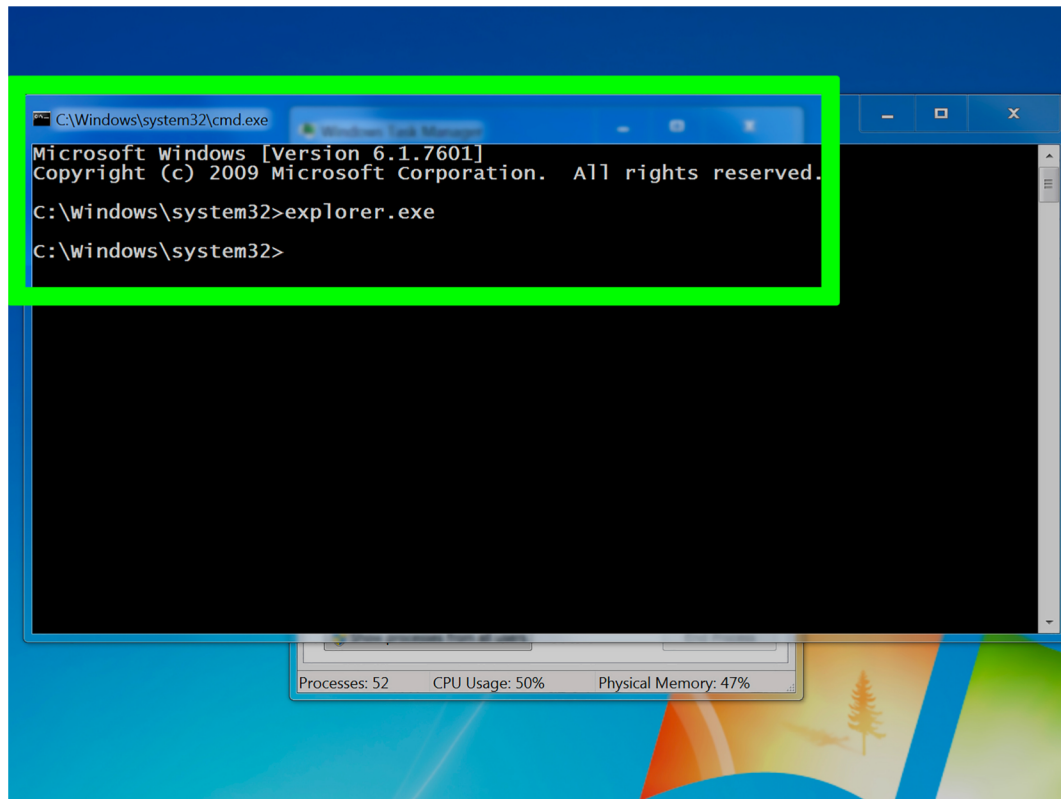
2. Match between system and the real world

The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms.



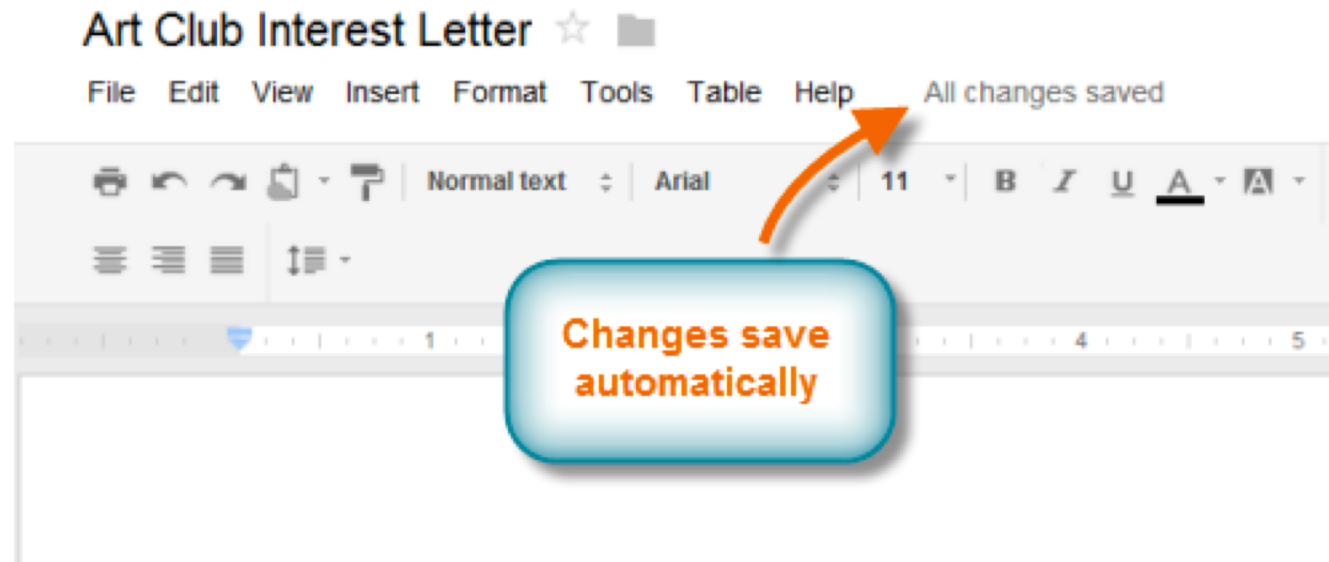
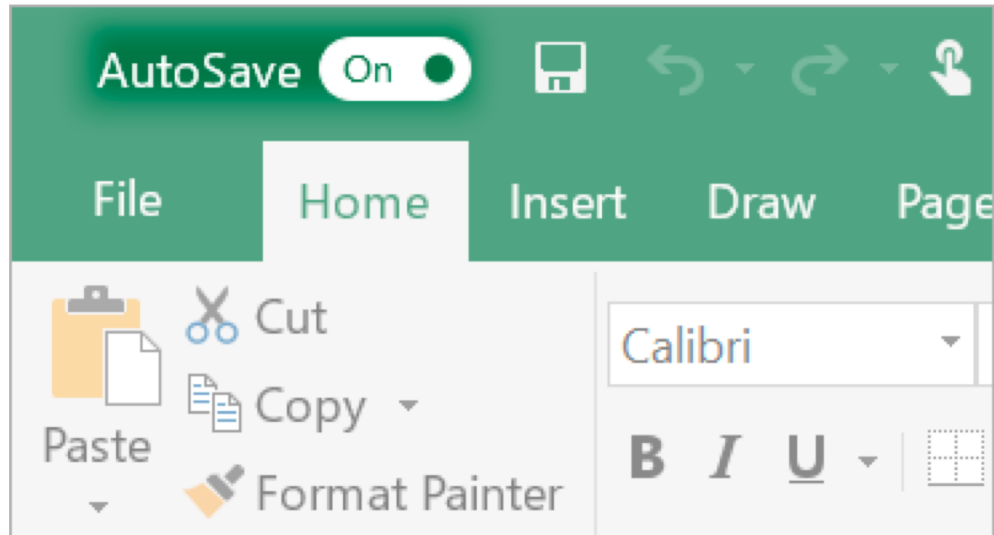
6. Recognition rather than recall

Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another.



5. Error prevention

Even better than good error messages is a careful design which prevents a problem from occurring in the first place.



