



# Python: From Beginner to **Intermediate**



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# Python: Basic

- **Why Python? What is Python? How to Use Python**
- **Data Types**
  - Dynamically-typed → no type specifier
  - Built-in compound data types: `str`, `tuple`\*, `list`\*, `set`\*, `dict`\* (\*support heterogenous data types)
- **Operators**
  - More natural (e.g. `&&` → `and`, condition `? A : B` → `A if condition else B`)
- **Flow Control**
  - Easier access to elements in compound data with `for` statement
- **Function Definition**
  - Multiple return values (as a `tuple`)
- **Object-oriented Programming**
  - Dynamically-typed → no definition for member variables

# My Comments for Better Python Programming



## 1. Take advantages of Python itself (a.k.a. *Pythonic*)

- e.g. Swap using unpacking

```
temp = a
a = b      VS.   (a, b) = (b, a)
b = temp
```

- References
  - [Code Style](#), The Hitchhiker's Guide to Python
  - [Write More Pythonic Code](#), Real Python
  - [PEP 8 – Style Guide for Python Code](#), Python

## 2. Utilize the exiting libraries (a.k.a. [Don't reinvent the wheel](#)) and master them if they are useful

- Problem #1) Too many libraries
  - Search your keywords in **Google**/[Github](#) (with *python*), [PyPI](#), and ...
- Problem #2) A few documents and examples
  - Select a popular one (if possible)
  - Search your problem in **Google** (or analyze the source codes)

# Data Types

## ▪ Numbers

- **int**: Integers with an unlimited range

```
a = 329
```

- **float**: Double-precision (64-bit) floating-point numbers

```
a = 3. # Same with 'a = 3.0'
```

```
b = 3.29
```

- **bool**: Boolean values (False or True)

```
a = False
```

```
b = (3 == 3.) # Check this result
```

Note) Dynamically-typed → no type specifier



## ▪ Numbers

- **int**: Integers with an unlimited range

a = 329                   # Decimal number

b = 0b101001001       # Binary number

c = 0o511               # Octal number

d = 0x149               # Hexadecimal number

- **float**: Double-precision (64-bit) floating-point numbers

Note) Python does not support single-precision (32-bit) floating-point numbers by itself.

- **complex**: Complex numbers with imaginary and real float numbers

a = 3.29 + 8.2j

- **Built-in constants**: False, True, None, ...

- None: Not available ([N/A](#)), not determined, ... (e.g. when your function does not return a value)

- Note) **None == False** # False

**type(None)**       # NoneType

# Data Types

- **String**

- **str**: A text encoded in Unicode

`name = 'Choi'`                      or   `name = "Choi"`

For multi-line text

`name = 'Sunglok\nChoi'`   or   `name = """Sunglok  
Choi"""`   # Also used for a block comment (~ /\* ... \*/ in C++)

Note) String is a **built-in** type, not in a library (~ `std::string` in C++).

# Data Types



## ▪ String

### – String formatting [\[Real Python\]](#) [\[Format Specifiers\]](#)

```
prof_dict = {'name': 'Choi', 'room_no': 327, 2021: True}
```

- % operator (~ printf in C): Mandatory type/format specifiers

```
'My name is %s and my room is %d' % ('Choi', 327)
```

```
'My name is %s and my room is %d' % ['Choi', 327] # Error!
```

```
'My name is %(name)s and my room is %(room_no)04d' % prof_dict # 327 -> 0327
```

- str.format function (~ std::cout in C++): Optional type/format specifiers

```
'My name is {} and my room is {}'.format('Choi', 327)
```

```
'My name is {1} and my room is {0}'.format(327, 'Choi')
```

```
'My name is {name} and my room is {room_no}'.format(name='Choi', room_no=327)
```

```
'My name is {name} and my room is {room_no}'.format('Choi', 327) # Error!
```

```
'My name is {name} and my room is {room_no:04d}'.format(**prof_dict) # 327 -> 0327
```



- String

- String formatting [\[Real Python\]](#) [\[Format Specifiers\]](#)

```
name = 'Choi'
```

```
room_no = 327 # Need to print the next room as 0328
```

- % operator (~ printf in C): Mandatory type/format specifiers

```
'My name is %s and my next room is %04d' % (name, room_no + 1)
```

