Computing for Medicine: Phase 3, Seminar 6 Project

Jennifer Campbell
Associate Professor, Teaching Stream
campbell@cs.toronto.edu

Seminar 6 Project

- The project handout is posted:
  - http://c4m.cdf.toronto.edu/cohort1/phase3/
- Two approaches for doing your work:
  - Use the Computer Science Teaching Labs computing network.
  - Use your personal computer.
- No software installation required.

OVERVIEW

Starter code and data

- Starter code:
  - `phenotips_project.py` (TODOs)
  - `ontology_parser.py` (complete)
  - `ontology_explorer.py` (TODOs)
- Data:
  - hp.obo (Human phenotype ontology)

Your tasks

0) Explore PhenoTips using your web browser.
1) Write a program to interact with PhenoTips.
2) Write a program to get information about the Human Phenotype Ontology (HPO).
3) Q&A: revisiting design decisions; more exploration

PROGRAMMING CONCEPTS

Type `set`

- Python sets are unordered collections of unique immutable objects.
- https://docs.python.org/3/library/stdtypes.html#set
  - `s = set()  # an empty set`
  - `s.add(1)`
  - `s.add(2)`
  - `s2 = set([1, 2, 3, 4])  # new set with 4 items`
  - `s2.add(3)  # 3 already in s2, so s2 is unchanged`

- Note: using type `set` is not a requirement, but you may find it helpful.

Assigning parameters default values

- For certain functions, including `range` and `print`, the number of arguments that you pass to them can vary.
- For example:
  - `print('hello')`
  - `print(1, 2, 3)`
  - `print('a', 'b', 'c', end='xyz')`
  - `print(1, 2, 3, sep='..', end='!')`

