CSCI 1106
Lecture 13

Introduction to Game Architecture

Announcements

- Today's Topics
  - Introduction to the Game Design Module
  - Components of a game
  - Introduction to event driven programming
  - Introduction to Flash and ActionScript
- Robotics module technical reports due **on Thursday**

The Game Design Module

Topics

- Structure of a game
- Game mechanics
  - Collision Detection
  - Player movement
  - Autonomous Game Elements
  - Randomness
  - Controls
- Playability and play testing

To Do List

- Five tutorials:
  - Implement a game
  - Learn about game design
- Game Design Project
  - Design your own game
  - Implement the game
  - Write a technical manual
  - Write a user manual

Components of a Game

- Stage: Displays (renders) the game
- Graphical Game Objects
  - Objects that interact on the stage
  - Represent various artifacts in the game
    - Characters
    - Projectiles
    - Goals
    - Dangers
- Game Code
  - Governs interactions between player and game
  - Implements the rules of the game
  - Governs interaction between game objects
  - Contains *event handlers* that respond to events in the game

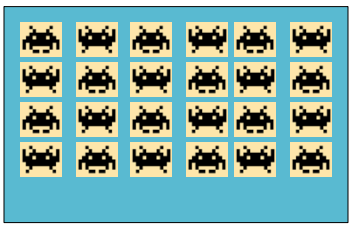
Flash Game Files

- The *stage* is located in a `.fla` file
- All graphical objects are located in the same `.fla` file
- Game code is located in `.as` files

- Once the game is completed, a "compiled" version is found in a `.swf` file

Flash Game Components

- Stage (`.fla` file)
- Game objects (`.fla` file)
  - Graphics
  - Movie clips
- Game Code (`.as` files)
  - ActionScript 3
  - One class per file
- How are these components linked?



Key Ideas

- Objects are designed and used on the stage
- Objects are controlled by code in `.as` files
- User actions on stage (actions on objects) invoke code in `.as` files
- Computer generated actions invoke code in `.as` files

Observation

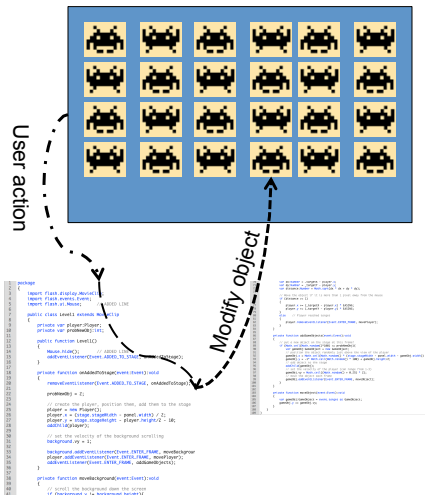
- Observation: A game performs "some action" when "something" happens
- Examples:
  - Character moves *when* the mouse is moved
  - An object explodes *when* it is hit by a laser
  - The screen is updated *after* 1/60th of a second
  - The stage is populated *when* the game starts up
- The "something" are called events

The Event-Driven Paradigm

- Idea: Game code simply responds to events
- Possible events:
  - External events
    - Player movement (mouse, keyboard, kinect, etc)
  - Internal events
    - Start of game
    - New Frame: stage update (every 1/60th of a second)
    - Timer expired
    - Objects appear/disappear
- Each event is handled by an *event handler*
- The game code simply consists of event handlers that handle all aspects (behaviours) of the game!

The Main Loop

- Idea: The main loop is implemented for you
- Main Loop:
  - Event (action) occurs
  - Handle (respond to) event
  - Update (modify) object(s)
- All you need to do is write the event handlers!



The Movie Metaphor

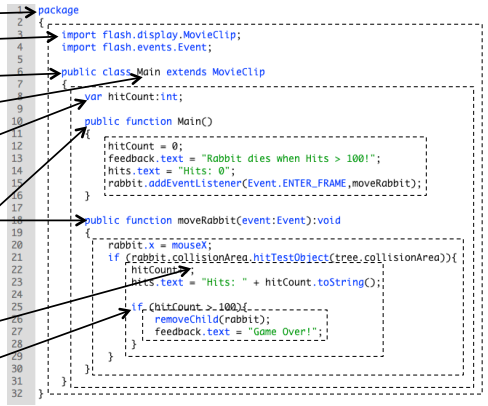
- Key Idea: Flash updates the stage every 1/60th of a second
- The update consists of:
  - ENTER_FRAME event
  - Redraw all objects on the stage
  - LEAVE_FRAME event
- Key Idea: Our game handles the ENTER_FRAME event
  - Updates the positions and properties of all objects
  - Adds/removes objects as needed
  - Updates graphics as needed
- Idea: The Flash system redraws all objects that are on stage
  - All we need to do is update the objects!