A breakthrough in UI design was the advent of

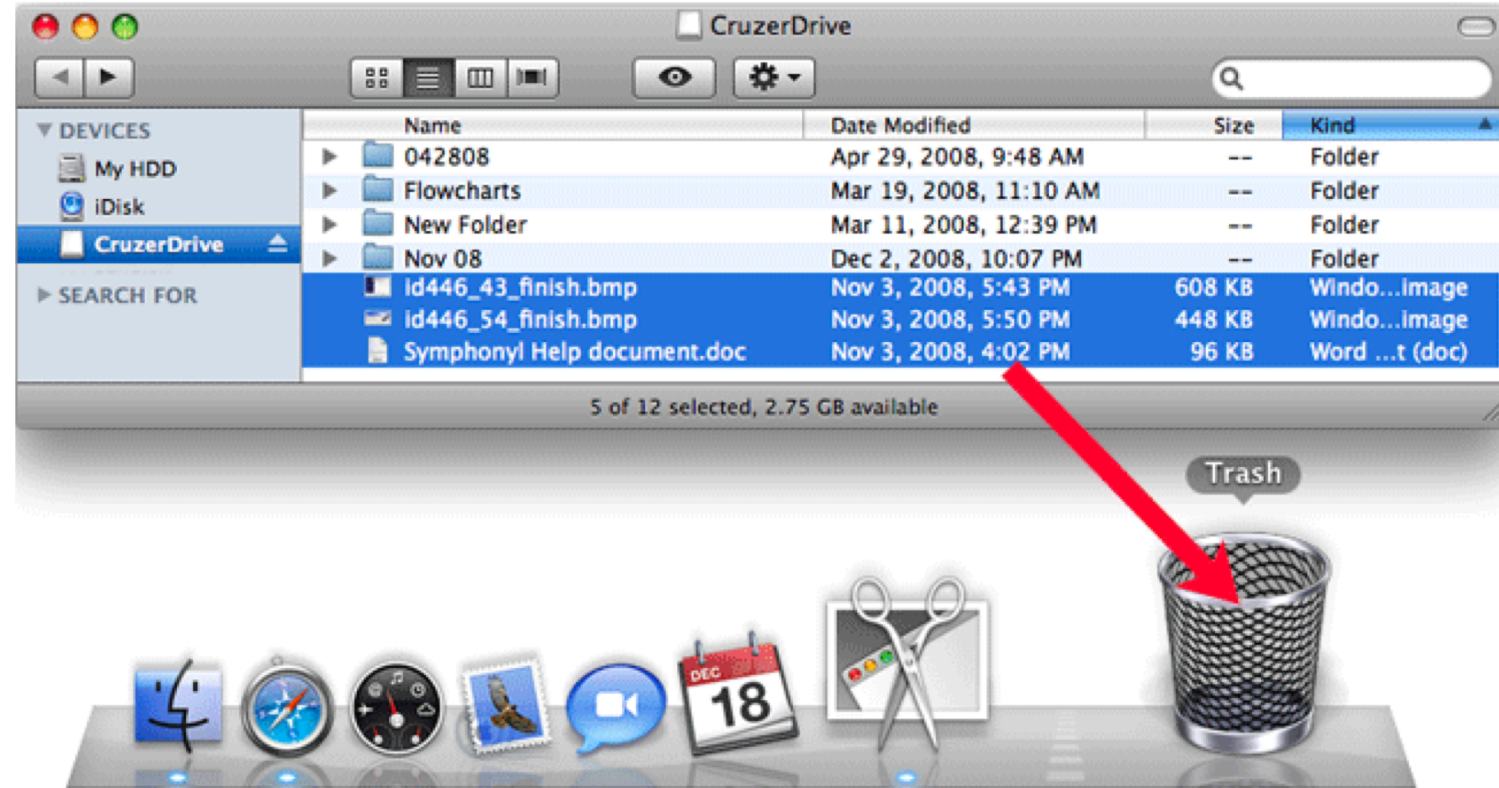
Direct manipulation

Direct Manipulation Properties

1. **Objects** are represented visually

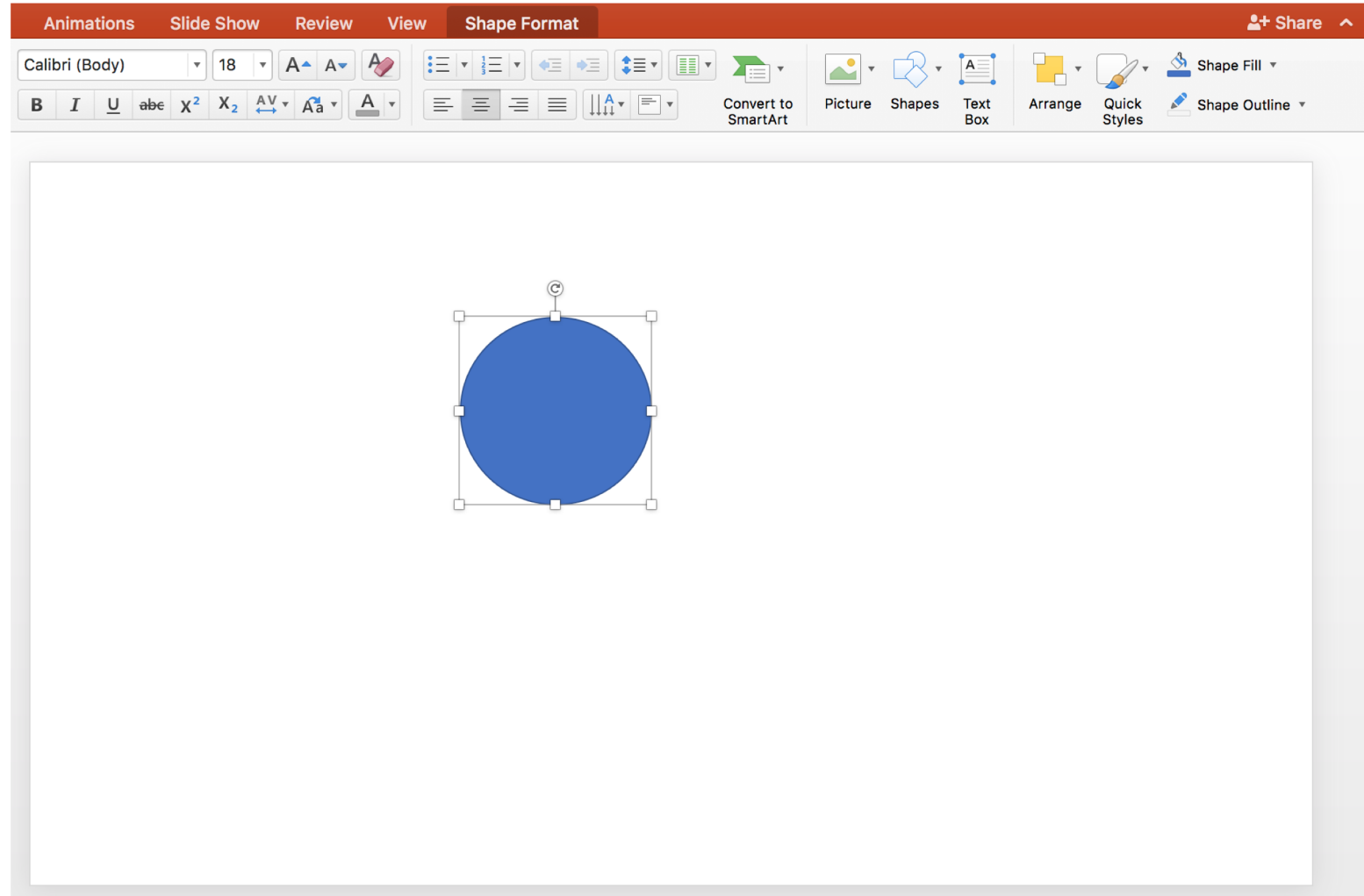
2. **Actions** are rapid, incremental and reversible

3. Users interact **directly with object representations**



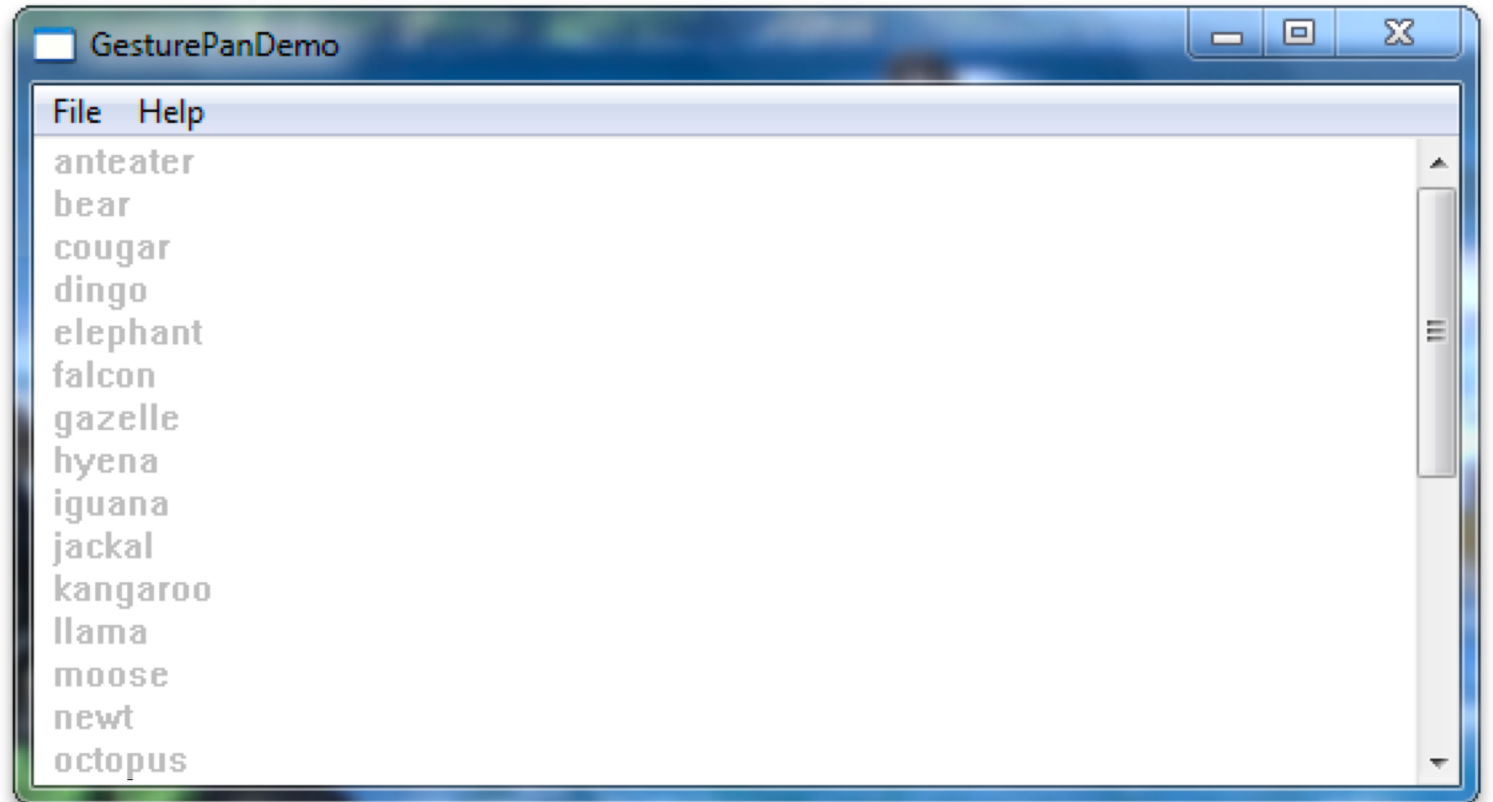
Goal: Make circle bigger.

1. What **Objects** are represented visually?
2. What **Actions** are rapid, incremental and reversible?
3. How do users interact **directly with object representations**



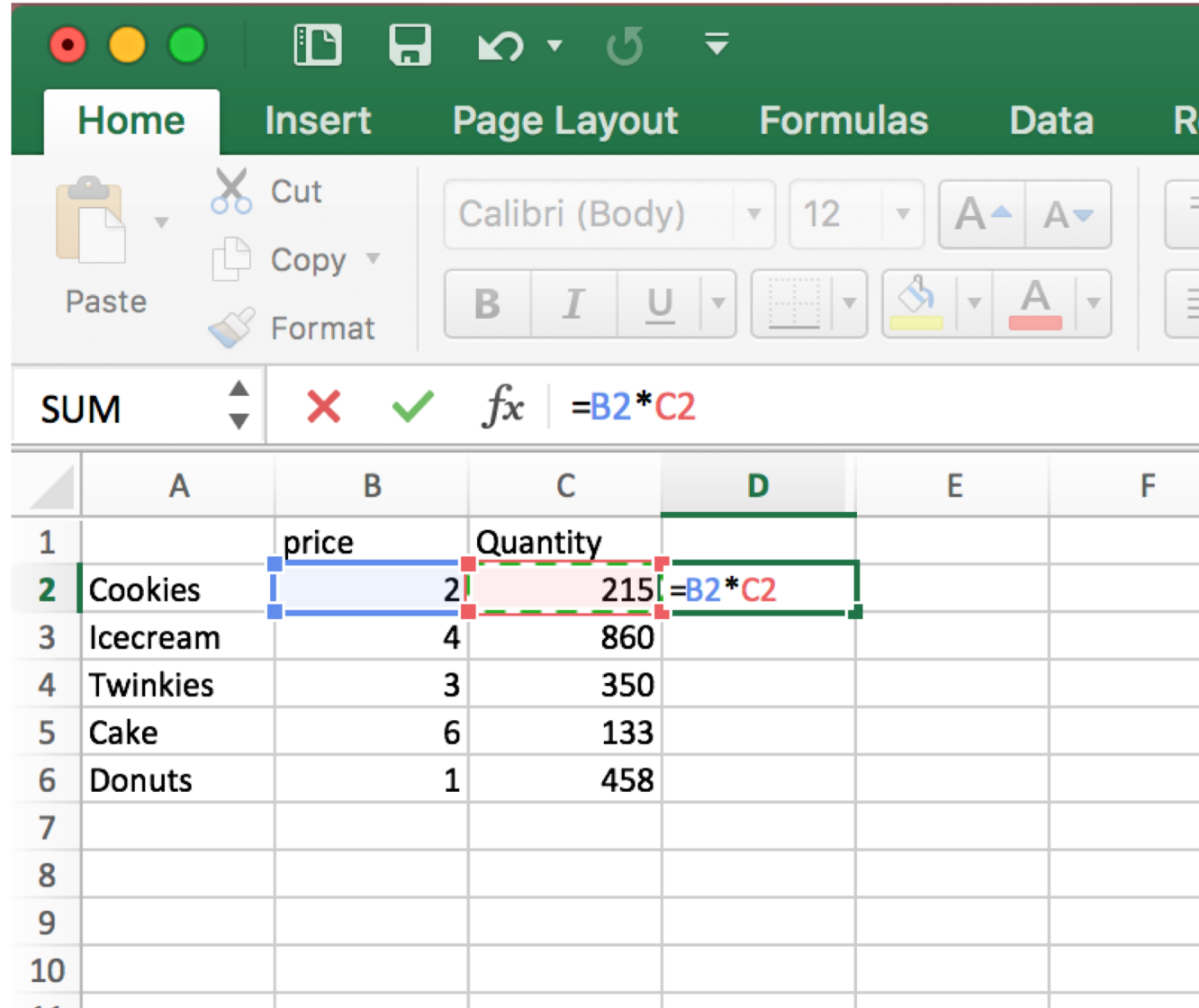
Goal: See stuff at the bottom on the list.

1. What **Objects** are represented visually?
2. What **Actions** are rapid, incremental and reversible?
3. How do users interact **directly with object representations**



Goal: Multiply numbers in a Spreadsheet.

1. What **Objects** are represented visually?
2. What **Actions** are rapid, incremental and reversible?
3. How do users interact **directly with object representations**



The screenshot shows a spreadsheet application interface. The ribbon includes 'Home', 'Insert', 'Page Layout', 'Formulas', and 'Data'. The 'Home' ribbon is active, showing options for 'Paste', 'Cut', 'Copy', and 'Format'. The font is set to 'Calibri (Body)' size 12. The formula bar shows the formula $=B2*C2$. The spreadsheet grid has columns A through F and rows 1 through 10. The data is as follows:

	A	B	C	D	E	F
1		price	Quantity			
2	Cookies	2	215	$=B2*C2$		
3	Icecream	4	860			
4	Twinkies	3	350			
5	Cake	6	133			
6	Donuts	1	458			
7						
8						
9						
10						

Direct Manipulation Properties

1. **Objects** are represented visually



Move file to...



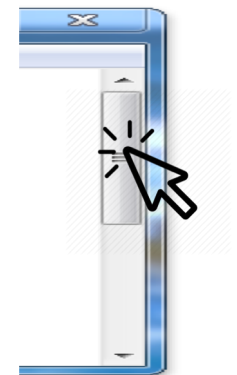
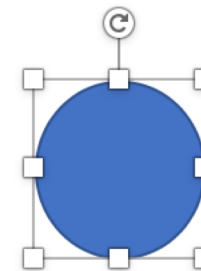
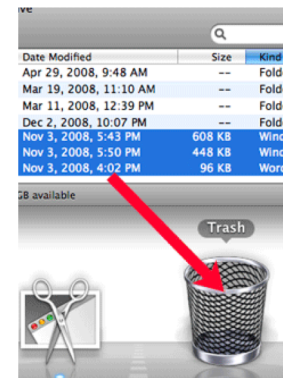
Resize



Move viewport

2. **Actions** are rapid,
incremental and reversible

3. Users interact
directly with object representations



Goal: Set an alarm on a 2003 cell phone.
Is this direct manipulation? **No.**

1. Are **Objects** are represented visually?

Yes.

2. Are **Actions** are rapid, incremental and reversible?

Sorta.

3. Do user interacts **directly with object representations?**

No.



Goal: Set an alarm on Google.