- str.format function (~ std::cout in C++): Optional type/format specifiers

```
'My name is {} and my next room is {:04d}'.format(name, room_no + 1)
```

- + operator: Unnecessary to match argument position

```
'My name is ' + name + ' and my next room is ' + str(room_no + 1)
```

- f-string (Python 3.6+): Concise (without + operators) and no type conversion (to str)

```
f'My name is {name} and my next room is {room_no + 1}'
```

```
f'My name is {name} and my next room is {room_no + 1:04d}'
```



# Data Types



- **String**

- **String trimming**

```
full_name = '\t Sunglok Choi \n'
```

```
full_name.strip()      # 'Sunglok Choi'
```

```
full_name.strip('\t\n') # ' Sunglok Choi '
```

```
full_name.lstrip()     # 'Sunglok Choi \n'
```

```
full_name.rstrip()     # '\t Sunglok Choi'
```

# Data Types



- **String**

- **String splitting**

```
prof = 'Choi, 327, 1'
```

```
prof.split(',')      # ['Choi', ' 327', ' 1']  
prof.split(', ')     # ['Choi', '327', '1']  
prof.split('|')      # ['Choi, 327, 1']  
prof.partition(', ') # ('Choi', ', ', '327, 1')
```

```
profs = 'Choi, 327, 1\nKang, 328, 1'
```

```
profs.split(', ')    # ['Choi', '327', '1\nKang', '328', '1']  
profs.splitlines()   # ['Choi, 327, 1', 'Kang, 328, 1']
```

# Data Types



## ▪ String

- **String matching:** Whether both are **same** or not
- **String searching:** Whether the given text **contains** the query text or not
  - Also known as *substring matching*

```
profs = [  
    'My name is Choi and my E-mail is sunglok@seoultech.ac.kr.',  
    'My name is Kim and my e-mail address is jindae.kim@seoultech.ac.kr.'  
]  
for line in profs:  
    print('e-mail' == line)           # False False  Note) Matching  
    print('e-mail' in line)           # False True   Note) Searching  
    print('e-mail' in line.lower())   # True  True   Note) upper()  
    print(line.find('e-mail'))        # -1    22    Note) Starting index  
    print(line.endswith('.'))         # True  True   Note) startswith()
```

# Data Types

## ▪ Compound data

- **tuple**: Comma-separated arbitrary Python objects

```
prof_tuple = ('Choi', 327, True) or prof_tuple = 'Choi', 327, True
```

- **list**: A list of arbitrary Python objects (~ std::array in C++)

```
prof_list = ['Choi', 327, True]
```

- **set**: A unordered set of unique arbitrary objects (~ std::set in C++)

```
prof_set = {'Choi', 327, True}
```

```
prof_set == {'Choi', True, 327}          # True (unordered)
```

```
prof_set == {'Choi', 327, True, True} # True (unique)
```

- **dict**: A hash table of arbitrary values indexed by arbitrary keys (~ std::map in C++)

```
prof_dict = {'name': 'Choi', 'room_no': 327, 2021: True}
```

Note) The *compound* data can contain **heterogenous** data types (not same with *arrays* with a homogeneous data type).

# Data Types

- **Compound data**

```
Given) prof_str    = 'Choi'
      prof_tuple   = ('Choi', 327, True)
      prof_list    = ['Choi', 327, True]
      prof_set     = {'Choi', 327, True}
      prof_dict    = {'name': 'Choi', 'room_no': 327, 2021: True}
```

- **Indexing**

```
prof_tuple[0] == 'Choi'
prof_list[-1] == True # Reverse indexing
prof_set[0]    # Error!
prof_dict['name'] == 'Choi'
prof_dict[2021] == True
```

- **Slicing**

```
prof_str[1:3] == 'ho'
prof_str[1:] == 'hoi'
prof_str[1::2] == 'hi'
prof_list[::-1] == [True, 327, 'Choi']
```



Note) in-place methods [\[More\]](#)

## ▪ Compound data

```
Given) prof_str    = 'Choi'
      prof_tuple   = ('Choi', 327, True)
      prof_list    = ['Choi', 327, True]
      prof_set     = {'Choi', 327, True}
      prof_dict    = {'name': 'Choi', 'room_no': 327, 2021: True}
```

