

ECE 20875

Python for Data Science

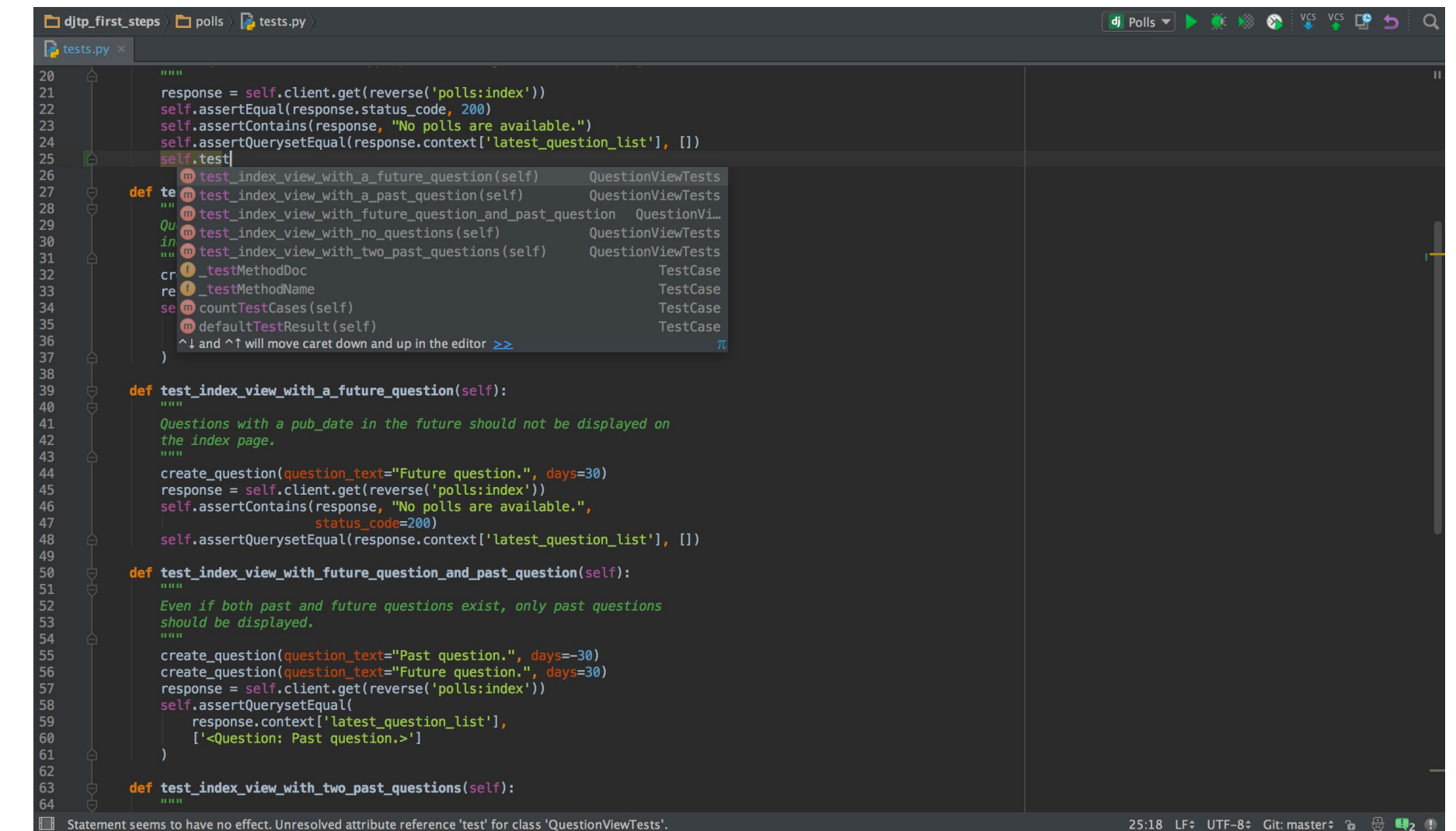
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(Adapted from material developed by Profs. Milind Kulkarni, Stanley Chan, Chris Brinton, David Inouye, and Qiang Qiu)

