Nested Loops & Arrays

CSE 120 Spring 2017

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Yes, There's Such Thing as a Professional Drone Racing Pilot

What do you get when you combine four powerful electric motors and a light carbon-fiber frame? You get instant speed. Drone Racing League's Racer 3 can get from zero to 80 mph in under a second.

These are the racing drones featured in The Drone Racing League. The races take place in huge physical spaces, like stadiums and abandoned shopping malls.

- http://www.thedrive.com/aerial/9079/yes-theres-such-thing-as-professional-drone-racing-pilot

Administrivia

- Assignments:
  - Creativity Planning due Tuesday (4/18)
    - Find a partner, come up with *two* proposed programs
  - Portfolio Update 1 due Tuesday (4/18)
  - Binary Practice (4/21)
  - Creativity Assignment (4/24)

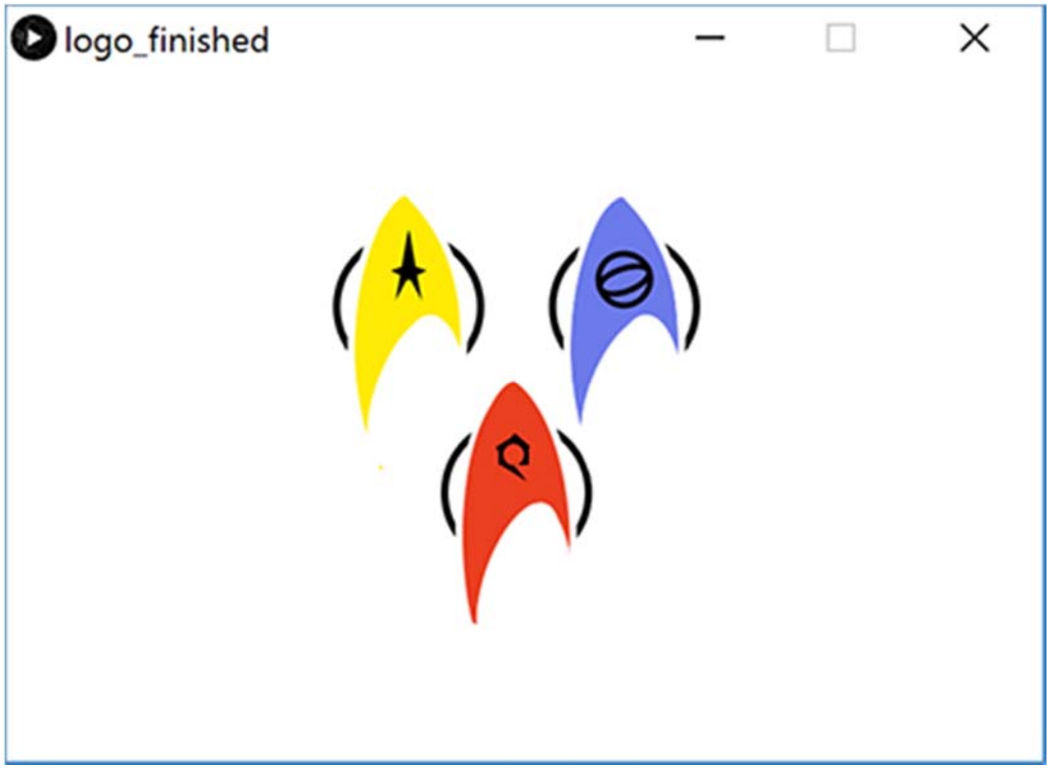
- Midterm in class on Wednesday, 4/26
  - 1 sheet of notes (2-sided, letter, handwritten)
  - Fill-in-the-blank(s), short answer questions, maybe simple drawing

