COMP1021
Introduction to Computer Science

Making Decisions

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Outcomes

- After completing this presentation, you are expected to be able to:
  1. Use the if statements (if, elif and else) to make decisions in a Python program
  2. Write code using nested if statements

The if Statement

- The if statement is used to decide whether some code will be executed
- Here is a simple example:

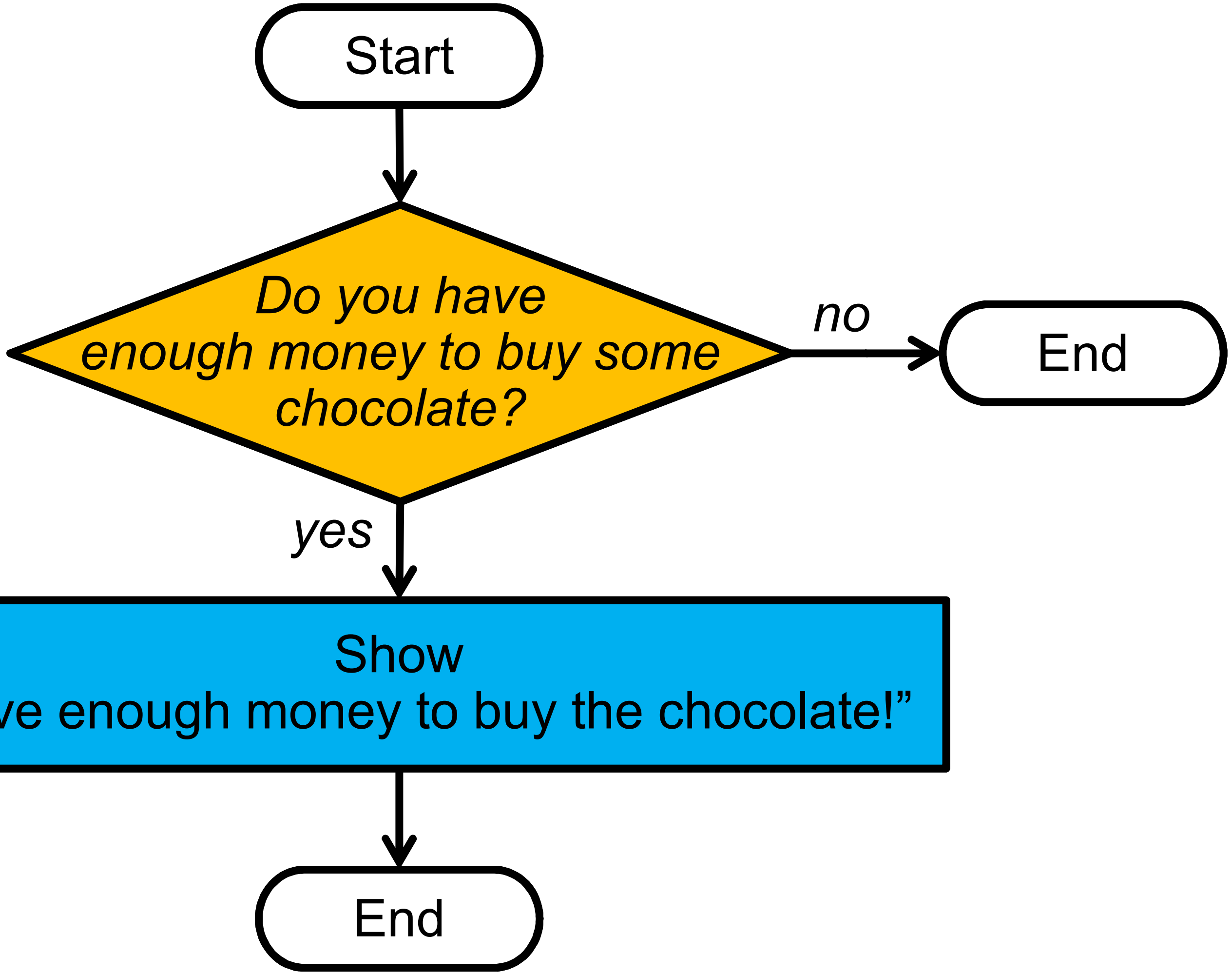
```
cost_of_chocolate = 10
money_in_pocket = 10

if money_in_pocket >= cost_of_chocolate:
    print("I have enough money to buy the chocolate!")
```

You need the **:** *(colon) here*

This means greater than or equal to

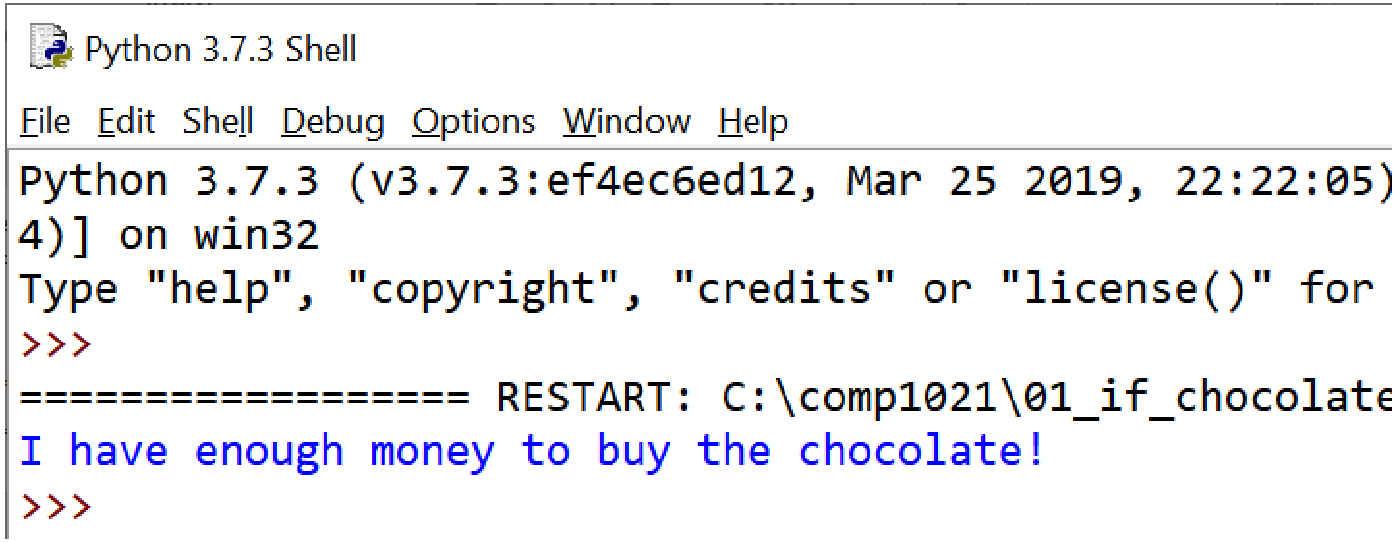
The Flow of the if Statement Example

- We can show the idea using a flowchart, like this:


Start
Do you have enough money to buy some chocolate?
no
End
yes
Show
“I have enough money to buy the chocolate!”
End

Running the if Example

- This is what we see when we load and run the program:



```
Python 3.7.3 (v3.7.3:ef4ec6ed12, Mar 25 2019, 22:22:05)
4)] on win32
Type "help", "copyright", "credits" or "license()" for
>>>
================== RESTART: C:\comp1021\01_if_chocolate
I have enough money to buy the chocolate!
>>>
```

- However, what happens if the result of the ‘if’ is different?

