CS148: Introduction to Computer Graphics and Imaging

Interactive Techniques

Topics

Processing to input

- Events
- Polling

Basic principles of interactive techniques

- "Input on output"
- Direct manipulation and dragging

Events

`input.py`

Events

1. May mark with time stamp
2. May store state of other devices
   - Add continuously changing devices like the mouse
3. May merge events for efficiency
   - Combine multiple mouse motion events into a single motion event
4. May reorder events based on priority
   - Input events from the keyboard have priority over PostRedisplay
5. May use as a general mechanism by the operating system for notifying the application

Polling

`joy.cpp`

Gamepads: Buttons, Hats, Axes, Balls

SONY Playstation 3

Microsoft XBOX 360

Polling vs. Events

Polling - Read state of the device directly

- **Read when needed**
- **Read at some regular rate (e.g. 100 Hz)**

Events - Notify when device state changes

- **Keyboard sends "make" when the key is pressed, and "break" when the key is released**

Comparison: Polling vs. Events

Polling - Read state of the device directly

- **Good if the device continuously changes state**
- **Bad because could miss a state change**
- **Bad because it has high overhead**

Events - Notify when a device state changes

- **Efficient if the state changes are intermittent**
- **Need to track state; may lose track of state**
- **Need to select the events of interest**

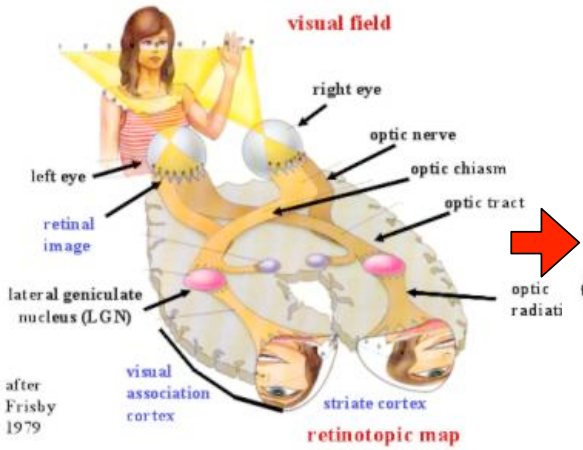
Graphical Interaction

Bits in input << Bits in output

20-40
words per minute

60
megapixels per sec

Bits in (sensing) > Bits out (motor)

