NLP Programming Tutorial 0 - Programming Basics

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About this Tutorial

- 14 parts, starting from easier topics
- Each time:
  - During the tutorial: Learn something new
  - At home: Do a programming exercise
  - Next week: Talk about results with your neighbor
- Programming language is your choice
  - Examples will be in Python, so it is recommended
  - I can help with Python, C++, Java, Perl
- Working in pairs is encouraged

Setting Up Your Environment

Open a Terminal

- If you are on Linux or Mac
  - From the program menu select “terminal”
- If you are on Windows
  - Install cygwin
  - or use “ssh” to log in to a Linux machine

Install Software (if necessary)

- 3 types of software:
  - python: the programming language
  - a text editor (gvim, emacs, etc.)
  - git: A version control system
- Linux:
  - sudo apt-get install git vim-gnome python
- Windows:
  - Run cygwin setup.exe, select “git”, “gvim”, and “python”

Download the Tutorial Files from Github

- Use the git “clone” command to download the code

```
$ git clone https://github.com/neubig/nlptutorial.git
```

- You should find this PDF in the downloaded directory

```
$ cd nlptutorial
$ ls download/00-intro/nlp-programming-en-00-intro.pdf
```

Using gvim

- You can use any text editor, but if you are using vim:
- If it is your first time, you may want to copy my vim settings file, which will make vim easier to use:

```
$ cp misc/vimrc ~/.vimrc
```

- Open vim:

```
$ gvim test.txt
```

- Press “i” to start input and write “test”
- Press escape, and type “:wq” to save and quit (“:w” is save, “:q” is quit)

Using git

- You can use git to save your progress
- First, add the changed file

```
$ git add test.txt
```

- And save your change

```
$ git commit
```

(Enter a message like “added a test file”)

- Using git, you can do things like go back to your last commit (git reset), download the latest updates (git pull), or upload code to github (git push)

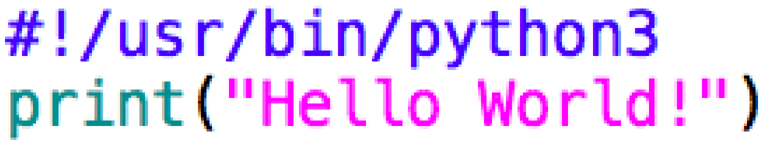
Basic Programming

Hello World!

1)Open my-program.py in an editor (gvim, emacs, gedit)

```
$ gvim my-program.py
```

2) Type in the following program



```
#!/usr/bin/python3
print("Hello World!")
```

3) Make the program executable

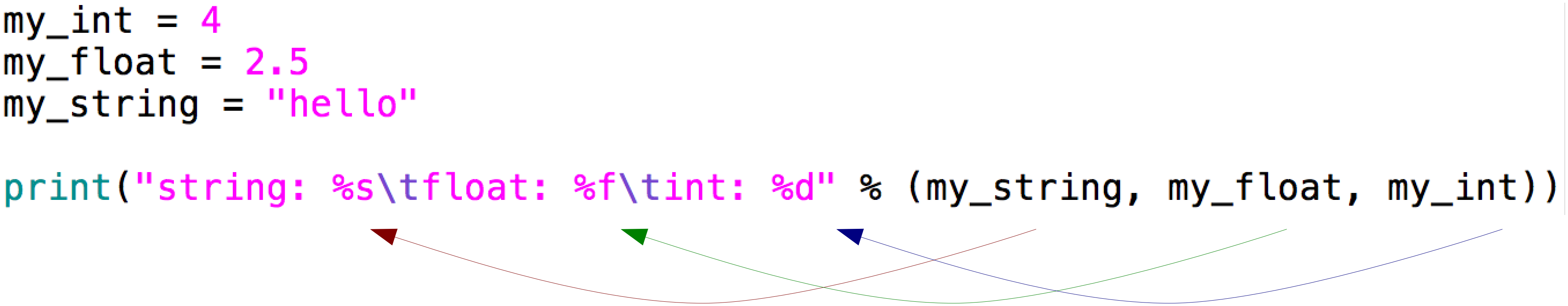
```
$ chmod 755 my-program.py
```

4) Run the program

```
$ ./my-program.py
Hello World!
```

Main data types used

- Strings: “hello”, “goodbye”
- Integers: -1, 0, 1, 3
- Floats: -4.2, 0.0, 3.14



```
my_int = 4
my_float = 2.5
my_string = "hello"

print("string: %s\tfloat: %f\tint: %d" % (my_string, my_float, my_int))
```

```
$ ./my-program.py
string: hello	float: 2.500000	int: 4
```