Running the if Example Again

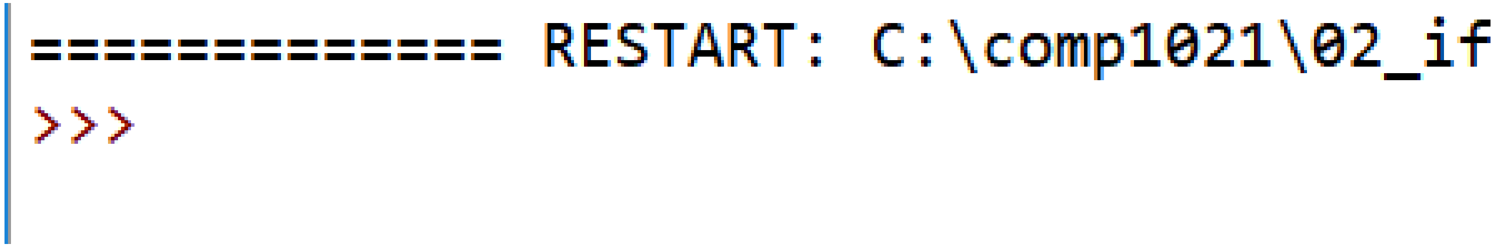
- Let’s edit the file and change this line of code:

```
cost_of_chocolate = 10
```

to this:

```
cost_of_chocolate = 12
```

- When we load and run the code, it looks like this:



```
============== RESTART: C:\comp1021\02_if
>>>
```

- As you can see, nothing is produced by the program!

The if Condition

- Python decides whether to run the code inside the if statement by evaluating the *condition*
- In our example, the condition is the one shown below (enough money to buy chocolate?):

```
. . .
if money_in_pocket >= cost_of_chocolate:
    . . .
```

- If the condition is true, Python will run the code inside the if statement; otherwise, Python will skip the code

Using Comparison Operators

- You can do the following comparisons:

<	less than
<=	less than or equal to
>	greater than
>=	greater than or equal to
==	equal to
!=	not equal to

- You can also use *and* *or* and *not*, discussed in another presentation

You Must Use Indentation

- In programming, ‘indentation’ means ‘moving the lines of code to the right, to the appropriate place’
- For Python code, indentation is **very important**!
- For example, there MUST be indentation here

```
cost_of_chocolate = 10
money_in_pocket = 10

if money_in_pocket >= cost_of_chocolate:
      print("I have enough money to buy the chocolate!")
```

You Must Use Indentation

```
cost_of_chocolate = 10
money_in_pocket = 10

if money_in_pocket >= cost_of_chocolate:
      print("I have enough money to buy the chocolate!")
```

- Without this indentation, the program won’t work!
- Although this sounds like trouble, it means that when you look at any Python code, it is easier to understand

How to Do the Indentation?

```
if money_in_pocket >= cost_of_chocolate:
    print("I have enough money to buy the chocolate!")
```

- How far should you move a line of code for each 'unit' of indentation?
- Usually, people simply press the Tab key
- When you press the Tab key the IDLE editor adds 4 spaces

Indentation in IDLE

- The IDLE editor which we use is helpful – for example, if you type

  ```
  if x > 4:
  ```

  and then press enter, IDLE will understand that you need to have some indentation on the next line and will automatically add it for you!

Extending the if Statement

- In English you might say:

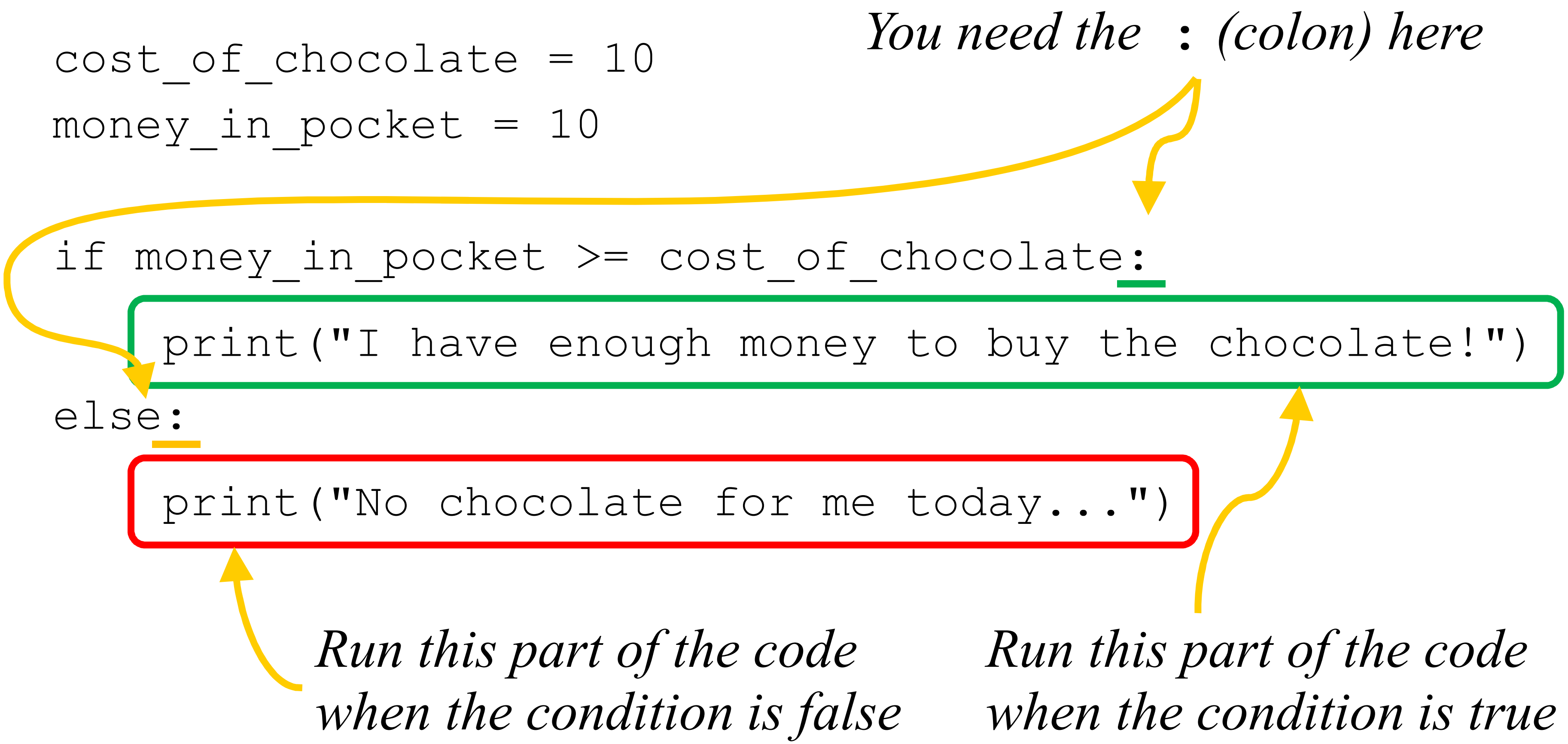
  “**if** *something* **otherwise** *something else*”