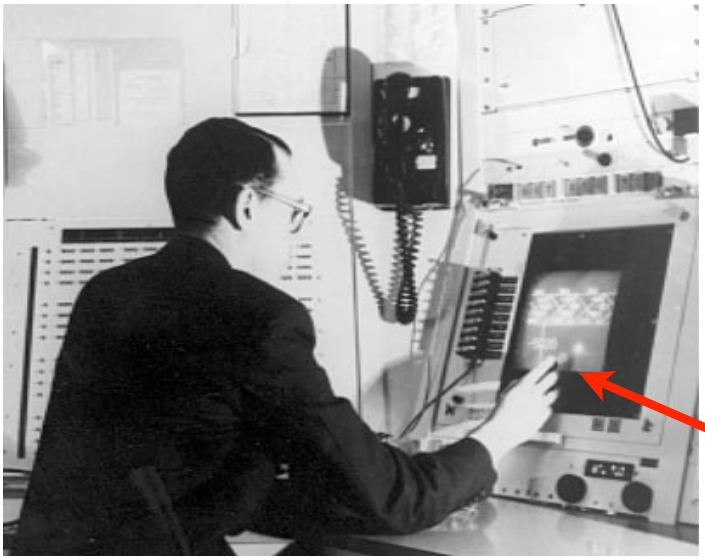


Visual cortex **Motor cortex**

Big Idea

Input on Output

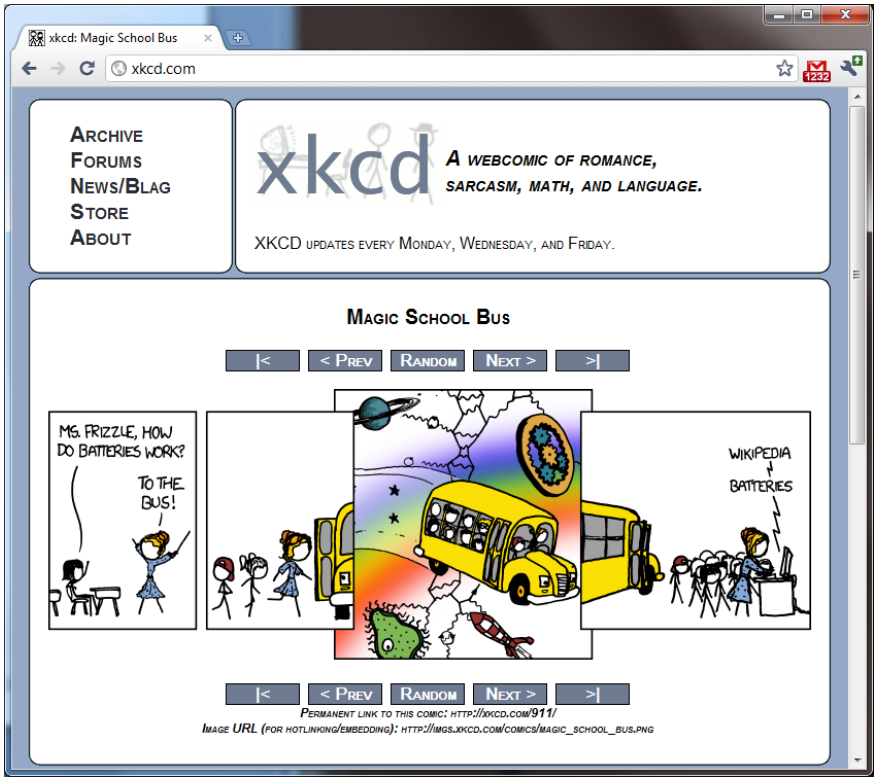
Sketchpad (1963)
Ivan Sutherland



Light Pen

Routing Input to Output

- What objects overlap the cursor?
  - Need to implement method for picking objects
  - Normally store objects in a data structure
- How to handle multiple objects?
  - The visible object (usually the last object drawn)