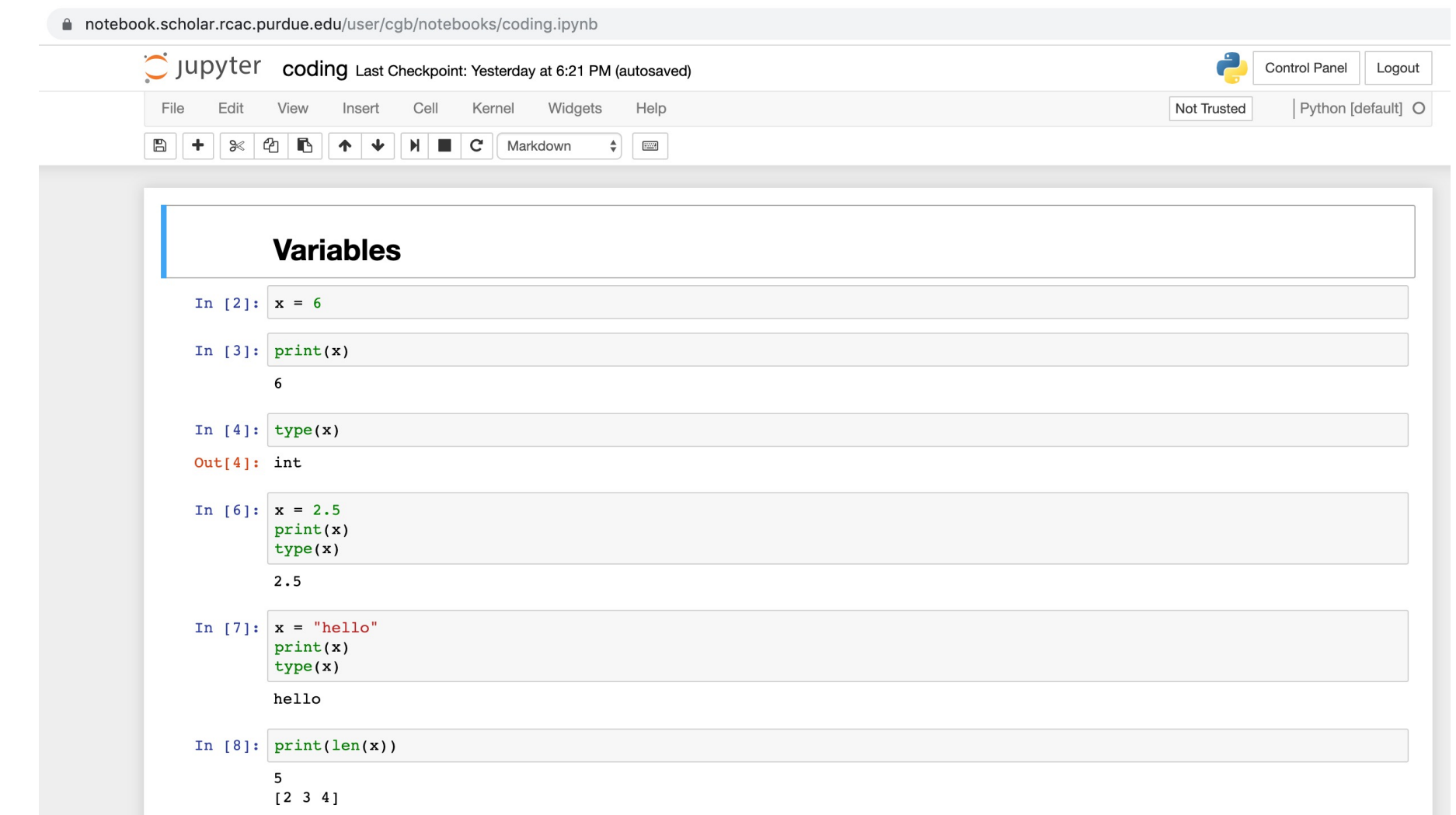
python basics

coding in python

- Standard Integrated Development Environments (IDEs)
 - IDLE: Python's own, basic IDE
 - PyCharm: Code completion, unit tests, integration with git, many advanced development features (<https://www.jetbrains.com/pycharm/>)
 - Spyder: Less plugins than PyCharm (not always a bad thing)
 - Many more!
- Jupyter Notebook (<https://jupyter.org/>)
 - Contains both computer code and rich text elements (paragraphs, figures, ...)
 - Supports several dozen programming languages
 - Very useful for data science development!
 - You can download the notebook app or use Jupyter Hub available on RCAC (<https://www.rcac.purdue.edu/compute/scholar>)
- Anaconda package manager (<https://www.anaconda.com/>)



```
20 response = self.client.get(reverse('polls:index'))
21 self.assertEqual(response.status_code, 200)
22 self.assertContains(response, "No polls are available.")
23 self.assertQuerysetEqual(response.context['latest_question_list'], [])
24
25 @test
26 def test_index_view_with_a_future_question(self):
27     """
28     Questions with a pub_date in the future should not be displayed on
29     the index page.
30     """
31     create_question(question_text="Future question.", days=30)
32     response = self.client.get(reverse('polls:index'))
33     self.assertContains(response, "No polls are available.",
34                        status_code=200)
35     self.assertQuerysetEqual(response.context['latest_question_list'], [])
36
37 def test_index_view_with_future_question_and_past_question(self):
38     """
39     Even if both past and future questions exist, only past questions
40     should be displayed.
41     """
42     create_question(question_text="Past question.", days=-30)
43     create_question(question_text="Future question.", days=30)
44     response = self.client.get(reverse('polls:index'))
45     self.assertQuerysetEqual(
46         response.context['latest_question_list'],
47         ['<Question: Past question.>']
48     )
49
50 def test_index_view_with_two_past_questions(self):
