COMPSCI 101

Principles of Programming

Lecture 11 – if … else, if ... elif statements, nested ifs

Learning outcomes

At the end of this lecture, students should:

- be able to use conditional statements which contain an else block (if…else statements)
- be able to use nested ifs
- be able to use if…elif statements

Recap

From lecture 10

- boolean expressions evaluate to either `True` or `False`
- There are only two boolean values `True` and `False`
- Relational operators (>, <, <=, <= and ==) are used to compare values
- Logical operators (not, and, or) can be used to build more complex boolean expressions
- an if statements is used when a block of code is to be executed only if a particular condition is True

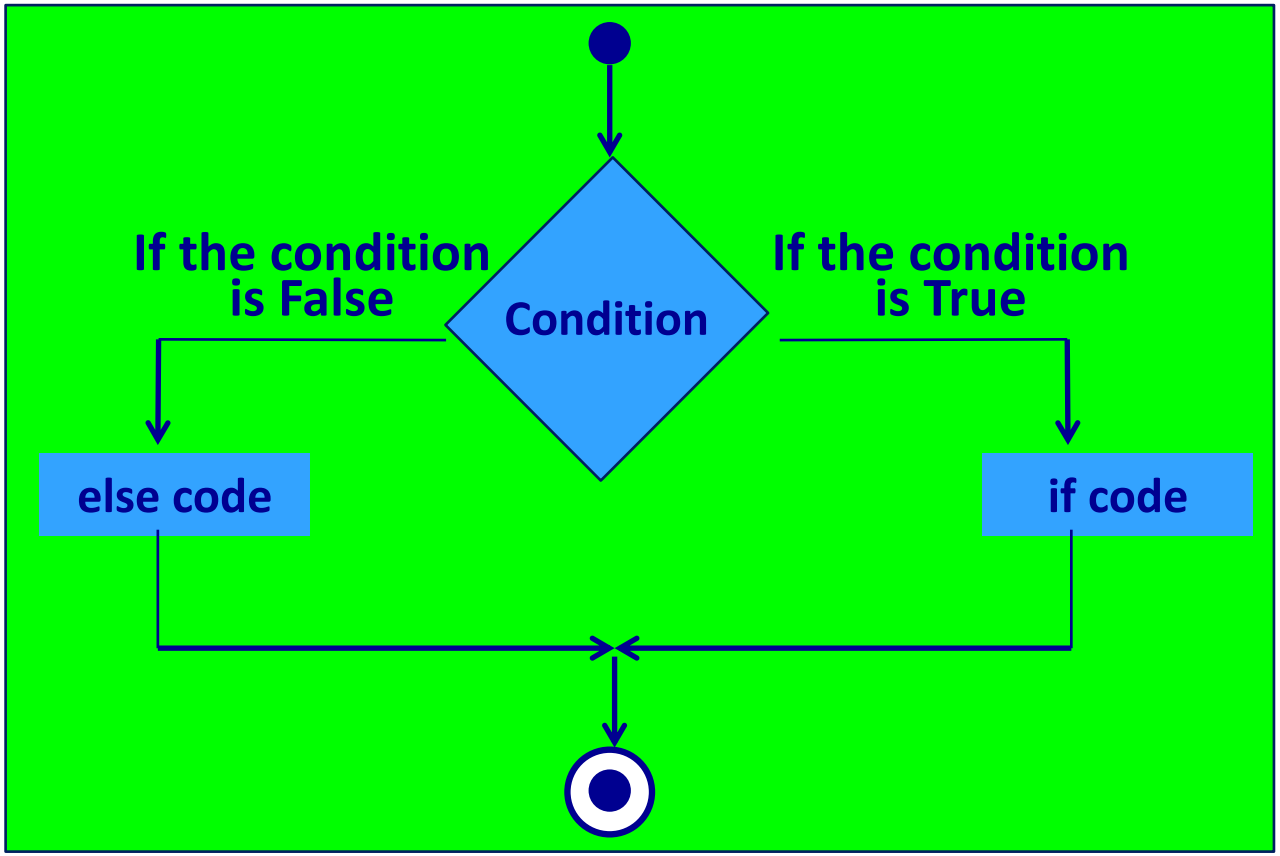
```
def copyright_check(current_y, death_y):
    if current_y - author_death_y >= 50:
        print("Out of copyright")

def main():
    current_year = 2020
    author_death_year = input("Enter year of author's death: ")
    author_death_year = int(author_death_year)
    copyright_check(current_year, author_death_year)

main()
```

