Breakout YEAH hours

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Road Map

- Lecture Review
- Using the debugger
- Assignment Overview
- Q&A!

Primitive variables

```
int x = 7;    // declare and initialize a variable
x = 9;        // change the value of x
x = x + 1;    // increment (add 1 to) x.  A.K.A. x++
x = x + 2;    // add 2 to x.              A.K.A. x += 2
x /= 2        // divide x by 2, and truncate result

double d = 3.5;

boolean isThisTrue = true;
isThisTrue = !isThisTrue;  // flip isThisTrue
```

Graphics

```
GRect rect = new GRect(50, 50, 200, 200);
rect.setFilled(true);
rect.setColor(Color.BLUE);

GOval oval = new GOval(0, 0, getWidth(), getHeight());
oval.setFilled(false);
oval.setColor(Color.GREEN);

GLabel text = new GLabel("banter", 200, 10);

add(text);
add(rect);
add(oval);
```

Things to remember

- Coordinates are `doubles`
- Coordinates are measured from the top left of the screen
- Coordinates of a shape are coordinates of its top left corner
- Coordinates of a label are coordinates of its bottom left corner
- Remember to `add` objects to the screen!
- Use the online documentation!
- These are class variables!

Variable scope

Variables live inside the block in which they're declared

Scope for i

Scope for y

```
for (int i = 0; i < 5; i++) {
    int y = i * 4;
}
i = 3; // Error!
y = 2; // Error!
```

Scope for y

```
... // in some code far, far away
int y = 0;
for (int i = 0; i < 5; i++) {
    y = i * 4;
}
y = 2; // Ayy!
```

Methods & parameters

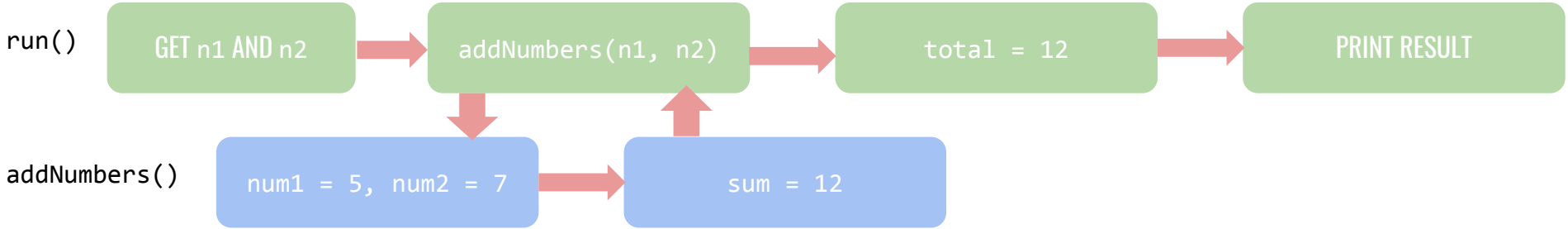

```
private returnType methodName(type parameter1, type parameter2,...)

private int returnsInt() {...}
private void drawsRect(int width, int length) {...} //void is no type
public boolean frontIsClear() {...} //look familiar?
```

Parameters and a return value are both optional!

Example: Methods and Parameters

```
public void run() {
     println("Choose 2 numbers!");
     int n1 = readInt("Enter n1"); //5
     int n2 = readInt("Enter n2"); //7

     int total = addNumbers(n1, n2);
     println ("The total is " + total);
}
```

```
                                        5          7
private int addNumbers(int num1, int num2) {
     int sum = num1 + num2;    //12
     return sum;
}
```



Returning in different places

```
private int multipleReturns(int x) {

      if (x == 5) {
            return 0;
      }

      return 1; // this only happens if x != 5
      return 5; // never gets to this line
}


// note: every path through the method ends
with a single return statement

// note: a function ends immediately after it
returns
```

Mouse Movement

We're not specifying what our program should do, we're specifying how it should react

The question we're answering:

> *"When the mouse does something interesting, how should our program respond"?*

When your mouse does that interesting thing, your program pauses

Mouse Movement

Step 1: Figure out the important mouse events you need to deal with

```
mouseMoved
mouseClicked
mouseDragged
mousePressed
mouseReleased
```

