Basic Program Structure
Data Type, Variable - PYTHON

Lesson Objectives

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

- Describe the following:
  - Variables in Python
  - Assignment operator in Python
  - Arithmetic operators in Python
  - Basic numeric data types in Python
- Use variables, assignment operator, arithmetic operators, and basic numeric data types in coding using Python

Topic Outline

- Variables in Python
- Assignment Operator in Python
- Arithmetic Operators in Python
- Basic Numeric Data Types in Python

Variables in Python

Names are used to make the program more readable, so that the "**something**" is easily understood.

e.g., **radiusFloat**

```
# 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)
```

More on import, read input, and type conversion

Identifier in Python

Identifier: a name given to an entity in Python

- Helps in differentiating one entity from another
- Name of the entity must be unique to be identified during the execution of the program

Rules for Writing Identifiers

What can be used?

- Uppercase and lowercase letters A through Z (26 * 2 = 52)
- The underscore, '_' (1)
- The digits 0 through 9, except for the first character (10)

52 + 1 + 10 = 63

Syntax Rules in Python

- Must begin with a letter or _
  - **'Ab123'** and **'_b123'** are ok
  - **'123ABC'** is not allowed
- May contain letters, digits, and underscores

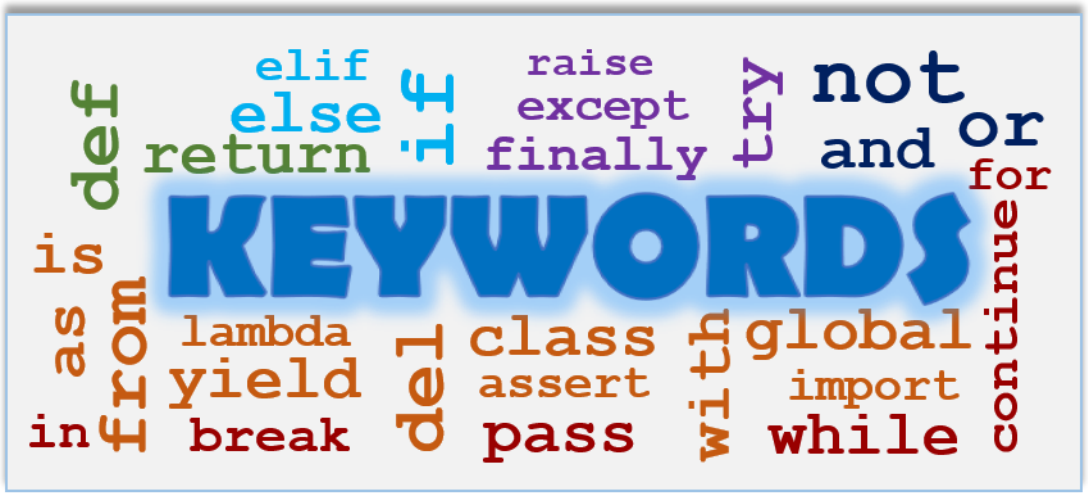
  this_is_an_identifier_123
- Should **not** use keywords
- Upper case and lower case letters are different

  'LengthOfRope' is not **'lengthofrope'**

  *Python is **case sensitive***
- Can be of any length
- Names starting with _ have special meaning

Keywords

- Special words reserved in Python
- Programmers should not use keywords to *name* things



Note: Old Python keyword '***exec***' was removed in Python 3

Quick Check

Let's examine the following variable names, which do you think are invalid?

int	return	For
Us$	2person	userName
HALF_WINWIDTH	__name__	Phone#

Quick Check: Answer

Let's examine the following variable names, which do you think are invalid?

int	return	For
Us$	2person	userName
HALF_WINWIDTH	__name__	Phone#

***Allowed Characters**: Uppercase and lowercase letters A through Z, the underscore, '_' and the digits 0 through 9 (except for the first character)*	• *(Us$, Phone#): $ and # are not allowed;* • *(2person): a digit is not allowed as a first character*
Should not use keyword	• *(return): 'return' is a keyword*

A Common Pitfall in Python

```
john_math_score = 90
peter_math_score = 70
mary_math_score = 80
john_eng_score = 60
peter_eng_score = 60
mary_eng_score = 60

total = john_math_score + peter_math_score + mary_math_score
average_math = total/3.0
print("average Math score =", average_math)
Total = john_eng_score + peter_eng_score + mary_eng_score
average_eng = total/3.0
print("average English score =", average_eng)
```

All English scores are 60

Message 1

Be careful! Python is case sensitive!

