香港浸會大學
HONG KONG BAPTIST UNIVERSITY

Python Basics

JOUR7280/COMM7780

Big Data Analytics for Media and Communication

Instructor: Dr. Xiaoyi Fu

Agenda

- Python & Jupyter Notebook
- Python basics
- Variables, expressions, and statements
- User inputs

Python & Jupyter Notebook

Interpreter and compiler

- Processor (CPU) understands machine language
  - Only binary values
  - ...1100010110010101010...
- An interpreter reads the source code of the program as written by the programmer, parses the source code, and interprets the instructions
  - An interpreter translates high-level instructions into an intermediate form, which it then executes.

Interpreter and compiler

- A compiler
  - Translates high-level instructions directly into machine language to create an executable program.
  - In windows ".exe" or ".dll" which stand for "executable" and "dynamic link library" respectively
  - In Linux and MacOS, there is no suffix that uniquely marks a file as executable though

Interpreter and compiler

- Interpreter vs. compiler
    - Compiled programs generally run faster than interpreted programs
    - But compilation can be time-consuming if the program is long.
    - The interpreter can immediately execute high-level programs.
- Python is an interpreted language
    - It goes through an interpreter, which turns code you write into the language understood by your computer's processor.

Before we start

- The most controversial feature of Python's syntax: Whitespace is meaningful!

```
a = 0
a = a + 1
```

is different from

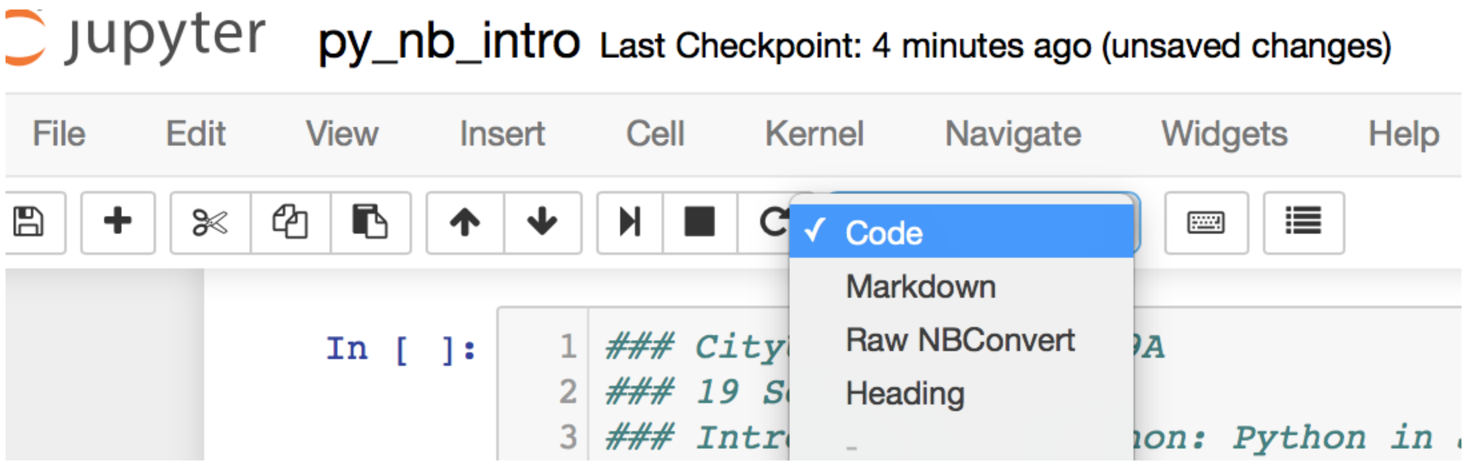
```
a = 0
    a = a + 1
```

THIS IS A SYNTAX ERROR

- Indentation: an empty space at the beginning of a line
  - It is used to identify blocks of code
  - If a block of code is "inside" the other, it means it should be executed separately from the previous (or when something happens)
- It is very important when
  - Using conditional statements (we'll see later)
  - Using iterative statements
  - Defining functions