### – Concatenation: Merging two compounds

```
new_str  = prof_str + ' Sunglok'
new_list = prof_list + ['Mirae Hall', 'SeoulTech']
prof_set.union({'Mirae Hall', 'SeoulTech'}) # prof_set = {'Choi', ..., 'MiraeHall', 'SeoulTech'}
prof_dict.update({'room_no': 109, 'building': 'Mirae Hall', 'school': 'SeoulTech'}) # ...
```

### – Appending: Adding an item to a compound

```
prof_list.append('Mirae Hall')           # prof_list = ['Choi', ..., 'MiraeHall']
prof_set.add('Mirae Hall')                # prof_set  = {'Choi', ..., 'MiraeHall'}
prof_dict['building'] = 'Mirae Hall'      # prof_dict = {'name': ..., 'building': 'MiraeHall'}
```

Check) How about concatenation and appending for a **tuple**?

# Data Types



## ▪ Compound data

### – tuple vs. list

```
prof_tuple[0] = 'Sunglok' # Error!
```

```
prof_list[0] = 'Sunglok'
```

### – Why tuple? ~~Collecting and modifying data~~

- **Packing** and **unpacking**

- e.g. Swap

```
(a, b) = (b, a) # a, b = b, a
```

- e.g. Multiple return values

- Note) Extended unpacking

```
name, *others = prof_tuple  
# name = 'Choi'  
# others = [327, True]
```

	Sequential		Editable
	Type	Ordered	Mutable
Indexing Slicing {	str	O	X
	tuple	O	X
	list	O	O
	set	X	O
	dict	X	O

```
def mean_var(data):  
    n = len(data)  
    if n > 0:  
        mean = sum(data) / n  
        sum2 = 0  
        for datum in data:  
            sum2 += datum**2  
        var = sum2 / n - mean**2  
        return mean, var  
    return None, None
```

```
data = [3, 2, 9, 1, 0, 8, 7, 5]  
pair = mean_var(data) # pair = (4.375, 9.984)  
mean, var = mean_var(data) # mean = 4.375, var = 9.984
```

# Data Types

- Useful built-in functions

- Type check

- ```
type(prof_str) == str
```

- Type casting

- ```
int(3.29) == 3
```

- ```
str(3) == '3'
```

- ```
int('29') == 29
```

- Note) The above two conversions are more easy-to-use than C/C++/Java.

- Length of compound data

- ```
len(prof_name) == 4 # The number of items
```



# Operators

- Operator precedence



| Operator Types                 | Operators                                                                      | Description                                                                   |
|--------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Compound data (Parentheses)    | (expressions...),<br>[expressions...],<br>{key: value...},<br>{expressions...} | Binding (tuple) / parenthesized expression,<br>list,<br>dictionary,<br>set    |
| Subscription                   | x[index],<br>x[index:index],<br>x(arguments...),<br>x.attribute                | Indexing,<br>slicing,<br>call,<br>attribute reference                         |
| Arithmetic (Bitwise)           | **                                                                             | Exponentiation                                                                |
|                                | +x, -x, ~x                                                                     | Positive, negative, bitwise NOT                                               |
|                                | *, @,<br>/, //, %                                                              | Multiplication, matrix multiplication,<br>division, floor division, remainder |
|                                | +, -                                                                           | Addition and subtraction                                                      |
| Bitwise                        | <<, >>                                                                         | Bitwise shifts                                                                |
|                                | &                                                                              | Bitwise AND                                                                   |
|                                | ^                                                                              | Bitwise XOR                                                                   |
|                                |                                                                                | Bitwise OR                                                                    |
| Membership Identity Comparison | in, not in,<br>is, is not,<br><, <=, >, >=, !=, ==                             | Membership tests,<br>Identity tests,<br>Comparisons                           |
| Logical                        | not                                                                            | Boolean NOT                                                                   |
|                                | and                                                                            | Boolean AND                                                                   |
|                                | or                                                                             | Boolean OR                                                                    |
| Ternary                        | if - else                                                                      | Conditional expression                                                        |
| Lambda                         | lambda                                                                         | Lambda expression                                                             |
| Assignment                     | =, +=, -=, *=, /=                                                              | Assignment expression                                                         |

# Operators

- **Arithmetic** operators

```
type(4 / 2) == float # Always 'float' type (not 'int' type)
(7.5 % 2) == 1.5     # Modulo (remainder)
(7.5 // 2) == 3       # Floor division (integer division; 'int' type)
(-7.5 // 2) == -4
(2 ** 4) == 16        # Exponentiation
```

Note) Please distinguish **division** (/; float type) and **floor division** (//; int type).