51     """
52     Questions whose pub_date is not in the future,
53     should be displayed on the index page.
54     """
55     create_question(question_text="Past question 1.", days=-30)
56     create_question(question_text="Past question 2.", days=-30)
57     response = self.client.get(reverse('polls:index'))
58     self.assertQuerysetEqual(
59         response.context['latest_question_list'],
60         ['<Question: Past question 1.>',
61         '<Question: Past question 2.>']
62     )
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```



```
coding Last Checkpoint: Yesterday at 6:21 PM (autosaved)
File Edit View Insert Cell Kernel Widgets Help Not Trusted Python [default]
Variables
In [2]: x = 6
Out[2]: 6
In [3]: print(x)
Out[3]: 6
In [4]: type(x)
Out[4]: int
In [6]: x = 2.5
print(x)
type(x)
Out[6]: 2.5
In [7]: x = "hello"
print(x)
type(x)
Out[7]: hello
In [8]: print(len(x))
Out[8]: 5
[2 3 4]
```

basic variables

- No "declaration" command as in other programming languages
 - Variable is created when a value is assigned to it
 - Can change type after they have been set
- Few rules on naming: Can make them very descriptive!
 - Must start with a letter or underscore
 - Case-sensitive (purdue & Purdue are different)
- Combinations (+) work on all types

“xyz ” + “abc” = “xyz abc”

3.2 + 1 = 4.2

operators and control statements

- Comparison operators:

`a == b, a != b, a < b,
a <= b, a > b, a >= b`

- If statement:

```
if r < 3:  
    print("x")
```

- If, elif, else (multiline blocks):

```
if b > a:  
    print("b is greater than a")  
elif a == b:  
    print("a and b are equal")  
else:  
    print("a is greater than b")
```

- Arithmetic operators:

`a + b, a - b, a * b,
a / b, a % b, a ** b, a//b`

- Assignment operators:

`a = b, a += b, a -= b,
a *= b, a /= b, a **= b`

- Logical operators:

`(a and b), (a or b),
not(a), not(a or b)`

lists

- One of the four collection data types
- Also tuples, sets, and dictionaries
- Lists are ordered, changeable, and allow duplicate members