if/else, for

```
my_variable = 5

if my_variable == 4:
    print("my_variable is 4")
else:
    print("my_variable is not 4")

for i in range(1, my_variable):
    print("i == %d" % (i))
```

if this condition is true

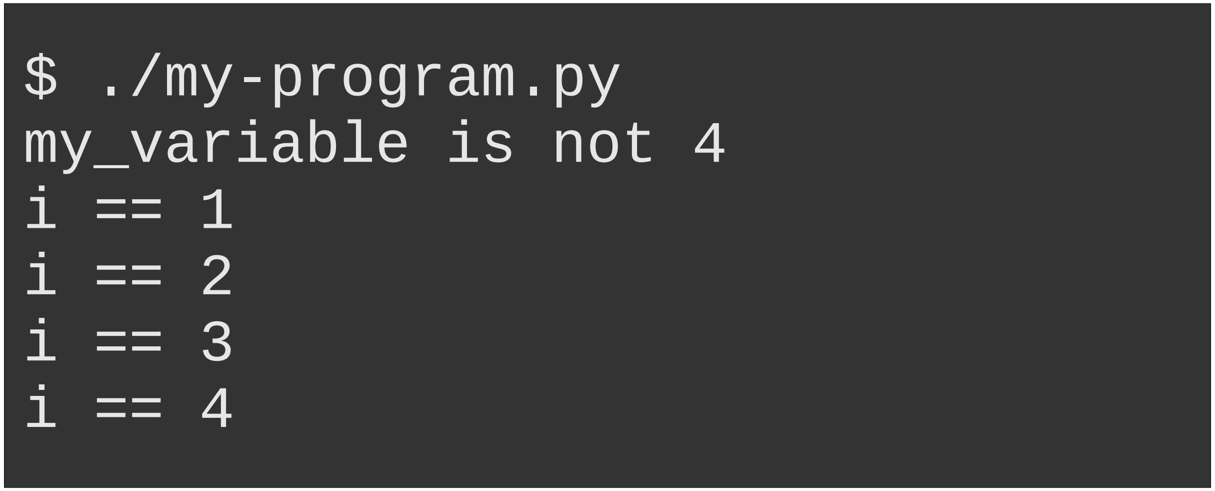
then do this

otherwise

do this

for every element in this

do this



```
$ ./my-program.py
my_variable is not 4
i == 1
i == 2
i == 3
i == 4
```

Be careful!
range(1, 5) == (1, 2, 3, 4)

Storing many pieces of data

Dense Storage

Index	Value
0	20
1	94
2	10
3	2
4	0
5	19
6	3

Sparse Storage

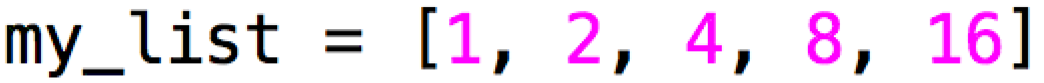
Index	Value
49	20
81	94
96	10
104	2

or

Index	Value
apple	20
banana	94
cherry	10
date	2

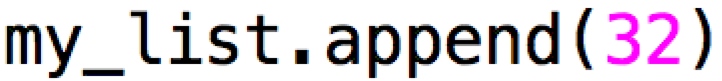
Arrays (or “lists” in Python)