Anatomy of a Mouse Method

Public so other programs can call it


```
public void mouseMoved(MouseEvent e) {



}
```

Anatomy of a Mouse Method

Doesn't return anything

```
public void mouseMoved(MouseEvent e) {



}
```

Anatomy of a Mouse Method

It *must* have one of the mouse event names


```
public void mouseMoved(MouseEvent e) {



}
```

Anatomy of a Mouse Method

A collection of information
about the Mouse Event


```
public void mouseMoved(MouseEvent e) {



}
```

Anatomy of a Mouse Method

```
public void mouseMoved(MouseEvent e) {
    double mouseX = e.getX();
    double mouseY = e.getY();

}
```

Get information about the event

Anatomy of a Mouse Method

```
public void mouseMoved(MouseEvent e) {
   double mouseX = e.getX();
   double mouseY = e.getY();
   // more sick code here
}
```

An annoying nuance

You don't call this method, so you can't specify its parameters


```
public void mouseMoved(MouseEvent e) {
    double mouseX = e.getX();
    double mouseY = e.getY();
    // more sick code here
}
```

An annoying nuance

You don't call this method, so you can't specify its parameters

So how can we give mouseMoved access to our other variables?

```
public void mouseMoved(MouseEvent e) {
    double mouseX = e.getX();
    double mouseY = e.getY();
    // more sick code here
}
```

Instance variables

```
private int x; // belongs to the instance
of the program

public void run() {
     x = 2;
     addTwo();
     println(x); // prints 4
}

private void addTwo() {
     x += 2;
}
```

Should you use an instance variable?

YES

- You **access** & **change** the variable everywhere
- You use it in `mouseListener` methods
- You have literally no other choice

NO

- It makes information flow more annoying to visualize (parameters are easier)
- Poor style to build up unnecessary instance variables

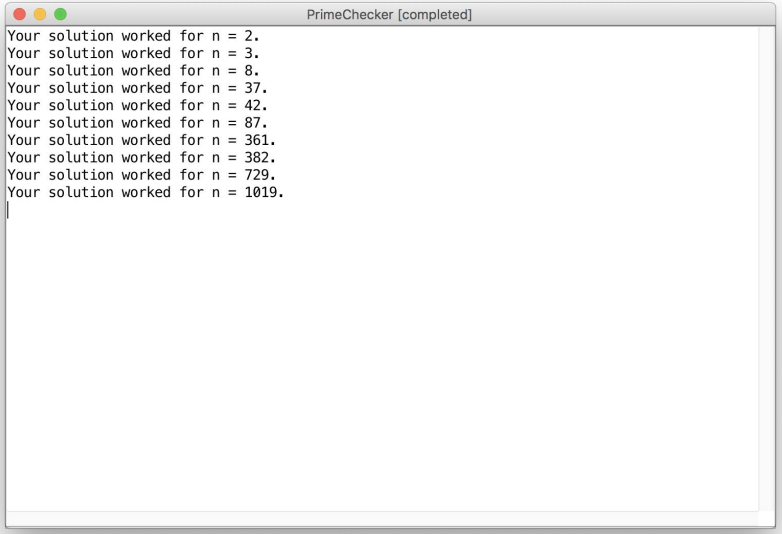
The opposite of an instance variable is a local variable

Breakout!

Due Wednesday, February 6th

Prime Checker

(A sandcastle)



Tips and tricks:

- Is it easier to conclude that a number is prime or that it isn't?
- What do you need to guarantee that a number is prime?

