Python workshop

Week 1: Writing your first program

barbera@van-schaik.org

About me

- During the day I'm a bioinformatician
- In my spare time I ...
  - Go to concerts and festivals
  - Cook (all cuisines)
  - Read (fantasy, popular science/philosophy, Dutch literature)
  - Make things (sewing, electronics, laser cutting, welding, 3d printing)
  - Look into self-hosted cloud services
  - Grow vegetables in my garden

Overview of this workshop series

- Week 1: Writing your first program
- Week 2: Make choices and reuse code
- Week 3: Loops and strings
- Week 4: Files and lists
- Week 5: Dictionaries and tuples

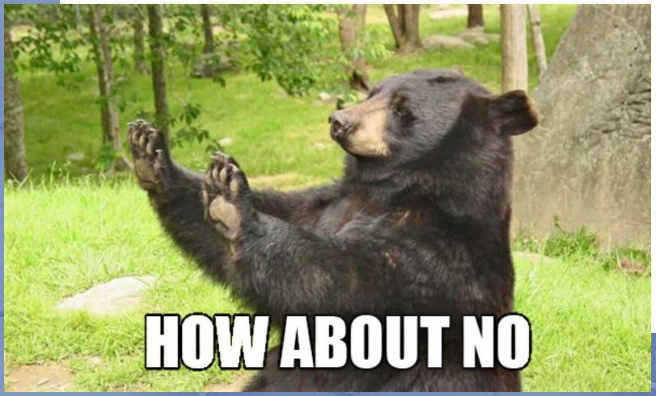
Acknowledgments

- Charles Severance aka Dr Chuck
  - For teaching me Python
  - For releasing teaching material to the public
  - http://www.pythonlearn.com/
- He gives the course “Programming for everybody”
- Structure of this workshop is based on his book
- Several examples too

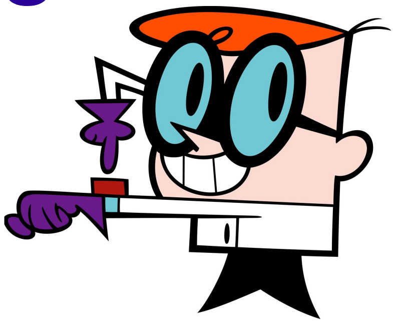
Why shouldn't you learn programming?

- Years of learning (to program really well)
- “Coding is not a goal. It's a tool for solving problems.”
- Programming doesn't make you rich
- There are always people better than you

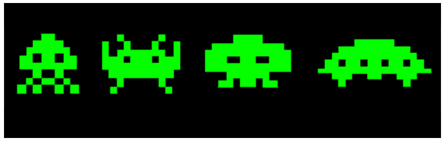
http://www.fastcolabs.com/3020126/no-you-dont-need-to-learn-to-code



Why should you learn programming?



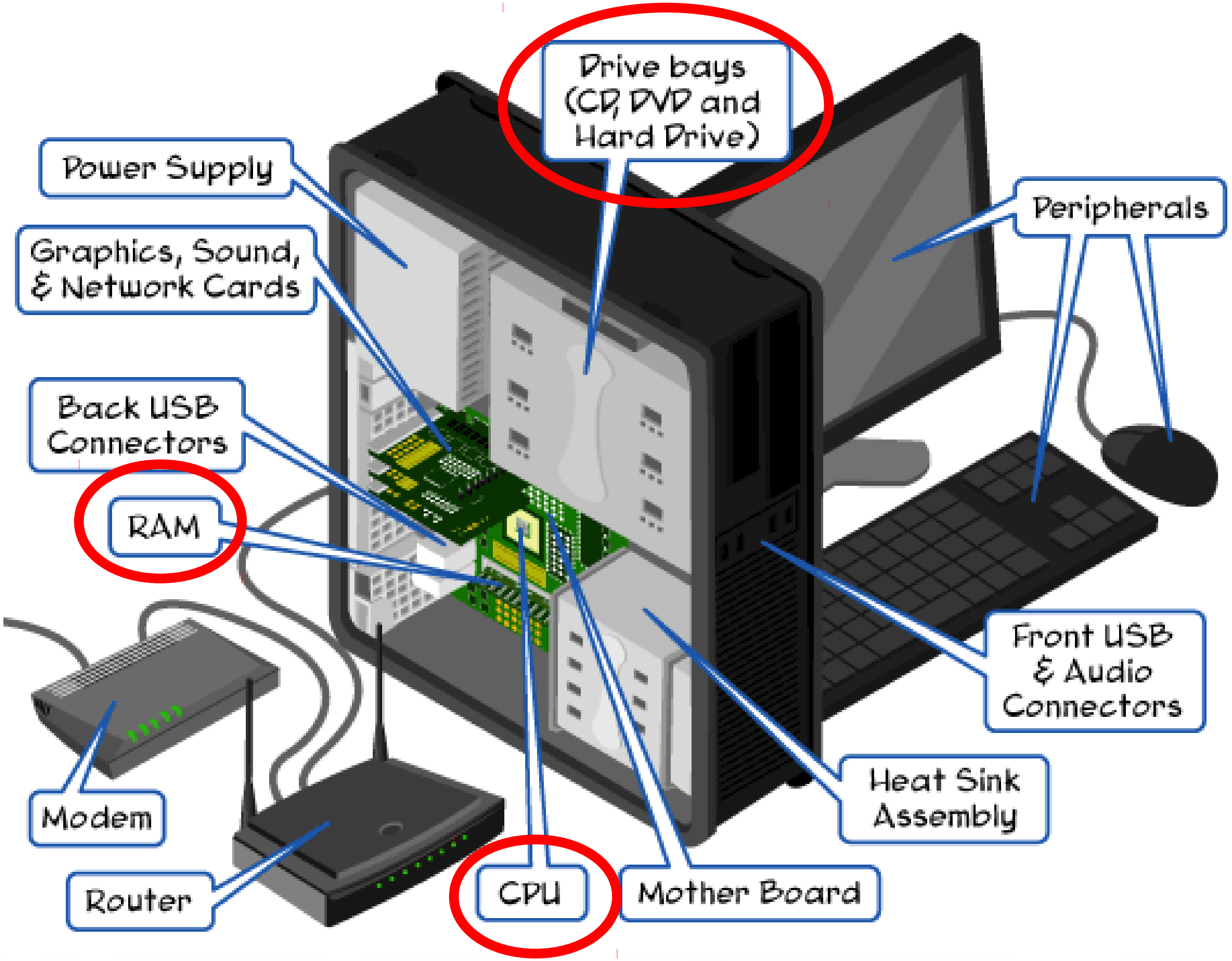
- It is fun and creative
- Because you can
- It is a tool for solving problems
  - Science
  - Apps
  - Games
  - Internet of things
  - Etc



