

# Nested For Loops and Intro to Graphics

## Lecture 7

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CS106A, Summer 2019

Sarai Gould && Laura Cruz-Albrecht



# Announcements

- Assignment 1 was due at **10am this morning.**
- Assignment 2 is going out right after lecture!
  - Assignment 2 is due at **10am on Wednesday, July 10th.**
- No lecture or sections Thursday for 4th of July.
  - If your section is cancelled, please try to attend a Wednesday section or Friday's section (11:30am in Skilling Auditorium)
- No LalR Wednesday, July 3rd due to Holiday.

# Announcements

- When emailing instructors, *always email both of us!*
  - We have a joint email: [cs106a-sum1819-staff@lists.stanford.edu](mailto:cs106a-sum1819-staff@lists.stanford.edu)
- If you don't have a discussion section, please email both instructors ASAP to be placed in a section.

# Plan for Today

- Review: Methods
- Nested For Loop with Ascii
- Intro to Graphics Program - Our First Graphics Program!
- Checkerboard
- Infinite Loops

# Review: Making Sandwiches

```
/* We will make Java a sandwich.  
* Pre: n/a  
* Post: We will have a completed sandwich.  
*/  
private food makeASandwich(food bread, food veg, food protein, food spread){  
    food sandwich = bread + veg + protein + spread + bread;  
  
    return sandwich;  
}
```

# Review: Parameters and Return Statements

```
/* We will do x, y, and z actions and return methodType data
 * Pre: What we assume is true beforehand.
 * Post: What we promise is true afterwards.
 */
visibility methodType methodName(paramType1 paramName1, paramType2 paramName2){

    commands;

    return dataThatIsMethodType;
}
```

# Review: Return Statements

```
public void run(){  
    double average = calculateAverage(5, 10);  
    println("The average is: " + average);  
}
```

7.5

calculateAverage(5, 10);

```
private double calculateAverage(double num1, double num2){  
    println("I can also do actions!");  
    println("I also HAVE to return a double because that's the method type!");  
  
    double sum = num1 + num2;  
    return sum / 2; // This will equal 7.5  
}
```



ParameterReturnExample [completed]

```
I can also do actions!  
I also HAVE to return a double because that's the method type!  
The average is 7.5
```

# Review: Return Statements

```
public void run(){  
    double average = 7.5;  
    println("The average is: " + average);  
}
```

7.5

average

```
private double calculateAverage(double num1, double num2){  
    println("I can also do actions!");  
    println("I also HAVE to return a double because that's the method type!");  
  
    double sum = num1 + num2;  
    return sum / 2; // This will equal 7.5  
}
```



ParameterReturnExample [completed]

```
I can also do actions!  
I also HAVE to return a double because that's the method type!  
The average is 7.5
```



# Review: Scope

**Scope** is the idea that variables only exist inside a certain block of code.

In Java, a variable is **born when it is declared**.

A variable **terminates when it hits the ending bracket** of the code block in which it was declared.

```
public void run(){  
    int newVariable = 0; // I am born!  
    ...  
    ...  
    ...  
} // I hope I haven't bored you. Goodbye.
```

# A Variable Love Story: Scope

The variable only exists from its declaration to the end of its current code block.

```
while (conditionAIsTrue){  
    if (conditionBIsTrue){  
        ...  
        int newVariable = 0; // I am born!  
        ...  
    } // I'm bored with it all. Goodbye.  
}
```

# A Variable Love Story: Scope

It doesn't exist before it's declared, and it doesn't exist outside of its current code block!


```
while (conditionAIsTrue){  
    if (conditionBIsTrue){  
        ...  
        int newVariable = 0; // I am born!  
        ...  
    } // I'm bored with it all. Goodbye.  
    println(newVariable);  
}
```

# Review: For Loop

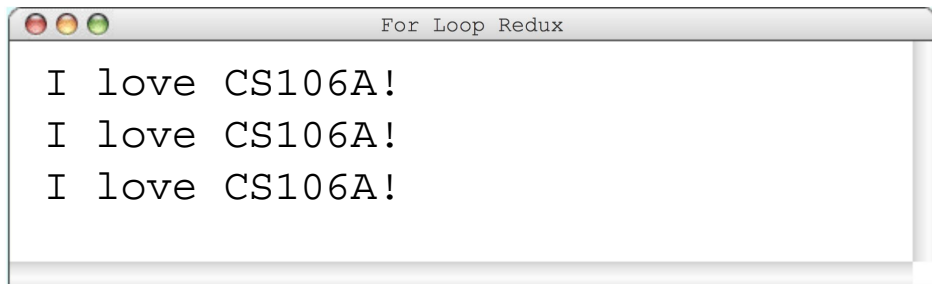
This code is run  
once, just before  
the for loop starts

Repeats the loop  
if this condition  
passes

This code is run each  
time the code gets to  
the end of the “body”



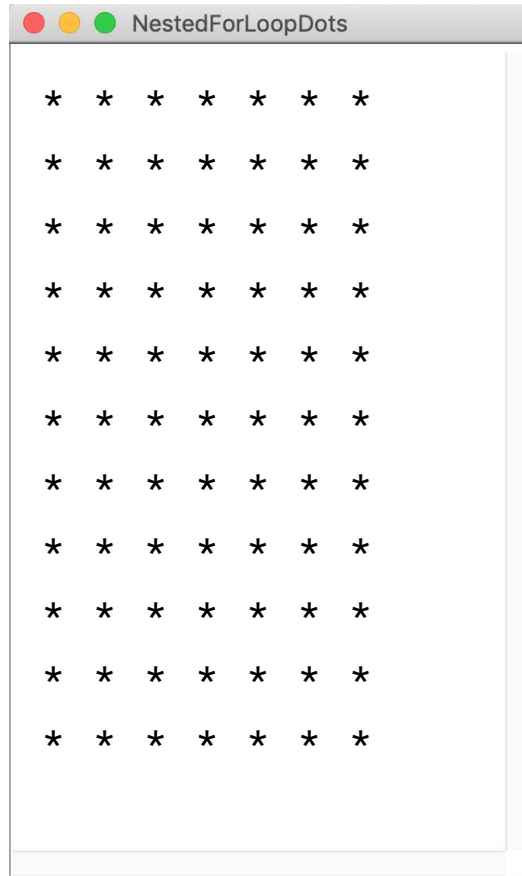
```
for (int i = 0; i < 3; i++) {  
    println("I love CS106A!");  
}
```



```
For Loop Redux  
I love CS106A!  
I love CS106A!  
I love CS106A!
```

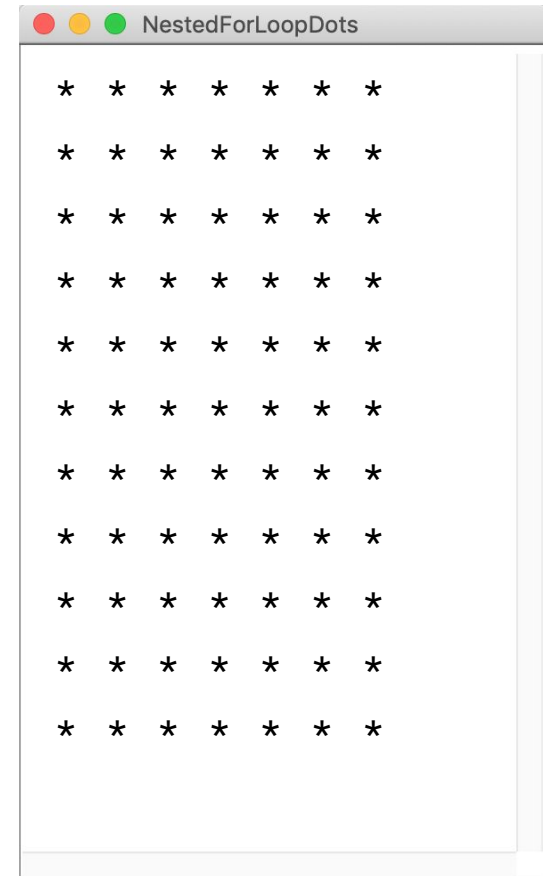
# Let's Make Some Art!

