The
little book of
programming
challenges

The following challenges are here to challenge and inspire you as well as help you on your journey to becoming a 'computational thinker'.

You may be set these as homework or in the classroom. Try to complete them to the best of your ability. If you can't write a successful solution don't worry, you are still learning from the attempt you have made.

Try to complete the extension exercises too whenever possible—extension doesn't mean 'optional'!

Writing programs can be frustrating - if you get stuck don't give up!

- Use the internet for help (but not the answer!)
- Use the help features of the programming development environment.
- Use features like break points and variable watches to try to work out what is happening if the program doesn't seem to work.
- Work with other students on the course—'two heads are better than one'
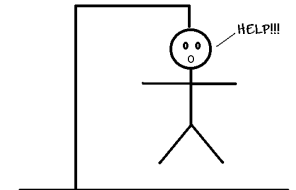
Challenge 26
CodeBreaker
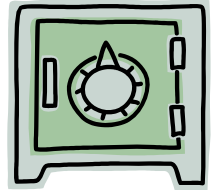
The computer generates a 4 digit code
The user types in a 4 digit code. Their guess.
The computer tells them how many digits they guessed correctly

Extension : the computer tells them how many digits are guessed correctly in the correct place and how many digits have been guessed correctly but in the wrong place.

The user gets 12 guesses to either win – guess the right code. Or lose – run out of guesses.

Challenge 27
HangMan

Player 1 types in a word

Player 2 has to guess the word in 5 lives

The display would look like this

Word to guess: ******
You have 5 lives left - Letter? E
Word to guess: **EE*E
You have 5 lives left - Letter? Z
Word to guess: **EE*E
You have 4 lives left - Letter?

Challenge 25
Remember Challenge 9?

Write a program that will generate a random playing card e.g. '9 Hearts', 'Queen Spades' when the return key is pressed.
Rather than generate a random number from 1 to 52. Create two random numbers – one for the suit and one for the card.

However we don't want the same card drawn twice. Update this program by using an array to prevent the same card being dealt twice from the pack of cards.

Convert this code into a procedure 'DealCard' that will display the card dealt or 'no more cards'.

Call your procedure 53 times!

Challenge 25 Extended
Blackjack.

Play a game that draws two random cards (see above).
The player then decides to draw or stick.

If the score goes over 21 the player loses (goes 'bust').
Keep drawing until the player sticks.

After the player sticks draw two computer cards. If the player beats the score they win.

Added complication : Aces can be 1 or 11! The number used is whichever gets the highest score.

Challenge 1

Write a program that will display a joke

Don't display the punchline until the reader hits the enter key.

Extension
display the punchline in a different colour

Prior Knowledge Needed

How to output information to the screen

Challenge 2

Write a program that will ask you your name

It will then display 'Hello Name' where 'Name' is the name you have entered.
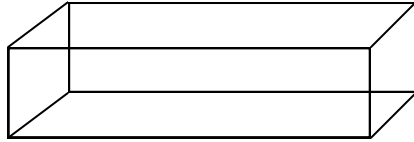**E.g.**
What is your name?
Ada
Hello Ada

Prior Knowledge Needed

How to create variables
How to input data into a variable
How to display variables

Challenge 3

Write a program to work out the areas of a rectangle.

Collect the width and height of the rectangle from the keyboard

Calculate the area

display the result.

Extension

display the volume of a cuboid.

See what happens when you don't type in numbers! – Try to explain what has happened and why

Prior Knowledge Needed

How to create variables
How to input data into a variable
How to display variables
How to perform basic mathematical calculations

Challenge 4

Write a program that will work out the distance travelled if the user enters in the speed and the time.

Extension
Get the program to tell you the speed you would have to travel at in order to go a distance within a certain time entered by the user.

Challenge 24
Create a program with the following record structure

Structure Results
> **HomeTeam as string**
> **HomeTeamScore as integer**
> **AwayTeam as string**
> **AwayTeamScore as integer**
End Structure

Make an array of 20 Results

Create a program with a menu whose options are
1. Add a result
2. Search for all results for a team

Write the code to carry out these two things.