- For example:

  “**if** I have a million dollars I am rich **otherwise** I am poor”

- We can do the same thing in Python by using the word ‘else’
- An example is shown on the next slide

The if … else Example



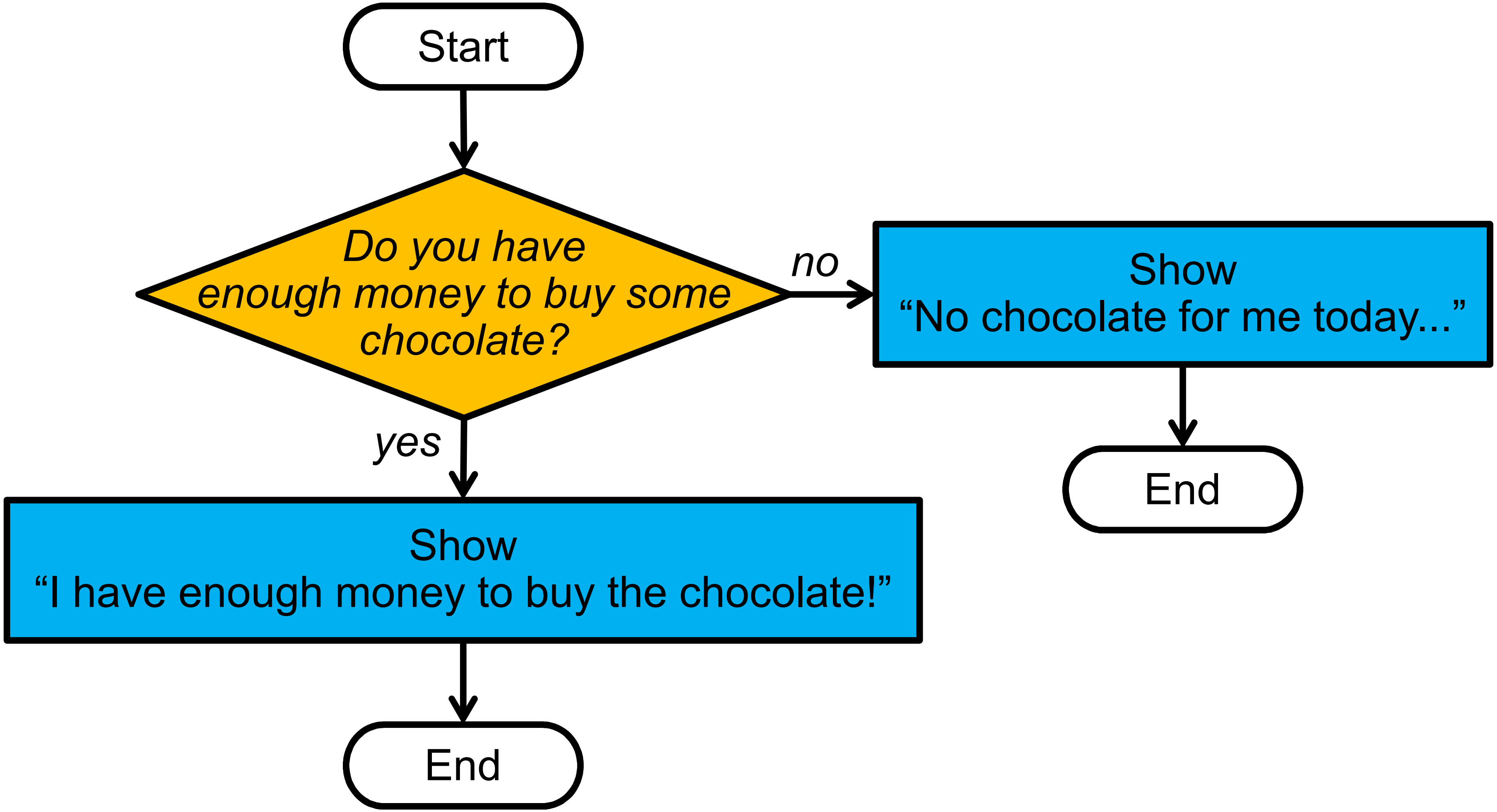
```
cost_of_chocolate = 10
money_in_pocket = 10

if money_in_pocket >= cost_of_chocolate:
    print("I have enough money to buy the chocolate!")
else:
    print("No chocolate for me today...")
```