Jupyter Notebook

- Jupyter Notebook can contain two main "cell types"
  - Markdown
  - Code
- To change cell type:


jupyter
py_nb_intro Last Checkpoint: 4 minutes ago (unsaved changes)
File Edit View Insert Cell Kernel Navigate Widgets Help
✓ Code
Markdown
Raw NBConvert
Heading

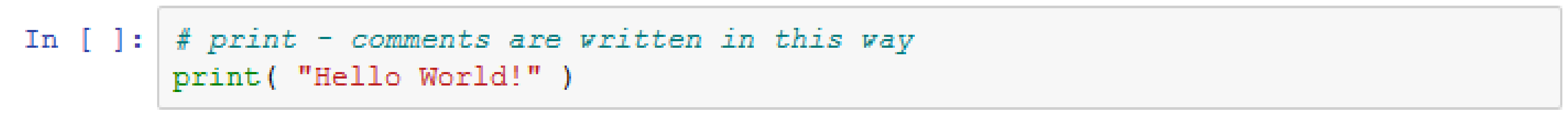
```
In [ ]:   ### City
          ### 19 S
          ### Intr
```

Jupyter Notebook

- Some short-cut keys
  - “alt” + “enter”: adding one more line
- When selecting a cell (NOT inside a cell)
  - “a” (adding one more line above the current line)
  - “b” (adding one more line below the current line)
  - “dd” (removing the current line - seems to be undoable…so please be careful here)
  - “m” turns the current line into markdown

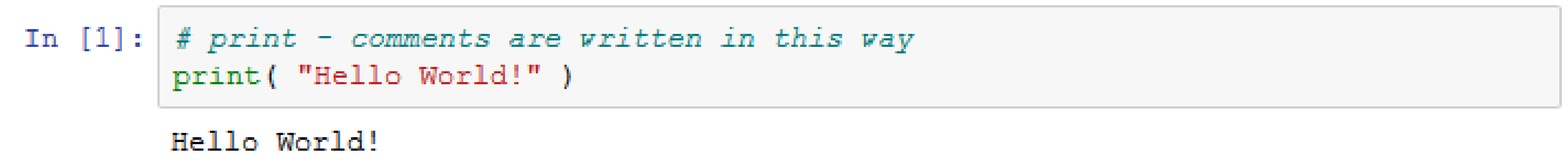
Code cells

- This cell is ready to be executed



```
In [ ]: # print - comments are written in this way
        print( "Hello World!" )
```

  - No number inside brackets ([ ])
  - No output below
- This cell has been already executed



```
In [1]: # print - comments are written in this way
        print( "Hello World!" )

        Hello World!
```

  - Number in brackets ([1]) represents the order of execution
  - Output below the cell

Kernel

- ‘kernel’ is a program that runs and introspects the user’s code.
- The kernel’s state persists over time and between cells
- It pertains to the document as a whole and not individual cells.

Before you start

- Switch to English keyboard

Python basics

Syntax Error

- You're talking to python and this is a language that you don't already know.
- The computer is going to seem to judge your mistakes harshly.
- Syntax error doesn't mean that Python thinks you're bad.
- Syntax error means Python is lost.
    - It just doesn't have really friendly words when it says it's lost
    - Your syntax is not something that Python understands.

Assignment Statement

Program

```
x = 1
print(x)
x = x+1
print(x)
```

Output

```
1

2
```

Take whatever's in x, which is a 1, and then add 1 to it, which becomes 2, and then stick it back in x.

Reserved Words

- Words that have very special meaning to Python.
  - They have one and only one meaning to Python.
  - Use it the way Python expects us to use it
- Can NOT use reserved words as variable names / identifiers

and	del	global	not	with
as	elif	if	or	yield
assert	else	import	pass	
break	except	in	raise	
class	finally	is	return	
continue	for	lambda	try	
def	from	nonlocal	while	