- How to handle object hierarchy?
  - Recursively send events from parents to children
  - Find visible object, send events to parents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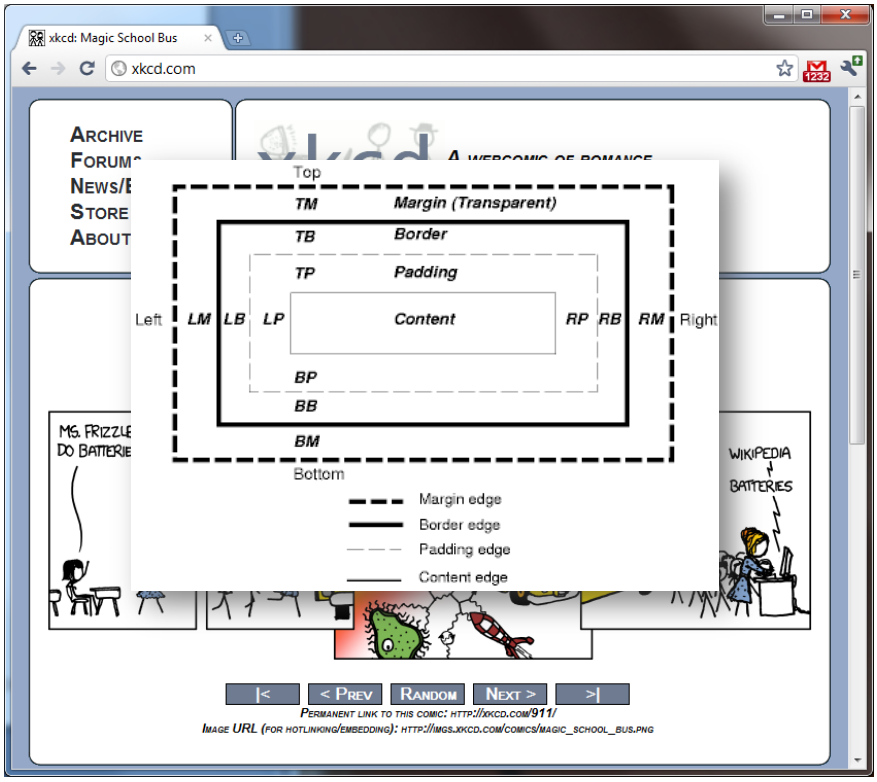
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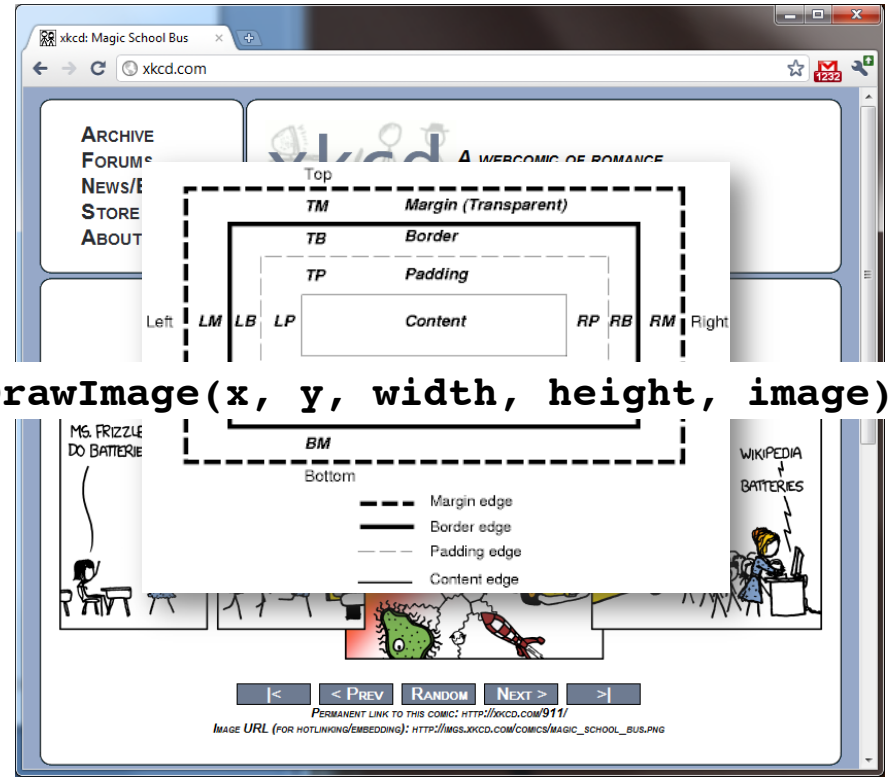
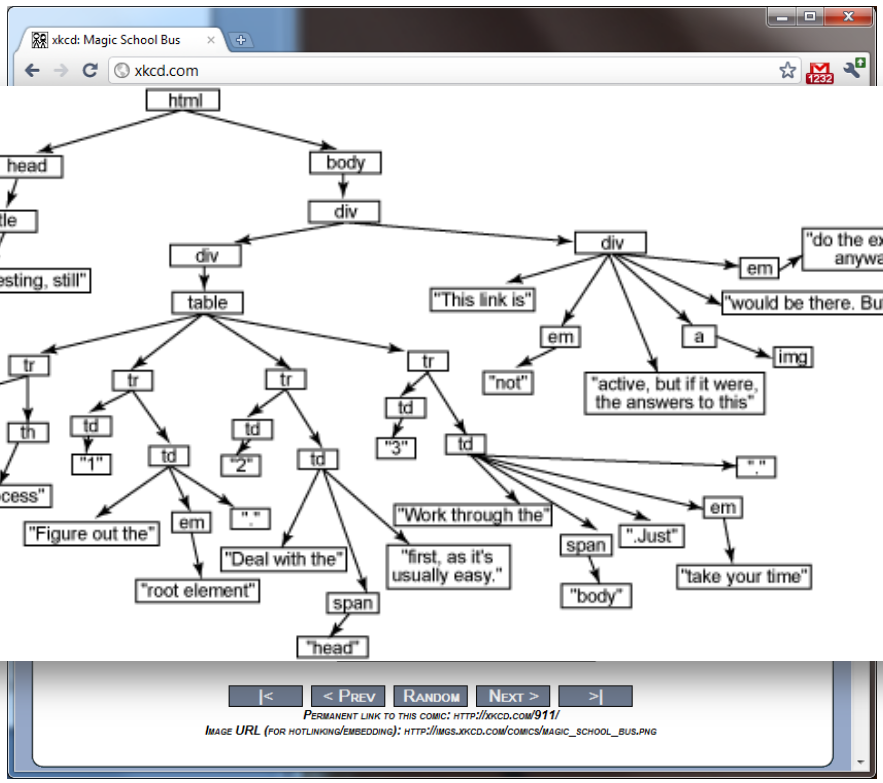
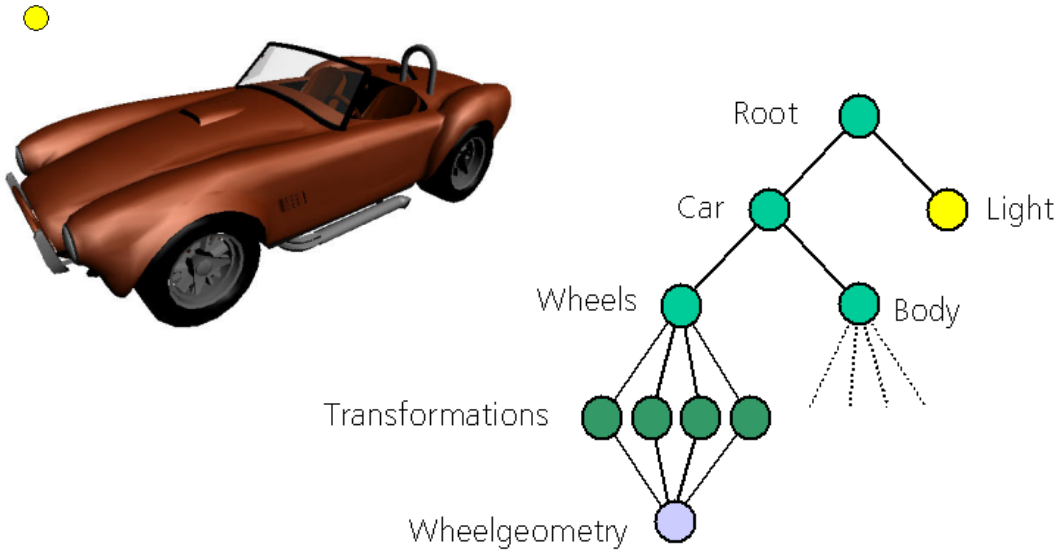



```
DrawImage(x, y, width, height, image);
```

