

Level 1

Programming and Iterative Processes Course Notes

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1 Introduction

A Programming Language is a language, so it has:

- **Vocabulary**

Words that we (our culture) agree on the meaning of. If we don't know what the word means, we can use a dictionary. Dictionary definitions contain a definition (explanation of the meaning of the word) and often will include an example of how the word is used in a real situation.

Programming languages have documentation. This documentation is often quite hard to understand without experience, but many websites serve a similar purpose and give more accessible explanations.

- **Syntax**

A way of organising words so that a sentence makes sense. "The jump moon cow over" does not make sense but "The cow jumped over the moon" does.

We need to learn about how a programming language organises words so we can make it do what we want it to do.

- **Organisation systems**

A way of putting blocks of writing together. In writing we use sentences and paragraphs, in programming we have systems to keep sections of code together or apart.

Python uses tab stops as special part of its organisation system and more generally, programs will use things like functions and objects

Every program language will have an official documentation <https://docs.python.org/3/>

Understanding the documentation can be a challenge, but there are many other references and tutorial sites, such as <https://www.w3schools.com/python/>

2 Variables

Variables are “holders” of some data and are given a name, so that we can identify them and use them.

Quite often we use “my” in the name to make it clear that it is a variable.

We can output the value of the variables using a print statement.

```
1 my_number = 10
2 print(my_number)
3 my_next_number = 10.0
4 print(my_next_number)
5 my_new_number = "10"
6 print(my_new_number)
7
8 my_number = "ten" + "hello"
9 print(my_number)
```

Listing 1: Python example

```
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/first_class-1.py
10
10.0
10
tenhello
>>>
```

Output

If the variables are numbers (integers or floats), we can use basic mathematical operations with them (+ , - , * , /).

```
1 first_number = 12
2 second_number = 15
3 print(first_number + second_number)
4 print(first_number - second_number)
5 print(first_number * second_number)
6 print(first_number / second_number)
```

Listing 2: Python example

```
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/math_operations.py
27
-3
180
0.8
>>> |
```

Output

2.1 Variables – datatypes

If we have a number such as 41834567, this could mean the value of 41 million .. or it just be a string of letters, for example, a phone number.

A program must know what type the variable is.

In the case above (and for lots of other situation), Python makes a “best guess”. In stricter languages you have define what type the variable is.

```
1 my_number = 10
2 print(type(my_number))
3 my_next_number = 10.0
4 print(type(my_next_number))
5 my_new_number = "10"
6 print(type(my_new_number))
7
8 my_number = "ten" + "hello"
9 print(my_number)
```

Listing 3: Python example

```
Python 3.7.2 (v3.7.2:9a3ffc0492, Dec 24 2018, 02:44:43)
[Clang 6.0 (clang-600.0.57)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: /Users/Paul/Desktop/code_activities/first_class.py ======
<class 'int'>
<class 'float'>
<class 'str'>
tenhello
>>> |
```

Output

3 Inputs and Formatting

The user input is held by a variable (which will be a string)

To get user input, use the `input` command and the message that will be printed in the console goes , as a string, in the brackets.

We can combine the information in the `my_string` variable with another string , by using `.format`.

The variable referred to at the end is placed in the empty bracket.

Combining strings is called **concatenation**.

```
1 my_string = input("Please enter your name -> ")
2 my_output = "The name you have entered is {}".format(my_string)
3 print(my_output)
```

Listing 4: Python example

```
>>>
=RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/input_format_output.py
Please enter your name -> Harry
The name you have entered is Harry
>>> |
```

Output

It is a good idea to be able to control output formatting very confidently:

See https://www.w3schools.com/python/ref_string_format.asp

Experiment with the following to get an idea about what the `format` method can do

```
1 my_name = "Harry"
2 my_age = 13
3 my_output = "My name is {} and I am {} years old".format(my_name,my_age)
4 print(my_output)
5 my_output = "My name is {1} and I am {0} years old".format(my_name,my_age)
6 print(my_output)
7 my_output = "My name is {:^10} and I am {:>10} years old".format(my_name,my_age)
8 print(my_output)
9 my_number = float(2.671998761726172)
10 print(my_number)
11 print("{:.4f}".format(my_number))
12 print("{:010.2f}".format(my_number))
```

Listing 5: Python example

4 Commenting

When programs become more complex, it is helpful to write comments in the code.

Comments do not run in any way, they are just there for the programmer to read.

Comments are created by starting a line with a “#”.

Comments are **essential**

```
1 #initialise variables
2 my_name = "Harry"
3 my_age = 13
4 # print out variables in a sentence
5 my_output = "My name is {} and I am {} years old".format(my_name,my_age)
6 print(my_output)
7 # swap the order
8 my_output = "My name is {1} and I am {0} years old".format(my_name,my_age)
9 print(my_output)
10 # print the first one with 10 character spaces centre aligned
11 # and the second one 10 character spaces right aligned
12 my_output = "My name is {:^10} and I am {:>10} years old".format(my_name,my_age)
13 print(my_output)
14 my_number = float(2.671998761726172)
15 print(my_number)
16 # print decimal to 4 decimal places (not rounded)
17 print("{:.4f}".format(my_number))
18 # print in 10 character spaces with trailing zeroes and with 2 decimal places
19 print("{:010.2f}".format(my_number))
```

Listing 6: Python example

5 Casting

At times we need to change a data type and the most common situation is to turn a string into a number (float or integer) or to go the other way.

To do this we need to **cast** the variable to a new data type.

```
1 # declare two string variables
2 num_a = "123"
3 num_b = "456"
4
5 print(num_a + num_b)
6
7 # cast them as integers
8 num_a = int(num_a)
9 num_b = int(num_b)
10
11 print(num_a + num_b)
12
13 # this cast will produce a program error
14 # because the value cannot be turned into number
15
16 my_string = "Twelve"
17 my_string = int(my_string)
```

Listing 7: Python example

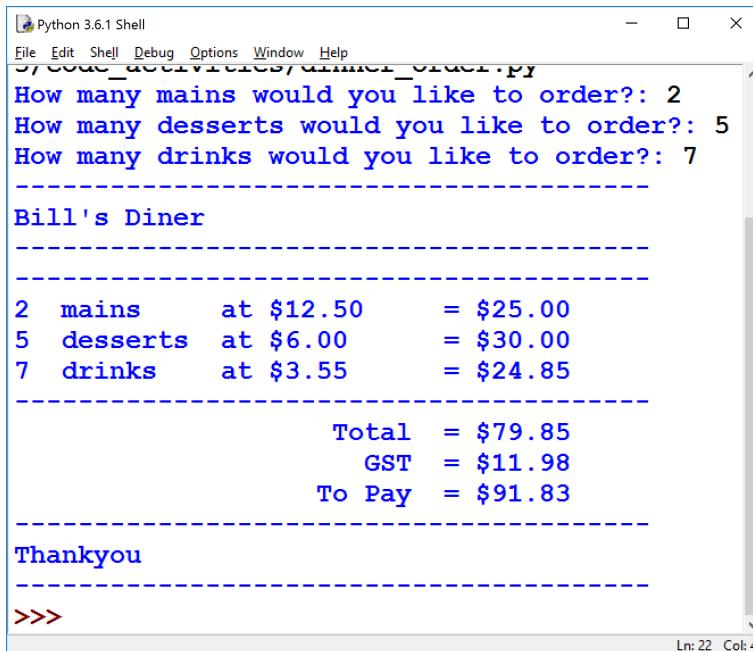
```
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/casting.py
123456
579
Traceback (most recent call last):
  File "/Users/khouripa/Documents/DTech/year11_2020/code_activities/casting.py", line 17, in <module>
    my_string = int(my_string)
ValueError: invalid literal for int() with base 10: 'Twelve'
>>>
```

6 Dinner Order - Basic Program - Design and Build

You need to create a program that allows a waiter to enter in the number of main meals (at \$12.50 each) , the number of desserts (at \$6.00 each) and the number of drinks (at \$3.55) ordered at a table.

The program then prints out a summary of the order, a total and then adds on GST (and gives the new total).

(Note: the program should be easy to alter so the price values should be declared as constant variables)



A screenshot of a Python 3.6.1 Shell window. The title bar says "Python 3.6.1 Shell". The menu bar includes File, Edit, Shell, Debug, Options, Window, Help. The file path in the title bar is "/Users/.../Desktop/dinner_order.py". The code in the shell window is:

```
How many mains would you like to order?: 2
How many desserts would you like to order?: 5
How many drinks would you like to order?: 7
-----
Bill's Diner
-----
2 mains      at $12.50      = $25.00
5 desserts    at $6.00       = $30.00
7 drinks      at $3.55       = $24.85
-----
      Total   = $79.85
      GST    = $11.98
      To Pay = $91.83
-----
Thankyou
-----
>>>
```

The status bar at the bottom right shows "Ln: 22 Col: 4".

An example of Dinner Order program run

6.0.1 Planning and Testing

Much of the planning work for a program is done on paper (and will need to be photographed and placed in a document)

The testing is done on the computer and is documented.

A basic idea of the process is given below (but we will expand on this as things go)

- **Breaking the problem down into components (or sub- problems):**

This means identifying the key things the program needs to do.

- **Writing Pseudo code**

This means sketching out in writing or diagrams how the code is going to be put together. (the writing should communicate how the code is going to work, but does not need to be the exact language)

- **Building and Trialling**

Build the program in stages and trial each stage as you go.

- **Assembled Outcome Testing**

Once you have got the program made, there needs to be some formal testing of it.

Errors need to be identified

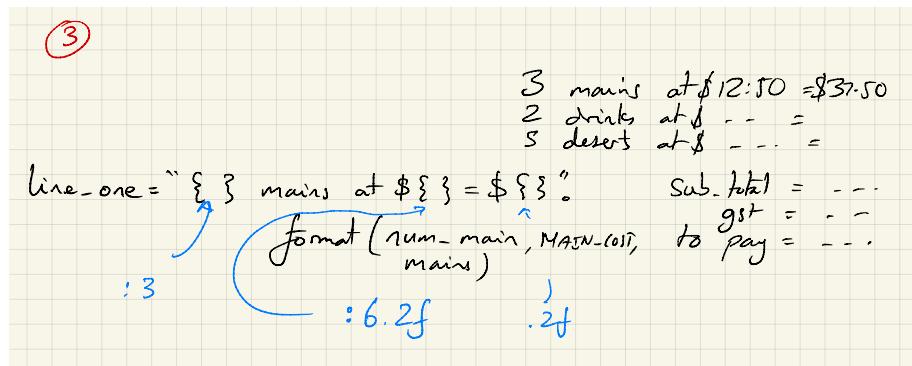
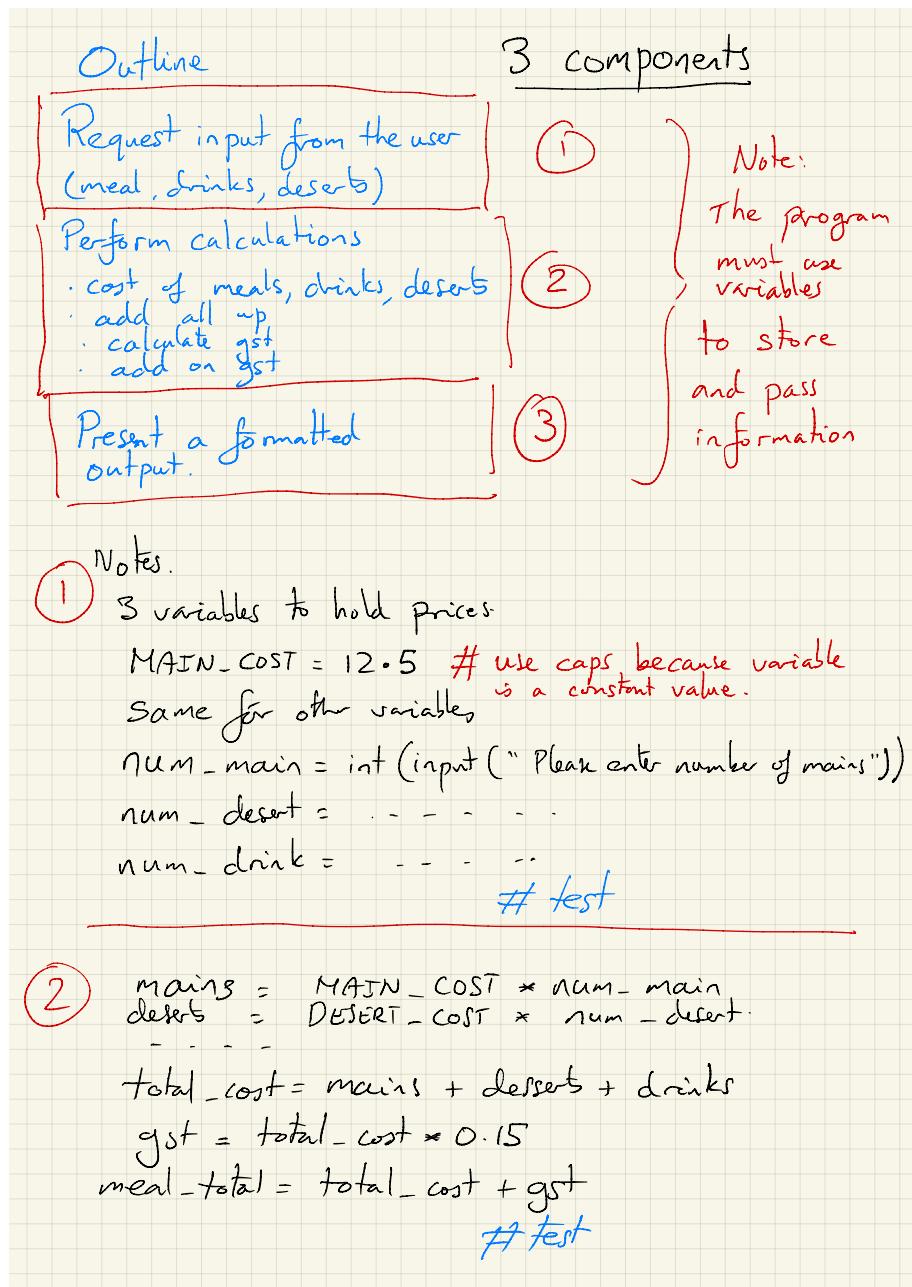
- **Usability Testing**

Ideally the program should be tested on some other user other than yourself

- **General Evaluation:**

A basic reflection

Examples of Component Planning



Basic Idea of Testing

When testing we consider

- Expected inputs (these are inputs we would normally expect the user to input).
Does the program give the right outputs with the given expected inputs.
- Boundary inputs (are there maximum or minimum value that the user can enter)
What happens at these boundaries (and if we go over them)
- Unexpected Inputs (these are character entries that we are not expecting)
These could be just pressing enter or having spaces , using letters instead of numbers or characters like * , & , etc.
These could occur if the user makes a mistake or misunderstands what is expected.

