COMP 204

Control flow - Conditionals

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based on material from Mathieu Blanchette, Carlos Oliver and Christopher Cameron

Quiz 5 password

Recap from last lecture

Variables in logical comparison

```
1 Weight = float(input("Enter weight (in kg): "))
2 Height = float(input("Enter height (in m): "))
3 userBMI = Weight/(Height**2)
4 LowBMI = 18.5
5 HighBMI = 25
6 userBMI < LowBMI # under weight
7 userBMI >= LowBMI and userBMI <= HighBMI # normal
8 userBMI > HighBMI # overweight
```

Control flow

Until now, every line of our programs was executed exactly once, from top to bottom. This is very limiting!

- Conditionals: we may want to only execute a piece of code if a particular condition holds (e.g. if BMI is low, do something)
- While Loops: We may want to re-use certain pieces of code multiple times (e.g. keep asking someone the same questions until we get the correct answer)
- For Loops: We may want to perform the same operation on a large number of objects (e.g. change every 'T' to an 'A' and every 'G' to a 'C' in a complementary DNA sequence)

This is achieved using control flow instructions. The control flow of a program determines :

- Which part of the code should be executed regardlessly
- Which blocks of code should be executed *only under certain circumstances* (conditional execution, **today lecture**)
- Which blocks of code should be executed repeatedly, and for how many times

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- For Loops: We may want to perform the same operation on a large number of objects (e.g. change every 'T' to an 'A' and every 'G' to a 'C' in a complementary DNA sequence)

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- Which blocks of code should be executed *only under certain circumstances* (conditional execution, **today lecture**)
- Which blocks of code should be executed repeatedly, and for how many times

Conditionals

We use conditional execution to only execute a block of code if a certain boolean expression is true.

```
1 if booleanCondition:
2     # this block of code is only executed
3     # if booleanCondition is true
4 else:
5     # this block of code is only executed
6     # if booleanCondition is false
7
8 # this is outside the conditional
9 # this gets executed no matter what
```

IMPORTANT: In Python, we use indentation (tab character) to indicate what block a line belongs to.

Example 1 : BMI revisited (demo in class)

```
1  weight = float( input('Please enter your weight: ') )
2  height = float( input('Please enter your height: ') )
3  BMI = weight/(height**2)
4  print('Your BMI is ',BMI)
5
6  if BMI < 18.5 :
7      print("You are underweight")  # Lines 7 and 8 are only
8      print("Try to gain weight")   # executed if BMI< 18.5
9  else:
10     print("You are not underweight")
11
12 print("Thank you for using the BMI calculator")
```

Notes:

- Lines 7 and 8 form a block of code. They are indented together.
- The block 7-8 only gets executed if BMI < 18.5
- The block 10 only gets executed is BMI is not < 18.5
- Line 12 is outside the conditional; it gets executed after the conditional.

Example 2 : BMI re-revisited

```
1  weight = float( input('Please enter your weight: ') )
2  height = float( input('Please enter your height: ') )
3  BMI = weight/(height**2)
4  print('Your BMI is ',BMI)
5
6  if BMI < 18.5 :
7      print("You are underweight")
8      print("Try to gain weight")
9
10 if BMI >= 18.5 and BMI <24.9:
11     print("Your weight is normal")
12
13 if BMI > 24.9:
14     print("You are overweight")
15
16 print("Thank you for using the BMI calculator")
```

In line 10, we use logical key word "and" to combine two statements "BMI >= 18.5" **and** "BMI < 24.9"

Example 2 : BMI re-revisited (a logical mistake)

This is almost the same code, but it won't work properly: why?

```
1  weight = float( input('Please enter your weight: ') )
2  height = float( input('Please enter your height: ') )
3  BMI = weight/(height**2)
4  print('Your BMI is ',BMI)
5
6  if BMI < 18.5 :
7      print("You are underweight")
8      print("Try to gain weight")
9
10 if BMI >= 18.5 and BMI <24.9:
11     print("Your weight is normal")
12 else:
13     print("You are overweight")
14
15 print("Thank you for using the BMI calculator")
```

