Workflow and debugging

10-601 Recitation
Fall 2020

How to write code, in a better way?

Why don’t we start with *a good IDE or text editor*?

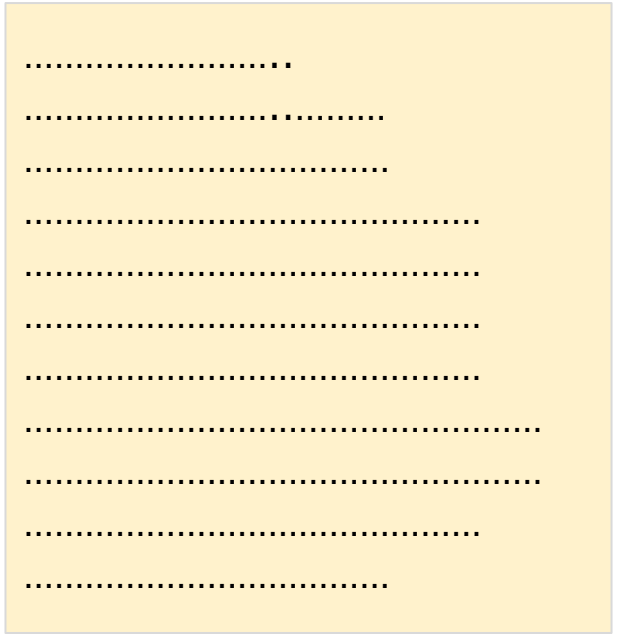
- IDEs: **Spyder**, **PyCharm**, Eclipse, CLion, XCode, ...
- Text editors: **Visual Studio Code**, Sublime Text, Atom, …

Benefits:

- Auto-completion, Syntax checks, Formatting options
- Interactive environment, Debugger, Command line support

An example workflow

Modularity: think about the conceptual flow rather than the concrete implementation.



⬅️ Don’t do this!

An example workflow

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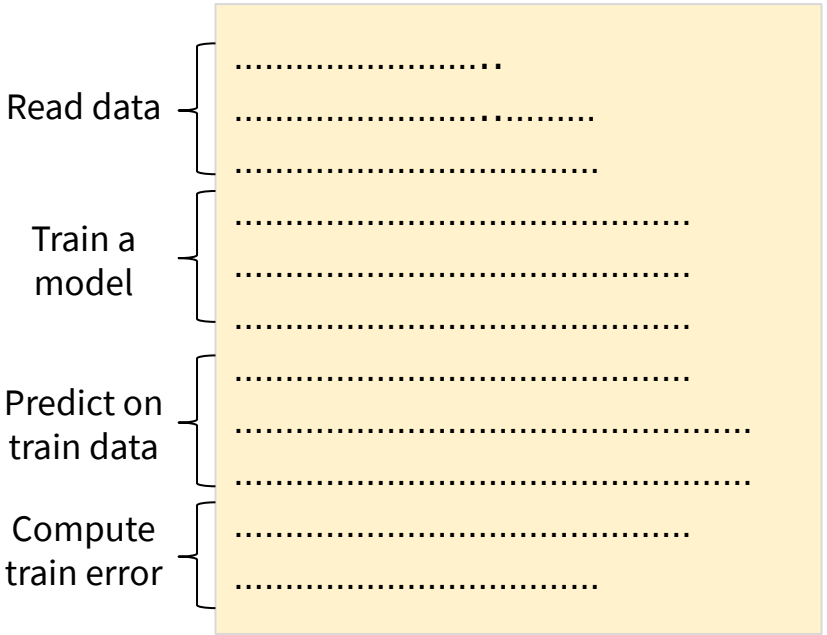

An example workflow

Modularity: think about the conceptual flow rather than the concrete implementation.