# Dot Art



# Dot Art

How can we do this?

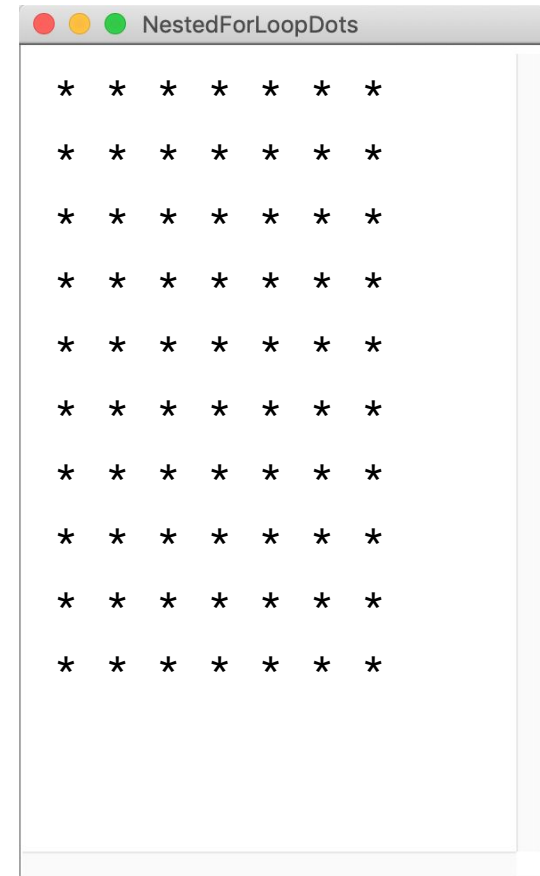


# Dot Art

How can we do this?

We use for loops to repeat an action a set number of times.

Let's try it!



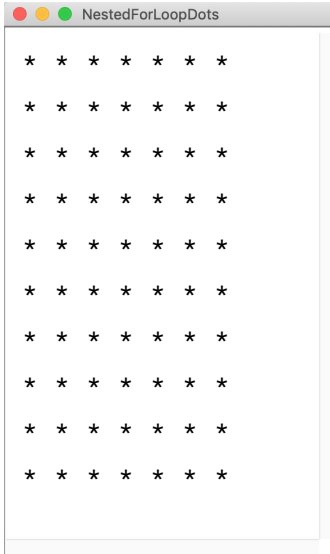


# Dot Art

## Pseudocode:

Repeat 10 times:

Draw a line of 7 stars



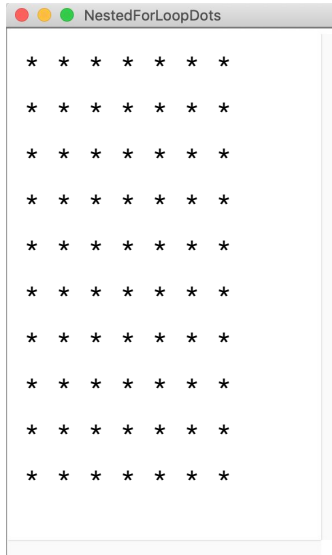
```
public void run(){  
    drawDotArt();  
}  
  
private void drawDotArt(){  
  
}
```

# Dot Art

## Pseudocode:

### Repeat 10 times:

Draw a line of 7 stars



```
public void run(){
    drawDotArt();
}

private void drawDotArt(){

    for (int i = 0; i < 10; i++) {

    }

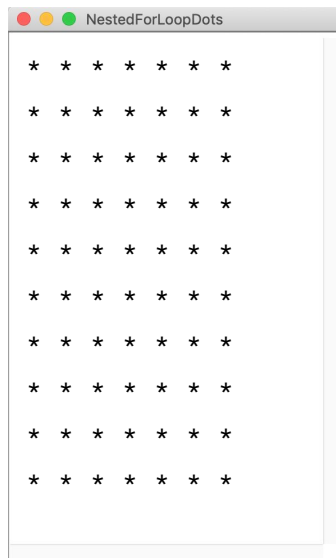
}
```

# Dot Art

## Pseudocode:

Repeat 10 times:

**Draw a line of 7 stars**



```
public void run(){
    drawDotArt();
}

private void drawDotArt(){

    for (int i = 0; i < 10; i++) {
        println("* * * * *");
    }

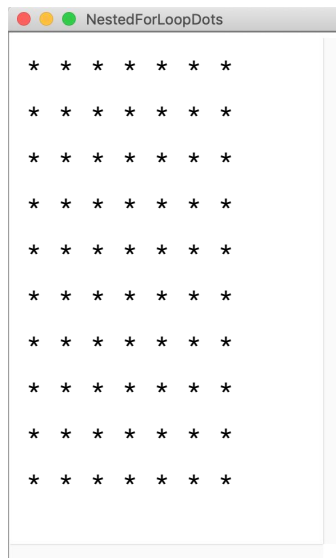
}
```

# Dot Art

## Pseudocode:

Repeat 10 times:

Draw a line of 7 stars



```
public void run(){  
    drawDotArt();  
}
```

This line seems a little repetitive.

```
private void drawDotArt(){
```

**How can we use code to make this less repetitive?**

```
    for (int i = 0; i < 10; i++) {  
        println("* * * * *");  
    }
```

```
}
```

# Dot Art: Nested For Loops

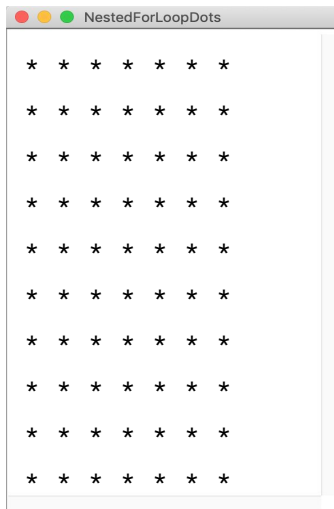
## Pseudocode:

Repeat 10 times:

Repeat 7 times:

Draw a star

Make a new line



```
public void run(){
    drawDotArt();
}

private void drawDotArt(){

    for (int i = 0; i < 11; i++) {
        println("* * * * * * *");
    }

}
```

# Dot Art: Nested For Loops

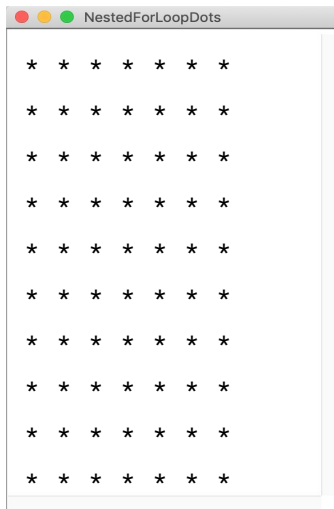
## Pseudocode:

Repeat 10 times:

    Repeat 7 times:

        Draw a star

    Make a new line



```
public void run(){
    drawDotArt();
}

private void drawDotArt(){

    for (int i = 0; i < 11; i++) {
        for (int j = 0; j < 7; j++) {

            }
        }
    }
}
```

