

# Chapter 3: Selections

Instructor: Dr. Murat Tunc

Lecture 3

November 23<sup>rd</sup>, 2021

# Last Week (Summary)

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# Writing a Simple Program

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**# 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

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- 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**

<i>Operator</i>	<i>Name</i>	<i>Example</i>	<i>Equivalent</i>
<b><math>+=</math></b>	Addition assignment	<b><math>i += 8</math></b>	<b><math>i = i + 8</math></b>
<b><math>-=</math></b>	Subtraction assignment	<b><math>i -= 8</math></b>	<b><math>i = i - 8</math></b>
<b><math>*=</math></b>	Multiplication assignment	<b><math>i *= 8</math></b>	<b><math>i = i * 8</math></b>
<b><math>/=</math></b>	Division assignment	<b><math>i /= 8</math></b>	<b><math>i = i / 8</math></b>
<b><math>\%=</math></b>	Remainder assignment	<b><math>i \%= 8</math></b>	<b><math>i = i \% 8</math></b>



# Practice Question 1

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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.



*# 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
```

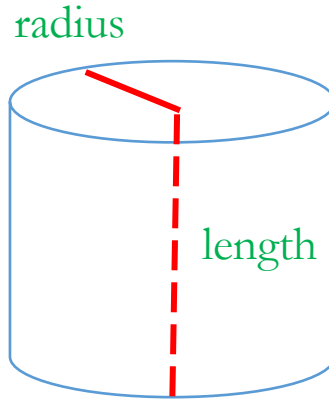
```
numberAfterSwap = secondNumberTemporary * 10 + firstNumberTemporary
```

*# Step 3: Display the result*

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







# Practice Question 2

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Write a program that

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

$$\text{area} = \text{radius} * \text{radius} * \pi$$

$$\text{volume} = \text{area} * \text{length}$$



## *# 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.

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