If option 1 is selected
- collect the result and add it to the end of the results array

If option 2 is selected
- Collect team name
- display all the results that in includes that team in either the home or away team

Hint
Include a variable to store the current number of results

Prior Knowledge Needed

How to create record structures

Creating arrays of record structures

Iteration and selection

Challenge 22

Create a two-dimensional array of integers 10 by 10.

Fill the array with random numbers in the range 0 to 15

Display the array on the screen showing the numbers

Display the array on the screen as spaces whose BackColor property has been set to the number in this position of the array.

> **Prior Knowledge Needed**
>
> How to create 2D arrays
>
> Using nested loops

Challenge 23

Create a simple treasure hunt game.

Create a two-dimensional array of integers 10 by 10.

In a random position in the array store the number 1.

repeat

Get the user to enter coordinates where they think the treasure is.

If there is a 1 at this position display 'success'.

Until they find the treasure

Extension

Add a feature to say 'hot' 'cold' 'warm' depending on how close their guess was to the actual hidden location.

> **Prior Knowledge Needed**
>
> How to create 2D arrays

Challenge 5

Write a program to work out how many days you have lived for.

Agorithm

> Enter date of birth
>
> Get today's date
>
> Get the difference in days between the two dates
>
> Display result

Extension

Work out how many seconds you've lived for.

> **Hints**
>
> Use Date.Now to get today's date
> Use the date type for a variable to store your date of birth
> Use the datediff function to get the difference between two days

> **Prior Knowledge Needed**
>
> How to create variables
> How to input data into a variable
> How to display variables
> How to use system functions.
> How to use system variables

Challenge 6

Make a game for seeing how good people are at guessing when 10 seconds have elapsed.

Algorithm

Tell them to hit enter key when ready

Get the first time in seconds

Get them to hit the enter key when they think time has elapsed

Get the second time in seconds

Subtract first time from the second time

Tell them how close to 10 the answer was.

Hint

Use **Now.Second** - *To get the current time in seconds of the minute*

Extension

Sometimes this solution doesn't work. Can you work out why it doesn't work? Can you fix it?

Prior Knowledge Needed

How to create variables
How to input data into a variable
How to display variables
How to use system functions.
How to use system variables

Challenge 21

Write a program that will store names into an array.

As a new name is entered it will be added to the end of the array. The user can keep adding names until they enter the dummy value 'exit'

Once this has been done the program will display any duplicate names.

E.g.

Enter name: Bill

Enter name: Mary

Enter name: Anisha

Enter name: Mary

Enter name: exit

Mary is a duplicate.

Extension

Display how many times each name has been duplicated
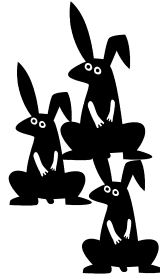

Prior Knowledge Needed

How to create a Nested FOR loop structure.

Using arrays

Challenge 20

Create a Fibonacci sequence generator. (*The Fibonacci sequence was originally used as a basic model for rabbit population growth*). The Fibonacci sequence goes like this.

0,1,1,2,3,5,8,13

The Nth term is the sum of the previous two terms. So in the example above the next term would be 21 because it would be the previous two terms added together (8+13).

You will need create a list of Fibonnaci numbers up to the 50th term.

The program will then ask the user for which position in the sequence they want to know the Fibonacci value for (up to 50).

E.g

Which position in sequence? 6   *(start counting at 0)*

Fibonacci number is 8

Hint

You will need to store the sequence in an array of Long (these numbers can get pretty big!)

Prior Knowledge Needed

How to create a FOR loop structure.

Using arrays

Challenge 7

Extend the program in Challenge 5 to make a game for seeing how quick people are at typing the alphabet.

Algorithm

    Tell them to hit enter key when ready

    Get the first time in seconds (and minutes)

    Get them to type in the alphabet and hit enter

    Get the second time in seconds (and minutes)

    Check they have entered the alphabet correctly

    If they entered it correctly then

      Subtract first time from the second time

      Tell them how many seconds they took

Hint

You'll need to store their attempt at the alphabet in a variable and compare with "abcdef..."

