Chapter 3: Selections

Instructor: Dr. Murat Tunc

Lecture 3

November 23rd, 2021

Last Week (Summary)

Writing a Simple Program

```
# Step 1: Read in radius from the user
radius = input("Please input the radius of a circle and press Enter: ")
radius = float(radius)

# Step 2: Compute area
area = radius * radius * 3.14159

# Step 3: Display the area
print("The area of a circle with the radius", radius, "is", area)
```

Variables

- Variables are used to **store values** to be used later in a program
- They are called variables because their **values can be changed**
- We need to tell the compiler the name of the variable
- Choose descriptive names for variables
  - **radius** for radius
  - **area** for area

Division, Integer Division and Remainder

- **Division** operator: **/**
  - will **always** result in a floating point number
  - **Example:** 5 / 2 yields a floating point number 2.5
- **Integer division** operator: **//**
  - **Example:** 5 // 2 yields an integer number 2
- **Remainder** operator: **%**
  - will result in the **remainder** of the division
  - **Example:** 5 % 2 yields an integer number 1

- Remainder operation is useful in programming
  - **Even** number % 2 is always 0
  - **Odd** number % 2 is always 1

Augmented Assignment Operators

- The operators +, -, *, /, and % can be combined with the assignment operator (=) to form **augmented operators**

Operator	*Name*	*Example*	*Equivalent*
`+=`	Addition assignment	`i += 8`	`i = i + 8`
`-=`	Subtraction assignment	`i -= 8`	`i = i - 8`
`*=`	Multiplication assignment	`i *= 8`	`i = i * 8`
`/=`	Division assignment	`i /= 8`	`i = i / 8`
`%=`	Remainder assignment	`i %= 8`	`i = i % 8`

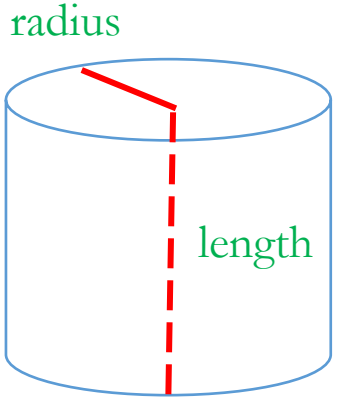
Practice Question 1

Write a program that

1) **reads a two digit integer** from the user and
2) **swap its digits** to create a new integer.

For example, if an integer is 93, after swapping it becomes 39.

```python
# Practice exercise 1

# Step 1: Read in the two-digit number from the user

twoDigitNumber = int(input("Please input a two-digit number and press Enter:"))

# Step 2: Swap its digits and create a new integer

firstNumberTemporary = twoDigitNumber // 10
secondNumberTemporary = twoDigitNumber % 10

numberAfterSwap = secondNumberTemporary * 10 + firstNumberTemporary

# Step 3: Display the result

print("After the swap, the new number is", numberAfterSwap)
```



Practice Question 2

Write a program that

1) **reads numbers for radius and length** from the user and
2) **displays the volume of a cylinder** on console.

area = radius * radius * π

volume = area * length

```python
# Practice Exercise 2

# Step 1: Read in radius and length from the user

radius = float(input("Please input the radius of a cylinder and press Enter:"))
length = float(input("Please input the length of a cylinder and press Enter:"))

# Step 2: Compute volume

area = radius * radius * 3.14159
volume = area * length

# Step 3: Display the area

print("The volume of a cylinder with the radius", radius, ", and length",
      length, "is", volume)
```

Practice Question 3

Write a program that

1) **reads the values of x and y** from the user and
2) **display the following result** on console.

$$y^{x-7} + \frac{x+y}{4} - \frac{2\,(x-y)+3}{5} + \frac{y}{3\,x\,-10}$$

Check the result for x=10, y=5 (The answer should be 126.4)

```
# Practice Exercise 3

# Step 1: Read in x and y

x = float(input("Please input x and press Enter: "))
y = float(input("Please input y and press Enter: "))

# Step 2: Compute the answer

result = pow(y, x-7) + (x+y)/4 - (2*(x-y)+3)/5 + y/(3*x-10)

# Step 3: Display the result

print("The result is", result)
```