- Good for dense storage
- Index is an integer, starting at 0



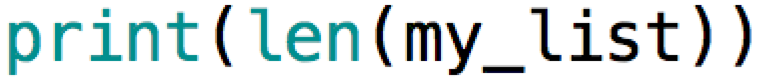
```
my_list = [1, 2, 4, 8, 16]
```

Make a list with 5 elements



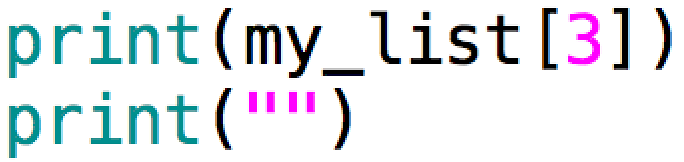
```
my_list.append(32)
```

Add one more element to the end of the list



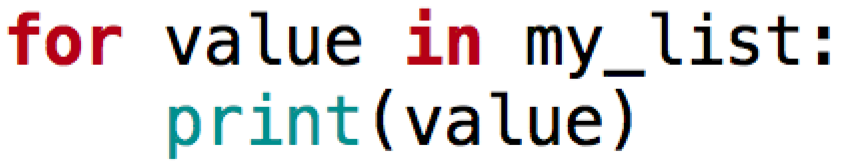
```
print(len(my_list))
```

Print the length of the list



```
print(my_list[3])
print("")
```

Print the 4th element



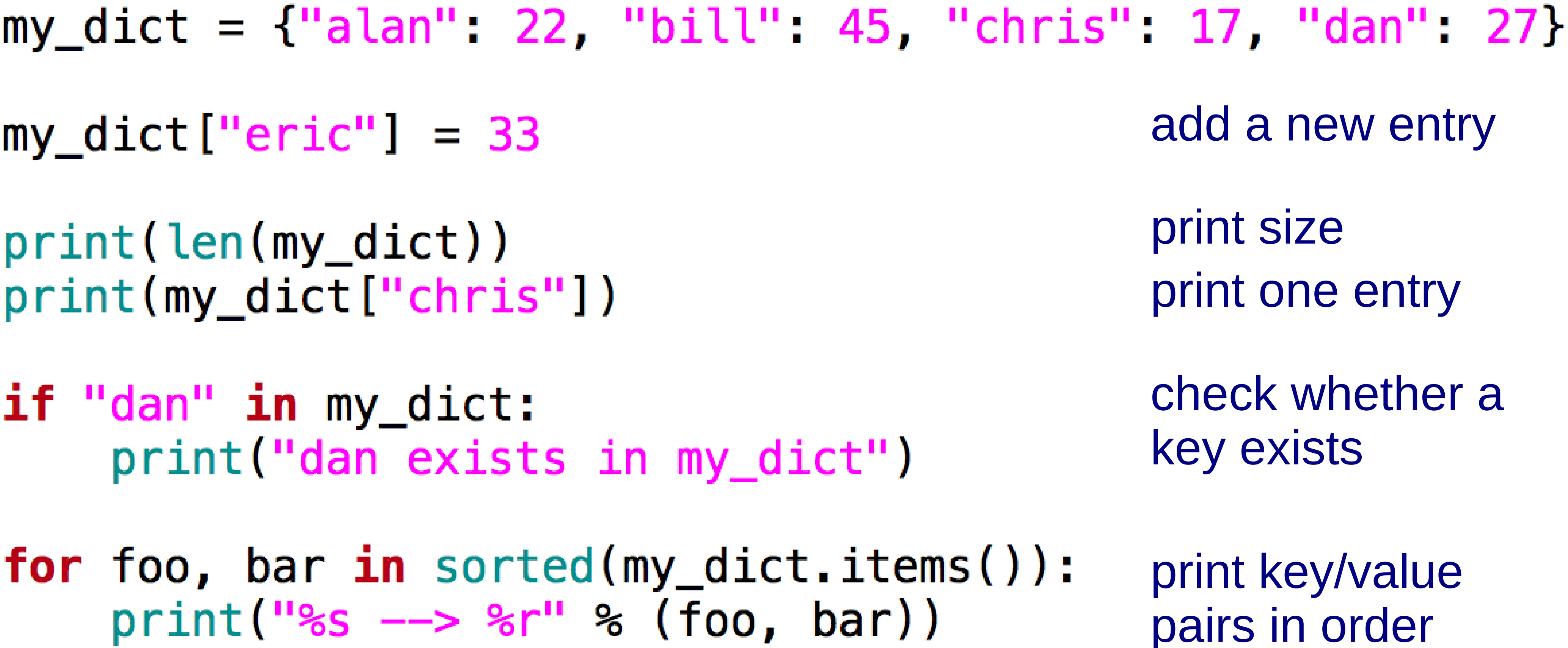
```
for value in my_list:
    print(value)
```

