CSCI 1106
Lecture 16

Player Movement

Announcements

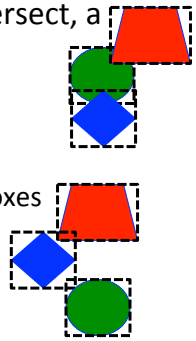
- Today's Topics
  - Collision detection (finish off last lecture)
  - Motivation for player movement
  - Mouse Movement
  - Easing
  - Keyboard Movement

hitTestObject()

- Idea: If the bounding boxes of two objects intersect, a collision has occurred
- Pros: Fast, cheap, simple to use
- Cons:
  - Cannot determine where the collision occurred
  - Irregularly shaped objects have large bounding boxes
  - False positives
- Use:

```
if(objA.hitTestObject(objB))
{ …
}
```

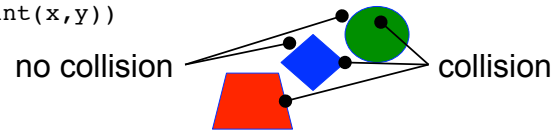
- Obs: Need finer granularity mechanism



hitTestPoint()

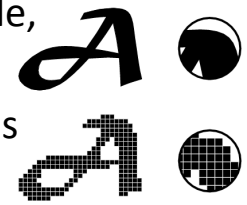
- Ideas:
  - Detect whether a specific point is within the shape of the object
  - Useful on vector objects (ones you draw with the rectangle tool)
  - Only the drawn part is checked for overlap with the point
  - The bounding box isn't considered!
- Pros: Still pretty simple
- Cons:
  - Can only check one point
  - Objects comprise many points so object collisions require multiple checks
    - E.g. ball and paddle
    - Expensive and slow if many points need to be checked
  - Does not work for bitmapped graphics
- Use:

```
if(obj.hitTestPoint(x,y))
{ …
}
```

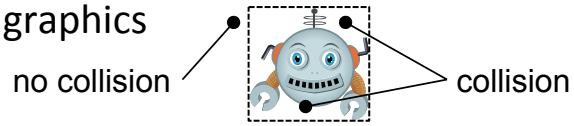


Vector vs Bitmapped Graphics

- Vector based graphics are those that you draw using the rectangle, circle, or other tools
- Bitmap based graphics are pictures that you import
- Problem: Flash uses the bounding box for point hit detection on bitmapped graphics

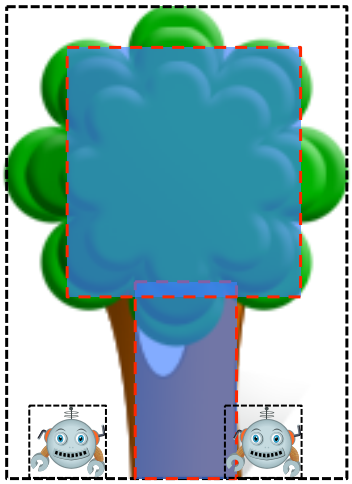


http://www.snap.ednet.ns.ca/hhs/tprofittcmt12/images/vector-vs-bitmap.png



A Compound Approach

- Problem:
  - Need to use `hitTestObject()` on irregular shaped object
  - Bounding box of object differs from object shape
- Solution:
  - Create invisible objects within this object with smaller bounding boxes
  - Use the smaller bounding boxes to detect collisions



Player Motion

- All interactive games have player movement
  - Players can move their character or avatar on the screen
  - Players can react to the game and move their avatar
- How the avatar moves is dictated by the game's
  - Laws and physics of the game
  - Goals and objectives
  - Environment and level of play
- Common ways to move the avatar are through
  - Mouse
  - Keyboard
  - Dedicated game controllers and joysticks

Direct Mouse Movement

- Idea: Make the player the "mouse"
  - The avatar appears where the mouse is pointing to
  - No need to control the velocity of the avatar
  - Position and velocity is managed by the mouse movement
- How:
  - Import the *Mouse* class

