Data Types and Operators

Variables, Data Types & Arithmetic Operators

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Topics list

- Variables.
- Java’s Primitive Data Types.
- Arithmetic operators and Order of Evaluation.

Variables

In Programming, variables:

- are created (defined) in your programs.
- are used to store data (whose value can change over time).
- have a data type.
- have a name.
- are a VERY important programming concept.

Variable names…

- Are case-sensitive.
- Can be any length you choose.
- Must not be a **keyword or reserved word** e.g. int, while, etc.
- Cannot contain white spaces (i.e. space bar value).
- Should use full words instead of abbreviations e.g. ratio and gear is better than r and g.
- If the name consists of:
  - only one word, spell that word in all lowercase letters e.g. gear.
  - more than one word, capitalise the first letter of each subsequent word e.g. engineSize and currentGear.

https://docs.oracle.com/javase/tutorial/java/nutsandbolts/variables.html

Assignment Statement

- Values are stored in variables via assignment statements:

Syntax	`variable = expression;`
Example	`currentGear = 4;`

- A variable stores a single value, so any previous value is lost.
- Assignment statements work by taking the value of what appears on the right-hand side of the operator and copying that value into a variable on the left-hand side.

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Data Types

- In Java, when we define a variable, we **<u>have</u>** to give it a data type.

- The data type defines the **<u>kinds of values</u>** (data) that can be stored in the variable e.g.
    - - 456
    - 2
    - 45.7897
    - I Love Programming
    - S
    - true

- The data type also determines the operations that may be performed on it.

Java's Primitive Data Types

- Java has eight primitive data types i.e. predefined types in the language:
  - Four whole number data types: byte, short, int, long
  - Two decimal number data types: float and double
  - A single character data type: char
  - A true/false data type: boolean

Java's Primitive Data Types

- We will cover three of these:
  - int, float, boolean.

- A primitive type is highlighted red when it is typed into the PDE e.g.

```
int a;
float number;
boolean flag;
```

Java's Primitive Data Types (whole numbers)

Type	Minimum value (inclusive)	Maximum value (inclusive)	Default value
int	-2,147,483,648	2,147,483,647	0
float	*Beyond the scope of this course.*		0.0f
boolean	Holds either **true** or **false** and is typically used as a flag.		false

Declaring variables of an int type

```
int secondNumber;       //declares a variable secondNumber of type int

firstNumber = 40;       //assign a value of 40 to firstNumber
secondNumber = 70;      //assign a value of 70 to secondNumber

int thirdNumber = 80;   //you can declare a variable and assign a value
                        //on one line.

int x, y, z;            //multiple variables of the same type can be defined
                        //on one line.
```

Declaring variables of an int type – some errors

sketch_150618a

```
//Some Errors with whole numbers

Int number = 60;
```

Cannot find a class or type named "Int"

Data types are case sensitive.

Int is not valid.
int is valid.