Message 2

A program, that can run doesn't mean that it is correct.

Logic error

Can we interpret and run this program?

Yes

Is the result correct?

Hint: Typo

NO!

Python Naming Conventions

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

vs.

```
import math
a = input("Enter the radius of your circle:")
b = float (a)
c = 2 * math.pi * b
d = math.pi * b * b
```

What is c? It is not immediately clear.

- **Both programs work**
- **They are different when readability counts**

- variable names should be in lowercase, with words separated by underscores as necessary to improve readability

  e.g. radius_float

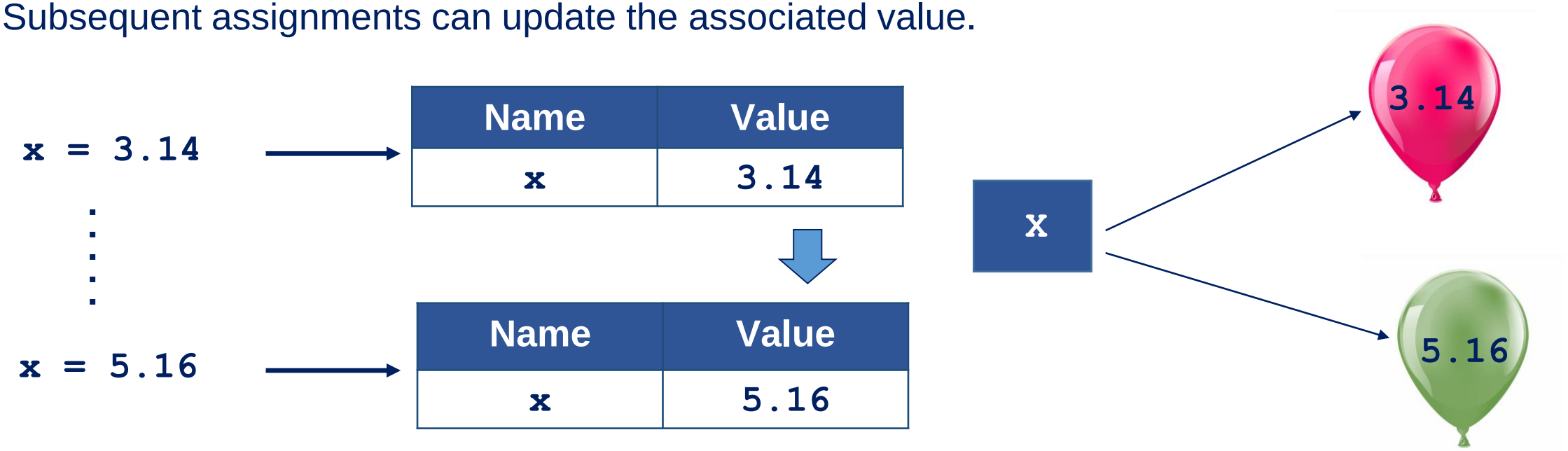
- mixedCase is allowed

  e.g. radiusFloat

Variable Objects

Operations

- Once a variable is created, we can **store**, **retrieve**, or **modify** the value associated with the variable name.
- Subsequent assignments can update the associated value.



Fun Guessing

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

```
x = 9
print (x)
x = 7.8
print (x)
x = "welcome"
print (x)
```

Fun Guessing: Answer

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

```
x = 9
print (x)
x = 7.8
print (x)
x = "welcome"
print (x)
```

Answer

9
7.8
welcome

Data Types

Compared to C and Java, how does Python know the data types?

Python uses *Duck-Typing*

"When I see a bird that walks like a duck and swims like a duck and quacks like a duck, I call that bird a duck." – James Whitcomb Riley

Examples

```
>>> a = 99
>>> b = 99.9
>>> c = '100'
>>> d = True
```

Four variables!