Events in Flash

- ADDED_TO_STAGE: object appears
- REMOVED_FROM_STAGE: object disappears
- ENTER_FRAME: objects are about to be redrawn
  - Occurs every 1/60th of a second
- LEAVE_FRAME: objects have been drawn
- ON_KEY: keyboard key pressed
- ON_MOUSE: mouse movement or click
- ON_TIMER: timer went off

ActionScript

- Package
- Imports
- Class
  - Associates code with an object
  - Has a name
  - Main is where the code starts running.
  - Contains variables and functions
- Functions
  - Each function has a specific purpose
  - Contains code
  - Statements, end in ;
  - control structures (if, for, etc)
  - Defined public function name(params) { ... }
- Code is delimited by { and }



```
package
{
    import flash.display.MovieClip;
    import flash.events.Event;

    public class Main extends MovieClip
    {
        var hitCount:int;

        public function Main()
        {
            hitCount = 0;
            feedback.text = "Rabbit dies when Hits > 100!";
            hits.text = "Hits: 0";
            rabbit.addEventListener(Event.ENTER_FRAME,moveRabbit);
        }

        public function moveRabbit(event:Event):void
        {
            rabbit.x = mouseX;
            if (rabbit.collisionArea.hitTestObject(tree.collisionArea)){
                hitCount++;
                hits.text = "Hits: " + hitCount.toString();

                if (hitCount > 100){
                    removeChild(rabbit);
                    feedback.text = "Game Over!";
                }
            }
        }
    }
}
```

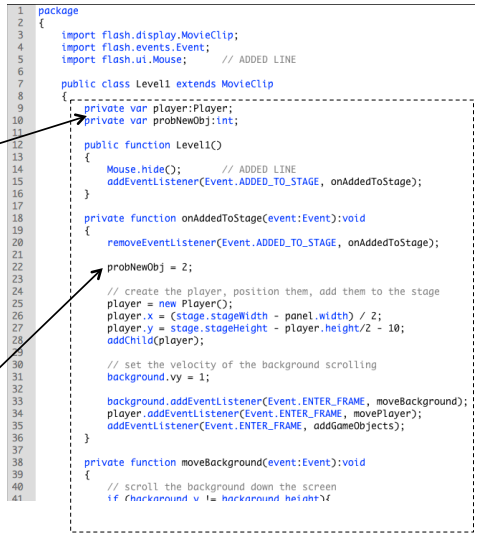
Variables

- Each variable has a type
  - Such as uint, String, etc
- Variables store data of that type
- Declared as

  `var name:type;`

  or

  `var name:type = value;`
- Declared in a class or function
- Only visible (accessible) in block where they are declared.
- Assigned using the = operator
  - e.g.,
  - Number = 42;



```
package
{
    import flash.display.MovieClip;
    import flash.events.Event;
    import flash.ui.Mouse;      // ADDED LINE

    public class Level1 extends MovieClip
    {
        private var player:Player;
        private var probNewObj:int;

        public function Level1()
        {
            Mouse.hide();       // ADDED LINE
            addEventListener(Event.ADDED_TO_STAGE, onAddedToStage);
        }

        private function onAddedToStage(event:Event):void
        {
            removeEventListener(Event.ADDED_TO_STAGE, onAddedToStage);

            probNewObj = 2;

            // create the player, position them, add them to the stage
            player = new Player();
            player.x = (stage.stageWidth - panel.width) / 2;
            player.y = stage.stageHeight - player.height/2 - 10;
            addChild(player);

            // set the velocity of the background scrolling
            background.vy = 1;

            background.addEventListener(Event.ENTER_FRAME, moveBackground);
            player.addEventListener(Event.ENTER_FRAME, movePlayer);
            addEventListener(Event.ENTER_FRAME, addGameObjects);
        }

        private function moveBackground(event:Event):void
        {
            // scroll the background down the screen
            if (background.y != background.height){
```

Event Listeners

- Idea: To handle an event, your program has to *listen* for it.
- How?
  - Create functions that will *handle the event*
    - These are called *listeners*
  - When program starts up, register (*add*) listeners
- When an event occurs, Flash will call the listener

```
1  package
2  {
3      import flash.display.MovieClip;
4      import flash.events.Event;
5
6      public class Main extends MovieClip
7      {
8          var hitCount:int;
9
10         public function Main()
11         {
12             hitCount = 0;
13             feedback.text = "Rabbit dies when Hits > 100!";
14             hits.text = "Hits: 0";
15             rabbit.addEventListener(Event.ENTER_FRAME,moveRabbit);
16         }
17
18         public function moveRabbit(event:Event):void
19         {
20             rabbit.x = mouseX;
21             if (rabbit.collisionArea.hitTestObject(tree.collisionArea)){
22                 hitCount++;
23                 hits.text = "Hits: " + hitCount.toString();
24
25                 if (hitCount > 100){
26                     removeChild(rabbit);
27                     feedback.text = "Game Over!";
28                 }
29             }
30         }
31     }
32 }
```