Testing should have some kind of plan and documentation of the results.

Testing dinner order. (Done once the program is made, or a version of it)		
Expected Input	Boundary Input (upper, lower limit)	Unexpected Input
How many mains ? 4	How many mains ? 30	How many mains ? Three
How many deserts ? 3	How many deserts ? 0	How many deserts ? *?
How many drinks ? 2	How many drinks ? -1	How many drinks ? ↳ space.
Expected output ?	Expected output ?	Expected Output ?
Actual output ?	Actual Output ?	Actual output ?
↳ is this okay ?	↳ is this okay ?	↳ is this okay ?

Result from expected

```
>>> 
= RESTART: /Users/Paul/Desktop/code_activities/tr
How many mains would you like to order?: 4
How many desserts would you like to order?: 3
How many drinks would you like to order?: 2
-----
Bill's Diner
-----
4 mains at $12.50 = $50.00
3 desserts at $6.00 = $18.00
2 drinks at $3.55 = $7.10
-----
Total = $75.1
GST = $11.26
To Pay = $86.36
-----
Thankyou
-----
>>> |
```

Result from boundary

```
>>> 
= RESTART: /Users/Paul/Desktop/code_activities/tr
How many mains would you like to order?: 30
How many desserts would you like to order?: 0
How many drinks would you like to order?: -1
-----
Bill's Diner
-----
30 mains at $12.50 = $375.00
0 desserts at $6.00 = $0.00
-1 drinks at $3.55 = $-3.55
-----
Total = $371.45
GST = $55.72
To Pay = $427.17
-----
Thankyou
-----
>>> |
```

Result from unexpected

```
type 'help', 'copyright', 'credits' or 'license()' for more information.
>>>
= RESTART: /Users/Paul/Desktop/code_activities/trinket/dinner_order_basic.py =
How many mains would you like to order?: Three
Traceback (most recent call last):
  File "/Users/Paul/Desktop/code_activities/trinket/dinner_order_basic.py", line 1
  3, in <module>
    mains = int(input("How many mains would you like to order?: "))
ValueError: invalid literal for int() with base 10: 'Three'
>>>
```

Evaluation

- What works
 - Works properly on expected inputs
 - Presentation of receipt clearly laid out on console.
- What could be improved
 - Should have an upper limit on how many meals can be entered
 - Should not allow entries below zero
 - Unexpected inputs cause a program crash
 - At the moment the program only runs once (so need a way to enter a new order)

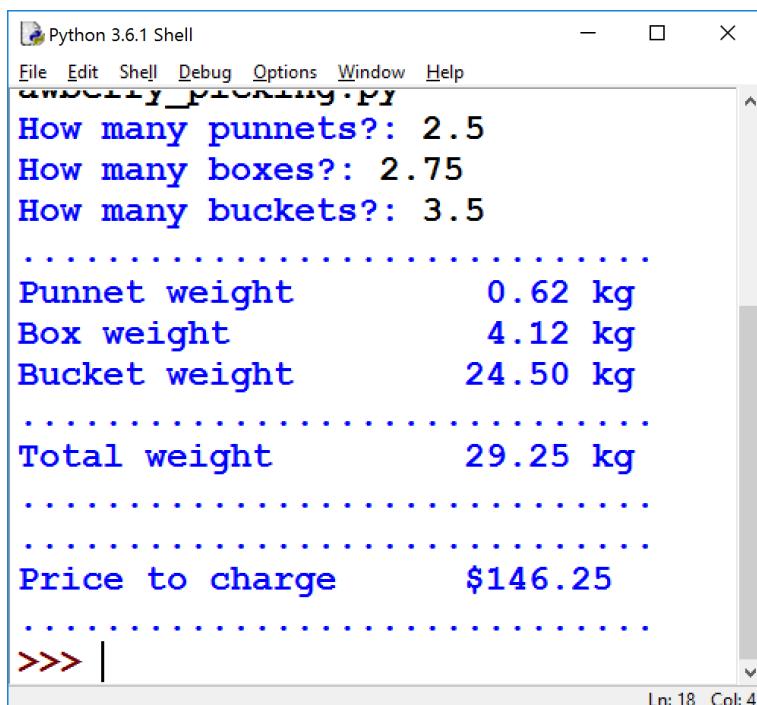
6.1 Strawberry picking

A strawberry farm lets families come and pick strawberries.

They can fill boxes, buckets or punnets (any combination).

- They charge a rate of 5 \$/kg.
- Full of strawberries, a punnet weighs 250 g, a box weighs 1.5 kg and a bucket weighs 7 kg.

Design a program that calculates the amount to be charged given a certain number of boxes, punnets and buckets have been picked.



The screenshot shows a Python 3.6.1 Shell window. The user has run a script named 'strawberry_picking.py'. The program prompts for the number of punnets, boxes, and buckets. It then calculates the weight of each type of container and the total weight. Finally, it calculates the price based on the total weight and the rate of 5 dollars per kilogram.

```
Python 3.6.1 Shell
File Edit Shell Debug Options Window Help
strawberry_picking.py
How many punnets?: 2.5
How many boxes?: 2.75
How many buckets?: 3.5
.
.
.
Punnet weight      0.62 kg
Box weight         4.12 kg
Bucket weight     24.50 kg
.
.
.
Total weight       29.25 kg
.
.
.
Price to charge   $146.25
.
.
.
>>> |
```

Ln: 18 Col: 4

An example of Strawberries program run

7 Conditions

The solutions to many programming problems require an action to occur only if a particular condition is true.

A condition can only result in true or false.

(These values are called Booleans. True and False are reserved words in the Python language. True and False are values / objects of type bool)

A condition often involves an expression which compares one value with another.

Comparisons between numerical values are made using the same comparison operators that are used in mathematics:

>	greater than
\geq	greater than or equal to
<	less than
\leq	less than or equal to

and the equality / inequality operators:

$= =$	equal to (the proper equals operator)
$! =$	not equal to

Boundary cases

Human languages are imprecise.

Does "every child over 5" mean "aged 5 and over" or "aged 6 and over"? The difference between \geq and $>$ is very important.

If you mean "every child aged 5 and over" you can express this as age > 4 or age ≥ 5 .

Any lack of clarity needs to be removed at the design phase. Always clarify before coding. The boundary cases are where errors in programming often occur.

Boundary cases are the values at and just outside the specified limits.

In the case "aged 5 and over" the specified limit is 5 and the age values of 4 and 5 are the boundary cases.

Only one condition can execute

```

my_variable = 89

# example 1
if my_variable < 90:
    print("{} is less than 90".format(my_variable))

#example 2
if my_variable < 89:
    print("{} is less than 89 ".format(my_variable))

#example 3
if my_variable < 89:
    print("{} is less than 89".format(my_variable))
else:
    print("{} is not less than 89".format(my_variable))

#example 4
if my_variable < 89:
    print("{} is less than 89".format(my_variable))
elif my_variable == 89:
    print("{} is exactly 89".format(my_variable))
else:
    print("{} is more than 89".format(my_variable))

```

Only one condition can execute

The code after the colon is “tabbed in” by 4 spaces.
The tabbed in code is what will run if the condition is met.

Running the code on pytutor : <http://www.pythontutor.com/visualize.html>

Python 3.6

```

1 my_variable = 89
2
3 # example 1
4 if my_variable < 90:
5     print("{} is less than 90".format(my_variable))
6
7 #example 2
8 if my_variable < 89:
9     print("{} is less than 89 ".format(my_variable))
10
11 #example 3
12 if my_variable < 89:
13     print("{} is less than 89".format(my_variable))
14 else:
15     print("{} is not less than 89".format(my_variable))
16
17 #example 4
18 if my_variable < 89:
19     print("{} is less than 89".format(my_variable))
20 elif my_variable == 89:
21     print("{} is exactly 89".format(my_variable))
22 else:
23     print("{} is more than 89".format(my_variable))

```

Print output (drag lower right corner to resize)

```

89 is less than 90
89 is not less than 89
89 is exactly 89

```

Frames Objects

Global frame
my_variable | 89

line that has just executed
next line to execute
Click a line of code to set a breakpoint; use the Back and Forward buttons to jump there.

<< First | < Back | Program terminated | Forward > | Last >>

```

1 age = 18
2
3 if age >= 18:
4     print("You are an adult")
5 else:
6     print("you are still a minor")
7 print(20*"-")
8
9 if age > 18:
10    print("You are an adult")
11 elif age == 18:
12    print("This is your first year as an adult")
13 else:
14    print("you are still a minor")
15 print(20*"-")
16
17 # True False (booleans)
18 flour = False
19 sugar = True
20 #grams (integer)
21 butter = 200
22
23 # nesting
24 if flour:
25     if sugar:
26         print("You have flour and sugar")
27     else:
28         print("You have flour but no sugar")
29 elif sugar:
30     print("You have sugar but no flour")
31 else:
32     print("Nothing in the cupboard")
33 print(20*"-")
34
35 # and or
36 if flour or sugar:
37     if butter > 250:
38         print("You should be able to make something")
39     else:
40         print("Low on butter")
41 else:
42     print("Out of dry ingredients")
43 print(20*"-")

```

Listing 8: Conditions Examples

7.1 Activities (conditions)

- a) Write a program that asks ‘What will the max temperature today?’

If the temperature is below 10° , print ‘Cold today’ , if between 10° and 20° , prints ’Regular Wellington day today’ and if over 20° prints ‘Hot today’.

Test table:

Test input	Expected output	Actual output

- b) Write a program that has a variable ‘allowance’ set to 5, and asks a ’Yes/No’ input , ‘Have your helped clean the kitchen?’,

If the user has, then add \$2.00 dollars to the allowance and if not add \$1.00 to the allowance.

Print out appropriate feedback.

Test table:

Test input	Expected output	Actual output

Extend this to include ‘Have your helped to put the garbage out?’.

If the user has done both add \$4.00 to the allowance, if they have done one of the two, add \$2.00 if none add \$1.00.

Test table:

Test input	Expected output	Actual output
-		
-		
-		
-		
-		
-		
-		
-		

- c) Using variables a, b, c in a program, each one is associated with an input asking to enter a number. Print out the minimum number. (Do not use Python's 'min' method , use conditional statements).

Test table:

Test input	Expected output	Actual output
-		
-		
-		
-		
-		
-		
-		
-		

- d) To go to university a person needs to be:

- over the age of 20
- or be 16 or older and have level 3 NCEA
- and (for both conditions) the person need to be competent with English.

Create a program that given the following variables:

age= 25

ncea = False

english = True

Will give a correct response about whether a person can go to university or not.

Do not worry about inputs , just test by changing the variables.

