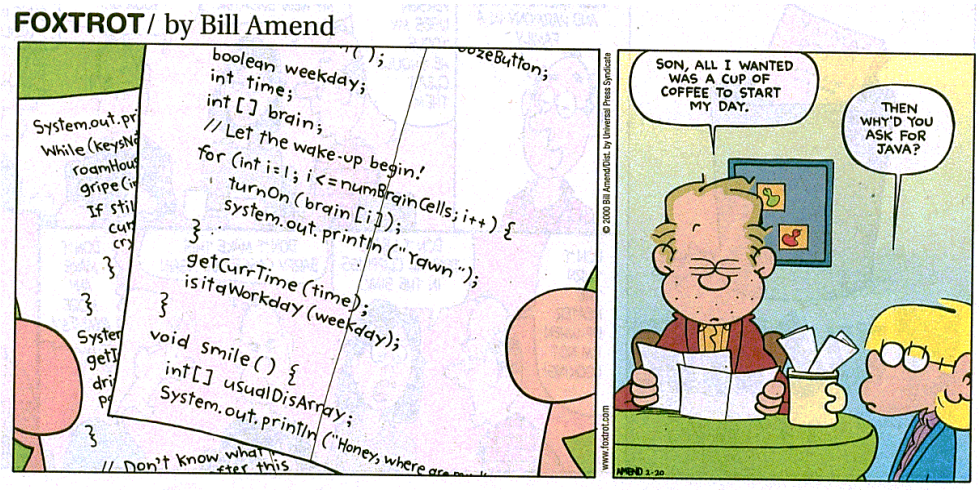
Mr. Fahrenbacher
AP Computer Science
Unit 2 - Data

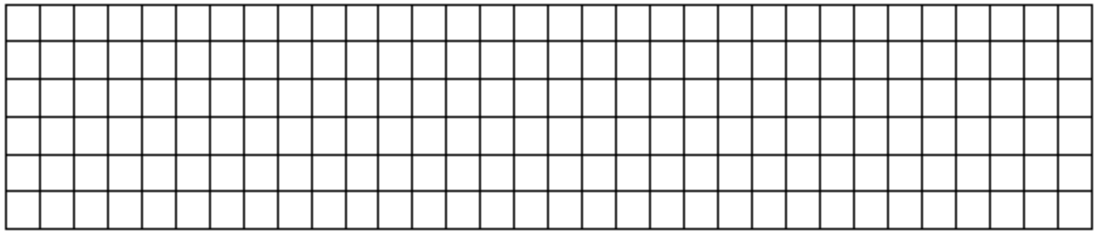
Name: _____

List of Java Concepts and Vocabulary From This Unit

- primitive and Object data type
- Variable declaration
- Variable naming
- Variable assignment
- Variable initialization
- Block (class, method)
- Style conventions
- Order of operations (precedence)
- Remainder operator
- Integer division
- Output statement
- Casting
- Compound operator
- String concatenation
- Escape Sequences
- Three types of errors
- Constant
- Math functions and constants
- Randomness
- Comments
- User Input
- Arrays



Primitive Data



	Code	Notes
Declaring (introducing) variables **type varName;**	**int** livesLeft; **double** timePlaying; **boolean** isInvincible;	-2 billion < int < 2 billion (integers) -10^308 < double < 10^308 (decimals), ~16 decimal places true, false
Assigning (given value to) variables **varName = data;**	**livesLeft = 3** **timePlaying = 300.0** **isInvincible = true;**	
Initializing (declaring and assigning) variables **type varName = data;**	**int** playerNumber = **1**; **double** speed = **13.1**; **boolean** isSuper = **false**;	

Object Data

```
Point coordinates = new Point(50, 75);

Color hatCol = new Color(255, 0, 0);

String name = "Mario";  //object with primitive features
```

An Example Program

Read the following program and identify the parts you understand. Use vocabulary we developed on the previous page - by precise! Try to identify what other parts of the program are doing that look new.

```
public class TipCalculator {

    public static void main(String[] args) {

        double bill = 45.95;
        double tipPercent = 0.15;

        double tipAmount = bill * tipPercent;
        String message = "You should pay $";

        System.out.print(message);
        System.out.print(tipAmount);
    }

}
```

Output when this program is run: **You should pay $6.8925**

A couple of math questions

1) 5 - 3 + 2 = ___4__

2) $6 \div 2 \cdot (5 + 3 - 4)$= __$6 \div 2 \cdot 4$____ = 12

_____3) 100 students are going to form baseball teams, with each team having 9 players. Will any student **not** be on a team? If so, how many?