- **Logical** operators

```
not 3.29 > 3 and 10.18 < 10 or 5.12 > 5 # Note) They are not '!', '&&', and '||'.
(not 3.29 > 3) and (10.18 < 10 or 5.12 > 5) # Check two results
```

- **Ternary** operators

```
x = 3
is_odd = True if x % 2 == 1 else False # In Python
is_odd = (x % 2) == 1 ? 1 : 0;         // In C/C++
```

# Operators



- Lambda expression: A short function (as a variable)

```
is_odd = lambda x: True if x % 2 == 1 else False
is_odd(3) # True
```

- **Note) Sorting**

```
data = [3, 2, 9]

# list.sort(): An in-place function
data.sort() # data = [2, 3, 9]
data.sort(reverse=True) # data = [9, 3, 2]
data.sort(key=lambda x: abs(x - 4)) # data = [3, 2, 9]

# sorted(): Returning a new list
sorted(data) # [2, 3, 9]
sorted(data, reverse=True) # [9, 3, 2]
sorted(data, key=lambda x: abs(x - 4)) # [3, 2, 9]
```

Example) Sorting points according to their distance from the origin (0, 0)

```
pts = [(3, 29), (10, 18), (10, 27), (5, 12)]
nearest_pts = sorted(pts, key=lambda pt: pt[0]**2 + pt[1]**2)
```

# Operators



- Lambda expression: A short function (as a variable)

```
is_odd = lambda x: True if x % 2 == 1 else False
is_odd(3) # True
```

- **Note) List comprehensions**

Example) Generate a list with  $[0^2, 1^2, \dots, 8^2, 9^2]$

- **C-style codes**

```
squares = []
for x in range(10):
    squares.append(x**2)
```

- **map function** (Note) filter, reduce)

```
squares = list(map(lambda x: x**2, range(10)))
```

- **List comprehension**

```
squares = [x**2 for x in range(10)]
```

# Operators



- **Identity** operator

**Equality** (value) vs. **identity** (~ address)

```
x = 2021
y = 2020 + 1
x == y # True Note) print(x, y)
x is y # False Note) print(id(x), id(y))
```

- **Membership** operator (~ string search)

```
1 in [0, 1, 2, 3, 4] # True
5 not in range(5) # True
1 not in range(0, 5, 2) # True
```

# Flow Control

- **Condition:** `if` statements, ~~`switch` statements~~
- **Loop:** `for` statements, `while` statements
  - Loop control: `break`, `continue`, and `else` statements
- **No action:** `pass` statements (similar to `;` and `{ }` in C/C++)
- Example) Factorial (of a positive integer  $n$ )
  - The product of all positive integers less than or equal to  $n$
  - $n! = n \cdot (n - 1)! = n \cdot (n - 1) \cdot (n - 2) \cdot \dots \cdot 3 \cdot 2 \cdot 1$

```
n = 7      # The given integer
f = 1      # The result of factorial
if n < 0:  # Note) No curly-bracket for a block
    pass
elif n == 0:
    pass
else:
    while n > 0:
        f = f * n
        n = n - 1
```

# Flow Control

- **Condition:** `if` statements, ~~`switch` statements~~
- **Loop:** `for` statements, `while` statements
  - Loop control: `break`, `continue`, and `else` statements
- **No action:** `pass` statements (similar to `;` and `{ }` in C/C++)
- Example) Prime number
  - A natural number ( $n > 1$ ) that is not a product of two smaller natural numbers

```
n = 7 # The given integer
for x in range(2, n):
    if n % x == 0:
        print(n, 'equals', x, '*', n//x)
        break
    else:
        print(n, 'is a prime number')
```

# Flow Control

- **Loop:** `for` statements
  - `for` statements with **sequential data** (string, list, tuple, ...)

```
year_list = [1982, 1984, 2014, 2016]
for idx in range(len(year_list)):
    print(idx)
for item in year_list:
    print(item)
for idx, item in enumerate(year_list):
    print(idx, item)
```

- Note) For compound data, you can loop with **each index**, **each item** (~ `std::iterator` in C++), and **both**.