Enter year of author's death: 1960
Out of copyright

Enter year of author's death: 1971

Python syntax for an if…else statement

In an **`if…else`** statement the code in the 'if block' is executed if the condition evaluates to `True` and the code in the 'else block' is executed if the condition evaluates to `False`.




```
if boolean_expression:
    statement1
    statement2
else:
    statement3
    statement4
```

if...else statement - example

```
1   def what_to_wear(temperature):
2       if temperature > 25:
3           print("Wear shorts.")
4       else:
5           print("Not hot today!")
6           print("Wear long pants.")
7       print("Enjoy yourself.")

8   def main():
9       what_to_wear(20)
10      print()
11      what_to_wear(30)

12  main()
```

```
Not hot today!
Wear long pants.
Enjoy yourself.

Wear shorts.
Enjoy yourself.
```

Give the output

```
1  def show_output(number):
2      if number >= 45 and number < 60:
3          print("A")
4          number = number - 10
5      else:
6          print("B")
7          number = number + 10
8      if number % 9 == 0:
9          print("C")
10         number = number - 5
11     else:
12         print("D")
13         number = number + 6
14     print(number)
15 def main():
16     show_output(45)
27 main()
```

Complete the function

Complete the `add_bonus()` function which prints "Good job!" and returns 30000 plus the salary if the parameter is a value greater than 150000. Otherwise it prints "Superb performance!" and returns 300 plus the salary.

```
def add_bonus(salary):




def main():
   salary = 34000
   new_salary = add_bonus(salary)
   print("Was: $" + str(salary), "Now: $" + str(new_salary))
   print()
   salary = 250000
   new_salary = add_bonus(salary)
   print("Was: $" + str(salary), "Now: $" + str(new_salary)))
main()
```

Superb performance!
Was: $34000 Now: $34300

Good job!
Was: $250000 Now: $280000

Nested if's - example

Any statements, including other if statements, can be used inside if statements. For example:

```
1  def ice_cream_info(scoops, with_extras, on_cone):
2      price = scoops * 1.50
3      message = "scoops: " + str(scoops)
4      if with_extras:
5          message = message + ", plus extras"
6          if on_cone:
7              message = message + ", on cone"
8              price = price + 2
9          else:
10             message = message + ", in cup"
11             price = price + 1
12     else:
13         if on_cone:
14             message = message + ", on cone"
15             price = price + 2
16         else:
17             message = message + ", in cup"
18             price = price + 1

19     print(message + " $" + str(price))
```

Three calls to the ice_cream_info() function

```
def main():
    ice_cream_info(3, True, False)
    ice_cream_info(2, False,False)
    ice_cream_info(4, True, True)

main()
```

```
scoops: 3, plus extras, in cup $5.5
scoops: 2, in cup $4.0
scoops: 4, plus extras, on cone $8.0
```

Give the output

```
1  def display_output(x, y, z):
2    if x == 5 or y > 5:
3      if x > 4 and z == 8:
4        print("A")
5      else:
6        if y == 6 and z >= x:
7          print("B")
8        else:
9          print("C")
10   else:
11     print("D")

12 def main():
13   display_output(4, 6, 8)

14 main()
```

Note how the indentation increases at every nested if and this moves the code further and further to the right hand side.

