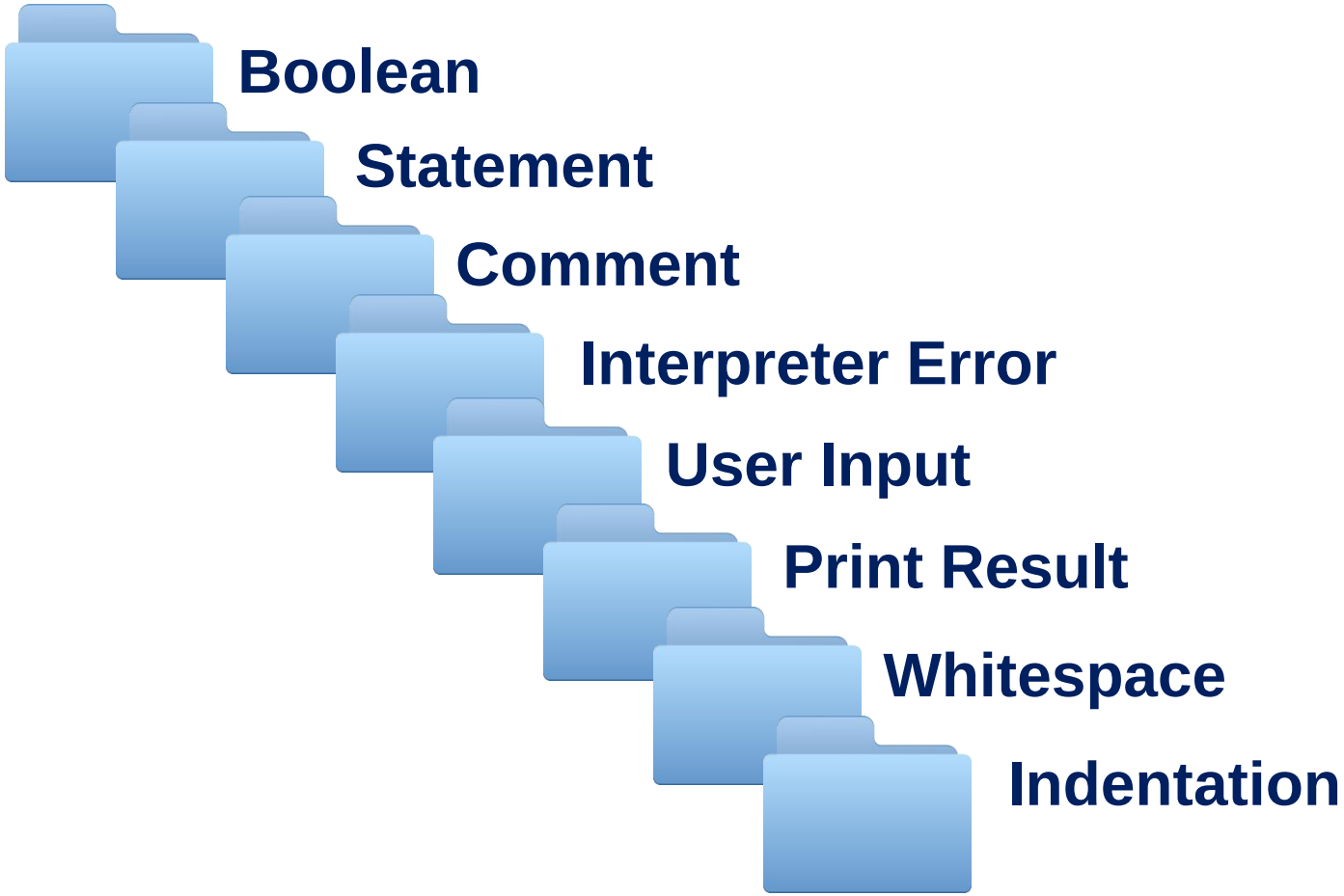
Basic Program Structure
Boolean Data Type, Relational Operators, and Selection Basics - PYTHON