1 = remainder 9*11 = 99

Operations on int's and double's.

Precedence	Evaluate First		Evaluate Second (left to right)			Evaluate Last (left to right)	
Name	**Parentheses**	**Exponent**	**Multiply**	**Divide**	**Remainder**	**Add**	**Subtract**
Symbol	()	You can't	*	/	%	+	-

The Remainder Operator (for int's) [we won't generally use it with double's]

Verbal Model	Code Model	Answer
A class of 20 students is going to break into groups of size three. How many students will not be in a group of three?	20 % 3	2
A water bottle needs 7 oz to be filled, and it only has 5 oz. How much water is not able to fill a full water bottle.	5 % 7	5
	13 % 33 27 % 14 41 % 14	13

The Division Operator (for int's) [it does what you think with double's]

Verbal Model	Code Model	Answer
A class of 20 students is going to break into groups of size three. How many full groups will there be?	20 / 3	6
A water bottle needs 7 oz to be filled, and it only has 5 oz. How much full water bottles do we have?	5 / 7	0

	13 / 1 27 / 2	13

Another Example Program

Read the following program and identify the parts you understand. Use vocabulary we have developed - by precise! Try to identify what other parts of the program are doing that look new, especially in comparison to the first program we looked at.

```
public class TimeConverter {

	public static void main(String[] args) {

		int totalSeconds = 10000;
		int seconds, minutes, hours;

		hours = totalSeconds / 3600;
		totalSeconds = totalSeconds % 3600;

		minutes = totalSeconds / 60;
		totalSeconds = totalSeconds % 60;

		seconds = totalSeconds;

		System.out.println("The hours are:  " + hours);
		System.out.println("The minutes are:  " + minutes);
		System.out.println("The seconds are:  " + seconds);
	}
}
```

Output when this program is run:

The hours are: 2
The minutes are: 46
The seconds are: 40

Mixed Type Operations (int / double)

Below are some segments of code. The left represents valid syntax, while the right side is invalid syntax. Explain what you think is invalid about the code on the right, then also list out what values you think the variables a through i have and why.

```
int a, d, e, x, y, z;
double b, c, f, g, h, i;
```

Legal Syntax		Illegal Syntax (Error)	
Code	Calculated Values and Why	Code	Why

a = 3;
 	
b = 3.0;
 	
c = 3;
	a = __3__
	
	b = __3.0__
	
	c = _3.0___ (c is a double)
		x = 3.0;	x is an integer, can't hold decimals!

d = (int)5.8;	d = __5__ (int) => convert (cast) truncates	y = (double)5;	y is an integer, can't hold decimals!

e = 5/4;
 	
f = 5/4.0;
	e = __1__ int/int => int
	
	f = _1.25___ int/double => double
		z = 5/4.0;	z is an integer, can't hold decimals!

g = 5/4;
 	
h = (double)(5/4);
 	
i = (double)5/4;
	g = _1.0___ int/int => int
	
	h = __1.0__
	
	i = _1.25___		

Compound Operators (int, double)

```
int x = 10;
```

Regular Update Operation	x = x + 5;	x = x - 4;	x = x * 5;	x = x / 6;	x = x % 7;	x = x + 1;	x = x - 1;
Compound Operation	x += 5;	x -= 4;	x *= 5;	x /= 6;	x %= 7;	x++;	x--;

Read the following program and identify the parts you understand. Use vocabulary we have developed - by precise! Try to identify what other parts of the program are doing that look new, especially in comparison to the first program we looked at. Can you determine the output? Is the output correct?

```
public class GPACalculator {

    public static void main(String[] args) {

        int math = 4;
        int science = 4;
        int english = 3;
        int socialStudies = 3;
        int fineArts = 3;
        int foreignLanguage = 2;

        int classes = 0;
        int gpa = 0;

        gpa += math;
        classes++;
        gpa += science;
        classes++;
        gpa += english;
        classes++;
        gpa += socialStudies;
        classes++;
        gpa += fineArts;
        classes++;
        gpa += foreignLanguage;
        classes++;

        gpa = gpa / classes;
        gpa /= classes;
        System.out.println("Your gpa for " + classes + " classes is " + gpa);
    }
}
```