You need the **:** *(colon) here*

Run this part of the code when the condition is false

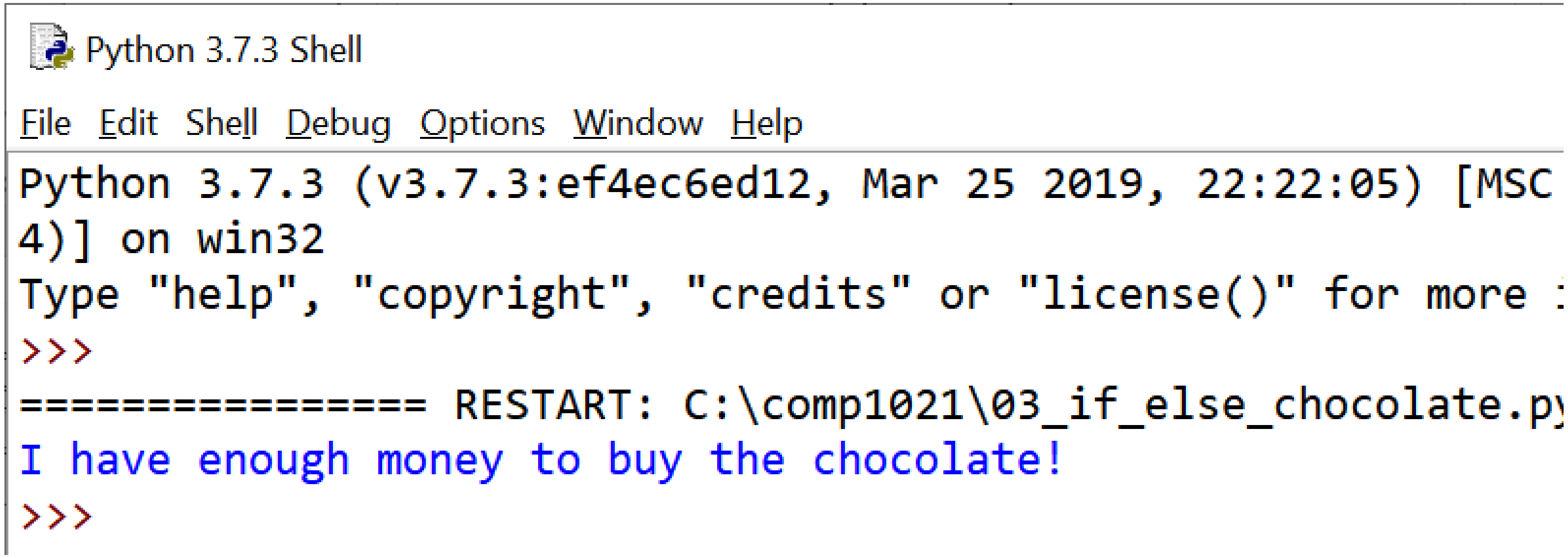
Run this part of the code when the condition is true

The Flow of the if … else Example


Start
Do you have enough money to buy some chocolate?
no
Show “No chocolate for me today...”
End
yes
Show “I have enough money to buy the chocolate!”
End

Running the if … else Example

- This is what we see when we run the program:



```
Python 3.7.3 (v3.7.3:ef4ec6ed12, Mar 25 2019, 22:22:05) [MSC
4)] on win32
Type "help", "copyright", "credits" or "license()" for more :
>>>
================ RESTART: C:\comp1021\03_if_else_chocolate.p
I have enough money to buy the chocolate!
>>>
```

- However, what happens if the result of the ‘if’ is different?

Running the if … else Example Again

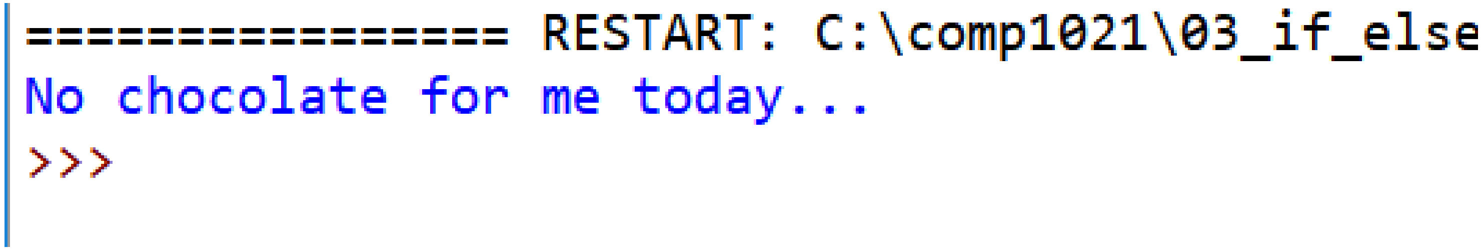
- Let’s edit the file and change this line of code:

```
cost_of_chocolate = 10
```

to this:

```
cost_of_chocolate = 12
```

- When we run the code, it looks like this:



```
================= RESTART: C:\comp1021\03_if_else
No chocolate for me today...
>>>
```

- This is much nicer than showing nothing!

Multiple if Statements

- Sometimes it is useful to do a second test if the first test fails
- Here is an example:

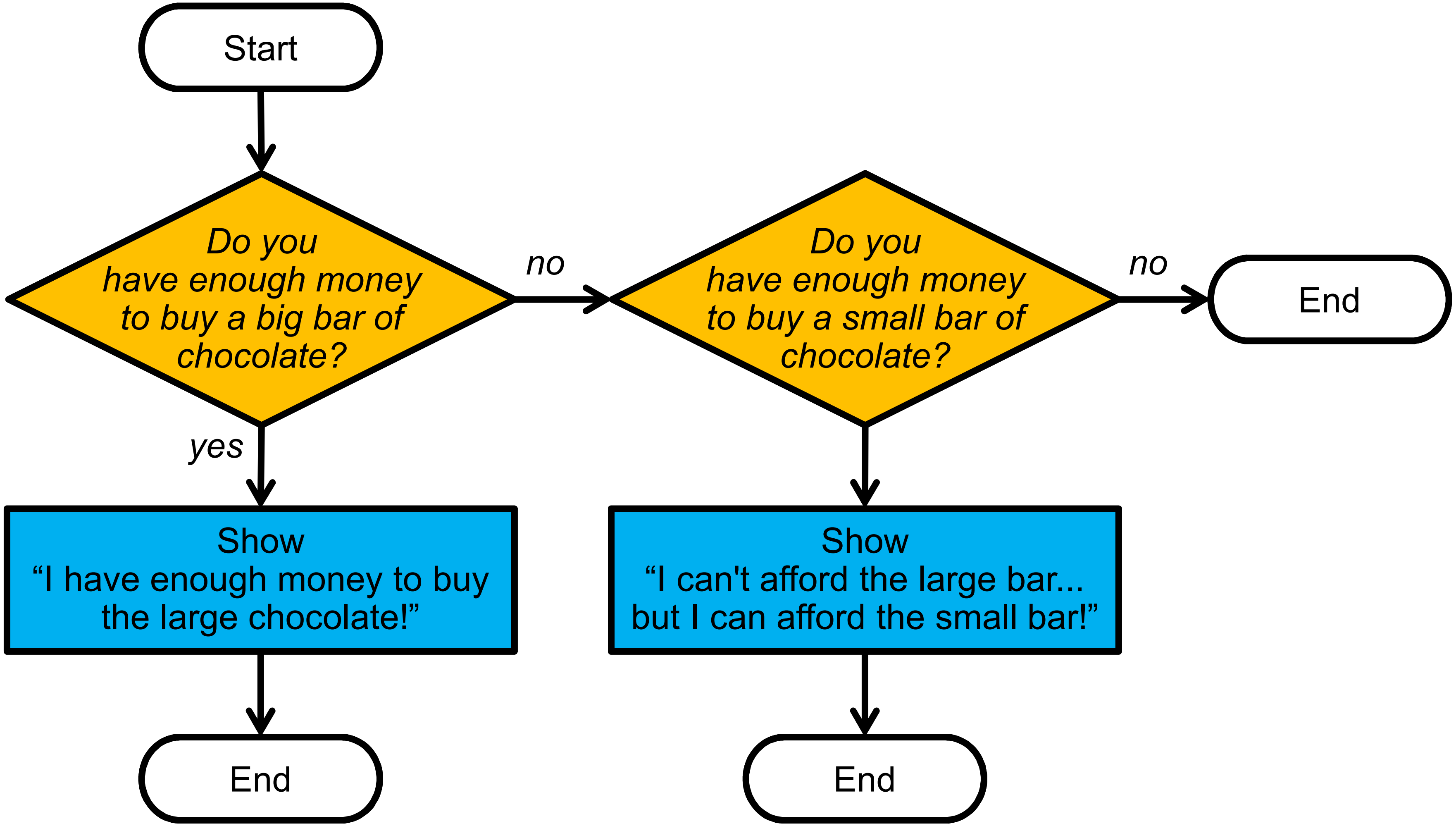
```
cost_of_large_chocolate_bar = 12
cost_of_small_chocolate_bar = 8
money_in_pocket = 10

if money_in_pocket >= cost_of_large_chocolate_bar:
    print("I have enough money to buy
          the large chocolate!")
else:
    if money_in_pocket >= cost_of_small_chocolate_bar:
        print("I can't afford the large bar...
              but I can afford the small bar!")
```

