Topic 1.3
Python Variables
Aims

• Understand the idea of a variable
• Using metaphors to explain variables
• Using variables to breakdown complex expressions
• Assignment statements

• Stages of understanding ‘variables’
Program Variable

• Understanding 1: Variables is a name for a value

• Names are really important
  • Name $\leftarrow \rightarrow$ meaning

• Value can change

Which are the following everyday values are like variables?

• Your height
• Your age
• The credit on your oyster
Using a Variable

• A variable can be used instead of a value:

```python
greeting = "Hello"
planet = "World"
print(greeting, planet)
```

• The output is:

'Hello World'

• The variables are: ‘greeting’ and ‘planet’
  • *Any names*
Decomposition using Variable

• How to break a complex calculation down into simpler steps?
  • Recurring question in programming

```python
>>> km_mile = (1760 * 36 * 2.54) / 100 / 1000
>>> km_mile
1.609344

>>> inch_mile = 1760 * 36
>>> cm_mile = inch_mile * 2.54
>>> m_mile = cm_mile / 100
>>> km_mile = m_mile / 1000
>>> km_mile
1.609344
```
Errors

• A variable must be given a value before it is used:

```python
>>> area = length * width
Traceback (most recent call last):
  File "<pyshell#4>", line 1, in <module>
    area = length * width
NameError: name 'length' is not defined
```

• Notice:
  • The message is complex – read it carefully
  • Only the first error is mentioned
Assignment

• The statement to set a variable is call ‘assignment’

```python
>>> x = 10
```

• … can be read as ‘10 is assigned to x’

• How do you read?

```python
>>> x = y
```

**Warning**: assignment is not equals
Assignment II

- “x is assigned the value of y” or “the value of y is assigned to variable x”

```python
>>> x = y
```

- How are the two variables used?
  - Variable ‘x’ changes value; the value of ‘y’ stays the same
  - The value of ‘y’ is used (or read); an error occurs if ‘y’ has never been given a value.
  - It does not matter if ‘x’ has no value before the statement; if it does, it is lost
Quiz – I

• What is the value of ‘x’ after these statements have been executed?

$$x = 5$$
$$x = x + 3$$

• You can check the answer using the Python shell
Variable as a Memory Location

- **Understanding 2**: A variable is a location in the computer’s memory.

- Python takes care of ‘where’ to put the values

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>subject</td>
<td>&quot;CS&quot;</td>
</tr>
<tr>
<td>number</td>
<td>4</td>
</tr>
<tr>
<td>activity</td>
<td>“FUN”</td>
</tr>
</tbody>
</table>
• What is the values of ‘x’ and ‘y’ after these statements have been executed?
  • Each box is a separate problem

\[
\begin{align*}
\text{x} &= 3 \\
\text{y} &= 2 \\
\text{x} &= \text{x} + \text{y}
\end{align*}
\]

\[
\begin{align*}
\text{x} &= 3 \\
\text{y} &= 2 + \text{x} \\
\text{x} &= \text{x} + \text{y}
\end{align*}
\]

\[
\begin{align*}
\text{x} &= 3 \\
\text{y} &= 2 \\
\text{x} &= \text{x} + \text{y} \\
\text{y} &= \text{x} - 2
\end{align*}
\]

• You can check the answers using the Python shell

Which understanding is needed?
Summary

• A variable gives a name to a value
  • Choose a meaningful name
• Reading and Assignment
  • A variable can be read in an expression
  • A variable can be changed in an assignment statement
• Use variables
  • To replace a complex expression with several simpler ones
  • To hold an ‘input’ string from the user