Declaring variables of an int type – some errors

sketch_150617a | Processing 2.2.1

File Edit Sketch Tools Help

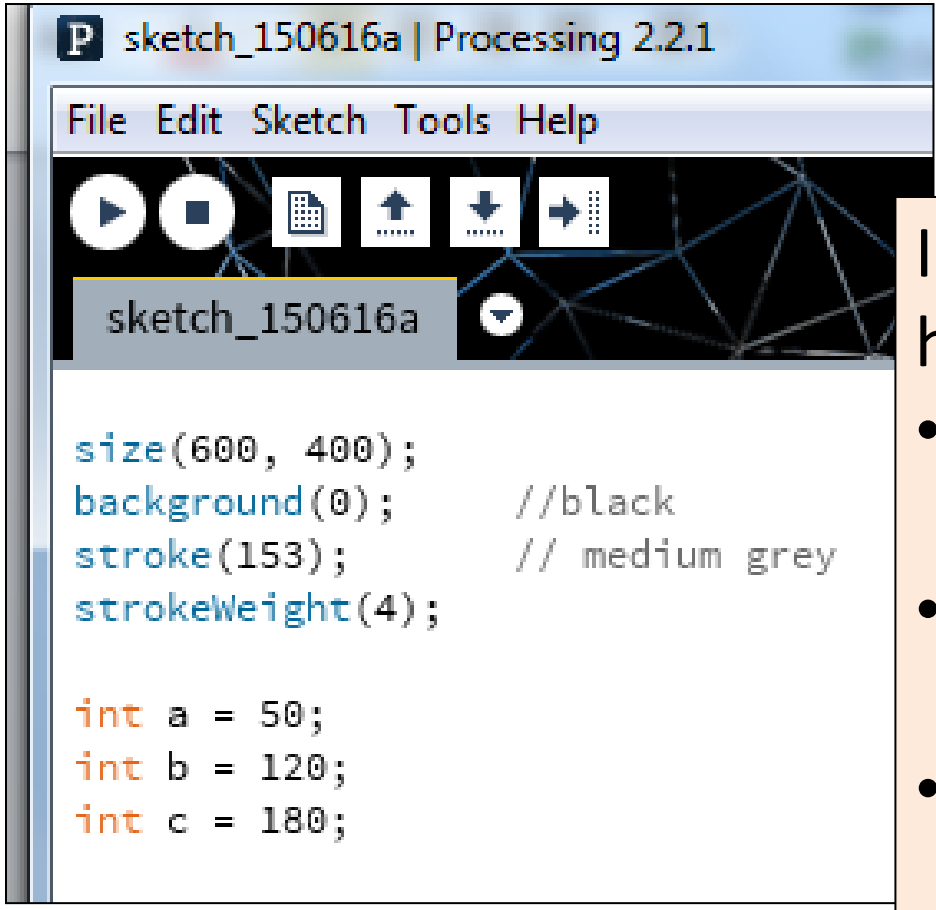
sketch_150617a

```
//Some Errors with whole numbers

int number = 60;
int number = 56;            //SYNTAX ERROR - you cannot define two variables with
                            //the same name

int anotherNumber = 58.98; //SYNTAX ERROR - you can only store whole numbers
                            //in int variables
```

Java's Primitive Data Types: int Example 3.1



In this example, we have:

- defined three variables (a, b and c)
- that can hold whole numbers (int).
- and are set with a starting value.

Based on the Processing Example: Basics → Data → Variables

Java's Primitive Data Types: int Example 3.2

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File Edit Sketch Tools Help

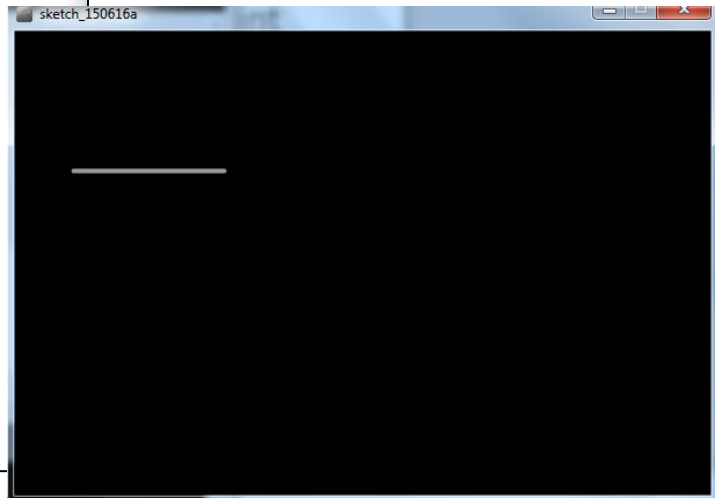
sketch_150616a

```
size(600, 400);
background(0);      //black
stroke(153);        // medium grey
strokeWeight(4);

int a = 50;
int b = 120;
int c = 180;

line(a, b, c, b);
```

We can pass the defined variables as values to functions.