Outline

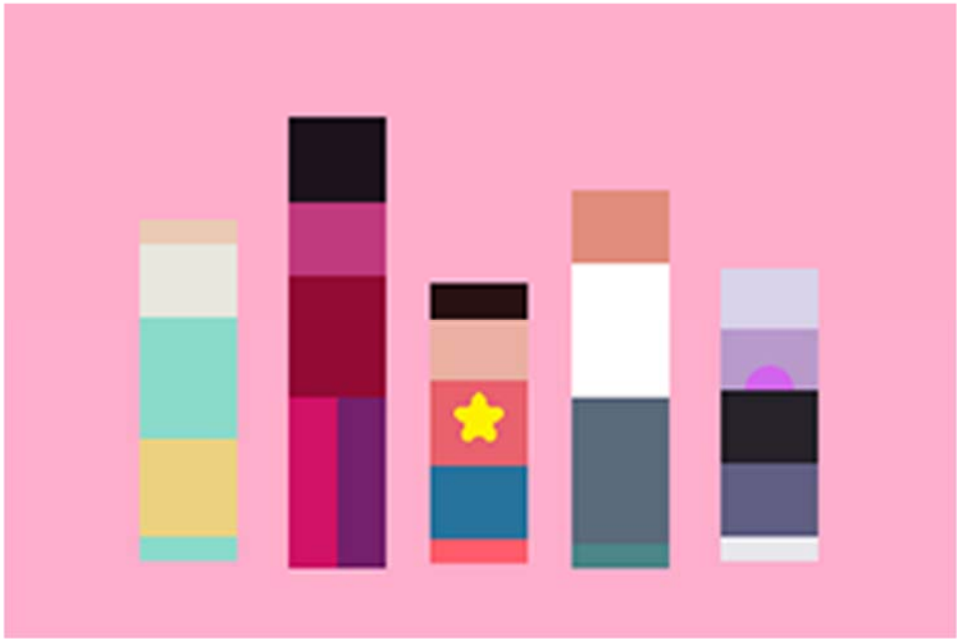
- **Student Work Showcase**
- For-Loop Review
- Nested Loops
- Arrays
  - Arrays and Loops

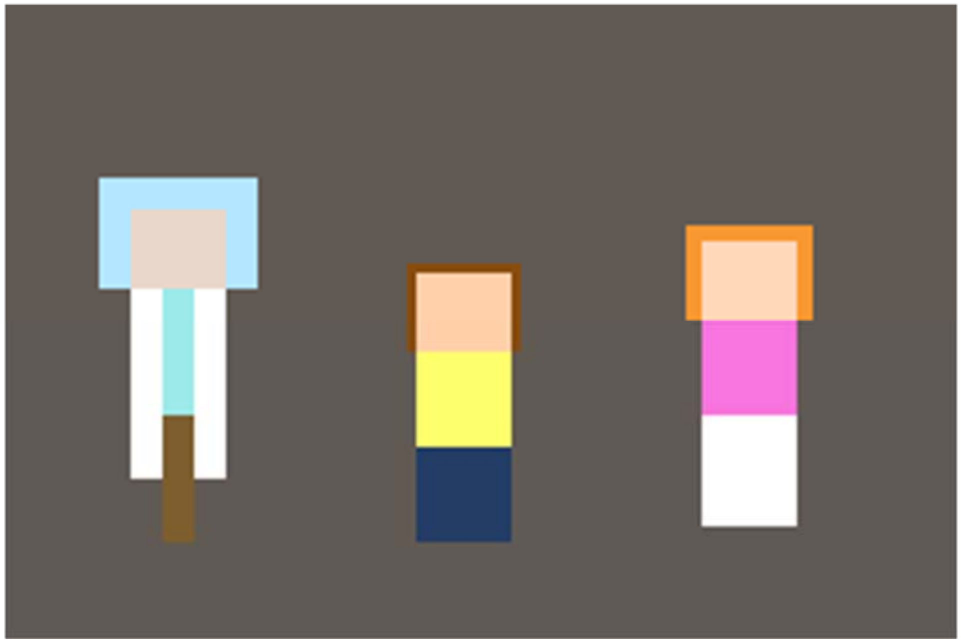
Custom Logo

Cadey Kwon



Lego Family


Sarah Liu



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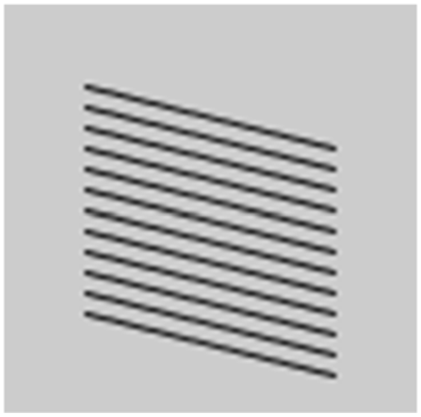
For-Loop Review

