Review

- Expressions and operators
- Iteration
  - while-loop
  - for-loop

Coding styles and assignment hand-ins

- Headers
- Comments
- Indentation
- Parentheses
- Spacing
- Processing's "Auto Format" command
- Ctrl-Shift-F/Ctrl-click

- Copy the entire sketch folder, not just the contents
- Create a separate document for your write-up, don't put it in the header
- Put the image file (screen shot) and the write-up document all in the sketch folder

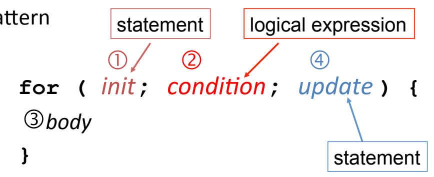
Examples

- text (demo text alignment)

- concentric
- forText
- forCircle
- flowers

for Loop

- Pattern

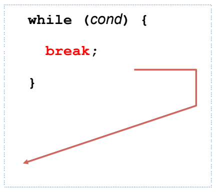


```
for ( init; condition; update ) {
③body
}
```

  - Each section can be blank.
  - Sequence: ① ②③④ ... ②③④ ② (condition fails)

`break` Statements

- Exit from a loop
- Typically used with an `if` statement



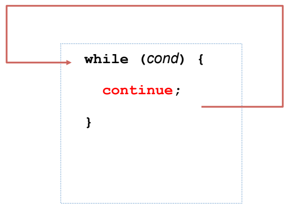
```
while (cond) {
  break;
}
```

Example

```
for(int i=1; i<=100; i++) {
  if (i > 50)
    break;
  println(i);
}
```

`continue` Statements

- Continue to the beginning of a loop
  - I.e., the condition will be checked
- Typically used with an `if` statement



```
while (cond) {
   continue;
}
```

Example

```
for(int i=1; i<=100; i++) {
  if (i >= 20 && i <= 30)
    continue;
  println(i);
}
```

More on Loops

- Loop index
  - `for (int i=0; i<10; i++) {…}`
  - start at 0 or 1?
  - stop at <n or <=n?
  - the value of `i` changes every iteration
- You can run it the other way around too!
  - `for (int i=10; i>0; i--) {…}`

Examples

- concentric
- manyShapes

Functions Informally

- The basic idea – we write a sequence of statements and then give that sequence a name. We can then execute this sequence at any time by referring to the name.
- Function definition: this is where you create a function and define exactly what it does
- Function call: when a function is used in a program, we say call it with its name and parameters.
- A function can only be defined once, but can be called many times.

Examples

```
void setup() { … }
void draw() { … }
```

- Return value, function name, parameter list and function body
- A `void` function doesn't return anything

```
void circleAndLine() {
  ellipse(random(width), random(height), 10, 10);
  line(random(width), random(height),
       random(width), random(height));
}
```

Functions

- Modularity
  - Allow the programmer to break down larger programs into smaller parts.
  - Promotes organization and manageability.
- Reuse
  - Enables the reuse of code blocks from arbitrary locations in a program.

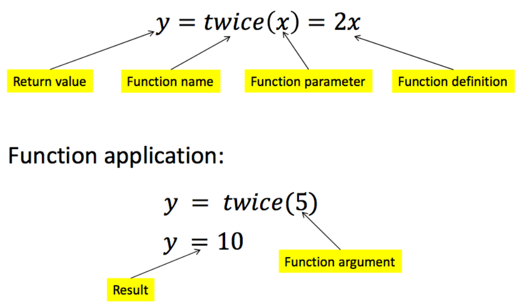
Function Example

- manyShapesFunction

Mathematical Functions

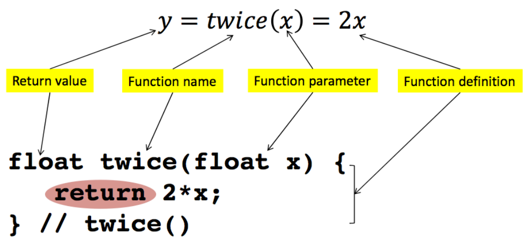
$$y = f(x)$$
$$y = twice(x) = 2x$$
$$a = area(r) = \pi r^2$$
$$y = f(x) = \begin{cases} 1 & if \quad x > 0 \\ 0 & otherwise \end{cases}$$

Functions: Terminology



Function application:

Functions: Defining Functions



```
float twice(float x) {
   return 2*x;
} // twice()
```

Function Parameters

- Parameters (arguments) can be “passed in” to a function and used in body.
- Parameters are a comma-delimited set of variable declarations.
- Parameters act as input to a function.
- Passing parameters provides a mechanism to execute a function with many different sets of input.
- We can call a function many times and get different results by changing its parameters.

What happens when we call a function?

- Execution of the main (calling) program is suspended.
- The argument expressions are evaluated.
- The resulting values are copied into the corresponding parameters.
- The statements in the function's body are executed in order.
- Execution of the main program is resumed when a function exits (finishes).

Parameterizing a shape

- Have code that draws something with a bunch of coordinates
- Want to draw the same thing anywhere, in any size and repeat any number of times
- How is a shape defined?
  - a reference point (center, corner)
  - a base size
- To move, scale and repeat
  - put code in a function
  - x and y increments
  - scaling factor

Examples

- penguin
- penguinTranslate
- penguinScale
- penguins