ILP 2022 – W2S3
While/Break statements

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Outline (Week2, Session3 – W2S3)

- While statements
- Infinite loops and how to kill them
- The break statement
- (If time allows, recursion!)

The while statement

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The **if** statement is the simplest **conditional structure**.

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  - If the Boolean condition specified for the **if** statement is **True**, then execute the block of code inside the **if** statement.
  - If the Boolean condition is **False**, ignore the block of code in the **if** statement.
  - Once we are done executing the code in **if** (or ignoring it), move on to the next (non-indented) line.

The **while** statement

The **while** statement is another type of **conditional structure.**

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The **if** statement is the simplest **conditional structure**.

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  - If the Boolean condition is **False**, ignore the block of code in the **while** statement.
  - Once we are done executing the code in **while**, **move back to the while statement, and repeat until the condition is no longer True.**

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  - If the Boolean condition is **False**, ignore the block of code in the **while** statement.
  - Once we are done executing the code in **while**, __move back to the while statement, and repeat until the condition is no longer True.__

```python
1  # Counting from 1 to 10
2  x = 0
3  print("Counting from 1 to 10...")
4  while(x<10):
5      x = x + 1
6      print(x)
7  print("Done!")
```
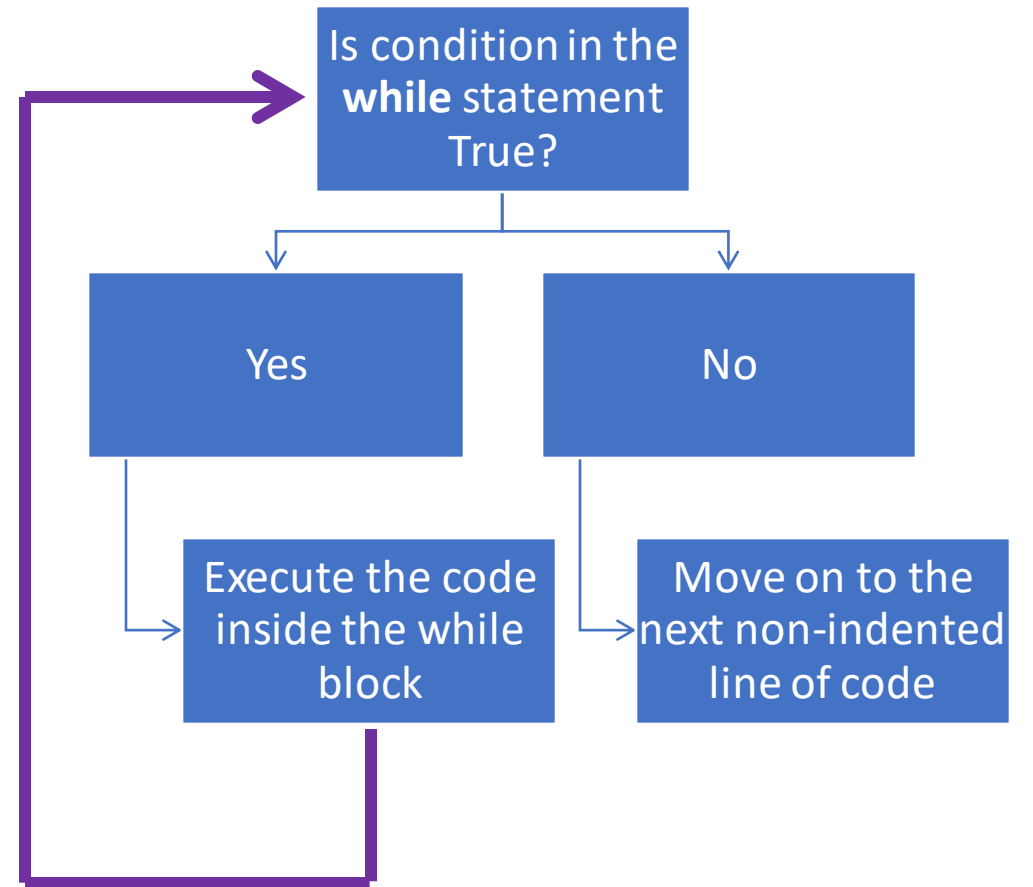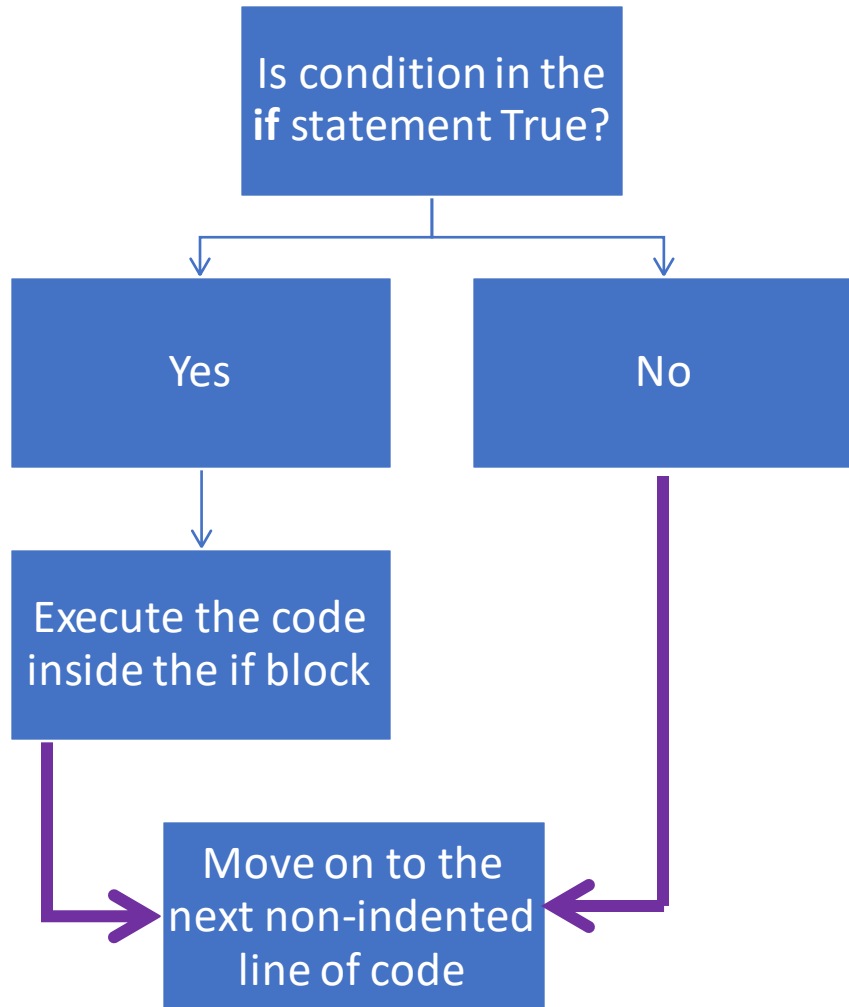
```
Counting from 1 to 10...
1
2
3
4
5
6
7
8
9
10
Done!
```