Chained conditional

To execute exactly one of several blocks, we can use the if-elif-else structure.

```
if condition1:
    # this is executed only if condition1 is true
elif condition2:
    # this is executed only if condition1 is false and
    condition2 is true
elif condition3:
    # this is executed only if condition1 is false and
    confition2 is false and condition3 is true
else:
    # this is executed only if all three conditions are
    false
```

Example 2 : BMI re-re-revisited

This version works correctly.

```
1  weight = float( input('Please enter your weight: ') )
2  height = float( input('Please enter your height: ') )
3  BMI = weight/(height**2)
4  print('Your BMI is ',BMI)
5
6  if BMI < 18.5 :
7      print("You are underweight")
8      print("Try to gain weight")
9  elif BMI >= 18.5 and BMI <24.9:
10     print("Your weight is normal")
11 else:
12     print("You are overweight")
13     print("Try to loose weight")
14
15 print("Thank you for using the BMI calculator")
```

Nested conditionals

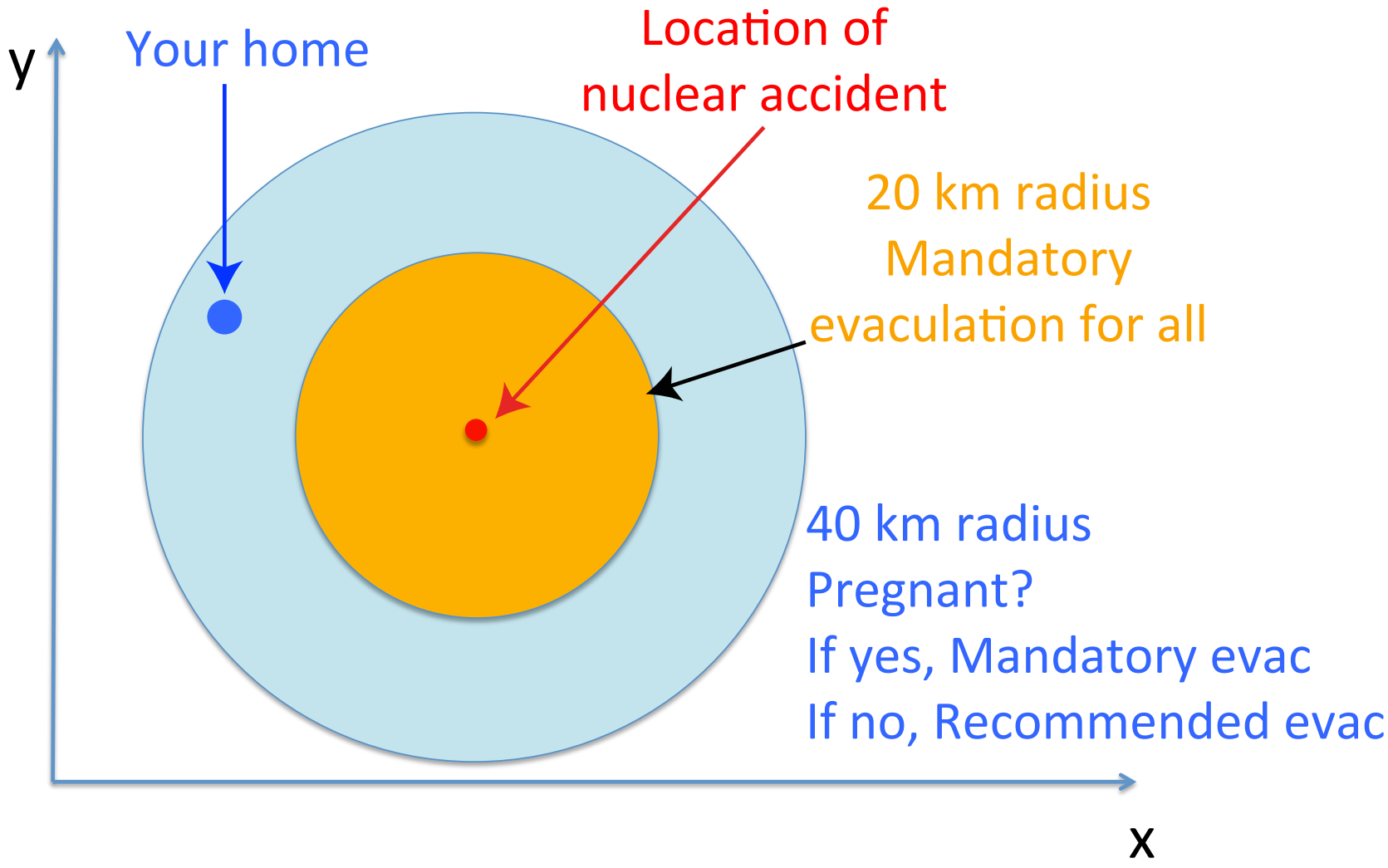
We can have conditionals inside conditionals:

```
1  if condition1:
2      # this is executed only if condition 1 is true
3      if condition2:
4          # this gets executed only if
5          # both conditions 1 and 2 are true
6      else:
7          # this gets executed only if
8          # condition 1 is true but condition 2 is false
9  else:
10     # gets executed only if condition1 is false
11     # we could have more if/else here
12
13 # this is outside the conditional
14 # this gets executed no matter what
```