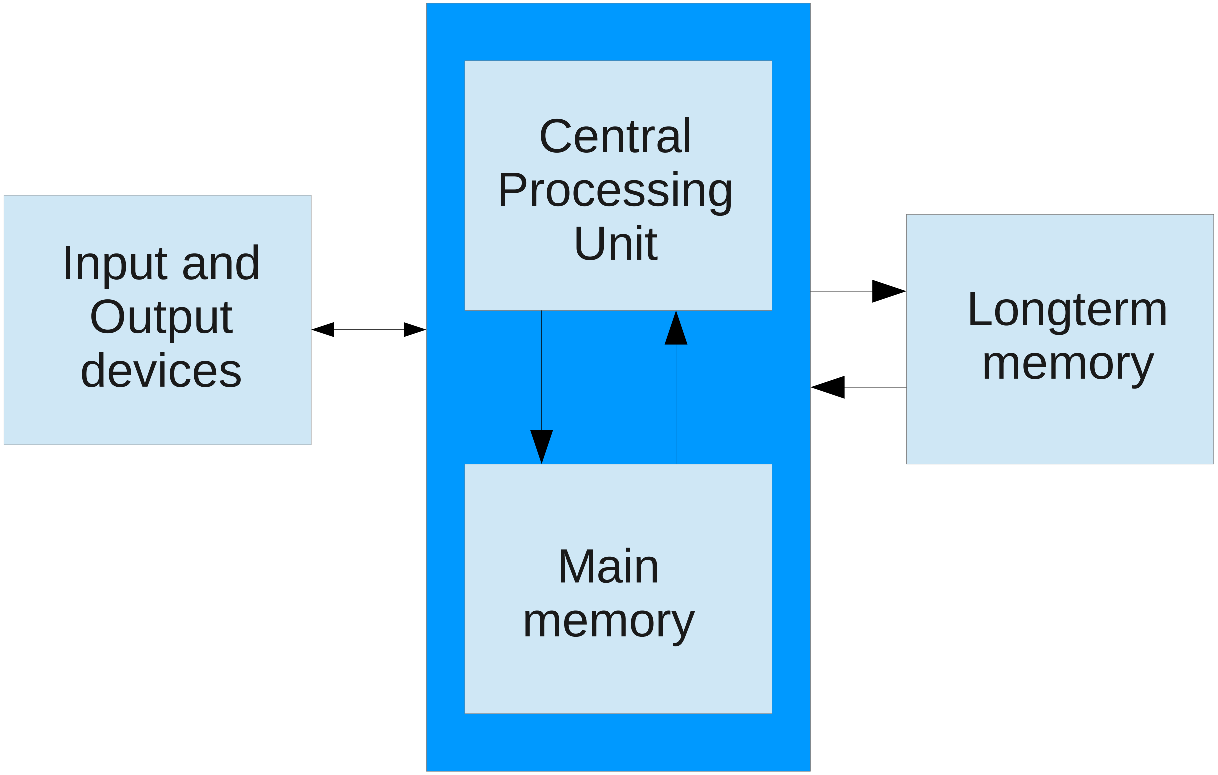
- A computer is fast and good for repetitive work
- There is no existing program for your needs

Computers and language

Computer anatomy


Drive bays (CD, DVD and Hard Drive)
Power Supply
Graphics, Sound, & Network Cards
Peripherals
Back USB Connectors
RAM
Front USB & Audio Connectors
Heat Sink Assembly
Modem
Router
CPU
Mother Board

Computer anatomy



Programming language

- To give instructions

https://youtu.be/XiBYM6g8Tck

Programming language

While music is playing:

Left hand out and up

Right hand out and up

Flip left hand

Flip right hand

Left hand to right shoulder

Right hand to right shoulder

Left hand to back of head

Right **ham** to back of head

Left hand to right **hik**

Right hand to left **hik**

Left hand on left bottom

Right hand on right bottom

Wiggle

Wiggle

Jump

Computer language

```
00101110100110010
10110000001111010
10111010100100101
00001110101111111
01010101001110101
01001010101001010
00100010110011010
01001110100011011
00101110100011000
11101010011101111
```

```
handle = open(filename, 'r')

song = handle.read()

words = song.split()

counts = dict()


for word in words:

    counts[word] = counts.get(word, 0) + 1


for word, count in counts.items():

    print word, count
```

Why Python

- Easy to learn
- Very readable
  - No long constructs
  - No special cryptic characters
  - Indentation is forced (more next week)
- Much code available (e.g. SciPy, NumPy)
- Cross-platform

http://helloworldcollection.de/

How smart is a computer?

- A computer (or phone) is not smart
  - Limited vocabulary
  - It needs literal instructions
- It will “complain” when instructions are not clear

```
out of memory

out of disk space
syntax error
```

