Exercise Session 2 - First Python Programs

Computer Science II

Wednesday, March 1, 2023

Program Today

Repetition of Course Content

Exceptions

In-class Exercises

Homework

1. Repetition of Course Content

Variables

Dynamic typing:[1] Types exist in Python. They are assigned during program run, not defined by the programmer.

Python

```
i = 1
```

```
d = 1.0
```

```
c = ’a’
```

```
b = True
```

C++

```
int i = 1;
```

```
double d = 1;
```

```
char c = ’a’;
```

```
bool b = true;
```

[1] This topic will be covered in depth later in the lecture.

Containers

Sequences (ordered)

- tuple
- list
- range
- string

Collections (unordered)

- set
- dictionary

Container Operations

Number of elements

```
len(c)
```

Does c contain x?

```
b = x in c
```

Iteration over c

```
for x in c:
    print(x)
```

Container Operations

Python

Number of elements

```
len(c)
```

Does c contain x?

```
x in c
```

Iteration over c

```
for x in c:
    print(x)
```

C++

```
c.size();
```

```
std::find(c.begin(), c.end(), x);
```

```
for(int i=0;i<c.size();i++)
    std::cout << c[i] << "\n";
```

Quiz

For all questions on this slide, assume:

c =	1	3.14	7	’a’	True
	0	1	2	3	4

What is the output of the following commands?

```
len(c)
```

```
5
```

```
2 in c
```

```
False
```

```
for x in c:
    print(x)
```

```
1
3.14
7
’a’
True
```

Sequences

- **tuple** *(all objects, immutable)*

```python
t = (0, 'a', 3.3)
```

- **list** *(all objects, mutable)*

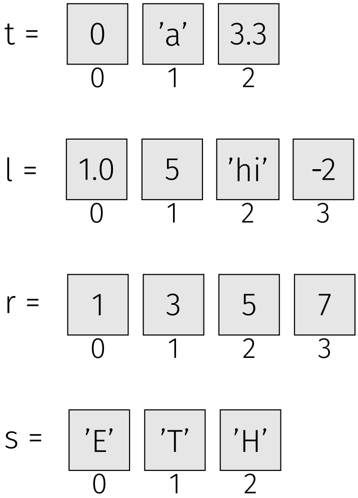
```python
l = [1.0, 5, 'hi', -2]
```

- **range** *(numbers, immutable)*

```python
r = range(1,8,2)
```

- **string** *(characters, immutable)*

```python
s = "ETH"
```



t = 0 'a' 3.3

t =	0	'a'	3.3	
	0	1	2	
l =	1.0	5	'hi'	-2
	0	1	2	3
r =	1	3	5	7
	0	1	2	3
s =	'E'	'T'	'H'	
	0	1	2	

Sequence Operations

- Subscript operator

```
s[i]
```

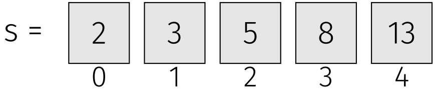
- Enumeration
  - Combine each element with its position.

```
for (i,x) in enumerate(s):
    print(i,x)
```

- Zip
  - Combine two sequences together.

```
z = zip(s,t)
l = list(z)
```

Enumeration



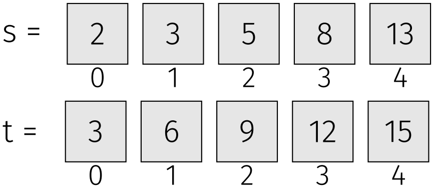
s = 2 3 5 8 13

0 1 2 3 4

```
for (i,x) in enumerate(s):
    print(i,x)
```

```
0 2
1 3
2 5
3 8
4 13
```

Zip



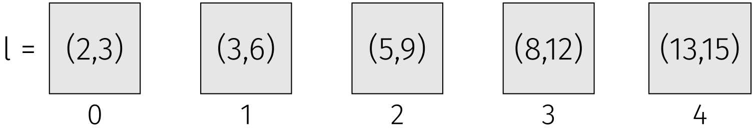
s = 2 3 5 8 13

0 1 2 3 4

t = 3 6 9 12 15

0 1 2 3 4

```
z = zip(s,t)
l = list(z)
```



l = (2,3) (3,6) (5,9) (8,12) (13,15)