The if … elif Statement

- Instead of using many if statements we can use the elif statement, for example:

```
cost_of_large_chocolate_bar = 12
cost_of_small_chocolate_bar = 8
money_in_pocket = 10

if money_in_pocket >= cost_of_large_chocolate_bar:
    print("I have enough money to buy
          the large chocolate!")
elif money_in_pocket >= cost_of_small_chocolate_bar:
    print("I can't afford the large bar...
          but I can afford the small bar!")
```

The Flow of the if … elif Example

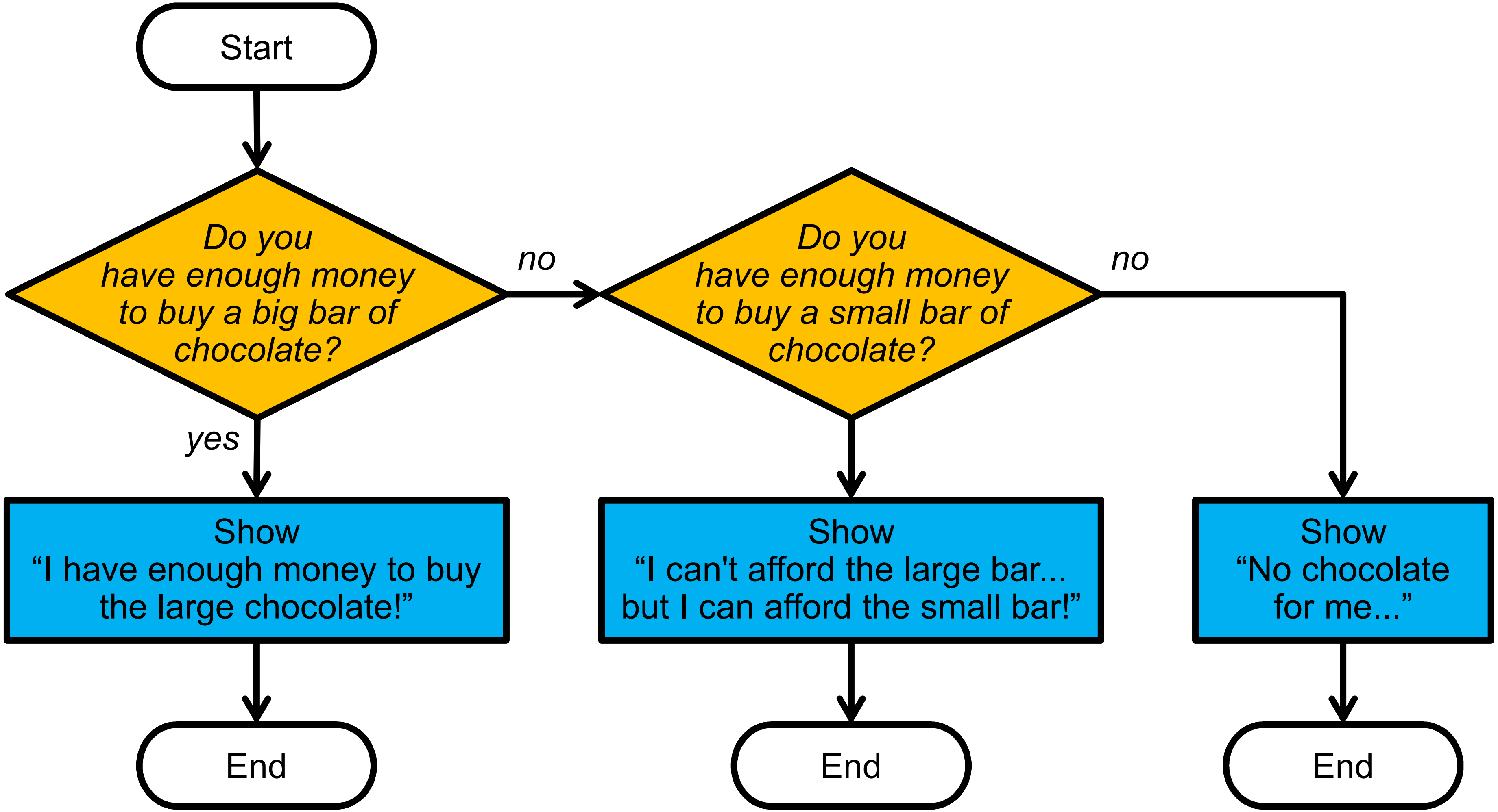

Start
Do you have enough money to buy a big bar of chocolate?
no
yes
Do you have enough money to buy a small bar of chocolate?
no
End
Show “I have enough money to buy the large chocolate!”
Show “I can't afford the large bar... but I can afford the small bar!”
End
End

Using if … elif … else

- If both tests fail, our previous example doesn’t display anything
- Let’s fix that by adding an else:

```
cost_of_large_chocolate_bar = 12
cost_of_small_chocolate_bar = 8
money_in_pocket = 10

if money_in_pocket >= cost_of_large_chocolate_bar:
    print("I have enough money to buy
          the large chocolate!")
elif money_in_pocket >= cost_of_small_chocolate_bar:
    print("I can't afford the large bar...
          but I can afford the small bar!")
else:
    print("No chocolate for me...")
```