Usually with a hint to guide you

Reserved words

and del for is raise

assert elif from lambda return

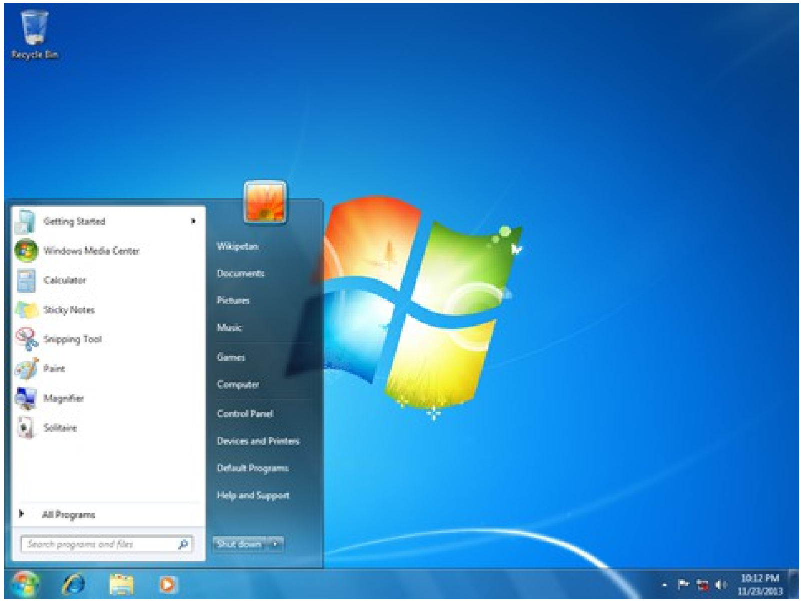
break else global not try

class except if or while

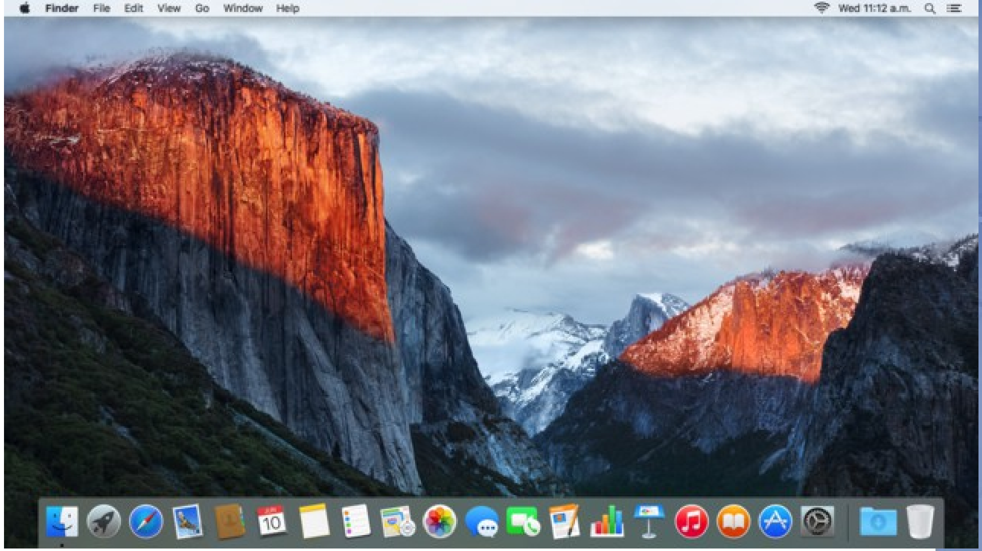
continue exec import pass yield

def finally in print

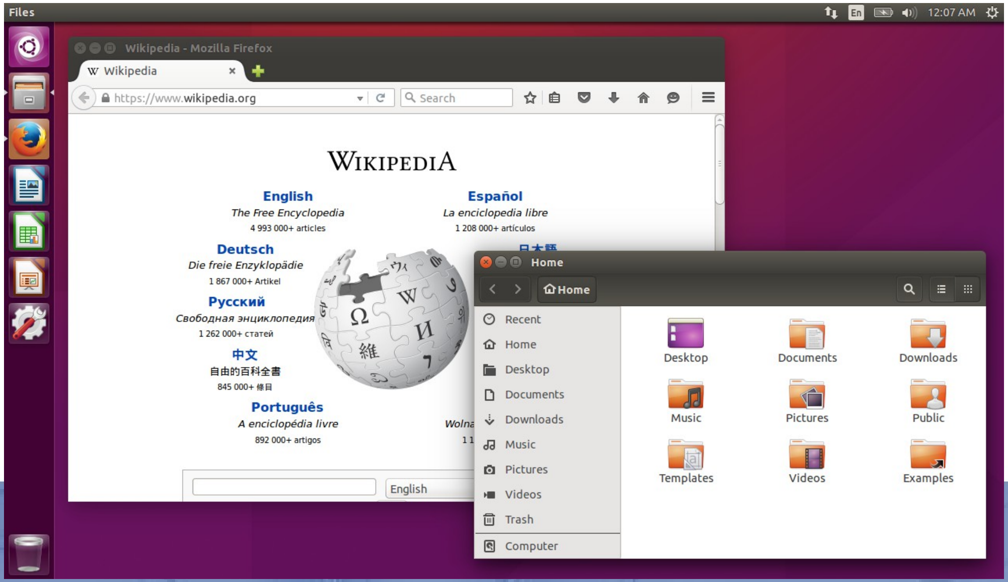
Terminal, scripts, Python?



Windows

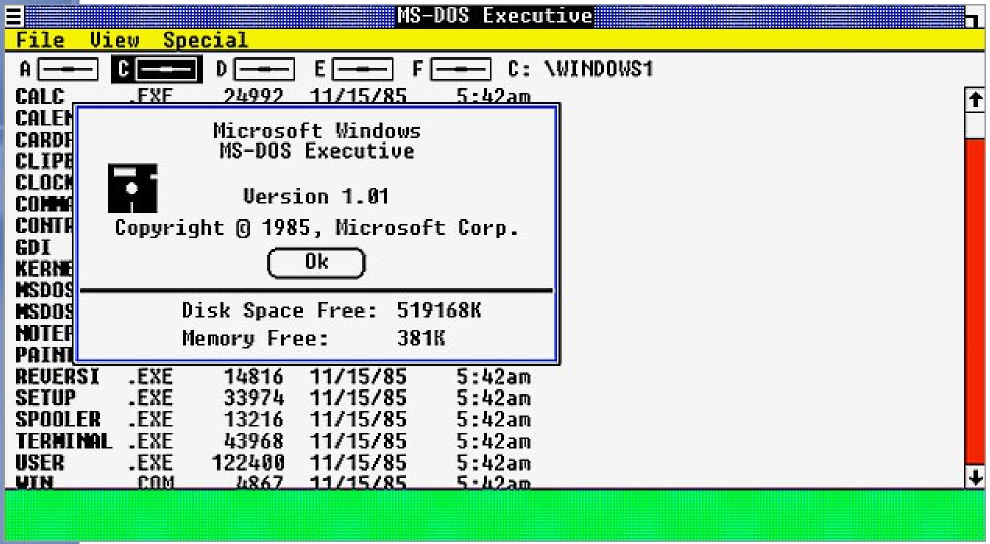


Mac OSX



Linux (Ubuntu)

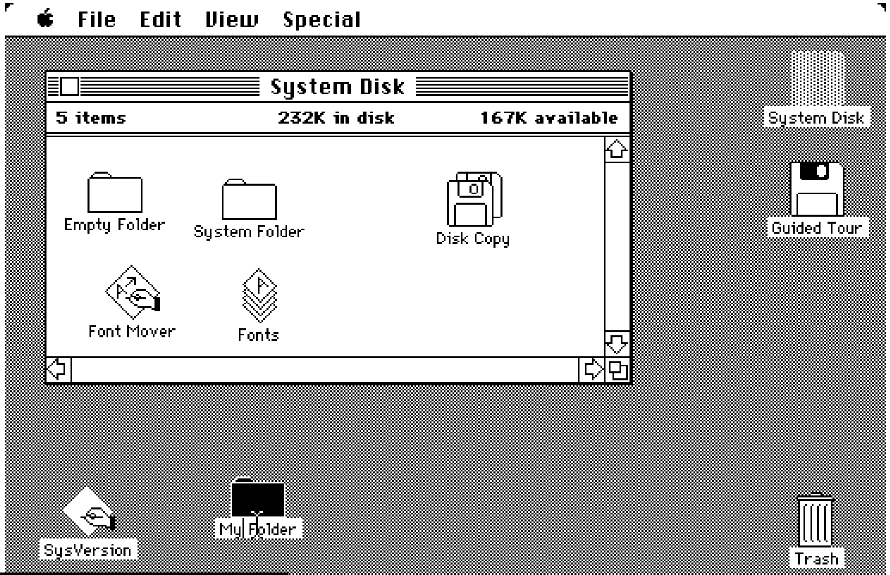
Vroegah...



