THE UNIVERSITY OF CHICAGO

MASTERS IN COMPUTATIONAL SOCIAL SCIENCE
THE UNIVERSITY OF CHICAGO

MACS 30111

Working with Files

Agenda/Misc

- **Needed file for today:**
- **names:** https://uchicago.box.com/s/kp207rd2vita1a4zz6749oe8jkvk85l6
- **Instructors.txt:** https://uchicago.box.com/s/oim7c3si6p8ju1b72nciqcdgp283ab1f

Topics:

- Basic file I/O
  - Open: load the data from disk
  - Read: manipulate the data
  - Close: print the results or write the data back to disk
- Working with tabular data using CSV files
- Working with JSON files
- Other file formats

Common Programming Pattern

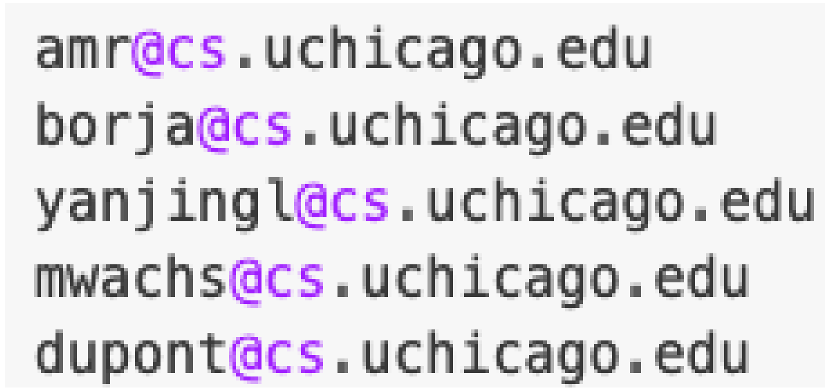
Common pattern when working with data:

1. **Read** the contents of a file (or files) from disk and **load** the data into one or more data structures
2. **Manipulate** the data in some way
3. **Print** the result or **write** the data back to disk

Sample application

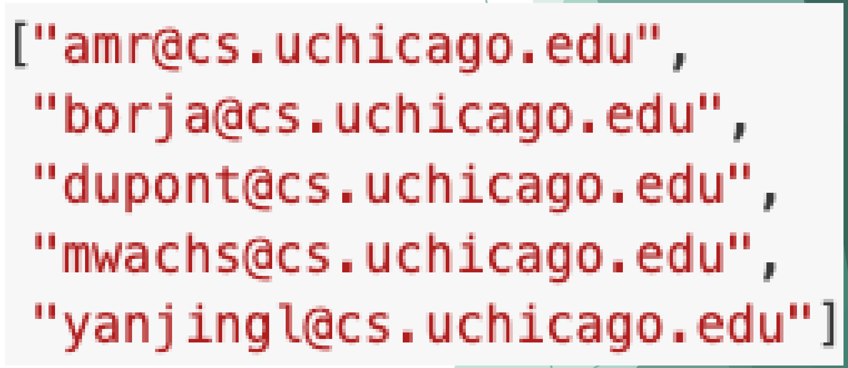
Given a file of email addresses (username@domain), construct a file with the corresponding user names.

`instructor-email.txt`



```
amr@cs.uchicago.edu
borja@cs.uchicago.edu
yanjingl@cs.uchicago.edu
mwachs@cs.uchicago.edu
dupont@cs.uchicago.edu
```

`instructor-email-sorted.txt`



```
["amr@cs.uchicago.edu",
 "borja@cs.uchicago.edu",
 "dupont@cs.uchicago.edu",
 "mwachs@cs.uchicago.edu",
 "yanjingl@cs.uchicago.edu"]
```

Coding practice: 4.1.1

Common Programming Pattern

Common pattern when working with data:

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Basic File I/O

To access the contents of a file, we first need to open it:

```
    f = open("instructor-email.txt")
```

file pointer

To read data from a file, we use the read method:

```
    addrs = f.read()
```

read the entire contents into a string

When we are done with a file, we need to close it:

```
    f.close()
```

close the file pointer

Coding practice: 4.1.1

Alternative to *close()*

The ***with*** statement to ensure that a file is closed once we're done with it:

```
with open('instructor-email.txt') as f:
    s = f.read()
    email_addresses = sorted(s.split())
```