Is this direct manipulation? **No.**

1. Are **Objects** are represented visually?

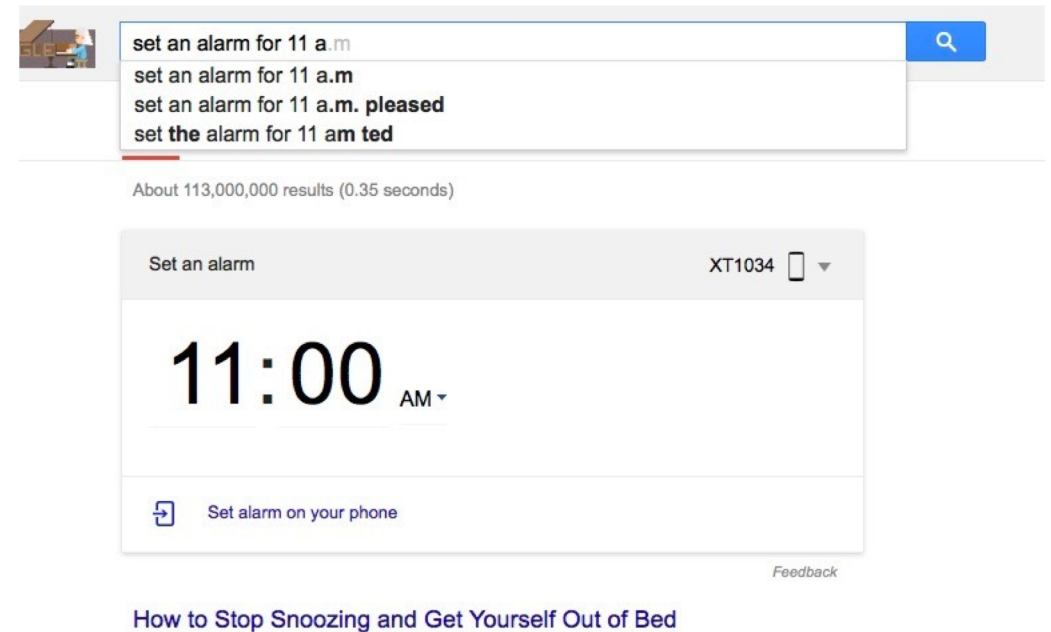
Yes.

2. Are **Actions** are rapid, incremental and reversible?

No.

3. Do user interacts **directly with object representations**?

No.



Goal: Set an alarm clock with on an iPhone.
Is this direct manipulation? **Yes.**

1. Are **Objects** are represented visually?

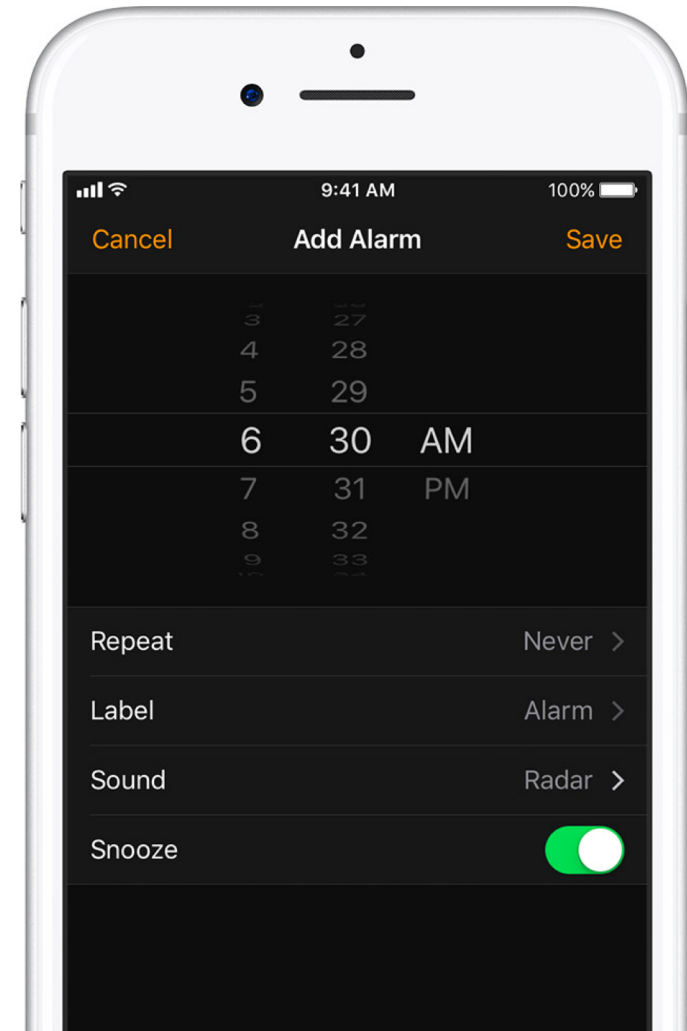
Yes.

2. Are **Actions** are rapid, incremental and reversible?

Yes.

3. Do user interacts **directly with object representations?**

Yes.



Goal: Set an alarm clock with Siri.

Is this direct manipulation? **No. But it's awesome!**

1. Are **Objects** are represented visually?

Yes.

2. Are **Actions** are rapid, incremental and reversible?

No.

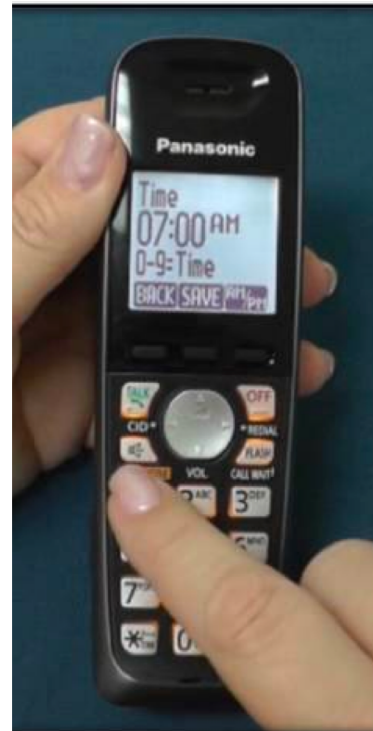
3. Do user interacts **directly with object representations?**

No.

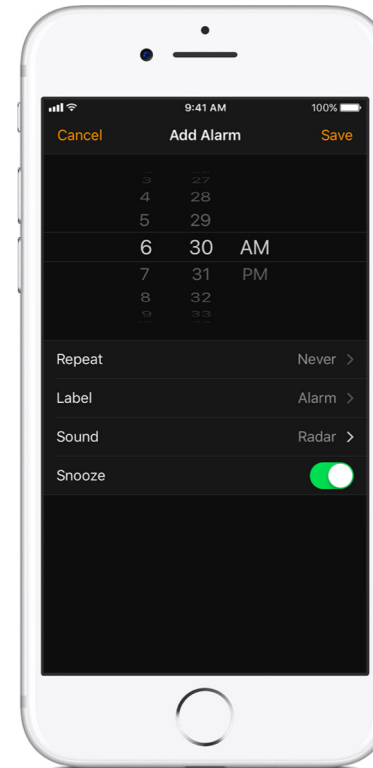


Direct manipulation requires directly interacting with object representation.

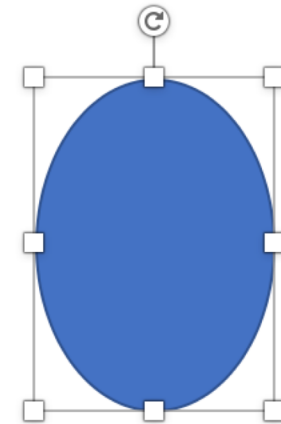
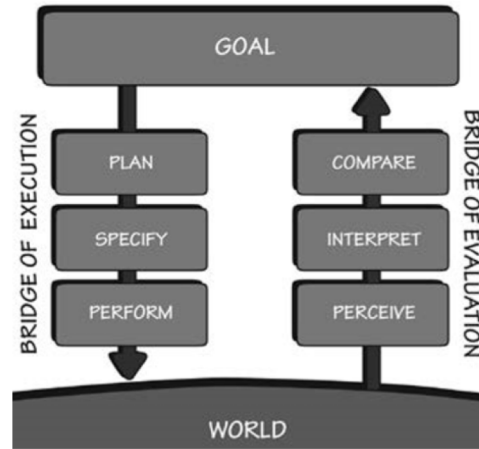
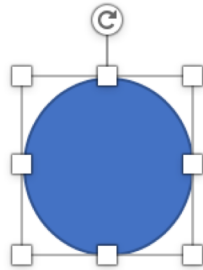
Not direct manipulation



Direct manipulation



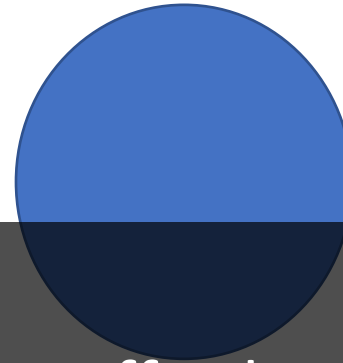
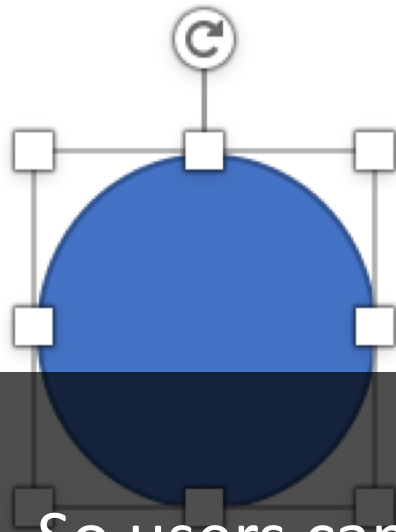
In the execution/evaluation model, why is Direct Manipulation good?



There are visible **actions**
the user can **execute**

There is visible **feedback**
the user can **evaluate**

Why is it important for the circle to have the resize handles?



So users can perceive the correct affordances.

(So people can see what to do.)

Signifiers of Affordances

Helping people see what they can do.

Affordance: What can do you with this?



Perceived Affordance Sitting

Signifier Flat part at knee-height
Back panel for support
Sturdy wood
Butt indentation

Feedback Test sitting on it.

Affordance Sitting

Affordance: What can do you with this?



Perceived Affordance

Sitting

Signifier

Flat part at knee-height
Back panel for support
Possibly sturdy cans?

Feedback

Test sitting on it.

Affordance

NOT sitting.
Looking awesome.

Affordance: What can do you with this?



Perceived Affordance	Pull
Signifier	A handle you can grasp and yank
Feedback	Yanking it
Affordance	NOT pull push

Affordance: What can do you with this?



Perceived Affordance Push

Signifier A handle you can lean on
and push

Feedback Push, depress handle

Affordance Push

Affordance: What should do you with this?



Perceived Affordance Put paper in it
Signifier Paper sized hole

Feedback None.

Affordance **Bottles and cans**

Design direct manipulation interfaces with good *perceived* affordances.

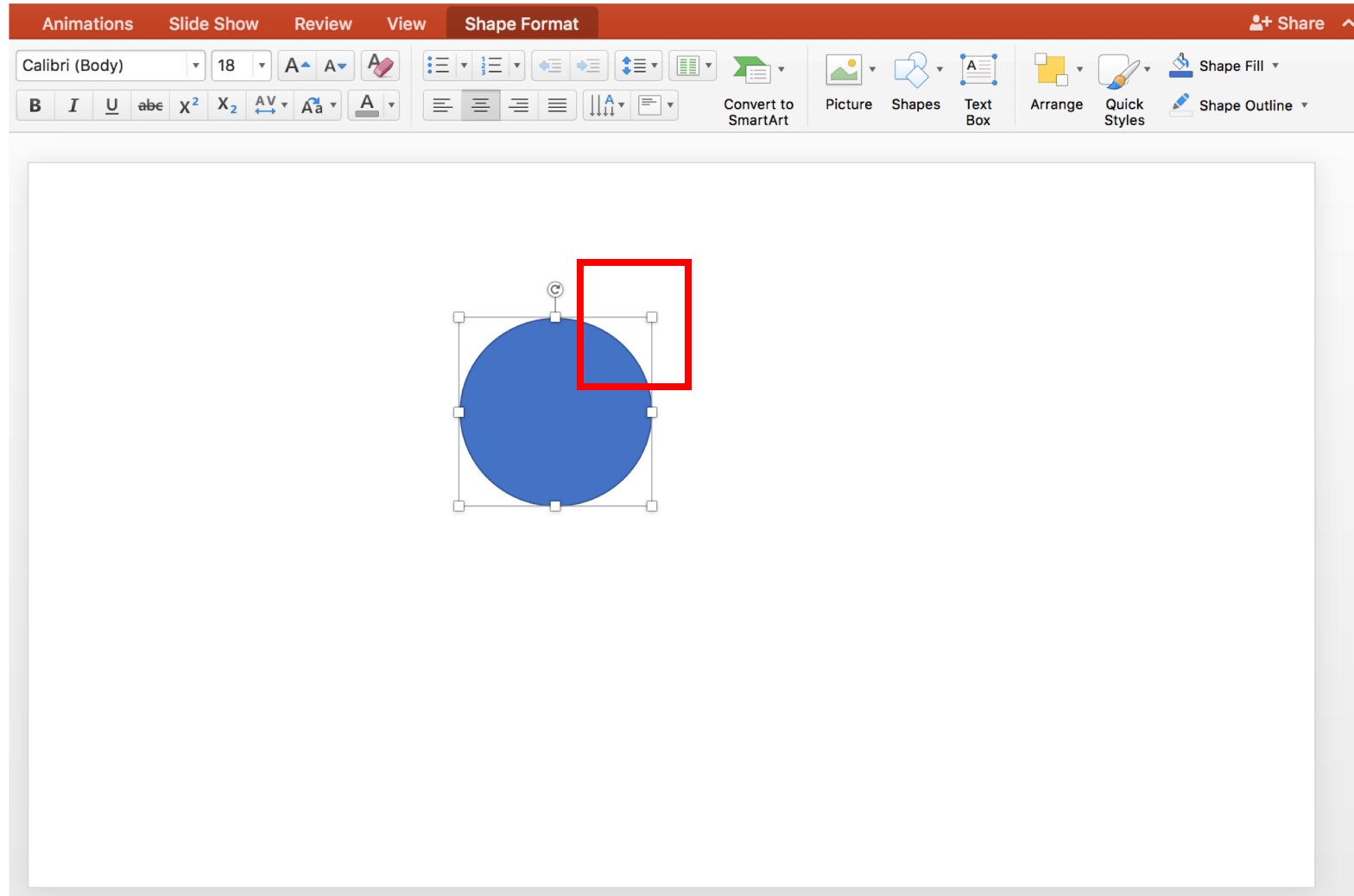
Bad signifiers / wrong perceived affordances