Executing one of several options

Sometimes you have a situation when you wish to execute one block of code from many options, e.g. if you wish to print one statement depending on the number entered by the user.

```
1  def what_to_do_now():
2     message = "Time to "
3     user_choice = int(input("Enter selection (1, 2,
                                                or 3): "))
4     if user_choice == 1:
5         print(message, "eat")
6     else:
7         if user_choice == 2:
8             print(message, "play")
9         else:
10            if user_choice == 3:
11                print(message, "sleep")
12            else:
13                print("incorrect selection!")
```

```
Enter selection (1, 2, or 3): 2
Time to  play
```

Complete the function

Using nested `if` statements complete the `compare_nums1()` function which is passed two integers and returns a string. The function compares the first number to the second number and returns one of the following three strings (i.e., the string which is applicable):

"equal to" OR "less than" OR "greater than"

```
def compare_nums1(                    ):









def main():
   num1 = random.randrange(1, 100)
   num2 = random.randrange(1, 100)
   comparison = compare_nums1(num1, num2)
   print(num1, "is", comparison, num2)
main()
```

Use a nested if to write the code

85 is greater than 21

64 is equal to 64

16 is less than 86

Python syntax of an if…elif statement

The **`if…elif` statement** allows at most one option (only one) to be executed out of many options. The else option (the last block) is optional.

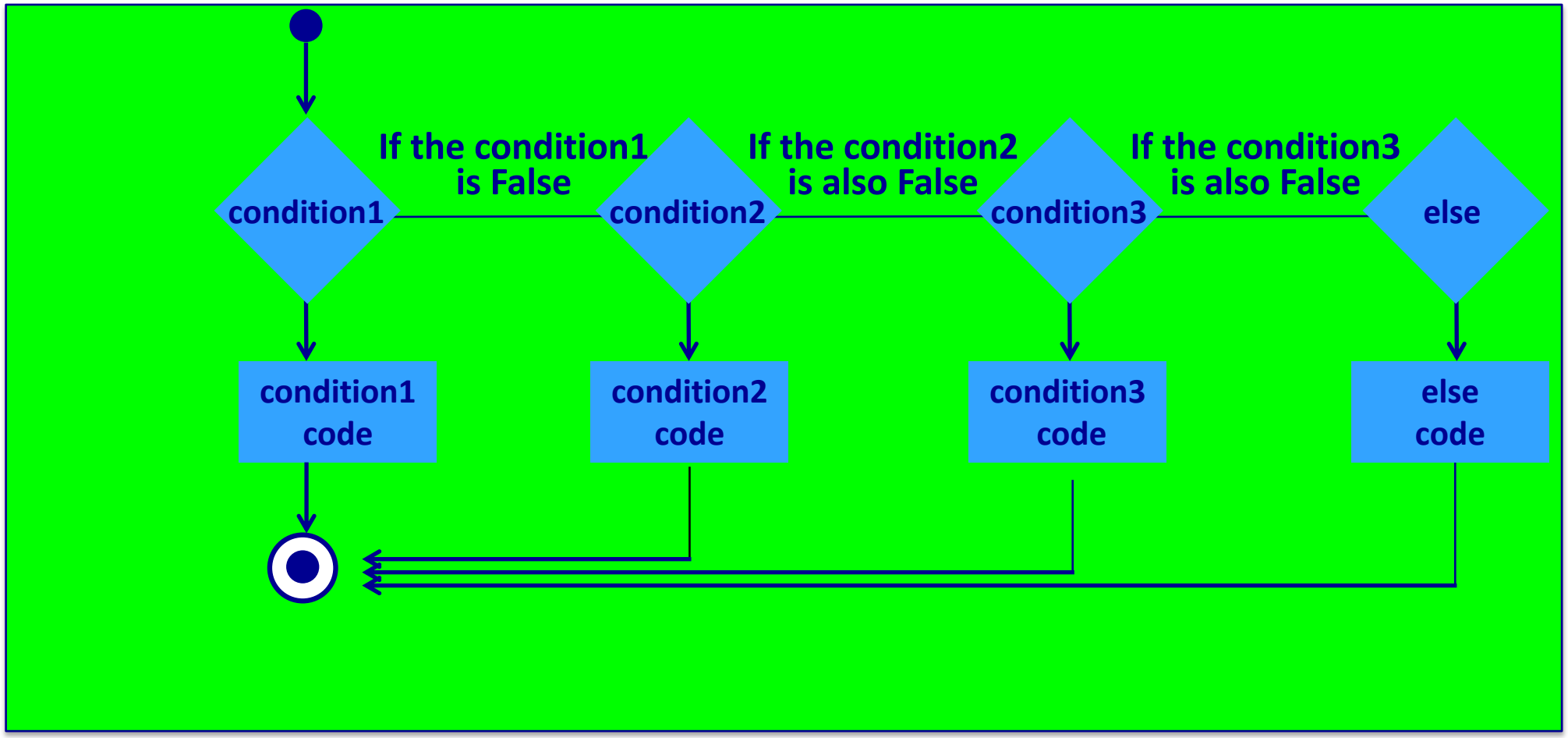
As soon as a match is found, the corresponding block of code is executed, then the if…elif statement is exited.

```
if boolean_expression1:
    statement1
    statement2
elif boolean_expression2:
    statement4
    statement5
elif boolean_expression3:
    statement6
    statement7
elif boolean_expression4:
    statement8
    statement9
else:
    statement10
    statement11
```