0 1 2 3 4

Slicing

Selecting a subsequence according to the following rules:

- Start at **start**, End **before** **stop**, Step size **step**

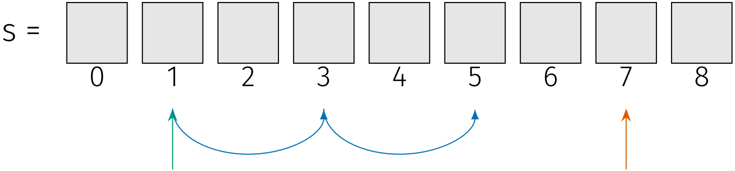
```
s[start:stop:step]
s[start:stop] #step = 1
s[:stop:step] #start = 0
s[start::step] #stop = len(s)
```

Slicing

Selecting a subsequence according to the following rules:

- Start at **start**, End **before stop**, Step size **step**

```
s[start:stop:step]
s[start:stop] #step = 1
s[:stop:step] #start = 0
s[start::step] #stop = len(s)
```



s[**1**:**7**:**2**]

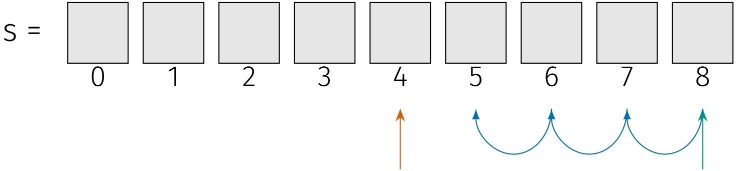
Slicing

Selecting a subsequence according to the following rules:

- Start at **start**, End **before stop**, Step size **step**

```
s[start:stop:step]
s[start:stop] #step = 1
s[:stop:step] #start = 0
s[start::step] #stop = len(s)
```

Negative **step**: go backward.



s[**8**:**4**:**-1**]

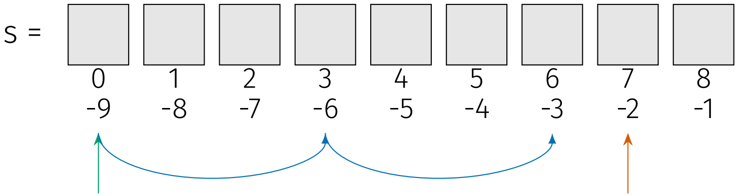
Slicing

Selecting a subsequence according to the following rules:

- Start at **start**, End **before** **stop**, Step size **step**

```
s[start:stop:step]
s[start:stop] #step = 1
s[:stop:step] #start = 0
s[start::step] #stop = len(s)
```

Negative **start**, stop: use negative indexing.



s[**-9**:**-2**:**3**]

Slicing: Quiz

On this slide, assume:

```
s = [1, 2, 3, 5, 8, 13, 21, 34, 55]
```

What is the output of the following code?

```
s[3::5]
```

```
[5, 55]
```

How would you slice sequence s to produce the following output?

```
[34, 8, 2]
```

```
s[7::-3], s[7:0:-3], s[-2:-9:-3], and combinations of those
```

Slicing: Quiz

Let us have a sequence s:

```
s = [’A’,’B’,’C’,’D’,’E’,’F’,’G’,’H’,’I’,’J’,’K’,’L’,’M’,’N’,’O’]
```

How would you slice to produce the following lists?

[’E’, ’F’, ’G’, ’H’, ’I’]	s[4:9]
[’L’, ’K’, ’J’, ’I’]	s[11:7:-1], s[-4:-8:-1]
[’C’, ’H’]	s[2:8:5], ..., s[2:12:5]
[’O’, ’L’, ’I’, ’F’]	s[14:4:-3], s[14:3:-3], s[14:2:-3], s[-1:-11:-3], s[-1:-12:-3], s[-1:-13:-3]

Range

A sequence that starts at **start**, ends **before stop** with step size **step**.

```
range(start, stop, step)
range(start, stop) #step = 1
range(stop) #start = 0, step = 1
```