Document Object Model (DOM)



Hierarchical Scene Graph



Picking

Simplest method

- **Find if pointer is inside the box**

Better methods

- **Object specific pick method: `Obj.pick(x,y)`**
- **Object tag buffer**
  - **Render tag (int) into a secondary framebuffer**
  - **Read tag at the pixel location of the mouse**
- **OpenGL picking**
  - **Tag objects, render all the fragments**
  - **Return object tag of the fragment under the cursor**

Push-Buttons & Menu-Buttons

Two Types of Buttons

Push button

- Press inside and release inside

Menu button

- Press inside *or outside* and release inside

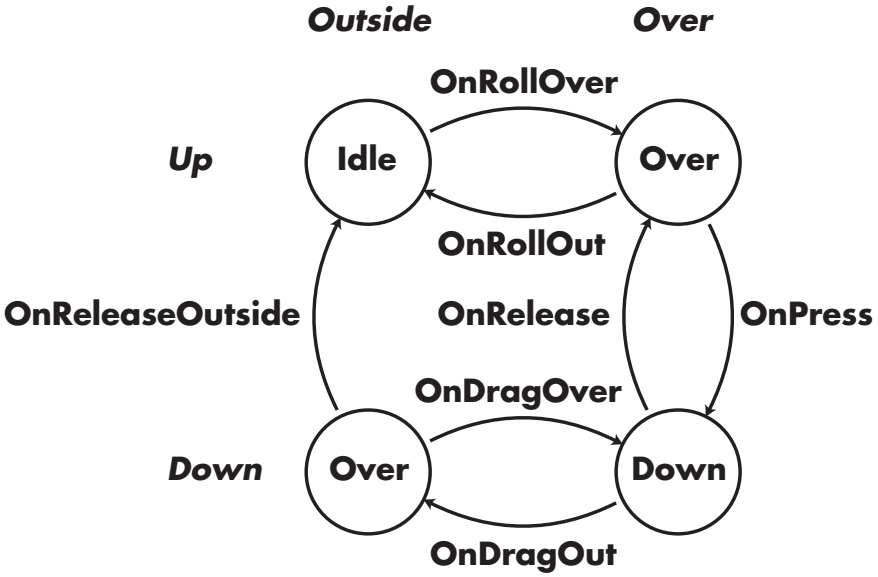
Flash menu button examples.