What are their data types?

Data Types (Cont'd)

Type Function

In Python, the `type()` function allows you to know the type of a **variable** or **literal**.

```
>>> x = 9
>>> type (x)
<class 'int'>
>>> x = 7.8
>>> type(x)
<class 'float'>
>>> x = "Welcome"
>>> type (x)
<class 'str'>
>>> x = 'Python'
>>> type (x)
<class 'str'>
>>> type (8.9)
<class 'float'>
```

- Python does not have variable declaration, like Java or C, to announce or create a variable.
- A variable is created by just assigning a value to it and the type of the value defines the type of the variable.
- If another value is re-assigned to the variable, its type can change.

Data Types (Cont'd)

String - designated as '**str**'

- It is basically a sequence, typically a sequence of characters delimited by single quote ('…') or double quotes ("…")
- First *collection* type that was discussed
- Collection type contains multiple objects organized as a single object

More on this later..

Examples

```
>>> a = "Length"
>>> b = "1003 welcome"
>>> c = "ewwew sdcd &8 $5##"
>>> d = 'ewwew sdcd &8 $5##'
```

Quick Check

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

```
total = 4 + 3
sum = total * 2
Total = total + sum
print (total)
print ('Total')
```

Quick Check: Answer

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

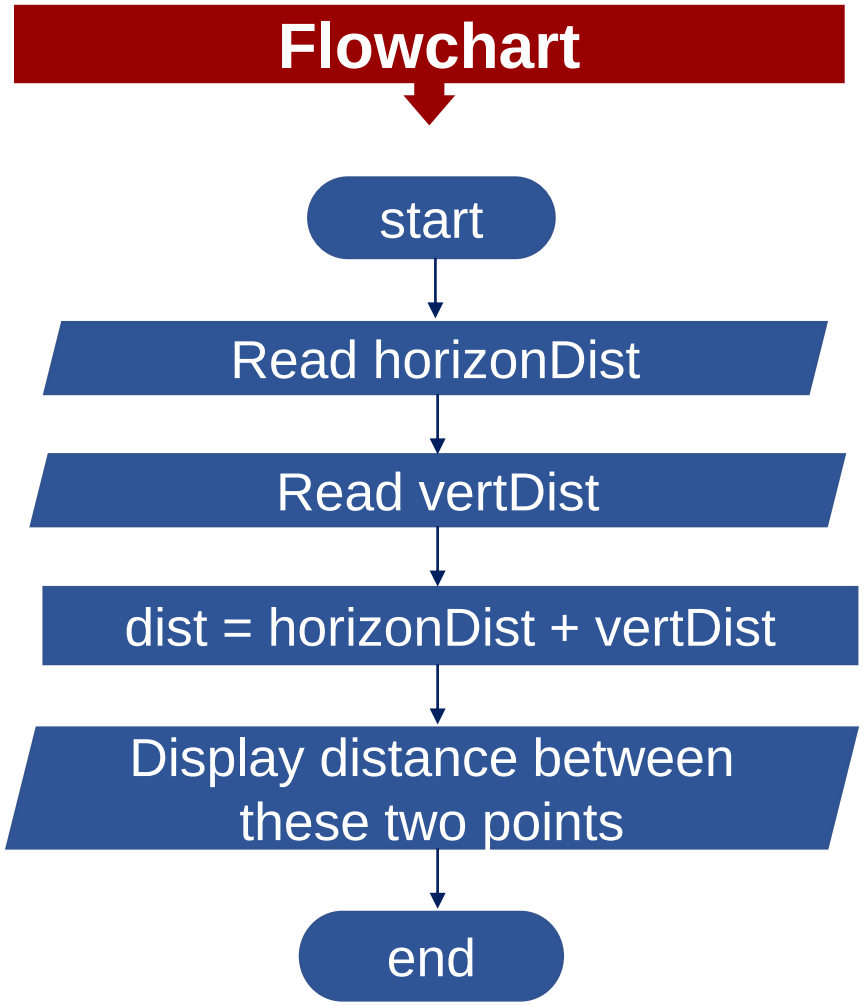
```
total = 4 + 3
sum = total * 2
Total = total + sum
print (total)
print ('Total')
```