- Note double identation

Example 3: Nuclear accident evacuation

Task: Write a program to provide the correct evacuation message following a nuclear accident.



Example 3: Nuclear accident evacuation

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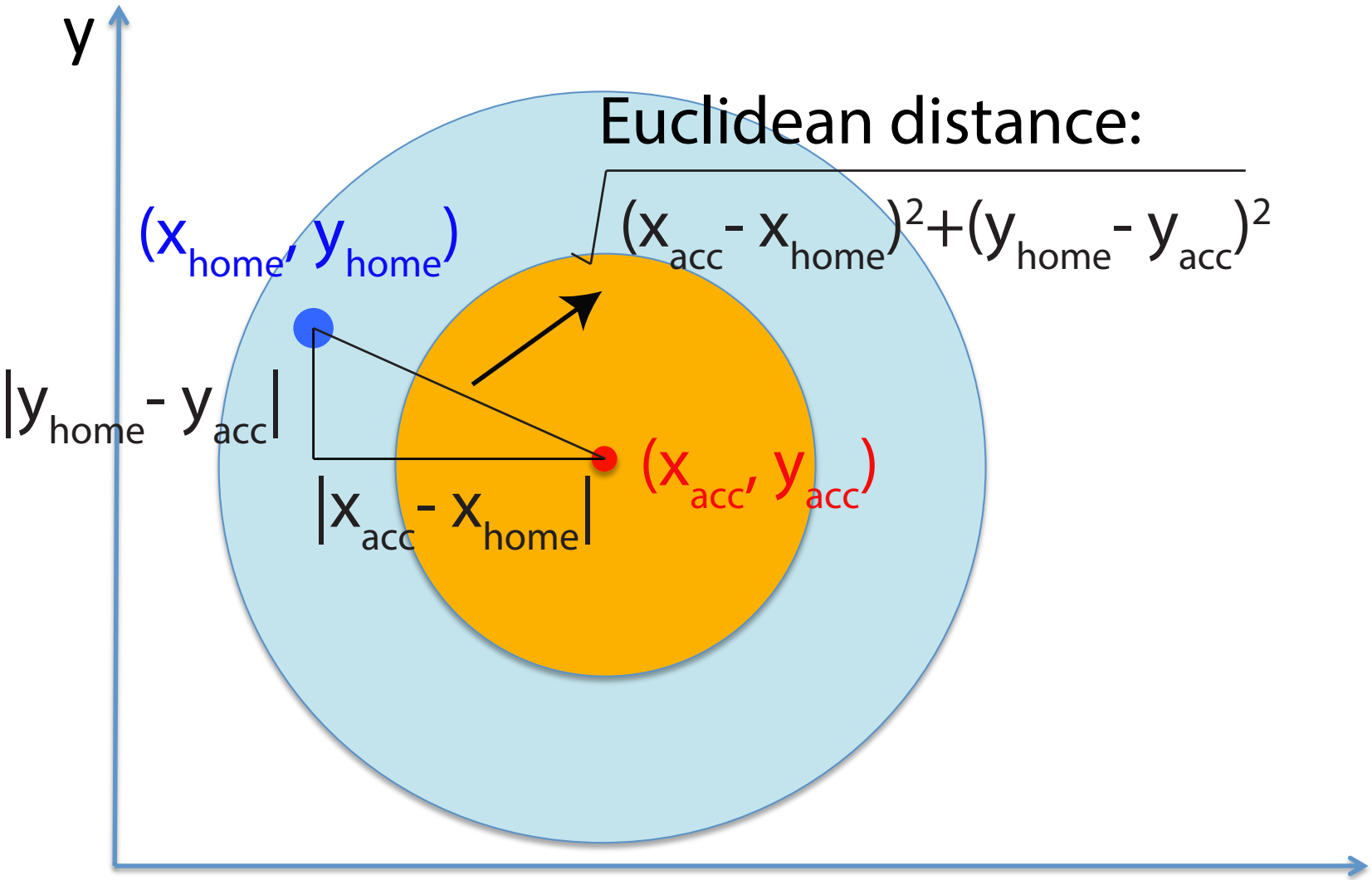