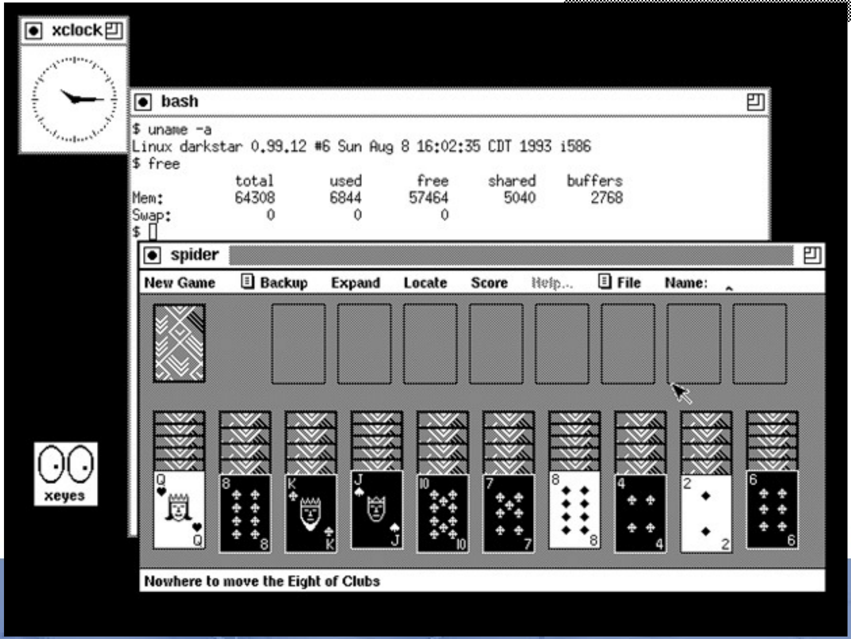
```
MS-DOS Executive
File  View  Special
A      C      D      E      F      C: \WINDOWS1
CALC      .EXE    24992  11/15/85    5:42am
CALEN
CARDF
CLIPB
CLOCK
COMMA
CONTR
GDI
KERNE
MSDOS
MSDOS
NOTEP
PAINT
REVERSI   .EXE    14816  11/15/85    5:42am
SETUP     .EXE    33974  11/15/85    5:42am
SPOOLER   .EXE    13216  11/15/85    5:42am
TERMINAL  .EXE    43968  11/15/85    5:42am
USER      .EXE   122400  11/15/85    5:42am
WIN       .COM     4867  11/15/85    5:42am
```

```
Microsoft Windows
MS-DOS Executive

Version 1.01
Copyright © 1985, Microsoft Corp.
Ok

Disk Space Free:  519168K
Memory Free:        381K
```

Windows



Mac



```
$ uname -a
Linux darkstar 0.99.12 #6 Sun Aug 8 16:02:35 CDT 1993 i586
$ free
             total       used       free     shared    buffers
Mem:         64308       6844      57464       5040       2768
Swap:            0          0          0
$ 
```

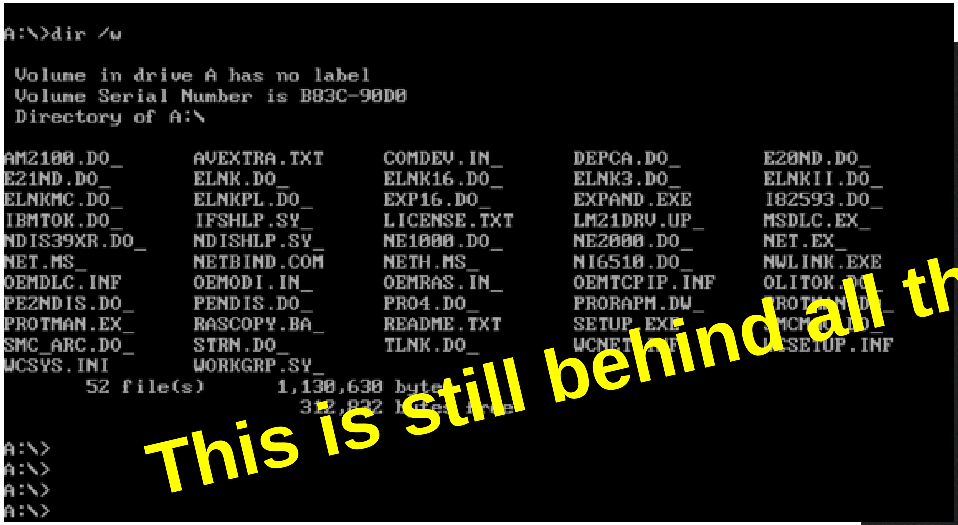
Nowhere to move the Eight of Clubs

Linux

Even earlier:
the black window

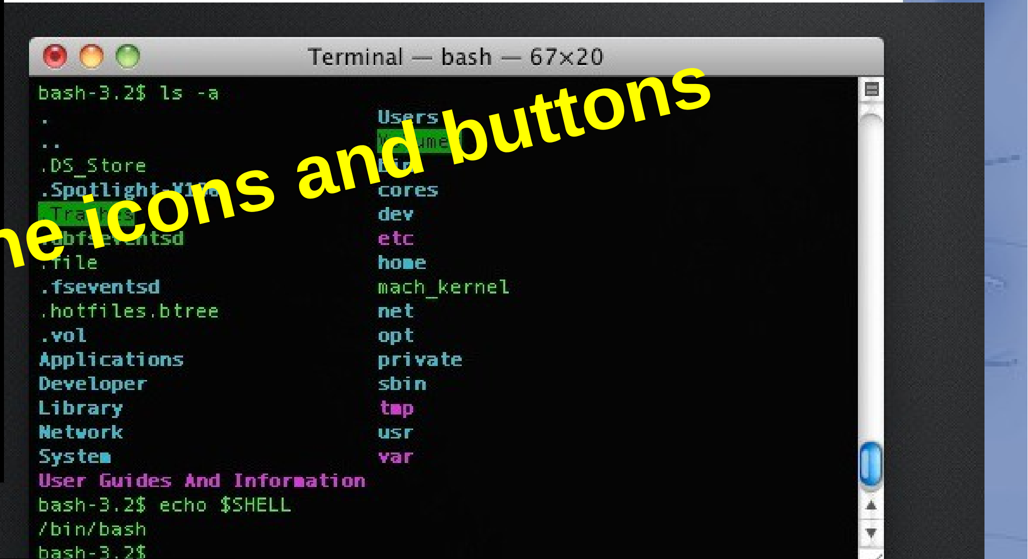
This is called a:

- Terminal
- Command-line (cmd)
- Shell



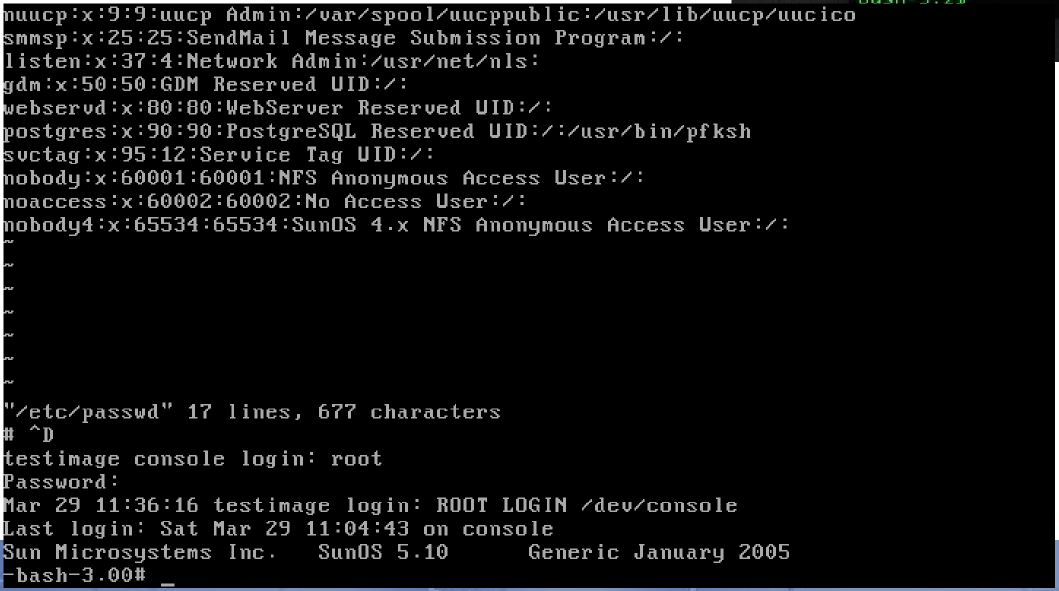
```
A:\>dir /w

 Volume in drive A has no label
 Volume Serial Number is B83C-90D0
 Directory of A:\

AM2100.DO_      AVEXTRA.TXT     COMDEV.IN_      DEPCA.DO_       E20ND.DO_
E21ND.DO_       ELNK.DO_        ELNK16.DO_      ELNK3.DO_       ELNKII.DO_
ELNKMC.DO_      ELNKPL.DO_      EXP16.DO_       EXPAND.EXE      I82593.DO_
IBMTOK.DO_      IFSHLP.SY_      LICENSE.TXT     LM21DRV.UP_     MSDLC.EX_
NDIS39XR.DO_    NDISHLP.SY_     NE1000.DO_      NE2000.DO_      NET.EX_
NET.MS_         NETBIND.COM     NETH.MS_        NI6510.DO_      NWLINK.EXE
OEMDLC.INF      OEMODI.IN_      OEMRAS.IN_      OEMTCPIP.INF    OLITOK.DO_
PE2NDIS.DO_     PENDIS.DO_      PRO4.DO_        PRORAPM.DW_     PROTMAN.DO_
PROTMAN.EX_     RASCOPY.BA_     README.TXT      SETUP.EXE       SMCMAC.DO_
SMC_ARC.DO_     STRN.DO_        TLNK.DO_        WCNET.INF       WCSETUP.INF
WCSYS.INI       WORKGRP.SY_
       52 file(s)      1,130,630 bytes
                         312,832 bytes free

A:\>
A:\>
A:\>
A:\>
```

This is still behind all the icons and buttons



Terminal — bash — 67×20

```
bash-3.2$ ls -a
.                               Users
..                              Volumes
.DS_Store                       bin
.Spotlight-V100                 cores
.Trashes                        dev
.dbfseventsd                    etc
.file                           home
.fseventsd                      mach_kernel
.hotfiles.btree                 net
.vol                            opt
Applications                    private
Developer                       sbin
Library                         tmp
Network                         usr
System                          var
User Guides And Information
bash-3.2$ echo $SHELL
/bin/bash
bash-3.2$
```

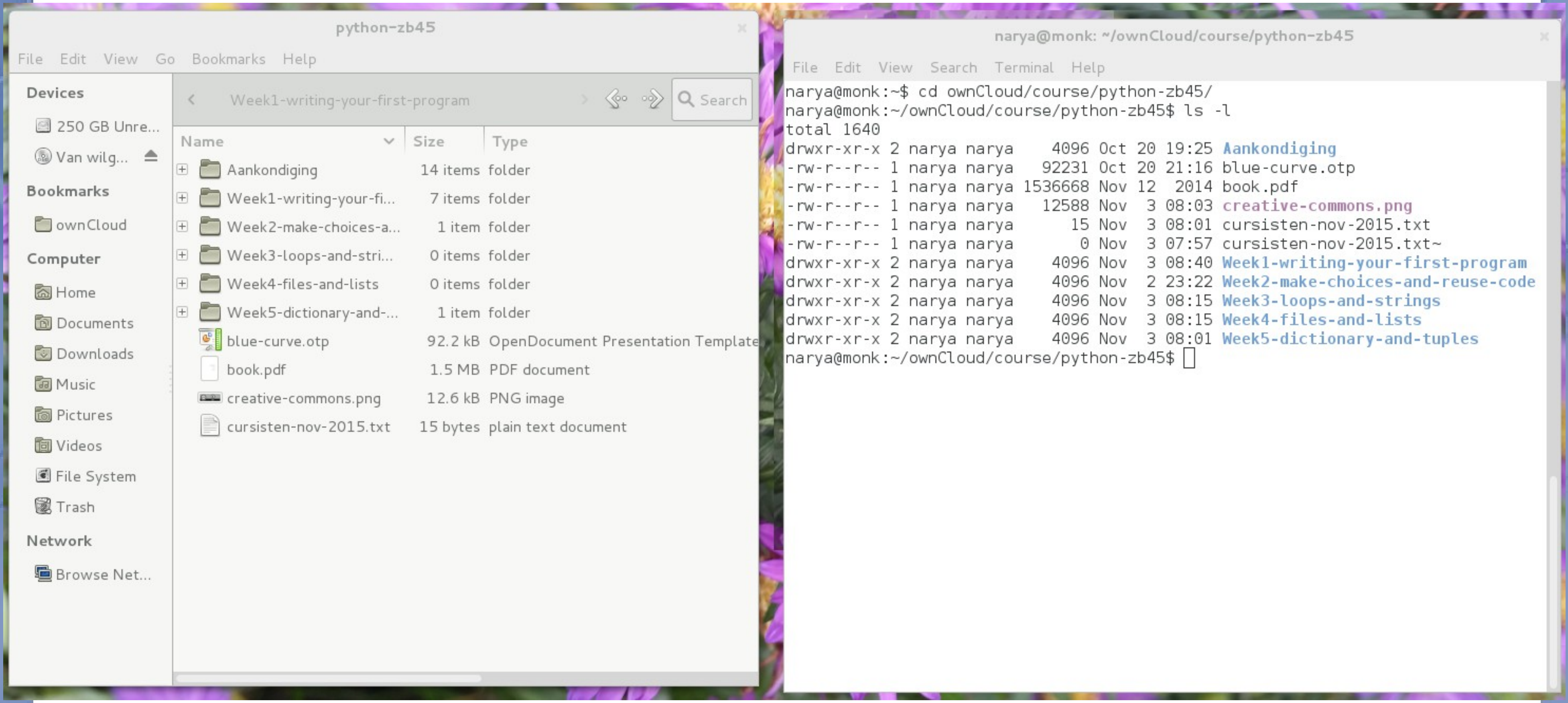


```
nuucp:x:9:9:uucp Admin:/var/spool/uucppublic:/usr/lib/uucp/uucico
smmsp:x:25:25:SendMail Message Submission Program:/:
listen:x:37:4:Network Admin:/usr/net/nls:
gdm:x:50:50:GDM Reserved UID:/:
webservd:x:80:80:WebServer Reserved UID:/:
postgres:x:90:90:PostgreSQL Reserved UID:/:/usr/bin/pfksh
svctag:x:95:12:Service Tag UID:/:
nobody:x:60001:60001:NFS Anonymous Access User:/:
noaccess:x:60002:60002:No Access User:/:
nobody4:x:65534:65534:SunOS 4.x NFS Anonymous Access User:/:
~
~
~
~
~
~
~

"/etc/passwd" 17 lines, 677 characters
# ^D
testimage console login: root
Password:
Mar 29 11:36:16 testimage login: ROOT LOGIN /dev/console
Last login: Sat Mar 29 11:04:43 on console
Sun Microsystems Inc.   SunOS 5.10      Generic January 2005
-bash-3.00# _
```