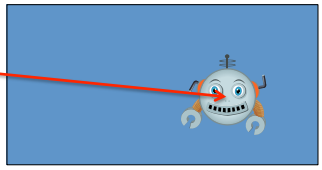
```
import flash.ui.Mouse;
```

  - Hide the mouse at the start of the level so that the avatar replaces the mouse pointer

```
Mouse.hide();
```

  - Set the player object's coordinates to the mouse coordinates at each ENTER_FRAME event

```
avatar.x = mouseX;
avatar.y = mouseY;
```



Direct Mouse Movement

- Pros:
  - Easy
  - Not much code required
- Cons:
  - Restrictions on movement may be needed, e.g.,
    - Disallowing movement in some dimensions (paddle)
    - Checking if mouse is over the game panel area
  - Violates of most accepted laws of physics
    - Avatar can accelerate and move instantly
- How can we solve these problems?

Mouse Movement using Easing

- Idea: gradually move avatar toward the location clicked on with the mouse pointer
  - A mouse click sets the target to move toward
  - Calculate distance between the avatar and target
  - Incrementally move the avatar toward the target
  - Note: the avatar isn't guaranteed to reach the target because the target will change if another location is clicked first
- Pros:
  - Makes the physics of the game more realistic
  - Restricts avatar movement by ignoring clicks on illegal areas of the stage
- Cons:
  - Allows only coarse-grained movement

Implementing Easing

- Declare an EASING constant
  - *0 < EASING < 1*
  - Smaller constant implies slower movement
- Declare "target" variables *(tx, ty)*
- Set *(tx,ty)* to the avatar's location
- On each MOUSE_DOWN event
  - Sets the target variables to the mouse location

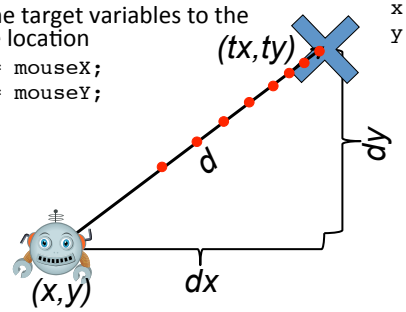
```
tx = mouseX;
ty = mouseY;
```

- On each NEXT_FRAME event
  - Calculate the distance *d* between avatar and target

```
dx = tx - x
dy = ty – y
d = sqrt(dx*dx + dy*dy)
```

  - If *d >1* pixel, move avatar toward the target

```
x = x + (dx * EASING)
y = y + (dy * EASING)
```



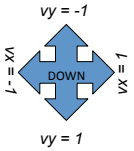
Keyboard based Movement

- Idea: Move the player with the keyboard
  - The arrow keys control the direction that the avatar moves
  - These directions allow the player to move diagonally as well
  - Need to respond to the KEY_DOWN and KEY_UP events
  - More than one key can be down at the same time
- Pros:
  - Very precise movement
- Con:
  - Requires the player to learn the control keys

Implementing Keyboard Controls

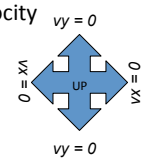
- Import the `KeyboardEvent` and `Keyboard` classes
- Use two variables, *(vx,vy)* to store the avatar's velocity (initially 0)
- Listen for the KEY_DOWN, KEY_UP, and ENTER_FRAME events
- On a KEY_DOWN event
  - Check which of the arrow keys are pressed and set velocity

```
if (event.keyCode == Keyboard.LEFT) vx = -5;
if (event.keyCode == Keyboard.RIGHT) vx = 5;
if (event.keyCode == Keyboard.UP) vy = -5;
if (event.keyCode == Keyboard.DOWN) vy = 5;
```



- On a KEY_UP event
  - Check which of the arrow keys were released and reset velocity

```
if (event.keyCode == Keyboard.LEFT) vx = 0;
…
```



- On the ENTER_FRAME event
  - Update the avatar's position

```
x = x + vx;
y = y + vy;
```