Test with other values. **Test table:**

Test input	Expected output	Actual output
-		
-		
-		
-		
-		
-		
-		
-		

7.1.1 Solutions

```
1 # temperature
2 temp = int( input("What will be the maximum temperature today? ") )
3 if temp <10:
4     print("Cold today")
5 elif temp < 20:
6     print("Regular Wellington day, today")
7 else:
8     print("Hot today")
9 print(20*"-")
10
11 # allowance
12 kitchen = input("Have you helped clean the kitchen (y/n) ? ")
13 allowance = 5
14 if kitchen == "y":
15     allowance += 2
16 else:
17     allowance +=1
18 output = "Your allowance is now ${:.2f} ".format(allowance)
19 print(output)
20 print(20*"-")
21
22 # allowance extended
23 kitchen = input("Have you helped clean the kitchen (y/n) ? ")
24 garbage = input("Have you helped put out the garbage (y/n) ? ")
25 allowance = 5
26
27 if kitchen == "y" and garbage == "y":
28     allowance += 4
29 elif kitchen == "y" or garbage == "y":
30     allowance += 2
31 else:
32     allowance +=1
33 output = "Your allowance is now ${:.2f} ".format(allowance)
34 print(output)
35 print(20*"-")
36
37 # minimum number
38 a = int( input("Please enter a number: ") )
39 b = int( input("Please enter a number: ") )
40 c = int( input("Please enter a number: ") )
41
42 if a < b and a < c:
43     print( "The minumum is {}".format(a) )
44 elif b < c:
45     print( "The minumum is {}".format(b) )
```

```
46 else:
47     print( "The minumum is {}".format(c) )
48 print(20*"-")
49 # university entrance
50 age = 17
51 ncea = True
52 english = True
53 # option 1
54 if english:
55     if age > 20 or (age > 16 and ncea):
56         print("Accepted")
57     else:
58         print("Not accepted")
59 else:
60     print("Not accepted")
61 print(20*".")
62 # option 2
63 if english and ( age > 20 or (age > 16 and ncea)) :
64     print("Accepted")
65 else:
66     print("Not accepted")
```

Listing 9: Worksheet Solutions

8 Random numbers

Random numbers are particularly useful for games and quizzes as they mean that the program will not always do things in the same order.

To get random numbers we need to import a **library** that handle random numbers.

Python has a large number of libraries that extend the functionality of the programming language.

```
1 # import the random number library
2 import random
3
4 #random number between 0 and 1
5 print(random.random())
6
7 # random number between two integers (inclusive)
8 print(random.randint(2,5))
9
10 # random number between two integers (inclusive)
11 # but with a step value (in this case will only get multiples
12 #of 5
13 print (random.randrange(0, 101, 5))
14
15 # create a list and randomly select a name from it
16 myList = ["Anna", "Michael", "Sarah", "Jessie"]
17 print(random.choice(myList))
```

Listing 10: Python example

9 Program using conditions and random numbers

9.1 Higher Lower

This program is very simple (because we don't have loops yet), but makes a useful base for future development.

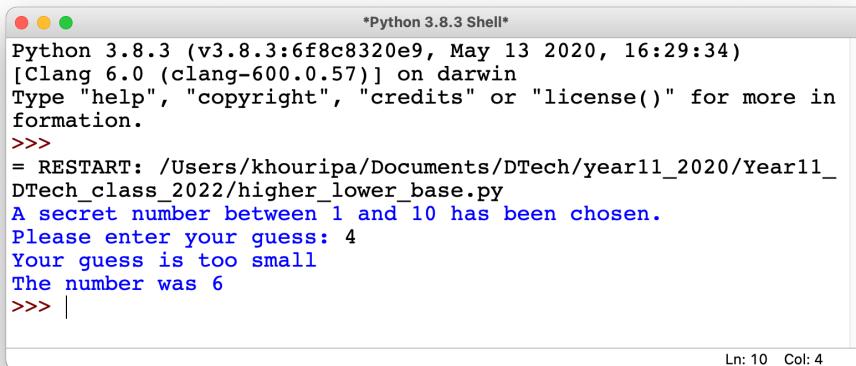
- Create a program that :

Generates a random number between two integers.

- It asks the user to guess the number
- It then gives feed back about whether their guess is too small or too large or correct.

- Planning and Testing

- Write a psuedo code outline
- When the program is made, create and complete a test table (introduce a small modification to the program to help you test it) .



The screenshot shows a terminal window titled "Python 3.8.3 Shell". The window displays the following text:

```
*Python 3.8.3 Shell*
Python 3.8.3 (v3.8.3:6f8c8320e9, May 13 2020, 16:29:34)
[Clang 6.0 (clang-600.0.57) on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/Year11_
DTech_class_2022/higher_lower_base.py
A secret number between 1 and 10 has been chosen.
Please enter your guess: 4
Your guess is too small
The number was 6
>>> |
```

At the bottom right of the terminal window, it says "Ln: 10 Col: 4".

An example of higher lower program run

Testing			
	Input	Random	Result
import random module	6	4	Too high
declare two variables to hold minimum and maximum values	7	2	Too high
min_num = 1		1	
max_num = 10			
create secret random number.	2	3	Too Low
secret_num = random.Integer(min.., max..)	5	5	You got it!
Testing reset secret num = ...			
Print task explanation			
request user input guess = int(input(-1))			
check =			
if guess < secret_num			
print too small			
elif guess > secret_num			
print too big			
elif: guess == secret_num			
print You got it!			
else:			
print ("Program Error")			
print print secret number for test purposes			

Pseudo code and test grid

```

1 import random
2 min_num = 1 # set min max boundaries
3 max_num = 10
4 secret_num = random.randint(min_num, max_num) # generate number
5 output = "A secret number bewteen {} and {} has been chosen.".format(min_num,
   max_num)
6 print(output)
7 guess = int( input("Please enter your guess: ") )
8 # check user guess
9 if guess < secret_num:
10     print("Your guess is too small")
11 elif guess > secret_num:
12     print("Your guess is too large")
13 elif guess == secret_num:
14     print("You guessed it!")
15 else:
16     print("Error")
17 # testing
18 output = "The number was {}".format(secret_num)
19 print(output)

```

Listing 11: Python example

10 Loops

Often we want the program to repeat some kind of operation or to repeatedly run a section of code.

To do this we use loops.

There are **for** loops and **while** loops and we will focus on the while loop.

This while loop uses a counter to know how many times to run.

```
1 # loop with a counting condition
2 counter = 0
3 while counter < 30:
4     print("inside counter loop and counter value is {}".format(counter) )
5     # add one to the counter variable
6     counter += 1
7
8 # once the counter gets to 30 the loop stops and the resto of the program runs
9 print("Have now finished the loop")
```

Listing 12: Python example

```
inside counter loop and counter value is 0
inside counter loop and counter value is 6
inside counter loop and counter value is 7
inside counter loop and counter value is 8
inside counter loop and counter value is 9
inside counter loop and counter value is 10
inside counter loop and counter value is 11
inside counter loop and counter value is 12
inside counter loop and counter value is 13
inside counter loop and counter value is 14
inside counter loop and counter value is 15
inside counter loop and counter value is 16
inside counter loop and counter value is 17
inside counter loop and counter value is 18
```

Section of the output

```
1 # the condition
2 name = "Jessie"
3 while name == "Jessie":
4     print("inside the loop")
5     name = input("Please enter name: ")
6
7 print("have now left the loop")
```

Listing 13: Python example

```

>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/loop_condition.py
inside the loop
Please enter name: Jessie
inside the loop
Please enter name: Jessie
inside the loop
Please enter name: Bob
have now left the loop
>>> |

```

```

1 continue_program = True
2 while continue_program == True:
3     print("This where the program runs")
4     # as if user wants to run the program (or part of it) again
5     user_response = input("Would you like to play again? (Y/N) - > ")
6     if user_response == "Y":
7         print("Here we go again")
8     elif user_response == "N":
9         print("Thankyou for playing")
10    continue_program = False
11 else:
12     print("Your input was not recognised (and we should do something about
13     this)")
14 print("The program has ended")

```

Listing 14: Python example

```

= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/loop_continue.py
This where the program runs
Would you like to play again? (Y/N) -> Y
Here we go again
This where the program runs
Would you like to play again? (Y/N) -> Y
Here we go again
This where the program runs
Would you like to play again? (Y/N) -> Y
Here we go again
This where the program runs
Would you like to play again? (Y/N) -> j
Your input was not recognised (and we should do something about this)
This where the program runs
Would you like to play again? (Y/N) -> k
Your input was not recognised (and we should do something about this)
This where the program runs
Would you like to play again? (Y/N) -> N
Thankyou for playing
The program has ended

```

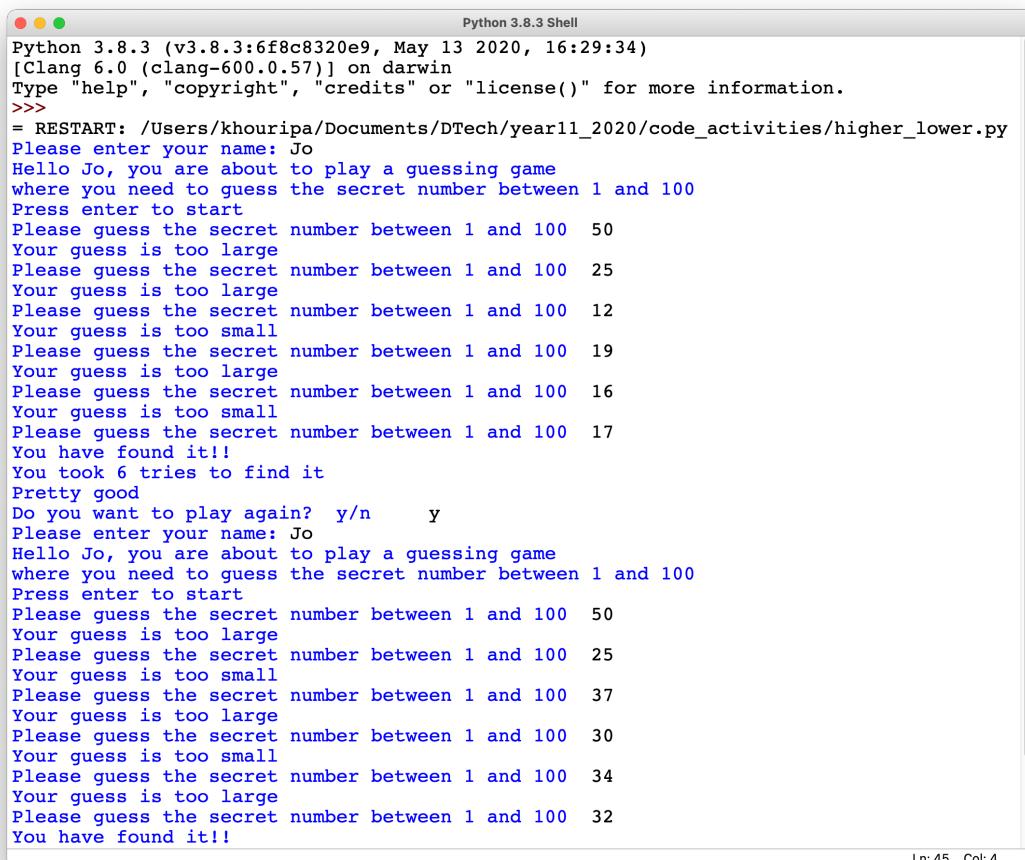
10.1 Activities - improving previously made programs

Take the Dinner Order and/or the Higher Lower Program (make min = 1 and max = 100) and make a new version so that they can run more than once.

There is now considerable scope for extension:

Consider:

- Dinner order prints out total cost of all orders when the program finishes (and/or total mains, deserts, drinks ordered)
- Higher Lower feeds back the number of guesses that the user took to find the number.
- Higher Lower, user could choose number of guesses that they need



The screenshot shows two separate sessions of a Python script named `higher_lower.py`. In the first session, the user enters their name as "Jo". The program then asks for a secret number between 1 and 100 and starts a guessing loop. The user's guesses are 50, 25, 12, 19, 16, and 17, with feedback indicating they are too large or too small. Finally, the user finds the number after 6 tries. In the second session, the user again enters "Jo" and starts another guessing loop. The user's guesses are 50, 25, 37, 30, 34, and 32, with feedback indicating they are too large or too small. Both sessions end with the message "You have found it!" and "Pretty good".

```
Python 3.8.3 (v3.8.3:6f8c8320e9, May 13 2020, 16:29:34)
[Clang 6.0 (clang-600.0.57)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/higher_lower.py
Please enter your name: Jo
Hello Jo, you are about to play a guessing game
where you need to guess the secret number between 1 and 100
Press enter to start
Please guess the secret number between 1 and 100 50
Your guess is too large
Please guess the secret number between 1 and 100 25
Your guess is too large
Please guess the secret number between 1 and 100 12
Your guess is too small
Please guess the secret number between 1 and 100 19
Your guess is too large
Please guess the secret number between 1 and 100 16
Your guess is too small
Please guess the secret number between 1 and 100 17
You have found it!!
You took 6 tries to find it
Pretty good
Do you want to play again? y/n      y
Please enter your name: Jo
Hello Jo, you are about to play a guessing game
where you need to guess the secret number between 1 and 100
Press enter to start
Please guess the secret number between 1 and 100 50
Your guess is too large
Please guess the secret number between 1 and 100 25
Your guess is too small
Please guess the secret number between 1 and 100 37
Your guess is too large
Please guess the secret number between 1 and 100 30
Your guess is too small
Please guess the secret number between 1 and 100 34
Your guess is too large
Please guess the secret number between 1 and 100 32
You have found it!!
```

Greater less equal, with loop and betting

```
import random
```

```
# declare variables
```

```
name = ""  
secret-number = 0  
guess = 0  
count = 0  
MIN-NUM = 1  
MAX-NUM = 100
```