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

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- 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

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- 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

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- Often in a program you need to **compare two values**, such as
  - whether  $i > j$  or not?
  - whether  $\text{radius} > 0$  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	<code>radius &lt; 0</code>	<code>false</code>
<=	≤	less than or equal to	<code>radius &lt;= 0</code>	<code>false</code>
>	>	greater than	<code>radius &gt; 0</code>	<code>true</code>
>=	≥	greater than or equal to	<code>radius &gt;= 0</code>	<code>true</code>
==	=	equal to	<code>radius == 0</code>	<code>false</code>
!=	≠	not equal to	<code>radius != 0</code>	<code>true</code>



# Selection Statements

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- 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

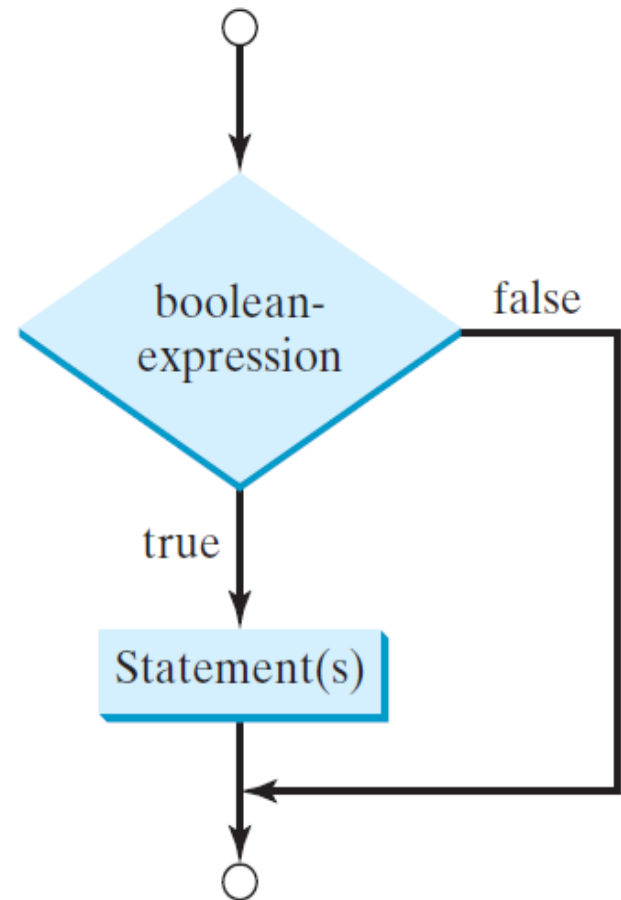
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One-way **if** statements



# 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

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Two-way **if-else** statements



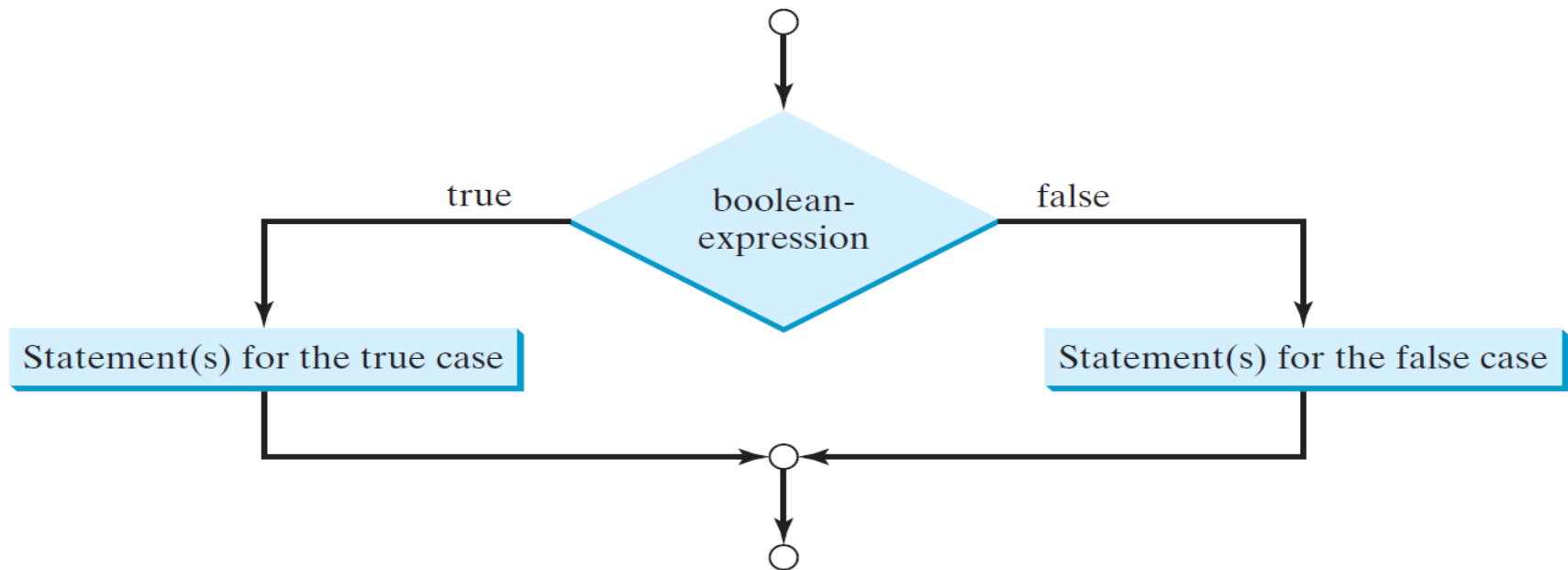
# Two-way **if-else** statements

**if** boolean-expression:

statement(s)-for-the-true-case

**else:**

statement(s)-for-the-false-case



# Two-way **if-else** example

---

**if** radius  $\geq$  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

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



# Q: What does the following program print?

---

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

- A. 7.5
- B. radius
- C. 7

- Ans: A



# Q: What does the following program print?

---

