Fundamentals

Question 1.1

Welcome to Learning C# with Unity

First, let us start with what exactly C# is, C# is a high-level language that is statically and strongly typed. C# was created by Microsoft in 2000 and is part of the C family of coding.

Now we understand the type of language that C# is we can continue to build on this knowledge. First, we are going to output a string to the console, however, if you run the code below, you will encounter errors, this is due to no semicolon being at the end of the statement meaning the compiler does not know this is the end of the statement. Building upon this, the correct spelling of functions and variables is paramount else the compiler does not know what you are referencing. There are two of these errors in the debug.log function, if you succeed in correcting them you should see ‘Hello World’ outputted on the right of your screen.

1. debug.log(“Hello World”)

**A statically typed language is one in which the type of a variable is known at compile-time instead of at run-time. An example of this would be having an integer value called 'num' this value always needs to be an integer and cannot change type to some other type like a float or a string.**

**A strongly-typed programming language is one in which each type of data (such as integer, character, hexadecimal, packed decimal, and so forth) is predefined as part of the programming language and all constants or variables defined for a given program must be described with one of the data types.**

**In C# there are 5 base variables which are then built upon to create more variables, these five variables are:**

1. **int – stores integer (whole numbers) values such as 123 or -123 and has a maximum value of 2147483647 and a minimum value of -2147483648**.
2. **double – stores floating point values such as 19.99 or -19.99 and doubles are accurate up to 16 decimal places.**
3. **char – stores single characters, such as 'a' or 'B'. Char values are surrounded by single quotes.**
4. **string –** **stores text, such as "Hello World". String values are surrounded by double quotes.**
5. **bool – stores values with two states: true or false**

**As mentioned earlier these are not the only variables within C#, as you can see int has a min and max value, if we exceed these values will we get errors in our program, to counter this a ‘long’ can be used. A long stores integer values just like the int but has a maximum and minimum value of 9,223,372,036,854,775,807 and -9,223,372,036,854,775,808 respectively.**

Question 1.2

Now we can output to the console, we can start building our knowledge. First, we are going to add to numbers together, this is done like real life, but the main difference is a variable is defined with an integer value before numbers can be added together. In C#, it would look like this.

1. int a = 5, b = 5, c;
2. c = a + b;

The code above would give us a result of 10, Try out the above code and see if you can find other ways of adding numbers together.

Question 1.3

Subtraction of integers works nearly the same as the addition of integers. In this lesson you will see a new technique of subtracting numbers which may also be used to add numbers.

Instead of subtracting two integers from one another, we could subtract by doing the following:

1. int a = 5;

2. a -= 5;

This code is saying that the new value of 'a' is equal to the current value of 'a' minus 5.

Try out the code and output the result to the console.

Question 1.4

Multiplication of integers works just like the real world; in C# we use the asterisk (\*) to represent a multiplication. Additionally, multiplication within C# has to follow the same PEMDAS system as the real world. For example, the following code would output a result of 30, this is because the multiplication is being done first and the compiler is calculating 5 + 25.

1. int a = 5 + 5 \* 5;

However, if we add a pair of parentheses around 5 + 5 to make the code look like this:

1. int a = (5 + 5) \* 5;

We would now get a result of 50 due to the compiler performing the operation in the parenthesis first.

Now we understand multiplication, try placing a pair of parentheses in this code so it no longer outputs 34 but instead outputs 64.

**PEMDAS is an acronym for Parentheses, Exponential, Multiplication, Division, Addition and Subtraction. In the United Kingdom this system may be know as BODMAS (Brackets, Orders, Division, Multiplication, Addition, Subtraction). Both systems can be used as the work the same and is to be used when there are two or more operations in a single expression.**

Question 1.5

The division of integers follows the same rules as the multiplication, in C# we represent a division with the forward slash (/). Division still follows the order of operation formally mentioned in the previous question. As there is not much more to say on division why not try solving the following equation so it so it no longer outputs -4 but now -1

1. int a = -2 \* 1 \* 4 - 2 / 2 + 6 + 2 - 3;

Question 1.6

The Modulus function is used to calculate the remainder between two integer values, this is donated in C# with the percentage sign, in code may look like this:

1. int a = (5 % 2);

This code above is checking how many times 2 can go into 5, which is two times with a remainder of one. If you were wondering how this is done, the compiler reads the above line using the following equation: a – ( a / b ) \* b. If we were to plug in our current numbers the equation would look like the following: 5 – ( 5 / 4 ) \* 4 and we would have a remainder of 1.