```
thislist = ["apple", "banana", "apple",  
           "cherry"]
```
- Can pass in an integer index, or a range of indexes

```
thislist[0] => "apple"  
thislist[-1] => "cherry"  
thislist[1:3] => ["banana", "apple"]
```
- Length using `len()` method

```
print(len(thislist))
```
- Adding items to a list

```
thislist.append("orange")  
thislist.insert(1, "orange")
```
- Removing items from a list

```
thislist.remove("banana")  
thislist.pop(1)
```
- Defining lists with shorthand

```
new_list = 5 * [0]  
new_list = list(range(5))
```

loops (more control statements)

- while loop: Execute while condition is true

```
i = 1
while i < 6:
    print(i)
    i += 1
```

- for loop: Iterate over a sequence

```
for x in "banana":
    print(x)
```

- range() operator can be a useful loop iterator:

```
for x in range(5,10):
    y = x % 2
    print(y)
```

- break: Stop a loop where it is and exit
- continue: Move to next iteration of loop

```
for val in "sammy_the_dog":
    if val == "h":
        break
    print(val)
```

lists in for loops

- In other programming languages, for loop variables are integers
- In Python, can use any 'iterable' object

```
fruits = ["apple", "banana", "cherry"]
for x in fruits:
    if x == "banana":
        continue
    print(x)
```
- Nested loops can be used too

```
adj = ["red", "big", "tasty"]
fruits = ["apple", "banana", "cherry"]
for x in adj:
    for y in fruits:
        print(x, y)
```
- Can also iterate through a list of lists

```
data_list = [[1,2],[2,6],[5,7]]
for point in data_list:
    [x,y] = point
    z = x ** 2
    print(x,y,z)
```
- Can use the range function to iterate through integers

```
for x in range(2, 30, 3):
    print(x)
```
- Can use a list to index another list

```
ind = [1, 3, 5, 7]
values = [0] * 8
for i in ind:
    values[i] = i / 2
```


functions

- Block of code which runs when called
- Defined using def keyword
- Call a function using its name
- Parameters can be passed as input to functions

```
def my_function():  
    print("Hello from a function")
```

```
my_function()
```

```
def my_function(country):  
    print("I am from " + country)
```

- To return a value, use the return statement

```
def my_function(x):  
    return 5 * x
```

```
print(my_function(3))
```

```
print(my_function(5))
```

- For multiple arguments, can use keywords to specify order

```
def arithmetic(x,y,z):  
    return (x+y)/z
```

```
print(arithmetic(z=3,x=2,y=4))
```

tuples

- Another of the four collection data types
- Tuples are ordered, **unchangeable**, and allow duplicate members
thistuple =
(“apple”, “banana”, “apple”, “cherry”)
- Indexed the same way as lists
thistuple[0] => “apple”
thistuple[-1] => “cherry”
thistuple[1:3] => (“banana”, “apple”)
- Once a tuple is created, items cannot be added or changed
- Workaround: Change to list, back to tuple
- Check if item exists

```
if "apple" in thistuple:  
    print("Yes, 'apple' is in the  
          fruits tuple")
```
- Tuple with one item needs comma
thistuple = (“apple”,) #Tuple
thistuple = (“apple”) #Not a tuple
- Built-in functions
thistuple.count(“apple”)
thistuple.index(“apple”)

sets

- Collection which is **unordered**, (half) changeable, and does **not** allow duplicates
- Written with curly brackets
`thisset = {"apple", "banana", "cherry"}`
- Cannot access items by index, but can loop through and check for items

```
for x in thisset:
```

```
    print(x)
```

```
print("banana" in thisset)
```

- Cannot change existing items, but can add and remove items

```
thisset.add("orange")
```

```
thisset.update(["orange", "mango", "grapes"])
```

```
thisset.remove("banana")
```

- Also have set operations just like mathematical objects