Architectures: if vs. while

Is condition in the **if** statement True?

Yes

No

Execute the code inside the if block

Move on to the next non-indented line of code

Is condition in the **while** statement True?

Yes

No

Execute the code inside the while block

Move on to the next non-indented line of code

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2
3
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5
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9
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This means that <u>there should be a</u> <u>clear process that **makes your**</u> <u>**condition no longer True**, at some</u> <u>point</u>.

Otherwise, the **while** block will keep on repeating indefinitely… This is called an **infinite loop**.

```python
In [4]:    1  # Counting from 1 to infinity
           2  x = 0
           3  while(x>=0):
           4      x = x + 1
           5      print(x)
           6  print("Done!")
```

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
```

Infinite loops and how to kill them

Infinite loops will keep on executing forever, unless

1. Your computer runs out of resources and performs an emergency shutdown before exploding (**bad thing to do**),

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This is called a **keyboard interrupt.** It is done with **CTRL+C** (or **CMD+C** on mac), in console mode and most IDEs.

```
Counting from 1 to infinity...
1
2
3
4
5
6
7
8
9
10
Traceback (most recent call last):
  File ".\infinite_loop.py", line 8, in <module>
    time.sleep(1)
KeyboardInterrupt
```

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Or, by using the **stop button** on Jupyter.

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7
8
9
10
Traceback (most recent call last):
  File ".\infinite_loop.py", line 8, in <module>
    time.sleep(1)
KeyboardInterrupt
```

⬡ jupyter 3. While statement and breaks Las

| File | Edit | View | Insert | | Kernel | Help |

interrupt the kernel

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Matt's Great advice #7

Matt's Great Advice #7: Avoid the infinite loops and dead code, by drawing structural diagrams.

Infinite loops and **dead code**, unless created on purpose, usually follow from a **poor design** in your code.