Mouse Reporter

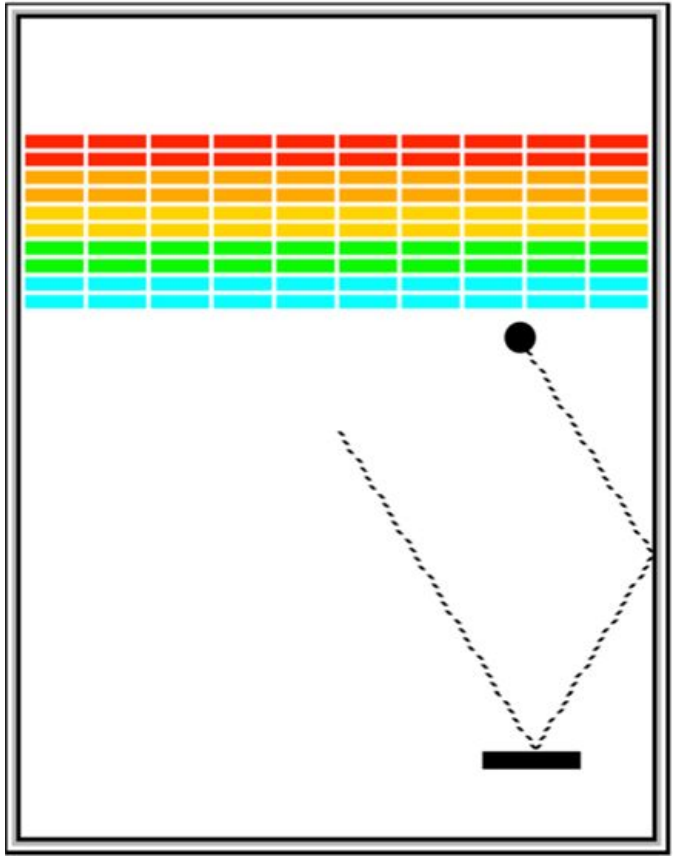
(Another sandcastle)

Tips and tricks:

- The starter code stores the label as an instance variable
- `getElementAt` might be useful here!

Breakout

(The actual assignment)



(What we're making!)

What you're given: Constants

- Use `getWidth()` and `getHeight()` for dimensions of window, not the ones in the constants!
- You might need to add more instance variables...

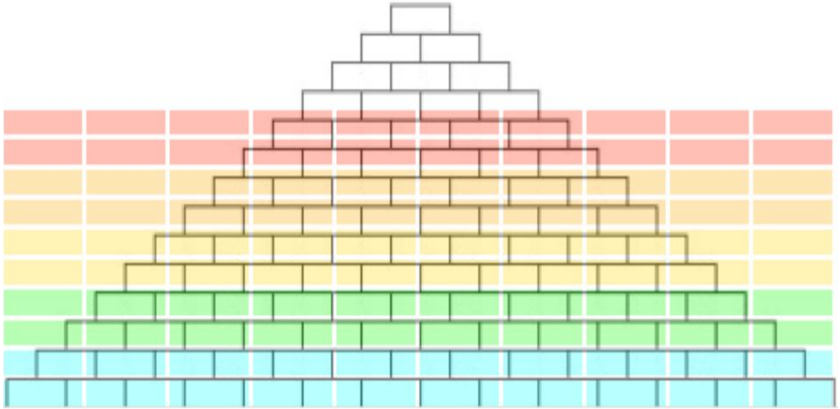
```java
/**
 * Width and height of application window, in pixels.
 * These should be used when setting up the initial size of the game,
 * but in later calculations you should use getWidth() and getHeight()
 * rather than these constants for accurate size information.
 */
public static final int APPLICATION_WIDTH = 420;
public static final int APPLICATION_HEIGHT = 600;

/** Dimensions of game board (usually the same), in pixels */
public static final int BOARD_WIDTH = APPLICATION_WIDTH;
public static final int BOARD_HEIGHT = APPLICATION_HEIGHT;

/** Number of bricks in each row */
public static final int NBRICKS_PER_ROW = 10;

/** Number of rows of bricks */
public static final int NBRICK_ROWS = 10;

/** Separation between neighboring bricks, in pixels */
public static final int BRICK_SEP = 4;

/** Width of each brick, in pixels */
public static final double BRICK_WIDTH =
    (BOARD_WIDTH - (NBRICKS_PER_ROW + 1.0) * BRICK_SEP) / NBRICKS_PER_ROW;

/** Height of each brick, in pixels */
public static final int BRICK_HEIGHT = 8;

/** Offset of the top brick row from the top, in pixels */
public static final int BRICK_Y_OFFSET = 70;

/** Dimensions of the paddle */
public static final int PADDLE_WIDTH = 60;
public static final int PADDLE_HEIGHT = 10;

/** Offset of the paddle up from the bottom */
public static final int PADDLE_Y_OFFSET = 30;

/** Radius of the ball in pixels */
public static final int BALL_RADIUS = 10;

/** initial random velocity that you should choose */
public static final double VELOCITY_MIN = 1.0;
public static final double VELOCITY_MAX = 3.0;

/** Animation delay or pause time between ball moves (ms) */
public static final int DELAY = 1000 / 60;

/** Number of turns */
public static final int NTURNS = 3;
```