Loop through and print every element of the list

Maps (or “dictionaries” in Python)

- Good for sparse storage:

create pairs of key/value



```
my_dict = {"alan": 22, "bill": 45, "chris": 17, "dan": 27}
```

```
my_dict["eric"] = 33
```

add a new entry

```
print(len(my_dict))
print(my_dict["chris"])
```

print size

print one entry

```
if "dan" in my_dict:
    print("dan exists in my_dict")
```

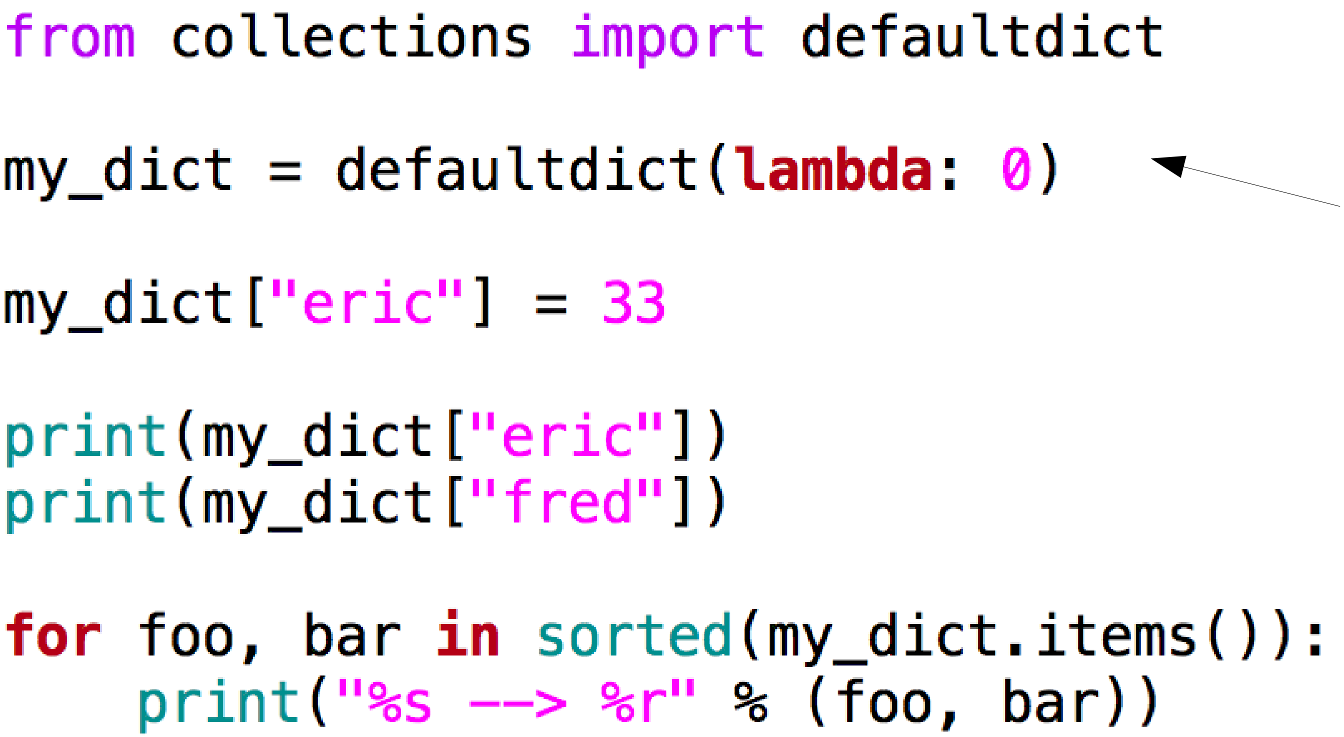
check whether a key exists

```
for foo, bar in sorted(my_dict.items()):
    print("%s --> %r" % (foo, bar))
```