Drawing a **structural diagram**, **before coding**, greatly helps figuring out the right structure for your code.
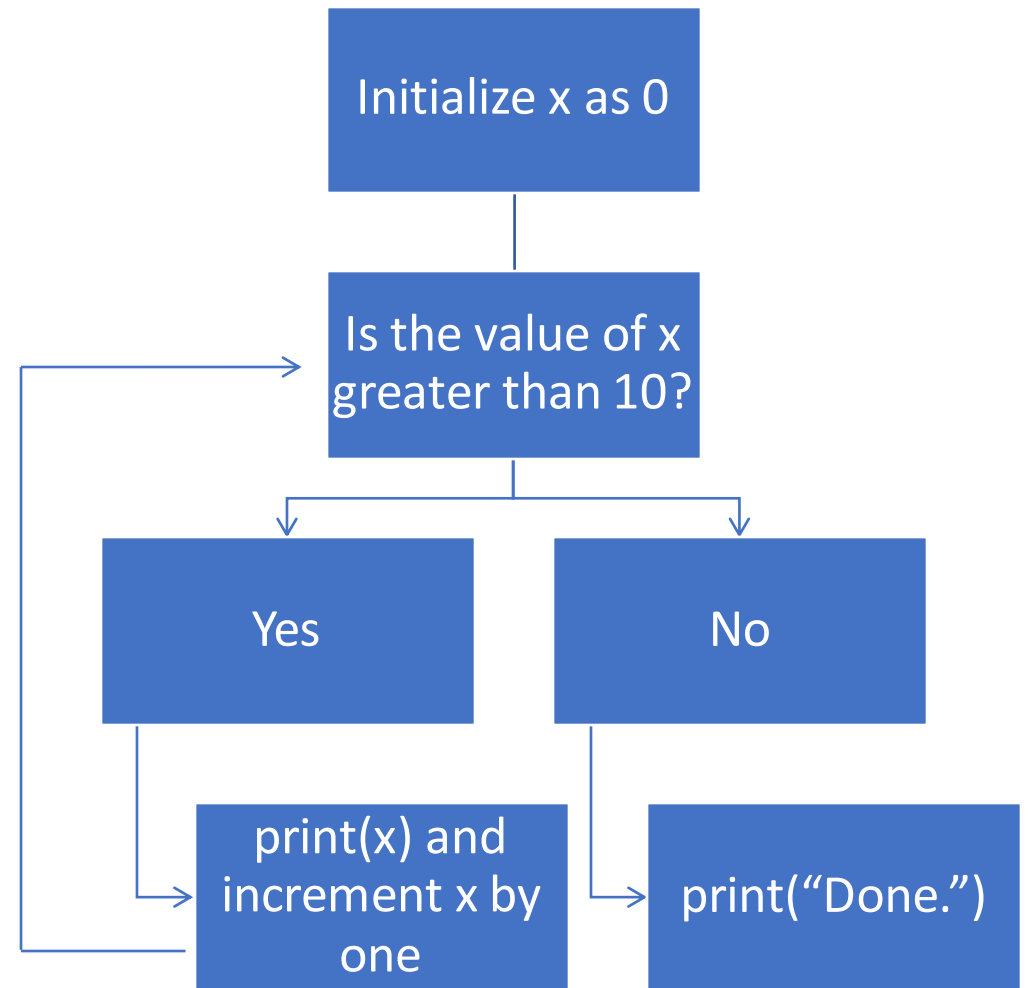
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```
Initialize x as 0
        |
Is the value of x
greater than 10?
   /         \
 Yes          No
   |           |
print(x) and   print("Done.")
increment x by
one
```

Example: diagram for our while loop, counting from 1 to 10.

Infinite loops and how to kill them

Infinite loops will keep on executing forever, unless

1. You decide to crash the program on purpose and kill the loop manually.

Infinite loops: the break statement

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2. You use a **break** statement.

When encountered, the **break** statement will immediately end the current **while** loop.

The code then resumes its execution with the next line outside of the **while** block.

```
1   # Counting from 1 to 10, with a break
2   x = 0
3   while(True):
4       x = x + 1
5       print(x)
6       # If x has reached the value 10, break the while loop
7       if(x>=10):
8           break
9           # Careful!
10          print("This is DEAD CODE, because the break is reached before.")
11  print("Done!")
```

```
1
2
3
4
5
6
7
8
9
10
Done!
```

Standard while vs. infinite while + break

1. Standard **while** loop with condition in the while statement.