Lesson Objectives

At the end of this lesson, you should be able to:

- Explain the following terminologies or syntax in Python:
  - Boolean data type
  - Relational operators
  - Selection basics
  - Comments using “#”
  - Built-in functions (e.g. input and print)
- Use the above terminologies or syntax in coding using Python

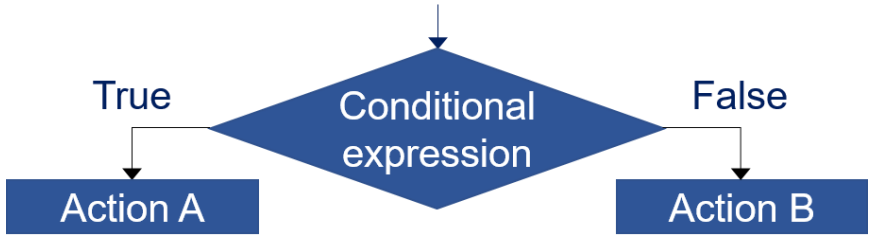
Topic Outline



Python Terminology #1: Boolean Data Type

Recall

- Designated as "**bool**"
- Either True or False




```
>>> a = True
>>> print(a)
True
>>> b = False
>>> c = true
Traceback (most recent call last):
      File "<pyshell#31>", line 1, in <module>
      c = true
NameError: name 'true' is not defined
```

Use capital T for True.

Use capital F for False.

This error occurs as Python is case-sensitive.

Quick Check

What do you think is the output of the following Python code?

```
tom = 19
print(tom > 18)
```

A. true B. True C. false D. False

Quick Check: Answer

What do you think is the output of the following Python code?

```
tom = 19
print(tom > 18)
```

A. true B. True C. false D. False

Answer **B. True**

Python Terminology #2: Statement

```
# 1. prompt user for the radius
# 2. apply circumference and area formulae
# 3. print the results

import math
radiusString = input("Enter the radius of your circle:")
radiusFloat = float(radiusString)
circumference = 2 * math.pi * radiusFloat
area = math.pi * radiusFloat * radiusFloat

print()    # print a line break
print("The circumference of your circle is: ",circumference,\
            ", and the area is:", area)
```

This line of code is one statement.

This is another statement.

This is one statement.

- Each line of code in a Python program is called a **statement**.
- Python **interprets** and **runs** the statements one by one.

Python Terminology #2: Statement (Cont'd)

```
# 1. prompt user for the radius
# 2. apply circumference and area formulae
# 3. print the results

import math
radiusString = input("Enter the radius of your circle:")
radiusFloat = float(radiusString)
circumference = 2 * math.pi * radiusFloat
area = math.pi * radiusFloat * radiusFloat

print()    # print a line break
print("The circumference of your circle is: ",circumference,\
            ", and the area is:", area)
```

- The symbol "****" is used to **continue a statement with the next** line so that the two lines can be joined as one statement.
- It improves readability in the text editor.

Python is **sensitive to end of line** in text files, which marks the end of a statement.
In text editors, we press "Enter".

Quick Try: Intelligent Guess

What do you think is the output of the following Python code?

```
print("The area") # print(" 18")
```

A. The area B. The area 18 C. Syntax error

Quick Try: Answer

What do you think is the output of the following Python code?

```
print("The area") # print(" 18")
```

A. The area B. The area 18 C. Syntax error

Answer **A. The area**

Python Terminology #3: Comment

```
# 1. prompt user for the radius
# 2. apply circumference and area formulae
# 3. print the results

import math
radiusString = input("Enter the radius of your circle:")
radiusFloat = float(radiusString)
circumference = 2 * math.pi * radiusFloat
area = math.pi * radiusFloat * radiusFloat

print()    # print a line break
print("The circumference of your circle is: ",circumference,\
            ", and the area is:", area)
```

These are comment lines.

- The pound sign "#" in Python indicates a **comment**.
- **Anything after "#"** is ignored during interpretation.