```
set1 = {"a", "b", "c"}
```

```
set2 = {1, "b", 3}
```

```
set1.union(set2) #Union
```

```
set1.intersection(set2) #Intersection
```

```
set1.difference(set2) #set1 \ set2
```

```
set1.issubset(set2) #Testing if subset
```

dictionaries

- Collection which is ordered (as of recent Python versions), changeable, and indexed

- Also written with curly brackets, but have keys and values

```
thisdict = {  
    "brand": "Ford",  
    "model": "Mustang",  
    "year": 1964  
}
```

- Access/change/add values of items by referring to the key name

```
thisdict["model"]  
thisdict["year"] = 2019  
thisdict["color"] = "red"
```

- Can iterate through the keys, values, or both

```
for x in thisdict:  
    print(thisdict[x])
```

```
for x in thisdict.values():  
    print(x)
```

```
for x, y in thisdict.items():  
    print(x, y)
```

- Like other collections, can create a dictionary of dictionaries

```
child1 = {"name": "Emil", "year": 2004}  
child2 = {"name": "Tobias", "year": 2007}  
child3 = {"name": "Linus", "year": 2011}
```

```
myfamily = {"child1": child1, "child2": child2,  
           "child3": child3}
```

- Use the copy method (not direct assignment) to make a copy of a dictionary

```
mydict = thisdict.copy()
```

version control

command line and bash

- Command Line Interface (CLI) for interacting with your operating system (OS)
- Unix shell: Available by default on Linux and macOS
- Windows users:
<https://www.howtogeek.com/249966/how-to-install-and-use-the-linux-bash-shell-on-windows-10/>
- Bash script: Sequence of commands, typically saved as .sh file

```
#!/bin/bash
#07/06/18 A BASH script to collect EXIF metadata
#07/06/18 create metadata directory, create text file output for each file, append basename, place output in metadata directory
#07/06/18 create script.log to verify processing of files and place in metadata directory
#07/06/18 Author: Sandy Lynn Ortiz - Stanford University Libraries - Born Digital Forensics Lab
#####

##### testing codeblock, clean up last run #####
rm -rf ./metadata
echo -ne "\n metadata directory cleaned! \n\n"
##### testing codeblock, clean up last run #####

#create variable current working directory
CWD=$(pwd)

#create directory and create variable META to store path, create LOGFILE in META directory
mkdir metadata
cd metadata
META=$(pwd)
LOGFILE="$META/script.log"
cd "$CWD"
echo -ne "\n Current working directory is: \n" $CWD "\n"

#create variable EXCL to exclude script file from processing
EXCL=$(basename "$0")
echo -ne "\n Exclude Script file from processing: " $EXCL "\n\n"

#####

#search for jpg files in curr dir/subdir, ignore case, pipe(send output from cmd1 to cmd2) to chain of commands
#create EXIF text files in META dir (redirect output)
echo -ne "\n Processing EXIF metadata now... \n\n"
find $(cd "$CWD") -depth -iname "*.jpg" | while read filename; do exiftool "$filename" > "$META"/"${(basename "$filename")}_exif.txt"; done