What you're given: starter code

```
public void run() {
    // Set the window's title bar text
    setTitle("CS 106A Breakout");

    // Set the canvas size. Remember to ALWAYS use getWidth()
    // and getHeight() to get the screen dimensions, not constants!
    setCanvasSize(CANVAS_WIDTH, CANVAS_HEIGHT);

    /* You fill this in, along with any subsidiary methods */
}
```

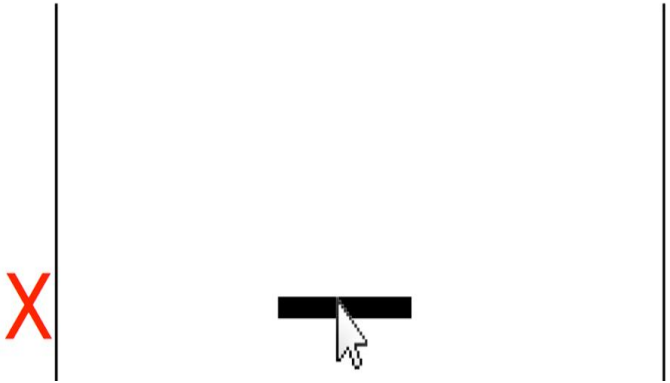
MILESTONE 1: BRICKS

- Similar to pyramid!
- Drawing multiple rows:
  - Figure out how to draw one row first
  - Bricks should be centered horizontally
- Reasonable coloring for any number of rows



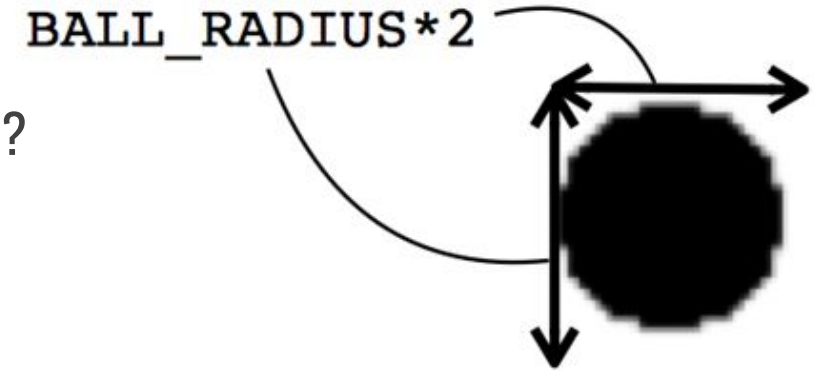
MILESTONE 2: PADDLE

- How do you make the mouse control the paddle?
- Chapter 9: GObject Methods
- Chapter 10: Event Driven Programs (responding to mouse events)
- Things to consider:
  - Paddle only needs to move in the x direction
  - Paddle can't move off the screen



MILESTONE 3: PLAY BALL!

- How do we move the ball?
- How do you choose the direction of the ball?
- What information do we need in the GOval constructor?