Sentences or Lines

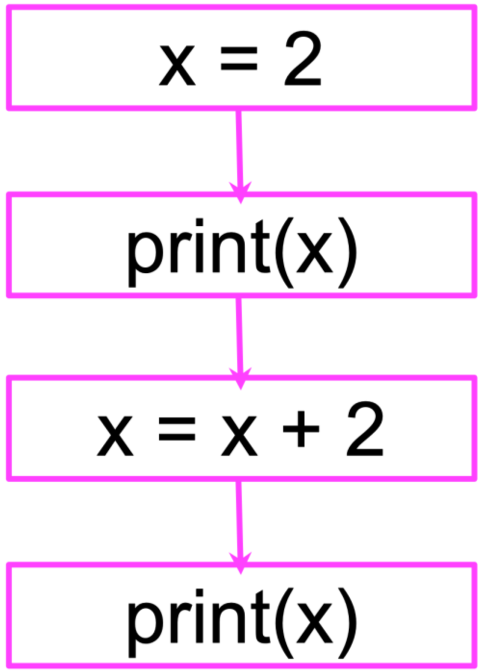
`x = 2`	←	Assignment statement
`x = x + 2`	←	Assignment with expression
`print(x)`	←	Print function

Variable Operator Constant Function

Program Steps or Program Flow

- Like a recipe or installation instructions, a program is a sequence of steps to be done in order.
- Some steps are conditional – they may be skipped.
- Sometimes a step or a group of steps is to be repeated.
- Sometimes we store a set of steps to be used over and over as needed several places throughout the program.

Program flow: Sequential steps



Program

```
x = 2
print(x)
x = x + 2
print(x)
```

Output

```
2
4
```

- When a program is running, it flows from one step to the next. As programmers, we set up "paths" for the program to follow.

Variables, expressions, and statements

Constants

- Fixed values such as numbers, letters, and strings
- Are called “constants” because their value does NOT change
- Numeric constants are as you expected
- String constants use single quotes (‘) or double quotes (")

Variables

- A variable is a named place in the memory where a programmer can store data and later retrieve the data using the variable "name"
- A variable is a name that refers to a value.
- Programmers get to choose the names of the variables
- You can change the contents of a variable in a later statement

```
x = 12.2
y = 14
x = 100
```

Python variable naming rules

- Must start with a letter or underscore _
- Must consist of letters, numbers, and underscores
- Case Sensitive
- Cannot use reserved words
- **Good** spam eggs spam23 _speed
- **Bad** 23spam #sign var.12
- **Different** spam Spam SPAM

Sentences or Lines

`x = 2`	Assignment statement
`x = x + 2`	Assignment with expression
`print(x)`	Print function

Variable Operator Constant Function

Choosing mnemonic variable names

```
x1q3z9ahd = 35.0
x1q3z9afd = 12.50
x1q3p9afd = x1q3z9ahd * x1q3z9afd
print(x1q3p9afd)
```

```
a = 35.0
b = 12.50
c = a * b
print(c)
```

```
hours = 35.0
rate = 12.50
pay = hours * rate
print(pay)
```

What is this bit of code doing?

- Python interpreter sees all three of these programs as exactly the same
- Humans will most quickly understand the intent of the third program

- $2\ expression.ipynb$

Assignment Statement

- We assign a value to a variable using the assignment statement (=)
- An assignment statement consists of an expression on the right-hand side and a variable to store the result.

```
x = 3.9 * x * (1 - x)
```

Expression

- The right side is an expression
- The reason why it's possible to have the same variable on both sides because right-hand side happens first, ignoring left-hand side.
- Once the expression is evaluated, the result is placed in (assigned to) x

Numeric expressions

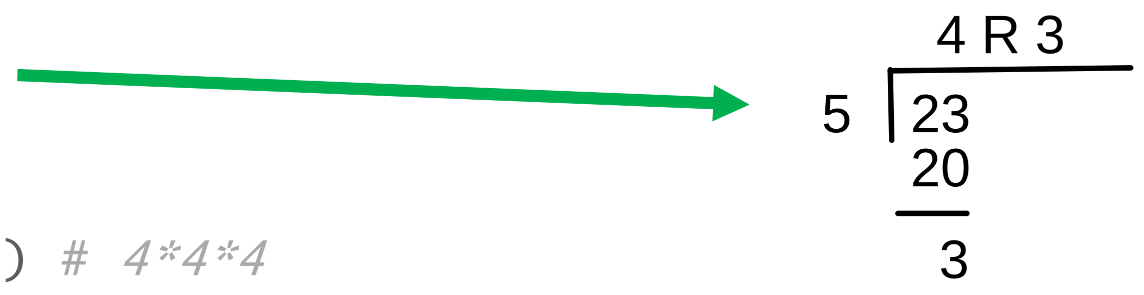
- **Operators** are special symbols that represent computations like addition and multiplication.
- Because of the lack of mathematical symbols on computer keyboards - we use "computer-speak" to express the classic math operations
- Asterisk is multiplication
- Exponentiation (raise to a power) looks different than in math.