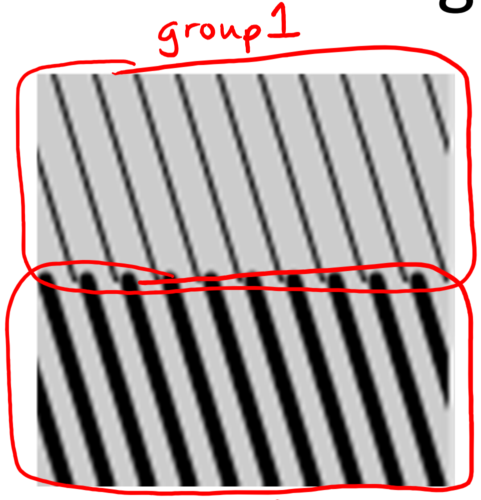
- Loops control a sequence of *repetitions*
  - Do the same thing (or similar things) over and over again

- Examples: What is changing?



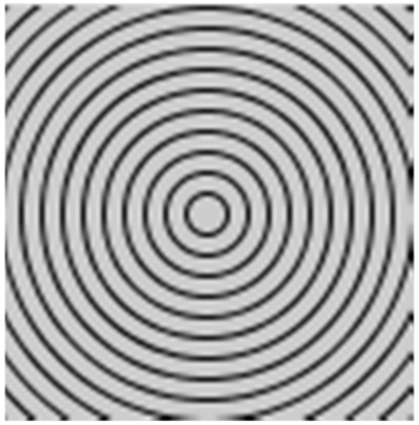
Common:
diagonal lines

Change:
y-position



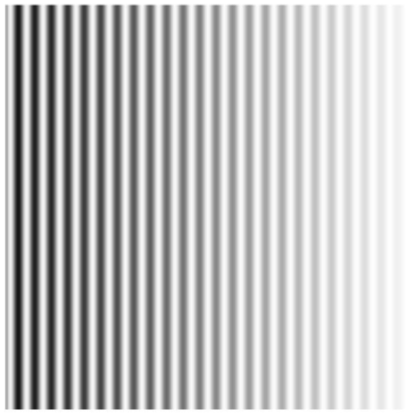
Common:
diagonal lines
(different thickness
per group)