Extension

Keep a record of the best time achieved.

Deal with upper or lower case letters entered

Prior Knowledge Needed

As challenge 5 plus..
How to write an IF statement.

Challenge 8

Write a program that will accept someone's date of birth and work out whether they can vote (i.e. Are they 18?)

Prior Knowledge Needed

How to create IF statement.

Using the dateDiff function

Challenge 9

Write a program that will generate a random playing card e.g. '9 Hearts', 'Queen Spades' when the return key is pressed.
Rather than generate a random number from 1 to 52. Create two random numbers – one for the suit and one for the card.

Extension

Make a loop structure so playing cards can keep being generated

Prior Knowledge Needed

How to create IF or CASE statements with logical operators .

How to generate random numbers

Challenge 19 Continued...

The Ceaser algorithms may have fooled the Gauls but it doesn't take a genius to crack. So a much better algorithm would be one that has a different offset for every letter. We can do this using the random number generator—because it generates the same sequence of random numbers from a 'seed' position. As long as sender and receiver agree where to 'seed' (this will be the encryption key) they can both work out the same offsets.

Algorithm for encrypt function

function Encrypt(text, key)

    Randomize(key)

    For each letter in text

        Get its ascii code

        Add random offset **int(rnd()*10)** to ascii code

        Turn this new ascii code back to a character

        Append character to ciphertext string

    End for

    return ciphertext

end

Extension

Try to use a single function with an extra parameter to indicate whether the text is being encrypted or decrypted rather than having two different functions.

Prior Knowledge Needed
How to create IF statements.

How to create a condition controlled loop structure.
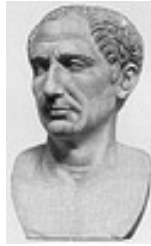
Using procedures and functions

String manipulation

Challenge 19

Write a program to perform a basic 'Ceaser' encryption and decryption on text.

This algorithm works by moving letters along by an 'offset'. If the offset is 2 then b —> d, h—>j etc.

Try to write two functions—One called 'encrypt' and one called 'decrypt'. Both will return a string.

The user selects whether the wish to encrypt or decrypt.

The user enters sentence to encrypt and the encryption key (i.e. How many we move the letters along—this is a smallish integer)

The program responds with the encrypted or decrypted version

Algorithm for encryption

Type in text

Type in encryption key

Display Encrypt(text, key)

function Encrypt(text,key)

    For each letter in text

        Get its ascii code

        Add the key to the ascii code

        Turn this new ascii code back to a character

        Append character to ciphertext string

    End for

    return ciphertext

end

Hints
To get a single character from a string of characters just add position in brackets after string name.
Text="Hello"
Text(0)="H"

Len(Text) or Text.length will give you the number of characters in string.

Challenge 10

Make a game of rock, paper scissors against the computer.

Algorithm

    Tell user to enter either rock,paper or scissors

    Get the response

    Generate a random number from 1 to 3 *(1=rock,2=paper, 3=scissors)*

    Compare user selection and computer selection

    Display who wins.

Hint

Don't forget to **randomize**!

Extension

Make sure the user enters a valid entry.

Add a loop structure to play several times and keep a running score

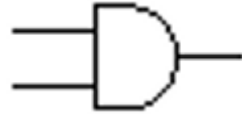Make an enumerated variable type to store choices.

Prior Knowledge Needed

How to create IF statements with logical operators (or nested Ifs)

How to generate random numbers

Challenge 11
Write a program that will give the students the answer to logic gate questions e.g.

Enter logic gate : OR

Enter first input : 1

Enter second input :0

Result = 1

It should work for the logic gates OR, AND and XOR

Extension

Include NAND and NOR gates

Prior Knowledge Needed
How to create IF statements using logical operators

Challenge 12
Write a program that will display all the factors of a number, entered by the user, that are bigger than 1.

(e.g. the factors of the number 12 are 6,4,3 and 2 because they divide into 12 exactly).