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Motivation

- If the user assigned a **negative value for radius** in compute area exercise in the last lecture, the program would print an **invalid** result

- **If** the radius is **negative**,
  - **then** you **do not** want the program to **compute the area**

- How can you deal with this situation?

boolean Data Type

- A variable that holds a boolean value is known as a **boolean variable**

- The boolean data type is used to declare boolean variables

- A boolean expression evaluates to **True** or **False**

```
b = 1 > 2  # b is assigned the value False
```

boolean Data Type

- Often in a program you need to **compare two values**, such as

  - whether i > j or not?
  - whether radius > 0 or not?

- Python provides six **comparison operators** (also known as relational operators) that can be used to compare two values

Relational Operators

Operator	Mathematics Symbol	Name	Example (radius is 5)	Result
<	<	less than	`radius < 0`	`false`
<=	≤	less than or equal to	`radius <= 0`	`false`
>	>	greater than	`radius > 0`	`true`
>=	≥	greater than or equal to	`radius >= 0`	`true`
==	=	equal to	`radius == 0`	`false`
!=	≠	not equal to	`radius != 0`	`true`

Selection Statements

- Selection statements use **conditions** that are Boolean expressions

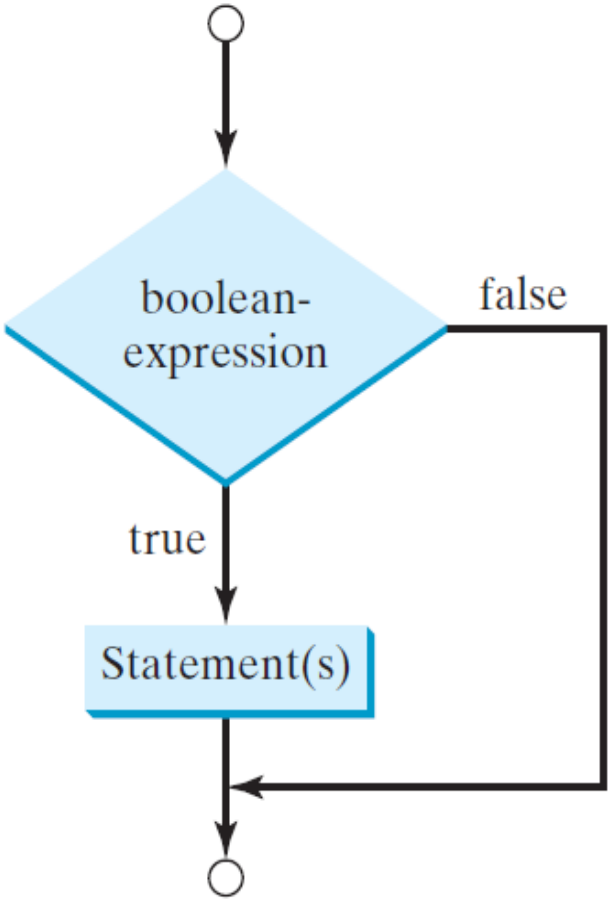
- Python has several types of selection statements:
  - One-way **if** statements
  - Two-way **if-else** statements
  - Nested **if** statements
  - Multi-way **if-else** statements