Note: at most one option is executed in an if…elif statement.

Python syntax for an if…elif statement

The following diagram shows an **`if…elif`** situation. As soon as a match is found, the corresponding block of code is executed, then the `if…elif` statement is exited.



Note: at most one option is executed in an if…elif statement.

An `if…elif` statement - example

A clearer way of writing the program from slide 10 is to use an **`if … elif`** statement:

```
1   def what_to_do_now():
2       message = "Time to "
3       prompt = "Enter selection (1, 2, or 3): "
4       user_choice = int(input(prompt))

5       if user_choice == 1:
6           print(message, "eat")
7       elif user_choice == 2:
8           print(message, "play")
9       elif user_choice == 3:
10          print(message, "sleep")
11      else:
12          print("incorrect selection!")
```

```
Enter selection (1, 2, or 3): 2
Time to  play
```

Complete the function

Using and `if … elif` statement complete the `compare_nums2()` function which is passed two integers and returns a string. The function compares the first number to the second number and returns one of the following three strings (i.e., the string which is applicable):

"equal to" OR "less than" OR "greater than"

```
def compare_nums2(                    ):









def main():
    num1 = random.randrange(1, 100)
    num2 = random.randrange(1, 100)
    comparison = compare_nums2(num1, num2)
    print(num1, "is", comparison, num2)
main()
```

Use an if…elif to write the code

16 is less than 86

64 is equal to 64

85 is greater than 21

Complete the function

A year is a leap year if it is divisible by 400, or divisible by 4 but not divisible by 100, e.g., 1900, 2011 and 2100 are not a leap years whereas 2000, 2008 and 2400 are leap years. Complete the `is_leap_year()` function.

```
def is_leap_year(year):




def main():
   print(is_leap_year(1900))
   print(is_leap_year(2011))
   print(is_leap_year(2100))
   print(is_leap_year(2000))
   print(is_leap_year(2008))
   print(is_leap_year(2018))
main()
```

```
False
False
False
True
True
False
```

If statements – exercise

Complete the `get_random_horoscope()` function which returns a random message. The function has 4 chances in 10 of returning "Amazing day ahead", 3 chances in 10 of returning "Romance is very likely", 1 chance in 10 of returning "Proceed with caution" and 2 chances in 10 of returning "Lucky lucky you".

```
import random
def get_random_horoscope():
   message1 = "Amazing day ahead"
   message2 = "Romance is very likely"
   message3 = "Proceed with caution"
   message4 = "Lucky lucky you"



def main():
   print("Today's message:", get_random_horoscope())
   print("Today's message:", get_random_horoscope())
main()
```

```
Today's message: Romance is very likely
Today's message: Amazing day ahead
```