Operator	Operation
+	Addition
-	Subtraction
*	Multiplication
/	Division
**	Power
%	Remainder

- $2\ expression.ipynb$

Numeric expressions

```
xx = 2
xx = xx+2
print (xx)

yy = 440*12
print(yy)

zz = yy/1000
print(zz)

jj = 23
kk = jj%5
print(kk)

print(4**3) # 4*4*4
```



- *2 expression.ipynb*

Order of Evaluation

- When we string operators together
    - Python must know which one to do first
- This is called operator precedence
- Which operator "takes precedence" over the others?

```
x = 1 + 2 * 3 - 4 / 5 ** 6
```

Operator Precedence Rules

- Highest precedence rule to lowest precedence rule:
  - Parentheses are always respected
  - Exponentiation (raise to a power)
  - Multiplication, division & remainder
  - Addition, subtraction
  - Left to right

Parentheses
Power
Multiplication
Addition
Left to Right

Operator Precedence

```
x = 1 + 2 ** 3 / 4 * 5
print(x)
```

- Output: 11.0

Parentheses

Power

Multiplication

Addition

Left to Right

Operator Precedence

- Remember the rules top to bottom
- When writing code
  - Use parentheses
  - Keep mathematical expressions simple enough so that they are easy to understand
- Break long series of mathematical operations up to make them more clear

Parentheses

Power

Multiplication

Addition

Left to Right

What does “Type” mean?

- In Python, variables, literals and constants have a “type”
- Python knows the difference between an integer number and a string
- For example, “+” means “addition” if something is a number and “concatenate” if something is a string
    - Concatenate: put together

```
ddd = 1+4
print(ddd)

eee = ‘hello '+'there'
print(eee)
```