Selection Statements

One-way **if** statements

One-way if Statements

```
if boolean-expression:
    statement(s)
```



Writing a Simple Program - Revisited

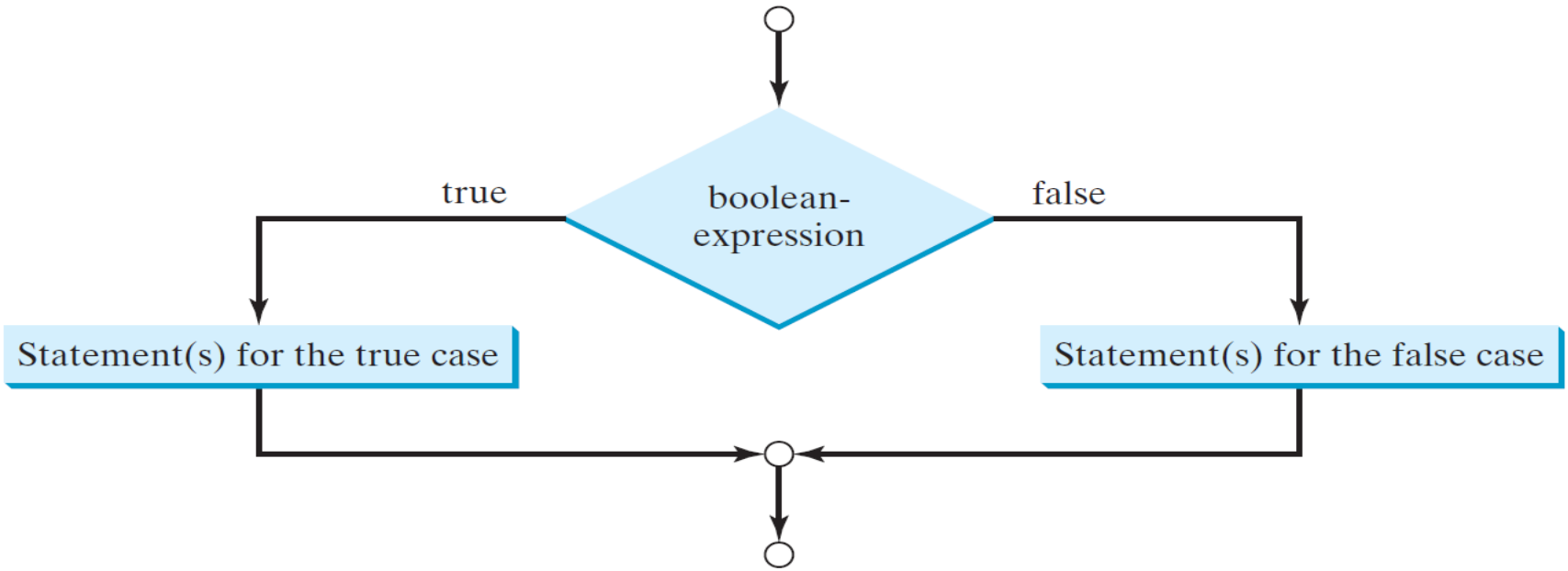
```
# Step 1: Read in radius from the user
radius = float( input("Please input the radius of a circle and press Enter: ") )


# Step 2: Check if the radius is positive
if radius >= 0:
        # Step 3: If radius > 0, calculate and print the area
        area = radius * radius * 3.14159
        print("The area of a circle with the radius", radius,
                "is", area)
```

Selection Statements

Two-way **if-else** statements

Two-way **if-else** statements

```
if boolean-expression:
    statement(s)-for-the-true-case
else:
    statement(s)-for-the-false-case
```



Two-way **if-else** example

```
if radius >= 0:
        area = 3.14159 * radius * radius
        print("The area of the circle of radius", radius, "is",
        area)
else:
        print("Negative input")
```

Writing a Simple Program - Revisited

```
# Step 1: Read in radius from the user
radius = float( input("Please input the radius of a circle and press Enter: ") )
# Step 2: Check if the radius is positive
if radius >= 0:
    # Step 3: If radius >= 0, calculate and print the area
    area = radius * radius * 3.14159
    print("The area of a circle with the radius", radius,
          "is", area)
else: # Step 4: If radius < 0, print warning message
    print("Negative input")
```

In-class Exercise 1 (Self-study – 15 min)

Write a program that

1) **randomly generates** two single-digit integers and

2) displays a question such as **" What is 3 + 5? "**,

3) **reads in** the answer from the user,

4) displays a message to indicate **whether the answer is correct** or not.