```
1  # Counting from 1 to 10
2  x = 0
3  print("Counting from 1 to 10...")
4  while(x<10):
5      x = x + 1
6      print(x)
7  print("Done!")
```

2. Infinite **while** loop with condition in an **if** statement, and **break** in the **if** block.

```
1  # Counting from 1 to 10, with a break
2  x = 0
3  while(True):
4      x = x + 1
5      print(x)
6      # If x has reached the value 10,
7      # break the while loop
8      if(x>=10):
9          break
10 print("Done!")
```

→ Both loops work and do the job, which one is better though?

Matt's Great advice #8

Matt's Great Advice #8: Avoid the infinite loops, if possible.

Relying on an **infinite while** loop with a **break** is **risky**, and should be avoided when possible.

Matt's Great advice #8

Matt's Great Advice #8: Avoid the infinite loops, if possible.

Relying on an **infinite while** loop with a **break** is **risky**, and should be avoided when possible.

It is often easily avoided, by using the Boolean expression of the **if** statement used for **break**, as the condition in the **while** statement.

```python
# Counting from 1 to 10, with a break
x = 0
while(True):
    x = x + 1
    print(x)
    # If x has reached the value 10,
    # break the while loop
    if(x>=10):
        break
print("Done!")
```

```python
# Counting from 1 to 10
x = 0
print("Counting from 1 to 10...")
while(x<10):
    x = x + 1
    print(x)
print("Done!")
```

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Relying on an **infinite while** loop with a **break** is **risky**, and should be avoided when possible.

It is often easily avoided, by using the Boolean expression of the **if** statement used for **break**, as the condition in the **while** statement.

Note: a few cases, however, require the use of a **break** statement.
For instance, **emergency shutdowns**.

```python
1   while(True):
2       print("All systems normal.")
3       print("Running operations as expected.")
4       if(overheating):
5           print("Overheating detected.")
6           print("Engaging emergency shutdown.")
7           break
```

Practice activities for while/break

Let us practice the **while**/**break** concepts a bit, with two activities.

Activity 1 – How many hits can you take.ipynb

Activity 1 - How many hits can you take

Your main character currently has a number of lifepoints, stored in **lifepoints_number**.

Your mentor gives you the following challenge: he will hit you, for a given number of times n.

- The **first hit** will make you **lose one lifepoint**,
- the **second**, **two lifepoints**,
- the **third**, **three lifepoints**,
- and **so on**.
- **If** you take too many hits and **your lifepoints fall at or below zero, you fail the challenge.**

- Assuming you survive n hits, your mentor will give you n^2 coins.

Write a function, named **maximal_coins_number()**, which

- **receives** your current number of **lifepoints**, as the variable **lifepoints_number**,
- and **returns** the **maximal number of coins** you can hope to obtain from the challenge,
- as well the **number of lifepoints** that will be **remaining after taking this maximal number of hits**.

Activity 2 – Guess the number game v2

Remember the guess the number game in W3S1, Activity 1? Back then, we had defined a function **guess_the_number()**,

- which received a **hidden number that the user had to guess** (passed as input **hidden_number**),

- **asked the user to input a number**, via the **input()** method and would store it in a variable **guessed_number**,

- and based on the two numbers would **display two messages**, reading:
  - "You have found the hidden number: True/False."
  - "Your number in guessed_number is lower than the hidden number: True/False."

Your task is to write a **second version** (v2!) of this function, called **guess_the_number_v2().**

Activity 2 – Guess the number game v2

This v2 function will have the following features, replacing the previous ones:

- The game will **keep on asking the user to input()** values, **until the right number is found**.
- It will **display the message** "Your have found the right number!", **once the user has found the right number.**
- When that happens, it **also displays** "It only took you ... tries!" with the blank filled with the number of times the user had to type a number via input().
- Once the number has been found, the function no longer asks the user for inputs and stops.
- **While the user has not found the right number**, the game will **display either**
  - "Your number is lower than the hidden number." (if the last number entered by the user is lower than the hidden number)
  - or "Your number is higher than the hidden number." (if the last number entered by the user is higher than the hidden number).

Conclusion

- While statements
- Infinite loops and how to kill them
- The break statement
- (If time allows, recursion!)

Up for a challenge?
(in the Extra challenges folder)

Challenge: Activity 1+ - How many hits can you take (extra challenge).ipynb

- Similarly, as in other challenges…

- Do not use any conditional statement (**if**/**while**)

- **Hint:** use a bit of maths on sequences!