Comments provide information to improve code *readability*.

Python Terminology #3: Comment (Cont'd)

How can you add comments to the following Python code?

```
horizon_dist = (int)(input("Read horizonDist"))
vertical_dist = (int)(input("Read vertDist"))
travel_dist = horizon_dist + vertical_dist
print("distance from A to B is", travel_dist)
```

```
#Calculate travel distance between two points
#Date: 11/04/2018
horizon_dist = (int)(input("Read horizonDist"))
vertical_dist = (int)(input("Read vertDist"))
travel_dist = horizon_dist + vertical_dist
print("distance from A to B is", travel_dist)
```

Python Terminology #4: Interpreter Error

The **interpreter** translates the Python code into machine language.

- The first stage of the process is to determine whether syntax of the code is valid or not.
- If the code is somehow invalid or malformed, Python cannot run the code and an **interpreter error** is received.

```
>>> print("there are no errors here")
there are no errors here
>>> print(but there is error here)
SyntaxError: invalid syntax
>>> print "more error here"
SyntaxError: invalid syntax
```

Syntax error: Double quotes are missing.

Syntax error: Brackets are missing.

Syntax error: Python cannot translate the code.

Quick Try: Intelligent Guess

What do you think is the output of the following Python code if the user inputs “25”?

```
date = input("date of today?")
thedayaftertomorrow = date + 2
print(thedayaftertomorrow)
```

A. 27 B. Error C. 25

Quick Try: Answer

What do you think is the output of the following Python code if the user inputs “25”?

```
date = input("date of today?")
thedayaftertomorrow = date + 2
print(thedayaftertomorrow)
```

A. 27 B. Error C. 25

Answer **B. Error**

Python Terminology #5: User Input

An **input** is a **built-in function**, to get an input provided by Python, that:

- prints the message string on the screen and waits until the user types anything and presses “Enter”.
- returns a **string** no matter what is given, even a number.

```
# 1. prompt user for the radius
# 2. apply circumference and area formulae
# 3. print the results
import math
radiusString = input("Enter the radius of your circle:")
radiusFloat = float(radiusString)
circumference = 2 * math.pi * radiusFloat
area = math.pi * radiusFloat * radiusFloat

print()    # print a line break
print("The circumference of your circle is: ",circumference,
            ", and the area is:", area)
```

Quick Check

What do you think is the output of the following modified Python code if the user inputs “25”?

```
date = input("date of today?")
thedayaftertomorrow = int(date) + 2
print(thedayaftertomorrow)
```

A. 27 B. Error C. 25

Quick Check: Answer

What do you think is the output of the following modified Python code if the user inputs “25”?

```
date = input("date of today?")
thedayaftertomorrow = int(date) + 2
print(thedayaftertomorrow)
```

A. 27 B. Error C. 25

Answer **A. 27**

Python Terminology #6: Print Result

Print is another **built-in function**, provided by Python, that displays related message and data on the shell screen.

- It uses a **comma** to separate the elements.

```
# 1. prompt user for the radius
# 2. apply circumference and area formulae
# 3. print the results
import math
radiusString = input("Enter the radius of your circle:")
radiusFloat = float(radiusString)
circumference = 2 * math.pi * radiusFloat
area = math.pi * radiusFloat * radiusFloat
print("radius is: ")
print(radiusFloat)
print()    # print a line break
print("The circumference of your circle is: ",circumference,\
            ", and the area is:", area)
```

The function "**print()**" makes an empty line.

*What happens if you use several "**print()**" functions?*

IF Statement

Pseudocode

```
IF condition is True
THEN
        DO THIS
END IF
...
```

We usually **indent** this/ these statement(s) to improve code readability that this part becomes code body of the true condition.

Note: Proper indentation is adopted in many programming languages. However, Python forces you to use proper indentation.

IF Statement: Python Syntax

Syntax

if < a Boolean expression> : ← A colon **must** be used to mark the start of a block.

one or more indented statements ← An indentation **must** be used for the entire true block.