The Flow of the if…elif…else Example


Start
Do you have enough money to buy a big bar of chocolate?
no
Do you have enough money to buy a small bar of chocolate?
no
yes
Show "I have enough money to buy the large chocolate!"
Show "I can't afford the large bar... but I can afford the small bar!"
Show "No chocolate for me..."
End
End
End

An Example with Many elif 1/2

- You can have as many elif parts as you like
- Here’s an example which ‘converts’ a number into English:

```
value = input("Enter a number from 0 to 9: ")
value = int(value)
if value == 0:
    number_in_english = "Zero"
elif value == 1:
    number_in_english = "One"
elif value == 2:
    number_in_english = "Two"
elif value == 3:
    number_in_english = "Three"
```

This means ‘equal to’

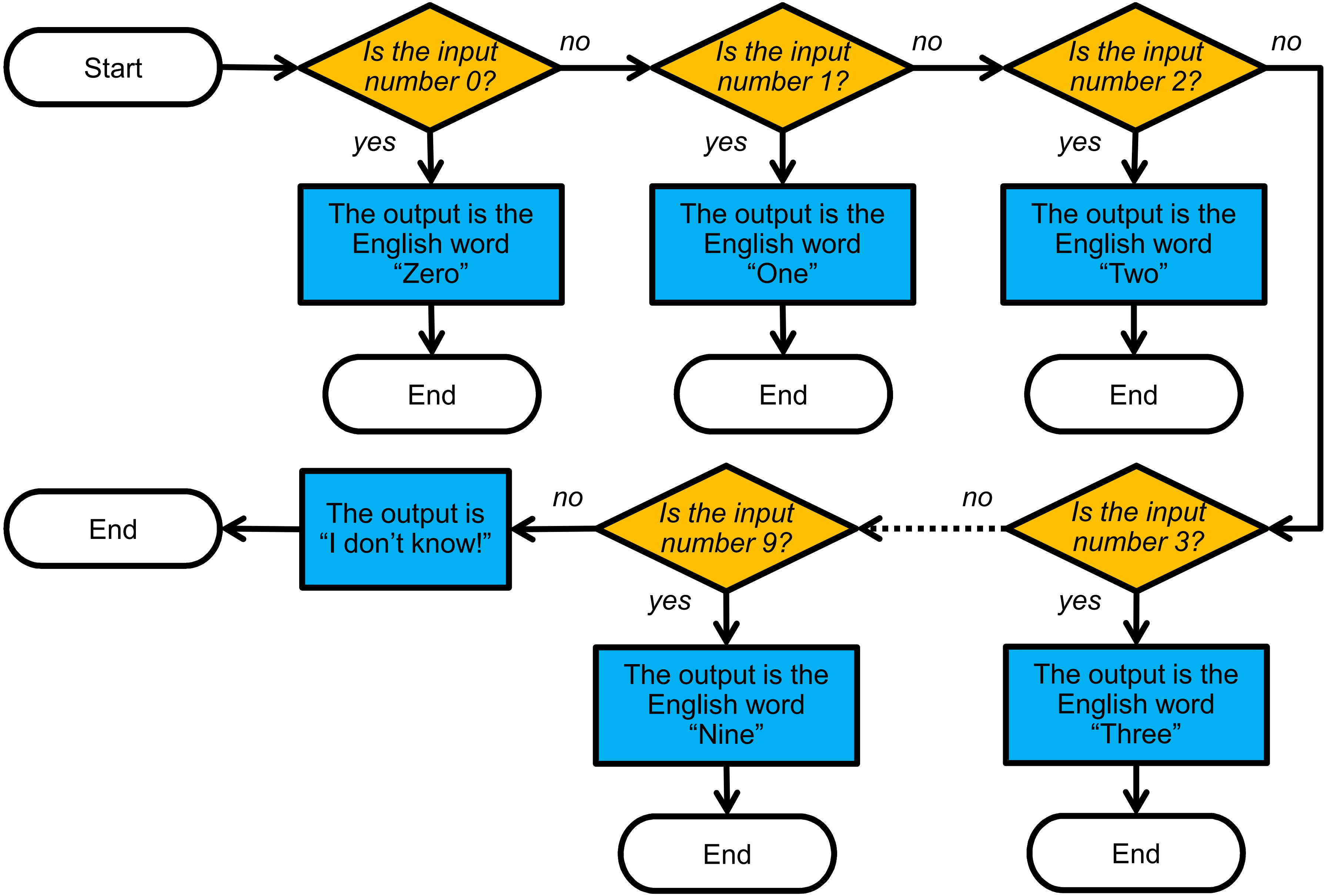
A space has been added at the end of the question so that the output looks nicer

An Example with Many elif 2/2

```
elif value == 4:
    number_in_english = "Four"
elif value == 5:
    number_in_english = "Five"
elif value == 6:
    number_in_english = "Six"
elif value == 7:
    number_in_english = "Seven"
elif value == 8:
    number_in_english = "Eight"
elif value == 9:
    number_in_english = "Nine"
else:
    number_in_english = "I don't know!"
print("The number in English is " + number_in_english)
```

- You can use + to put together many pieces of text into a single piece of text
- Using + in this way is called *concatenation*

The Flow of Using Many elif



Start

Is the input number 0?

no

yes

The output is the English word "Zero"

End

Is the input number 1?

no

yes

The output is the English word "One"

End

Is the input number 2?

no

yes

The output is the English word "Two"

End

Is the input number 3?

no

yes

The output is the English word "Three"

End

Is the input number 9?

no

yes

The output is the English word "Nine"