Change:
x-position



Common:
concentric circles

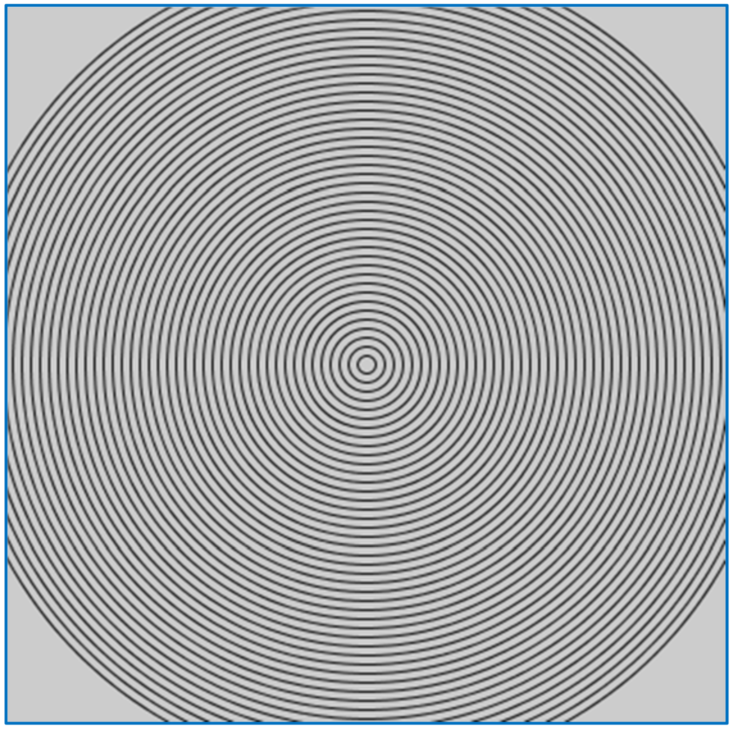
Change:
radius/size



Common:
vertical lines

Change:
transparency/ color
x-position

Example: Circle Loop

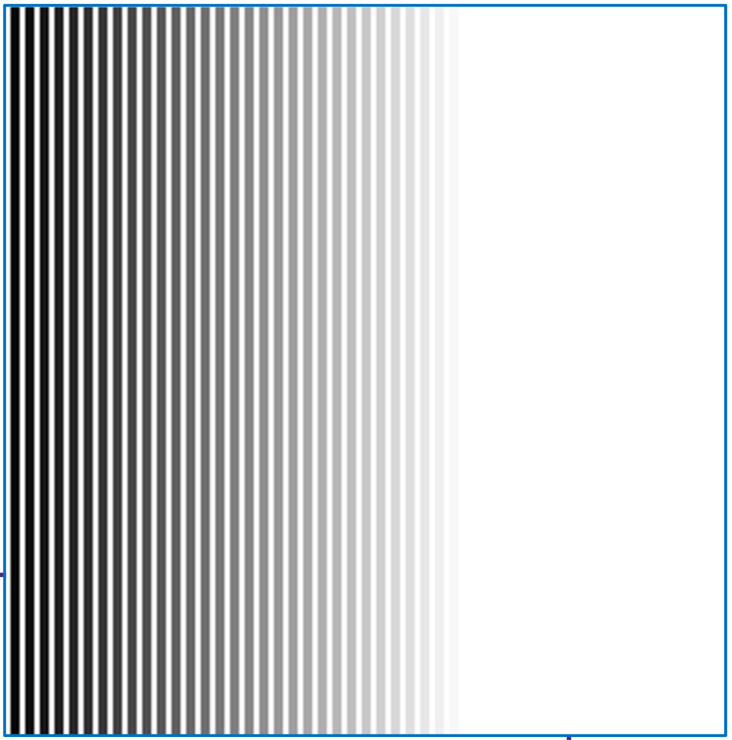


radius/diameter

$\text{ellipse}(x, y, \underset{\uparrow}{w}, \underset{\uparrow}{h})$

```
size(400, 400);

noFill();
for(int d = 450; d > 0; d = d - 10) {
  ellipse(width/2, height/2, d, d);
}
```

Example: Line Gradient



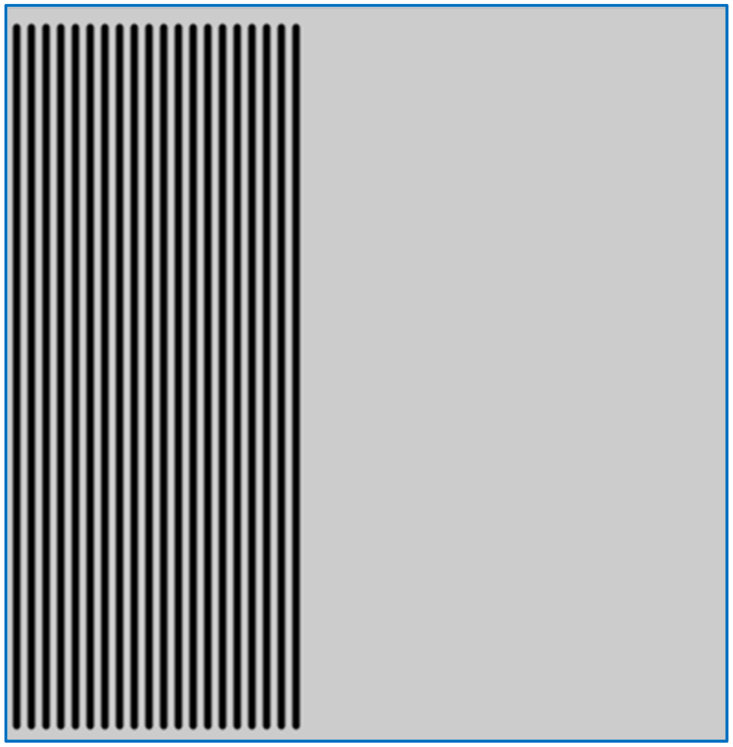
```
size(400, 400);

background(255);
strokeWeight(5);

for(int i = 0; i < 400; i = i + 8){
  stroke(i);
  line(i, 0, i, 400);
}
```

line color

x-position

Example: Looping with User Interaction?