Good signifiers / correct perceived affordances

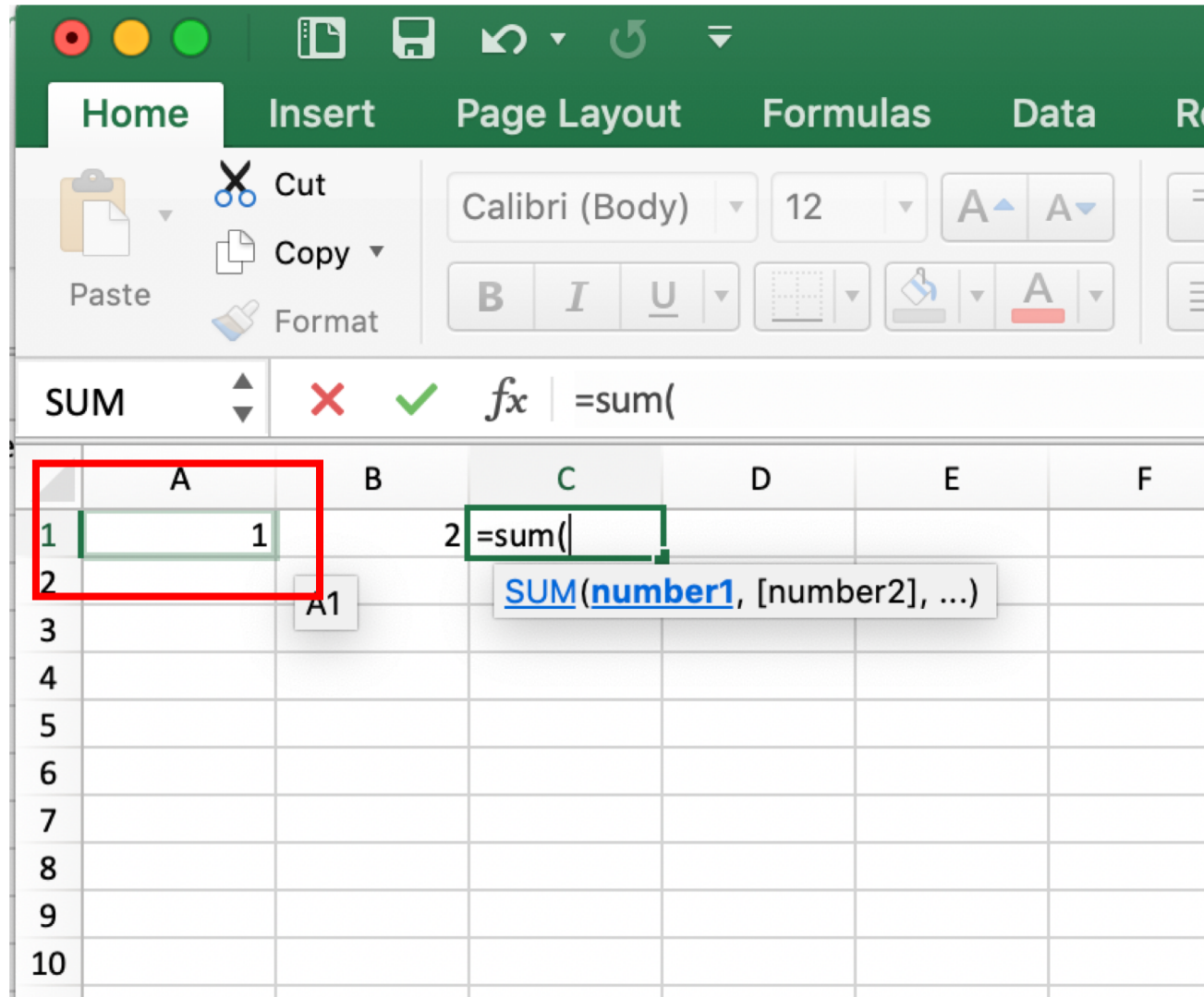


What signifiers do these UIs use to signal affordances?

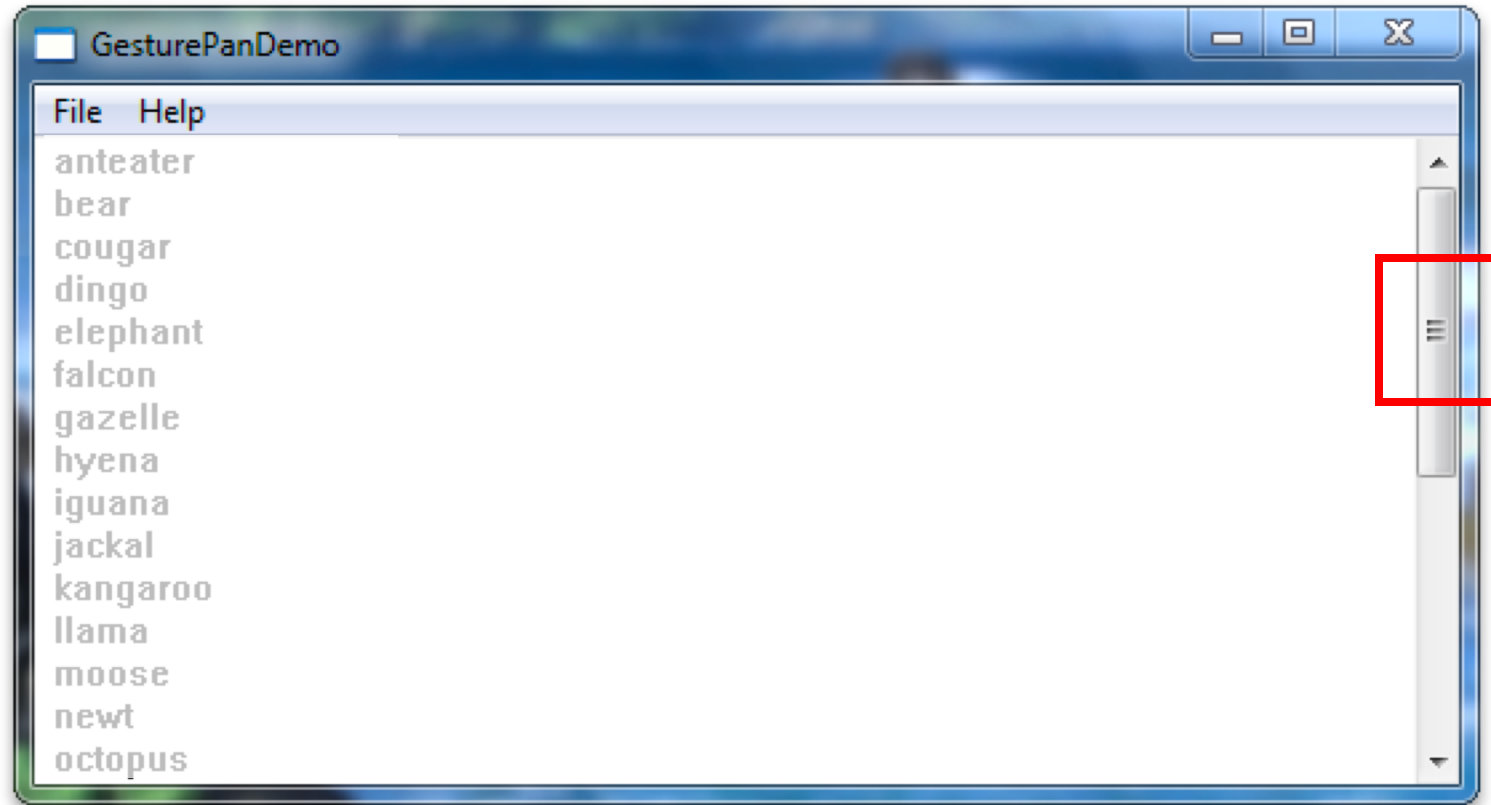
What are the signifiers of affordances?



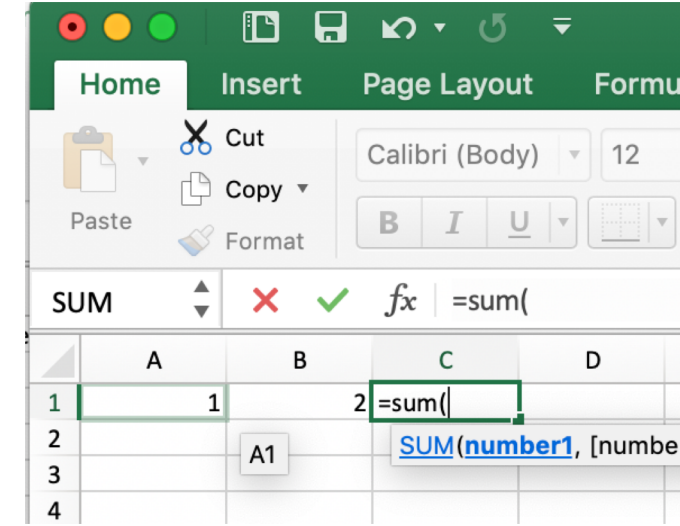
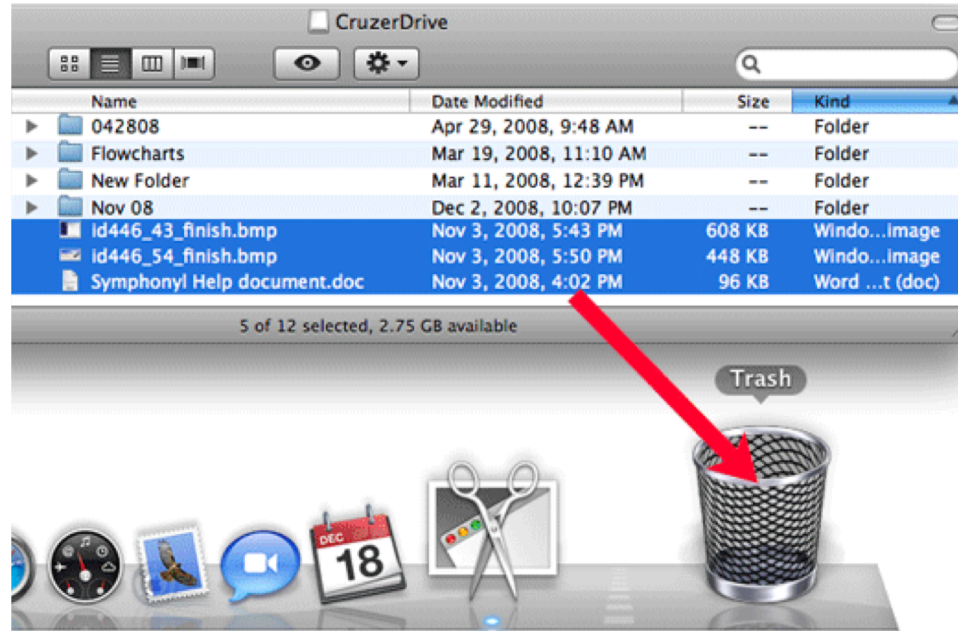
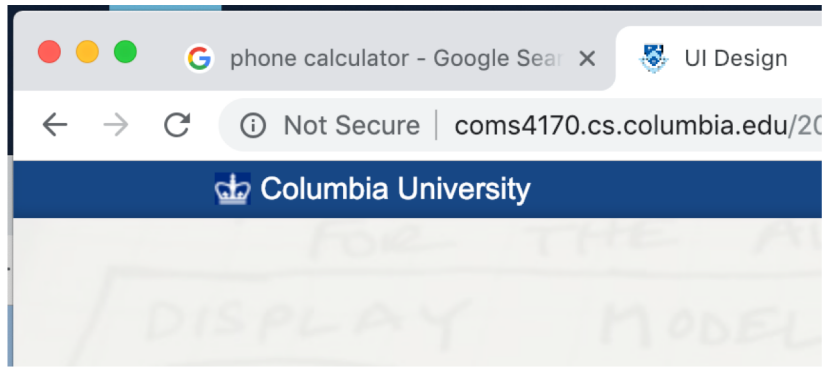
What are the signifiers of affordances?