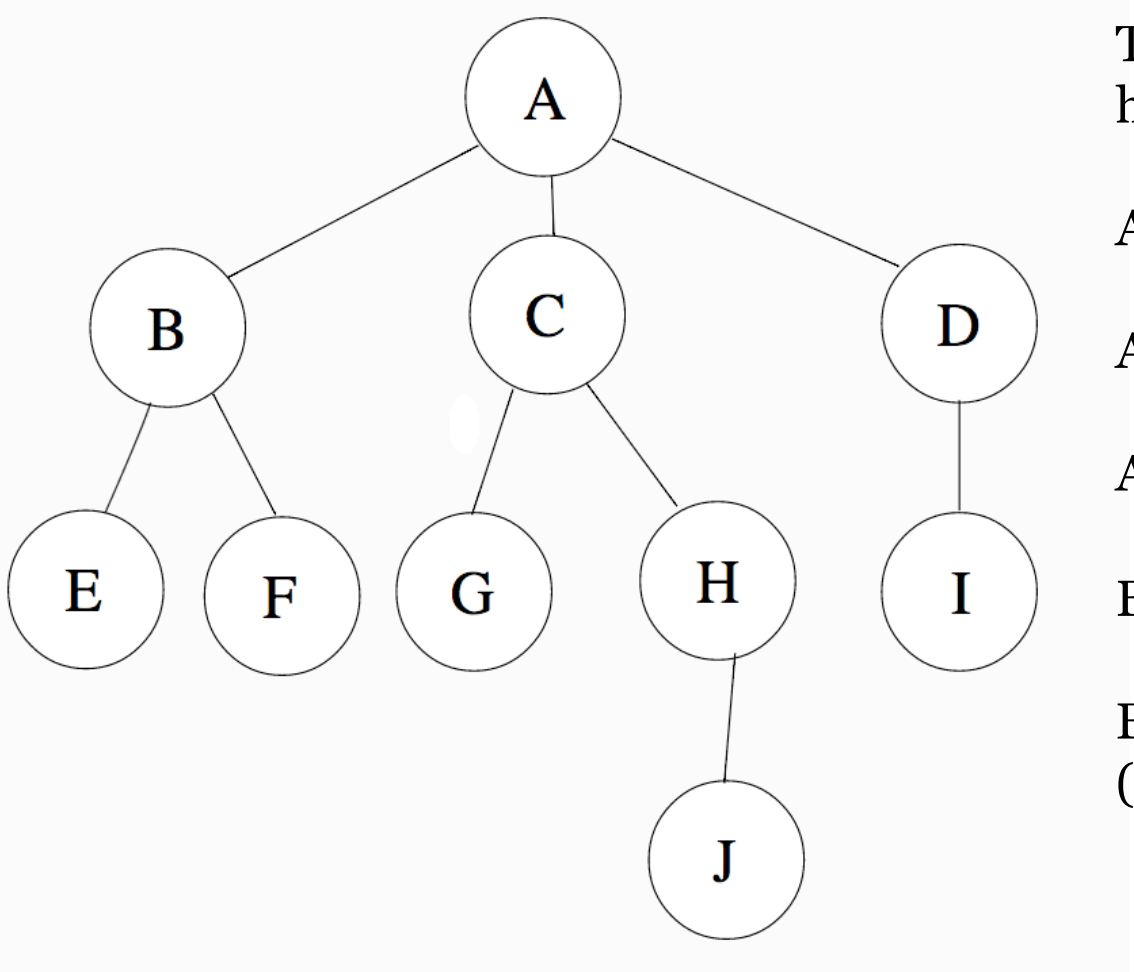
- Demo: `default_parameters.py`

Recursion

- To solve a problem, identify how it can be broken down into smaller instances with the same structure.
- A *recursive function* is a function that calls itself.
- Any problem that we can solve with recursion can be solved with iteration (loops) and vice versa.
  - Some problems have simple recursive solutions and complex iterative solutions.
- Demo:
  - Searching a list; reversing a list
- Resources:
  - http://www.cdf.toronto.edu/~csc148h/fall/lectures/recursion/common/recursion.html
  - http://www.cdf.toronto.edu/~csc148h/fall/lectures/recursion/diane/Recursion-wrapup.pdf

Trees

http://www.cdf.toronto.edu/~csc148h/fall/lectures/trees/common/trees.html



Trees can represent data that has a hierarchical structure.

A, B, C … J are *nodes*.

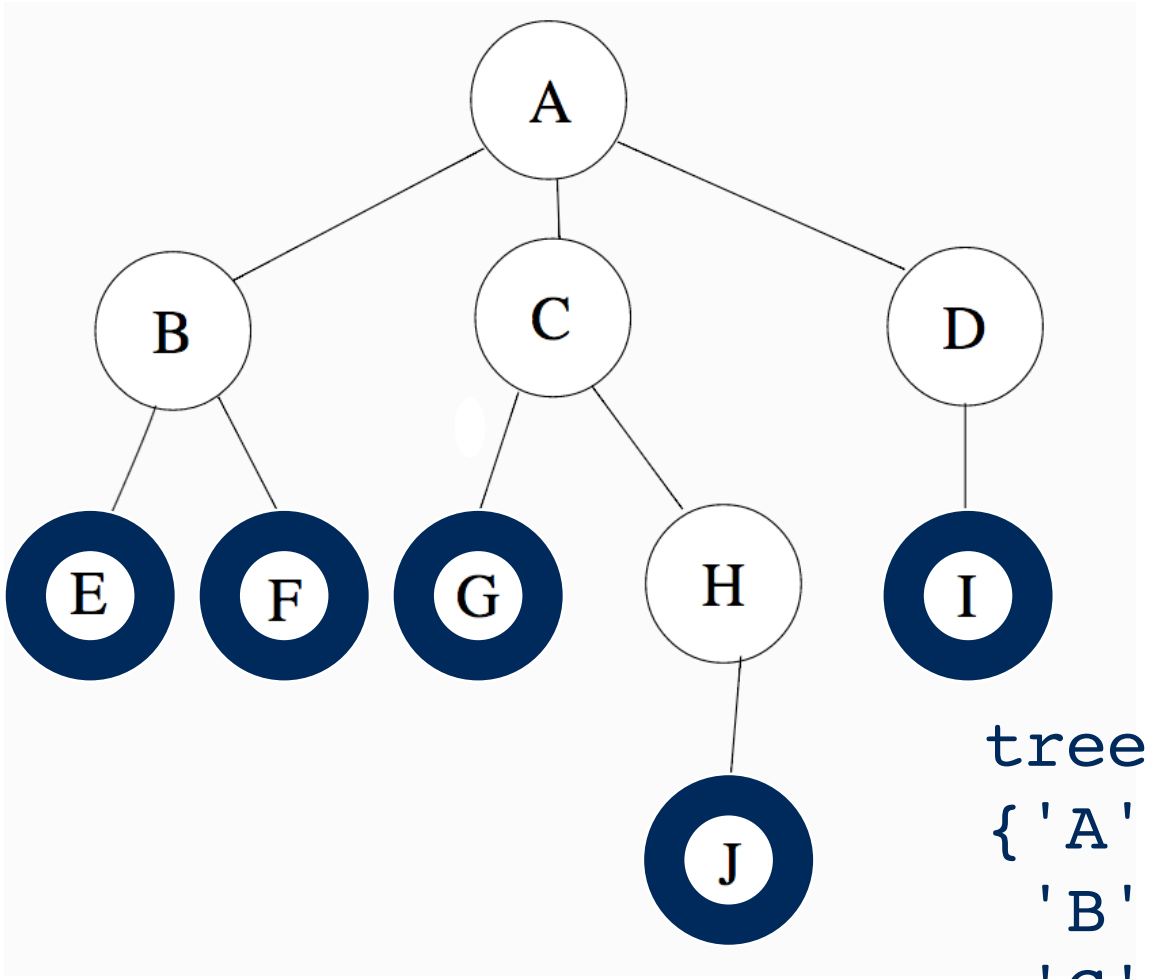
A is the *root* of the tree.