No fancy windows
No icons
No clicking

You need to type in commands to the computer

Directories and files

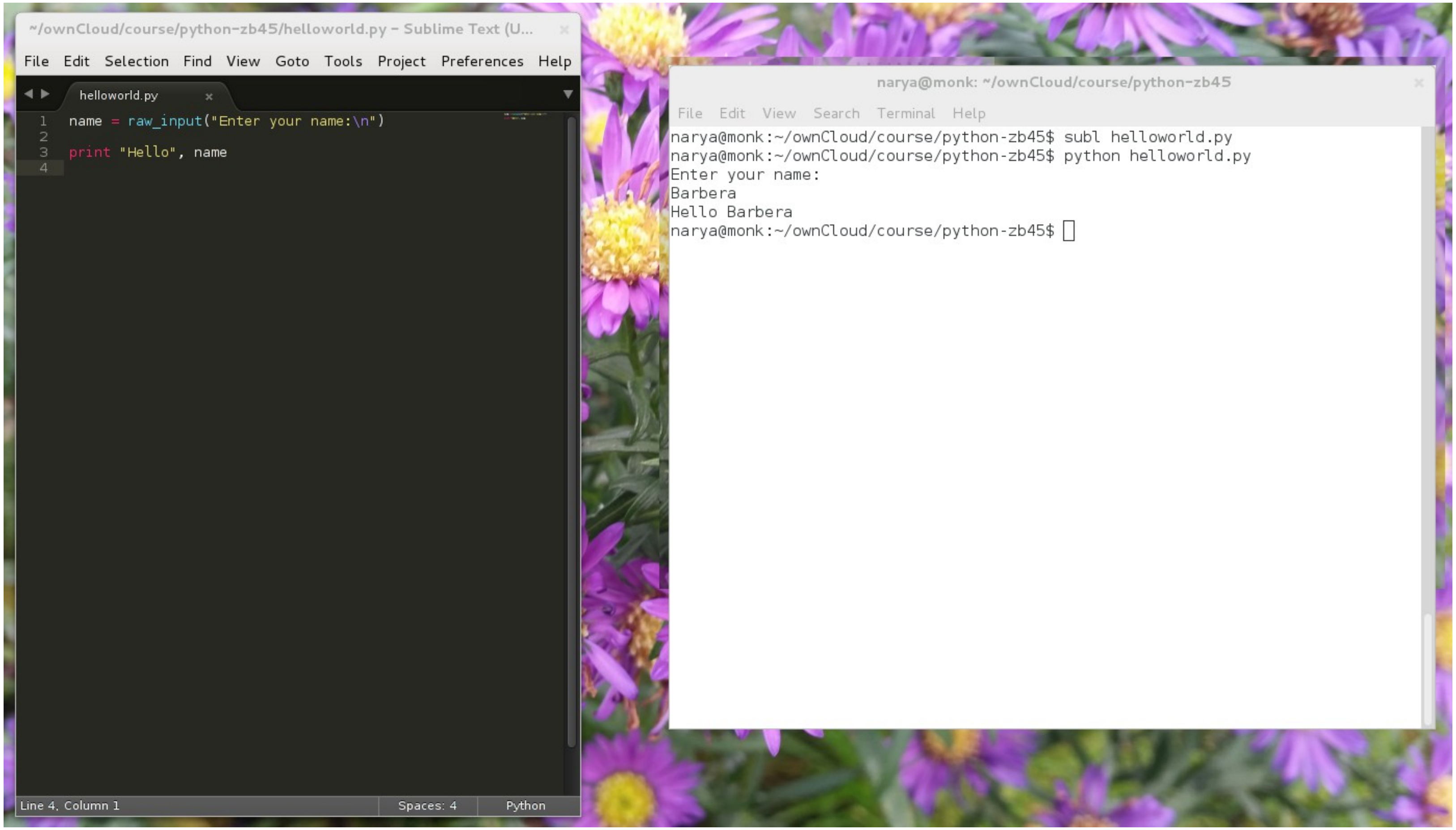


Name	Size	Type
Aankondiging	14 items	folder
Week1-writing-your-fi...	7 items	folder
Week2-make-choices-a...	1 item	folder
Week3-loops-and-stri...	0 items	folder
Week4-files-and-lists	0 items	folder
Week5-dictionary-and-...	1 item	folder
blue-curve.otp	92.2 kB	OpenDocument Presentation Template
book.pdf	1.5 MB	PDF document
creative-commons.png	12.6 kB	PNG image
cursisten-nov-2015.txt	15 bytes	plain text document

```
narya@monk:~$ cd ownCloud/course/python-zb45/
narya@monk:~/ownCloud/course/python-zb45$ ls -l
total 1640
drwxr-xr-x 2 narya narya    4096 Oct 20 19:25 Aankondiging
-rw-r--r-- 1 narya narya   92231 Oct 20 21:16 blue-curve.otp
-rw-r--r-- 1 narya narya 1536668 Nov 12  2014 book.pdf
-rw-r--r-- 1 narya narya   12588 Nov  3 08:03 creative-commons.png
-rw-r--r-- 1 narya narya      15 Nov  3 08:01 cursisten-nov-2015.txt
-rw-r--r-- 1 narya narya       0 Nov  3 07:57 cursisten-nov-2015.txt~
drwxr-xr-x 2 narya narya    4096 Nov  3 08:40 Week1-writing-your-first-program
drwxr-xr-x 2 narya narya    4096 Nov  2 23:22 Week2-make-choices-and-reuse-code
drwxr-xr-x 2 narya narya    4096 Nov  3 08:15 Week3-loops-and-strings
drwxr-xr-x 2 narya narya    4096 Nov  3 08:15 Week4-files-and-lists
drwxr-xr-x 2 narya narya    4096 Nov  3 08:01 Week5-dictionary-and-tuples
narya@monk:~/ownCloud/course/python-zb45$
```