Although 5 / 4 will equal 1.25, as these are integers the value will always be rounded to the nearest whole value that is less than the original value, so in our case this is 1.

Run the following code and you will see that using the equation of the modulus will yield the same result.

Question 1.7

The addition and subtraction of floats works both the same as in real life and how we add integers together in the previous section, the only difference is a floating-point number needs an ‘f’ at the end of the number so the compiler knows that it is a floating-point number. However, there is a problem with using floats and that is due to then fact they are only accurate to, on average, eight decimal places. This is due to a float being stored using only 4 bytes and anything larger than this will give floating point errors.

If you run the following code the second answer will be incorrect, the answer should 0.2463574474 but due to the answer being stored as a float the last three decimal places are rounded to the 7th decimal place (or the eight bit).

Question 1.8

The modulus of floats is similar to the integer method but the equation now looks like the following:

|x| - n \* |y|

Where |x| and |y| are the absolute values of x and y, this means they need to be real numbers resulting in negative numbers being treated as positive and n the largest possible integer that is less than or equal to the value of |x| / |y|.

If you were to run the following code, you would see that the both methods do not produce the same result as the integer example and this is due to the second equation not rounding the float to a integer.

Question 1.9

In the first tutorial on floats it was shown that a float has limitations due to the size of a float only being 4 bytes. To get around this problem there are two other types that can be used for floating point numbers, these are doubles; which are 8 bytes long and are accurate up to 16-19 decimal places and decimals; which are 16 bytes long meaning they are accurate up to 28-29 decimals places.

Doubles and decimals work exactly the same as floats but the suffix is no longer ‘f’ at the end of the number but instead a ‘d’ for doubles and a ‘m’ for decimals.

Correct the following code so it outputs the example floating-point numbers correctly.

Remember, the suffix needs to match the variable type.

Question 1.10

Chars in C# are a variable type that are 16bits long, the reason for them being 16 bits is 216 is 65536 meaning a char can be any Unicode character. A char can only store one character at a time but chars can be added together to make longer words.

If you run the following code then ‘Hello World’ will be printed using chars.

Question 1.11

A string is a sequential collection of characters that is used to represent text. We have been using strings all the way through these tutorials. When we output text using Debug.Log it is being outputted as a string.

Strings are the next step from chars and are very powerful within programming. Due to strings being collections of characters they can be broken down into these characters, we can also look for specific words in strings but more will be spoke on this in upcoming tutorials.

When using strings in C#, we surround the text we want to be a string with quotation marks, “”, to tell the compiler that it is a string and not text to be ran by the compiler. E.g.

1. string a = “Hello World”;

For this tutorial, create a string called ‘s1’ that will output the following sentence to the console:

“The quick brown fox jumps over the lazy dog”.

Question 1.12

The amazing thing about strings is the ability to add them together, in programming we call this the concatenation of strings. The method of adding strings together works similar to adding numbers together, we just say “string 1” + “string 2” equals our new string.

Now it is your turn to try concatenate strings, add the following sentences together to create 1 string:

“The quick brown fox”

“jumps over the”

“lazy dog”

Make sure the spacing is correct, remember everything inside the quotation marks will be read as part of the string.

Question 1.13

Boolean variables will always return either true or false and this makes them extremely useful in programming. For example, if we want to check a collision in a video game, we check if the collision boxes have overlapped and if they have we can set a Boolean to true which then executes more code.

In C#, a Boolean variable would be defined as the following:

1. bool a = true;
2. bool b = false;
3. bool c;

If you run the following code you will get an output string out “It is not hot”, however, try changing the value of temp and see if the output changes.

Question 1.14

C# makes use of something called a ternary operator, sometimes called a conditional operator. As you saw in the previous tutorial we made use of ‘if’ statements, we won’t go into much detail until the next tutorial but for know all you need to know is if statements compare two or more variables and this is what the ternary operator does without the use of if statements. The ternary operator makes use of the ? (question mark) character and the : (colon) character, if you struggle to remember what they mean, just think of then ? as saying ‘if’ and the : as saying ‘else’.

A ternary operation may be written like the following:

1. bool isItHot = tempOutside <= 15 ? false : true;

The statement above is saying, if the value of tempOutside is less than 15, set the value of our boolean to false, if it is higher than 15, set the value to true.

Try running this code and you will see it works exactly the same as the other code but is another way of writing it and it also takes up less lines.