} ← to be updated
] ← constants

```
get user name  
print game instructions.
```

```
start main program loop
```

```
Secret-num = random num
```

```
press start to play
```

```
reset count to zero
```

```
start question loop
```

```
guess = user guess
```

```
if guess < secret-num :
```

```
    too small
```

```
elif guess > secret-num :
```

```
    too large
```

```
elif guess == secret-num :
```

```
    correct !
```

```
    end loop
```

```
else : program error
```

```
# loop ends.
```

```
print feedback
```

```
if count < 6
```

```
    great
```

```
elif count < 8
```

```
    pretty good
```

```
else
```

```
    do better
```

```
play again ?
```

```
yes → let main run again
```

```
no → end main loop
```

```
print (Program has ended).
```

```

1 import random
2
3 #declare variables
4 name=""
5 secret_number=0
6 guess=0
7 count=0
8 MIN_NUM = 1
9 MAX_NUM = 100
10
11 #get user input and validate
12 name=input("Please enter your name: ")
13 # welcome
14 print("Hello {}, you are about to play a guessing game".format(name))
15 print("where you need to guess the secret number between {} and {}".format(
    MIN_NUM ,MAX_NUM))
16
17 mainLoop="y"
18 while mainLoop=="y":
19     #generate secret number
20     secret_number=random.randint(MIN_NUM ,MAX_NUM)
21     #testing help
22     #print("Testing help: the secret number is {}".format(secretNumber))
23     ready=input("Starting new game, press enter:")
24     #----- start game
25     # reset count
26     count=0
27     question_loop="y"
28     while question_loop == "y":
29         guess=int( input("Please guess the secret number between {} and {}: ".format(MIN_NUM , MAX_NUM) ) )
30         #respond to input
31         if guess<secret_number:
32             print("Your guess is too small")
33         elif guess>secret_number:
34             print("Your guess is too large")
35         elif guess == secret_number:
36             #number is found, end loop and print responses
37             print("You have found it!!")
38             question_loop ="n"
39         else:
40             print("Program error")
41         # add to question count
42         count=count+1
43     # ----- end of loop
44
45     print("You took {} tries to find it".format(count))

```

```
46 if count<5:
47     print("You are really fast")
48 elif count<7:
49     print("Pretty good")
50 else:
51     print("You can improve, I think")
52 mainLoop=input("Do you want to play again? (y/n): ")
53 #---- exited main loop
54 print("Thankyou for playing")
55 print("The program has ended")
```

Listing 15: Python example

10.2 Higher Lower Game

```
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/higher_lower.py
Please enter your name Paul
Hello Paul, you are about to play a guessing game
where you need to guess the secret number between 1 and 50
Testing help: the secret number is 37
Press enter to start
Please guess the secret number between 1 and 50 25
Your guess is too small
Please guess the secret number between 1 and 50 37
You have found it!!
You took 2 tries to find it
You are really fast
Do you want to play again? y/n  n
The program has ended
>>>
```

10.2.1 Program

Scenario:

You have a younger family member who loves the ‘higher / lower’ game so you decide to make a game that they can play whenever they want.

Your game should:

- Ask for the user’s name (and address them by their name)
 - Generate a ‘secret’ number between 1 and 100 and then ask the user to guess the number.
 - Tell the user if their guess is ‘too high’ or ‘too low’.
 - Then asks them to guess again (until they find the number)
 - If the user correctly guesses the number, the game should congratulate them.
 - Tell the user how many goes it took them to guess the number.
 - If they don’t guess the number in 10 goes, they should be told that they have lost the game and the mystery number should be revealed.
-

Improvements:

(do not worry about these until you have completed the main requirements):

Create small test programs to work out how to solve the problem before you include them in your next program version.

- Allow the user to choose the lowest and highest number that will be used to generate the secret number between.

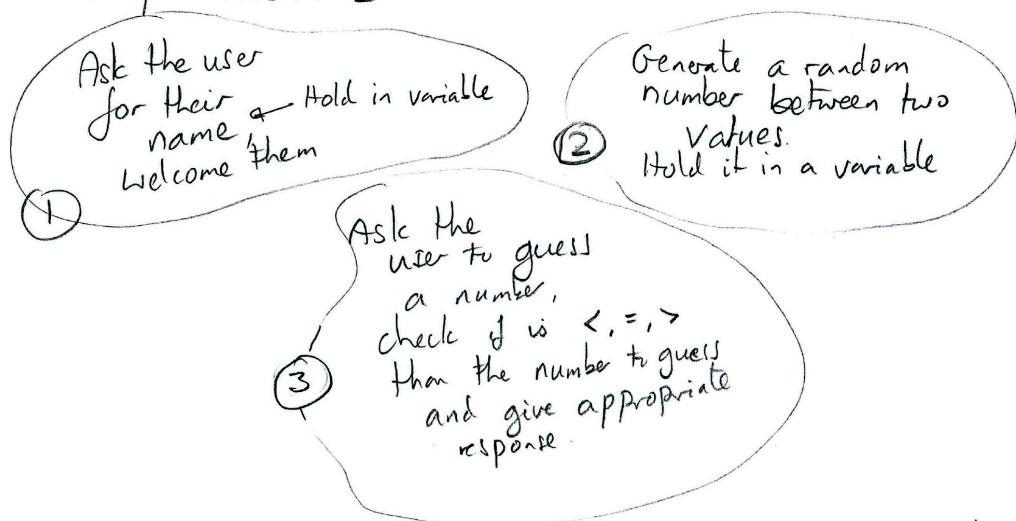
- Ideally the game should be set up so that users can't guess the same "wrong" number twice
()This will require collecting a list of the guessed numbers).
 - Either allow the user to choose the number of guesses or set a sensible limit based on the difference between the highest and lowest number.
 - Keep track of the number of rounds played and the user's scores.
 - Improve the **usability** of the game by **validating** the user entry to make sure that it is appropriate.
-

10.2.2 Planning, Developing, Testing

- **On paper** you need to break the big problem of making the program into a set of smaller sub-problems
 - If a problem looks tricky or there may be more than one way to solve it, you should make small test programs
- Sketch out psuedo code for the main things you are going to make
(ideally before you make it :))
- Don't create the program all in one go, build the simplest **version** you can.
 - Then test it and then plan and build the next version.
 - After each version you should make some simple notes about what works, what could be improved , what the aim for the next stage is.
 - Then plan, build and test the next **version**
 - Repeat this process to **iteratively** develop the program.

Paper Planning for Higher Lower Game.

- Main subproblems/components of a simple version 1.



Build in steps to get



Test

Gives version 1.

- Next level

Subproblem.

Be able to
Repeat the guessing process.

keeping doing the guessing requires a loop

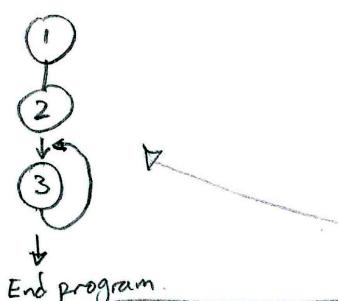
Loop conditions

what is needed for the loop

to run → The user has not guessed correctly

→ The user has not guessed 10 times.

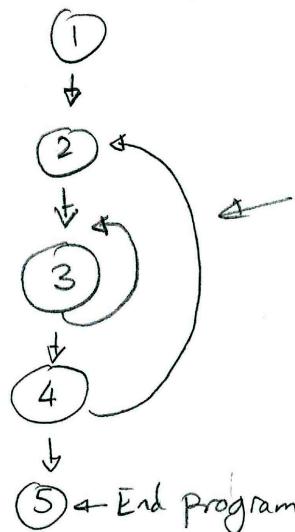
Version 2



Test

- Next level Subproblem.

Be able to repeat the whole game



outer loop that holds
whole main part of
the program.

Ask the user if they want
to play again
Ask for yes or no input
and evaluate this whether
to stop the program or
not.

Version 3

Test

Next level subproblem
improve the user experience

- Make sure the user has entered an appropriate name. If they make a mistake (e.g. press <enter>) ask them to enter again.
- Make sure the user enters an appropriate number (not below the smallest number, not above the highest number).

Make sure the number is a number (5 rather than "Five").

Version 4

Test

11 Functions

Functions allow us to package up blocks of code in a separate place and re-use them whenever we need them.

- A function is made using the “def” statement
- It is then given any logical name (no spaces, no numbers in the name)
- A function has values that can be given to it. These are placed as variable names in the round brackets after the name.
- we can then use these values “inside” the function
- the function can be “called” (made to do its thing) by writing the function name in the main body of code (with values)
- functions can send values back to the main part of the program using the “return” statement.

```
1 def adding(X,Y):  
2     A = X  
3     B = Y  
4     C = X + Y  
5     output = "{} + {} = ".format(A,B)  
6     answer = int(input(output))  
7     if answer == C:  
8         print("answer is correct")  
9     else:  
10        print("Sorry, the answer was {}".format(C))  
11  
12 def subtracting(X,Y):  
13     A = X  
14     B = Y  
15     C = X - Y  
16     output = "{} - {} = ".format(A,B)  
17     answer = int(input(output))  
18     if answer == C:  
19         print("answer is correct")  
20     else:  
21        print("Sorry, the answer was {}".format(C))  
22  
23 def multiplying(X,Y):  
24     A = X  
25     B = Y  
26     C = X * Y  
27     output = "{} {} {} = ".format(A,chr(215),B)
```

```

28     answer = int(input(output))
29
30     if answer == C:
31         print("answer is correct")
32     else:
33         print("Sorry, the answer was {}".format(C))
34
35
36
37
38
39
40
41
42
43
44
45
46 # calling the functions
47 # we can do this as often as we like with lots of different values
48 adding(70, 30)
49 subtracting(70, 30)
50 multiplying(80, 40)
51 dividing(80,40)

```

Listing 16: Functions

70 + 30 = 80
Sorry, the answer was 100
70 - 30 = 40
answer is correct
80 × 40 = 3200
answer is correct
80 ÷ 40 = 3
Sorry, the answer was 2.0
>>>

Functions output

11.1 Developing the maths functions into a little quiz

Idea 1:

- The quiz asks 4 maths questions and at the end gives the number correct (the score) and the number of questions asked

Idea 2:

- (A loop would be nice.)

Just using the adding function, the quiz asks 5 questions, and the numbers in the addition are randomly chosen.

The score is printed out as well as the total number of questions.

Idea 3:

- The quiz asks 6 questions. Whether it will be a addition, subtraction, multiplication or division question is randomly chosen.

12 Validation

When a user is making an input they may make an error and enter an **invalid** input.

This is an input that the program is not expecting:

Examples include:

- Entering a string instead of a number (such as “Two” or “Tracy” when the program is expecting an integer or float).
- Entering nothing or a single letter , when the program wants a full name.
- Entering a letter “outside of bounds” (For example: the program expects one of A,B,C,D and the user enters F)
- Entering a number outside of bounds (For example, the program expects a number between 1 and 10 and the user enters 11).
- The program expects a single letter (“y” or “n”), but is given a word (“Yes”, “No”).
- The program expects a capital letter (“A”) and is given a lower case letter (“a”).

Some of these entries can cause a program crash or just lead to poor “performance” of the program (for example: rejecting a user entry when what the user intended was valid).

The aim is always to make the program perform as well as possible and to be **User Friendly**.

To manage this **Usability** we need to **Validate** the user input.

This means one or both of two things:

- If the user input is invalid, communicate the problem to the user and ask the user again for the entry
- Evaluate and possibly alter the user entry, so that its meaning is not changed but that it is formatted in a way that program expects. (An example of this is changing “A” to “a”. In this case the user does not need to be informed)

12.1 Integer Validation

Consider an input request “How many hamburgers would you like to order?”

- We would expect this to be an integer with a value of 0 or more.
- Most likely we would like to “operate” on this later in the program (for example: multiply it by the cost of the hamburger to get a total price)

The input is always read as a string, so we need to cast the input to an integer.

```
1 hamburger_price = 7.5
2 #note the casting int(      ----      )
3 #this converts the string input to an integer
4 num_burgers = int(input("How many hamburgers would you like? -> "))
5
6 total_cost = num_burgers*hamburger_price
7 print("Please pay ${:.2f}".format(total_cost))
```

Listing 17: Python example

This works properly assuming the user enters a valid input.

This assumption is not good enough, and we need to deal with situations like the user entering <Enter> or 3.5 or “six”.

If they do, we get a program crash: To manage integer casting, we need a “try except” statement.

```
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/validation_int_2.py
How many hamburgers would you like? -> 3.5
Traceback (most recent call last):
  File "/Users/khouripa/Documents/DTech/year11_2020/code_activities/validation_int_2.py", line 4, in <module>
    num_burgers = int(input("How many hamburgers would you like? -> "))
ValueError: invalid literal for int() with base 10: '3.5'
>>>
```

This gets the program to do a check before accepting the cast.

The “except ValueError” will run if the input is not an integer.

```
1 hamburger_price = 7.5
2
3 try:
4     num_burgers = int(input("How many hamburgers would you like? -> "))
5 except ValueError:
6     print("The entry is not a valid integer")
7
8 #total_cost = num_burgers*hamburger_price
9 #print("Please pay ${:.2f}".format(total_cost))
```

Listing 18: Python example

```

>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/validation_int_2.py
How many hamburgers would you like? -> 3.5
The entry is not a valid integer
>>> |

```

This partly fixes the problem, but we still don't have an acceptable value for the number of hamburgers.