Hint: import random

```
number = random.randint (0, 9)
```

In-class Exercise 1 - Answer

```
import random
# Step 1: Randomly generate two numbers
number1 = random.randint(0, 9)
number2 = random.randint(0, 9)
# Step 2: Display the question and read in the answer
print("What is", number1, "+", number2, "?")
answer = int( input("Please type the answer and press Enter:") )
# Step 3: Check whether the answer is correct or not
    if answer == number1 + number2:
            print("Your answer is correct!")
    else:
            print("Your answer is wrong!")
```

Review

- Q: **if** statement must be accompanied by **else** statement.
  A. True
  B. False

- Ans: B

Q: What does the following program prints?

```
radius = 7.5
if radius > 7:
        print(radius)
```

A. 7.5
B. radius
C. 7

- Ans: A

Q: What does the following program prints?

```
radius = 8
if radius > 8:
        print(radius)
else:
        radius = 9
```

A. 8
B. 9
C. This program does not print anything

- Ans: C

Q: What does the following program prints?

```
radius = 8
if radius != 8:
        print(radius)
else:
        radius = 9
        print(radius)
```

A. 8
B. 9
C. This program does not print anything

- Ans: B

Q: What does the following program prints?

```
b = 1 > 2
if b:
        print(b)
```

A. 1 > 2
B. False
C. This program does not print anything

- Ans: C

Selection Statements

Nested-**if** statements

Nested-**if** Statement

- An **if** statement can be inside another **if** statement to form a nested-**if** statement

```
if i > k:
    if j > k:
        print("i and j are greater than k")
    else:
        print("i is greater than k and j is less than or equal to k")
else:
    print("i is less than or equal to k")
```