Coding practice: 4.1.1

Read the file one line at a time

Use a *for* loop to iterate over a text file line by line:

```
with open('instructor-email.txt') as f:
        for line in f:
                print(line)
```

extra empty line

```
with open('instructor-email.txt') as f:
        for line in f.readlines():
                print(line)
```

line.strip()

Coding practice: 4.1.1

Common Programming Pattern

Common pattern when working with data:

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Write data to a file

To write to a file, we must open the file in **write mode**.

```
with open("names.txt", "w") as f:
    f.write("Anne Rogers\n")
    f.write("Borja Sotomayor\n")
    f.write("Yanjing Li\n")
    f.write("Matthew Wachs\n")
    f.write("Todd Dupont\n")
```

We can also use ***print*** to avoid having to worry about the newline.

```
with open("names2.txt", "w") as f:
    print("Anne Rogers", file=f)
    print("Borja Sotomayor", file=f)
    print("Yanjing Li", file=f)
    print("Matthew Wachs", file=f)
    print("Todd Dupont", file=f)
```

Very important:

- Opening an existing file in write mode will **wipe all its contents**!
- Opening a file that does not exist in write mode will **create** the file.

Coding practice: 4.1.2

Summary

The common programming pattern:

1. Load the data from disk:
   a. **Open** a file to **read**
   b. Read the contents of the file from disk
   c. Load the data into a data structure
2. Manipulate the data in some way
3. Print the result or write the data back to disk
   a. **Write** the data
   b. **Close** the file (or use a with statement when you open it)

Coding practice: 4.1.2

Topics:

- Basic file I/O
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- **Working with tabular data using CSV files**
- Working with JSON files
- Other file formats

CSV (Comma Separated Values) format

CSV files are useful for storing **tabular data**: any data that can be organized into rows, each with the same columns (or "fields")

`instructors.csv`

```
id,lname,fname,email
hdambane,Dambanemuya,Henry,hdambane@uchicago.edu
dapeterson,Peterson,David,dapeterson@uchicago.edu
zwang13,Wang,Zhao,zwang13@uchicago.edu
jclindaniel,Clindaniel,Jon,jclindaniel@uchicago.edu
nardin,Nardin,Sabrina,nardin@uchicago.edu
```

header

Applied practice!

Working with text

Exercise

- You are working on a project creating a directory of buildings based on where MACSS classes typically meet.
- Use text file: https://uchicago.box.com/s/kp207rd2vita1a4zz6749oe8jkvk85l6

- How would you load your data?
- Next, you want to select the following buildings: `sched = ["1155", "SS", "TTI", "K"]` and output the new list into a separate file

What if you want to skip lines?

- Multiple ways to approach:

```
new_lst = []
with open('names.txt') as names:
    next(names)
    next(names)
    next(names)
    new_lst = names.readlines()
```

```
new_list = []
with open('names.txt') as names:
    for i, line in enumerate(names):
        if i > 3 and  i < 149:
        new_list.append(line)
```

Sample application

1. Read the original data from `instructors.csv`
   - https://uchicago.box.com/s/bay5suooc7nm48gxr0t2cloyfiuzvfb1
2. Manipulate the data by:
   a. getting field information for each row
3. Print the formatted output of the data

Coding practice: 4.1.3

Read file using *csv* module

- *csv.DictReader* - read rows from a CSV file into dictionaries
- *csv.DictWriter* - write dictionaries into rows of a CSV file

Alternatively, we could also use:

- *csv.reader* - read rows from a CSV file into a list of lists
- *csv.writer* - write lists into rows of a CSV file

Different ‘modes’

- You can open files in different ‘modes’
  - r: ‘read’ mode (default)
  - w: ‘write’ mode (needs specified)
  - a: append

If you’re just reading a file, you can operate as normal. If you’re wanting to write a new file, *then* you will use “w”.

DANGER ALERT!!! In “w” mode, you will OVERWRITE THE PREEXISTING FILE!!