So we need to ask the user again for an input and if we want to ask again (and maybe again) we need a loop:

```

1 hamburger_price = 7.5
2 #set a condition for the loop
3 have_value = False
4 while have_value == False:
5     try:
6         num_burgers = int(input("How many hamburgers would you like? -> "))
7     except ValueError:
8         # a pleasant, helpful error message.
9         print("Unfortunately you have not given a whole number for the hamburgers
. Please try again")
10        # introduce a 'continue', this means the program will jump straight back
11        # to the top of the loop.
12        continue
13    #if we get to this point then we have a valid integer, so end the loop
14    have_value = True
15
16 # we now know that we have what we need, so can proceed
17 total_cost = num_burgers*hamburger_price
18 print("Please pay ${:.2f}".format(total_cost))

```

Listing 19: Python example

```

= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/validation_int_3.py
How many hamburgers would you like? -> 3.5
Unfortunately you have not given a whole number for the hamburgers. Please try again
How many hamburgers would you like? ->
Unfortunately you have not given a whole number for the hamburgers. Please try again
How many hamburgers would you like? -> Three hundred
Unfortunately you have not given a whole number for the hamburgers. Please try again
How many hamburgers would you like? -> 4
Please pay $30.00
>>> |

```

We still have a problem that the program accepts negative numbers:

```

>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/validation_int_3.py
How many hamburgers would you like? -> -30
Please pay $-225.00
>>> |

```

So we can extend the validation loop

```
1 hamburger_price = 7.5
2 #set a condition for the loop
3 have_value = False
4 while have_value == False:
5     try:
6         num_burgers = int(input("How many hamburgers would you like? -> "))
7     except ValueError:
8         # a pleasant, helpful error message.
9         print("Unfortunately you have not given a whole number for the hamburgers
. Please try again")
10        # introduce a 'continue', this means the program will jump straight back
11        # to the top of the loop.
12        continue
13        # this will now request re-entry if the number of burgers is outside an
14        acceptable range
15        if num_burgers < 1 or num_burgers > 10:
16            print("Please enter at least one burger and no more than 10")
17            continue
18        #if we get to this point then we have a valid integer, so end the loop
19        have_value = True
20
21 # we now know that we have what we need, so can proceed
22 total_cost = num_burgers*hamburger_price
23 print("Please pay ${:.2f}".format(total_cost))
```

Listing 20: Python example

```
>>>
=RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/validation_int_3.py
How many hamburgers would you like? ->
Unfortunately you have not given a whole number for the hamburgers. Please try again
How many hamburgers would you like? -> 3.5
Unfortunately you have not given a whole number for the hamburgers. Please try again
How many hamburgers would you like? -> 0
Please enter at least one burger and no more than 10
How many hamburgers would you like? -> 11
Please enter at least one burger and no more than 10
How many hamburgers would you like? -> 9
Please pay $67.50
>>> |
```

12.2 String Validation

If we require a name, we still need to check that we are getting something acceptable. A simple validation can be to check that the entry has at least 2 characters and no more than (maybe) 20 (what do you think is the longest number of characters that can be in a name?).

```
1 # set a loop variable
2 have_name = False
3
4 while have_name == False:
5     # request name
6     name = input("Please enter your name: -> ")
7
8     # check the number of characters in the name and
9     # print error message if it is outside of an acceptable range.
10    # and continue to top of loop if it is
11    if len(name)< 2 or len(name) > 20:
12        print("This doesn't look like a valid name, please try again")
13        continue
14
15    # if have got here, then all okay so end loop
16    have_name = True
17
18 print("Welome {}".format(name))
```

Listing 21: Python example

```
>>>
=RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/validation_name.py
Please enter your name: -> p
This doesn't look like a valid name, please try again
Please enter your name: -> ksdhksfjhkdsfhkdhfkdfhkdhkdkdsfh
This doesn't look like a valid name, please try again
Please enter your name: -> Paul
Welome Paul
>>> |
```

This validation checks that the characters in the name are all acceptable (i.e no numbers or special characters).

It does this by checking each character in the name against a list of characters than are acceptable.

```
1 chars = ["a", "b", "c", "d", "e", "f", "g", "h", "i", "j", "k", "l", "m", "n", "o", "p", "q", "r",
2         "s", "t", "u", "v", "w", "x", "y", "z", " ", "-"]
3 have_name = False
4
5     name = input("Please enter your name: -> ")
6     # check name lenght and continue to the top
7     if len(name)< 2 or len(name) > 20:
8         print("This doesn't look like a valid name, please try again")
```

```

9         continue
10        # assume all the characters are acceptable
11        chars_okay = True
12        # loop through the letters in the name (that have been set to lower case)
13        for x in name.lower():
14            # if an unacceptable character is found
15            # print a useful message
16            # set chars_okay to be false
17            if x not in chars:
18                print("{} is not an acceptable character in a name.".format(x))
19                chars_okay = False
20        # once the letter loop is finished
21        # check if chars_okay is false and if it is
22        # continue to top of loop
23        if chars_okay == False:
24            continue
25
26        # if no problems
27        have_name = True
28
29 print("Welcome {}".format(name.title()))

```

Listing 22: Python example

```

>>>
=RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/validation_name_1.py
Please enter your name: -> mary5
5 is not an acceptable character in a name.
Please enter your name: -> may@logs.com
@ is not an acceptable character in a name.
. is not an acceptable character in a name.
Please enter your name: -> mary anne
Welcome Mary Anne
>>> |

```

- Checking that strings follow an acceptable “pattern” is called ”regular expressions” and this is outside of the scope of Level 1 (but we can explore options like in the code example).

https://www.w3schools.com/python/python_regex.asp

- It is also a good idea to be familiar with “string methods” as they can be very useful.

https://www.w3schools.com/python/python_strings_methods.asp

13 Lists

Quite often we want to store a whole set of items (for example, names). Having a variable for each one is not very helpful (particularly if we want to add more names to the lists or remove some names). Suppose we have a small class of 6 students and we want to store all of their names.

Their names are: Agatha , Melinda, Harriet, Hine, Dandelion and Te Aroha

To create a list we use square brackets and commas.

```
1 # each item in the list has an index number 0,1,2,3,4,5
2 # the first item is at index 0 (Agatha)
3 # the length of the list is 6 (because it has 6 items in it)
4 # but the last index number is 6-1 = 5 ( because the counting starts from 0 )
5
6 my_class = ["Agatha" , " Melinda" , "Harriet" , "Hine" , "Dandelion" , "Te Aroha"]
```

Listing 23: Python example

To manage lists, there are a large range of methods that can be used.

See the examples below.

```
1 my_class = ["Agatha" , "Melinda" , "Harriet" , "Hine" , "Dandelion" , "Te Aroha"]
2
3 #print out a name at a specific index (use the square bracket notation)
4 # this prints out the fourth person in the last
5 print(my_class[3])
6 print()
7 # print the list out "informally"
8 print(my_class)
9 print()
10 # print using a loop (this is the usual way to do it)
11 # this a shorthand way of doing it,
12 # where the "x" is, we can use anything we like and it
13 # will hold the value on each iteration of the loop
14 for x in my_class:
15     print(x)
16 print()
17 # find out how long the list is (you often need to do this)
18 class_length = len(my_class)
19 output = "There are {} students in the class\n".format(class_length)
20 print(output)
21 # sort the list
22 my_class.sort()
23 print(my_class)
24 print()
25 # shuffle the list
26 # for this we need the random module(should be up the top)
27 import random
28 random.shuffle(my_class)
```

```

29 print(my_class)
30 print()
31 # add a new name to a list
32 my_class.append("Phoebe")
33 print(my_class)
34 print()
35 # check if someone is in the list
36 check_name = "Jane"
37 if check_name in my_class:
38     print("{} is in the class".format(check_name))
39 else:
40     print("{} is not in the class".format(check_name))
41 print()
42 # find the index number of a particular name (where is Harriet??)
43 index_num = my_class.index("Harriet")
44 print("{} is at index number {}".format("Harriet" , index_num))
45 print()
46 # remove someone from the list
47 my_class.remove("Harriet")
48 print(my_class)
49 print("{} is no longer in the list".format("Harriet"))

```

Listing 24: Python example

See also:

- Python Lists: https://www.w3schools.com/python/python_lists.asp
- Python List Methods: https://www.w3schools.com/python/python_lists_methods.asp

14 Lists and Loops

14.1 Creating and modifying a class group

Scenario:

Create a simple program that asks the user to enter the names for students in a class.

Once the names have been entered it prints out the names as a numbered list.

Extension:

Once the names have been entered and listed, ask the user if they would like to modify or remove any of the names. (and if they do allow them to do it)

14.2 Lucky Unicorn Game

14.2.1 Program

Scenario:

You have decided to create a fun game to raise money for the charity Doctors without Borders.
You will set up your computer at lunchtime and players will pay to play.

Here are the rules:

Users pay an initial amount at the start of the game.

- The cost should be \$1 per round and users should press <enter> to play.
 - The computer should then generate a token that is either a zebra, horse, donkey or unicorn.
 - This should be displayed to the user (as text).
 - If the token is a unicorn, the user wins \$5, if it is a zebra or horse, they win 50c and if it is a donkey then they don't win anything.
-

The maximum amount of money that students can spend on the game is \$10 per session.

- The game should allow players continue / quit provided they have not lost all of their money.
 - It should supply appropriate feedback so that the user knows how much money they have won / lost each round and how much money they have left.
-

Once students have no more money, the game should end (although players do have the option of quitting while they are ahead).

Variations (optional) Once you have a working game, you are welcome to develop the outcome further.

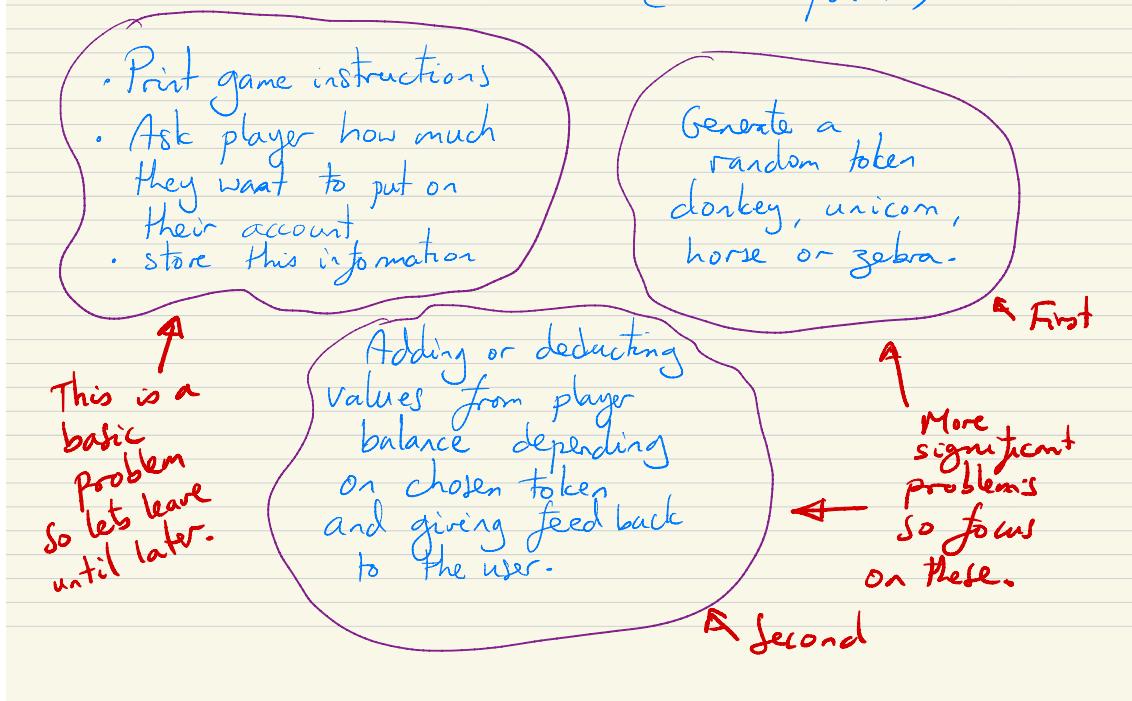
Here are some variations you could consider...

- Change the tokens / context (so rather than having zebra, horses, donkeys and unicorns the game could involve other items)
- Allow users to bet more than \$1 per round and adjust the pay-outs proportionally
(be careful to set up your game so that the house has a long term advantage)

14.2.2 Planning: Iterative Processes

- Break the problem down into parts (Draw some kind of diagram)
- Each of the parts can be called a “component” of the program or a “sub-problem”.
- You need plan and test code for each of these “sub-problems”.
 - Ideally (and this must happen somewhere), you need to look at “tralling” different ways to solve the sub-problem), with the idea being that you can trial the different ways and choose the best (and also look to ways of improving).
This needs to be captured in the planning documentation for the iterative processes assessment.
- Combine your code into a fully working program (your first version)
 - Test the program and document the test (gridded test plan)
 - Write a short reflection on what works and what could be improved upon.
- Plan the next version
 - Test the program and document the test (gridded test plan)
 - Write a short reflection on what works and what could be improved upon.
- Repeat this planning and testing process.
- If new sub-problems appear , then work on them in the same way as referred to above

Lucky Unicorn: Basic sub-problems (aka components)



Breaking the problem down into components

Lucky Unicorn Subproblem:

First

- How to randomly select a token: "Unicorn", "Horse", "Zebra", "Donkey".