MILESTONE 3: PLAY BALL!

```
/* Animation: */
while(condition) {
   // update graphics
   obj.move(5, 5);
   pause(DELAY);
}
```

MILESTONE 3: PLAY BALL!

```
/* Moving the ball: */
double vx;
double vy;
...
while(condition) {
   // update graphics
   ball.move(vx, vy);
   pause(DELAY);
}
```

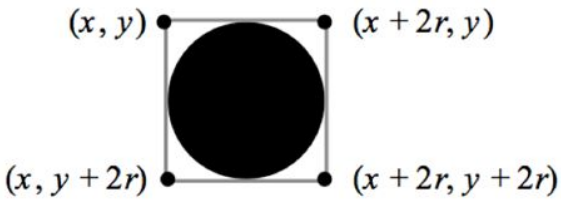
MILESTONE 3: PLAY BALL!

```
/* Randomizing the ball’s initial velocity: */
// make a random generator instance variable
private RandomGenerator rgen = RandomGenerator.getInstance();

// give the ball an initial direction
vx = rgen.nextDouble(1.0, 3.0); // choose speed
if(rgen.nextBoolean(0.5)) vx = -vx; // choose left or right

// wait until player clicks the screen
waitForClick();
```

MILESTONE 4: COLLISIONS

- Handle bouncing off walls first

- Collisions with objects: check if there's anything at each of the 4 corners and return one GObject



- Useful method:

```
GObject getElementAt(double x, double y);
```

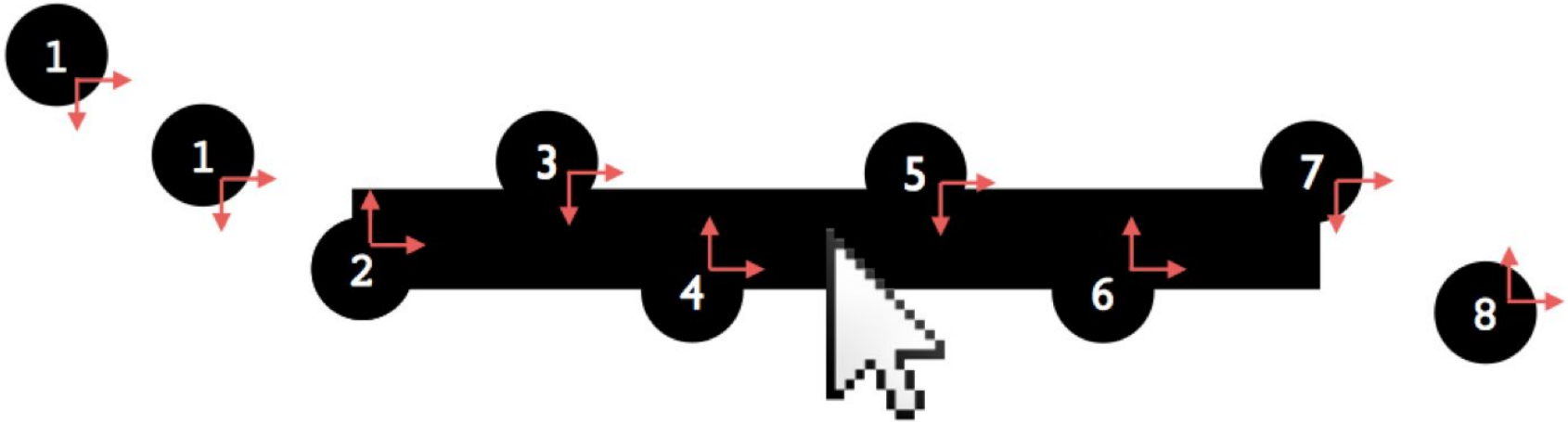
MILESTONE 4: COLLISIONS

```
/* Handling collisions: */
private GObject getCollidingObject() {
    // sick code
    // return a GObject
}
...
GObject coll = getCollidingObject();
// bounce vertically if collider is brick or paddle
// also need to handle collisions with walls--separate logic!
```

Ending the game

- Remove the ball when it goes off the screen
  - `remove(ball);`
- Determine wins and losses by the count of bricks

Tragedy strikes: the sticky paddle



Testing the program

- Check if it deals with changed constants
- Win condition / loss condition
- Try mega paddle
- Try sticky paddle

Wrapping up

- Read the spec (seriously, read the whole thing)!
- Comment your code!
- Incorporate IG feedback!
- Asking for help
- Extensions

Questions?