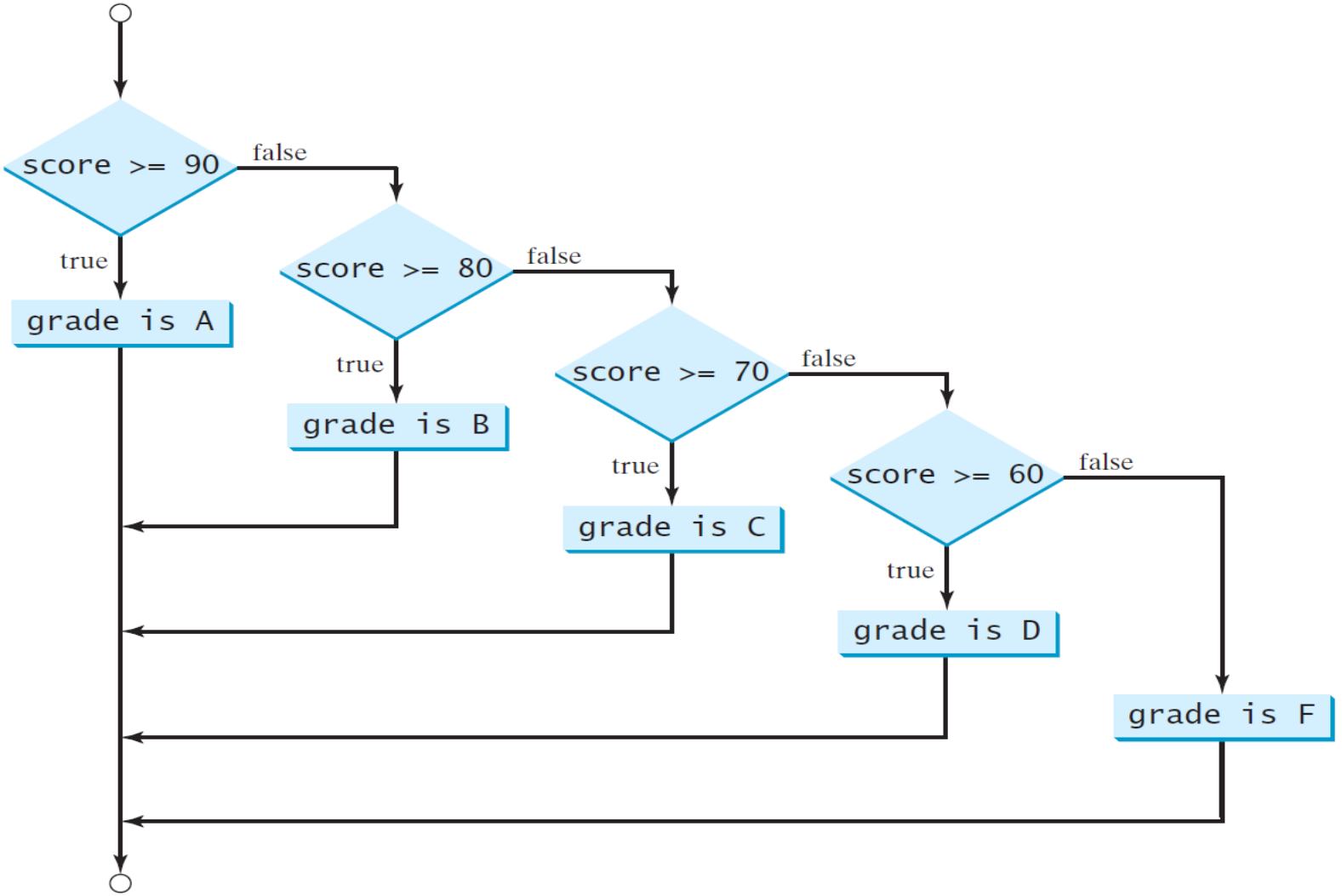
Selection Statements

Multi-way **if-else** statements

Multi-way **if-else** Statement

- **Print the letter grade** based on the following:
  - 90 <= Score <= 100 : **A**
  - 80 <= Score < 90 : **B**
  - 70 <= Score < 80 : **C**
  - 60 <= Score < 70 : **D**
  - Score < 60 : **F**

Multi-way **if-else** statements



Tracing **if-else** Statements

Suppose score is 70.0

The condition is false

```
if (score >= 90.0):
  print("A")
elif (score >= 80.0):
  print("B")
elif (score >= 70.0):
  print("C")
elif (score >= 60.0):
  print("D")
else:
  print("F")
```

Tracing **if-else** Statements

Suppose score is 70.0

The condition is false

```
if (score >= 90.0):
  print("A")
elif (score >= 80.0):
  print("B")
elif (score >= 70.0):
  print("C")
elif (score >= 60.0):
  print("D")
else:
  print("F")
```

Tracing **if-else** Statements

Suppose score is 70.0

The condition is true

```
if (score >= 90.0):
  print("A")
elif (score >= 80.0):
  print("B")
elif (score >= 70.0):
  print("C")
elif (score >= 60.0):
  print("D")
else:
  print("F")
```

Tracing if-else Statements

Suppose score is 70.0

grade is C

```
if (score >= 90.0):
  print("A")
elif (score >= 80.0):
  print("B")
elif (score >= 70.0):
  print("C")
elif (score >= 60.0):
  print("D")
else:
  print("F")
```

Tracing if-else Statements

Suppose score is 70.0

```
if (score >= 90.0):
  print("A")
elif (score >= 80.0):
  print("B")
elif (score >= 70.0):
  print("C")
elif (score >= 60.0):
  print("D")
else:
  print("F")
```

Exit the if statement

Review

Q: What does the following program prints?

```
score = 75
if score > 70:
        print(score)
elif score > 65:
        score += 10
        print(score)
```

A. 75
B. 85
C. 75
   85

- Ans: A

Q: What does the following program prints?

```
score = 75
if score > 70:
        print(score)
if  score > 65:
        score += 10
        print(score)
```

A. 75
B. 85
C. 75
   85

- Ans: C

Q: What does the following program prints?

```
score = 75
if score > 70:
        if score < 60:
                print(score)
else:
        score += 10
        print(score)
```

A. 75
B. 85
C. This program does not print anything

- Ans: C

Q: What does the following program prints?

```
score = 75
if score > 70:
        if score < 60:
                print(score)
        else:
                score += 10
                print(score)
```

A. 75
B. 85
C. This program does not print anything

- Ans: B

Common Pitfall

- To force the **else** clause to match the first **if** clause, you must align them accordingly:

```
i = 1
j = 2
k = 3
if i > j:
    if i < k:
        print("A")
else:
    print("B")
```

This statement prints B.

```
i = 1
j = 2
k = 3
if i > j:
    if i < k:
        print("A")
    else:
        print("B")
```

This statement does not print anything.