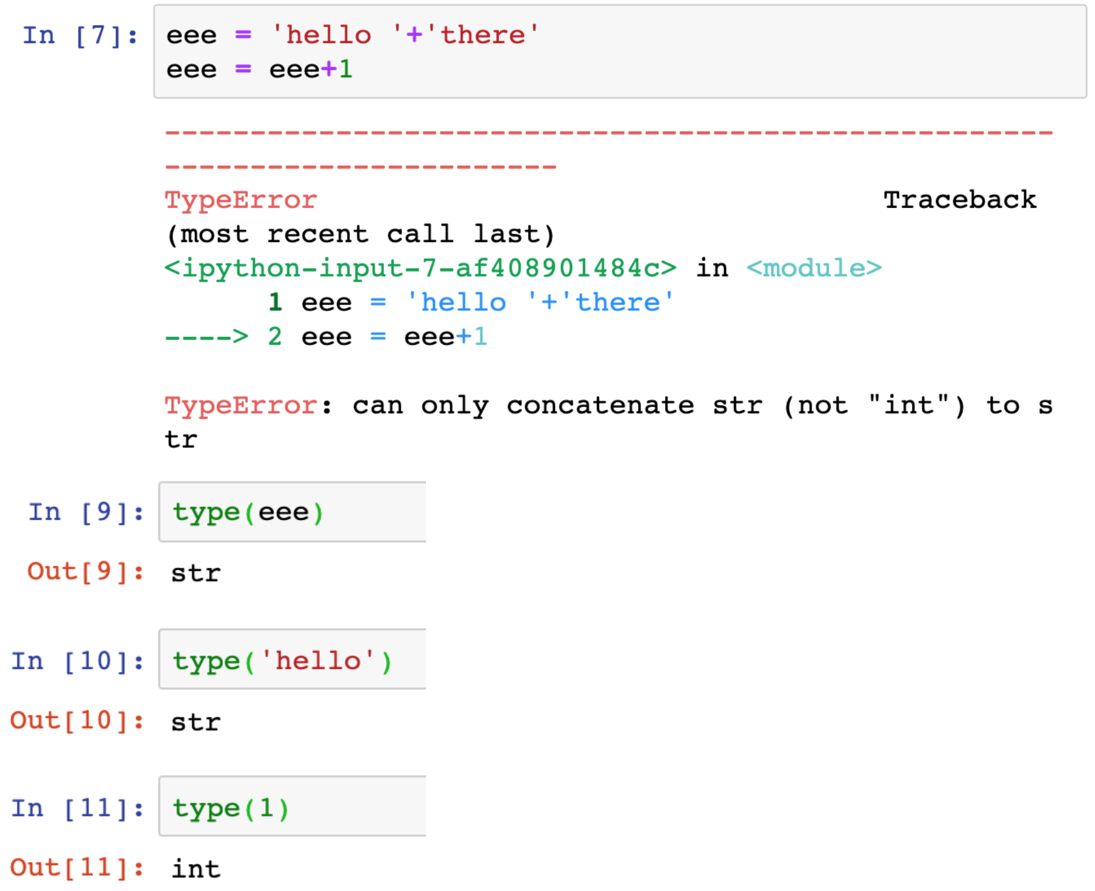
$2\ expression.ipynb$

“Simple” data types

Type	Example	Description
int	x = 1	integers (i.e., whole numbers)
float	x = 1.0	floating-point numbers (i.e., real numbers)
complex	x = 1 + 2j	Complex numbers (i.e., numbers with real and imaginary part)
bool	x = True	Boolean: True/False values
str	X = “abc”	String: characters or text. A string is a sequence of characters.
NoneType	X = None	Special object indicating nulls

Type Matters

- Python knows what "type" everything is
- Some operations are prohibited
- E.g., you cannot "add 1" to a string
- We can ask what type something is by using `type()` function

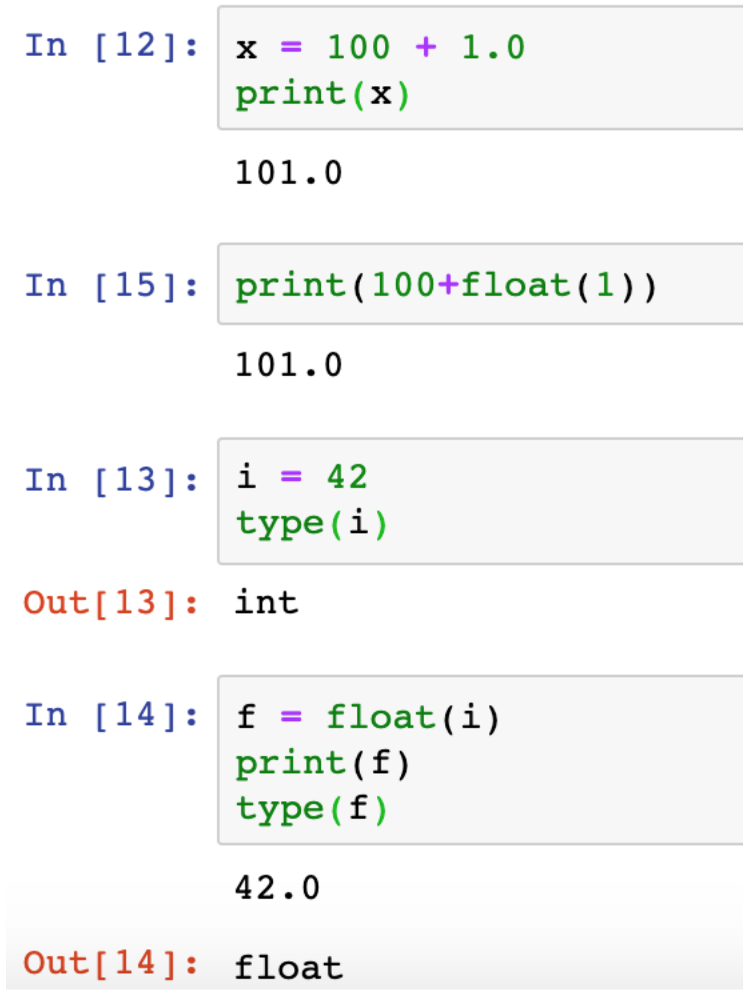


```
In [7]: eee = 'hello '+'there'
        eee = eee+1

        ---------------------------------------------------------------------------
        TypeError                                 Traceback
        (most recent call last)
        <ipython-input-7-af408901484c> in <module>
              1 eee = 'hello '+'there'
        ----> 2 eee = eee+1

        TypeError: can only concatenate str (not "int") to s
        tr

In [9]: type(eee)

Out[9]: str

In [10]: type('hello')

Out[10]: str

In [11]: type(1)

Out[11]: int
```

