Constants

Quantity	Symbol	Value in our universe
Speed of light	c	299792458 m s^{-1}
Gravitational constant	G	6.673 $\times 10^{-11}$ m^3 kg^{-1} s^{-2}
(Reduced) Planck constant	$\hbar$	1.05457148 $\times 10^{-34}$ m^2 kg s^{-2}
Planck mass-energy	$m_{\mathrm{Pl}} = \sqrt{\hbar c/G}$	1.2209 $\times 10^{22}$ MeV
Mass of electron; proton; neutron	m_{e}; m_{p}; m_{n}	0.511; 938.3; 939.6 MeV
Mass of up; down; strange quark	m_{u}; m_{d}; m_{s}	(Approx.) 2.4; 4.8; 104 MeV
Ratio of electron to proton mass	β	$(1836.15)^{-1}$

Constants

A constant is a variable that you do not want to change (accidentally). This could be a real world constant or some kind of setting in your program.

```
final double PI = 3.14159;

final String VERSION = "v2.1";
```

Constants

The word final turns a variable into a constant. Typically, constants are written in ALL_CAPITAL_LETTERS using underscores between words.

```
final int SECONDS_PER_HOUR = 3600;

final int MAX_PLAYERS = 16;

final double DOLLARS_TO_EUROS = 0.89;
```

Constants

Eclipse will give you an error if you are trying to change the value of a constant (this is a good thing).

```
final int NUMBER_OF_PLAYERS = 16;

NUMBER_OF_PLAYERS = 5;
```

Constants

Use constants instead of “magic numbers” - it will be easier to change the settings of your program later.

No!

```
damage = level * 10.0;
gold = exp * 10.0;
```

Yes!

```
final double BASE_DAMAGE = 10.0;

damage = level * BASE_DAMAGE;
gold = exp * BASE_DAMAGE;
```

Comments

// Slides made by Carmine Guida

Comments

A comment is text that you add to your program to help (yourself) and others understand what your program does.

Comments are for humans to read.

Comments are ignored by the compiler (they do not end up in your final program anywhere).

Comments

There are two common types of comments: single-line and multi-line.

```
// A single line comment begins with two slashes

/*
   A multi line comment begins with slash and asterisk
   and does not end until it finds
   an asterisk and then a slash.
*/
```

Comments

Comments can be on a line by themselves, or after a statement.

```
/*
  Coded by: Carmine Guida
  Email: cguida@pace.edu
*/

area = PI * (r * r); // Area of a circle
```

Comments

Use comments to explain your thought process or what you are up to.
Do not use comments to teach someone how to program!

No!

```
total = total + 1;          // Add 1 to total
average = score / total;    // Divide score by total
```

Yes!

```
/*
  Calculate the average based on the total score and the
  number of tests taken.
*/
total = total + 1;
average = score / total;
```

Whitespace and Style

Whitespace and Style

Whitespace is the spaces, tabs and blank lines between statements.

No!

```
total=total+1;

int w=5;
int     length = 10;
```

Yes!

```
total = total + 1;

int w = 5;
int length = 10;


// Or something like this:

int w       = 5;
int length  = 10;
```

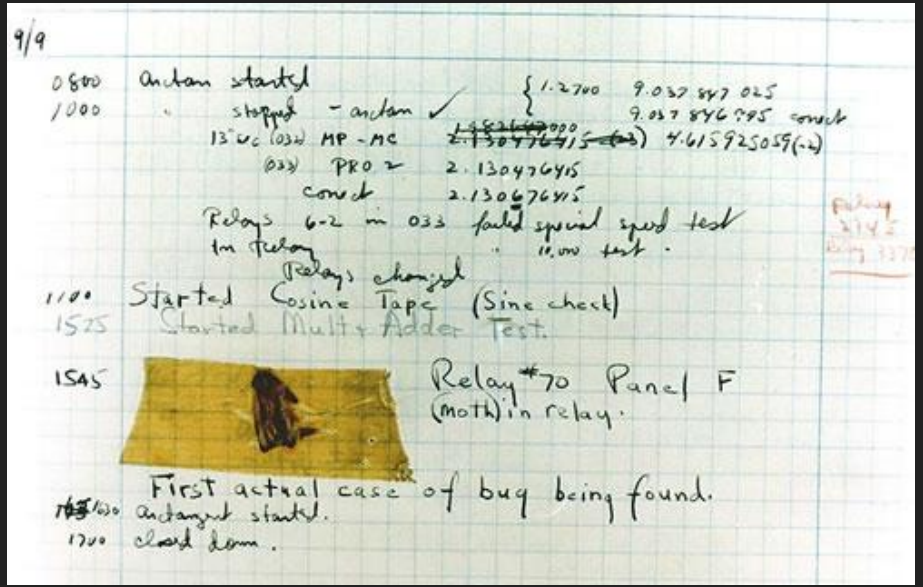
Debugging


MY CODE DOESN'T WORK
I HAVE NO IDEA WHY
MY CODE WORKS
I HAVE NO IDEA WHY

Debugging

While the term bug and debugging were used before computers existed, engineers working on a computer in Harvard in 1947 found a moth that was causing issues with a component in the system. The moth was taped into a logbook with a comment:

“First actual case of bug being found.”