Range is often used in for loops:

Python

```
for i in range(a, b, c):
    do_something
```

C++

```
for(int i=a; i<b; i+=c)
    do_something;
```

Quiz

What is the output of the following code?

```
tuple(range(3,15,4))
```

```
(3, 7, 11)
```

```
tuple(range(19,2,-2)[2:7:3])
```

```
(15, 9)
```

How would you generate the following output using one range command? Can you think of another range command doing the same? How many are there?

```
(2019, 2023, 2027)
```

`range(2019,2028,4), stop can also be 2029, 2030, or 2031`

Quiz

How would you generate the following output using one range command?

```
[-12, -6, 0, 6, 12]
```

range(-12,13,6), ..., range(-12,18,6)

```
[8, 4, 0, -4]
```

range(8,-5,-4), ..., range(8,-8,-4)

How would you slice `range(15,-15,-3)` to get the following output?

```
[-9, -3, 3, 9]
```

range(15,-15,-3)[8:1:-2], range(15,-15,-3)[-2:1:-2]

Operations on List

- Change an element

```
l[i] = val
```

- Append an element

```
l.append(val)
```

- Remove an element

```
del l[i]
```

- Reverse the list

```
l.reverse()
```

- List of k elements with value val

```
l = [val] * k
```

Quiz

What does list l look like after each step?

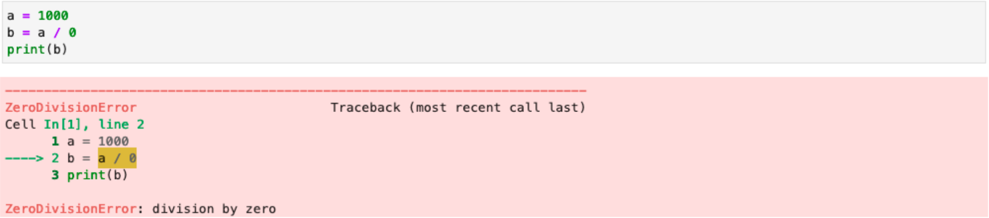
```python
l = [0] * 4
l[1] = 3
l.append(5)
l.reverse()
del l[3]
```

```
l = [0,0,0,0]
l = [0,3,0,0]
l = [0,3,0,0,5]
l = [5,0,0,3,0]
l = [5,0,0,0]
```

2. Exceptions

Example

- Exceptions are raised when the program is syntactically correct but the code resulted in an error.
- Some of the standard exceptions which are most frequent include **IndexError**, **ImportError**, **IOError**, **ZeroDivisionError**, **TypeError**, and **FileNotFoundError**.
- Following example raises a **ZeroDivisionError** exception, as we are trying to divide a number by 0.



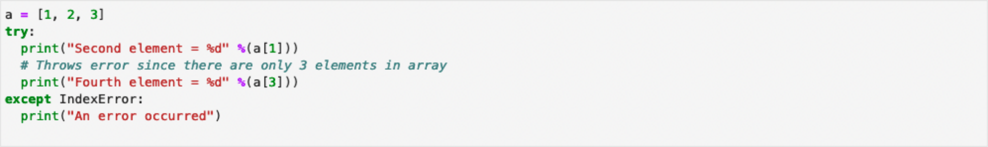
```
a = 1000
b = a / 0
print(b)
```

```
---------------------------------------------------------------------------
ZeroDivisionError                         Traceback (most recent call last)
Cell In[1], line 2
      1 a = 1000
----> 2 b = a / 0
      3 print(b)

ZeroDivisionError: division by zero
```

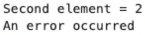
Exception Handling

- We can use **try** and **except** clauses to handle exceptions.
- A try statement can have more than once except clause, to specify handlers for different exceptions.
- However, at most one handler will be executed.



```
a = [1, 2, 3]
try:
  print("Second element = %d" %(a[1]))
  # Throws error since there are only 3 elements in array
  print("Fourth element = %d" %(a[3]))
except IndexError:
  print("An error occurred")
```