In-class Exercise 2 (Practice at home – 10 min)

Write a program that

1) prompts the user to **enter an integer** for a day of the week

2) The program **checks whether** the corresponding **day is a weekday or weekend** and

3) **displays the result** appropriately

Logical Operators

Operator	Description
not	logical negation
and	logical conjunction
or	logical disjunction

Truth Table for Operator **not**

p	not p	Example (assume age = 24, weight = 140)
true	false	not age > 18 is false
false	true	not weight == 150 is true

Truth Table for Operator **and**

p_1	p_2	p_1 **and** p_2	**Example (assume age = 24, weight = 140)**
false	false	false	age <= 18 **and** weight < 140 is false
false	true	false	age <= 18 **and** weight == 140 is false
true	false	false	age > 18 **and** weight > 140 is false
true	true	true	age > 18 **and** weight >= 140 is true

Truth Table for Operator **or**

p_1	p_2	p_1 **or** p_2	**Example (assume age = 24, weight = 140)**
false	false	false	age < 18 **or** weight >= 150 is false
false	true	true	age < 18 **or** weight >= 130 is true
true	false	true	age > 18 **or** weight >= 150 is true
true	true	true	age > 18 **or** weight >= 130 is true

In-class Exercise 3 (Self study – 15 min)

Write a program that

1) prompts the user to **enter a year** as an integer, and

2) **checks whether** it is a **leap year**

Hint: A year is a leap year if

(1) it is divisible by 400, **or**

(2a) it is divisible by 4 **and (2b)** not divisible by 100

In-class Exercise 3 - Answer

```
# Step 1: Read in the year
year = int(input("Please input the year and press Enter:"))
# Step 2: Check whether the year is a leap year
if year % 400 == 0 or (year % 4 == 0 and not year % 100 == 0):
        print("It's a leap year!")
else:
        print("It's not a leap year!")
```

Review

Q: What does the following program prints?

```
score = 75
age = 19
height = 181
if age > 19:
        print(score)
elif not age > 18:
        score += 10
        print(score)
```

A. 75
B. 85
C. This program does not print anything

- Ans: C

Q: What does the following program prints?

```
score = 75
age = 19
height = 181
if age > 19 or height < 190:
        print(score)
elif age > 18:
        score += 10
        print(score)
```

A. 75
B. 85
C. This program does not print anything

- Ans: A

Q: What does the following program prints?

```
score = 75
age = 19
height = 181
if age > 18 and height < 180:
        print(score)
elif  age > 19 or height > 190:
        score += 10
        print(score)
```

A. 75
B. 85
C. This program does not print anything

- Ans: C

Q: What does the following program prints?

```
score = 75
age = 19
height = 181
if not age > 19 and height < 180:
        print(score)
elif not age > 18 or height < 190:
        score += 10
        print(score)
```

A. 75
B. 85
C. This program does not print anything

- Ans: B

Q: What does the following program prints?

```
score = 75
age = 19
height = 181
if not age > 19 and height < 180:
        print(score)
elif not (age > 18 or height < 190):
        score += 10
        print(score)
```

A. 75
B. 85
C. This program does not print anything

- Ans: C

Q: What does the following program prints?

```
score = 75
age = 19
height = 181
if not (age > 19 and height < 180):
        print(score)
elif not (age > 18 or height < 190):
        score += 10
        print(score)
```

A. 75
B. 85
C. This program does not print anything

- Ans: A

Practice Exercise 1

Write a program that

1) **prompts** the user to enter a movie's IMDB rating (0 to 10 – may include decimal, like 3.5) and Metascore (0 to 100 - integer), and
2) **checks** whether the movie is recommended to watch

Hint: Recommend if rating > 7.0 & Metascore > 60

Practice Exercise 2

Write a program that

1) **prompts** the user to enter the day, month and year he/she was born, and
2) **displays** whether he/she can legally purchase beer in US

- Give me a beer, please.
- Can I see an ID? 6.12.2000
- I'm sorry, but I cannot sell you a beer.