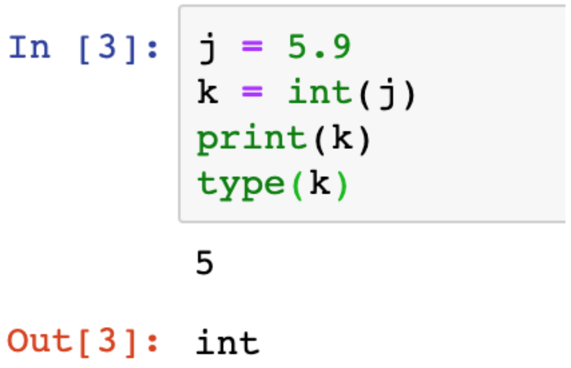
$2\ expression.ipynb$

Type Conversions

- When you put an integer and a floating point number in one expression, the integer is implicitly converted to a float
- You can control this with the built-in functions int() and float()



```
In [12]: x = 100 + 1.0
         print(x)

         101.0

In [15]: print(100+float(1))

         101.0

In [13]: i = 42
         type(i)

Out[13]: int

In [14]: f = float(i)
         print(f)
         type(f)

         42.0

Out[14]: float
```

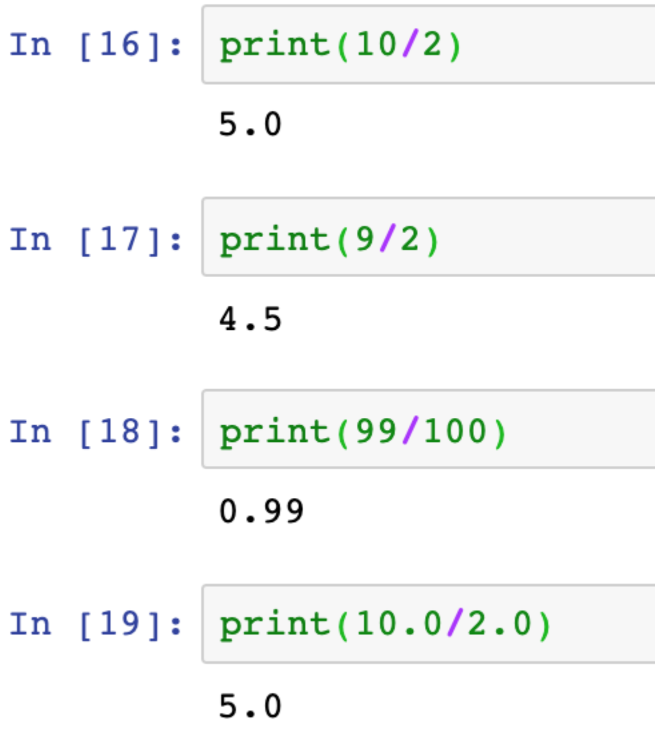


```
In [3]: j = 5.9
        k = int(j)
        print(k)
        type(k)

        5

Out[3]: int
```