- Draw lines from left side of screen to the horizontal position of the mouse



Example: Draw Lines to mouseX

```
void setup() {
  size(400, 400);
  strokeWeight(4);
}

void draw() {
  background(204);

  for(int i = 10; i < mouseX; i = i + 8){
    line(i, 10, i, 390);
  }
}
```

loop condition (when to stop)

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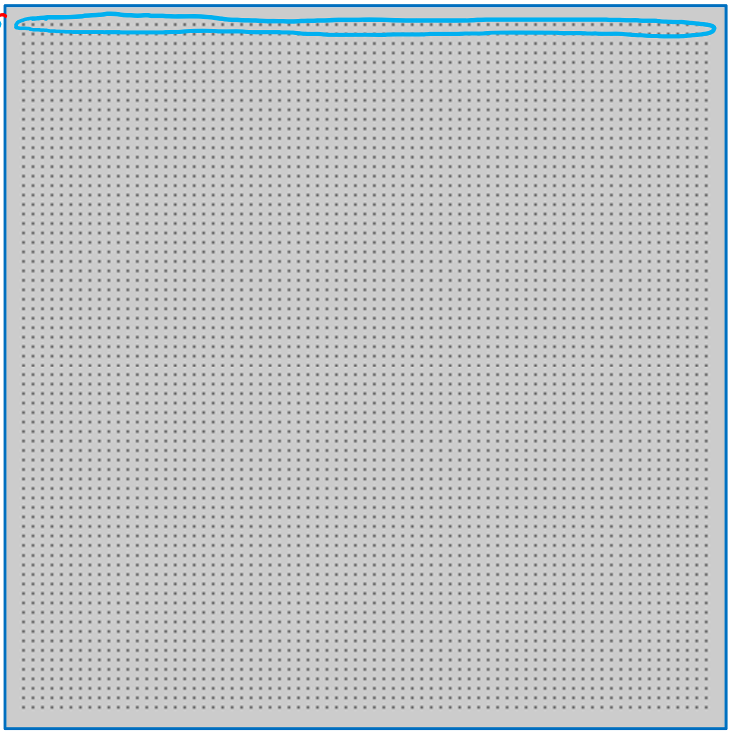
Nested Loops

- Generally a for-loop has a single loop variable that changes with each iteration
- What if you need/want more things to change?
  - Can nest loops – *i.e.* put a loop inside of another loop

Example: Dot Grid

single for-loop (one row)

2nd for-loop (all rows)



in this case could switch loop ordering and get the same result, but sometimes this will affect the behavior!

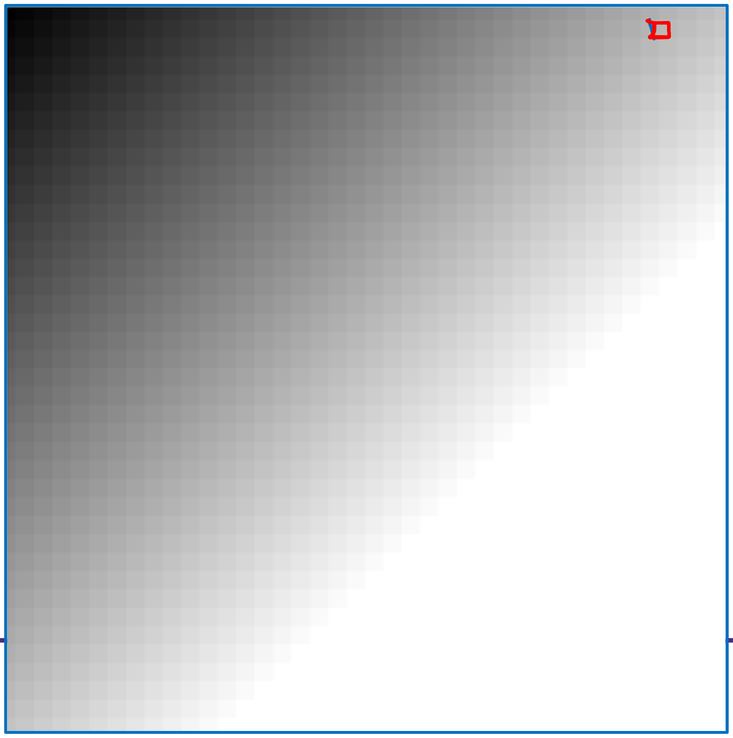
```
size(400, 400);

for(int y = 20; y <= height-20; y = y + 5){
  for(int x = 20; x <= width-20; x = x + 5){
    point(x, y);
  }
}
```

body of the outer for-loop

body of the inner for-loop

Example: 2D Gradient



```
size(400, 400);
noStroke();

for(int y = 0; y < width; y = y + 10){
  for(int x = 0; x < height; x = x + 10){
    fill((x+y)*0.5);
    rect(x, y, 10, 10);
  }
}
```