# Dot Art: Nested For Loops

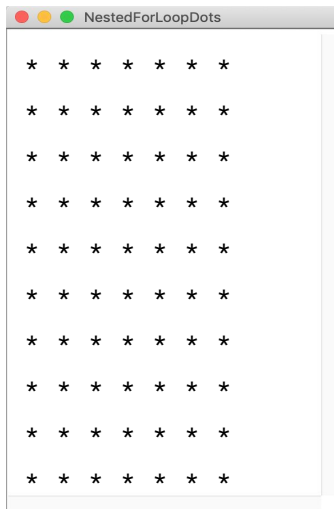
## Pseudocode:

Repeat 10 times:

Repeat 7 times:

**Draw a star**

Make a new line



```
public void run(){
    drawDotArt();
}

private void drawDotArt(){

    for (int i = 0; i < 11; i++) {
        for (int j = 0; j < 7; j++) {
            print("*");
        }
    }
}
```

# Dot Art: Nested For Loops

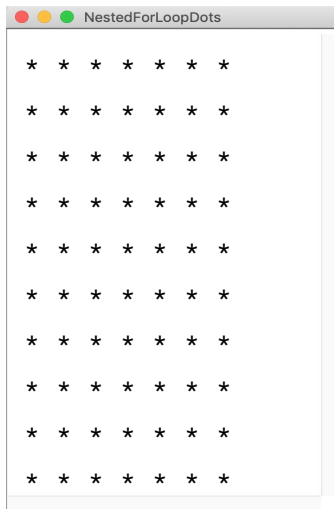
## Pseudocode:

Repeat 10 times:

    Repeat 7 times:

        Draw a star

**Make a new line**



```
public void run(){
    drawDotArt();
}

private void drawDotArt(){

    for (int i = 0; i < 11; i++) {
        for (int j = 0; j < 7; j++) {
            print("*");
        }
        println();
    }

}
```



# Let's Code It!

---

# Dot Art: Nested For Loops

We've added parameters so we can take our user input and pass it into our method.

`r` will equal `rows` and `c` will equal `cols`.

```
public void run(){
    int rows = readInt("How many rows?");
    int cols = readInt("How many cols?");
    drawDotArt(rows, cols);
}

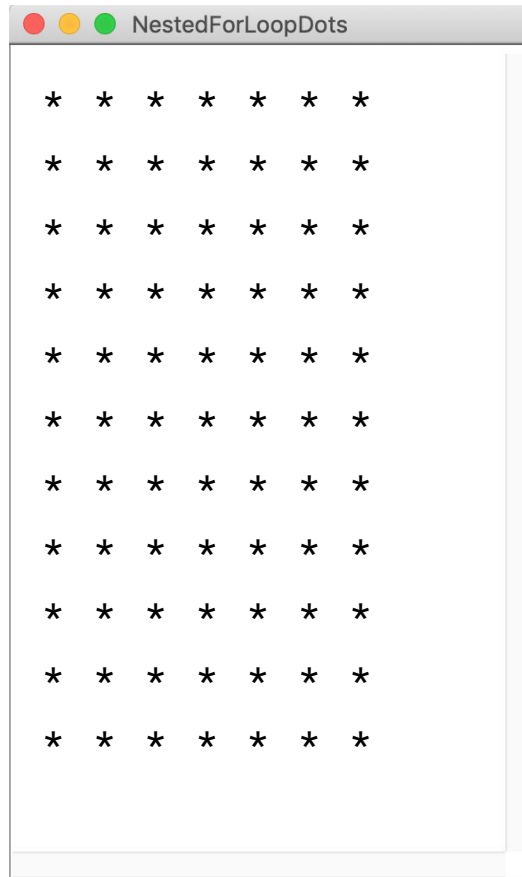
private void drawDotArt(int r, int c){

    for (int i = 0; i < r; i++) {
        for (int j = 0; j < c; j++) {
            print("*");
        }
        println();
    }

}
```

A diagram with two arrows pointing from the `rows` and `cols` arguments in the `drawDotArt` call of the `run` method to the `r` and `c` parameters in the `drawDotArt` method signature.

# Can Dots be Art?



# Isn't This Art???

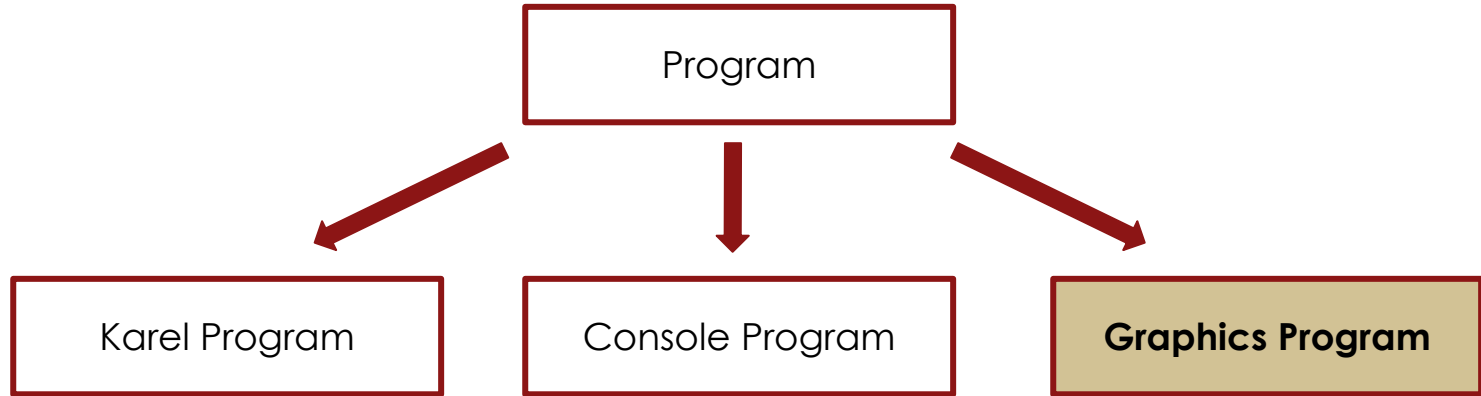


Not really the same, but  
okay...