Output when this program is run: ___Your gpa for 6 classes is 3_

String Concatenation

Strings also support being added together (and being add with other types!)

```
String x;
int age = 34;
int height = 6;
```

Operation	Value in x
x = "I am " + age + " years old";	"I am 34 years old"
x = "I am " + age + " years old and " + height + " feet tall";	"I am 34 years old and 6 feet tall"

Explain why you think the results below are occurring.

Operation	Value in x	Why
x = "My stats are " + age + height + "!";	"My stats are 346!"	If you want a space between 34 and 6, you'd need a **+ " " +** First add combines string with number, then next adds another number to the end of the string
x = "My stats are " + (age + height) + "!";	"My stats are 40!"	Parenthesis forces the number addition before placing at the end of the string

Identify the mistakes in the code below.

Operation	Error and How to Fix
x = "My age is " age;	Missing + symbol between the string and the variable
x = "I am " + age + " years old and " + height + feet tall";	Missing the " before feet tall

Escape Sequences

Read the code below and compare it with the output. Identify the special pairs of symbols that are formatting the output in interesting ways.

\n => skip a line (go to the next line)
\t => indent (tab key)
\" => "
**\\ => **

```
public class MessageInABottle {

    public static void main(String[] args) {

        String msgA = "August 10th, 1815\n\nTo whom it may concern\n\n";
        String msgB = "\tThanks for finding my \"message\"!  I've been stranded on St. Helena for many days.\n\tPlease send help!\n\n";
        String msgC = "Sincerely,\n\\Napoleon\\";

        System.out.print(msgA + msgB + msgC);
    }
}
```

Output:

```
August 10th, 1815

To whom it may concern

    Thanks for finding my "message"!  I've been stranded on St. Helena for many days.
    Please send help!

Sincerely,
\Napoleon\
```

Types of Errors

The program below has three errors, each of a different kind. Find the errors.

```
public class WorkingTheNumbers {

    public static void main(String[] args) {

        int linesOfCode = 2147483647;
        int people = 0;

        linesOfCode++;  //-2147483648  //Logic error
```

```
                //forgetting the type when introducing a variable is called a syntax error
                int rate = linesOfCode / people; //runtime error - divide by 0 (ArithmeticException)
                System.out.println("The rate at which the code was written is " + rate);

        }
}
```

Constants

A new keyword is introduced in the code below. Identify the keyword, then explain what purpose the keyword serves (compare the legal and illegal code).

Legal Syntax	Illegal Syntax

final double pi = 3.14;
double r = 5;
double circumference = 2 *pi * r;
	final double circumference = 0;
	double pi = 3.14;
	double r = 5;
	circumference = 2 * pi * r;

final variable = can't change later!

Math FUNctions

Java has many built in math functions. Several are listed in the table below. Identify what you think each command does.

```
int x;
double y;
```

Command	variable's value	What the command does
x = Math.abs(-5);	5	Absolute Value
x = Math.max(2, 7);	7	Maximum
x = Math.min(2, 7);	2	Minimum
y = Math.pow(3, 4);	81.0	Power (Exponent)
y = Math.sqrt(25);	5.0	Square Root

```
int z = -4;
int x = Math.abs(z);
System.out.println(x);
```

A common error is to think that Math.min(2, 3, 4) is valid syntax, but the min function only supports two inputs. Try to think of another way to determine the smallest value between 3 values using the min function.

```
int x = Math.min(2,3)
int y = Math.min(x,4)
```

Note: Math.abs(), Math.max(), and Math.min() will give a double result if at least one of the inputs is a double. Math.pow() and Math.sqrt() always give a double result.