Based on the Processing Example: Basics → Data → Variables

Java's Primitive Data Types: float Example 3.3

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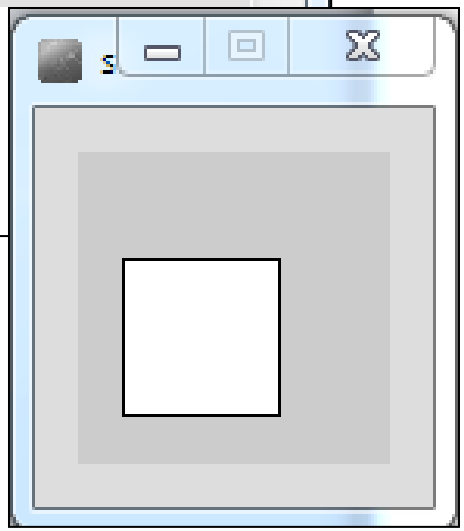
File Edit Sketch Tools Help

Java

sketch_150618a

```
float xCoordinate = 14.65;
float yCoordinate = 34.43;

rect(xCoordinate, yCoordinate, 50, 50);
```



We can pass the defined variables as values to functions.

Java's Primitive Data Types: float Example 3.4

sketch_150618a

```
float xCoordinate = 14;
float yCoordinate = 34;

rect(xCoordinate, yCoordinate, 50, 50);
```

Whole numbers can be placed into a float variable.

Q: Why?

A: There is no loss of precision. We are not loosing any data.

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- Variables.
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- Arithmetic operators and Order of Evaluation.

Arithmetic Operators

Arithmetic Operator	Explanation	Example(s)
+	Addition	6 + 2 amountOwed + 10
-	Subtraction	6 – 2 amountOwed – 10
*	Multiplication	6 * 2 amountOwed * 10
/	Division	6 / 2 amountOwed / 10