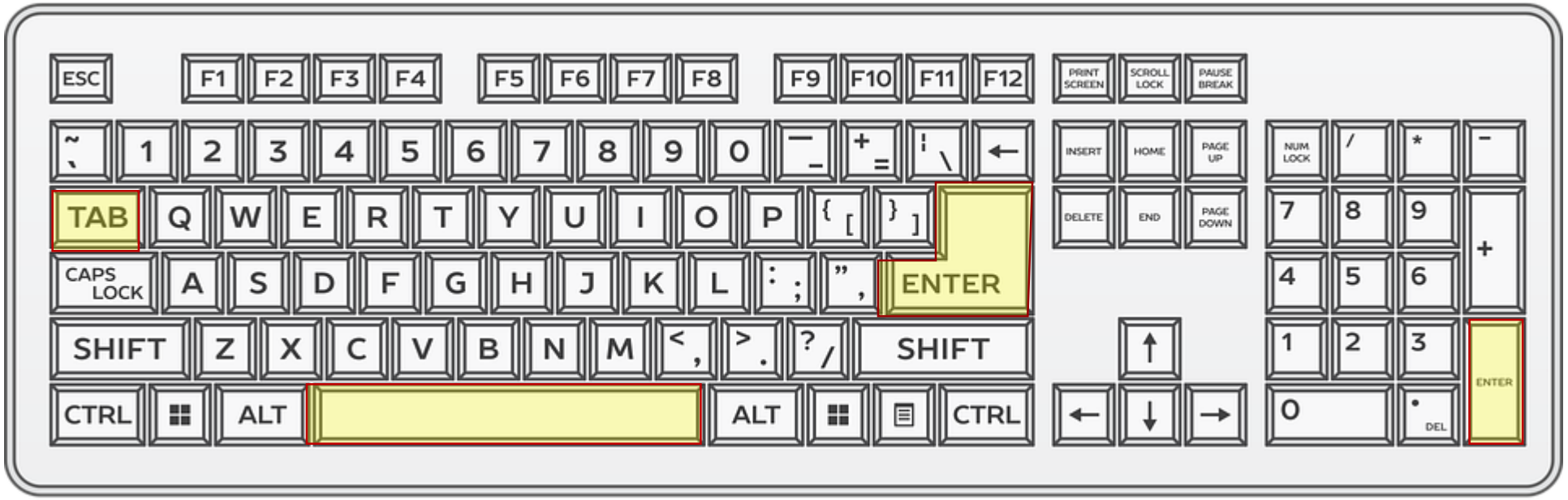
Examples

```
if a > b:
      print("a > b")
```

```
bodyTemp = (float)(input("Read body
temperature"))
if bodyTemp >= 37.5:
      print(“Fever")
      print("Time to see a doctor!")
print("End of program")
```

Python Terminology #7: Whitespace

Python counts the “Tab”, “Spacebar” and “Enter” as **whitespaces**:



- **Purpose of whitespace**: separates words in a statement
- For the most part, you can place whitespaces anywhere in your program to make the code more **readable**. E.g., use a = a + 1 + c instead of a=a+1+c

Quick Try: Intelligent Guess

Is the following Python code correct?

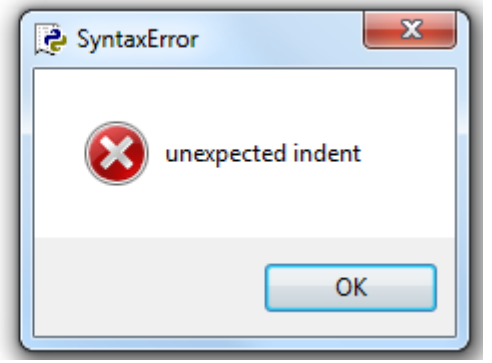
```
print("H1")
 print()
print("H2")
```

Quick Try: Answer

Is the following Python code correct?

```
print("H1")
 print()
print("H2")
```

```
print(" H1")
 print()
print("H2")
```



Answer No

Python Terminology #8: Indentation

An **indentation** is a leading whitespace at the start of a statement.

