

# LING/C SC 581: Advanced Computational Linguistics

Lecture 4

# Today's Topics

- Homework 1 Review
- Python code: `bfs.py`      (*breadth-first search for WordNet*)
- (Quick) Homework 2: install two Python modules

# Homework 1 Review

1. Find the connection between *chair* (noun, sense 1) and *furniture* (noun, sense 1). Show the links (relations).

## Noun

- S: (n) **chair#1** (a seat for one person, with a support for the back) "*he put his coat over the back of the chair and sat down*"
  - [direct hyponym](#) / [full hyponym](#)
  - [part meronym](#)
  - [direct hypernym](#) / [inherited hypernym](#) / [sister term](#)
    - S: (n) **seat#3** (furniture that is designed for sitting on) "*there were not enough seats for all the guests*"
      - [S: \(n\) furniture#1, piece of furniture#1, article of furniture#1](#) (furnishings that make a room or other area ready for occupancy) "*they had too much furniture for the small apartment*"; "*there was only one piece of furniture in the room*"

# Homework 1 Review

2. Find the connection between *amble* (verb, sense 1) and *run* (verb, sense 1). Show the links (relations).

## Verb

- S: (v) [amble#1](#), [mosey#1](#) (walk leisurely)
  - [direct hypernym](#) / [inherited hypernym](#) / [sister term](#)
    - S: (v) [walk#1](#) (use one's feet to advance; advance by steps) "Walk, don't run!"; "We walked instead of driving"; "She walks with a slight limp"; "The patient cannot walk yet"; "Walk over to the cabinet"
      - S: (v) [travel#1](#), [go#1](#), [move#1](#), [locomote#1](#) (change location; move, travel, or proceed, also metaphorically) "How fast does your new car go?"; "We travelled from Rome to Naples by bus"; "The policemen went from door to door looking for the suspect"; "The soldiers moved towards the city in an attempt to take it before night fell"; "news travelled fast"

# Homework 1 Review

2. Find the connection between *amble* (verb, sense 1) and *run* (verb, sense 1). Show the links (relations).

## Verb

- S: (v) [travel#1](#), [go#1](#), [move#1](#), [locomote#1](#) (change location; move, travel, or proceed, also metaphorically) "How fast does your new car go?"; "We travelled from Rome to Naples by bus"; "The policemen went from door to door looking for the suspect"; "The soldiers moved towards the city in an attempt to take it before night fell"; "news travelled fast"
  - [direct troponym](#) / [full troponym](#)
- S: (v) [go around#2](#), [spread#6](#), [circulate#1](#) (become widely known and passed on) "the rumor spread"; "the story went around in the office"

...

- S: (v) [travel rapidly#1](#), [speed#3](#), [hurry#1](#), [zip#2](#) (move very fast) "The runner zipped past us at breakneck speed"
  - [direct troponym](#) / [full troponym](#)
    - S: (v) [flit#1](#), [flutter#1](#), [fleet#1](#), [dart#1](#) (move along rapidly and lightly; skim or dart) "The hummingbird flitted among the branches"
    - S: (v) [run#1](#) (move fast by using one's feet, with one foot off the ground at any given time) "Don't run--you'll be out of breath"; "The children ran to the store"
    - S: (v) [zoom#1](#), [zoom along#1](#), [whizz#2](#), [whizz along#1](#) (move along very quickly)

# Homework 1 Review

3. Find a connection between *dirty* (verb) and *dirty* (adjective). Which senses? Show the links (relations).

## Verb

- S: (v) [dirty#1](#), [soil#1](#), [begrime#1](#), [grime#1](#), [colly#1](#), [bemire#1](#) (make soiled, filthy, or dirty) "don't soil your clothes when you play outside!"
  - [direct troponym](#) / [full troponym](#)
  - [direct hypernym](#) / [inherited hypernym](#) / [sister term](#)
  - [antonym](#)
  - [derivationally related form](#)
    - W: (n) [dirtying#1](#) [Related to: [dirty](#)] (the act of soiling something)
    - W: (n) [soil#1](#) [Related to: [soil](#)] (the state of being covered with unclean things)
      - [derivationally related form](#)
      - [Overview](#)
      - [synset](#)
        - S: (n) [dirt#2](#), [filth#2](#), [grime#1](#), [soil#1](#), [stain#3](#), [grease#2](#), [grunge#1](#) (the state of being covered with unclean things)
    - W: (n) [soilure#1](#) [Related to: [soil](#)] (the act of soiling something)
    - W: (n) [soiling#1](#) [Related to: [soil](#)] (the act of soiling something)
    - W: (n) [grime#1](#) [Related to: [grime](#)] (the state of being covered with unclean things)