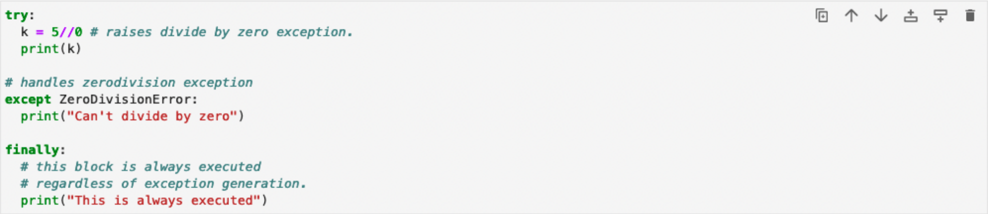
Output:



```
Second element = 2
An error occurred
```

Finally

- **finally** defines code that is always executed after a try and except block, independently if an exception is raised or not.

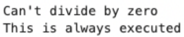


```
try:
  k = 5//0 # raises divide by zero exception.
  print(k)

# handles zerodivision exception
except ZeroDivisionError:
  print("Can't divide by zero")

finally:
  # this block is always executed
  # regardless of exception generation.
  print("This is always executed")
```

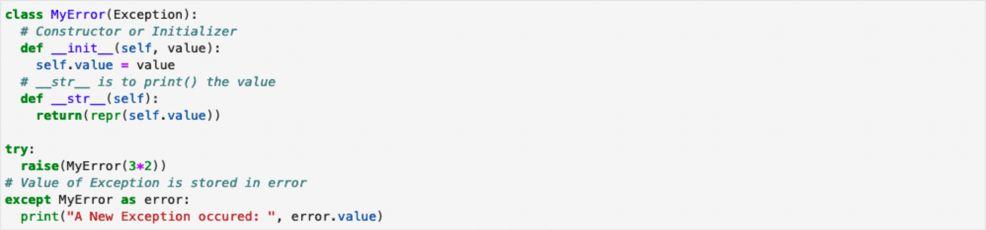
Output:



```
Can't divide by zero
This is always executed
```

User-Defined Exceptions

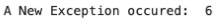
- You can create your own exceptions by creating a new class.
- New exceptions must derive from the **Exception** class.



```python
class MyError(Exception):
  # Constructor or Initializer
  def __init__(self, value):
    self.value = value
  # __str__ is to print() the value
  def __str__(self):
    return(repr(self.value))

try:
  raise(MyError(3*2))
# Value of Exception is stored in error
except MyError as error:
  print("A New Exception occured: ", error.value)
```

Output:



```
A New Exception occured:  6
```

3. In-class Exercises

Reading user input

```python
word = input("Enter a word : ")
```

- This code writes a text "`Enter a word :  `" on a console and waits for user input.
- After the user enters some text, it is stored into variable `word` as data type string.

Reading user input in a loop

```
word = input("Enter a word : ")
  again = True
  while again:
    #Do something with word...
    word = input("Enter a word (or just <ENTER> to stop): ")
    again = len(word) > 0
```

- This code sequentially reads strings from user, and processes them.
- If the user enters an empty string, the program terminates.

In-class exercise: Palindrome

A **palindrome** is a word that is spelt the same way backwards and forwards.

Write a python program that:

- Sequentially reads words (possibly containing spaces) from user input.
- For each word, the program prints whether the word is a palindrome.
- If the user enters an empty string, the program terminates.

Go to CodeExpert - Code Examples - Exercise 2 - In-class

Hint: a string is a sequence. All sequence operations can be applied to it.

In-class exercise: Count of numbers above average

Write a python program with the following input, and output:[2]
Input: A list `s` of numbers.
Output: The count of numbers in list `s` that are strictly larger than the average value.

Example: `s = [1,1,2,3,4,1]`
The average value in list `s` is equal to 2. There are two numbers in `s` that are larger than 2: 3, and 4. Therefore, the output should be 2.

[2] Do this exercise if there is spare time.

4. Homework

Exercise 1: Python I

On https://expert.ethz.ch/mycourses/SS23/mavt2/exercises

- Sum and Maximum
- List Comprehension
- Dict Comprehension
- Crops & Dictionaries

Due date: Monday 06.03.2023, 20:00 CET

NO HARDCODING

Questions?