(TRIAL DIFFERENT WAYS TO SOLVE THE SAME SUB PROBLEM)

- ① Put the tokens in a list ["unicorn", ...]
- ② Use a list, and use randint.
- ③ Use random. random(). This will give a number (decimal) between 0 and one.
- ④ Use 2 and have chosen_token = ""

```

use the random module to
select the token.
token_list = ["Unicorn", "Zebra", "Horse", "Donkey"]
chosen_token = random.choice(token_list)
print(chosen_token)

if random_num < 0.25:
    chosen_token = "unicorn"
elif random_num < 0.5:
    chosen_token = "horse"
elif random_num < 0.75:
    chosen_token = "zebra"
else:
    chosen_token = "donkey"
  
```

Planning options for the first sub-problem

Component (aka sub-problem) trials for randomly selecting a token. With outputs to test that they are working.

```
# Trial idea 1
import random
token_list = ["unicorn", "horse", "zebra", "donkey"]
chosen_token = random.choice(token_list)
print(chosen_token)

#loop test
# to make sure all the tokens are getting chosen ,
#|roughly equally
count = 0
while count < 100:
    chosen_token = random.choice(token_list)
    print(chosen_token)
    count += 1
```

Ln: 9 Col: 2

```
zebra
unicorn
donkey
donkey
donkey
unicorn
zebra
donkey
donkey
donkey
donkey
unicorn
```

```
#Trial idea 2
import random
token_list = ["unicorn", "horse", "zebra", "donkey"]
random_index = random.randint(0,3)
chosen_token = token_list[random_index]
print(chosen_token)

#loop test
# to make sure all the tokens are getting chosen ,
#|roughly equally
count = 0
while count < 100:
    random_index = random.randint(0,3)
    chosen_token = token_list[random_index]
    print(chosen_token)
    count += 1
```

Ln: 7 Col: 0

```
donkey
zebra
unicorn
donkey
donkey
horse
donkey
donkey
horse
horse
horse
horse
```

```
#Trial idea 3
import random
chosen_token = ""
random_num = random.random()
if random_num < 0.25:
    chosen_token = "Unicorn"
elif random_num < 0.5:
    chosen_token = "Horse"
elif random_num < 0.75:
    chosen_token = "Zebra"
else:
    chosen_token = "Donkey"

print(chosen_token)
```

Ln: 17 Col: 0

```
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_3.py
Unicorn
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_3.py
Horse
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_3.py
Horse
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_3.py
Donkey
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_3.py
Donkey
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_3.py
Donkey
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_3.py
Zebra
>>>
```

```
#Trial idea 4
import random
chosen_token = ""
random_num = random.randint(0,3)
if random_num == 0:
    chosen_token = "Unicorn"
elif random_num == 1:
    chosen_token = "Horse"
elif random_num == 2:
    chosen_token = "Zebra"
else:
    chosen_token = "Donkey"

print(chosen_token)
```

Ln: 15 Col: 4

```
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_4.py
Donkey
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_4.py
Zebra
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_4.py
Zebra
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_4.py
Donkey
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_4.py
Unicorn
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_act
ests/get_token_4.py
Horse
>>>
```

Trialling different ways to solve the same sub-problem

Reflection on the trials.

- ① The shortest code. + Don't know which index gets chosen each time. - (but could possibly sort out)
- ② clearly "see" which index number is selected and then can access the list using this + - A bit longer than ①
- ③ Although it is much longer I can adjust the intervals so the probabilities don't have to be equal for each token. + - Much longer. Difficult to add or remove tokens.
- ④ ? ? Longer, difficult to add or remove tokens.

An going to choose ②.

A reflection on the trials and a choice

Subproblem.

Second

Check what the token is and add or subtract money from user.

Program needs:

total-money of user.
to deduct \$1 for each play.
to check the result and then add/subtract money.

```
(1) total-money = 10
chosen-token = "Unicorn"
total-money -= 1
if chosen-token == "Unicorn" :
    total-money += 5
elif chosen-token == "Zebra" :
    total-money += 0.5
elif chosen-token == "Horse" :
    total-money += 0.5
else :
    total-money += 0
print("You have a {}".format(chosen-token))
print("You now have ${}.".format(total-money))
```

② We could use a parallel list.

tokens = ["Unic.", "Zeb.", "Hor.", "Dont"]
values = [5, 0.5, 0.5, 0]
token_index = random.randint(0, 3)

total-money -= 1
total-money += values[token_index]
print("You have ...")
print("You now have ...").

Planning options for the second sub-problem

Component (aka sub-problem) trials for adding or deducting player money and feedback to player.

```
● ○ ● add_subtract_feed_back.py - /Users/khouripa/Documents/DTech/year11_2020/code_activities/luckyunicorn/sub...
total_money = 10
chosen_token = "Zebra"

total_money -= 1
if chosen_token == "Unicorn":
    total_money += 5
elif chosen_token == "Horse":
    total_money += 0.5
elif chosen_token == "Zebra":
    total_money -= 0.5
elif chosen_token == "Donkey":
    total_money += 0

print("You got a {}".format(chosen_token))
print("You now have ${:.2f}".format(total_money))

Ln: 2 Col: 21
```

```
● ○ ● add_subtract_feed_back_1.py - /Users/khouripa/Documents/DTech/year11_2020/code_activities/luckyunicorn/su...
import random
total_money = 10
token_list = ["Unicorn", "horse", "zebra", "donkey"]
values = [5, 0.5, 0.5, 0]
token_index = 3

total_money -= 1
total_money += values[token_index]

print("You got a {}".format(token_list[token_index]))
print("You now have ${:.2f}".format(total_money))

Ln: 5 Col: 15
```

```
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/luckyuni
ests/add_subtract_feed_back.py
You got a Unicorn
You now have $14.00
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/luckyuni
ests/add_subtract_feed_back.py
You got a Donkey
You now have $9.00
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/luckyuni
ests/add_subtract_feed_back.py
You got a Horse
You now have $9.50
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/luckyuni
ests/add_subtract_feed_back.py
You got a Zebra
You now have $9.50
>>>
```

↓ Improvement after the first trial

```
● ○ ● add_subtract_feed_back-a.py - /Users/khouripa/Documents/DTech/year11_2020/code_activities/luckyunicorn/sub...
# after the first trial of this idea
# I modified it to simplify the
# conditions so it is now much more efficient

total_money = 10
chosen_token = "Unicorn"

total_money -= 1
if chosen_token == "Unicorn":
    total_money += 5
elif chosen_token == "Horse" or chosen_token == "Zebra":
    total_money -= 0.5

print("You got a {}".format(chosen_token))
print("You now have ${:.2f}".format(total_money))

Ln: 6 Col: 23
```

```
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/luci
ests/add_subtract_feed_back-a.py
You got a Zebra
You now have $9.50
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/luci
ests/add_subtract_feed_back-a.py
You got a Horse
You now have $9.50
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/luci
ests/add_subtract_feed_back-a.py
You got a Donkey
You now have $9.00
>>>
= RESTART: /Users/khouripa/Documents/DTech/year11_2020/code_activities/luci
ests/add_subtract_feed_back-a.py
You got a Unicorn
You now have $14.00
>>>|
```

Trialling different ways to solve the same sub-problem (the second)

Reflection on Trials for adding and subtracting player amount and feedback.

① Using of chf.

A standard solution
easy to understand
works fine.

Is still a bit "cumbersome".
could be a bit laborious
to add on new tokens or
to update values.

→ The second trial was able to improve
the efficiency of the code
and make it clever. There was no need to
include the donkey as not no money is added.

②

Very simple and
is easy to add new tokens
and change token values.

None at this stage
(Possibly could be improved further,
but okay for now).

A reflection on the trials and a choice

```

1 import random
2 # print output for start of Lucky Unicorn Game
3 print("----- Welcome to the Lucky Unicorn Game -----")
4 print("Enter between $1 and $10 to play")
5 print("It costs $1 per round")
6 print("If you get a unicorn you will get $5 back")
7 print("If it is a Zebra or Horse you get 50c back")
8 print("A donkey gives nothing back")
9 print("----- Start -----")
10 print()
11 # get amount of money to play with
12 tokens = ["horse", "zebra", "donkey", "unicorn"]
13 player_amount=int(input("Please enter a value between 1 and 10: -> "))
14 print("You have entered ${:.2f}".format(player_amount))
15 #game play
16 play=""
17 while play=="":
18     player_token = random.choice(tokens)
19     player_amount -= 1
20     if player_token == "unicorn":
21         player_amount += 5
22         print("Congratulations, you had a {}".format(player_token))
23     elif player_token == "horse" or player_token == "zebra":
24         player_amount +=0.5
25         print("You had a {}".format(player_token))
26     else:
27         print("Unfortunately you had a {}".format(player_token))
28     print("Your balance is now ${:.2f}".format(player_amount))
29     play=input("Press <Enter> to continue or quit(q)")
```

Listing 25: Python example

15 Code Examples

15.1 Dinner Order

```
1 #constants
2 MAIN_PRICE = 12.5
3 DESSERT_PRICE = 6.0
4 DRINKS_PRICE = 3.55
5
6 #totalling variables (initially declared as 0)
7 mains_total = 0.0
8 desserts_total = 0.0
9 drinks_total = 0.0
10 ext_gst = 0.0
11
12 # input variables
13 mains = int(input("How many mains would you like to order?: "))
14 desserts = int(input("How many desserts would you like to order?: "))
15 drinks = int(input("How many drinks would you like to order?: "))
16
17 #calulate costs
18 mains_total = mains * MAIN_PRICE
19 desserts_total = desserts * DESSERT_PRICE
20 drinks_total = drinks * DRINKS_PRICE
21
22 ext_gst = mains_total + desserts_total + drinks_total
23 my_gst = ext_gst*0.15
24 my_to_pay = ext_gst + my_gst
25
26 print("-"*40)
27 print("Bill's Diner")
28 print("-"*40)
29 print("{:<3}{:10}at ${:<10.2f}= ${:.2f}".format(mains,"mains", MAIN_PRICE,
   mains_total))
30 print("{:<3}{:10}at ${:<10.2f}= ${:.2f}".format(desserts,"desserts",
   DESSERT_PRICE, desserts_total))
31 print("{:<3}{:10}at ${:<10.2f}= ${:.2f}".format(drinks,"drinks", DRINKS_PRICE,
   drinks_total))
32 print("-"*40)
33 print("{:>27}= ${}{}".format("Total ", ext_gst))
34 print("{:>27}= ${:.2f}{}".format("GST ", my_gst))
35 print("{:>27}= ${:.2f}{}".format("To Pay ", my_to_pay))
36 print("-"*40)
37 print("Thankyou")
38 print("-"*40)
```

Listing 26: Dinner Order Program

15.2 Strawberry Picking

```
1 # get number of punnets boxes buckets
2 my_punnets = float(input("How many punnets?: "))
3 my_boxes = float(input("How many boxes?: "))
4 my_buckets = float(input("How many buckets?: "))
5
6 #testing
7 #my_punnets = 2.5
8 #my_boxes = 1.75
9 #my_buckets = 3.5
10
11 punnet_weight = my_punnets*0.25
12 box_weight = my_boxes*1.5
13 bucket_weight = my_buckets*7
14
15 total_weight = punnet_weight + box_weight + bucket_weight
16
17 total_price = total_weight * 5
18 print("."*30)
19 print("{:20}{:>6.2f} kg".format("Punnet weight" , punnet_weight))
20 print("{:20}{:>6.2f} kg".format("Box weight" , box_weight))
21 print("{:20}{:>6.2f} kg".format("Bucket weight", bucket_weight))
22 print("."*30)
23 print("{:20}{:>6.2f} kg".format("Total weight", total_weight))
24 print("."*30)
25 print("."*30)
26 print("{:20} ${:>6.2f}".format("Price to charge", total_price))
27 print("."*30)
```

Listing 27: Python example

15.3 Guess greater, less or equal

```
1 import random
2 lower = 4
3 higher = 15
4 my_random = random.randint(lower,higher)
5 middle_number = round((lower + higher)/2)
6 #print(middle_number)
7 #print(my_random)
8
9 print("A random number has been chosen between {} and {}".format(lower, higher))
10 print(40*"-")
11 guess = input("Enter L if you think the number is less than {0} \n"
12             "Enter G if you think the number is more than {0} \n"
13             "Enter E if you think the number is equal to {0} : ".format(
    middle_number))
```

```

14
15 if guess == "L" and my_random < middle_number:
16     print("you win")
17 elif guess == "G" and my_random > middle_number:
18     print("you win")
19 elif guess == "E" and my_random == middle_number:
20     print("you win")
21 elif guess != "G" and guess != "L" and guess != "E":
22     print("you have not entered an appropriate letter")
23 else:
24     print("you lose")
25 print("The number was {}".format(my_random))

