Simple Programs

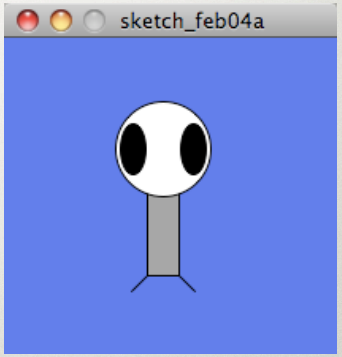
ISE 108: Introduction to Programming
Stony Brook University

Today's Agenda

- Writing a simple program in Processing
- Introduction to algorithms
- Introduction to functions
  - setup() and draw()
- Relevant reading: Chapters 2 and 3

Meet Zoog

- Zoog is a small creature designed with Processing
- Zoog is drawn using a rectangle, three ellipses, and two lines
- We'll use Zoog to try out new programming concepts

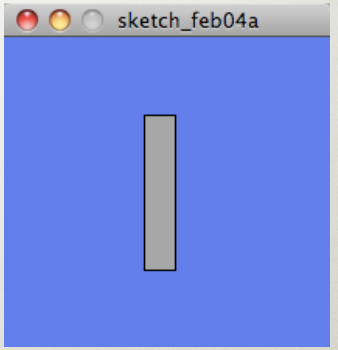


Drawing Zoog, Part 1

```
ellipseMode(CENTER);
rectMode(CENTER);

// Get rid of jaggy lines
smooth();

// Draw Zoog's body
stroke(0);
fill(150);
rect(100,100,20,100);
```

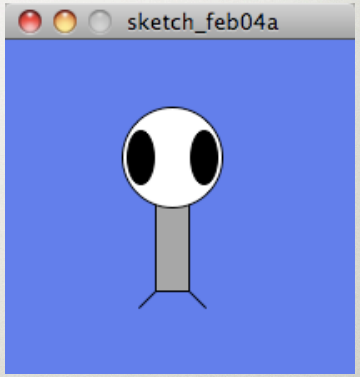


Drawing Zoog, Part 2

```
// Draw Zoog's head
fill(255);
ellipse(100,70,60,60);

// Draw Zoog's eyes
fill(0);
ellipse(81,70,16,32);
ellipse(119,70,16,32);

// Draw Zoog's legs
stroke(0);
line(90,150,80,160);
line(110,150,120,160);
```



Algorithms

"Computer Science is no more about computers than astronomy is about telescopes."
— E. W. Dijkstra

Algorithms

- An algorithm is a description of the steps necessary to solve a problem
  - "problem" = "task to be performed"
- Algorithms are the heart of computer science
- A computer program embodies (carries out) an algorithm

Algorithm Examples

- Grandma's recipe for chocolate chip cookies
- Driving directions
- Putting together a class schedule
- Playing a board game (e.g., Monopoly)

Algorithm Attributes

- An algorithm must be *complete*
  - It must describe *every* step of the solution
- An algorithm must be *precise*
  - It should tell you *exactly* what to do for a given step

Developing an Algorithm

- Start with the input and desired output
- Divide and conquer the problem
  - Break it up into smaller pieces
- Iterative refinement of solution
  - Keep applying divide and conquer to each sub-step

Algorithm Building Blocks

1. Expressions
2. Conditional (selection) statements
3. Iteration (repetition) statements
4. Subprograms (methods)
   - These are previously-defined algorithms

An Algorithm Example

- What's a good algorithm for making a peanut butter and jelly sandwich?
  - HINT: start with the ingredients (input)
- A good rule of thumb for algorithms is to imagine that you need to tell a 3-year-old how to perform the task

Another Example

- Problem: Given two integers, find their greatest common divisor (the largest number that divides evenly into both)
- The best-known algorithm for this was developed by Euclid

Euclid's GCD Algorithm

1. Let A be the larger of the two integers
2. Let B be the smaller of the two integers
3. If B is 0, stop.
4. Otherwise, replace B with the remainder of (A divided by B)
5. Go to Step 1

Functions

What's a Function?

- A *function* (also called a *method*) is a block (group) of program instructions
  - A name is assigned to this block
  - The block is surrounded by curly braces
- Whenever we call the function's name, that set of instructions is executed
  - This lets us do something many times, but only write the code one time

Functions We've Seen

- line()
- rect()
- ellipse()
- size()
- background()
- etc.

Function Input and Output

- A function can take one or more values as *arguments* (input)
  - e.g., `line()` takes two sets of coordinates
  - Arguments are placed in the parentheses after the function's name
- A function can return a value as its output
  - A *void* function does not return a value

setup() and draw()

- Most Processing programs have two special functions: setup() and draw()
  - These functions are useful for animation
- setup() is called *once*, when the program starts
- draw() is called *over and over*, and puts new information on the screen
  - e.g., the next frame of animation

Flow of Control

```
void setup ()
{
    // Step 1a
    // Step 1b
    // Step 1c
}
void draw ()
{
    //Step 2a
    //Step 2b
}
```

These instructions will be executed as follows:

1a, 1b, 1c, 2a, 2b, 2a, 2b, 2a, 2b, 2a, 2b, 2a, 2b, ...

Drawing Zoog With Functions

- Remember that setup() only runs once
  - Use this function for things that don't change

```
void setup ()
{
    size(210,200);
    background(80, 100, 240);

    ellipseMode(CENTER);
    rectMode(CENTER);
    smooth(); // Get rid of jaggy lines
}
```

Another Zoog Function

- The draw() function is called repeatedly
  - Use it for things that (may) change
- Right now, nothing seems to change
  - We'll fix that soon...

```
void draw ()
{
    // Draw Zoog's body
    stroke(0);
    fill(150);
    rect(100,100,20,100);

    // Draw Zoog's head
    fill(255);
    ellipse(100,70,60,60);

    // Draw Zoog's eyes
    fill(0);
    ellipse(81,70,16,32);
    ellipse(119,70,16,32);

    // Draw Zoog's legs
    stroke(0);
    line(90,150,80,160);
    line(110,150,120,160);
}
```

Next Time

- Working with the mouse
  - Mouse positions
  - Mouse clicks
- Variables
  - How to store and work with information