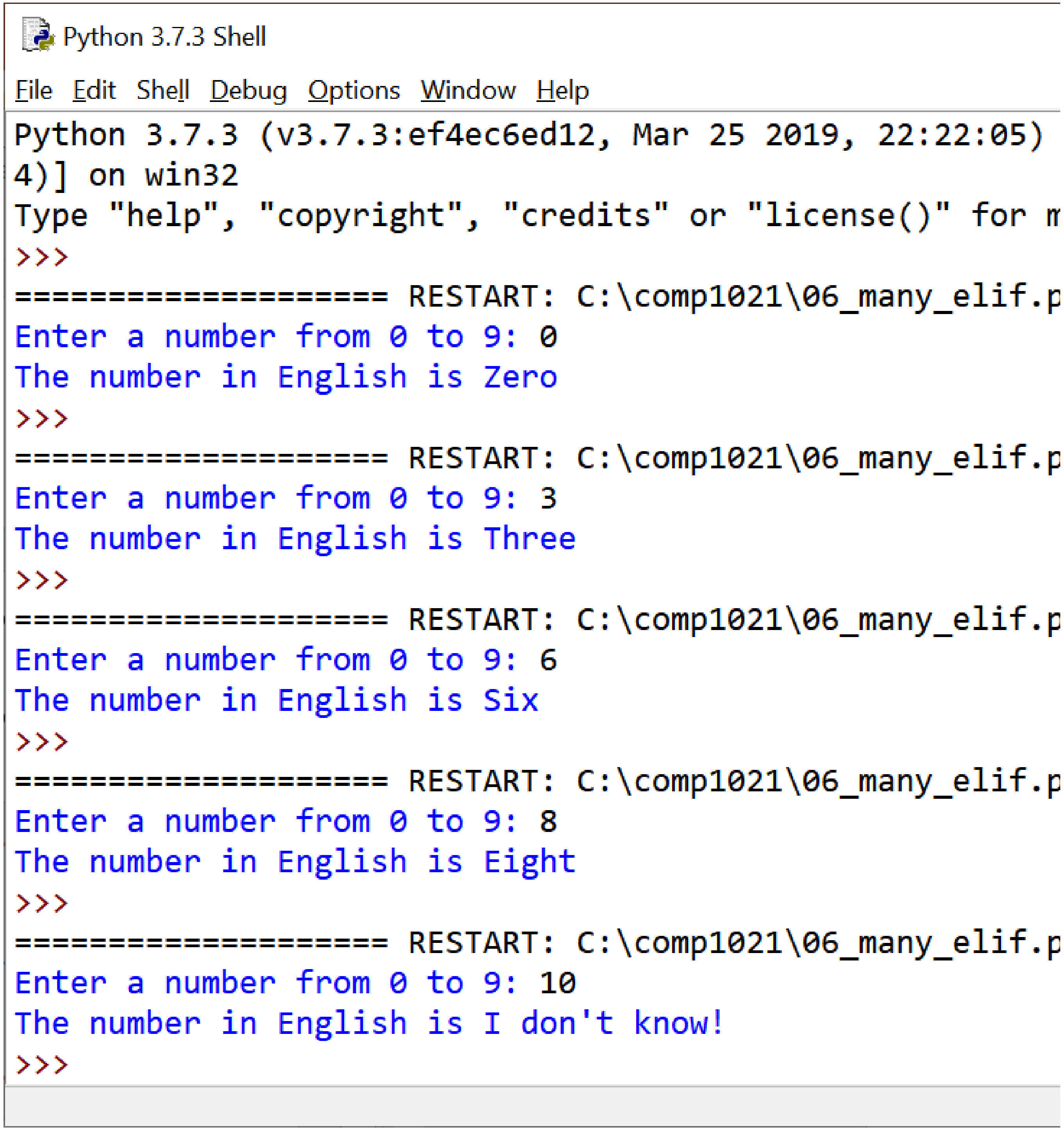
End

The output is "I don't know!"

End

Running the Program

- Here's some examples of running the program



```
Python 3.7.3 (v3.7.3:ef4ec6ed12, Mar 25 2019, 22:22:05)
4)] on win32
Type "help", "copyright", "credits" or "license()" for m
>>>
==================== RESTART: C:\comp1021\06_many_elif.p
Enter a number from 0 to 9: 0
The number in English is Zero
>>>
==================== RESTART: C:\comp1021\06_many_elif.p
Enter a number from 0 to 9: 3
The number in English is Three
>>>
==================== RESTART: C:\comp1021\06_many_elif.p
Enter a number from 0 to 9: 6
The number in English is Six
>>>
==================== RESTART: C:\comp1021\06_many_elif.p
Enter a number from 0 to 9: 8
The number in English is Eight
>>>
==================== RESTART: C:\comp1021\06_many_elif.p
Enter a number from 0 to 9: 10
The number in English is I don't know!
>>>
```

The Basic Pattern of if

```
if ...condition...    :
      ...some code...
elif ...condition... :
      ...some code...
else :
      ...some code...
```

- The *if* gets things started

- There's >=0 *elif*
- You can have as many *elif* as you want

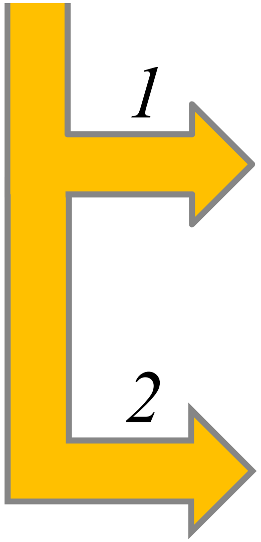
- There's zero or 1 *else*
- If *else* is used then it is always at the end

Nested if Statements

- If you want to you can put an if statement inside another if statement
- When you do that it is called a *nested if*
- The next slide shows the ‘flow structure’ of an example using turtle graphics and nested if statements

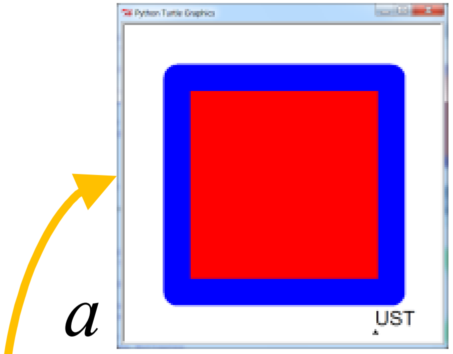
```
if ...condition... :
    ...some code...
    if ...condition... :
        ...some code...
    ...some code...
```

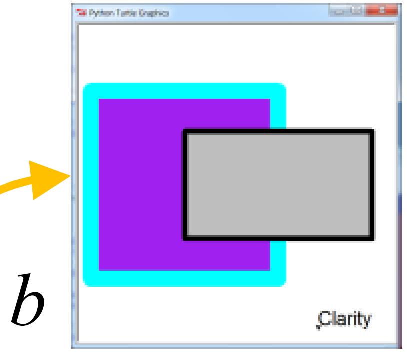
```
Beautiful Modern Art!

This program will display some beautiful
modern art, according to your choices.

Please choose one of the following.

1 - using squares/rectangles
2 - using turtle.circle

Which one do you want?
```

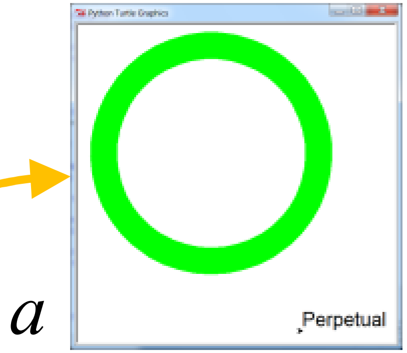


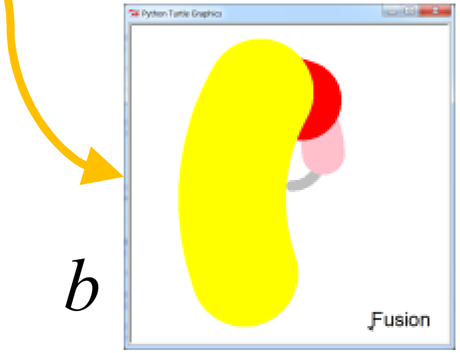
```
Please choose one of the following.

a - simple art using squares/rectangles
b - advanced art using squares/rectangles

Which one do you want?
```

```
Please choose one of the following.

a - simple art using turtle.circle
b - advanced art using turtle.circle

Which one do you want?
```