Pseudocode

```
IF body temperature > 37.5
THEN
      print("Fever!")
      print("Time to see a doctor!")
END IF
...
```

Note: Use the same number of spaces for indentation **consistently**.

In Python, this group of indented statement(s) is called a **suite** or a **block**.

A **compound statement** is a set of statements being used as a group.

Purpose of Indentation:

- For making the code more **readable**
- For **grouping**, particularly for **control flow** such as **branching** and **looping**

Python Terminology #8: Indentation for Grouping

```
N = int(input("Input N: "))
if N <= 1:
        NFact = 1
else:
        NFact = 2
        for i in range(3, N + 1):
                NFact = NFact * i
print(NFact)
```

One level of indentation

Two levels of indentation

- The power of an IF statement is that the program can **selectively run** the block based on the runtime condition.
- Sometimes the program runs it, sometimes the program skips it!

Quick Check

What is the output of the following Python code?

```
a = 3
if a > 5:
      print(a)
      print(a + 3)
print(a + 5)
```

A. 3

B. 6

C. 8

D. Syntax error

E. A & B & C

F. B & C

Quick Check: Answer

What is the output of the following Python code?

```
a = 3
if a > 5:
      print(a)
      print(a + 3)
print(a + 5)
```

A. 3

B. 6

C. 8

D. Syntax error

E. A & B & C

F. B & C

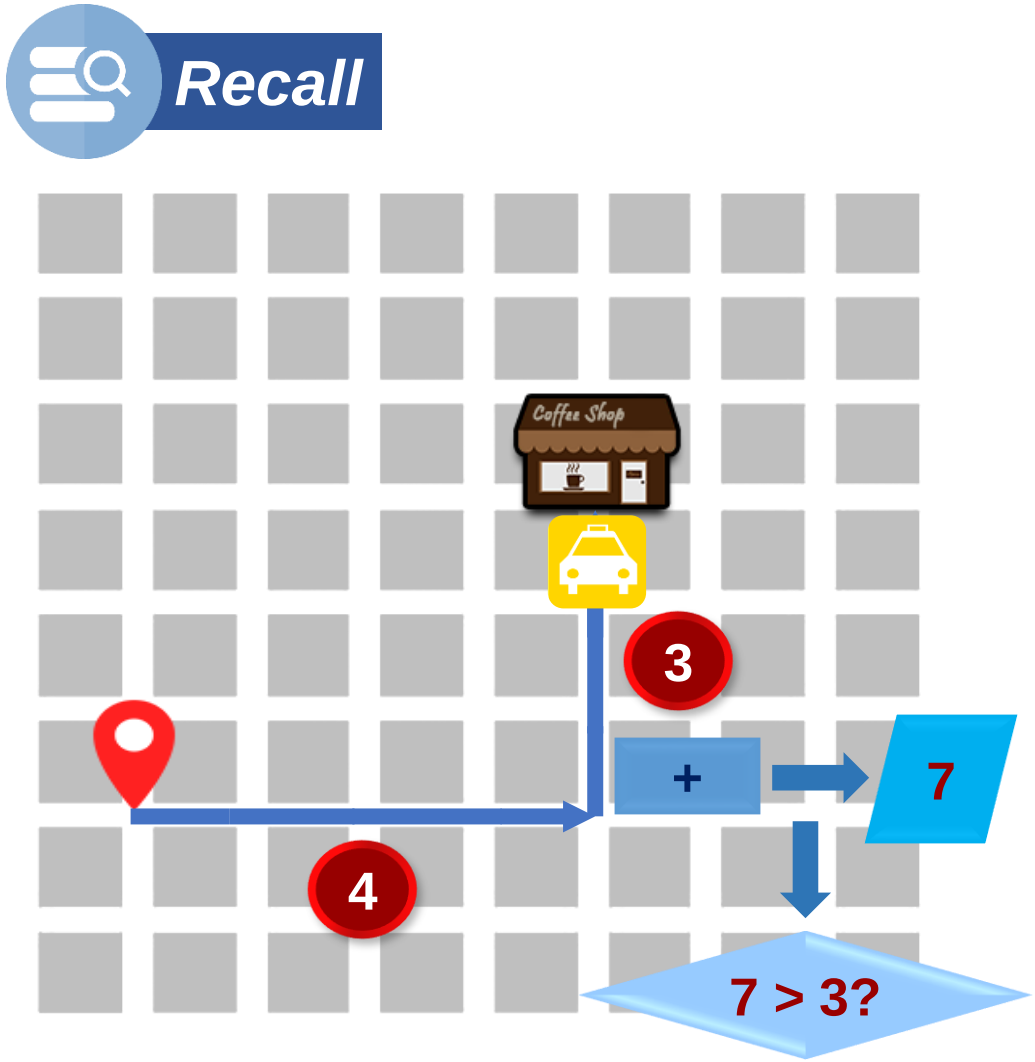
Answer **C. 8**

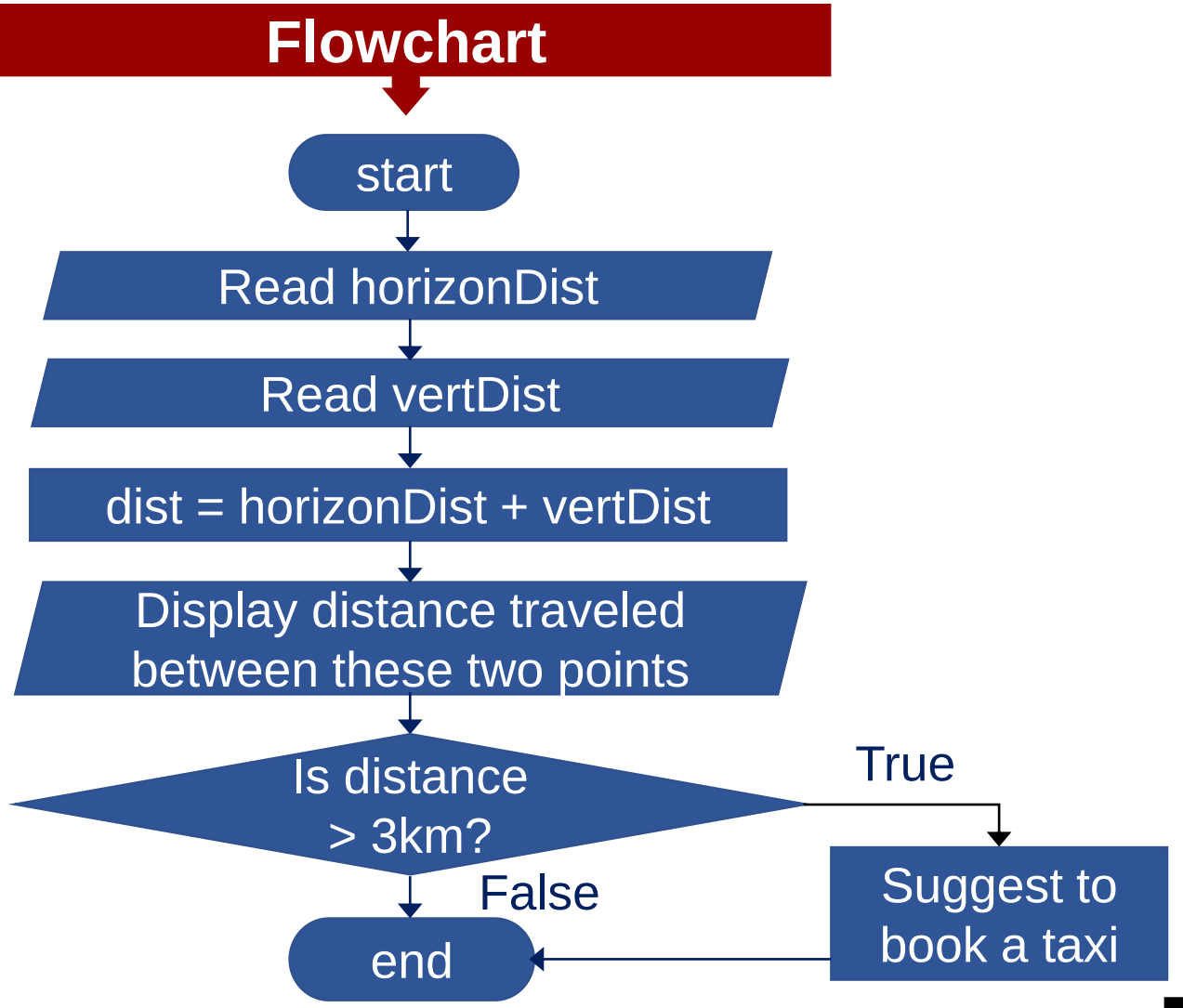
Recap

- A **colon** marks the start of a block.
- In Python, an **indentation** is not just for readability but also for defining the scope of a block.
- The number of **whitespace** for indentation is flexible but should be consistent for the same level in the same program.

```
if a > b:
        print("a > b")
        print("still this block")
```

Scenario 4: Decide if a Taxi is Needed





Scenario 4: Decide if a Taxi is Needed - Python Code

```
#Decide if a Taxi is Needed
#Date: 11/04/2018
horizon_dist = (int)(input("Read horizonDist"))
vertical_dist = (int)(input("Read vertDist"))
travel_dist = horizon_dist + vertical_dist
print("distance from A to B is ", travel_dist, "m")
if travel_dist > 3000:
        print("You are suggested to book a taxi")
print("Thank you for using this application")
```

Output when True

```
Read horizonDist in meters 4000
Read vertDist in meters 3000
distance from A to B is 7000 m
You are suggested to book a taxi
Thank you for using this application
```