- `button.swf`
- `menubutton.swf`

Push Button State Transitions

Product of states: Outside vs. Over / Up vs. Down

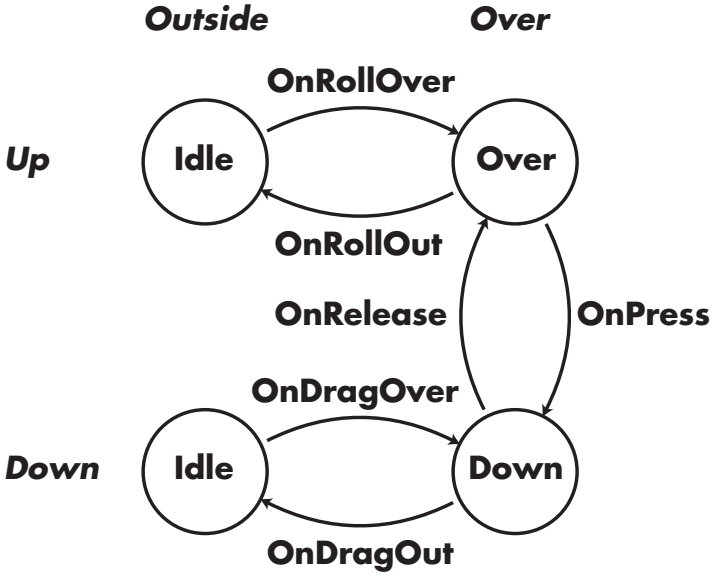
Three views of the button: Idle, Over, Down



Menu Button State Transitions

Product of states: Outside vs. Over / Up vs. Down

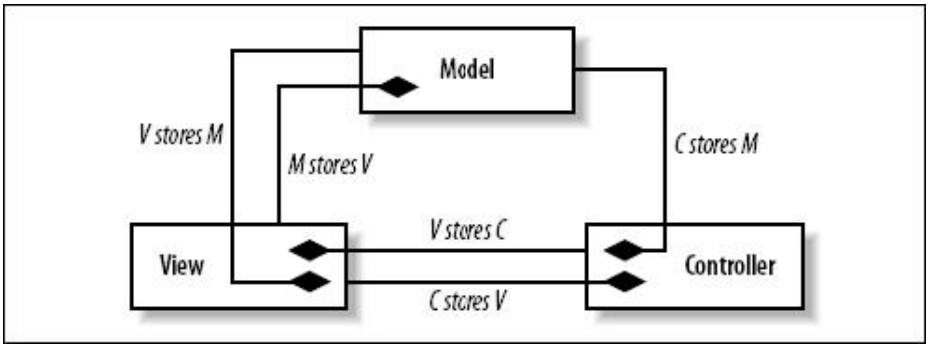
Three views of the button: Idle, Over, Down



Model-View-Controller

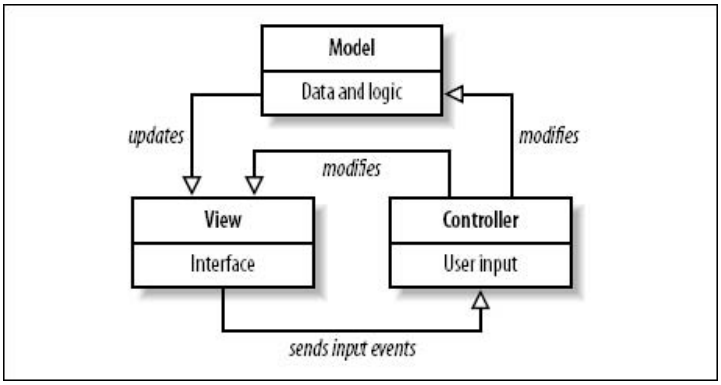
Model-View-Controller Design Pattern

```
m = new Model();
m.addView(v1);
m.addView(v2);
```