```

Listing 28: Python example

15.4 Higher Lower Game

```

1 import random
2
3 mainLoop="y"
4 while mainLoop=="y":
5     #declare variables
6     name=""
7     secretNumber=0
8     guess=0
9     count=0
10    min_num = 1
11    max_num = 100
12    #get user input and validate
13    getUserNameLoop="y"
14    while getUserNameLoop=="y":
15        name=input("Please enter your name: ")
16        if len(name)<2 or len(name)>30 or name.isalpha()!=True:
17            print("Please enter a valid name")
18            continue
19        else:
20            #name has been captured correctly
21            getUserNameLoop="n"
22    # welcome
23    print("Hello {}, you are about to play a guessing game".format(name))
24    print("where you need to guess the secret number between {} and {}".format(
min_num, max_num))
25    secretNumber=random.randint(min_num,max_num)
26    #testing help
27    #print("Testing help: the secret number is {}".format(secretNumber))
28    ready=input("Press enter to start   ")
29    #start game
30    gameLoop="y"

```

```

31     while gameLoop=="y":
32         # get guess and validate
33         getGuessInputLoop="y"
34         while getGuessInputLoop=="y":
35             try:
36                 guess=int(input("Please guess the secret number between {} and {}"
37                             ".format(min_num, max_num)))")
38                 except ValueError:
39                     print("Please enter a valid integer")
40                     continue
41                     if guess<min_num or guess>max_num:
42                         print("Please enter a number between 1 and 50".format(min_num,
43 max_num))
44                     else:
45                         # integer correctly entered
46                         getGuessInputLoop="n"
47                         #guess count
48                         count=count+1
49                         #respond to input
50                         if guess<secretNumber:
51                             print("Your guess is too small")
52                         elif guess>secretNumber:
53                             print("Your guess is too large")
54                         else:
55                             #number is found, end loop and print responses
56                             print("You have found it!!")
57                             gameLoop="n"
58                             print("You took {} tries to find it".format(count))
59                             if count<5:
60                                 print("You are really fast")
61                             elif count<7:
62                                 print("Pretty good")
63                             else:
64                                 print("You can improve, I think")
65 #exited game loop
66 mainLoop=input("Do you want to play again? y/n      ")
67 #exited main loop
68 print("The program has ended")

```

Listing 29: Python example

16 Testing

17 Dictionaries

```
1 car = {  
2     "brand": "Ford",  
3     "model": "Mustang",  
4     "year": 1964  
5 }  
6  
7 x = car.setdefault("model", "Bronco")  
8  
9 print(x)  
10  
11 quiz_one = {  
12     "question": "What is the capital of France? ",  
13     "answer": "Paris"  
14 }  
15 quiz_two = {  
16     "question": "What is the capital of Spain? ",  
17     "answer": "Madrid"  
18 }  
19 quiz_three = {  
20     "question": "What is the capital of Germany? ",  
21     "answer": "Berlin"  
22 }  
23 print(quiz_one.get("question"))  
24  
25 user_answer = input(quiz_one.get("question"))  
26 if user_answer == quiz_one.get("answer"):  
27     print("Correct")  
28 user_answer = input(quiz_two.get("question"))  
29 if user_answer == quiz_two.get("answer"):  
30     print("Correct")  
31 user_answer = input(quiz_three.get("question"))  
32 if user_answer == quiz_three.get("answer"):  
33     print("Correct")  
34  
35 quiz_set = [  
36     {  
37         "question": "What is the capital of France? ",  
38         "answer": "Paris"  
39     },  
40     {  
41         "question": "What is the capital of Spain? ",  
42         "answer": "Madrid"  
43     },  
44     {  
45         "question": "What is the capital of Germany? ",
```

```

46     "answer" : "Berlin"
47 }
48 ]
49
50 for x in quiz_set:
51     user_answer = input( x.get("question") )
52     if user_answer == x.get("answer"):
53         print("Correct")

```

Listing 30: Python example

```

1 question_one = {
2     "question": "What is the capital of France?",
3     "A": "Paris",
4     "B": "Moscow",
5     "C": "Shanghai",
6     "answer": "C"
7 }
8 print(question_one["A"])
9 print(question_one["B"])
10 print("-"*30)
11
12 for x,y in question_one.items():
13     if x in ["A", "B", "C"]:
14         print("{} , {}".format(x,y))

```

Listing 31: Python example

18 Coffee

```
1 import random
2
3 char_list = ["C", "O", "F", "E"]
4
5
6
7 def run_trial():
8     counter = 1
9     C_count = 0
10    O_count = 0
11    F_count = 0
12    E_count = 0
13    char_string = ""
14    while True:
15        my_char = random.choice(char_list)
16        char_string += my_char
17        # count number of C, O,
18        C_count = char_string.count("C")
19        O_count = char_string.count("O")
20        F_count = char_string.count("F")
21        E_count = char_string.count("E")
22        if C_count >= 1 and O_count >= 1 and F_count >= 2 and E_count >= 2:
23            break
24        # increment count
25        counter += 1
26    #print(char_string)
27    return len(char_string)
28
29
30 total_trials = 100
31 trials = 1
32 total_chars = 0
33 while trials <= total_trials:
34     total_chars += run_trial()
35     trials += 1
36
37
38 print(total_chars)
39 print(total_trials)
40
41 my_average = total_chars/total_trials
42 print(my_average)
```

Listing 32: Python example

```

1 import random
2
3 my_list=["c", "o", "f", "e"]
4
5 my_string = ""
6 count = 1
7 while count<100:
8     my_letter = random.choice(my_list)
9     my_string += my_letter
10    #print(my_letter)
11    if my_string.count("c")>=1 and my_string.count("o")>=1 \
12        and my_string.count("f")>=2 and my_string.count("e")>=2:
13        break
14    count += 1
15 for x in my_list:
16     print("{} * {}".format(x,my_string.count(x)))
17 print(my_string)
18 print("count is {}".format(count))

```

Listing 33: Python example

```

1 import random
2
3 my_list=["c", "o", "f", "e"]
4
5 my_string = ""
6 count = 1
7 while count<100:
8     my_letter = random.choice(my_list)
9     my_string += my_letter
10    #print(my_letter)
11    if my_string.count("c")>=1 and my_string.count("o")>=1 \
12        and my_string.count("f")>=2 and my_string.count("e")>=2:
13        break
14    count += 1
15 for x in my_list:
16     print("{} * {}".format(x,my_string.count(x)))
17 print(my_string)
18 print("count is {}".format(count))

```

Listing 34: Python example

```

1 import random
2
3 my_list=["c", "o", "f", "e"]
4
5 string_list = []
6

```

```

7 counter = 0
8 while counter < 1000:
9     my_string = ""
10    count = 1
11    while True:
12        my_letter = random.choice(my_list)
13        my_string += my_letter
14        #print(my_letter)
15        if my_string.count("c")>=1 and my_string.count("o")>=1 \
16            and my_string.count("f")>=2 and my_string.count("e")>=2:
17            break
18        count += 1
19        string_list.append(my_string)
20        counter += 1
21        # print(my_string)
22 #print(string_list)
23 string_list.sort(key=len)
24 print(string_list[0])
25 print(string_list[- 1])
26
27 total_times = 0
28 number_trials = 0
29 for x in string_list:
30     total_times += len(x)
31     number_trials += 1
32 print(total_times)
33 print(number_trials)

```

Listing 35: Python example

```

1 import random
2
3 char_list = ["C", "O", "F", "E"]
4
5
6 chars_in_six = 0
7
8 C_count = 0
9 O_count = 0
10 F_count = 0
11 E_count = 0
12
13
14 trials = 0
15 trial_total = 100000
16 while trials < trial_total:
17     counter = 0
18     char_string = ""

```

```

19     while counter < 6:
20         my_char = random.choice(char_list)
21         char_string += my_char
22         # count number of C, O,
23         C_count = char_string.count("C")
24         O_count = char_string.count("O")
25         F_count = char_string.count("F")
26         E_count = char_string.count("E")
27         if C_count >= 1 and O_count >= 1 and F_count >= 2 and E_count >= 2:
28             chars_in_six +=1
29             # increment count
30             counter += 1
31         #print(char_string)
32         trials += 1
33
34 print(chars_in_six/trial_total)
35 #print(char_string.count("C"))

```

Listing 36: Python example

```

1 import random
2
3 char_list = ["C", "O", "F", "E"]
4
5 # empty list
6 string_list = []
7
8
9 #-----
10 def make_coffee():
11     C_count = 0
12     O_count = 0
13     F_count = 0
14     E_count = 0
15
16     char_string = ""
17     while True:
18         my_char = random.choice(char_list)
19         char_string += my_char
20         # count number of C, O,
21         C_count = char_string.count("C")
22         O_count = char_string.count("O")
23         F_count = char_string.count("F")
24         E_count = char_string.count("E")
25         if C_count >= 1 and O_count >= 1 and F_count >= 2 and E_count >= 2:
26             string_list.append(char_string)
27             break
28             # increment count

```

```

29
30
31     #print(char_string)
32     #print( len(char_string) )
33     return len(char_string)
34 #-----
35
36
37 total_trials = 1000000
38 trials = 1
39
40 total_string_lengths = 0
41
42 while trials <= total_trials:
43     my_number = make_coffee()
44     total_string_lengths += my_number
45     #print(my_number)
46     trials +=1
47 #print(total_string_lengths)
48 average = round(total_string_lengths / total_trials)
49 print("On average you will need {} visits".format(average))
50 #print(string_list)
51
52 string_list.sort(key=len)
53 #print(string_list)
54 #print first item (thing)
55 print(string_list[0])
56 #print last item
57 print(string_list[total_trials-1])
58 print( len( string_list[total_trials-1] ) )
59
60
61
62
63
64
65
66
67
68
69 #print(string_list)
70
71
72
73 #string_list.sort(key = len)

```

Listing 37: Python example

```

1 import random
2
3 char_list = ["C", "O", "F", "E"]
4
5 string_list = []
6
7
8 def run_trial():
9     counter = 1
10    C_count = 0
11    O_count = 0
12    F_count = 0
13    E_count = 0
14    char_string = ""
15    while True:
16        my_char = random.choice(char_list)
17        char_string += my_char
18        # count number of C, O,
19        C_count = char_string.count("C")
20        O_count = char_string.count("O")
21        F_count = char_string.count("F")
22        E_count = char_string.count("E")
23        if C_count >= 1 and O_count >= 1 and F_count >= 2 and E_count >= 2:
24            string_list.append(char_string)
25            break
26        # increment count
27        counter += 1
28    #print(char_string)
29    return len(char_string)
30
31
32
33
34 total_trials = 100
35 trials = 1
36 total_chars = 0
37 while trials <= total_trials:
38     total_chars += run_trial()
39     trials += 1
40
41
42 print(total_chars)
43 print(total_trials)
44 my_average = total_chars/total_trials
45 print(my_average)
46
47 #print(string_list)

```

```

48 string_list.sort(key = len)
49 #print(string_list)
50 print(string_list[0])
51 print(string_list[-1])
52 print(len(string_list[0]))
53 print(len(string_list[-1]))
54
55 my_dict = {}
56 for i in range(len(string_list[0]), len(string_list[-1])+1):
57     my_dict[i]=0
58     #print(i)
59
60 #print(my_dict)
61 for x in string_list:
62     my_dict[len(x)]+=1
63     #print(x)
64 print(my_dict)
65 my_sum = 0
66 for x in my_dict:
67     my_sum += my_dict[x]
68 print(my_sum)
69 # dictionary not the same lenght as string list
70 for x,y in my_dict.items():
71     temp = int(y)
72     temp = temp/total_trials
73     print(temp)
74     my_dict[x] = temp
75 print(my_dict)

```

Listing 38: Python example

```

1 import random
2
3 char_list = ["C", "O", "F", "E"]
4
5
6 chars_in_seven = 0
7
8 C_count = 0
9 O_count = 0
10 F_count = 0
11 E_count = 0
12
13
14 trials = 0
15 trial_total = 1000000
16 while trials < trial_total:
17     counter = 1

```

```

18     char_string = ""
19     while counter <= 7:
20         my_char = random.choice(char_list)
21         char_string += my_char
22         # count number of C, O, F, E
23         C_count = char_string.count("C")
24         O_count = char_string.count("O")
25         F_count = char_string.count("F")
26         E_count = char_string.count("E")
27
28         # increment count
29         counter += 1
30     # test string at end
31     if C_count >= 1 and O_count >= 1 and F_count >= 2 and E_count >= 2:
32         chars_in_seven +=1
33     #print(char_string)
34     trials += 1
35
36 print(chars_in_seven/trial_total)
37 #print(char_string.count("C"))

```

Listing 39: Python example

```

1 import random
2
3 char_list = ["C", "O", "F", "E"]
4
5
6 chars_in_eight = 0
7
8 C_count = 0
9 O_count = 0
10 F_count = 0
11 E_count = 0
12
13
14 trials = 0
15 trial_total = 1000000
16 while trials < trial_total:
17     counter = 1
18     char_string = ""
19     while counter <= 8:
20         my_char = random.choice(char_list)
21         char_string += my_char
22         # count number of C, O, F, E
23         C_count = char_string.count("C")
24         O_count = char_string.count("O")
25         F_count = char_string.count("F")