cd somedirectoryname (go to directory, or Change Directory)
dir (shows content of directory, windows)
ls -l (shows content of directory, linux/mac)

Starting a program

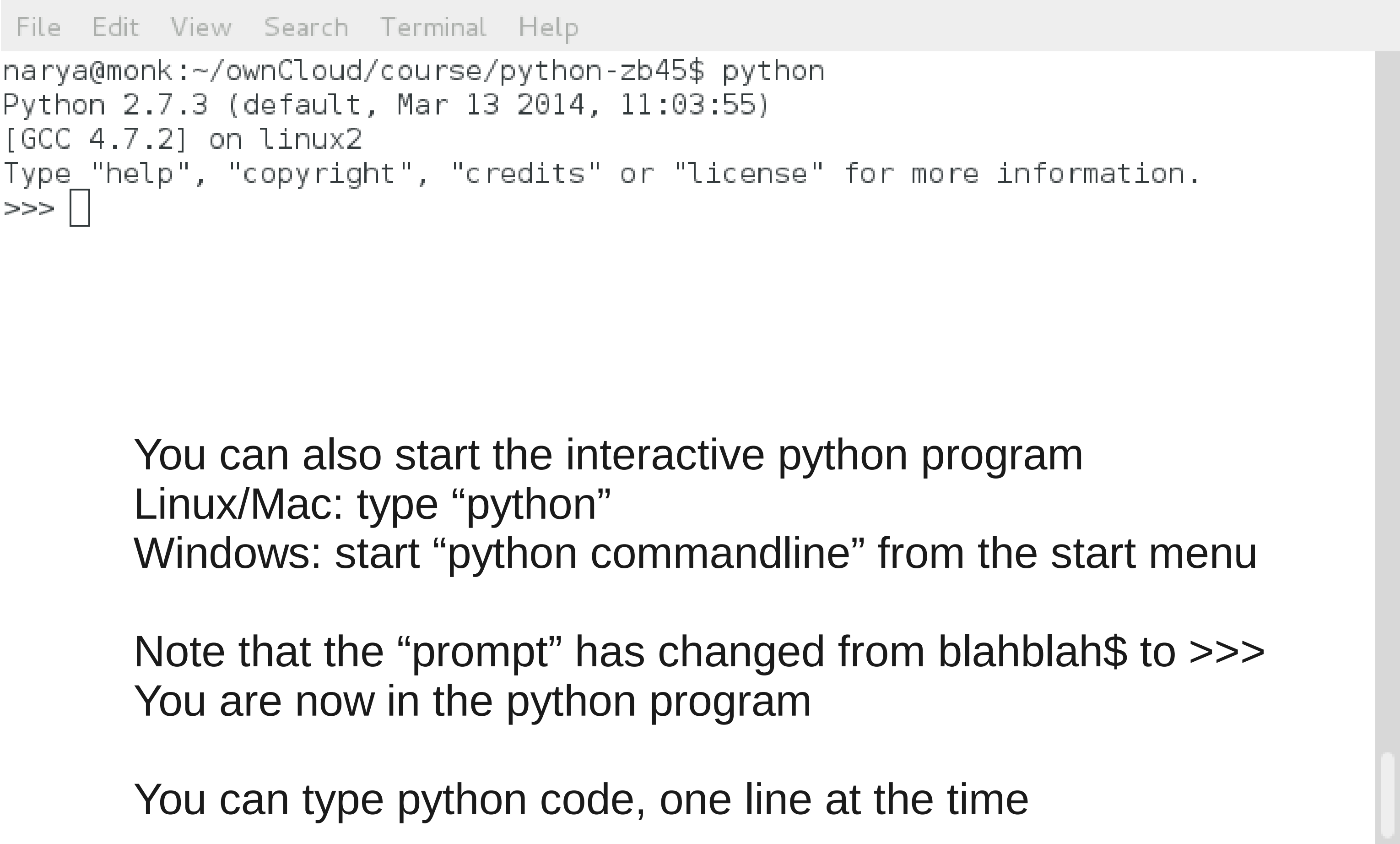

~/ownCloud/course/python-zb45/helloworld.py - Sublime Text (U...
File Edit Selection Find View Goto Tools Project Preferences Help
helloworld.py
Line 4, Column 1
Spaces: 4
Python
narya@monk: ~/ownCloud/course/python-zb45
File Edit View Search Terminal Help

```
name = raw_input("Enter your name:\n")

print "Hello", name

```

```
narya@monk:~/ownCloud/course/python-zb45$ subl helloworld.py
narya@monk:~/ownCloud/course/python-zb45$ python helloworld.py
Enter your name:
Barbera
Hello Barbera
narya@monk:~/ownCloud/course/python-zb45$
```

The program “subl” is started (a text editor)
After that the program “helloworld.py”
Linux/mac: start “helloworld.py” with “python” before that
Windows: you only need to type “helloworld.py”

Start the Python program



```
narya@monk:~/ownCloud/course/python-zb45$ python
Python 2.7.3 (default, Mar 13 2014, 11:03:55)
[GCC 4.7.2] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> 
```

You can also start the interactive python program
Linux/Mac: type “python”
Windows: start “python commandline” from the start menu

Note that the “prompt” has changed from blahblah$ to >>>
You are now in the python program

You can type python code, one line at the time

Python: first attempt

- Open python and type:

```
>>> Hi there
```

- Then type:

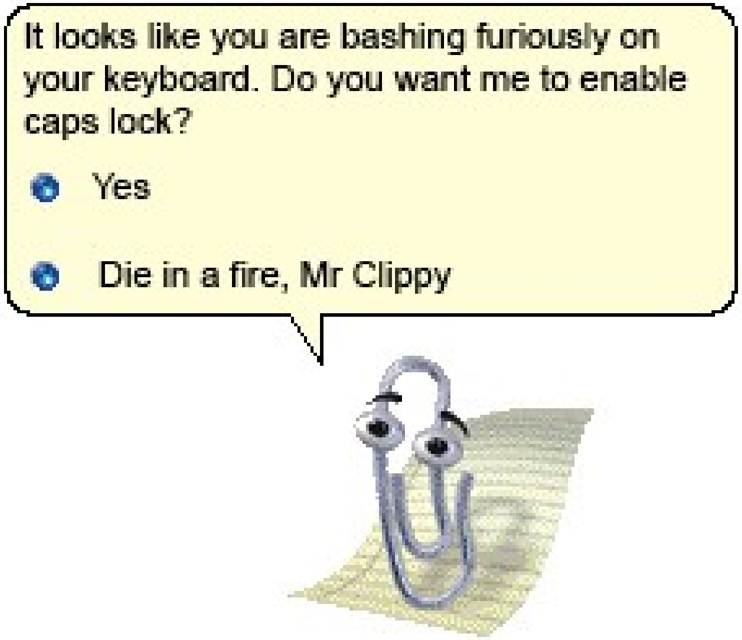
```
>>> answer me!
```

- One more try:

```
>>> help
```

Python: help()

```
help> keywords

help> if

help> quit
```


It looks like you are bashing furiously on your keyboard. Do you want me to enable caps lock?
○ Yes
○ Die in a fire, Mr Clippy

Hello world

```
>>> print “Hello world”
```

Try this again without the last quotes

```
>>> 27+15


>>> x = 7

>>> print x

>>> x = x+2

>>> print x


>>> 1+2=3

>>> 1+2==3
```

Scripts

- Like a recipe, a set of instructions
- Open sublime, notepad++ or another editor
- Type the following in the editor and save the file as “myscript.py”

```
x = 7
print x
x = x + 2
print x
```

Start the script from the commandline:

```
cmd> python myscript.py
```

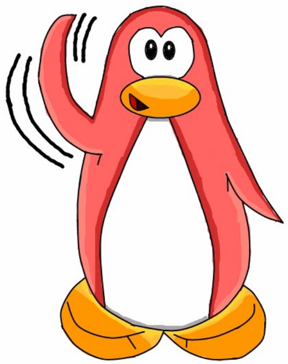
Hello <your-name-here>

- New script “helloworld.py”

```
name = raw_input("Enter your name:\n")

print "Hello", name
```

- Start the script from the commandline

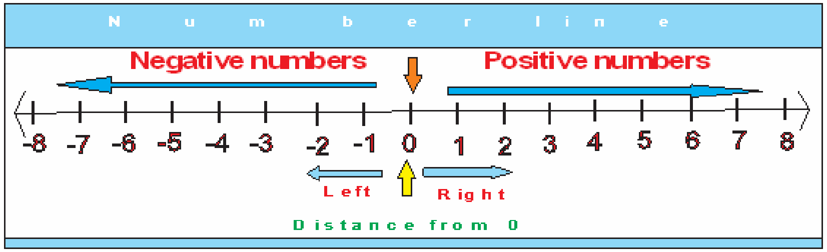
```
cmd> python helloworld.py
```



Data types

- Start an interactive Python session
- The basic data types:

```
>>> type(4)

>>> type(3.141592653)

>>> type(“Yo”)

>>> type('Yo')

>>> type(“13”)
```



integer

float

string

Variables

- Assign values to variables

```
>>> message = “hello”
>>> n = 2
>>> pi = 3.14159265358979311

>>> print n
>>> print message
>>> type(message)
>>> type(n)
>>> type(pi)
```

Variable names

- A combination of letters, numbers and underscores
- No reserved words!
- No special characters!
- Case sensitive!
- Name has to start with letter or underscore

- Tip: use meaningful names

Variable names

- Doesn't work:

```
>>> 7of9 = “borg”

>>> mail@ = “barbera@van-schaik.org”
```

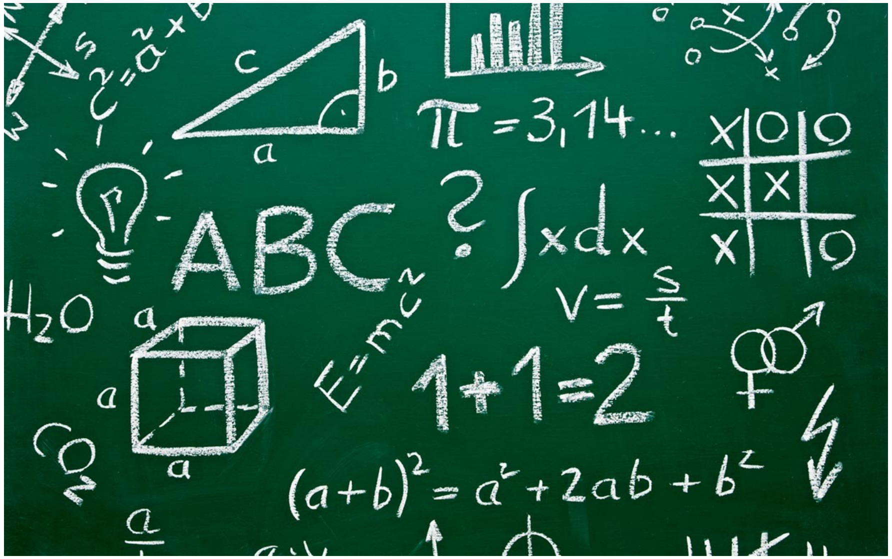
- Works:

```
>>> city = “Amsterdam”

>>> pin_code = 1234
```

Calculator

- Operators: +, -, *, /, **, %

```
>>> 20+32

>>> hour – 1

>>> hour * 60 + minute

>>> minute / 60

>>> 5**2

>>> (5+9)*(15-7)
```



Python and floats

```
>>> minute = 59

>>> minute/60


>>> minute/60.0
```

Order of operations

- Parenthesis: (1+2)*(3+1) = 3*4 = 12
- Exponentiation: 2**1+1 = 2+1 = 3
- Multiplication and division: 2*3-1 = 6-1 = 5
- Addition and subtraction: 5-3-1 = 2-1 = 1

- Same precedence from left to right

String operations

- Concatenation

```
>>> first = 10

>>> second = 15

>>> print first + second


>>> first = '10'

>>> second = '15'

>>> print first + second
```

- Multiplication

```
>>> word = “bla”

>>> n = 7

>>> print n * word
```

Comments

blah, blah,
blah, whatever

- Programs tend to get long and unreadable
- Solutions:
  - Give meaningful variable names
  - Insert comments

```
# Ask user for input
hours = raw_input(“How many hours did you work?\n”)
seconds = hours / 3600   # python sees this as correct
```

Next week

- Next: Make choices and reuse code
- Want more practice?
  - Exercises in chapter 1 and 2 of the book
- See you next week!!