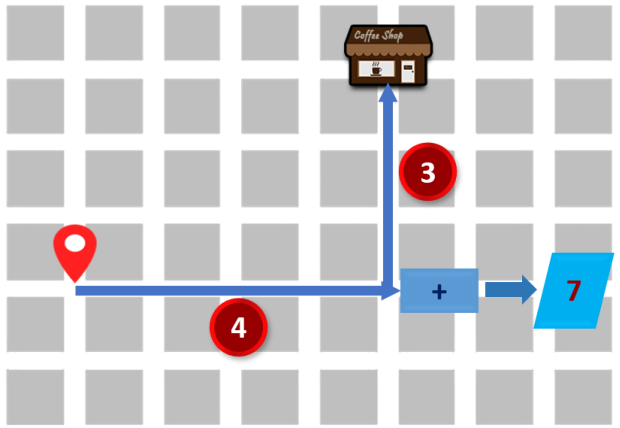
Answer

7
Total

Scenario 3: Find the Distance Traveled - Recall

Flowchart



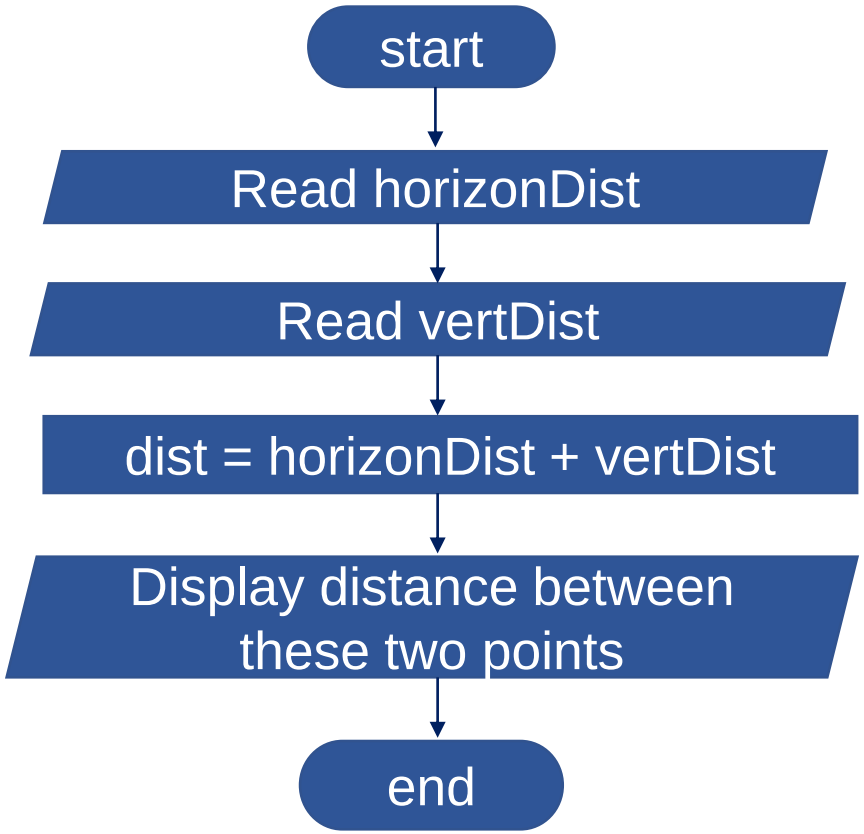


Preparatory Questions

- How many variables should you define? (**3**)
- What is the data type of each variable? (**integer**)
- Do you need assignment operator in your program? (**Yes**)
- Do you need arithmetic operators in your program? (**Yes**)

Scenario 3 - Python Codes

Flowchart



Python Code Version 1

```
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)
```

Output

```
Read horizonDist 4
Read vertiDist 3
distance from A to B is 7
```

`print`
(for displaying data)

`input`
(for reading data)