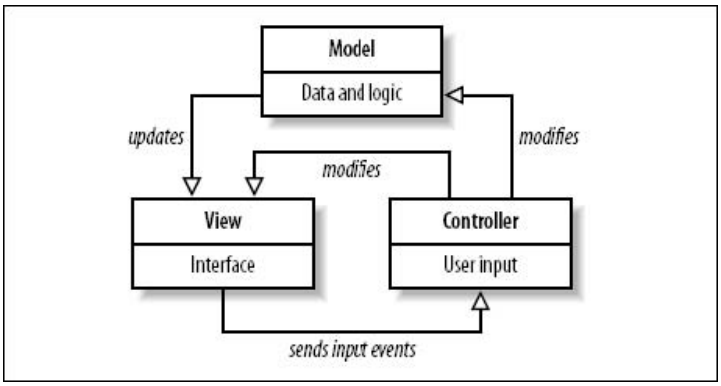

```
v1 = new ViewA(m,c);   c = new Controller(m);
v2 = new ViewB(m,c);
```

Model-View-Controller Design Pattern




```
v.onChange = function() {
  v.c.setValue(v.value);
}
```


Model-View-Controller Design Pattern

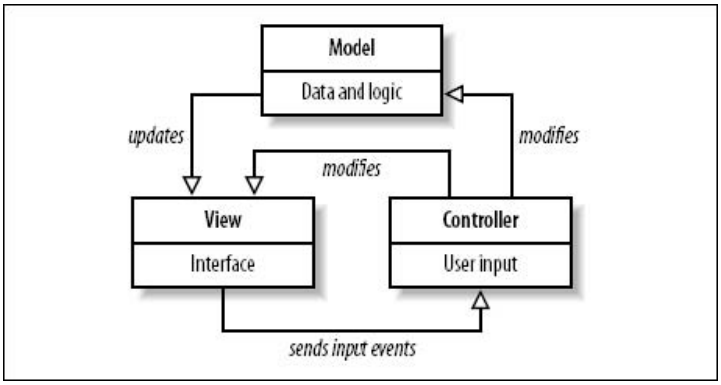



```
v.onChange() = function() {
  v.c.setValue(v.value);
}
```

```
c.setValue = function(s) {
  c.m.setValue(s);
  c.m.onUpdate();
}
```

Model-View-Controller Design Pattern

```
m.onUpdate = function() {
  for v in m.views:
    v.onUpdate();
}
```

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Model-View-Controller Design Pattern

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m.onUpdate = function() {
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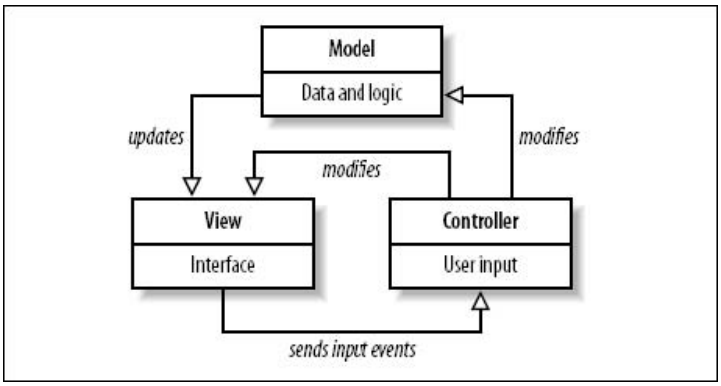


```
v.onUpdate = function() {
  m.draw(v);
}
```

Direct Manipulation

Dragging

Dragging

```
this.startdrag(true);
```

- Attaches `this` to the cursor
- Position of object updated when cursor moves

```
stopdrag();
```

Flash dragging examples.

- `line.swf, triangle.swf, curve.swf`

Represent the world to "afford" action

Selection by pointing (not by typing)

Moving by dragging

Immediate and continuous display of the state

Indicate consequences of "dropping"

- B. Schneiderman (1983)

Things to Remember

Processing input

- **Events**
- **Polling**

Basic principles of interactive techniques

- **"Input on output"**
  - **Document/scene model**
  - **Picking**
  - **Model-view-controller**
- **Direct manipulation**