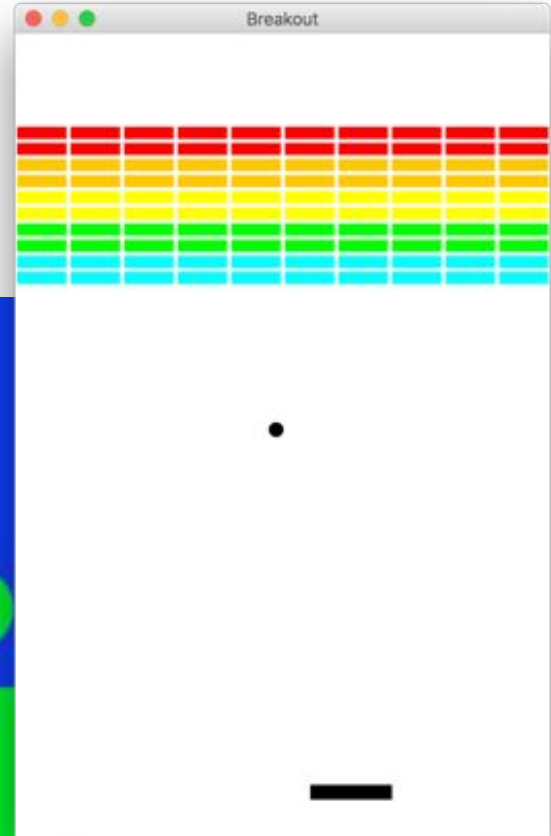
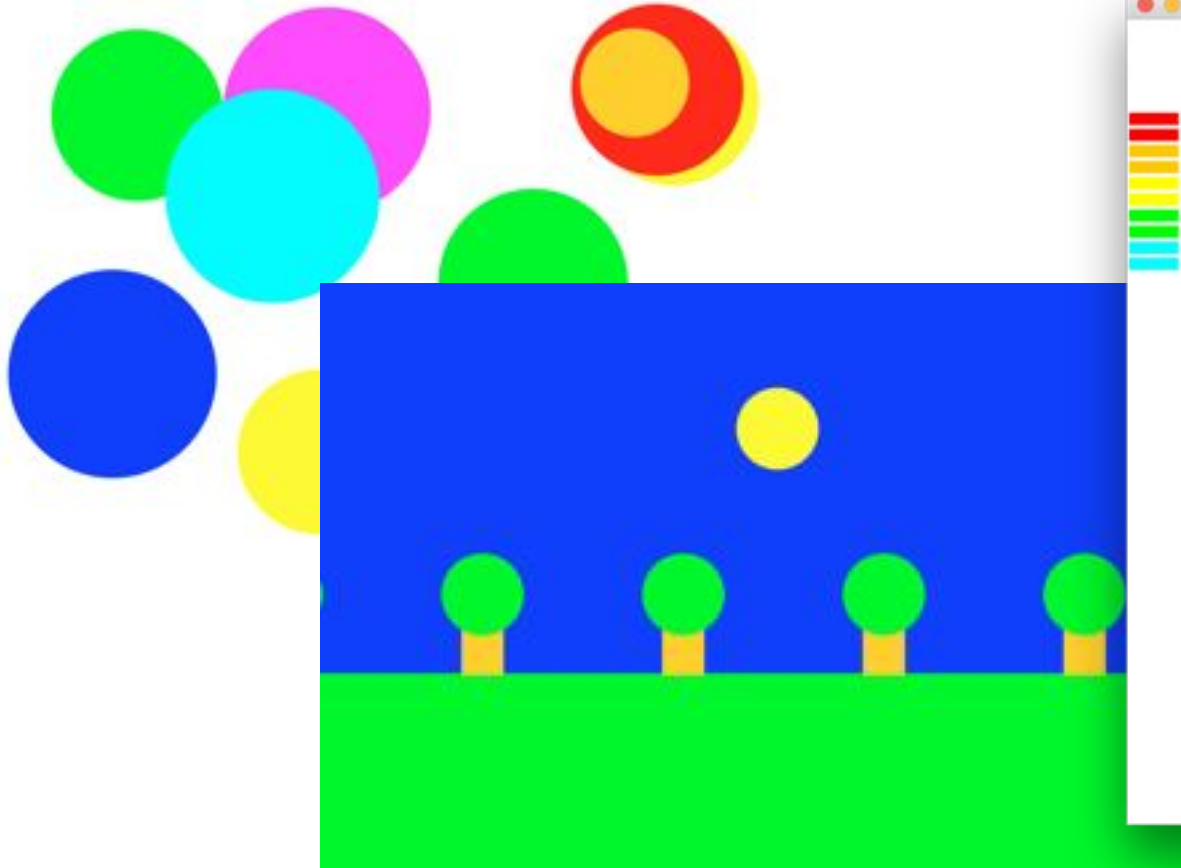


# Speaking of Art...

# Let's Look at Some Graphics Programs!



# Let's Look at Some Graphics Programs!



# As We're Learning: JavaDocs!



## CS 106A: Programming Methodology

Summer 2019

Monday, Tuesday, Wednesday, Thursday 10:30AM-11:20AM PST in Bishop Au

### RESOURCES

- Course Schedule
- Style Guide
- Piazza
- Eclipse
- Paperless
- Textbooks
- Stanford Java Docs**
- Pair Programming
- Course Staff

### NEW ANNOUNCEMENTS

#### July 4 Holiday

2 days ago

As a reminder, because of the July 4 holiday, we  
Additionally, Thursday sections are cancelled. If you a  
to **attend either a Wednesday section** (times/locatio  
Sections") **OR the Friday (July 5) section at 11:30**  
place this week due to the Holiday.

### Overview Package Class Tree Index Help

PREV NEXT

FRAMES NO FRAMES

## The ACM Java Libraries

### Packages

<a href="#">acm.graphics</a>	This package provides a set of classes that support the creation of simple, object-oriented graphical displ
<a href="#">acm.gui</a>	This package provides a set of classes that support the creation of simple, interactive programs.

### Package acm.graphics

This package provides a set of classes that support the creation of simple, object-oriented graphical displays.

See:  
[Description](#)

### Interface Summary

<a href="#">GContainer</a>	Defines the functionality of an object that can serve as the parent of a <a href="#">gobject</a> .
<a href="#">GFillable</a>	Specifies the characteristics of a graphical object that supports filling.
<a href="#">GResizable</a>	Specifies the characteristics of a graphical object that supports the <code>setSize</code> and <code>setBounds</code> meth
<a href="#">GScalable</a>	Specifies the characteristics of a graphical object that supports the <code>scale</code> method.

### Class Summary

<a href="#">G3DRect</a>	The <code>G3DRect</code> class is used to represent a rectangle whose borders are drawn to create a three-dim
<a href="#">GArc</a>	The <code>GArc</code> class is a graphical object whose appearance consists of an arc.
<a href="#">GCanvas</a>	The <code>GCanvas</code> class is a lightweight component that also serves as a container for graphical object
<a href="#">GCompound</a>	This class defines a graphical object that consists of a collection of other graphical objects.
<a href="#">GDimension</a>	This class is a double-precision version of the <code>Dimension</code> class in <code>java.awt</code> .
<a href="#">GImage</a>	The <code>GImage</code> class is a graphical object whose appearance is defined by an image.



# As We're Learning: JavaDocs!



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## The ACM Java Libraries

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### Package acm.graphics

This package provides a set of classes that support the creation of simple, object-oriented graphical displays.

See:  
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### Interface Summary

<a href="#">GContainer</a>	Defines the functionality of an object that can serve as the parent of a <a href="#">GObject</a> .
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### Class Summary

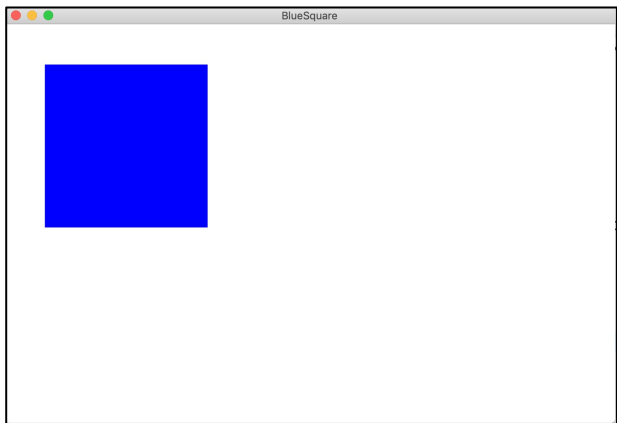
<a href="#">G3DRect</a>	The <code>G3DRect</code> class is used to represent a rectangle whose borders are drawn to create a three-dimensional effect.
<a href="#">GArc</a>	The <code>GArc</code> class is a graphical object whose appearance consists of an arc.
<a href="#">GCanvas</a>	The <code>GCanvas</code> class is a lightweight component that also serves as a container for graphical objects.
<a href="#">GCompound</a>	This class defines a graphical object that consists of a collection of other graphical objects.
<a href="#">GDimension</a>	This class is a double-precision version of the <code>Dimension</code> class in <code>java.awt</code> .
<a href="#">GImage</a>	The <code>GImage</code> class is a graphical object whose appearance is defined by an image.

**We don't expect you to memorize everything!** Use the graphics library documentation to look up methods you can use in graphics programs!

# Our First Graphics Object: GRect

A GRect is a variable type that stores a rectangle.

As an example, the following code displays a blue square.