What are the signifiers of affordances?



What are the signifiers of affordances?



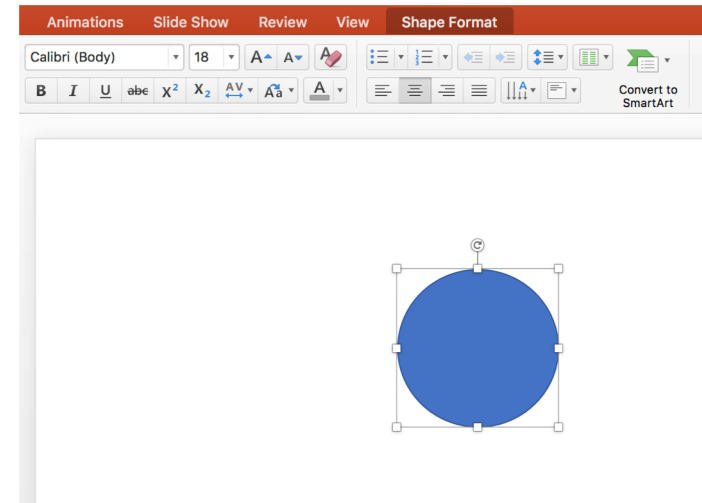
Hover event changes (like highlighting) often signify direct manipulation

Design direct manipulation interfaces with good *perceived* affordances.

Bad signifiers / wrong perceived affordances



Good signifiers / correct perceived affordances

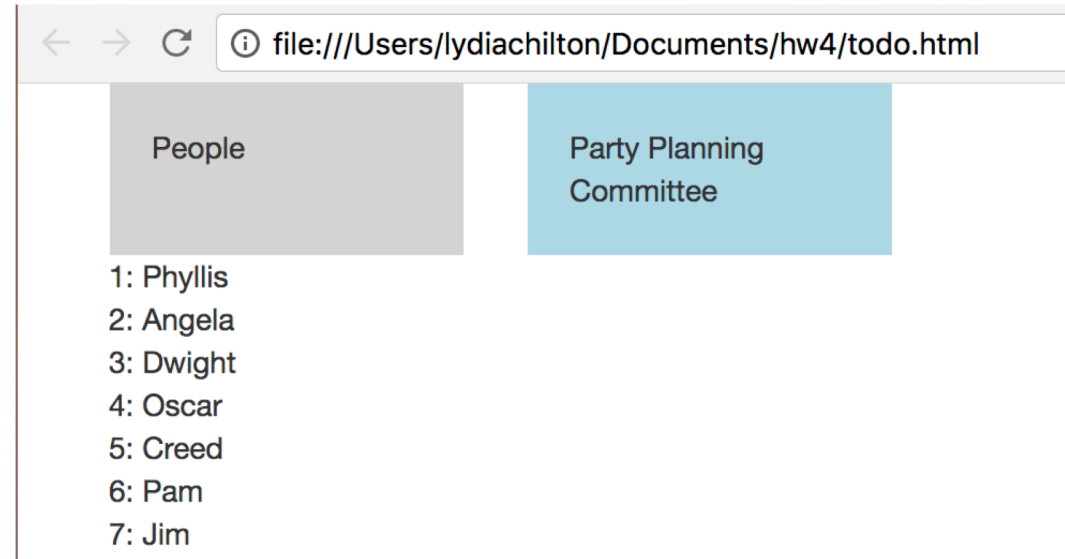


The image shows a screenshot of a spreadsheet interface. The formula bar at the top contains the text "=sum(" and is followed by a red 'X' and a green checkmark. Below the formula bar is a grid with columns labeled A, B, C, and D, and rows labeled 1, 2, 3, and 4. The cell at row 1, column C is selected and contains the text "=sum(". A tooltip for the SUM function is visible, showing "SUM(number1, [number2], ...)".

	A	B	C	D
1	1	2	=sum(
2		A1	SUM(number1, [number2], ...)	
3				
4				



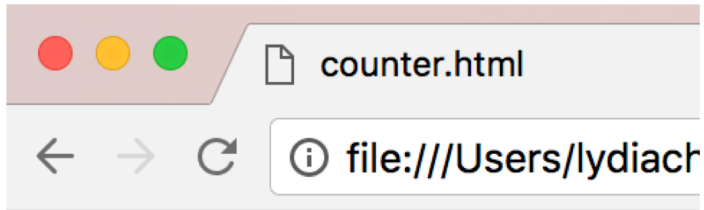
Implementing Direct Manipulation Interfaces



BUT FIRST...

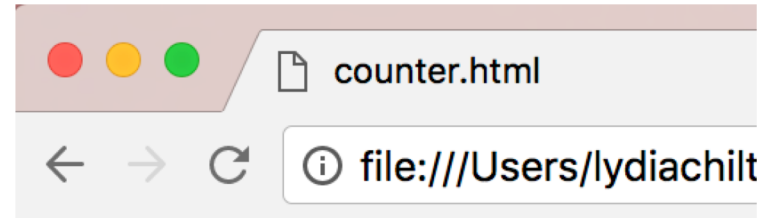
Model, View, Controller (MVC) Style Programming

When users interact with data, How do we update the database?



Counter (0)

Click

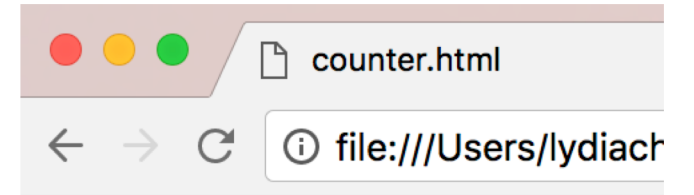


Counter (1)

Create a Button in HTML

HTML

```
30  
31 <body>  
32   <button id="counter" class="btn btn-primary">Counter (0)</button>  
33  
34 </body>  
35  
36
```

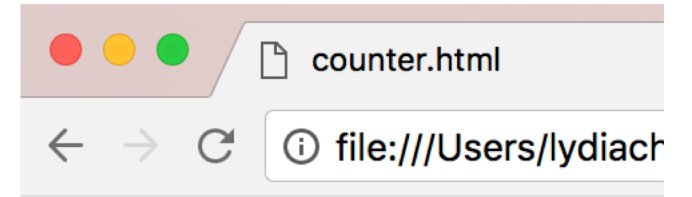


Counter (0)

Add JQuery and Bootstrap “libraries”

HTML

```
30  
31 <body>  
32  
33   <button id="counter" class="btn btn-primary">Counter (0)</button>  
34  
35 </body>  
36
```



Counter (0)

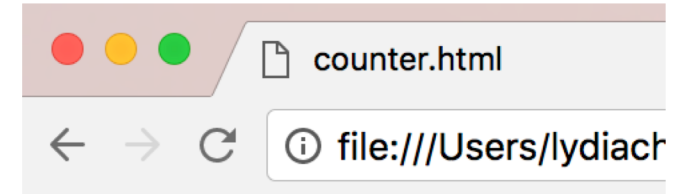
JavaScript

```
14  
15 <head>  
16   <!-- bootstrap -->  
17   <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/bootstrap/3.3.7/css/bootstrap.min.css">  
18   <!-- JQuery -->  
19   <script src="http://code.jquery.com/jquery-3.3.1.min.js"></script>  
20   <script src="http://code.jquery.com/ui/1.11.4/jquery-ui.min.js"></script>  
21 </head>  
22
```

We attach a click handler

HTML

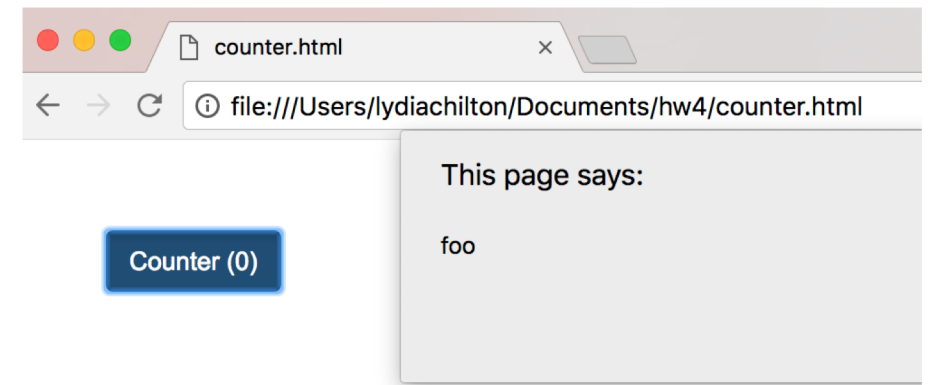
```
30  
31 <body>  
32  
33   <button id="counter" class="btn btn-primary">Counter (0)</button>  
34  
35 </body>  
36
```



Counter (0)

JavaScript

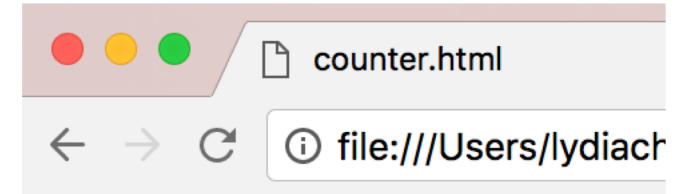
```
25  
26 $(document).ready(function(){  
27   $("#counter").click(function(){  
28     alert("foo")  
29   })  
30 })  
31
```



How NOT to increment the count?

HTML

```
30  
31 <body>  
32  
33 <button id="counter" class="btn btn-primary">Counter (0)</button>  
34  
35 </body>  
36
```



Counter (0)

JavaScript

```
25  
26 $(document).ready(function(){  
27     $("#counter").click(function(){  
28         let html = $(this).html()  
29  
30         let regexp = /\(([^\)]+)\)/;  
31         let matches = regexp.exec(html);  
32  
33         let number = 1*matches[1]  
34         let incremented_number = number +1  
35  
36         $(this).html("Counter (" + incremented_number + ")")  
37     })  
38 })  
39
```

Get the button text: **“Counter (0)”**

Extract the data from from the text

Cast to a number and add one

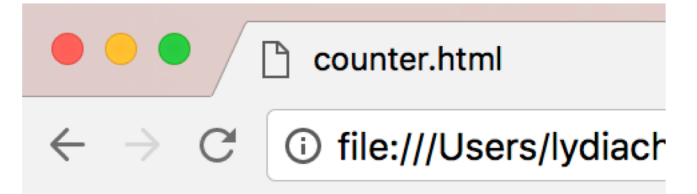
Replace the button text: **“Counter (1)”**

Problem? State is stored ONLY in the UI.

How TO increment the count?

HTML

```
61 <body>
62
63   <button id="counter" class="btn btn-primary"></button>
64
65 </body>
66
```



Counter (0)

JavaScript

```
41
42 let count = 0
43
44 function setCount(count){
45   $("#counter").html("Counter (" + count + ")")
46 }
47
48 $(document).ready(function(){
49   setCount(count)
50
51   $("#counter").click(function(){
52     count = count + 1
53     setCount(count)
54   })
55 })
56
```

Create a model of the data separate from the HTML (the view)

Create a function that can set the counter data to the view

When the page first loads, set the counter to 0

When the counter is clicked,
modify the data,
then update the view

Good UI programming separates the **data** model from the **view** and controller