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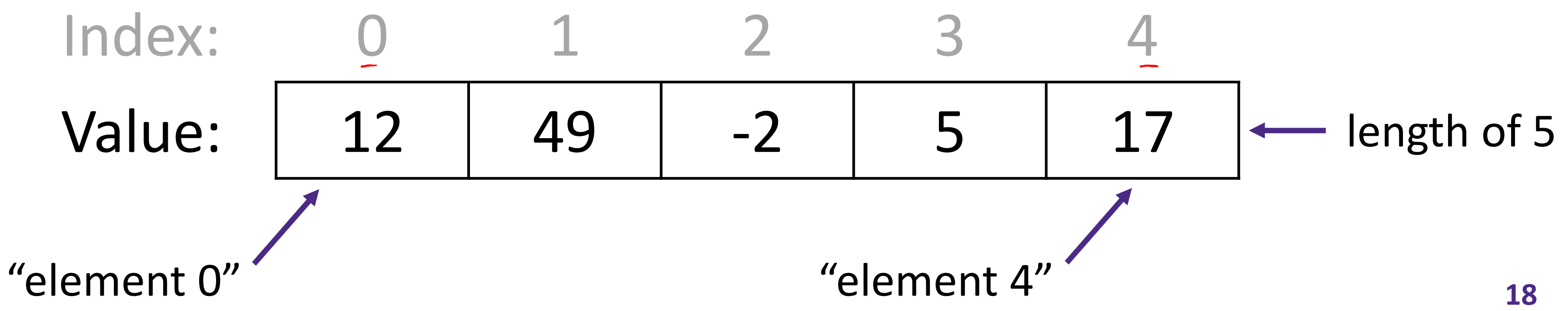
Arrays

- "Structures" that store many values *of the same datatype*
  - Help us group related data
- Arrays store large amounts of data that you can access using a single variable name
  - Accessing arrays with loops is very convenient

Arrays

- "Structures" that store many values *of the same datatype*
  - Element: a single value in the array
  - Index: a number that specifies the location of a particular element of the array
    - Start from 0
  - Length: total number of elements in the array

- Example:



Arrays in Processing

- Declaration: `type[] name`
  - *e.g.* `int[]` is array of integers, `color[]` is array of colors
- Creation: `new type[num]` length
  - *e.g.* `int[] intArr = new int[5];`
  - Default value for *all* elements is "zero-equivalent" (0, 0.0, `false`, black) color(0,0,0)
  - Remember that actual indices are from `0` to `num-1`
- Initialization: `{elem0, elem1, …, elemN};`
  - *e.g.* `int[] intArr = {12, 49, -2, 5, 17};`

Arrays in Processing

- Use element: `name[index]`
  - In *expression*, uses value of that index of the array
  - In *assignment*, modifies value of that index of the array

- Get length: `name.length`

- Example:

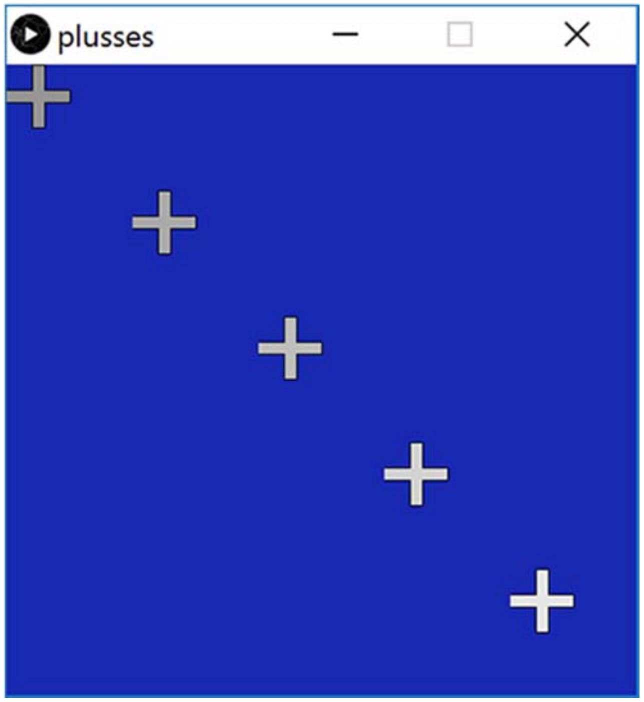
```
int[] intArr = {12, 49, -2, 5, 17};
println(intArr[0]);           // prints 12 to console
intArr[2] = intArr.length; // changes -2 to 5
```