```
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 print?

---

```
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 print?

---

```
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

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- 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



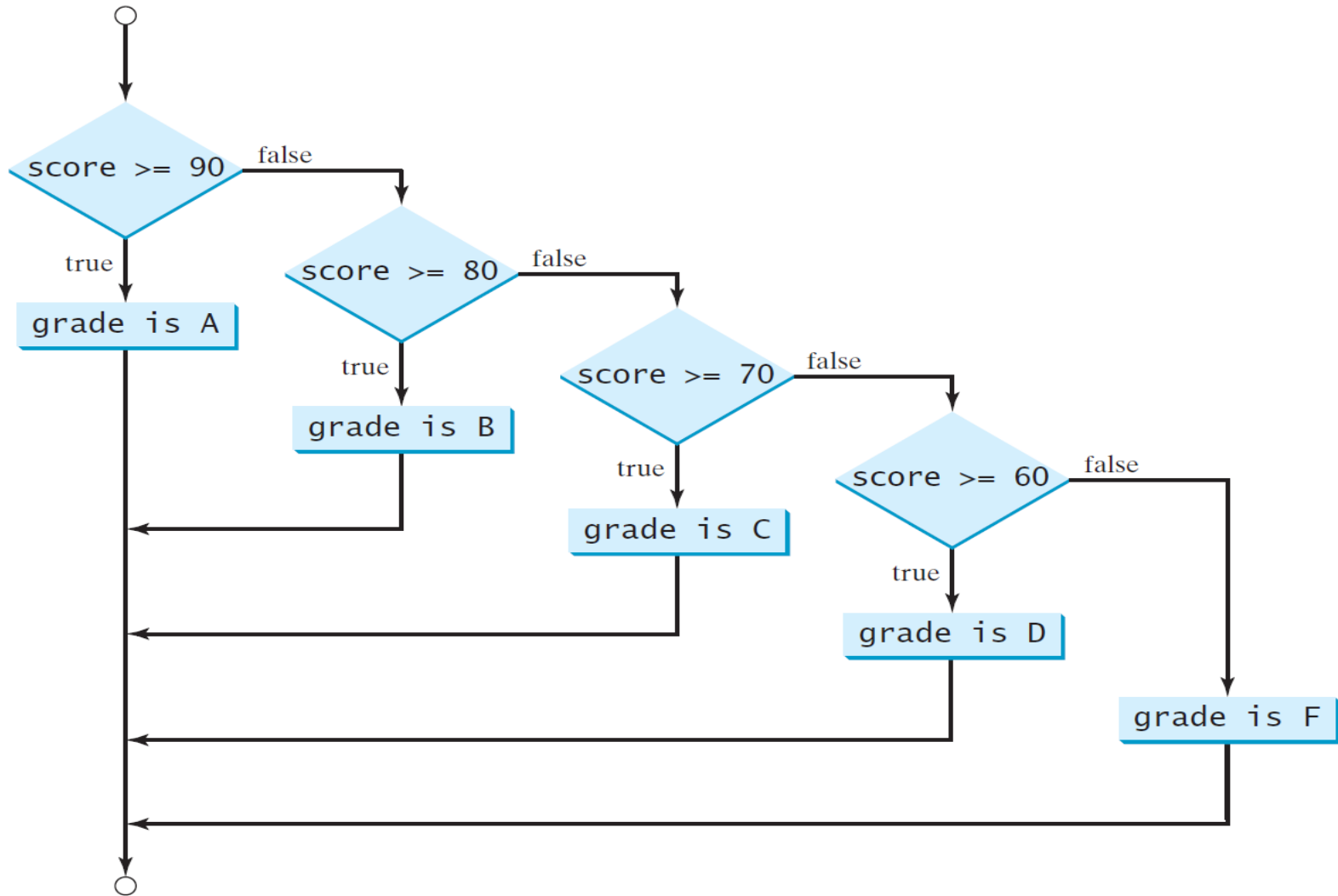
# Multi-way **if-else** Statement

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- **Print the letter grade** based on the following:
  - $90 \leq \text{Score} \leq 100$  : **A**
  - $80 \leq \text{Score} < 90$  : **B**
  - $70 \leq \text{Score} < 80$  : **C**
  - $60 \leq \text{Score} < 70$  : **D**
  - $\text{Score} < 60$  : **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

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# Q: What does the following program print?

---

```
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 print?

---

```
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 print?

```
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 print?

---

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



# Truth Table for Operator **and**

$p_1$	$p_2$	$p_1$ <b>and</b> $p_2$	Example (assume age = 24, weight = 140)
false	false	false	age $\leq$ 18 <b>and</b> weight $<$ 140 is false
false	true	false	age $\leq$ 18 <b>and</b> weight $=$ 140 is false
true	false	false	age $>$ 18 <b>and</b> weight $>$ 140 is false
true	true	true	age $>$ 18 <b>and</b> weight $\geq$ 140 is true



# Truth Table for Operator **or**

$p_1$	$p_2$	$p_1$ <b>or</b> $p_2$	Example (assume age = 24, weight = 140)
false	false	false	age < 18 <b>or</b> weight >= 150 is false
false	true	true	age < 18 <b>or</b> weight >= 130 is true
true	false	true	age > 18 <b>or</b> weight >= 150 is true
true	true	true	age > 18 <b>or</b> 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 print?

---

```
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 print?

---

```
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 print?

```
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 print?

---

```
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 print?

```
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 print?

```
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  $\text{rating} > 7.0$  &  $\text{Metascore} > 60$





# 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.