# Flow Control



- **Loop:** `for` statements
  - `for` statements with **set-type data**

```
year_set = {1982, 1984, 2014, 2016}
for item in year_set:
    print(item)
for num, item in enumerate(year_set):
    print(num, item) # 'num' is not a index.
```

- `for` statements with **dictionary-type data**

```
year_dict = {'S': 1982, 'K': 1984, 'J': 2014, 'Y': 2016}
for key in year_dict:
    print(key)
for key in year_dict.keys():
    print(key)
for value in year_dict.values():
    print(value)
for pair in year_dict.items():
    print(pair)
for key, value in year_dict.items():
    print(key, value)
```

# Flow Control



- **Condition:** `if` statements
  - Note) [Falsy and trusy values](#)

```
values = [False, 0, 0., None, '', (), [], {}, range(0), (None), (None, ), [None], {None}]

for val in values:
    if val:
        print(f'{val} is True.')
    else:
        print(f'{val} is False.')
```

# Function Definition

## ▪ Function definition

- Example) Factorial (of a positive integer  $n$ )
  - The product of all positive integers less than or equal to  $n$
  - $n! = n \cdot (n - 1)! = n \cdot (n - 1) \cdot (n - 2) \cdot \dots \cdot 3 \cdot 2 \cdot 1$

```
def factorial_for(n):  
    f = 1  
    for m in range(1, n + 1):  
        f *= m  
    return f  
  
def factorial_rec(n=1): # Default argument values  
    if n <= 0:  
        return 1  
    else:  
        return n * factorial_rec(n - 1)  
  
factorial_for(10) # 3628800  
factorial_rec(10) # 3628800  
factorial_for()   # Error!  
factorial_rec()   # 1
```



# Function Definition

- **Multiple return values (as a tuple)**

- Example) Mean and variance of data

- Mean (a.k.a. average):  $\mu = E(X) = \frac{1}{n}(x_1 + x_2 + \dots + x_n)$
    - Variance:  $\text{Var}(X) = E((X - \mu)^2) = E(X^2) - \mu^2$

```
def mean_var(data):
    n = len(data)
    if n > 0:
        mean = sum(data) / n
        sum2 = 0
        for datum in data:
            sum2 += datum**2
        var = sum2 / n - mean**2
    return mean, var
return None, None

data = [3, 2, 9, 1, 0, 8, 7, 5 ]
pair = mean_var(data)      # pair = (4.375, 9.984)
mean, var = mean_var(data) # mean = 4.375, var = 9.984
mean, _ = mean_var(data)   # Get only the first one
mean = mean_var(data)[0]   # Get only the first one
```

# Function Definition



- **Function overloading is not supported.** [\[Stack Overflow\]](#)

- Example) My range function #1

```
def range1(end):          # Ignored
    return list(range(end))

def range1(start, end): # Ignored
    return list(range(start, end))

def range1(start, end, step):
    return list(range(start, end, step))

range1(10)                # Error!
```

# Function Definition



## ▪ Various argument passing

- Positional arguments, **keyword arguments**, and [more](#)
- Example) My range function #2

```
def range2(end, start=0, step=1):
    if start > end:
        (start, end) = (end, start)
    return list(range(start, end, step))

print(range2(10))           # [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
print(range2(1, 10))        # [1, 2, 3, 4, 5, 6, 7, 8, 9]
print(range2(1, 10, 2))     # [1, 3, 5, 7, 9]
print(range2(10, step=2))   # [0, 2, 4, 6, 8]
print(range2(step=2, 10))   # Error!
print(range2(10, step=2, start=1)) # [1, 3, 5, 7, 9]
print(range2(step=2, end=10)) # Check the result
print(range2(10, 2, start=1)) # Check the result
arg_tuple = (1, 10, 2)
print(range2(*arg_tuple))    # [1, 3, 5, 7, 9]
arg_dict = {'end': 10, 'step': 2, 'start': 1}
print(range2(**arg_dict))    # [1, 3, 5, 7, 9]
```

