Objects

Review

- Visualization
  - Use arrays of data
  - Or sample a mathematical function
    - directly
    - or by making an array of discrete values
  - Plot data
  - Plot axes and supporting information.
  - Rects (for bar plot)
  - points, lines, and/or vertices for Line plots

Variable Grouping

- Concept 1 (sequence)
  - Array
    - a fixed size
    - one type of value
  - declare an array
    - int[] intervals;
    - float[] temps;
    - String[] names;
  - instantiate an array
    - intervals = new int[10];
    - temps = {1.0,32.0,212.0};
    - names = new String[5];
  - assign values to elements of an array
    - intervals[0] = 10;
    - names[3] = "Beyonce";
    - temps[2] = -300.0;
- Concept 2 (set of values with cohesive meaning)
  - Class/Object
    - class PVector{
      float x;
      float y;
      float z;
      }
    - Declare a PVector
      - PVector position;
    - Instantiate PVector
      - position = new PVector(10,10);
    - Assign values to elements of PVector
      - position.x = 100;
      - position.y = 10;

Beyond Grouping: Methods

- Methods provide the ability to access and change the values of an Object
- PVector
  - set – set the values using floats, a PVector, or a float[]
  - add(),sub() – adds/subtracts values using floats or a PVector
  - mult(), div() – multiplies/divides vector by a scalar
  - dist() – returns the Euclidean distance between 2 points
  - angleBetween() – returns the angle between 2 points
  - …

PVector

- Declaring PVector

```
PVector pos;
PVector vel;
```

- Instantiating PVector

```
void setup() {
  pos = new PVector(10,10);
  vel = new PVector(1,0);
}
```

- Using PVector

```
void draw() {
  pos.add(vel);
  point(pos.x,pos.y);
}
```

What is an Object?

- An object is an instance of a class.
- What is an instance?
  - An instance is a distinct example of the class that
    - is in memory
    - has specific assignments for the variables declared by the class it represents.
    - has functionality based on the class.
- What is a class?
  - A complex data type.
  - The design for objects of its type.

Object Oriented Programming

- Objects group related variables and functions.
  - Object variables are called fields
  - Object functions are called methods
- An object has to be designed first and it has a custom type
- Objects can be created, named and referenced with variables
  - Very similar to standard data types

Class/Object

- Keyword class
  - declares a new type
- Data fields (class variables)
- Constructor
- Methods (class functions)
  - update
  - move
  - display/draw

```
class Point {
  // Fields
  int x;
  int y;
  Color c;

  // Constructor
  Point() {
    x = 0;
    y = 0;
    c = Color(255, 255, 255);
  }

  // Methods
  void update() {
  }

  void display() {
    noStroke;
    fill(c);
    ellipse(x, y, 10, 10);
  }
}
```

Creating New Objects with Classes

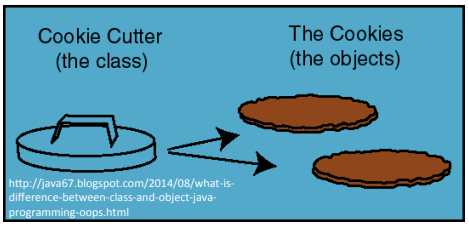
- To create a new instance of an object, use the ***new*** keyword and call the object Constructor

```
MyObjectName ob = new MyObjectName();
Point p1 = new Point();
Point p2 = new Point();
```

- To access fields and methods, use the dot notation

```
p1.display();
println(p2.x);
```

Class vs. Object



Example

- eyes

The Constructor

- A special function that always carries the same name as the class itself.
- Called automatically at the creation/instantiation of an object.
- Used to initialize all of the objects variables.

Defining Your Own Objects with Classes

```
// Defining a new class of object

class MyObjectName {

  // All field variable declarations go here;

  // Define a special function-like statement called
  // the class's Constructor.
  // It's name is same as object class name,
  // with no return value.

  MyObjectName( optional arguments ) {

    // Perform all initialization here

  }

  // Declare all method functions here.
}
```

```
// A Ball Class
class Ball {
  // Fields
  int w; int h; // width and height of ball
  float x;      // x position
  float y;      // y position
  float spdX;   // x velocity
  float spdY;   // y velocity
  float gravity = .03;

  // Constructor
  Ball() {
    w = h = 20;
    x = random(0, width/2); y = random(10, 20);
    spdX = random(0.5, 1.3); spdY = 0;
  }

  // Methods
  void update() {
    x += spdX;
    spdY += gravity;
    y += spdY;

    // Bounce off walls and floor
    if (x + w/2 > width || x - w/2  < 0) spdX = -spdX;
    if (y + h/2 > height || y - h/2 < 0) spdY = -spdY;
  }

  void display() {
    ellipse( x, y, w, h);
  }
}
```

Example

- Ball Object

Defining Your Own Object with Classes

- Classes are blueprints or prototypes for new objects
- Classes define all field and method declarations
  - … which are repeated for each new object created
- Classes DO NOT set the data values stored in fields
  - … but they likely determine how
- Using a class to create a new object is called *instantiating* an object
  - … creating a new object instance of the class
- Classes often model real-world items

Constructor overloading

- Constructors can take arguments.
- More than one constructor can be written for a class.
- As long as they are differentiable in the number/type of parameters they take.
- There is a default constructor even if you don't write one
  - it doesn't do much though.
  - all basic data types are initialized to their default value (usually 0 or false), color is a basic data type in Processing
  - all Reference data types are initialized to null;

`this` Keyword

- Within an instance method, **`this`** is a reference to the current object – the object whose method is being called

```
class Ball {
  // Fields
  int w; int h; // width and height of ball
  float x;      // x position
  float y;      // y position
  // ...

  // Constructor
  Ball(int x, int y) {
    w = h = 20;
    this.x = x;
    this.y = y;
  }

  // ...
}

Ball b1 = new Ball(0, 0);
Ball b2 = new Ball(20, 20);
```

Examples

- ballDropObj2
- ballDropObjArray
- ballDropObjArray2