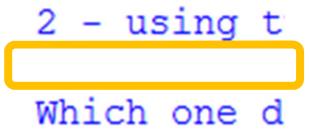




The Code 1/4

```
import turtle

print("Beautiful Modern Art!")
print()
print("This program will display some beautiful")
print("modern art, according to your choices.")
print()
print("Please choose one of the following.")
print()
print("1 - using squares/rectangles")
print("2 - using turtle.circle")
print()

choice = input("Which one do you want? ")
```

This code prints an empty line, i.e.

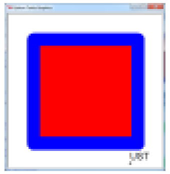


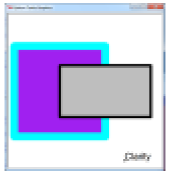
```
2 - using t

Which one d
```

The Code 2/4

Single indentation (4 spaces) for these areas

```
if choice == "1":
    print("Please choose one of the following.")
    print()
    print("a - simple art using squares/rectangles")
    print("b - advanced art using squares/rectangles")
    print()
    second_choice = input("Which one do you want? ")

    if second_choice == "a":
        ... draw a square ...
    elif second_choice == "b":
        ... draw a square and rectangle ...
    else:
        print("You need to enter a or b!")
```

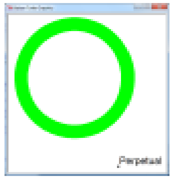


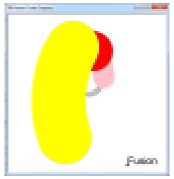


Double indentation (i.e. 8 spaces) for these areas

The Code 3/4

```
elif choice == "2":
    print("Please choose one of the following.")
    print()
    print("a - simple art using turtle.circle")
    print("b - advanced art using turtle.circle")
    print()
    second_choice = input("Which one do you want? ")

    if second_choice == "a":
        ... draw a circle ...
    elif second_choice == "b":
        ... draw sections of circles ...
    else:
        print("You need to enter a or b!")
```

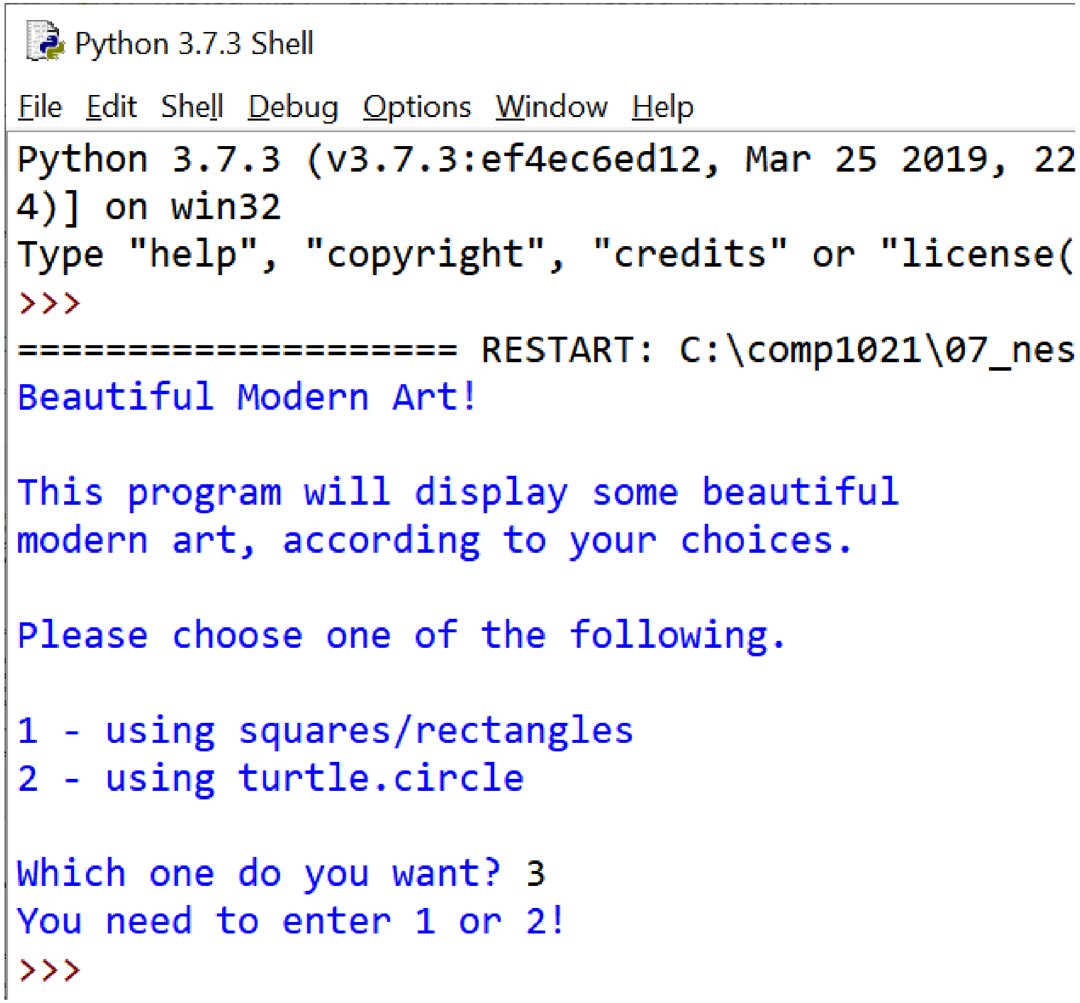




The Code 4/4

```
else:
    print("You need to enter 1 or 2!")
```

- If the user doesn't enter a '1' or a '2' when replying to the first question, this part will be executed



```
Python 3.7.3 (v3.7.3:ef4ec6ed12, Mar 25 2019, 22
4)] on win32
Type "help", "copyright", "credits" or "license(
>>> 
==================== RESTART: C:\comp1021\07_nes
Beautiful Modern Art!

This program will display some beautiful
modern art, according to your choices.

Please choose one of the following.

1 - using squares/rectangles
2 - using turtle.circle

Which one do you want? 3
You need to enter 1 or 2!
>>> 
```