print key/value pairs in order

defaultdict

- A useful expansion on dictionary with a default value



```
from collections import defaultdict

my_dict = defaultdict(lambda: 0)

my_dict["eric"] = 33

print(my_dict["eric"])
print(my_dict["fred"])

for foo, bar in sorted(my_dict.items()):
    print("%s --> %r" % (foo, bar))
```

import library

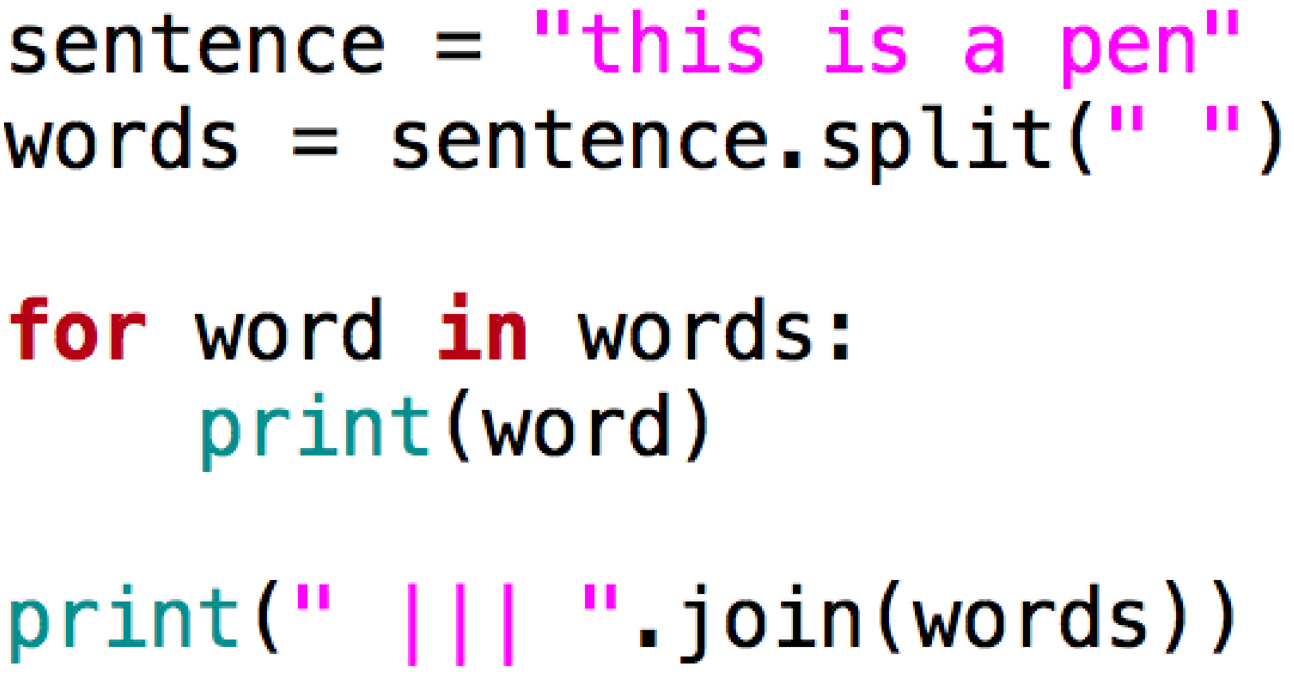
default value of zero

print existing key

print non-existent key

Splitting and joining strings

- In NLP: often split sentences into words



```
sentence = "this is a pen"
words = sentence.split(" ")

for word in words:
    print(word)

print(" ||| ".join(words))
```

