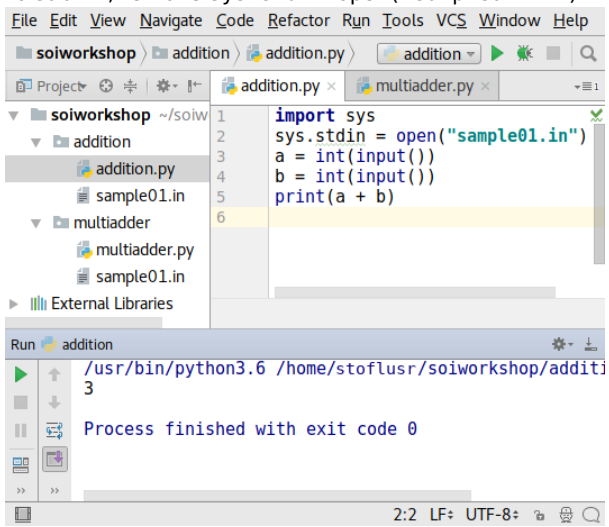
Python Cheat Sheet – SOI Workshop Zürich 2017

Python Docs

https://docs.python.org/

Recommended PyCharm Setup

To submit, remove `sys.stdin=open("sample01.in")`.



I/O

```
string = input()        # read line as string
number = int(input())   # read line as integer
print(string)           # prints string with newline
print(string, end="")   # don't print newline
print(number, string)   # print separated by space
print("impossible")     # print a string literal
print(f"Case #{testcase}: {solution}")  # formatting
#      ^-- the f is important and stands for formatted
```

Files

```
import sys
sys.stdin = open("sample01.in")
sys.stdout = open("sample01.out", "w")
```

Remove those lines before submitting at grader.soi.ch!

Loops

`for` loops iterate over a range:

```
for i in range(5):  # for loop
    print(i)  # prints 0, 1, 2, 3, 4
for i in range(2, 14, 4):  # start, stop, step
    print(i)  # prints 2, 6, 10
```

`while` loops repeat as long as the condition remains true:

```
i = 5
while i > 0: # while loop
    i -= 1   # i has values 5, 4, 3, 2, 1
```

Tuples

```
tup = 3, 4, 5  # create tuple of two elements
a, b, c = tup  # extract tuple: a=3, b=4, c=5
_, _, c = tup  # when you don't care about
               # some elements, use _
c = tup[2]     # indexing works
```

Lists (can be used as stacks)

Basics:

```
numbers = [] # create new list
for i in range(5):
    numbers.append(int(input()))  # add new element
for x in numbers:  # iterate over list
    print(x)
```

Operations:

```
numbers.append(3) # O(1) append at the end
x = numbers.pop() # O(1) remove last element
numbers = [1] + numbers  # O(len(numbers))
```

Indexing:

- `a[0]`: first element
- `a[len(a)-1]`: last element
- `a[-1]`: last element
- `a[-len(a)]`: first element

Slices:

- `a[3:6]`: elements at indices 3, 4, 5
- `a[:3]`: elements at indices 0, 1, 2
- `a[3:]`: elements at indices 3, 4, ..., `len(a)-1`
- `a[:]`: copy of whole list

List comprehensions:

```
numbers = [3, 1, 4, 1, 5, 9]     # create new list
doubled = [2*x for x in numbers] # list comprehension
```

Useful functions:

```
sum(numbers)  # sum of all elements
max(numbers)  # maximum of all elements
min(numbers)  # minimum of all elements
max(numbers, key=lambda x: x%7)  # max with key
sorted(numbers)  # increasingly sorted copy
sorted(numbers, reverse=True)  # decreasing
```

Deques (can be used as queues)

```
from collections import deque
q = deque()     # empty
q = deque([2])  # prefilled
q.append(4)     # O(1) append at the end
q.appendleft(1) # O(1) append at the front
x = q.pop()     # O(1) remove last element
y = q.popleft() # O(1) remove first element
```

Min-Heaps/Priority Queues

Datastructure with fast insert and fast access to the minimum. (Trick: to sort it in reserve, insert -x.)

```
from heapq import *
pq = [];           # O(1)     declare a new heap
heappush(pq, 1);   # O(log n) insert elements
print(heappop(pq)) # O(log n) get and remove min.
```

Dictionaries

Stores key-value pairs with fast key lookup. All keys are unique.

```
m = {}  # create an empty dict
m = {"Turing": 1954: "Newton": 1727}  # prefilled
m = {x: 2**x for x in range(10)}      # list compr.
m["Einstein"] = 1955   # O(1) insert or modify
print("Einstein" in m) # O(1) check if key exists
del m["Einstein"]      # O(1) remove item
for key, value in m.items():  # O(len(m))) iterate
    print(f"key: {key} -> {value}")  # not sorted
```

Sets

Like a dict, but only stores keys. Elements are stored only once.

```
s = set() # create an empty set
s = {1, 2} # prefilled
s = set(values) # convert list to set
# WARNING: s = {} creates a dict, not a set
s.add(1)       # O(1) add element to set
print(1 in s)  # O(1) check if element exists
s.remove(2)    # O(1) remove element
for element in s: # O(len(s)) iterate
    print(s)   # careful: not sorted
```

Using map to parse and print lists

`map(f, values)` behaves like `[f(x) for x in values]`, except that it returns a generator and not a list.

```
n, m = map(int, input().split())  # extract directly
# to store many numbers, convert them to a list
numbers = list(map(int, input().split()))   # map
numbers = [int(x) for x in input().split()] # list comp
print(" ".join(map(str, numbers)))          # map
print(" ".join([str(x) for x in numbers]))  # list comp
```

Lambdas

```
negate = lambda x: -x     # negate(3) == -3
add = lambda a, b: a + b  # add(1, 3) == 4
# use lambdas as key functions
sort(values, key=lambda x: x%7)
```