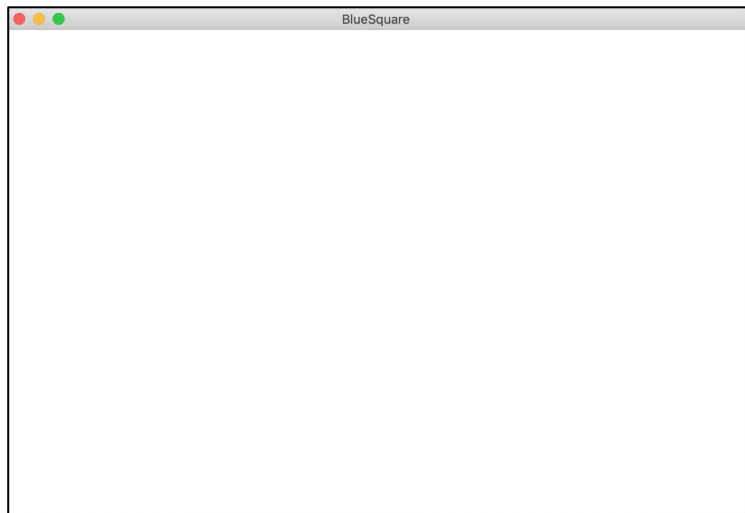
```
public void run(){
    drawBlueSquare();
}

private void drawBlueSquare(){
    GRect rect = new GRect(200, 200);
    rect.setFilled(true);
    rect.setColor(Color.BLUE);
    add(rect, 50, 50);
}
```

rect



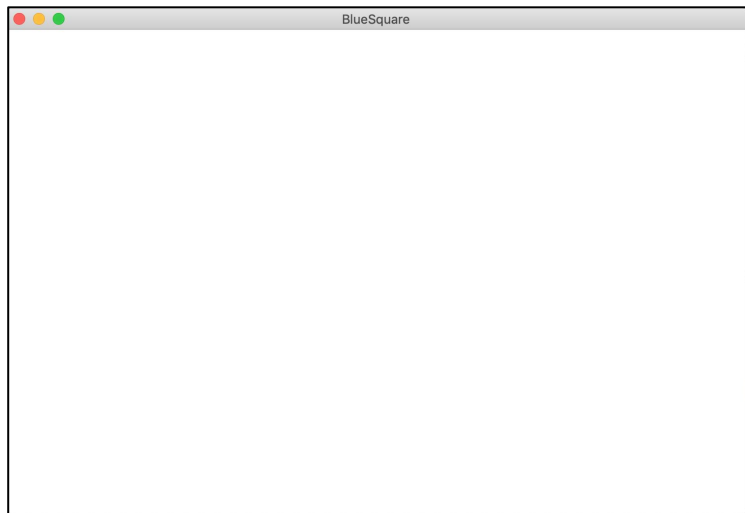
# Our First Graphics Object: GRect



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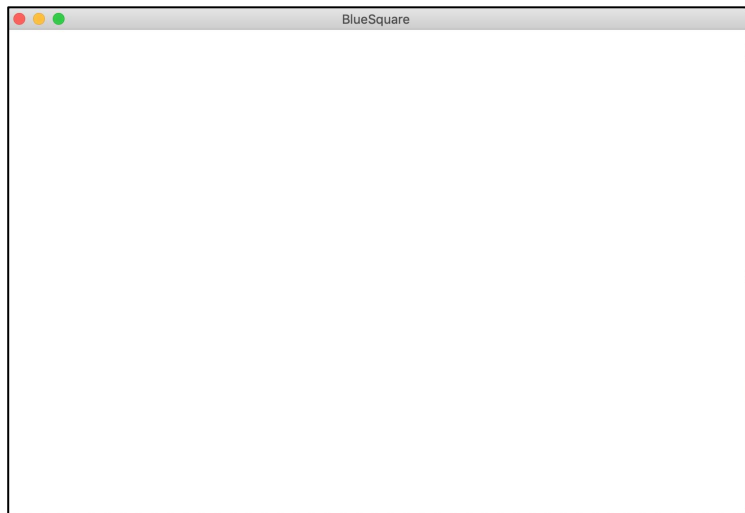
# Our First Graphics Object: GRect



```
public void run(){
    drawBlueSquare();
}

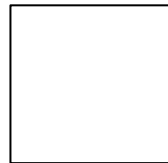
private void drawBlueSquare(){
    GRect rect = new GRect(200, 200);
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# Our First Graphics Object: GRect



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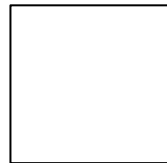
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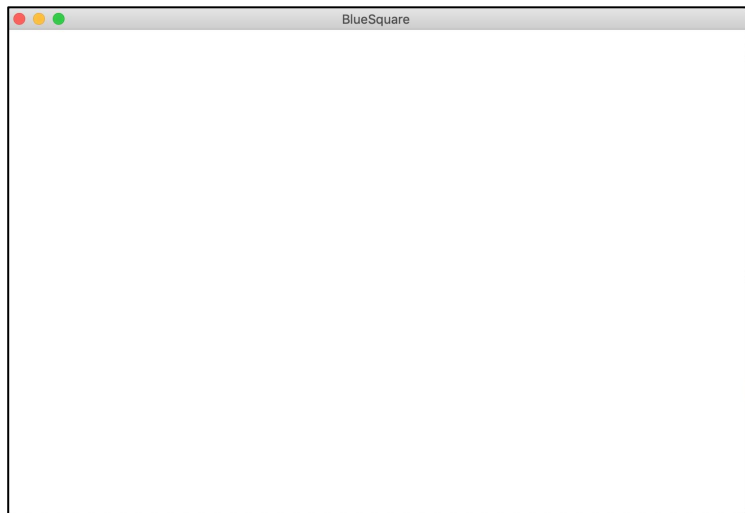
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# Our First Graphics Object: GRect



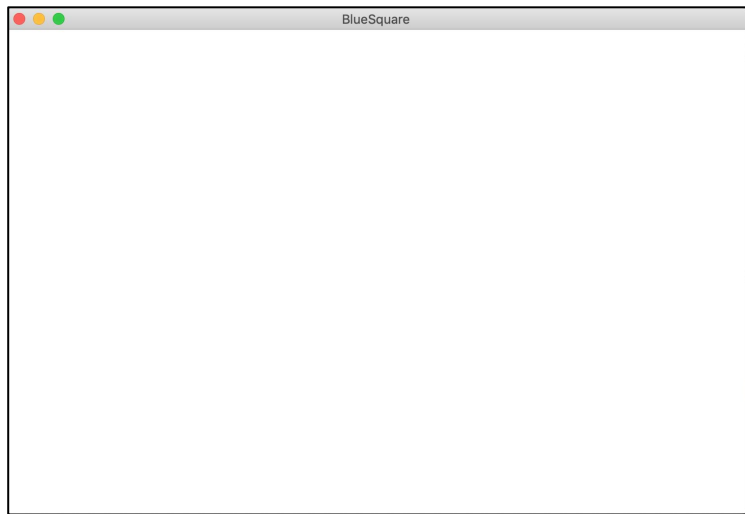
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rect



# Our First Graphics Object: GRect



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    add(rect, 50, 50);
}
```