$2\ expression.ipynb$

Integer division

- Integer division produces a floating point result

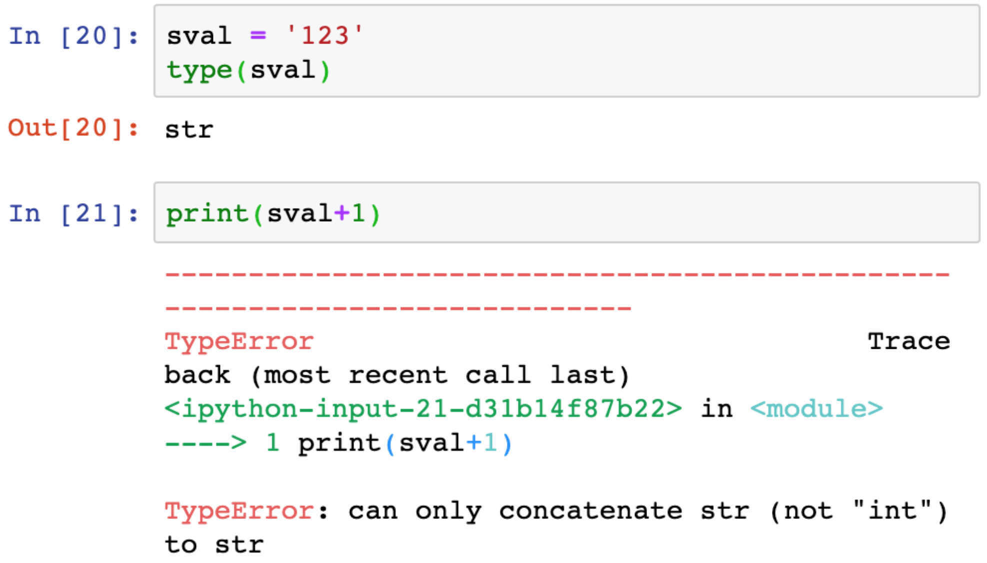


```
In [16]: print(10/2)
5.0

In [17]: print(9/2)
4.5

In [18]: print(99/100)
0.99

In [19]: print(10.0/2.0)
5.0
```