Read data

Train a model

Predict on train data

Compute train error

```
def read_data(input_file):
    ..........
    ..........
def train(x_train, y_train):
    ..........
    ..........
def predict(model, x_train):
    ..........
    ..........
def error(y_train, y_pred):
    ..........
```

```
input_file = sys.argv[0]
x_train, y_train = read_data(input_file)

model = train(x_train, y_train)

y_pred = predict(model, x_train)

train_error = error(y_train, y_pred)
```

An example workflow

Modularity: think about the conceptual flow rather than the concrete implementation.

- Separation of complex functionalities
- Better readability
- Easier debugging and maintenance
- Facilitate code reuse

An example workflow

Write your awesome code, *as well as your awesome comments*.

```
def read_data(input_file):
    """Code author: Matt Gormley"""
    with open(input_file, 'r') as f:
        lines = f.readlines()

    # Drop header
    lines = lines[1:]
    # Convert to list of lists of strings
    rows = [l.strip().split('\t') for l in lines]
    # Convert to numpy array
    return np.array(rows)
```

An example workflow

After finishing your code, *do some unit tests right away, if possible.*

- Unit test (noun.): test for the individual components of a software [Modularity!]
- A good practice is to separate tests from the main program

```
def transpose(A):
    # do something plausible
    return A

A = np.array([[1, 2], [3, 4]])
A_true_transpose = np.array([[1, 3], [2, 4]])
assert np.array_equal(transpose(A), A_true_transpose)
```

An example workflow

After finishing your code, an error occurs!

- Understand the error message
  - Google it if you don’t understand the error
  - Quickly locate your error from the error message

An example workflow

After finishing your code, an error occurs!

- Understand the error message
  - Google it if you don’t understand the error
  - Quickly locate your error from the error message
- Use a debugger
  - PDB for Python, JDB for Java, GDB/LLDB for C++; Debugging tools in IDE
  - *Print relevant variables to see if the program works as expected*
  - Logging in Python/Java: advanced print for debugging

Coding Style Conventions

- Why have good style?
- Not required for the class but ….
  - Make it easier when you are coding through ideas
  - Makes debugging easier
- What’s a good coding style to follow?
  - Python PEP 8 Style Guide
  - Full guide can be found if you just google that

Spacing and Maximum Line Length

- Tabs vs Spaces
  - 1 tab or 4 spaces
  - Stay consistent, don’t mix!!!

```
# Hanging indents should add a level.
foo = long_function_name(
    var_one, var_two,
    var_three, var_four)
```

- Try using blank lines to separate different chunks of code
- Do not have more than 79 characters per line
  - Usually text editors will tell you how many characters there are on a certain line

Importing and Comments

- Import packages on seperate lines, not on same line!
- Do not import wildcard
  - Never do: “from os import *”
- Comments are super important and useful!
  - When looking back it's easier to figure out what certain chunks of code do
  - Helps with debugging
  - Use # for commenting out a single line

```
# Correct:
import os
import sys
```

```
# Wrong:
import sys, os
```

Variable Naming Conventions

- Do not give variables and functions non descriptive names:
  - Bad examples: “x”, “a”, “myFun”
  - Having descriptive variable and function names is similar to good commenting
  - Easier coding and debugging
  - You won’t forget what a variable is being used for if it’s descriptive
- Constant names should be in all caps
- In general DON’T USE global variables

Debugging: Common Python Errors

- SyntaxError: invalid syntax
  - Forgetting the parens around the arguments to print
  - Forgetting the colon at the end of the condition in an if statement
  - Trying to use a reserved word as a variable name
- IndentationError: expected an indented block
  - Forgetting to indent the statements within a compound statement (such as the bodies of if and for)
  - Forgetting to indent the statements of a user-defined function
- IndexError: list index out of range
  - Trying to access an item in a list at an invalid index

Debugging: Common Python Errors

- KeyError
  - Trying to access a non-existing key in a dict
- TypeError: 'list' object cannot be interpreted as an integer
  - Forgetting the len() call in a for loop statement.
- IndexError
  - Trying to access an item in a list at an invalid index
- UnboundLocalError: local variable 'foobar' referenced before assignment
  - Using a local variable (with the same name as a global variable) in a function before assigning the local variable