If Statements

Question 2.1

If statements make use of conditional logic to execute a block of code. This means that if the conditions within the if statement is met, any code within the next {} (curly brackets) will be executed.

Now you are probably wondering how we actually use if statements, well, this is done using conditional operators from mathematics, there are six of them and they are commonly know as relational operators:

1. Less than: a < b
2. Greater than: a > b
3. Less than or equal to: a <= b
4. Greater than or equal to: a >= b;
5. Equal to: a == b
6. Not equal to: a != b

Furthermore, we have six relational operators but we also have four boolean operators (sometimes called logical operators), to understand these operators a basic understand of logic gates is needed.

1. AND: a && b
2. OR: a || b
3. NOT: !a
4. XOR: a ^ b

There are 10 if statements, put the correct operator in each one to continue.

|  |  |  |
| --- | --- | --- |
| Inputs | | Output |
| a | b | a && b |
| 0 | 0 | 0 |
| 1 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 1 | 1 |

|  |  |  |
| --- | --- | --- |
| Inputs | | Output |
| a | b | a && b |
| 0 | 0 | 0 |
| 1 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 1 | 1 |

|  |  |
| --- | --- |
| Inputs | Output |
| a | !a |
| 0 | 1 |
| 1 | 0 |

|  |  |  |
| --- | --- | --- |
| Inputs | | Output |
| a | b | a ^ b |
| 0 | 0 | 0 |
| 1 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 1 | 0 |

Question 2.2

Else If statements work that same as a If statement but will be used when you want to try another block of code if the initial if statement does not meet the requirements to be executed.

1. if ( condition){
2. } else if (condition){
3. }

Add a ‘else if’ statement that will output the string, “b is less than a”, when the conditions are met.

Question 2.3

Else statements always come at the end of the block of if statements, there can only be one else statement with every if statement. This is due to the fact an else statement doesn’t have any conditions meaning it will only be used if none of the above conditions are met.

1. if(condition){
2. } else if(condition){
3. } else {
4. }

You may have noticed in the last tutorial that nothing is outputted to the console if the values are equal, add a else statement to the code that will output the string, “a and b are equal”.

Switch Statements

Question 3.1

Switch statements share some similarities with the previous if statements but can be a quicker way of executing code blocks. For example, if statements need to check each condition when executing while a switch statement checks itself once and looks for a match between value of the expression and the value of the case, if a match is found then the code is executed. In the editor window there is an example of a switch statement, they look complicated, but we will break it down now.

First, we define the switch with an expression, in this instance this is an integer called ‘num’. Next, the first case has an integer value of 1, if this matches the value of ‘num’ than the code is executed. Additionally, you may have noticed the ‘break’ at the end of each statement, this is to tell the compiler this is the end of this specific case, if the break is not included then the case will not run. Finally, the ‘default’ case can be thought of as the ‘else’ of switch statements, if no cases match the expression, then the default block of code is ran.

Question 3.2

For this test you need to create a switch statement that will output the name of the days of the week based of the value of ‘day’. The first one is done for you and remember to add a default statement that outputs the following string “What day is it?”

For Loops

Question 4.1

In C#, a ‘for’ loop is used when you want to loop through a specific block of code a certain number of times. For a ‘for’ loop to work it needs three statements to be executed:

1. for(statement 1; statements 2; statement 3)

In the editor window is an example of a for loop that loops 10 times and prints the value of our variable ‘i’, each time.

If we break down this for loop our first statement is the definition of a integer variable called ‘i’ that is set to zero, this is a very common way of creating for loops and you will continue to see ‘i’ be used in the create of for loops.

The second statement is a conditional statement that checks that the value of ‘i’ is less than ten and once ‘i’ is equal to ten the loop is stopped.

The third statement is incrementing the value of ‘i’, an increment is denoted using two plus signs not separated with spaces, ++, similarly a decrement is denoted in the same way but by using minus/hyphens, --. It is also worth noting that you can post-increment (i++) like shown in the tutorial, this will return the output of the code before ‘i’ is incremented while pre-increment (++i) will return the output of the code after ‘i’ is incremented.

Question 4.2

The Fibonacci sequence is a sequence in mathematics where you and the two previous numbers together to create the next number in the sequence. For example, the first 5 terms of this sequence is:

1. 0, 1, 1, 2, 3

If we breaks this down the first thing we are doing is 0 + 1, which gives us a result of 1, next we are doing 1 + 1 which gives us a result of 2, as you can see where this sequence is going.