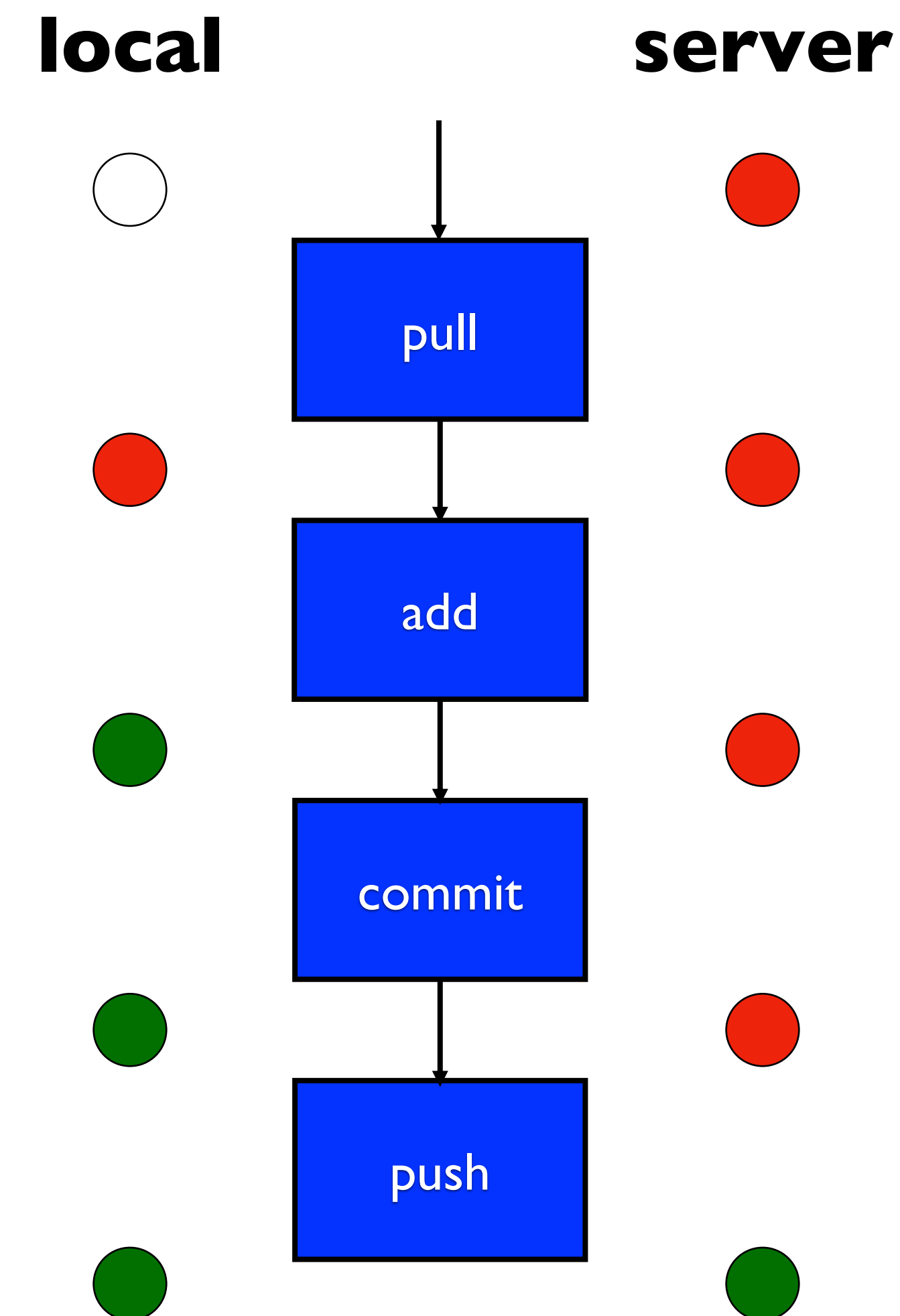
#TEST - create EXIF text files in META dir(redirect), print file STDOUT redirect/append to LOGFILE - TEST
#echo -ne "\n Processing EXIF metadata now... \n\n"
#find $(cd "$CWD") -depth -iname "*.jpg" | while read filename; do exiftool "$filename" > "$META"/"${(basename "$filename")}_exif.txt"
#printf "\n $filename" >> "$LOGFILE"; done

#####

echo -ne "\n\n Processing is finished! \n\n\n"
#####
```

overview of version control

- Automatically keep old versions of code and/or documentation
 - Can revert back to old versions
 - Can see differences (“diffs”) between versions
- Typically through maintenance of repository on a server
 - Can sync up code between different machines
 - Can share code updates across many people
- “git”: One of the most popular version control systems
 - Each “project” goes into a different “repository”
 - Repositories can be public (e.g., homework assignments) or private (e.g., homework solutions prior to the due date :D)
 - We will use GitHub to manage assignments in this course



git illustration



git illustration