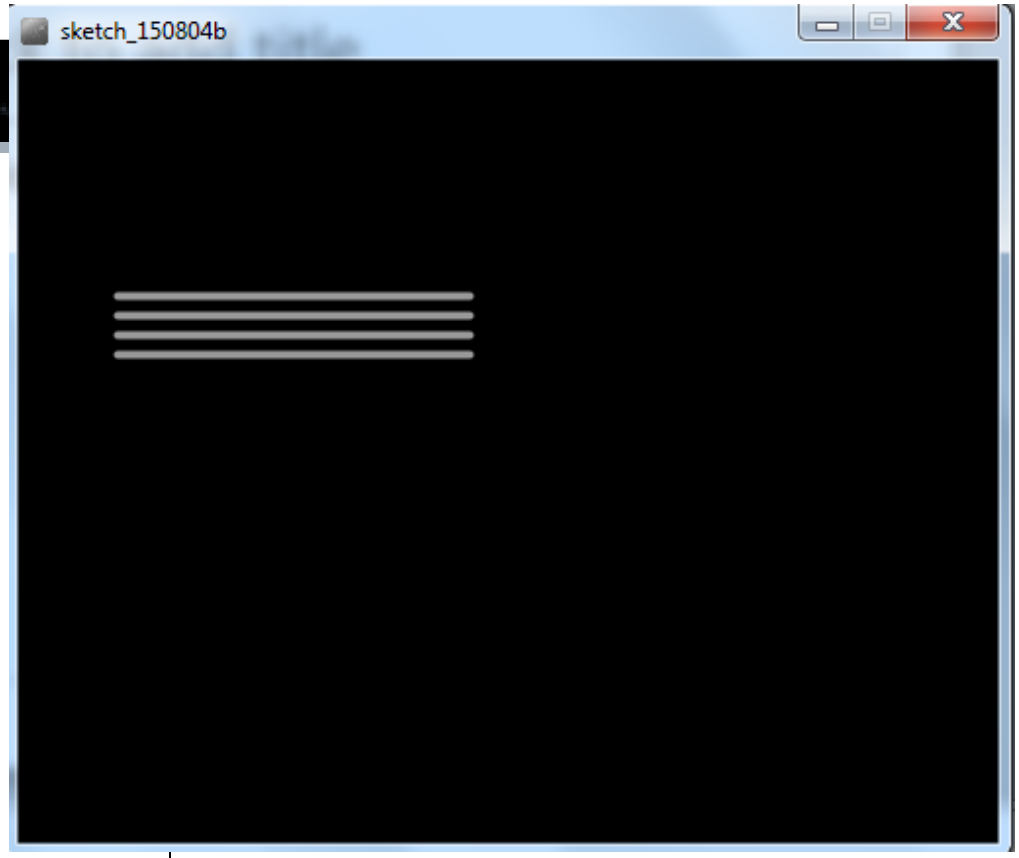
Arithmetic operators: Example 3.5

sketch_150804b

```
size(500, 400);
background(0);
stroke(153);
strokeWeight(4);

int a = 50;
int b = 120;
int c = 180;

line(a, b, a+c, b);
line(a, b+10, a+c, b+10);
line(a, b+20, a+c, b+20);
line(a, b+30, a+c, b+30);
```



Based on the Processing Example: Basics → Data → Variables

Arithmetic operators: Example 3.6

sketch_150804b

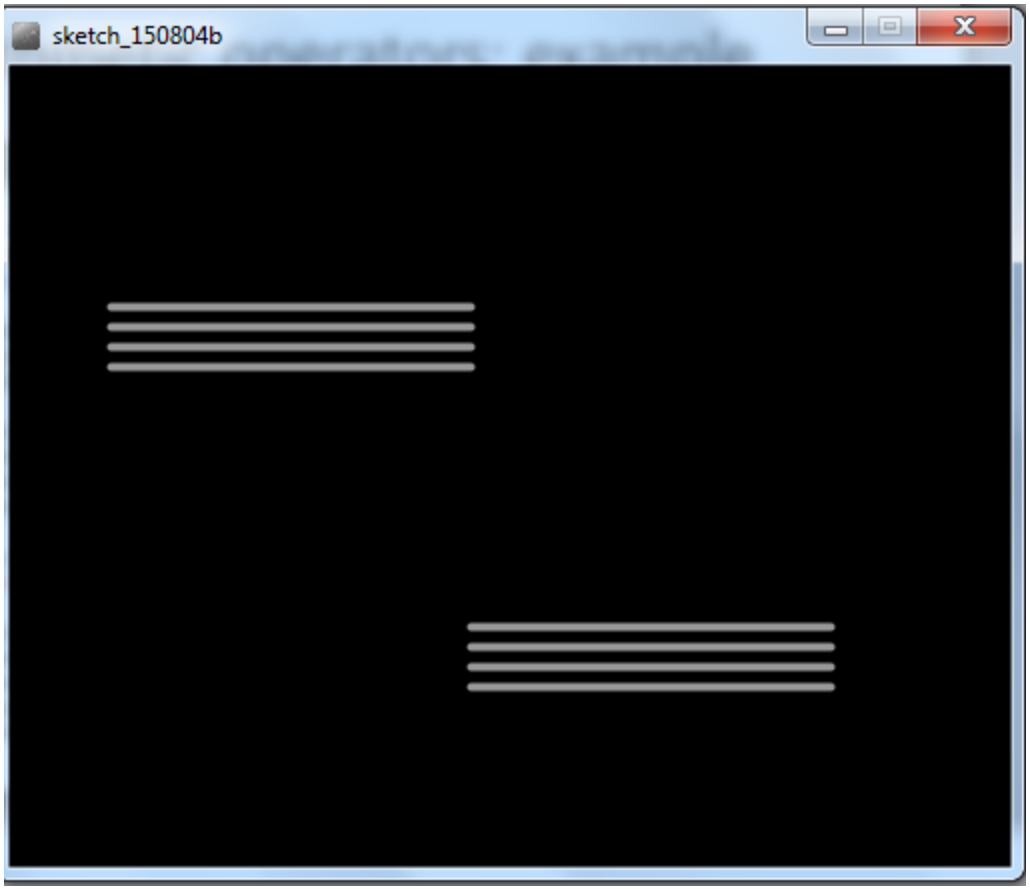
```
size(500, 400);
background(0);
stroke(153);
strokeWeight(4);

int a = 50;
int b = 120;
int c = 180;

line(a, b, a+c, b);
line(a, b+10, a+c, b+10);
line(a, b+20, a+c, b+20);
line(a, b+30, a+c, b+30);

a = a + c;
b = height-b;

line(a, b, a+c, b);
line(a, b+10, a+c, b+10);
line(a, b+20, a+c, b+20);
line(a, b+30, a+c, b+30);
```