Hint

to find out whether a number X is a factor of Y use :

IF Y mod X =0 (there is nothing remaining when Y is divided by X)

Extension
Tell the user if the number they entered is a prime number

Prior Knowledge Needed
How to create IF statements

How to create a loop structure

Challenge 18
Write a procedure(sub) **drawstars** that will draw a sequence of spaces followed by a sequence of stars. It should accept two parameters—the number of spaces and the number of stars.

E.g

Drawstars(3,5) would produce

_ _ _ * * * * *   (_ indicates a space!)

Use your procedure to draw

```
  * * *

  * * *

   *

  * * *

* * * * * * *

  * * *

  *   *

 * *   * *
```

Prior Knowledge Needed
How to create procedures
How to use parameters

Extension

Now write a program using this procedure that will draw a pyramid whose base is a width specified by the user. E.g.

Enter base size of pyramid : 5

```
  *
 ***
*****
```

(assume the user has to enter an odd number)

Challenge 17

Write a **function** that will convert a UMS score into a grade. The function will return 'A'—> 'U'.

The function will require a parameter to do its job: the mark

The formula for AS level is >=80% —>'A', >=70%—>'B', >=60%—>'C' etc.

Assume the maximum module mark is 100

Having written the function we want to use it three times.

Write a program with the function that allows the user to enter two module AS scores and displays the grade. It then adds the two results together and displays the students overall grade. E.g.

Enter Module 1 result: 78

Enter Module 1 result: 67

Result

Module 1 : B

Module 2: C

AS Level : B

Extension

Allow a maximum mark other than 100. This will require the user to enter both the mark and maximum possible for that module. The function will also require the maximum mark in order to calculate the grade so another parameter will be needed.

> ***Prior Knowledge Needed***
> How to create functions
> How to use parameters

Challenge 13

Write a program for a game where the computer generates a random starting number between 20 and 30.

The player and the computer can remove 1,2 or 3 from the number in turns. Something like this...

Starting number : 25

How many do you want to remove? 3

22 left

Computer removes 2

20 left

The player who has to remove the last value to bring the number down to 0 is the loser.

1 left

Computer removes 1

You win!

Easy option

Get the computer to choose a number between 1—3 at random

Harder option

Get the computer to employ a strategy to try and win

> ***Prior Knowledge Needed***
> How to generate random numbers.
> How to create IF statements
>
> How to create a loop structure

Challenge 14

Write a program for a Higher / Lower guessing game

The computer randomly generates a sequence of up to 10 numbers between 1 and 13. The player each after seeing each number in turn has to decide whether the next number is higher or lower. If you can remember Brucie's 'Play your cards right' it's basically that. If you get 10 guesses right you win the game.

Starting number : 12

Higher(H) or lower(L)? L

Next number 8

Higher(H) or lower(L)? L

Next number 11

You lose

Hints

Use a condition controlled loop (do until, while etc) to control the game. Do not find yourself repeating the same code over and over!

You don't need to remember all 10 numbers just the current number /next number. Don't forget you'll have to keep a count of the number of turns they've had.

Extensions

Give the players two lives

Make sure only H or L can be entered

Prior Knowledge Needed
How to create IF statements.

How to create a condition controlled loop structure.

Challenge 15

Write a program to count the number of words in a sentence.

The user enters a sentence.

The program responds with the number of words in the sentence.

Hint

Look for spaces and full stops in the string.

Extension

Develop a program that will display a sentence backwards after entered.

Prior Knowledge Needed

How to use string manipulation functions
Using loops and selection

Challenge 16

Guess the number game.

The computer selects a random number between 1 and 100.

The user keeps guessing which number the computer has chosen until they get it right.

The computer responds 'got it' or 'too high' or 'too low' after each guess.

After the user has guessed the number the computer tells them how many attempts they have made.

Extension- Reverse the game. You think of a number. Get the computer to guess a number and you respond with too high(H), too low(L) or got it(G). Make sure the computer has a game plan—don't just let it guess at random!