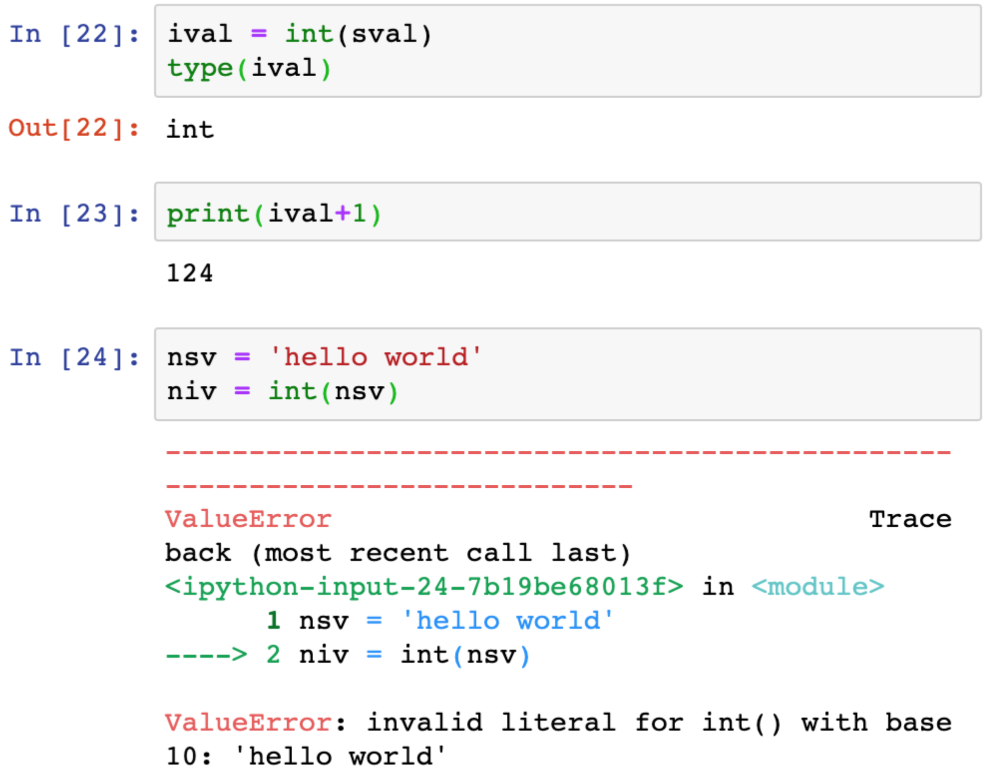
$2\ expression.ipynb$

String Conversions

- You can also use int() and float() to convert between strings and integers
- You will get an error if the string does not contain numeric characters



```
In [20]: sval = '123'
         type(sval)

Out[20]: str

In [21]: print(sval+1)

         ---------------------------------------------------------------
         ----------------------------
         TypeError                                         Trace
         back (most recent call last)
         <ipython-input-21-d31b14f87b22> in <module>
         ----> 1 print(sval+1)

         TypeError: can only concatenate str (not "int")
         to str
```

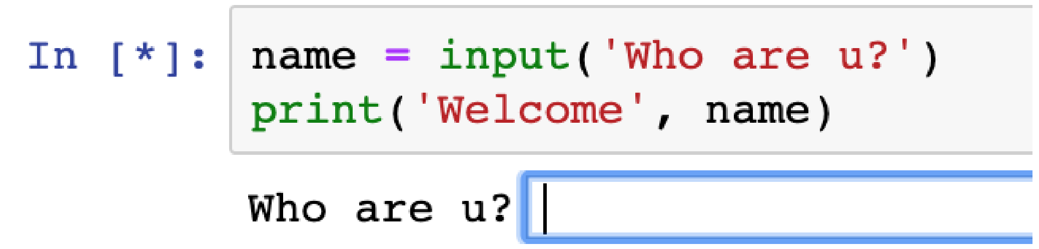


```
In [22]: ival = int(sval)
         type(ival)

Out[22]: int

In [23]: print(ival+1)

         124

In [24]: nsv = 'hello world'
         niv = int(nsv)

         ---------------------------------------------------------------
         ----------------------------
         ValueError                                        Trace
         back (most recent call last)
         <ipython-input-24-7b19be68013f> in <module>
               1 nsv = 'hello world'
         ----> 2 niv = int(nsv)

         ValueError: invalid literal for int() with base
         10: 'hello world'
```

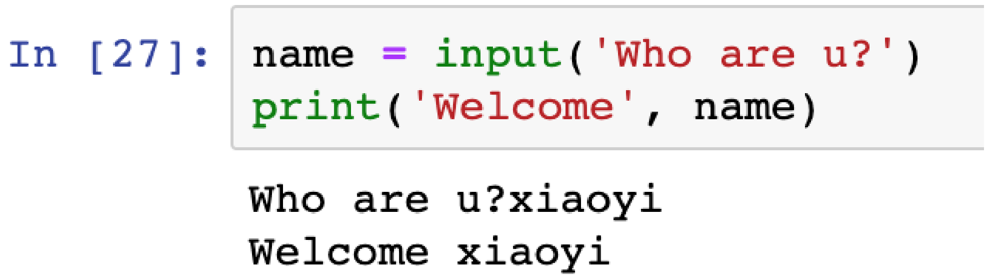
User Input

User Input

- We can instruct Python to pause and read data from the user using the input() function
  - The parameter to the input function is what's called a prompt
- The input() function returns a string
- We can also input a file (more on file inputs later)



```
In [*]: name = input('Who are u?')
        print('Welcome', name)

        Who are u? |
```



```
In [27]: name = input('Who are u?')
         print('Welcome', name)

         Who are u?xiaoyi
         Welcome xiaoyi
```

$2\ expression.ipynb$

Comments in Python

- Anything after a # is ignored by Python
- Why comments?
    - Describe what is going to happen in a sequence of code
    - Document who wrote the code or other ancillary information
    - Turn off a line of code – perhaps temporarily

Converting User Input

- If we want to read a number from the user, we must convert it from a string to a number using a type conversion function.
- Later we will deal with bad input data.

```python
# convert elevator floors
inp = input('Europe floor?')
usf = int(inp)+1
print('US Floor', usf)
```

```
Europe floor? 0
US Floor 1
```

$2\ expression.ipynb$

Acknowledgements / Contributions

- Some of the slides used in this lecture from:
    - Charles R. Severance - University of Michigan School of Information
    - Dr. Xinzhi Zhang – School of Communication - HKBU

Thank You