access value

change value

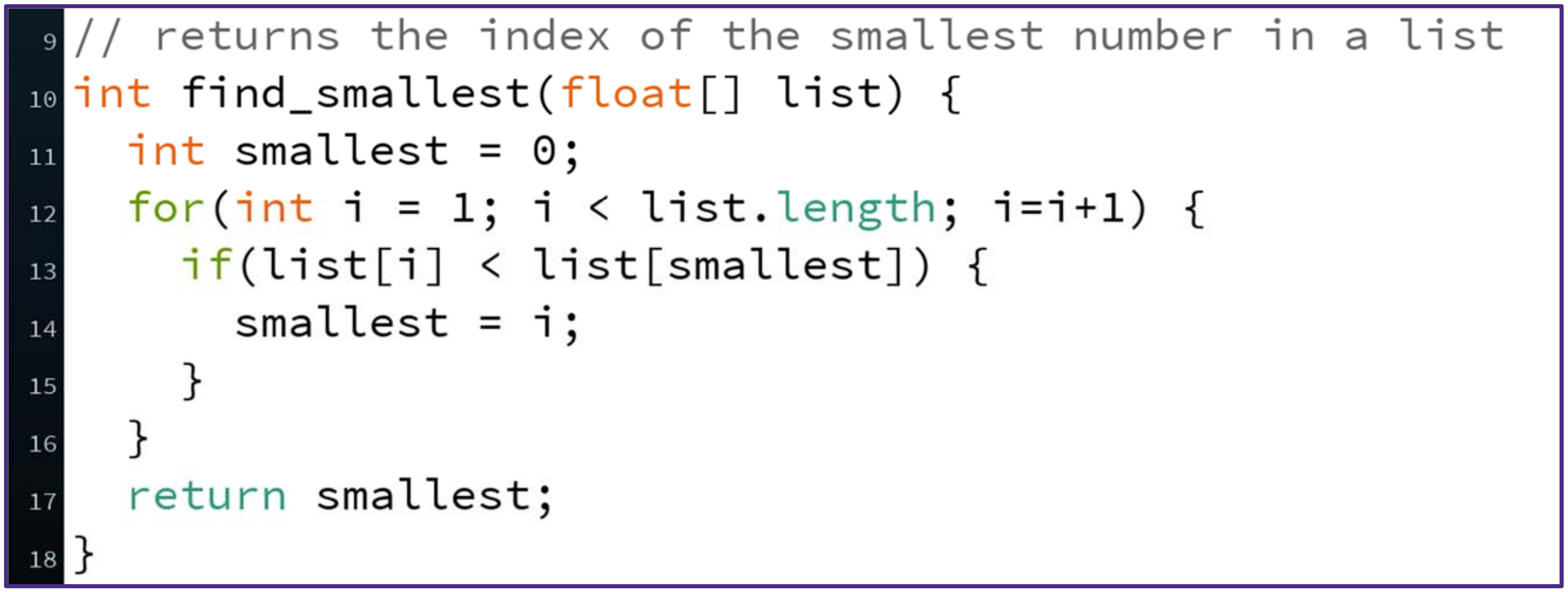
Index:	0	1	2	3	4
Value:	12	49	~~-2~~ 5	5	17

Example: Lots of Plusses



Example: Index of Smallest Number

- Algorithm:
  - Keep track of the *index* of the smallest number seen so far
    - Start with index 0
  - Check each *element* 1-by-1; if number is smaller, then update the smallest index



```
// returns the index of the smallest number in a list
int find_smallest(float[] list) {
  int smallest = 0;
  for(int i = 1; i < list.length; i=i+1) {
    if(list[i] < list[smallest]) {
      smallest = i;
    }
  }
  return smallest;
}
```