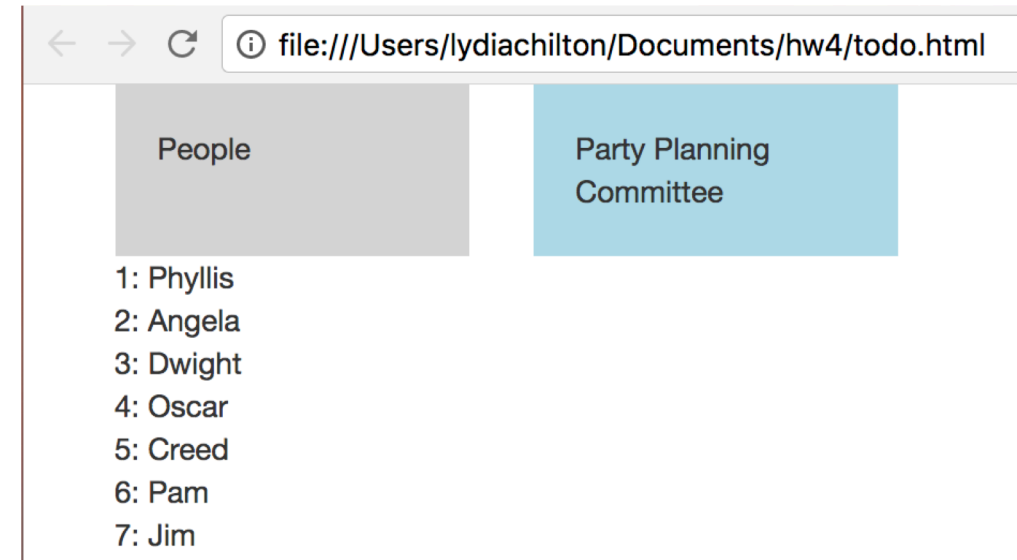
Not MVC:
data stored in UI

Good (MVC):
Data stored as a variable.
UI generated from data

```
31 <body>
32   <button id="counter" class="btn btn-primary">Counter (0)</button>
33 </body>
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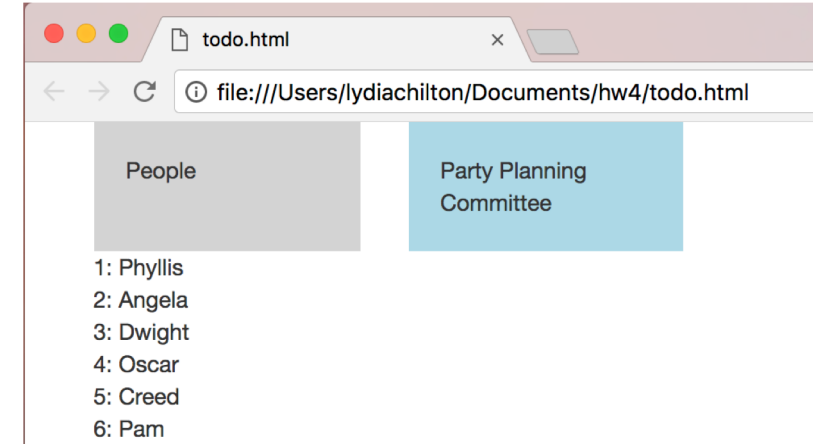
```
41
42 let count = 0
43
44 function setCount(count){
45   $("#counter").html("Counter (" + count + ")")
46 }
47
48 $(document).ready(function(){
49   setCount(count)
50
51   $("#counter").click(function(){
52     count = count + 1
53     setCount(count)
54   })
55 })
56
```

Implementing Direct Manipulation



Direct Manipulation Properties

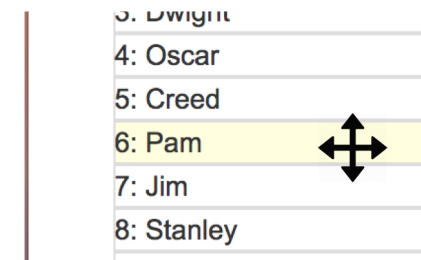
1. **Objects** are represented visually



2. **Actions** are rapid,
incremental and reversible

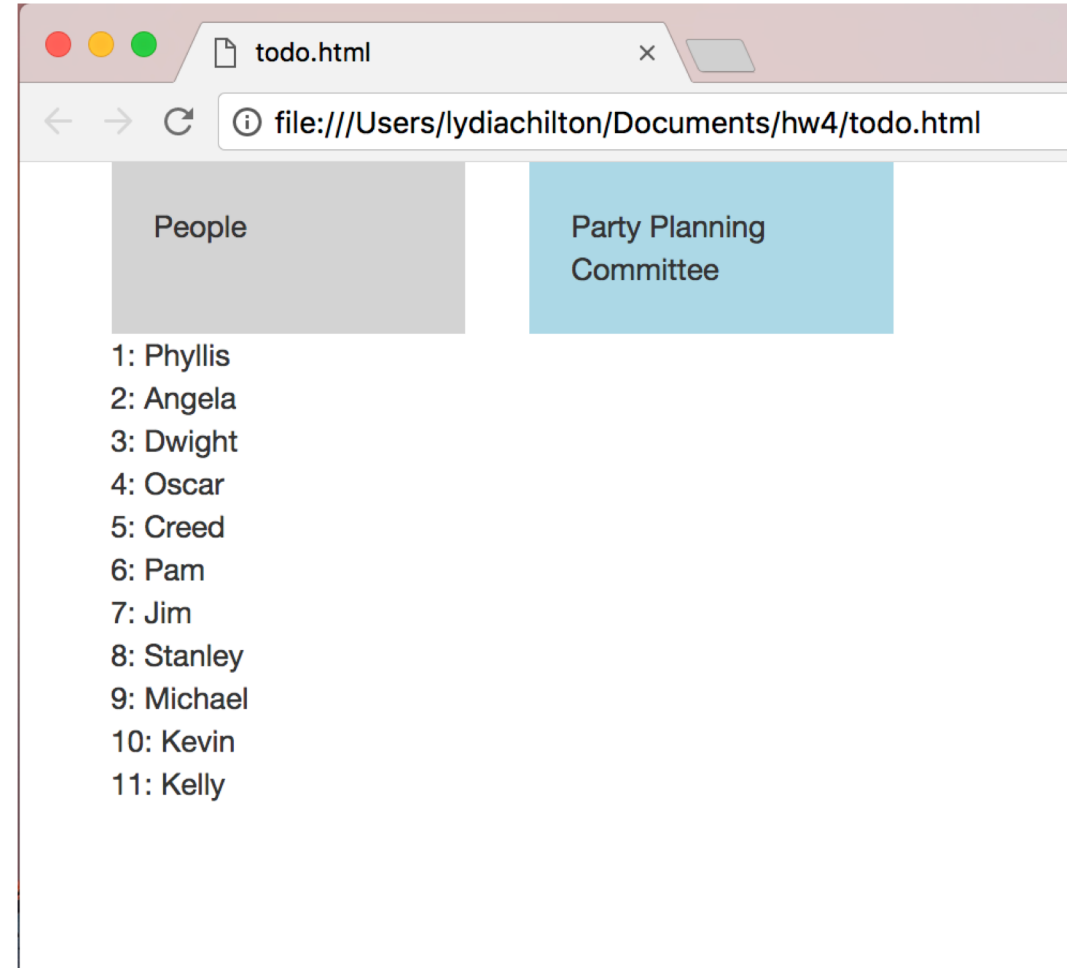
Drag and Drop

3. User interacts
directly with object representations



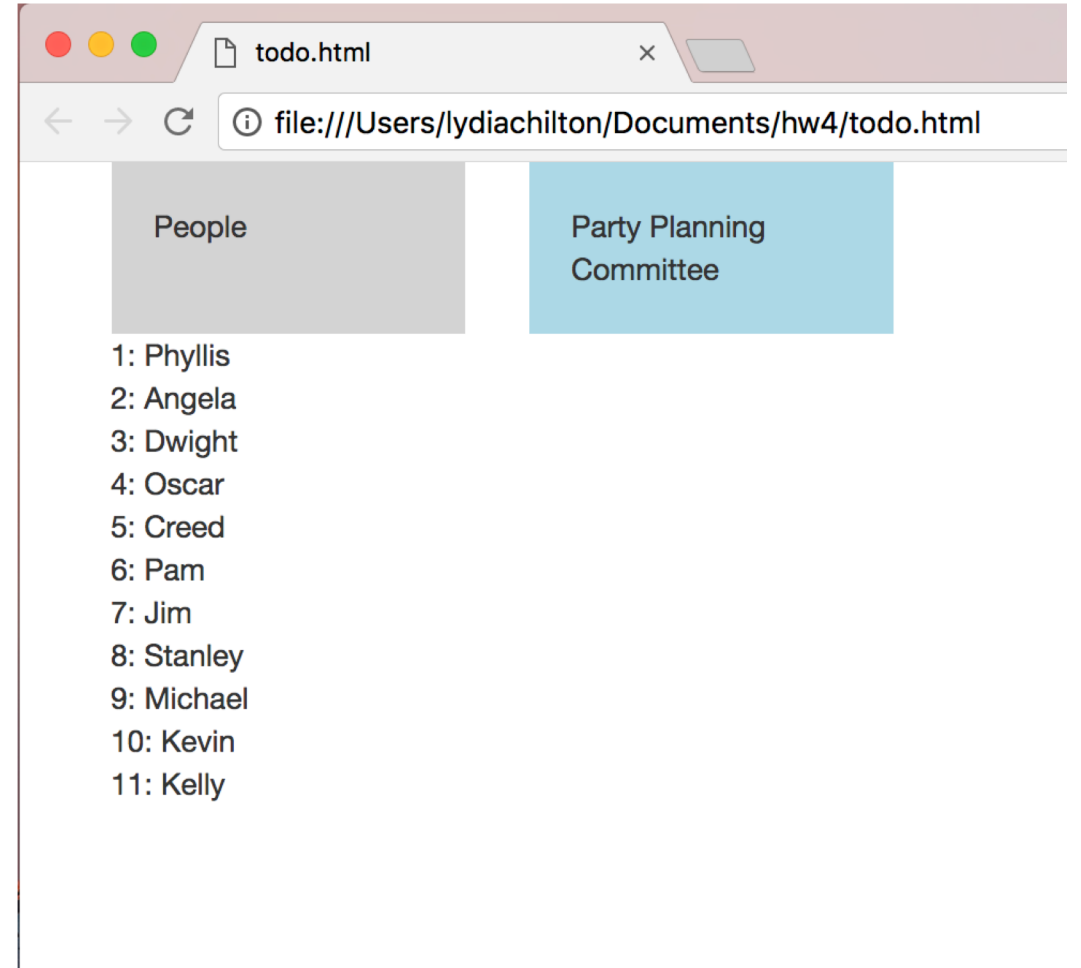
How to NOT implement this?

```
27
28 <div class="header"> NAMES </div>
29 <div>Phyllis</div>
30 <div>Angela</div>
31 <div>Dwight</div>
32 <div>Oscar</div>
33 <div>Creed</div>
34 <div>Stanley</div>
35
36
```



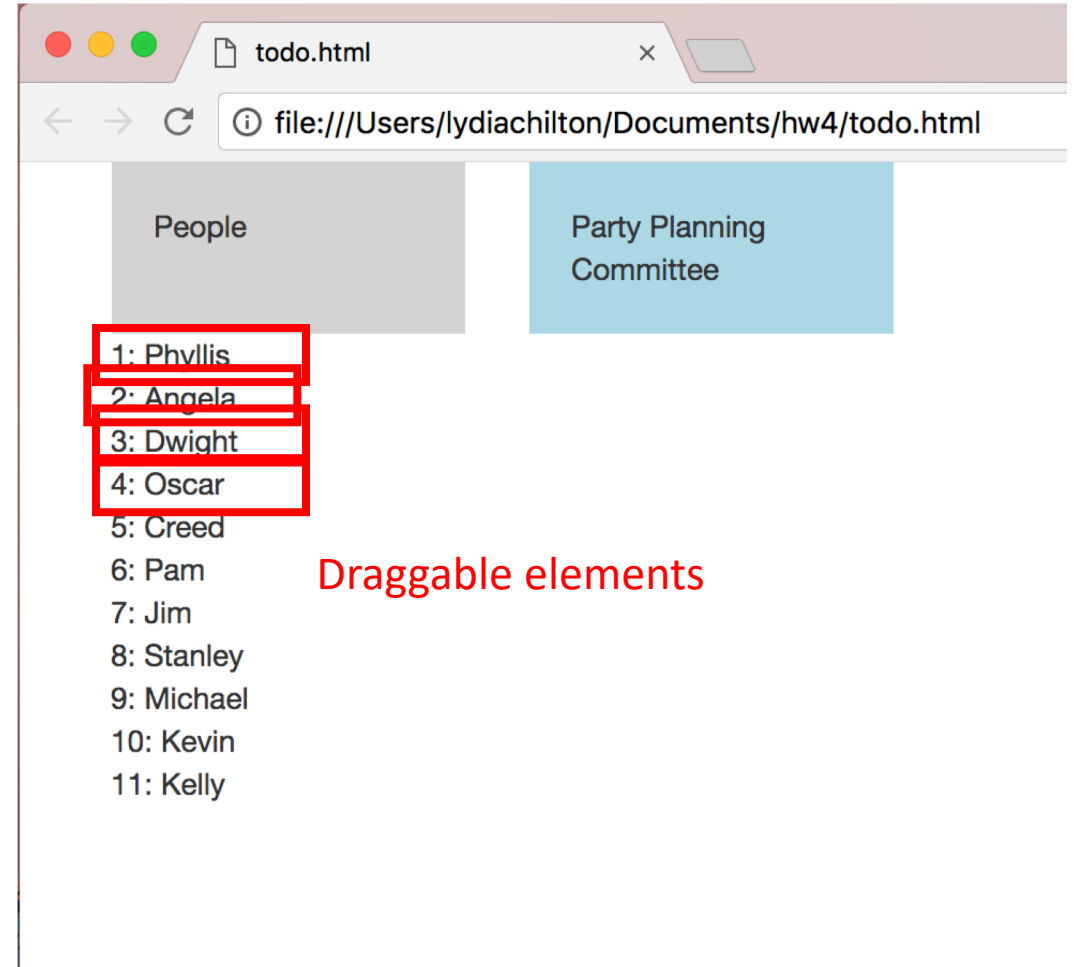
Step 1. Create the Data Model