Example 3: Nuclear accident evacuation

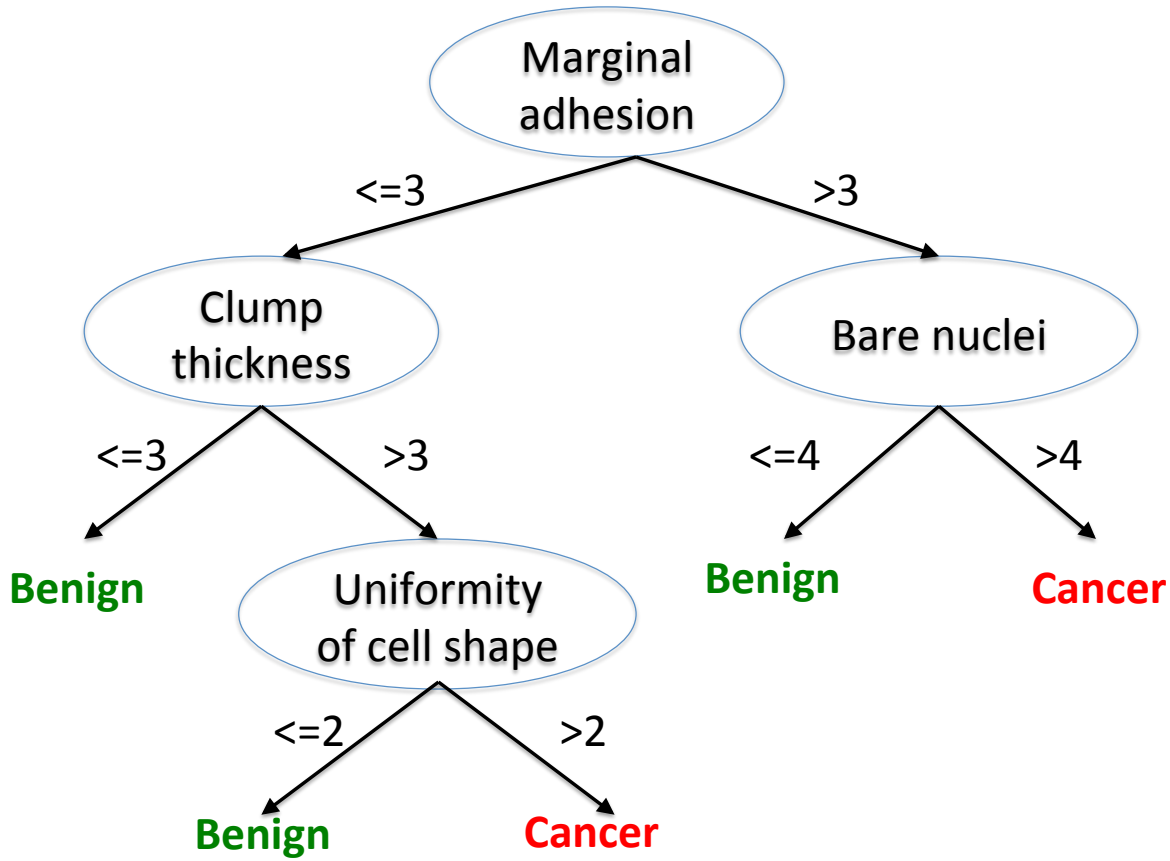
```
1  import math  # this imports the math module
2
3  xAcc = float(input("Enter x coord. of nuclear accident: "))
4  yAcc = float(input("Enter y coord. of nuclear accident: "))
5  xHome = float(input("Enter x coordinate of home: "))
6  yHome = float(input("Enter y coordinate of home: "))
7
8  distance = math.sqrt((xHome - xAcc)**2 + (yHome - yAcc)**2)
9
10 if distance <= 20:
11     print("You must evacuate")
12 elif distance <= 40:
13     pregnant = input("Are you pregnant? (yes/no) ")
14     if (pregnant == "yes" or pregnant == "Yes" or pregnant
       == "Y" or pregnant == "y"):
15         print("You must evacuate")
16     else:
17         print("Evacuation is recommended")
18 else:
19     print("No need to evacuate")
```

Example 3: Nuclear accident evacuation (flexible answers)

```
1  import math  # this imports the math module
2
3  xAcc = float(input("Enter x coord. of nuclear accident: "))
4  yAcc = float(input("Enter y coord. of nuclear accident: "))
5  xHome = float(input("Enter x coordinate of home: "))
6  yHome = float(input("Enter y coordinate of home: "))
7
8  distance = math.sqrt((xHome - xAcc)**2 + (yHome - yAcc)**2)
9
10 if distance <= 20:
11     print("You must evacuate")
12 elif distance <= 40:
13     pregnant = input("Are you pregnant? (yes/no) ")
14     if (pregnant == "yes" or pregnant == "Yes" or pregnant
       == "Y" or pregnant == "y"):
15         print("You must evacuate")
16     else:
17         print("Evacuation is recommended")
18 else:
19     print("No need to evacuate")
```

Example 4: Tumor classification by decision tree

Task: Write a program to guide doctors in their assessment of tumors.



Example 4: Tumor classification

```
# the content of this variable
# will be changed by the code below
tumorType=""

adhesion = int(input("Enter marginal adhesion level") )
if adhesion<=3:
    clump = int(input("Enter clump thickness"))
    if clump<=3:
#         tumorType="Benign"
        a=""
    else:
        uniformity = int(input("Enter uniformity of cell
    shape"))
        if uniformity<=2:
            tumorType="Benign"
        else:
            tumorType="Cancer"
else:
    bare = int(input("Enter level of bare nuclei"))
    if bare<=4:
        tumorType="Benign"
    else:
        tumorType="Cancer"
print("The tumor type is: ",tumorType)
```

Assignment 1 will be released tonight after midnight