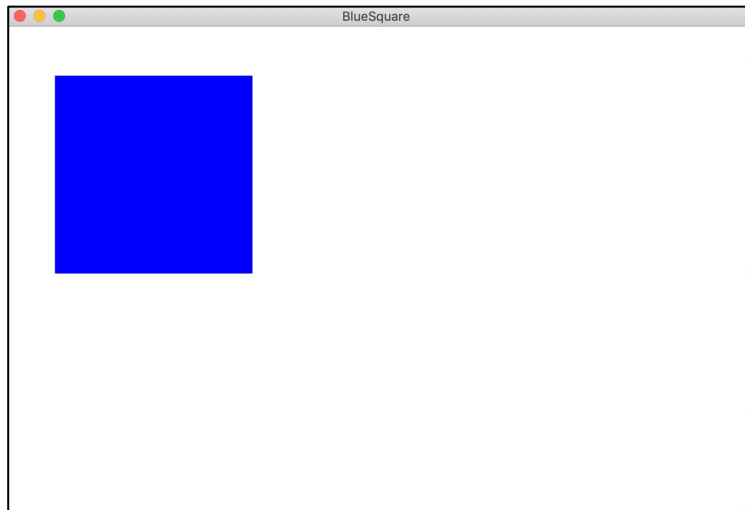
**Note:** The GRect is *created*, but hasn't been *added to the screen*.

rect





# Our First Graphics Object: GRect



```
public void run(){
    drawBlueSquare();
}

private void drawBlueSquare(){
    GRect rect = new GRect(200, 200);
    rect.setFilled(true);
    rect.setColor(Color.BLUE);
    add(rect, 50, 50);
}
```

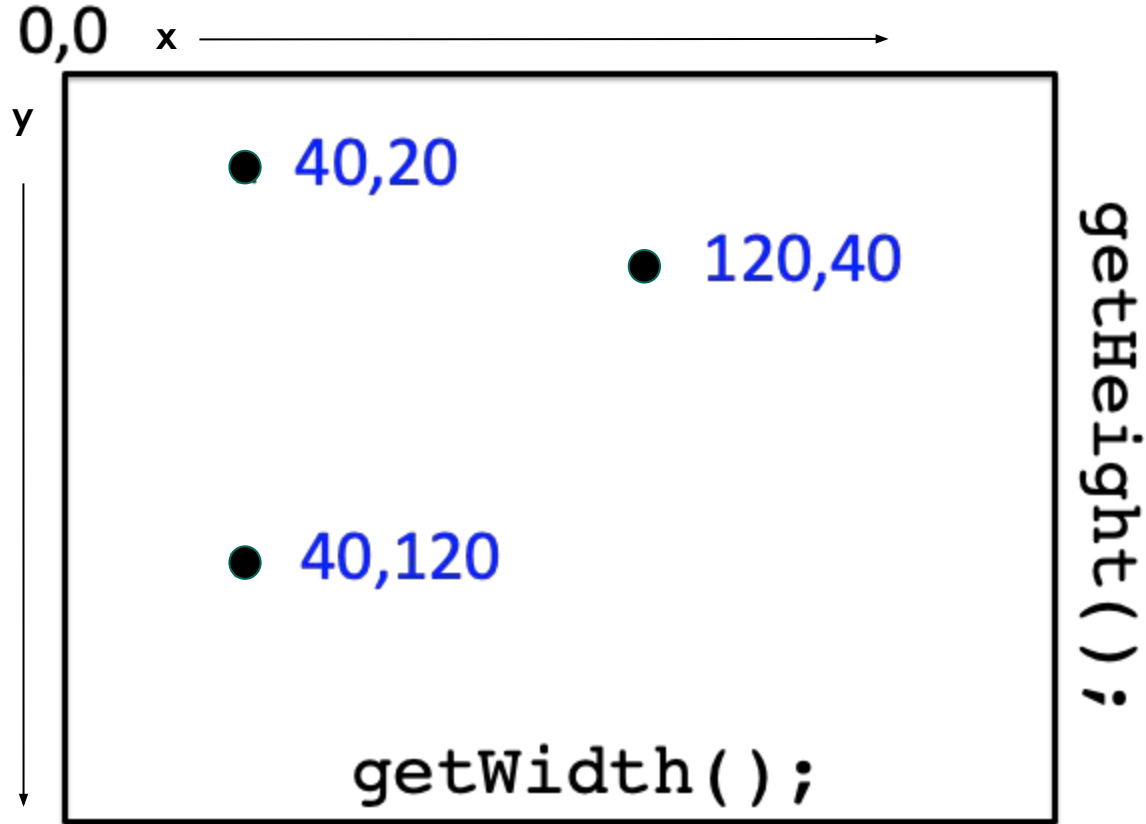
rect



# Java Coordinate System

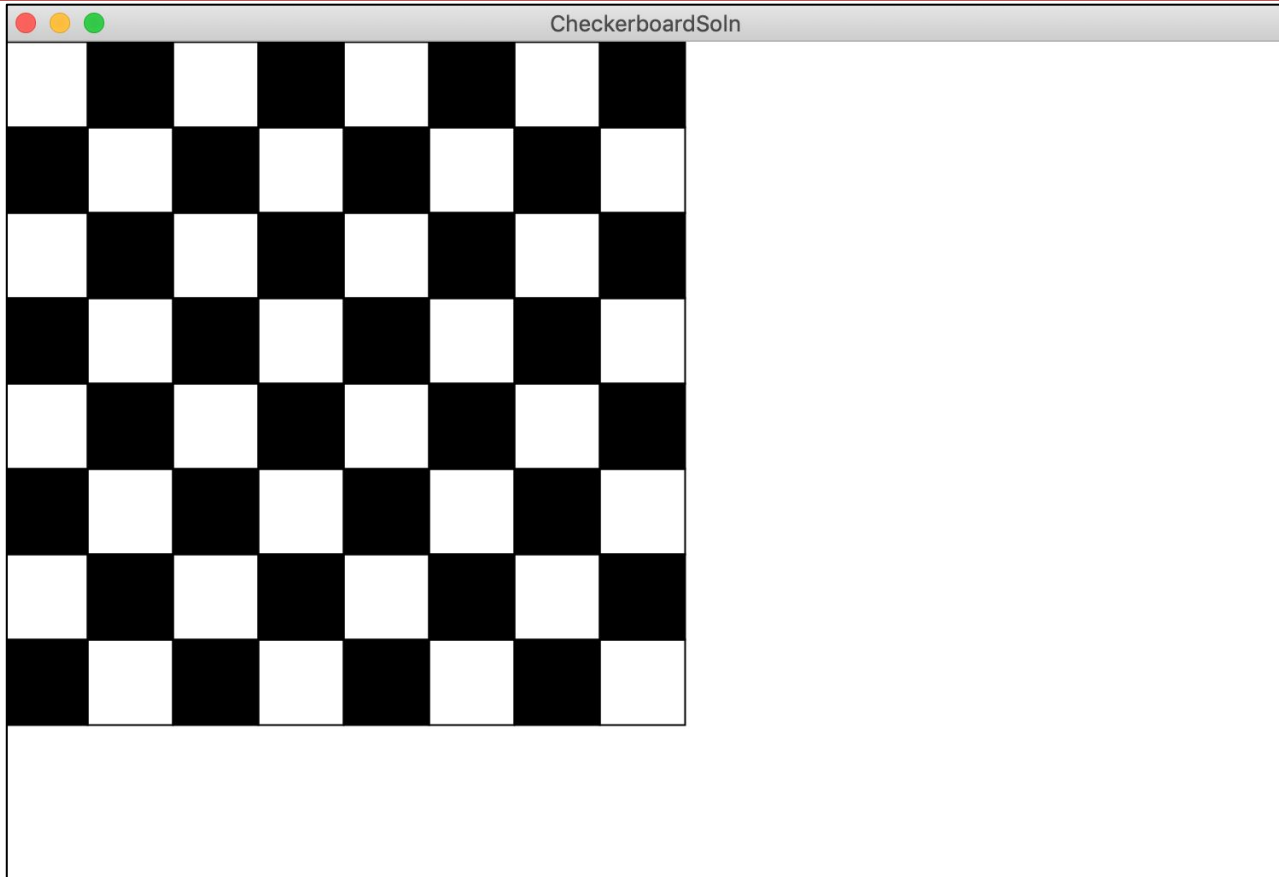
**Note:**

The y coordinate gets *bigger* as we go *down*. This is opposite of how it acts in most math classes!