```
1  var names = [  
2  "Phyllis",  
3  "Angela",  
4  "Dwight",  
5  "Oscar",  
6  "Creed",  
7  "Pam",  
8  "Jim",  
9  "Stanley",  
10 "Michael",  
11 "Kevin",  
12 "Kelly"  
13 ]  
14  
15 var list1 = []  
16
```



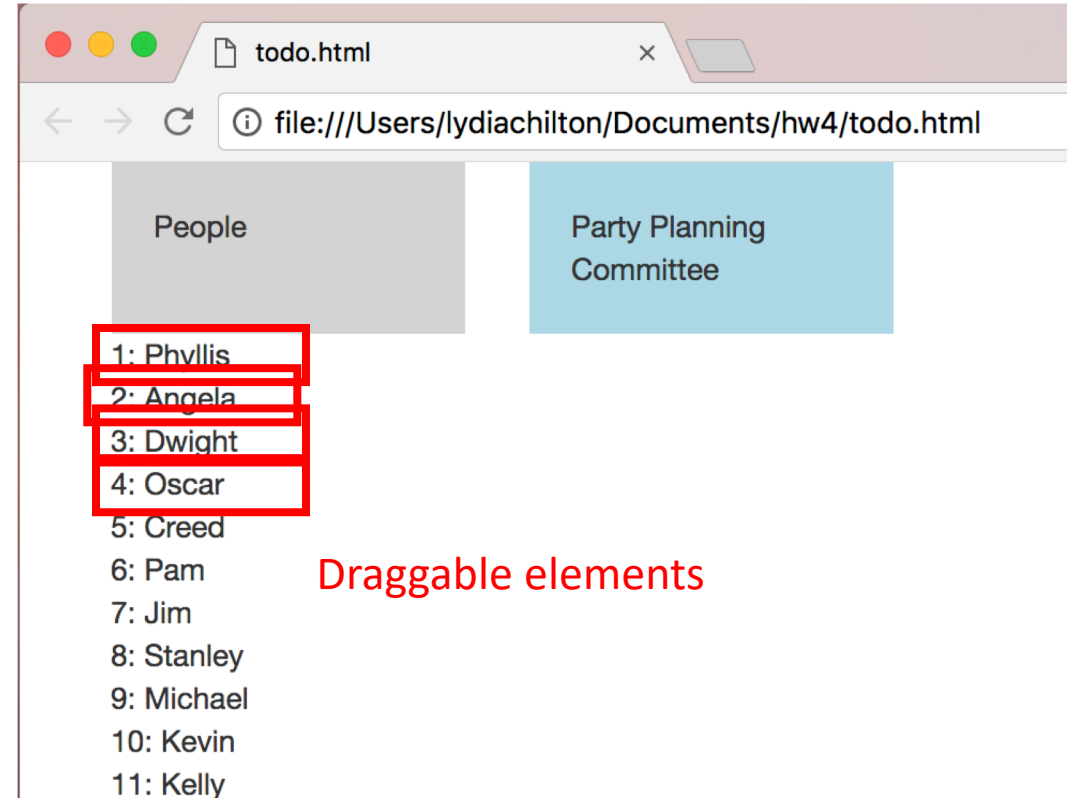
Step 2. Create a function that updates the view with new data

```
170
171 var names = [
172   "Phyllis",
173   "Angela",
174   "Dwight",
175   "Oscar",
176   "Creed",
177   "Pam"
178 ]
179 var list1 = []
180
181
182 function makeNames(names){
183   $("#names").empty()
184   $.each(names, function( index, value ) {
185     //make the draggable name object
186   });
187 }
188
```



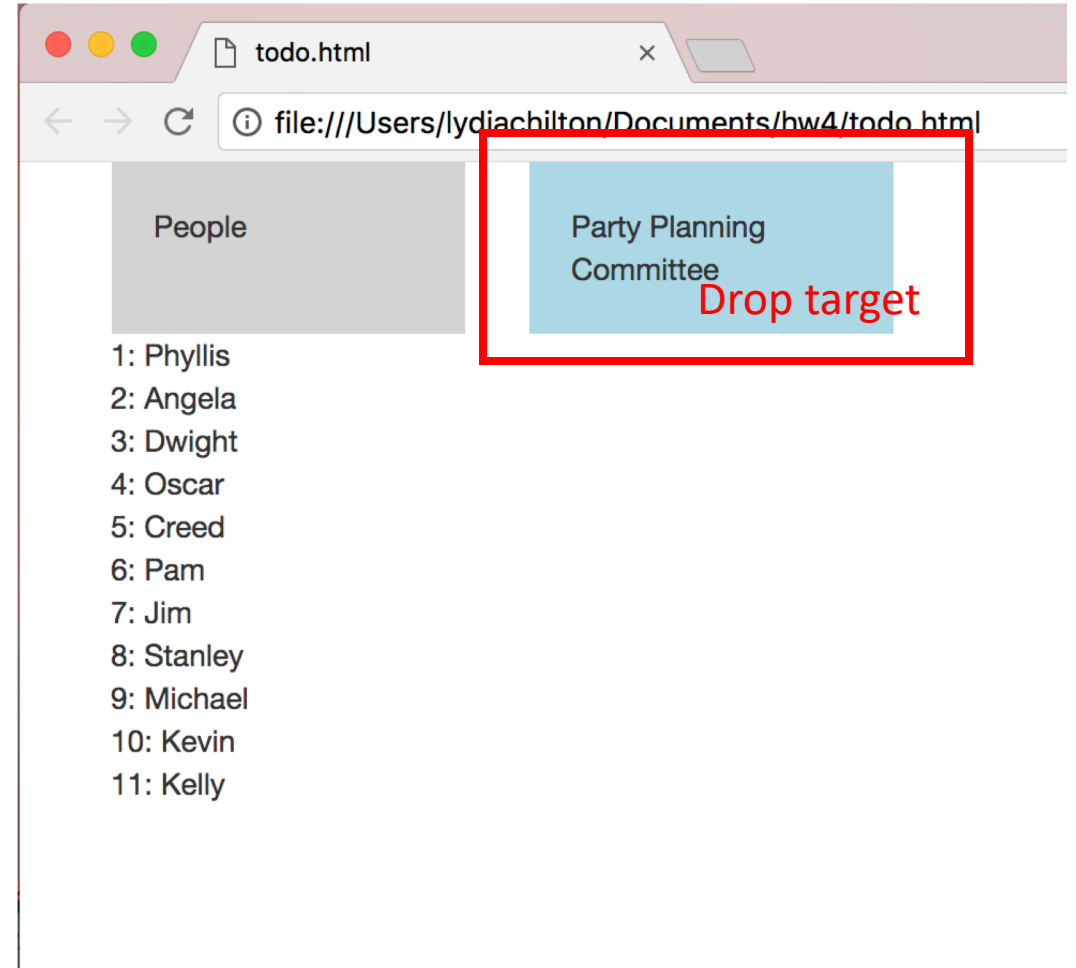
Step 3. On page load, create view.

```
170
171 var names = [
172   "Phyllis",
173   "Angela",
174   "Dwight",
175   "Oscar",
176   "Creed",
177   "Pam"
178 ]
179 var list1 = []
180
181
182 function makeNames(names){
183   $("#names").empty()
184   $.each(names, function( index, value ) {
185     //make the draggable name object
186   });
187 }
188
189
190 $(document).ready(function(){
191   makeNames(names)
192 })
```

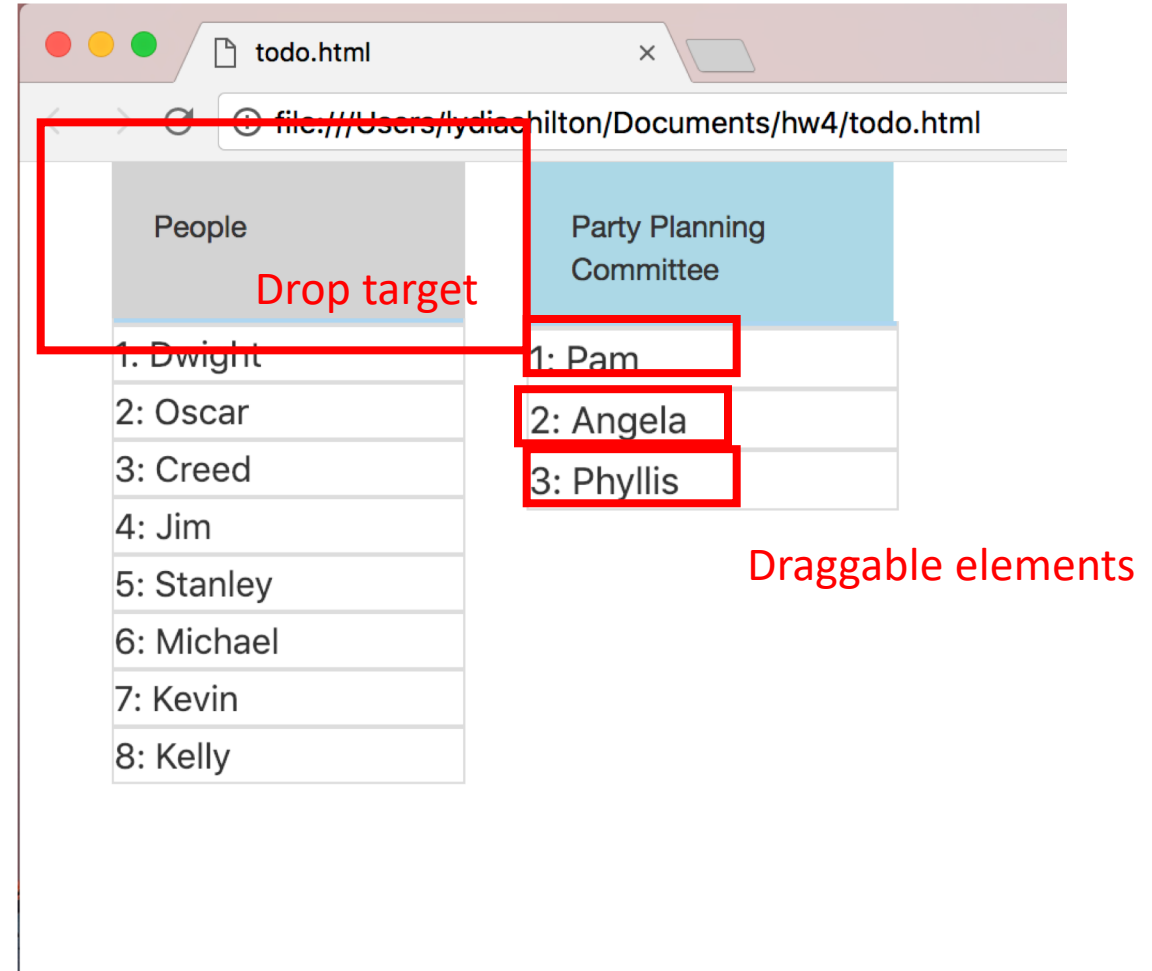


Step 4. Attach a drop event to the drop target.
It should update the data, then update the view

```
188
189
190 $(document).ready(function(){
191     makeNames(names)
192
193     $('#ppc_label').droppable({
194         drop: function(event, ui) {
195             //get dropped name
196
197             //update names array
198
199             //update list1 array
200
201             //update the interface to display the new lists
202         }
203     });
204 }
205
```

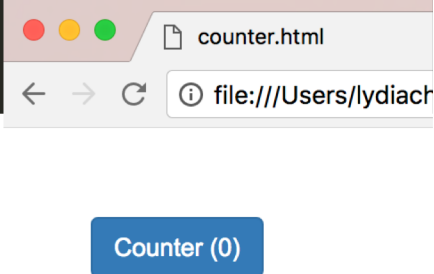


Step 5. What else do we need to do?

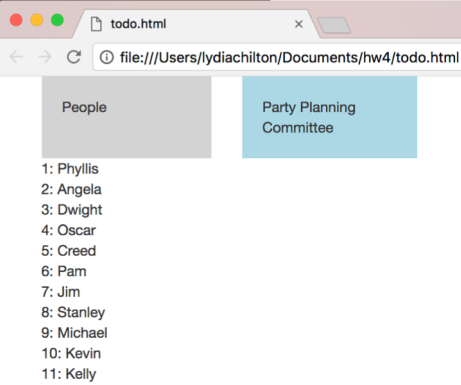


Good UI programming separates the **data** model from the **view** and **controller**