Based on the Processing Example: Basics → Data → Variables

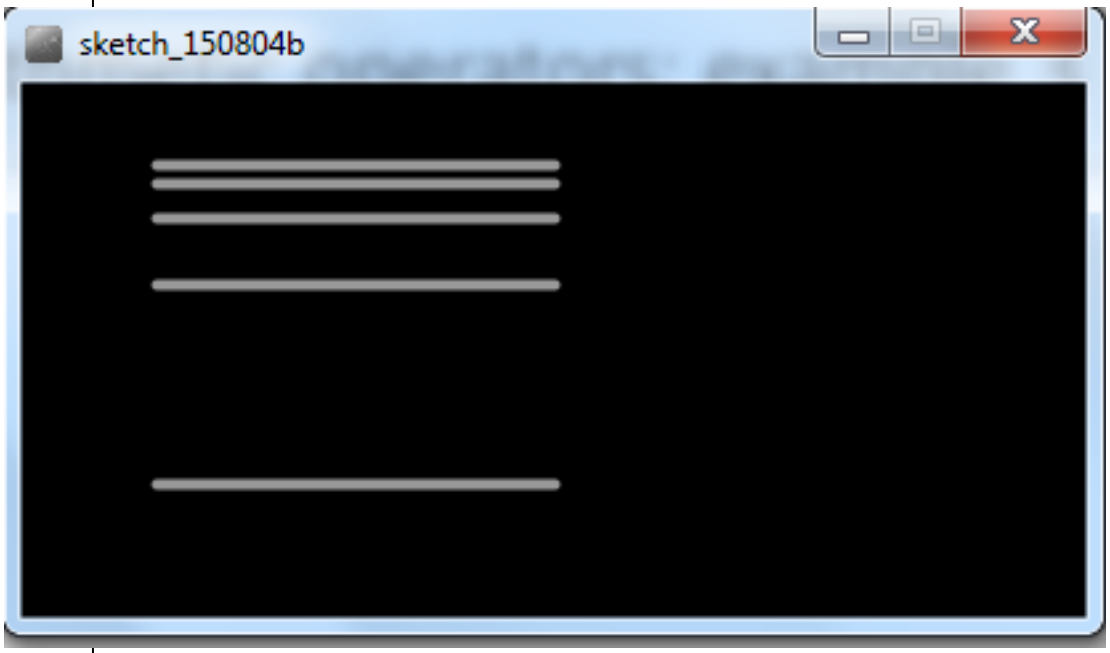
Arithmetic operators: Example 3.7

sketch_150804b

```
size(400, 200);
background(0);
stroke(153);
strokeWeight(4);

int a = 50;
int b = 1500;
int c = 4;

line(a, b/10, a*c, b/10);
line(a, b/20, a*c, b/20);
line(a, b/30, a*c, b/30);
line(a, b/40, a*c, b/40);
line(a, b/50, a*c, b/50);
```



Based on the Processing Example: Basics → Data → Variables

Arithmetic Operators

- If you want to keep track of how many times something happens, you are keeping a **running total** e.g.
  - The number of times you drew a line on the computer screen.
  - As each line is drawn, you add one to your counter variable.

Arithmetic Operators

```
int counter = 0;


void draw()
{
  line (mouseX, mouseY, 50,50);
  counter = counter + 1;
  println (counter);
}
```

Arithmetic Operators

- These examples are straightforward uses of the arithmetic operators.
- However, we typically want to do more complex calculations involving many arithmetic operators.
- To do this, we need to understand the **Order of Evaluation.**

Order of Evaluation

- Brackets ()
- Multiplication (*)
- Division (/)
- Addition (+)
- Subtraction (-)

BoMDAS

Beware My Dear Aunt Sally

Order of Evaluation - Quiz

What are the results of these calculations?

Q1:	3+6*5-2
Q2:	3+6*(5-2)
Q3:	(3+6)*5-2

Questions?

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