Debugging

There are a couple of different methods for debugging and troubleshooting problems with your code.

```
// Print the value so far (and remove this later)
System.out.println("average = " + average);

// Force to a specific value (and remove later)
average = 90.5;
```

Use the **integrated debugger** (coming up in the demo).

Let’s Code

Don’t Forget!

Check the syllabus / schedule for reading assignments and due dates!

Type Conversions

```
int gpa = (int)average;
```

Type Conversions

You may need to convert from one data type (such as double) to another data type (such as int). We've seen implicit type conversions.

```
int x = 5;

// An (int / double) is converted into a double
System.out.println(x / 2.0);
```

Type Casting

A type cast explicitly converts from one datatype to another.

```
double total;

System.out.print("Total: ");
total = scan.nextDouble();

int x = (int)total;
```

Type Casting

You may want to use type casting to make sure a formula is behaving as expected.

```
int numberOfScores = 3;
double average = totalPoints / (double)numberOfScores;
int distance = (int)(totalSeconds * metersPerSecond);
```

Type Casting

When in doubt, add a type cast to be sure!

```
int x = 5;
int y = 2;

// No! z will be 2.0 (not 2.5)
double z = x / y;

// Yes! z will be 2.5
double z = (double)x / (double)y;
```

Overflow

1000000 * 1000000 = -727379968

Overflow

When storing (or printing values) some interesting things can happen when you try to go beyond the limits of the data type. For instance, int has a range of `-2,147,483,648 to 2,147,483,647`

```
int x = 2147483647;

System.out.println(x);                  // 2147483647
System.out.println(x + 1);              // -2147483648
```

Overflow

Eclipse is aware of the ranges of data types and will present an error if you are trying to initialize to a value that is out of range. However, it does not know about the math you are doing.

```
int x = 2147483648; // Shows an error here
int y = 2147483647;

y = y + 1;  // Does not know this is bad
```

Numeric Data Types

byte, short, int, long, float, double

Numeric Data Types

So far we have used int and double. There are some other numeric data types to know about.

```
byte        8 bits    -128 to 127
short      16 bits    -32,768 to 32,767
int        32 bits    -2,147,483,648 to 2,147,483,647
long       64 bits    -9,223,372,036,854,775,808
                          to 9,223,372,036,854,775,807
```

Numeric Data Types

You will typically use int and occasionally long (for when you need a number greater than 2 billion). For instance as an ID column in a database or a session number for users on a very active website.

If you are working on a simple computer such as a wearable or embedded system you may need to save on memory space and use the shorter data types such as byte and short.

Numeric Data Types

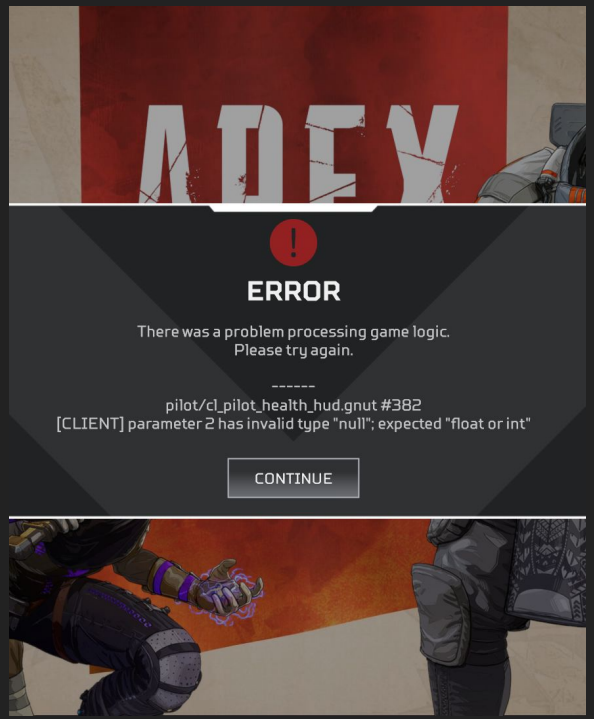
Double gets its name from being a double precision float.

`float`	`32 bits`	-3.4×10^{38} to $3.4 * 10^{38}$
`double`	`64 bits`	-1.7×10^{308} to $1.7 * 10^{308}$

Numeric Data Types

double is the default in Java when using decimal point numbers. You will mostly use double.

Why not use it all the time?
Many game engines will use the float data type for decimal numbers. Graphics cards only started supporting 64 bit floats (FP64) around 2014. When using double precision on graphics cards performance is 1/20th then that of floats!



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