A is the *parent* of B, C, D.

B, C, D are *children* of A.

E, F, G, J, I are *leaf nodes* (nodes with no children).

More recursion: getting leaf nodes



Demo:
tree_recursive.py

```
tree =
{'A': ['B', 'C', 'D'],
 'B': ['E', 'F'],
 'C': ['G', 'H'],
 'H': ['J'],
 'D': ['I']}
```

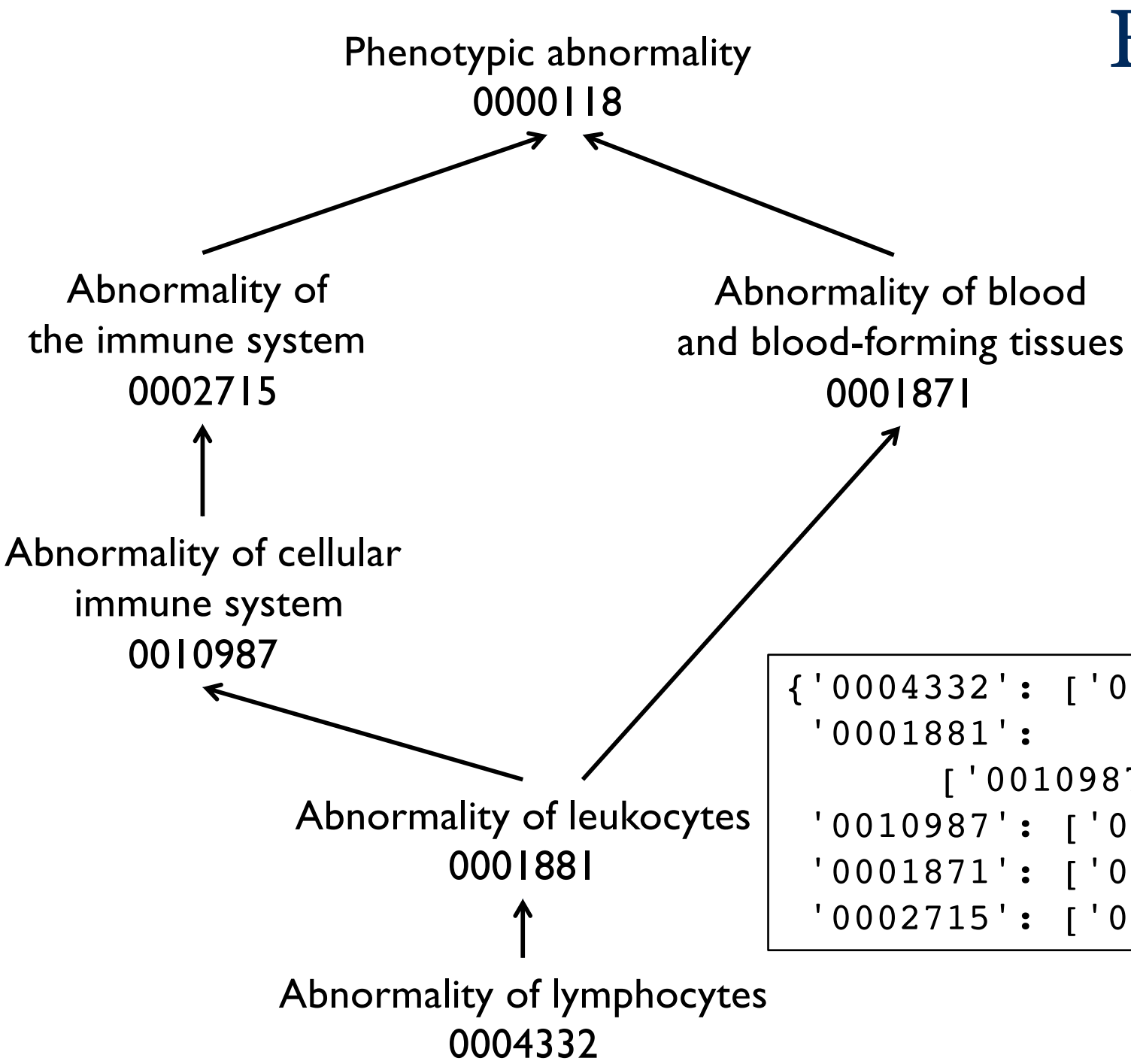
Starter code: class `Ontology`

- You already know how to use Python's classes (e.g., `str` and `list`) and methods (e.g., `str.startswith` and `list.append`).
- In `ontology_parser.py` , a class named `Ontology` is defined.
- For this project, you will use class `Ontology` and call on its methods.
- You do not need to know how to define classes to complete this project. However, if you would like to learn more about object-oriented programming, you may find these videos helpful.

Ontology representation

- The starter code produces two dictionaries to represent the human phenotype ontology:
  - `pid_to_name:` each key is an ID for a phenotypic feature and each value is its name
  - `pid_to_parents:` each key is an ID for a phenotypic feature and each value is a list of its parent IDs

Example




```
{'0004332': ['0001881'],
 '0001881':
       ['0010987','0001871'],
 '0010987': ['0002715'],
 '0001871': ['0000118'],
 '0002715': ['0000118']}
```

Tips

- Test your code as you write it, a little bit at a time.
- Use the Wing debugger, especially when implementing recursive code.
- The `Ontology` class represents the HPO using a dictionary that maps a child node to its parents, unlike the tree dictionary which mapped a parent to its children. If you prefer to have the opposite, you can write a helper function to invert the dictionary.

SUBMITTING PROJECTS

Project submission

- Deadlines: TODAY And February 29th by 6:00pm
- Submission process:
  - Submit on MarkUs:
    - https://markus.teach.cs.toronto.edu/c4m-2016-01
  - Email Jen <campbell@cs.toronto.edu> to specify which project you submitted.
- Getting help:
  - Piazza (https://piazza.com/utoronto.ca/fall2016/c4mph3)
  - Email (campbell@cs.toronto.edu)

FEEDBACK

Phase 3, Seminar 6 Survey

- You will receive an email with the subject
  "C4M: Phase 3, Seminar 6 Feedback Survey".
- Please complete that survey now:
  - https://www.surveymonkey.com/r/C4MSeminar6