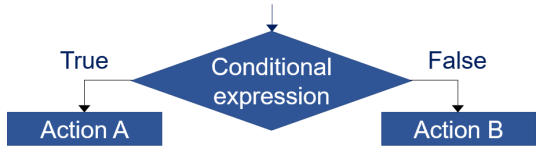
Scenario 4: Decide if a Taxi is Needed - Python Code

```
#Decide if a Taxi is Needed
#Date: 11/04/2018
horizon_dist = (int)(input("Read horizonDist"))
vertical_dist = (int)(input("Read vertDist"))
travel_dist = horizon_dist + vertical_dist
print("distance from A to B is ", travel_dist, "m")
if travel_dist > 3000:
        print("You are suggested to book a taxi")
print("Thank you for using this application")
```

Output when False

```
Read horizonDist in meters 4000
Read vertDist in meters 3000
distance from A to B is 7000 m
Thank you for using this application
```

Summary

Terminology	Description	Illustrative Example
Boolean	Either True or False	
Statement	A line of code; uses "\" to continue a statement with the next line so that the two lines can be joined as one statement.	`print("The circumference of your circle is: ",circumference,\` `", and the area is:", area)`

Comment	Indicated by a "#" and ignored during interpretation	`#My first Python application`
		`#Date: 11/04/2018`
		
		`horizon_dist = (int)(input("Read horizonDist"))`
		`vert_dist = (int)(input("Read vertDist"))`
		`travel_dist = horizon_dist + vert_dist`
		`print("dist from A to B is", travel_dist)`