```

```

26     E_count = char_string.count("E")
27
28     # increment count
29     counter += 1
30
31     # test string at end
32     if C_count >= 1 and O_count >= 1 and F_count >= 2 and E_count >= 2:
33         chars_in_eight +=1
34     #print(char_string)
35
36 trials += 1
37
38 print(chars_in_eight/trial_total)
39 #print(char_string.count("C"))

```

Listing 40: Python example

```

1 import random
2
3 char_list = ["C", "O", "F", "E"]
4
5
6
7 C_count = 0
8 O_count = 0
9 F_count = 0
10 E_count = 0
11
12 char_string = ""
13 while True:
14     my_char = random.choice(char_list)
15     char_string += my_char
16     # count number of C, O,
17     C_count = char_string.count("C")
18     O_count = char_string.count("O")
19     F_count = char_string.count("F")
20     E_count = char_string.count("E")
21     if C_count >= 1 and O_count >= 1 and F_count >= 2 and E_count >= 2:
22         break
23     # increment count
24
25
26 print(char_string)
27 print( len(char_string) )
28
29 #print(char_string.count("C"))

```

Listing 41: Python example

```

1 import random

```

```

2
3 char_list = ["C", "O", "F", "E"]
4
5
6
7
8 #-----
9 def make_coffee():
10     C_count = 0
11     O_count = 0
12     F_count = 0
13     E_count = 0
14
15     char_string = ""
16     while True:
17         my_char = random.choice(char_list)
18         char_string += my_char
19         # count number of C, O,
20         C_count = char_string.count("C")
21         O_count = char_string.count("O")
22         F_count = char_string.count("F")
23         E_count = char_string.count("E")
24         if C_count >= 1 and O_count >= 1 and F_count >= 2 and E_count >= 2:
25             break
26         # increment count
27
28
29     #print(char_string)
30     #print( len(char_string) )
31     return len(char_string)
32 #-----
33
34
35 total_trials = 100
36 trials = 1
37
38 total_string_lengths = 0
39
40 while trials <= total_trials:
41     my_number = make_coffee()
42     total_string_lengths += my_number
43     #print(my_number)
44     trials +=1
45 #print(total_string_lengths)
46 average = round(total_string_lengths / total_trials)

```

```
47 print("On average you will need {} visits".format(average))
```

Listing 42: Python example

```
1 import random
2
3 char_list = ["C", "O", "F", "E"]
4
5 string_list = []
6
7
8 def run_trial():
9     counter = 1
10    C_count = 0
11    O_count = 0
12    F_count = 0
13    E_count = 0
14    char_string = ""
15    while True:
16        my_char = random.choice(char_list)
17        char_string += my_char
18        # count number of C, O,
19        C_count = char_string.count("C")
20        O_count = char_string.count("O")
21        F_count = char_string.count("F")
22        E_count = char_string.count("E")
23        if C_count >= 1 and O_count >= 1 and F_count >= 2 and E_count >= 2:
24            string_list.append(char_string)
25            break
26        # increment count
27        counter += 1
28    #print(char_string)
29    return len(char_string)
30
31
32
33
34 total_trials = 1000000
35 trials = 1
36 total_chars = 0
37 while trials <= total_trials:
38     total_chars += run_trial()
39     trials += 1
40
41
42 print(total_chars)
43 print(total_trials)
44 my_average = total_chars/total_trials
```

```

45 print(my_average)
46
47 #print(string_list)
48 string_list.sort(key = len)
49 #print(string_list)
50 print(string_list[0])
51 print(string_list[-1])
52 print(len(string_list[0]))
53 print(len(string_list[-1]))
54
55 my_dict = {}
56 for i in range(len(string_list[0]), len(string_list[-1])+1):
57     my_dict[i]=0
58     #print(i)
59
60 #print(my_dict)
61 for x in string_list:
62     my_dict[len(x)]+=1
63
64 print(my_dict)
65 my_sum = 0
66 for x in my_dict:
67     my_sum += my_dict[x]
68 print(my_sum)
69 # dictionary not the same lenght as string list
70 for x,y in my_dict.items():
71     temp = int(y)
72     temp = temp/total_trials
73     my_dict[x]= temp
74 print(my_dict)
75
76 my_file = open("distribution_next.txt","a")
77 for x,y in my_dict.items():
78     my_string = "{},{:.6f}\n".format(x,y)
79     my_file.write(my_string)
80
81 #my_file.write("hello")
82 #my_file.write("\n")
83 #my_file.write("goodbye")
84 my_file.close()
85 #my_file = open("MyFile.txt","w")
86 #my_file.write("")
87 #my_file.close()

```

Listing 43: Python example

19 Tests

```
1 # roll a dice
2 import random
3 two_d_list = []
4
5
6
7 def searchfor(n):
8     if len(two_d_list)== 0:
9         two_d_list.append([n,1])
10        return
11    added = False
12    for sublist in two_d_list:
13        if sublist[0]==n:
14            sublist[1] += 1
15            added = True
16            break
17    if added == False:
18        two_d_list.append([n,1])
19
20 for i in range(0,1500):
21     diceroll = random.randint(1,6)+random.randint(1,6)+random.randint(1,6)
22     searchfor(diceroll)
23     #print(diceroll)
24
25
26 two_d_list.sort()
27 print(two_d_list)
```

Listing 44: Dice Roll

```
1 guess_list = [45,78,90,21,7]
2
3 guess=int(input("Enter your guess"))
4
5
6 while guess in guess_list:
7     guess = int(input("You have already tried this number,\n
8 have another guess"))
9 guess_list.append(guess)
10 print(guess_list)
```

Listing 45: Python example

```
1 import time
2 start= time.time()
3 t= time.localtime()
```

```

4 print(t)
5 print(start)
6
7
8
9
10 word = "halloween"
11 char_list = list(word)
12 print(char_list)
13 char_list_chosen=["l", "w", "e"]
14 outstring = ""
15 for x in char_list:
16     if x in char_list_chosen:
17         outstring += " "+x+" "
18     else:
19         outstring += " _ "
20 print(outstring)
21
22
23
24
25
26
27 question_one = {
28     "question": "What is the capital of France?",
29     "A": "Paris",
30     "B": "Moscow",
31     "C": "Shanghai",
32     "answer": "C"
33 }
34
35 print(question_one["question"])
36 for x,y in question_one.items():
37     if x != "question" and x != "answer":
38         print("{} {})".format(x,y))
39
40 for x,y in question_one.items():
41     if len(x)== 1:
42         print("{} {})".format(x,y))
43
44 answer = input("Enter your choice ")
45 if answer == question_one["answer"]:
46     print(" Brilliant ")
47 end=time.time()
48 print(end)
49 print(end-start)
50 count = 0

```

```

51 while count < 3:
52     temp={}
53     temp["english"] = input("Enter your english word")
54     temp["thai"] = input("Enter your thai word")
55     print(temp)
56     count +=1

```

Listing 46: Python example

```

1 my_num=0.0000067
2 print("{:.6f}".format(my_num) )

```

Listing 47: Python example

```

1 word = "halloween"
2
3 def pic(c):
4     if c >= 1:
5         print(" "*30+" - - - -")
6     if c >=2:
7         print(" "*30+" | | ")
8     if c >=3:
9         print(" "*30+" () | ")
10    if c >= 4:
11        print(" "*30+" | | ")
12    if c >= 5:
13        print(" "*30+" --- | ")
14        print(" "*30+" | | ")
15        print(" "*30+" / \ | ")
16        print(" "*30+" _ _ | ")
17 pic(5)
18 char_list = list(word)
19 char_individual_list=[]
20 char_list_chosen=[]
21
22 for x in char_list:
23     if x not in char_individual_list:
24         char_individual_list.append(x)
25
26 wrong_count = 0
27 while len(char_individual_list)>0:
28     outstring = ""
29     for x in char_list:
30         if x in char_list_chosen:
31             outstring += " "+x+" "
32         else:
33             outstring += " _ "
34     print("{}\n\n".format(outstring))

```

```

35     char = input("guess a letter: ")
36     if char in char_individual_list:
37         char_list_chosen.append(char)
38         char_individual_list.remove(char)
39     else:
40         wrong_count += 1
41         pic(wrong_count)
42     if len(char_individual_list) == 0:
43         print("you got it")
44
45
46 outstring = ""
47 for x in char_list:
48     if x in char_list_chosen:
49         outstring += " "+x+" "
50     else:
51         outstring += " _ "
52 print(outstring)

```

Listing 48: Python example

20 Strings

```

1 my_string="adkadkkdjk jkjdhkdh"
2 my_split=my_string.split("a")
3 print(my_split)
4 my_list=list(my_string)
5 print(my_list)

```

Listing 49: Python example

```

1 my_string = "woollooomooloo"
2
3 my_letters=[]
4 count_letters = []
5
6 for x in my_string:
7     if x not in my_letters:
8         my_letters.append(x)
9         count_letters.append(my_string.count(x))
10
11 print(my_letters)
12 print(count_letters)

```

Listing 50: Python example

21 Objects

```

1 class Shark:
2
3     def __init__(self, name, age):
4         self.name = name
5         self.age = age
6         """ constructor """
7         print("This is the constructor")
8
9     def swim(self):
10        """ what the shark is doing"""
11        print(self.name+" is swimming")
12
13    def be_awesome(self):
14        """ what the shark is being"""
15        print(self.name+" is being awesome")
16
17    def _age(self):
18        """ how old is it """
19        print(self.name + " is "+str(self.age)+" years old")
20
21
22 def main():
23     sammy = Shark("Sammy", 5)
24     stevie = Shark("Stevie", 3)
25     sammy.swim()
26     stevie.be_awesome()
27     sammy._age()
28
29 if __name__ == "__main__":
30     main()

```

Listing 51: Python example

```

1 class Store:
2
3     def __init__(self):
4         self.colour = "rgb(0,0,0,0)"
5
6
7
8
9
10 class Shark:
11
12     def __init__(self, name, age):
13         self.name = name
14         self.age = age
15         """ constructor """

```

```

16     store.colour = "rgb(255,255,255,1)"
17     print("This is the constructor")
18
19     def swim(self):
20         """ what the shark is doing"""
21         print(self.name+" is swimming")
22
23     def be_awesome(self):
24         """ what the shark is being"""
25         print(self.name+" is being awesome")
26
27     def _age(self):
28         """ how old is it """
29         print(self.name + " is "+str(self.age)+" years old")
30
31 store = Store()
32 shark = Shark("sam", 10)
33 print(store.colour)

```

Listing 52: Python example

```

1 class Question:
2
3     def __init__(self, question, answer, score):
4
5         self.question = question
6         self.answer = answer
7         self.score = score
8
9         self.user_answer = ""
10        self.user_score = 0
11        self.response_to_user = ""
12
13    def make_question(self):
14        msg = self.question
15        self.user_answer = input(msg)
16        if self.user_answer == self.answer:
17            self.response_to_user = "Correct"
18            self.user_score = self.score
19        else:
20            self.response_to_user = "Incorrect"
21
22    def feedback(self):
23        strOne = "For the question: "+self.question+"\n"
24        strTwo = "You answered: "+self.user_answer+"\n"
25        strThree = "Your answer was "+self.response_to_user
26        print(strOne + strTwo + strThree)

```

```

28 #q_one = Question("What is the capital of France?", "Paris", 10)
29 #q_one.make_question()
30 #q_one.feedback()
31 q_list = []
32 q_list.append(Question("What is the capital of France?", "Paris", 10))
33 q_list.append(Question("What is the capital of Belgium?", "Brussels", 10))
34 q_list.append(Question("What is the capital of Holland?", "Amstredam", 10))
35
36 count = 0
37 while count < len(q_list):
38     q_list[count].make_question()
39     count += 1
40
41 count = 0
42 while count < len(q_list):
43     q_list[count].feedback()
44     count += 1

```

Listing 53: Python example

22 Extension

22.1 Basics

Be able to work reasonably comfortably with loops lists and functions.

For example, be able to loop to create a number sequence 3, 9, 27,... and load this into a list

Ideally this is built as a function.

22.2 Some foundations

Create a function that takes a string for it argument and returns the string written backwards. (do not use built in methods such reverse)

Create a function that can generate prime numbers (assuming the program knows ‘nothing’).

Algorithm:

- start with a list prime_list = [2,3]
- looping with numbers 4 - 100,
 - for each number start a second loop that loops through the prime list
 - check if the number is divisible by each number in the prime_list
 - * if it is break out of the loop
 - * if this second loop completes, add the number to prime_list
- return the prime_list

22.3 Sorting

Make a little function that given list and two index numbers will swap the items in the list.

Make a function that given an unordered list of numbers will sort the list from smallest to largest.

This is a foundational problem in Computer Science (yes Python has a sort function, but by making ourselves we learn a lot about algorithm design).

The algorithm that you want to use is **Selection Sort**.

Can look up.

Selection Sort is the simplest and worst sorting algorithm but is a great place to start.

We can look at others from there.