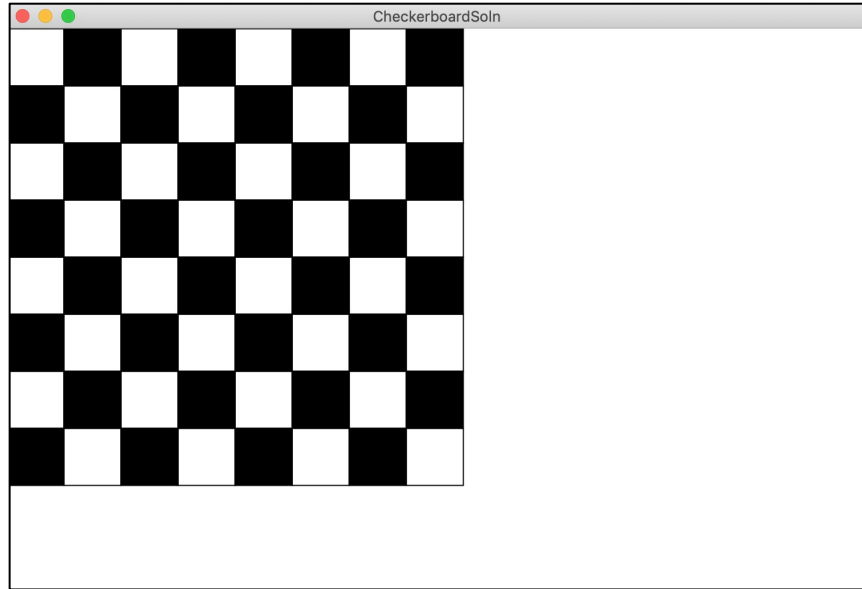


# Our First Graphics Challenge

# Checkerboard

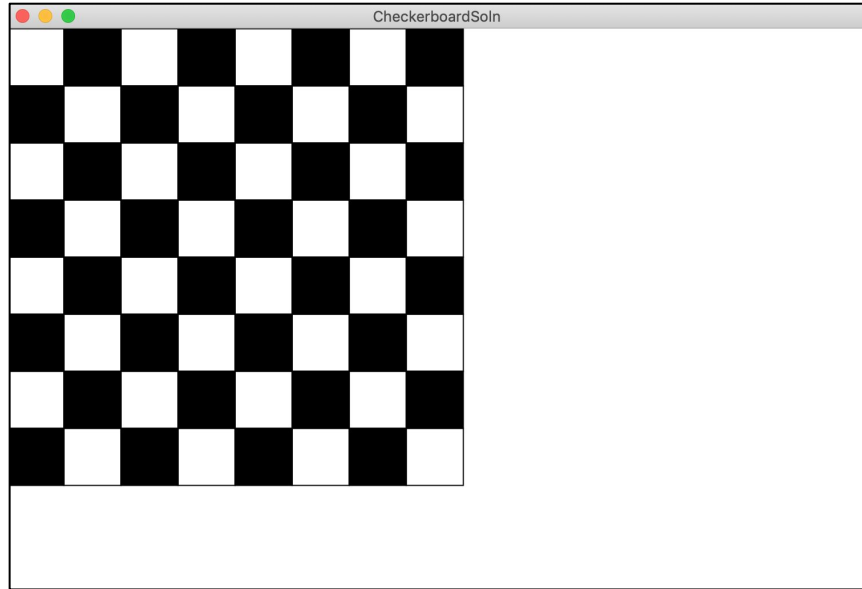


# Our First Graphics Challenge



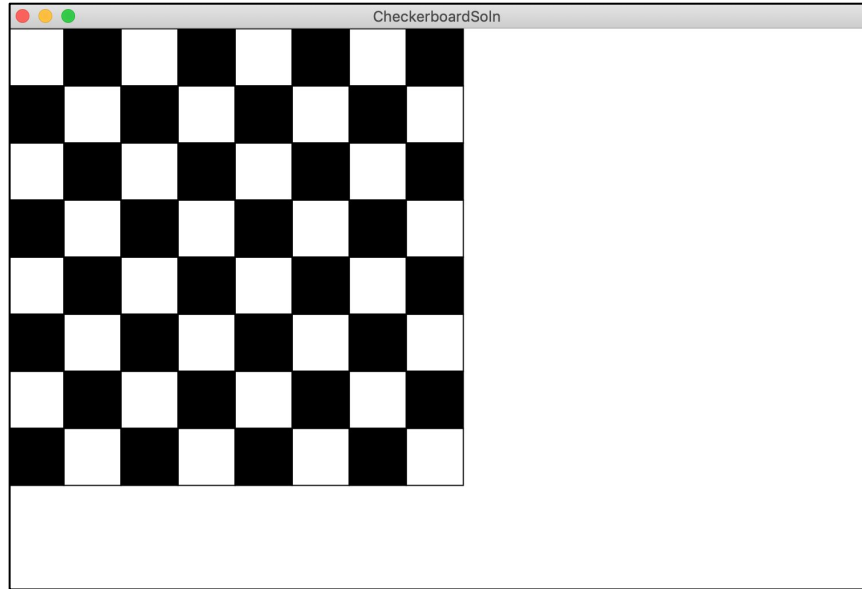
What's the Pseudocode?

# Our First Graphics Challenge



What's the Pseudocode for drawing the first row of boxes?

# Our First Graphics Challenge



What's the Pseudocode for drawing the first row of boxes?

repeat for 8 columns:

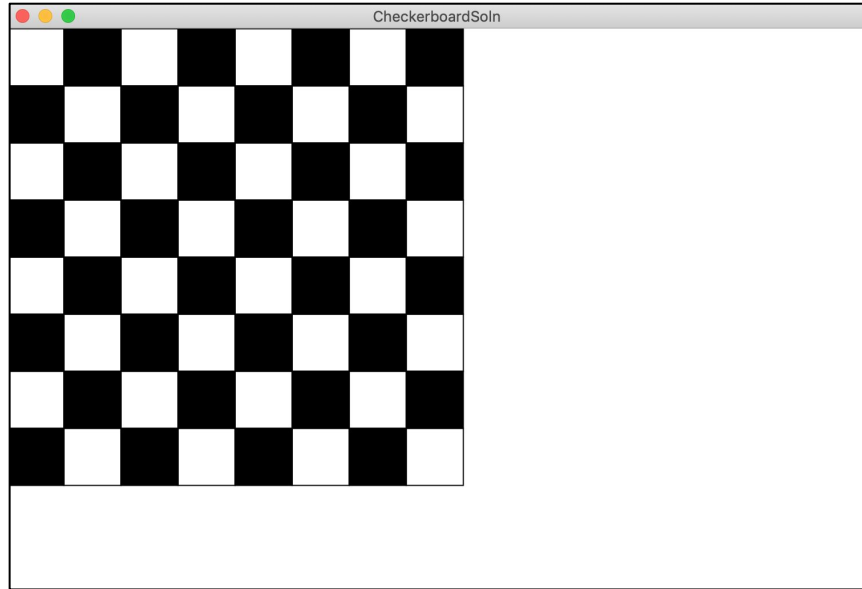
- draw a box

- (x location is  $\text{col\#} * \text{box size}$ )*

- (y location is 0)*

- add the box to the screen

# Our First Graphics Challenge



How can we change the Pseudocode to draw all of the boxes?