Summary

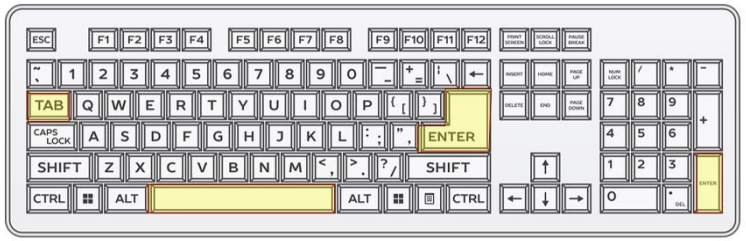
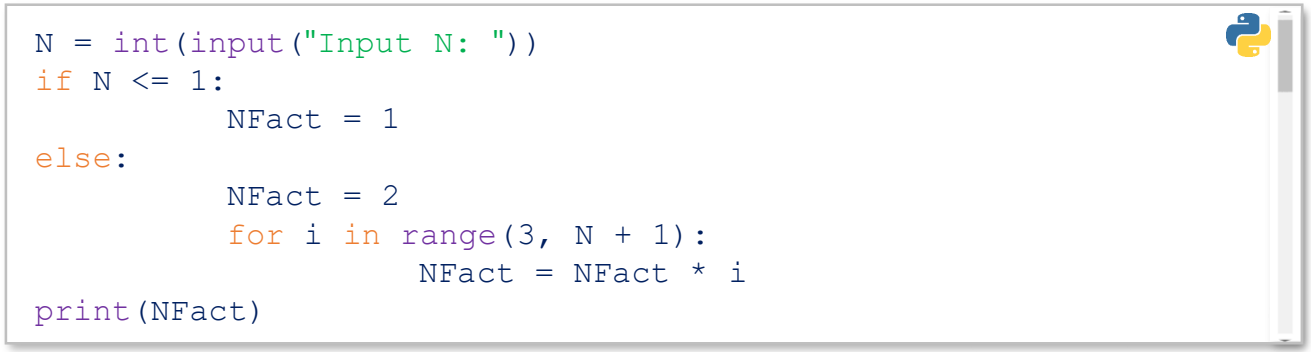
Terminology	Description	Illustrative Example

Interpreter error	Occurs when the code is invalid	`>>> print(but there is error here)`
		`SyntaxError: invalid syntax`
		`>>> print "more error here"`
		`SyntaxError: invalid syntax`

User input	Prints the message string on the screen and waits until the user types anything as input and presses “Enter”
	Note: In Python 2, the function call is raw_input, instead of input.
		`import math`
		`radiusString = input("Enter the radius of your circle:")`
		`radiusFloat = float(radiusString)`
		`circumference = 2 * math.pi * radiusFloat`
		`area = math.pi * radiusFloat * radiusFloat`

Print result	Displays related message and data on the shell screen	`print()  # print a line break`
		`print("The circumference of your circle is: ", circumference,\`
		`  ", and the area is:", area)`

Summary

Terminology	Description	Illustrative Example
Whitespace	A character that separates words in a statement (Tab, Spacebar and Enter)	
Indentation	A leading whitespace at the start of a statement for grouping and making the code more readable	

```
N = int(input("Input N: "))
if N <= 1:
        NFact = 1
else:
        NFact = 2
        for i in range(3, N + 1):
                NFact = NFact * i
print(NFact)
```

References for Images

No.	Slide No.	Image	Reference
1	5, 21, 31		Search [Online Image]. Retrieved April 18, 2018 from https://pixabay.com/en/database-search-database-search-icon-2797375/.
2	All pages with Python codes		Python Logo [Online Image]. Retrieved April 18, 2018 from https://pixabay.com/en/language-logo-python-2024210/.
3	13, 20		Question problem [Online Image]. Retrieved April 18, 2018 from https://pixabay.com/en/question-problem-think-thinking-622164/.
4	21, 26		By User:Bobarino - Made by following Information.png, CC BY-SA 3.0, retrieved April 18, 2018 from https://en.wikipedia.org/w/index.php?curid=9180601.
5	22		Survey icon [Online Image]. Retrieved April 18, 2018 from https://pixabay.com/en/survey-icon-survey-icon-2316468/.

References for Images

No.	Slide No.	Image	Reference
6	23, 36		Keyboard [Online Image]. Retrieved April 18, 2018 from https://pixabay.com/en/keyboard-the-keys-on-the-keyboard-2170063/.