# Object-oriented Programming

- Class definition and object instantiation

- Example) Dice and coin

```
from random import randint

class Dice:
    def throw(self):
        return randint(1, 6)

dice = Dice()
print(dice.throw()) # [1, 6]
```

```
from random import randint

class Dice:
    def __init__(self, boundary=(1, 6)): # A constructor
        self.start = min(boundary)
        self.end = max(boundary)

    def throw(self):
        return randint(self.start, self.end)

dice = Dice()
print(dice.throw()) # [1, 6]

coin = Dice((0, 1))
print(coin.throw()) # 0 or 1
```

# Object-oriented Programming



- **Class inheritance** (and function overriding)
  - Example) Dice and coin

```
from random import randint

class Dice:
    def throw(self):
        return randint(1, 6)

dice = Dice()
print(dice.throw()) # [1, 6]
```

```
class Coin(Dice):
    def throw(self):
        return super().throw() % 2

coin = Coin()
print(coin.throw()) # 0 or 1
```

```
from random import randint

class Dice:
    def __init__(self, boundary=(1, 6)): # A constructor
        self.start = min(boundary)
        self.end = max(boundary)

    def throw(self):
        return randint(self.start, self.end)

dice = Dice()
print(dice.throw()) # [1, 6]

coin = Dice((0, 1))
print(coin.throw()) # 0 or 1
```



# Object-oriented Programming



## ▪ Private member definition

- Example) Dice and coin

```
from random import randint

class Dice:
    def throw(self):
        return randint(1, 6)

dice = Dice()
print(dice.throw()) # [1, 6]
```

```
class Coin(Dice):
    def throw(self):
        return super().throw() % 2

coin = Coin()
print(coin.throw()) # 0 or 1
```

```
from random import randint

class Dice:
    def __init__(self, boundary=(1, 6)): # A constructor
        self.__start = min(boundary)
        self.__end = max(boundary)

    def throw(self):
        return randint(self.start, self.end)

dice = Dice()
print(dice.__start, dice.__end) # Error!
print(dice._Dice__start, dice._Dice__end) # 1 6
```

What is better programming (in the view of OOP or users)?



# File Input and Output

- Example) Read a text file using `read()`

```
f = open('data/class_score_kr.csv', 'r')
lines = f.read()          # Read all lines together
print(lines)
f.close()
```
- Example) Read a text file using `readline()`

```
f = open('data/class_score_kr.csv', 'r')
while True:
    line = f.readline()   # Read a line sequentially
    if not line:
        break
    print(line)
f.close()
```
- Example) Read a text file using `readlines()`

```
with open('data/class_score_kr.csv', 'r') as f:
    for line in f.readlines(): # Read all lines as a list
        print(line.strip())
```

```
123, 94
112, 92
97, 98
87, 90
89, 87
...
```

```
123, 94

112, 92

97, 98

...
```

```
123, 94
112, 92
97, 98
87, 90
89, 87
...
```

# File Input and Output



- Example) Write a text file using write()

```
with open('data/class_score_kr.csv', 'r') as fi, open('class_score_mean.csv', 'w') as fo:
    for line in fi.readlines():
        values = [int(text) for text in line.split(',')]
        mean = sum(values) / len(values)
        for val in values:
            fo.write(f'{val}, ')
        fo.write(f'{mean}\n')
```

- Check) Please try the above example with

- 'data/class\_score\_en.csv' (which contains the header) → **ValueError**: invalid literal for int() with based 10: ...
- 'data/class\_score.csv' (which does not exist) → **FileNotFoundError**: [Errno 2] No such file or directory: ...

# Exception Handling



- [Exception](#) (~ runtime error)
  - Anomalous or exceptional conditions requiring special processing (during the execution of a program)
  - [Built-in exceptions in Python](#)
- Example) Calculate averaged scores from a text file with the header

```
with open('data/class_score_en.csv', 'r') as fi, \
    open('class_score_mean.csv', 'w') as fo:
    for line in fi.readlines():
        try:
            values = [int(text) for text in line.split(',')]
            mean = sum(values) / len(values)
            for val in values:
                fo.write(f'{val}, ')
            fo.write(f'{mean}\n')

        except ValueError as ex: # Try 'FileNotFoundError' and 'Exception' (base class)
            print(f'A line is ignored. (message: {ex})')
```