repeat for 8 columns:

draw a box

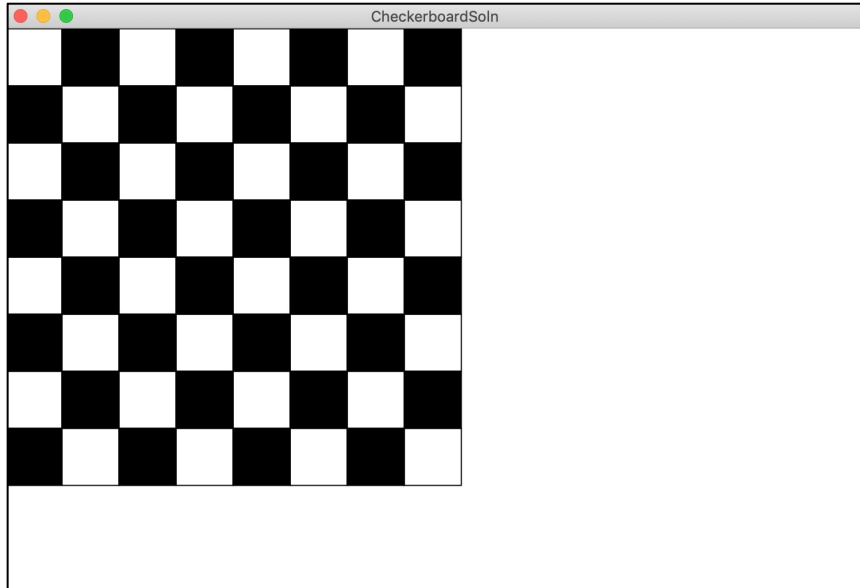
(*x location is col# \* box size*)

(*y location is 0*)

add the box to the screen



# Our First Graphics Challenge



Pseudocode for drawing all of the boxes:

**repeat for 8 rows:**

    repeat for 8 columns:

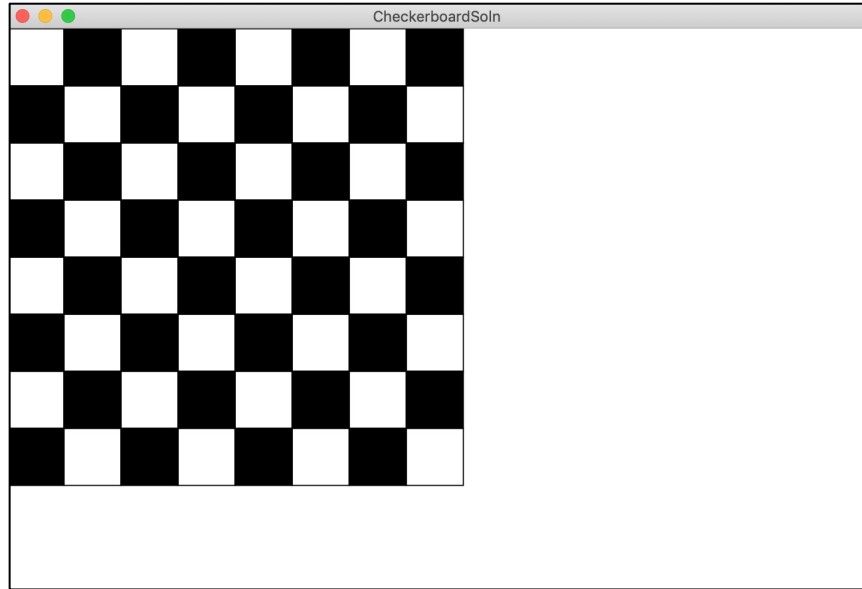
        draw a box

        (*x location is col# \* box size*)

        (**y location is row# \* box size**)

        add the box to the screen

# Our First Graphics Challenge



How can we change the Pseudocode to fill in the correct boxes?

repeat for 8 rows:

repeat for 8 columns:

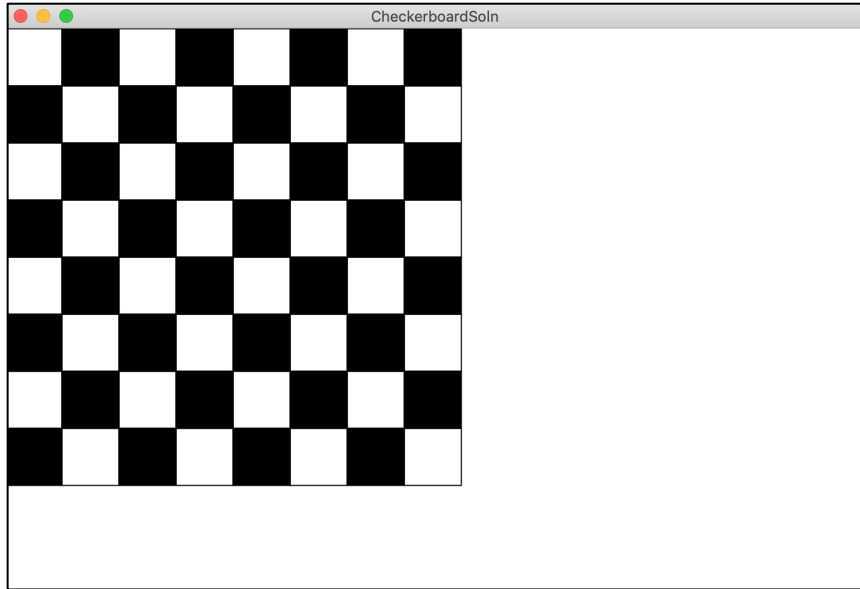
draw a box

*(x location is col# \* box size)*

*(y location is row# \* box size)*

add the box to the screen

# Our First Graphics Challenge



Pseudocode for filling the correct boxes:

repeat for 8 rows:

repeat for 8 columns:

draw a box

*(x location is  $\text{col\#} * \text{box size}$ )*

*(y location is  $\text{row\#} * \text{box size}$ )*

**If row+column is odd:**

**color the box black**

add the box to the screen

# Let's Code It!

---

# Infinite Loops

What's an infinite loop?



# Infinite Loops

Infinite loops are loops that *never end*.

**Why would this ever happen?**

# Example: Infinite Loops

What is wrong with this loop?

```
int answer = readInt("What is 1 + 1?");  
  
while (answer != 2){  
    println("Wrong answer! Try again");  
}
```

# Example: Infinite Loops

What is wrong with this loop?

**It doesn't give the user a chance to change their answer.**

```
int answer = readInt("What is 1 + 1?");  
  
while (answer != 2){  
    println("Wrong answer! Try again");  
}
```



# Example: Infinite Loops

What is wrong with this loop?

**It doesn't give the user a chance to change their answer.**

This means the while loop will never end! This is effectively a `while(true)` loop!

```
int answer = readInt("What is 1 + 1?");  
  
while (answer != 2){  
    println("Wrong answer! Try again");  
}
```

# Example: Infinite Loops

How can we fix it?

```
int answer = readInt("What is 1 + 1?");  
  
while (answer != 2){  
    println("Wrong answer! Try again");  
}
```

# Example: Infinite Loops

How can we fix it?

We can add a line where we give the user a chance to change their answer!

```
int answer = readInt("What is 1 + 1?");  
  
while (answer != 2){  
    println("Wrong answer! Try again");  
    answer = readInt("What is 1 + 1?");  
}
```

# Plan for Today

- Review: Methods
- Nested For Loop with Ascii
- Intro to Graphics Program - Our First Graphics Program!
- Checkerboard
- Infinite Loops

## Reminders:

- Assignment 2 is due at **10am on Wednesday, July 10th.**
- No lecture or sections Thursday for 4th of July.
- No LalR Wednesday, July 3rd due to Holiday.