Writing files

“w” for “write mode”

```
with open("names_cleaned.txt", "w") as f:
    for build in new_list:
        print(build, file=f)
```

Bringing the exercise together:

```
# making it pretty:

def get_buildings(input_filename, output_filename, sched):
'''

extract relevant buildings from campus list

Inputs:
input_filename: (string) name of a file with buildings
output_filename: (string) name for the output file.
'''
# Load data into a data structure (a list of strings)
buildings = []
with open(input_filename) as f:
        for line in f:
                builds = line.strip().split("\t", 1)
                buildings.append(builds)

# Transform the data
buildings_select = []
for line in buildings:
        if line[0] in sched:
                buildings_select.append(line)

# Write the data
with open(output_filename, "w") as f:
        for build in buildings_select:
                print(build, file=f)
```

Exam prep: spot 3 errors and rewrite code

```
# making it pretty:

def get_buildings(input_filename, output_filename, sched):
'''

extract relevant buildings from campus list

Inputs:
input_filename: (string) name of a file with buildings
output_filename: (string) name for the output file.
'''
```

```
# Load data into a data structure (a list of strings)
buildings = []
with open(input_filename) as f:
        for line in f:
                builds = line.strip().split("\t", 1)
                buildings.append(builds)

# Transform the data
buildings_select = []
for line[0] in buildings:
        if line in sched:
                buildings_select.append(line)

# Write the data
with open(output_filename) as f:
        for build in buildings:
                print(build, file=f)
```

Topics:

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JSON (JavaScript Object Notation) format

JSON is a **lightweight** data-interchange / data-storage format commonly used in web services.

Supports different types:

- Object: key-value pairs separated by commas
    - Keys must be strings
    - Values must be valid JSON data types
- Array: empty list or list of objects
- Value: string, number, object, array, true, false, null

File operation using JSON module

String operation:

- *json.dumps*: encodes data into JSON format string
- *json.loads*: decodes JSON format string into a data structure

File operation:

- *json.dump*: encodes data into a JSON file
- *json.load*: decodes data from a JSON file into a data structure

Coding practice: 4.1.4

Topics:

- Basic file I/O
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- **Other file formats**

Other file formats

- HTML: HyperText Markup Language (beautifulsoup)
- XLS, XLSX: Excel formats (xlrd)
- XML: eXtensible Markup Language (beautifulsoup)
- YAML: YAML Ain't Markup Language (yaml)

Application

- You are a social scientist interested in who has won the Nobel Prize.
- In your groups, open up the json data from: https://uchicago.box.com/s/yyq4tf6bxus97ftn08gq0hy85sz13227
- Use section 4.1.4 (near end) to load and inspect the data
- Note: this is a tiny dataset! The goal is to not overwhelm your machine.
- Provide a dictionary of the number of years and awards covered by this dataset.
- **Bonus**! Export this to a json file

Troubleshooting

Troubleshooting code: how do debug

- Break into smaller chunks
- Test each chunk:
  - Are there errors?
  - Does it work as expected?
  - What kind of case might be ‘weird’ … did that work?
- Bring chunks together

Recap

- Sometimes you have text or data that you need to work with
- Python is here for you! You can pull it in and write over it / work with it in files
- Be careful of how you access the text (write may overwrite a file)
- Think about your goals and the best way to work through things

Additional practice

Prep for Thursday!

- Post on ED:
  - One question you have (be specific, include an example)
  - One question you think would be good for the midterm

Optional practice on your own!

- **Data work**: Nobel prizes
  - Pull in data and create a dictionary from an original dataset.
- **Simulation**: Conway's game of life: https://playgameoflife.com/
  - Create a simple simulation of Conway's game of life

Application #1

- Go to Tuesday's class. Sort the ed discussion posts by OLDEST: https://edstem.org/us/courses/48338/discussion/3711199
- Choose the post ABOVE your post
- Run the code. Does it run? Does it work as expected? Try to troubleshoot it.
- Reply to the comment with if it ran, if it worked as expected, and any suggestions for improving the code. Also, comment on if you learned anything from their approach vs how you did yours.