Scenario 3 - Python Codes: Comparison

Version 1

```
horizon_dist = 4
vertical_dist = 3
travel_dist = horizon_dist + vertical_dist
print(travel_dist)
```

Output: 7

Version 2

```
horizon_dist = 4
vertical_dist = 3
travel_dist = horizon_dist + vertical_dist
print("distance from A to B is ", travel_dist)
```

Output: distance from A to B is 7

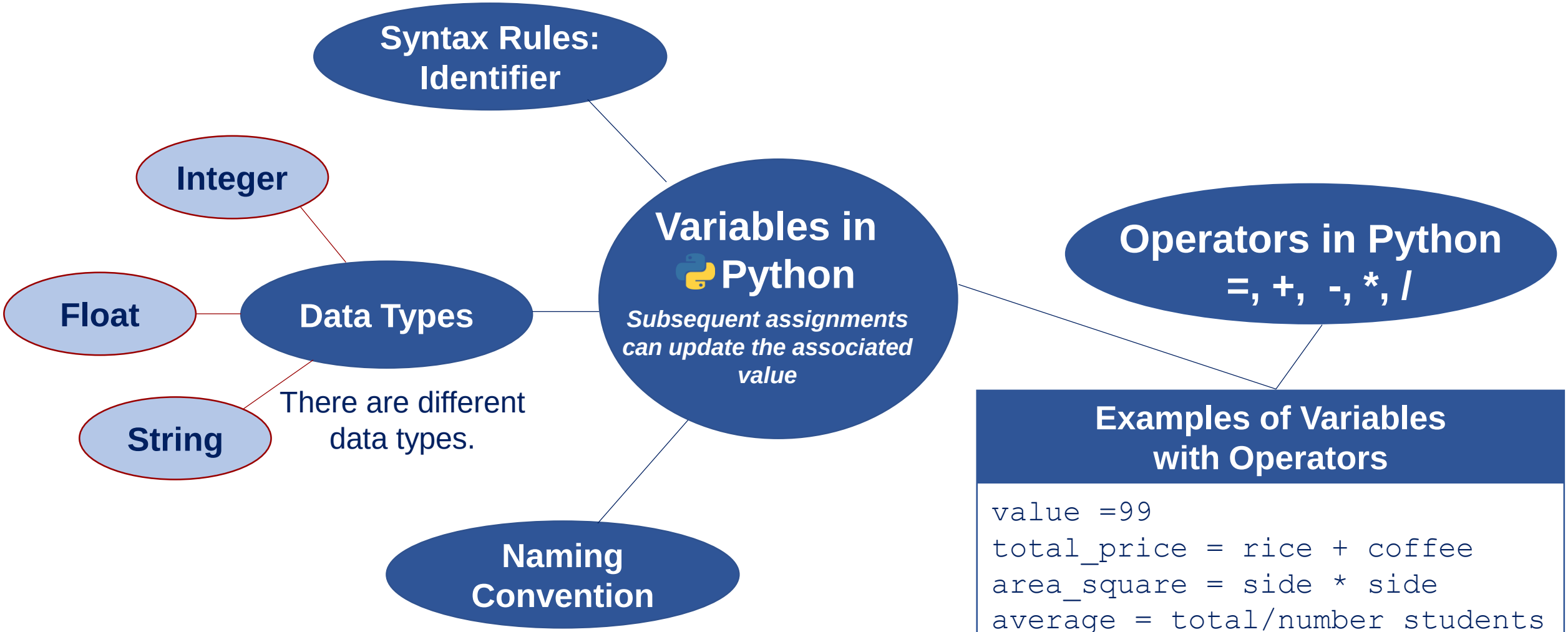
Version 3

```
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)
```

Output:

Read horizonDist 4
Read vertDist 7
distance from A to B is 7

Summary


Syntax Rules: Identifier
Integer
Float
Data Types
String
There are different data types.
Variables in Python
Subsequent assignments can update the associated value
Operators in Python
=, +, -, *, /
Naming Convention
Examples of Variables with Operators
value =99
total_price = rice + coffee
area_square = side * side
average = total/number_students

References for Images

Placeholder

Knowledge Concept Check

Information for other school

Hands-on Demonstration