get_random_horoscope() – solution 1

A solution to the function on slide 17:

```
def get_random_horoscope():
   message1 = "Amazing day ahead"
   message2 = "Romance is very likely"
   message3 = "Proceed with caution"
   message4 = "Lucky lucky you"
   message = ""
   number = random.randrange(0, 10)
   if number >= 0 and number < 4:
      message = message1
   if number >= 4 and number < 7:
      message = message2
   if number >= 7 and number < 8:
      message = message3
   if number >= 8 and number < 10:
      message = message4
   return message
```

get_random_horoscope() – solution 2

A second solution to the function on slide 17:

```
def get_random_horoscope():
   message1 = "Amazing day ahead"
   message2 = "Romance is very likely"
   message3 = "Proceed with caution"
   message4 = "Lucky lucky you"
   message = ""
   number = random.randrange(0, 10)
   if number < 4:
      message = message1
   elif number < 7:
      message = message2
   elif number < 8:
      message = message3
   else:
      message = message4
   return message
```

get_random_horoscope() function – solution 3

A third solution to the function on slide 17:

```
def get_random_horoscope():
   message1 = "Amazing day ahead"
   message2 = "Romance is very likely"
   message3 = "Proceed with caution"
   message4 = "Lucky lucky you"
   message = message4
   number = random.randrange(0, 10)

   if number < 4:
      message = message1
   elif number < 7:
      message = message2
   elif number < 8:
      message = message3

   return message
```

get_random_horoscope() – solution 4

A fourth solution to the function on slide 17:

```
def get_random_horoscope():
   message1 = "Amazing day ahead"
   message2 = "Romance is very likely"
   message3 = "Proceed with caution"
   message4 = "Lucky lucky you"

   number = random.randrange(0, 10)

   if number < 4:
      return message1
   elif number < 7:
      return message2
   elif number < 8:
      return message3
   else:
      return message4
```

get_random_horoscope() – solution 5

A fifth solution to the function on slide 17:

```
def get_random_horoscope():
   message1 = "Amazing day ahead"
   message2 = "Romance is very likely"
   message3 = "Proceed with caution"
   message4 = "Lucky lucky you"

   number = random.randrange(0, 10)

   if number < 4:
      return message1
   elif number < 7:
      return message2
   elif number < 8:
      return message3

   return message4
```

get_random_horoscope() – solution 6

A sixth solution to the function on slide 17:

```
def get_random_horoscope():
   message1 = "Amazing day ahead"
   message2 = "Romance is very likely"
   message3 = "Proceed with caution"
   message4 = "Lucky lucky you"

   number = random.randrange(0, 10)

   if number < 4:
      return message1
   if number < 7:
      return message2
   if number < 8:
      return message3

   return message4
```

get_random_horoscope() – OOOPS!

Why is the following code not a correct solution?

```
def get_random_horoscope():
   message1 = "Amazing day ahead"
   message2 = "Romance is very likely"
   message3 = "Proceed with caution"
   message4 = "Lucky lucky you"

   if random.randrange(0, 10) < 4:
      return message1
   elif random.randrange(0, 10) < 7:
      return message2
   elif random.randrange(0, 10) < 8:
      return message3

   return message4
```

Summary

In a Python program:

- the if block of an if…else statement is executed only if the boolean expression evaluates to True, otherwise the else block is executed.
- if statements can be nested inside other if statements.
- if…elif statements are useful if there is a situation where at most one option is to be selected from many options. The if…elif statement has an optional final else part.

Examples of Python features used in this lecture

```
if temperature > 25:
      print("Wear shorts.")
else:
      print("Not hot today!")
      print("Wear long pants.")

message = "Time to "
user_choice = int(input("Enter selection (1, 2, or 3): "))

if user_choice == 1:
      print(message, "eat")
elif user_choice == 2:
      print(message, "play")
elif user_choice == 3:
      print(message, "sleep")
else:
      print("incorrect selection!")
```