```
41
42 var count = 0
43
44 function setCount(count){
45     $("#counter").html("Counter (" + count + ")")
46 }
47
48 $(document).ready(function(){
49     setCount(count)
50
51     $("#counter").click(function(){
52         count = count + 1
53         setCount(count)
54     })
55 })
56
```

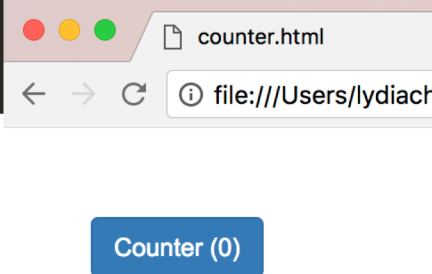


```
170
171 var names = [
172     "Phyllis",
173     "Angela",
174     "Dwight",
175     "Oscar",
176     "Creed",
177     "Pam"
178 ]
179 var list1 = []
180
181
182 function makeNames(names){
183     $("#names").empty()
184     $.each(names, function( index, value ) {
185         //make the draggable name object
186     });
187 }
188
189
190 $(document).ready(function(){
191     makeNames(names)
192
193     $("#ppc_label").droppable({
194         drop: function( event, ui ) {
195             //get dropped name
196
197             //update names array
198
199             //update list1 array
200
201             //update the interface to dis
202         }
203     });
204 })
205
206
```

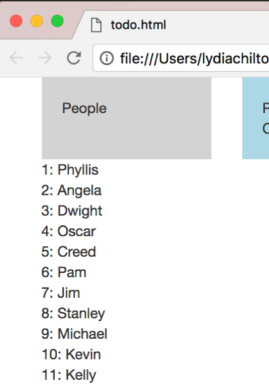


Good UI programming separates the **data** model from the **view** and **controller**

```
41
42 var count = 0
43
44 function setCount(count){
45     $("#counter").html("Counter (" + count + ")")
46 }
47
48 $(document).ready(function(){
49     setCount(count)
50
51     $("#counter").click(function(){
52         count = count + 1
53         setCount(count)
54     })
55 })
56
```

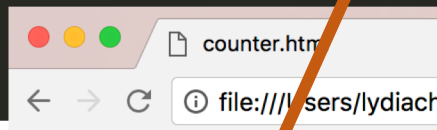


```
170
171 var names = [
172     "Phyllis",
173     "Angela",
174     "Dwight",
175     "Oscar",
176     "Creed",
177     "Pam"
178 ]
179 var list1 = []
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182 function makeNames(names){
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187 }
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190 $(document).ready(function(){
191     makeNames(names)
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193     $("#ppc_label").draggable({
194         drop: function( event, ui ) {
195             //get dropped name
196
197             //update names array
198
199             //update list1 array
200
201             //update the interface to dis
202         }
203     });
204 })
205
206
```



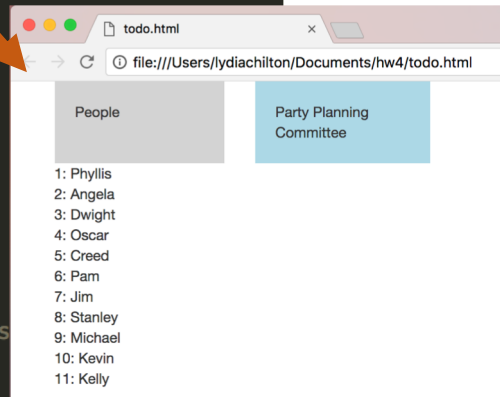
Good UI programming separates the **data** model from the **view** and **controller**

```
41
42 var count = 0
43
44 function setCount(count){
45     $("#counter").html("Counter (" + count + ")")
46 }
47
48 $(document).ready(function(){
49     setCount(count)
50
51     $("#counter").click(function(){
52         count = count + 1
53         setCount(count)
54     })
55 })
56
```



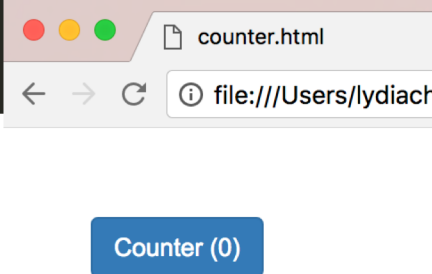
Counter (0)

```
170
171 var names = [
172     "Phyllis",
173     "Angela",
174     "Dwight",
175     "Oscar",
176     "Creed",
177     "Pam"
178 ]
179 var list1 = []
180
181
182 function makeNames(names){
183     $("#names").empty()
184     $.each(names, function(index, value) {
185         //make the draggable name object
186     });
187 }
188
189
190 $(document).ready(function(){
191     makeNames(names)
192
193     $("#ppc_label").droppable({
194         drop: function(event, ui) {
195             //get dropped name
196
197             //update names array
198
199             //update list1 array
200
201             //update the interface to dis
202         }
203     });
204 }
205
206
```

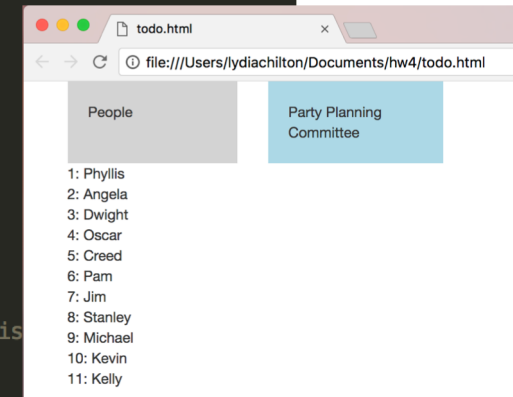


Good UI programming separates the **data** model from the **view** and **controller**

```
41
42 var count = 0
43
44 function setCount(count){
45     $("#counter").html("Counter (" + count + ")")
46 }
47
48 $(document).ready(function(){
49     setCount(count)
50
51     $("#counter").click(function(){
52         count = count + 1
53         setCount(count)
54     })
55 })
56
```

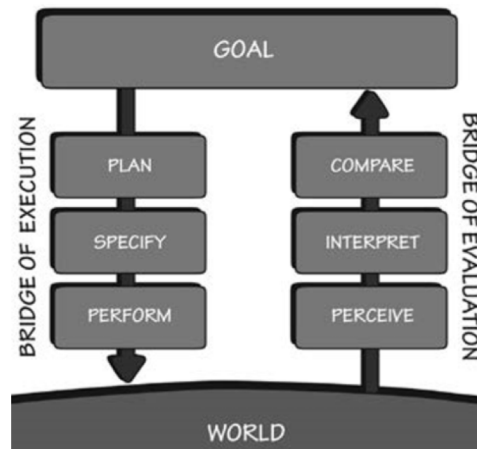
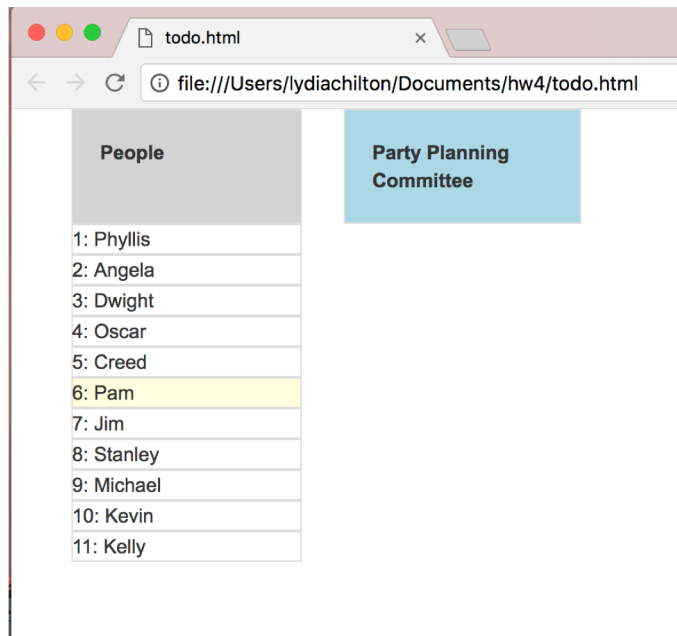


```
170
171 var names = [
172     "Phyllis",
173     "Angela",
174     "Dwight",
175     "Oscar",
176     "Creed",
177     "Pam"
178 ]
179 var list1 = []
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181 function makeNames(names){
182     $("#names").empty()
183     $.each(names, function( index, value ) {
184         //make the draggable name object
185     });
186 }
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189
190 $(document).ready(function(){
191     makeNames(names)
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193     $("#ppc_label").draggable({
194         drop: function( event, ui ) {
195             //get dropped name
196
197             //update names array
198
199             //update list1 array
200
201             //update the interface to dis
202         }
203     });
204 }
205
206
```



Summary

Direct manipulation interfaces help users directly **execute** an action and immediately **evaluate** feedback.



There are visible **actions** the user can **execute**

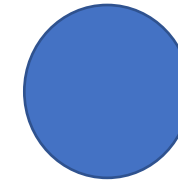
There is visible **feedback** the user can **evaluate**

Direct Manipulation Properties

1. **Objects** are represented visually



Move to trash



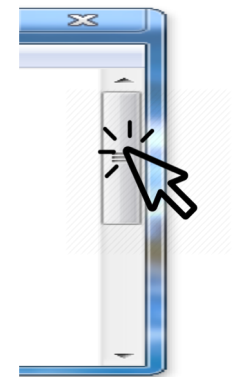
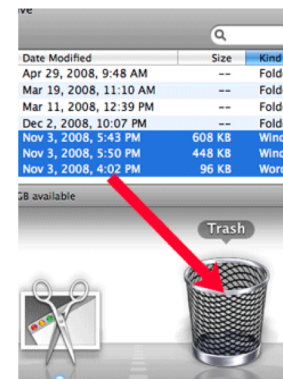
Resize



Move viewport

2. **Actions** are rapid,
incremental and reversible

3. User interacts
directly with object representations



Signifiers help users perceive affordances

Bad signifiers



Signifier Handle that can be yanked toward you

Perceived affordance **Pull**

Affordance **Push**

Good signifiers



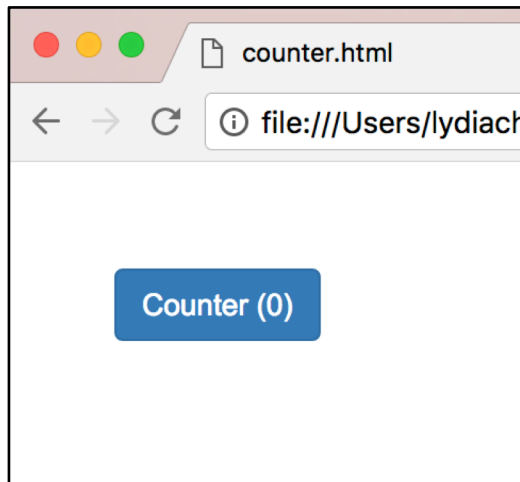
Signifier Handle that can be leaned on

Perceived affordance **Push**

Affordance **Push**

Use MVC to implement Direct Manipulation

Create an **object**
in the view



Add an **event handler**
to respond to user's actions

```
25
26 $(document).ready(function(){
27     $("#counter").click(function(){
28         alert("foo")
29     })
30 })
31
```

Modify the **data**,
then update the **view**

```
41
42 var count = 0
43
44 function setCount(count){
45     $("#counter").html("Counter (" + count + ")")
46 }
47
48 $(document).ready(function(){
49     setCount(count)
50
51     $("#counter").click(function(){
52         count = count + 1
53         setCount(count)
54     })
55 })
56
```

Good UI programming separates the **data** model from the **view** and controller

Not MVC:
data stored in UI

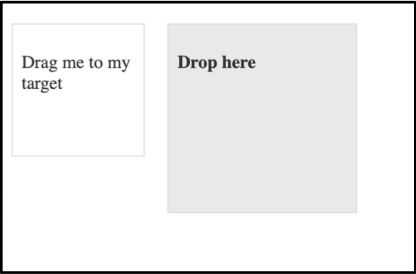
Good (MVC):
Data stored as a variable.
UI generated from data

```
31 <body>
32   <button id="counter" class="btn btn-primary">Counter (0)</button>
33 </body>
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```
41
42 let count = 0
43
44 function setCount(count){
45   $("#counter").html("Counter (" + count + ")")
46 }
47
48 $(document).ready(function(){
49   setCount(count)
50
51   $("#counter").click(function(){
52     count = count + 1
53     setCount(count)
54   })
55 })
56
```

Homework 4: JavaScript Widgets and MVC

Warm-up:



Adding a drag and drop widget with customization

Main:

The screenshot shows a web application titled "Columbia Paper Infinity". At the top, there is a light blue header bar with the title. Below the header is a grey trash bin icon labeled "trash". Underneath is a form titled "Log your paper sales:" with two input fields: "Client" and "# Reams", and a blue "Submit" button. Below the form is a table with three columns: "Client", "# Reams", and a delete button (a yellow square with a black 'X').

Client	# Reams	Delete	
James D. Halpert	Shake Shack	100	X
Stanley Hudson	Toast	400	X
Michael G. Scott	Computer Science Department	1000	X

Dynamically creating and updating elements in MVC style