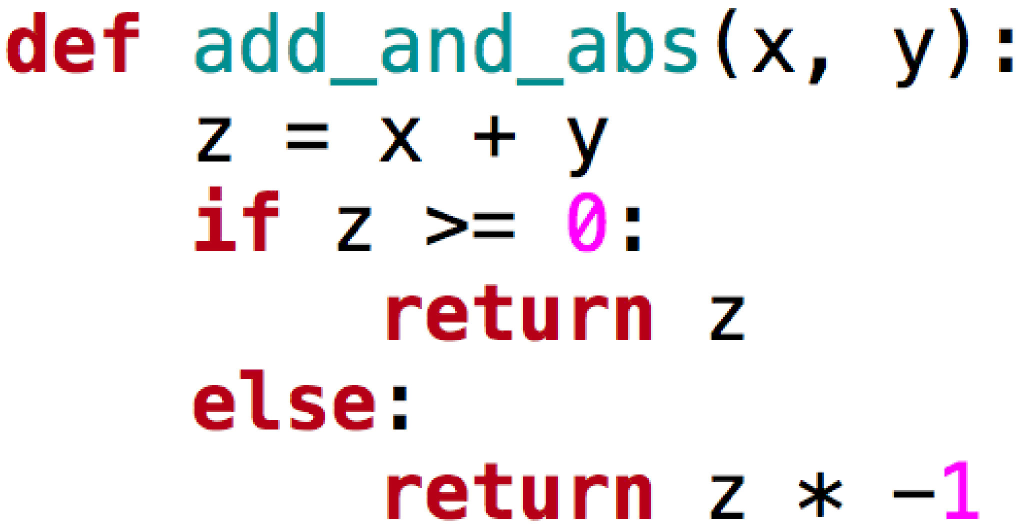
Split string at white space into an array of words

Combine the array into a single string, separating with " ||| "

```
$ ./my-program.py
...
this ||| is ||| a ||| pen
```

Functions

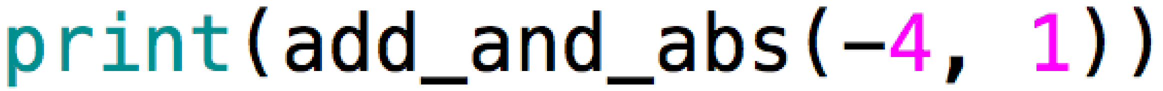
- Functions take an input, transform the input, and return an output



```
def add_and_abs(x, y):
    z = x + y
    if z >= 0:
        return z
    else:
        return z * -1
```

function add_and_abs takes “x” and “y” as input

add x and y together and return the absolute value



```
print(add_and_abs(-4, 1))
```

call add_and_abs with x=-4 and y=1

Using command line arguments/ Reading files

```
#!/usr/bin/python3

import sys
my_file = open(sys.argv[1], "r")

for line in my_file:

    line = line.strip()

    if len(line) != 0:
        print(line)
```

First argument

Open file for reading with “r”

Read the file one line at a time

Delete the line end symbol “\n”

If the line is not empty, print

```
$ ./my-program.py test.txt
```

Testing Your Code

Simple Input/Output Tests

Example:

Program word-count.py should count the words in a file

1) Create a small input file

2) Count the words by hand, write them in an output file

test-word-count-in.txt

```
a b c
b c d
```

test-word-count-out.txt

```
a 1
b 2
c 2
d 1
```

3) Run the program

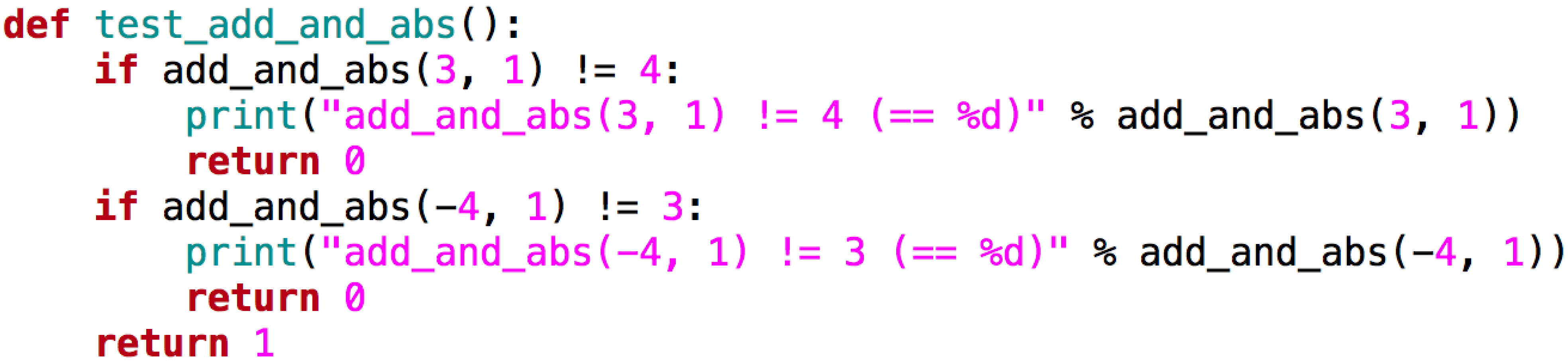
```
$ ./word-count.py test-word-count-in.txt > word-count-out.txt
```

4) Compare the results

```
$ diff test-word-count-out.txt word-count-out.txt
```

Unit Tests

- Write code to test each function
- Test several cases, and print an error if result is wrong
- Return 1 if all tests passed, 0 otherwise



```
def test_add_and_abs():
    if add_and_abs(3, 1) != 4:
        print("add_and_abs(3, 1) != 4 (== %d)" % add_and_abs(3, 1))
        return 0
    if add_and_abs(-4, 1) != 3:
        print("add_and_abs(-4, 1) != 3 (== %d)" % add_and_abs(-4, 1))
        return 0
    return 1
```

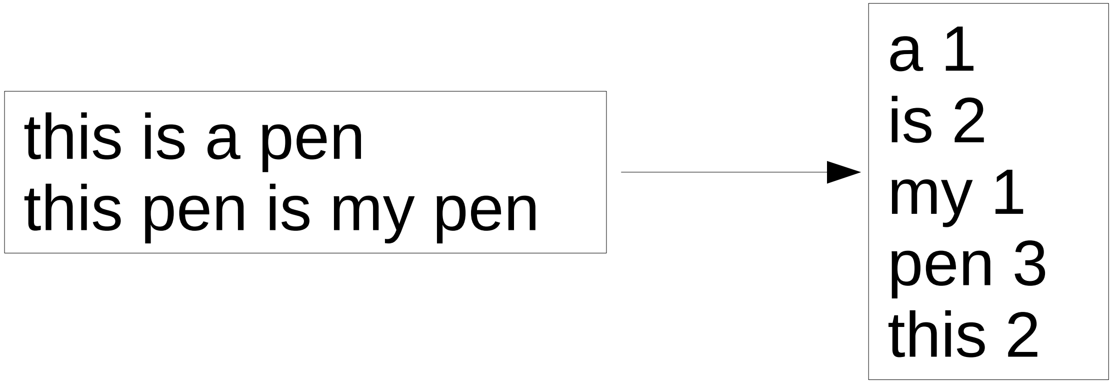
ALWAYS Test your Code

- Creating tests:
  - Makes you think about the problem before writing code
  - Will reduce your debugging time drastically
  - Will make your code easier to understand later

Practice Exercise

Practice Exercise

- Make a program that counts the frequency of words in a file



```
this is a pen
this pen is my pen
```

```
a 1
is 2
my 1
pen 3
this 2
```

- Test it on test/00-input.txt, test/00-answer.txt
- Run the program on the file data/wiki-en-train.word
- Report:
    - The number of unique words
    - The frequencies of the first few words in the list

Pseudo-code

```
create a dictionary counts                    create a map to hold counts

open a file

for each line in the file
    split line into words

    for w in words
        if w exists in counts, add 1 to counts[w]
        else set counts[w] = 1

print key, value of counts
```