# Exception Handling



- **Exception** (~ runtime error)
  - Anomalous or exceptional conditions requiring special processing (during the execution of a program)
  - Built-in exceptions in Python
- Example) Calculate averaged scores from a not-exist text file

```
try:
    with open('data/class_score.csv', 'r') as fi, \
        open('class_score_mean.csv', 'w') as fo:
        for line in fi.readlines():
            try:
                values = [int(text) for text in line.split(',')]
                mean = sum(values) / len(values)
                for val in values:
                    fo.write(f'{val}, ')
                fo.write(f'{mean}\n')
            except ValueError as ex: # Try 'data/class_score_en.csv' without this try/except
                print(f'A line is ignored. (message: {ex})')
except Exception as ex:
    print(f'Cannot run the program. (message: {ex})')
```

# Package Import



- Example) Calculate mean and variance of scores using the previous example

mean\_var.py

```
def mean_var(data):
    n = len(data)
    if n > 0:
        mean = sum(data) / n
        sum2 = sum([datum**2 for datum in data])
        var = sum2 / n - mean**2
        return mean, var
    return None, None

data = [3, 2, 9, 1, 0, 8, 7, 5 ]
mean, var = mean_var(data)
print(f'mean = {mean:.3f}, var = {var:.3f}')
```

Result)

```
mean = 4.375, var = 9.984
```

class\_score\_mean.py

```
from mean_var import mean_var

try:
    with open('data/class_score_kr.csv', 'r') as fi, \
        open('class_score_mean.csv', 'w') as fo:
        for line in fi.readlines():
            try:
                values = [int(text) for text in line.split(',')]
                mean, var = mean_var(values)
                for val in values:
                    fo.write(f'{val}, ')
                fo.write(f'{mean}, {var}\n')

            except ValueError as ex:
                print(f'A line is ignored. (message: {ex})')
        print('The program was terminated successfully.')
except Exception as ex:
    print(f'Cannot run the program. (message: {ex})')
```

Result)

```
mean = 4.375, var = 9.984
The program was terminated successfully.
```

# Package Import



- Example) Calculate mean and variance of scores using the previous example

mean\_var.py

```
def mean_var(data):
    n = len(data)
    if n > 0:
        mean = sum(data) / n
        sum2 = sum([datum**2 for datum in data])
        var = sum2 / n - mean**2
        return mean, var
    return None, None

if __name__ == '__main__':
    data = [3, 2, 9, 1, 0, 8, 7, 5 ]
    mean, var = mean_var(data)
    print(f'mean = {mean:.3f}, var = {var:.3f}')
```

Result)

```
mean = 4.375, var = 9.984
```

mean\_var.py: \_\_name\_\_ == '\_\_main\_\_' (entry point)

class\_score\_mean.py

```
from mean_var import mean_var

try:
    with open('data/class_score_kr.csv', 'r') as fi, \
        open('class_score_mean.csv', 'w') as fo:
        for line in fi.readlines():
            try:
                values = [int(text) for text in line.split(',')]
                mean, var = mean_var(values)
                for val in values:
                    fo.write(f'{val}, ')
                fo.write(f'{mean}, {var}\n')

            except ValueError as ex:
                print(f'A line is ignored. (message: {ex})')
                print('The program was terminated successfully.')
except Exception as ex:
    print(f'Cannot run the program. (message: {ex})')
```

Result)

```
The program was terminated successfully.
```

class\_score\_mean.py: \_\_name\_\_ == '\_\_main\_\_' (entry point)  
mean\_var.py : \_\_name\_\_ == 'mean\_var'

# Summary



- **My Comments for Better Python Programming**
  - 1) Take advantages of Python itself / 2) Utilize the exiting libraries and master them if they are useful
- **Data Types**
  - **String**: Formatting, trimming, splitting (tokenization), matching, and searching
  - Compound data: In-place methods, **tuple (immutable; packing/unpacking)** vs. **list (mutable)**
- **Operators**
  - Lambda operator: A way to define a function shortly
    - **key** in **sorting**
    - **map(/filter/reduce)** function → **list comprehensions**
  - Identity (**id** ~ address) and membership (**in**) operators
- **Flow Control**
  - Easier access to elements in compound data with **for** statement
  - Falsy and trusy values
- **Function Definition: Keyword argument association**, passing compound data as a series of arguments
- **Object-oriented Programming**: Inheritance, private member definition
- **File Input and Output**: **open** function
- **Exception Handling**: **try** - **except** statement
- **Package Import**: Why `__name__ == '__main__'` is necessary?