Randomness

Below is some new code that allows you to generate one random number that represents a class in high school (9th-12th). Identify the different commands that generated the random numbers, and explain why you think they are being used. For example, what do you think would happen if you changed the numbers?

```
public class ContestWinner {

    public static void main(String[] args) {

        int winningClass = (int)(Math.random() * 4) + 9;
        System.out.print("The winning class is the " + winningClass + "th graders!");
    }

}
```

Example output when this program is run: **The winning class is the 12th graders!**

Randomness Analyzed

```
int x, double y;
```

Command	Stored Value (Math Notation)	Stored Value (Examples)
y = Math.random();	[0, 1)	0.1245671, 0, 0.900000001, 0.9999999999
x = (int)(Math.random() * 4);	(int)[0, 4) = {0, 1, 2, 3}	3, 3, 3, 1, 0, 0, 2
x = (int)(Math.random()*4) + 9;	{9, 10, 11, 12}	
x = (int)(Math.random() * nums) + start;	{start, start + 1, …, start + nums - 1}	

Randomness Mistakes

Command	Desired Values	Actual Values	Why
x = (int)Math.random()*6 + 1;	1, 2, ..., 6	1	Missing (Math.random()*6)
x = (int)(Math.random()*10) + 2	2, 3, ..., 12	2, …, 11	Need to multiply by 11
x = (int)(Math.random()*10);	1, 2, ..., 10	0, …, 9	Add 1 to the end to fix it
x = (int)(Math.random()*3) + 2	3, 4		

Math Constants

These two constants are provided by the Math class. The first you know, the second you may not (if you don't, no worries - we won't really use it).

Constant	Value
Math.PI	3.141592653589793
Math.E	2.718281828459045

Example use:

```
double circleArea = Math.PI * Math.pow(5.0, 2);  //calculate the area of a circle

double loan = 1000 * Math.pow(Math.E, 0.05 * 10);          //calculate the value of a loan, compounding continuously
```

Comments

Read the information below about comments in the example program

```
/* Comments are sections of code that are the documentation of the program - they do not impact the running of the program
   At the top of a program, this is a good place to put your name and a general description of your program
*/

public class Area { //This kind of comment only makes text to the right of the two slashes into a comment

        /* Whereas the slash star creates a comment that continue from left to right, line by line, until
           a star slash is encountered, like the one on the next line
        */
        public static void main(String[] args) {

                //comments are useful ways to describe what a program is doing
                int side = 5;

                /* Comments should ideally describe what a program is doing - but you don't have to comment everything - be judicious */
                double area = Math.pow(side, 2);

                //Comments are also useful for turning code "off" for testing purposes, like the line below
                //System.out.println(area);
        }
}
```

Input

Below is an example of Mad Libs program. This type of program allows the user to interact with the program while it is running. Find the lines of code that look new and try to determine what these lines of code accomplish.

```
import java.util.Scanner;  //lets the MadLib class use the built in Scanner class

public class MadLib {

	public static void main(String[] args) {

		Scanner input = new Scanner(System.in);  //making a new Scanner object
		                                         //initializing a variable named input
		                                         //type of the variable is Scanner
	//Prompt
		System.out.print("Please enter a noun: "); //#1 - print out a request
		String noun = input.nextLine();            //#2 - read in what they enter, and store in a variable

		System.out.print("Please enter an adjective: ");
		String adj = input.nextLine();

		System.out.print("Please enter an verb: ");
		String verb = input.nextLine();

		System.out.print("Please enter an integer: ");
		int num = input.nextInt();

		System.out.print("Please enter a decimal: ");
		double value = input.nextDouble();

		System.out.print("Our story is about a " + noun + ".   This particular " + noun + " likes to " + verb + ".\n");
		System.out.print("It is also very " + adj + "!  It only costs $" + value + " on Amazon.  Would you like to buy " + num + "?");
	}
}
```

Arrays

Read through the code below. Identify the new syntax and try to interpret what it means. How is this new syntax useful? Does the new syntax have any drawbacks?

```
public class PropertyValueCalculator {

    public static void main(String[] args) {

        double[] housePrices = new double[5];

        housePrices[0] = 200000.0;
        housePrices[1] = 340000.0;
        housePrices[2] = 190000.0;
        housePrices[3] = 260000.0;
        housePrices[4] = 500000.0;

        double total = housePrices[0] + housePrices[1] + housePrices[2] + housePrices[3] + housePrices[4];
        double avg = total / housePrices.length;

        System.out.println("The average property value is $" + avg);
    }
}
```