# Homework 1 Review

3. Find a connection between *dirty* (verb) and *dirty* (adjective). Which senses? Show the links (relations).

## Noun

- S: (n) soil#2, dirt#1 (the part of the earth's surface consisting of humus and disintegrated rock)
- S: (n) dirt#2, filth#2, grime#1, soil#1, stain#3, grease#2, grunge#1 (the state of being covered with unclean things)
  - *direct hypernym / inherited hypernym / sister term*
  - *derivationally related form*
    - W: (adj) dirty#4 [Related to: dirt] (spreading pollution or contamination; especially radioactive contamination) "the air near the foundry was always dirty"; "a dirty bomb releases enormous amounts of long-lived radioactive fallout"
    - W: (adj) dirty#1 [Related to: dirt] (soiled or likely to soil with dirt or grime) "dirty unswept sidewalks"; "a child in dirty overalls"; "dirty slums"; "piles of dirty dishes"; "put his dirty feet on the clean sheet"; "wore an unclean shirt"; "mining is a dirty job"; "Cinderella did the dirty work while her sisters preened themselves"
    - W: (adj) filthy#1 [Related to: filth] (disgustingly dirty; filled or smeared with offensive matter) "as filthy as a pigsty"; "a foul pond"; "a nasty pigsty of a room"

# Homework 1 Review

3. Find a connection between *dirty* (verb) and *dirty* (adjective). Which senses? Show the links (relations).

- Not the shortest, but also semantically plausible?
  1. *dirty*#v# has hyponym *pollute*#v#1
  2. *pollute*#v#1 derivationally related to *pollution*#n#2
  3. *pollution*#n#2 has hypernym *dirtiness*#n#1
  4. *dirtiness*#n#1 derivationally related to *dirty*#a#1

# Homework 1 Review

3. Find a connection between *dirty* (verb) and *dirty* (adjective). Which senses? Show the links (relations).

## Verb

- S: (v) [dirty#1](#), [soil#1](#), [begrim#1](#), [grime#1](#), [colly#1](#),  [bemire#1](#) (make soiled, filthy, or dirty) "don't soil your clothes when you play outside!"
  - [direct troponym](#) / [full troponym](#)
    - S: (v) [foul#6](#) (make unclean) "foul the water"
    - S: (v) [pollute#1](#), [foul#2](#), [contaminate#1](#) (make impure) "The industrial wastes polluted the lake"
    - S: (v) [smear#1](#) (stain by smearing or daubing with a dirty substance)
    - S: (v) [slime#1](#) (cover or stain with slime) "The snake slimed his victim"
    - S: (v) [muddy#1](#), [muddy up#1](#) (dirty with mud)
    - S: (v) [splash#6](#) (soil or stain with a splashed liquid)
    - S: (v) [mire#4](#), [muck#3](#), [mud#1](#), [muck up#2](#) (soil with mud, muck, or mire) "The child mucked up his shirt while playing ball in the garden"
    - S: (v) [crock#2](#) (soil with or as with crock)
    - S: (v) [blemish#2](#), [spot#3](#) (mar or impair with a flaw) "her face was blemished"

# Homework 1 Review

3. Find the connection between *dirty* (verb) and *dirty* (adjective). Which senses? Show the links (relations).

- S: (v) pollute#1, foul#2, contaminate#1 (make impure) "The industrial wastes *polluted* the lake"
  - direct troponym / full troponym
  - direct hypernym / inherited hypernym / sister term
  - derivationally related form
    - W: (n) pollution#2 [Related to: pollute] (the state of being polluted)
    - W: (n) pollution#1 [Related to: pollute] (undesirable state of the natural environment being contaminated with harmful substances as a consequence of human activities)
- • •

# Homework 1 Review

3. Find the connection between *dirty* (verb) and *dirty* (adjective). Which senses? Show the links (relations).

## Noun

- S: (n) pollution#1 (undesirable state of the natural environment being contaminated with harmful substances as a consequence of human activities)
- S: (n) befoulement#1, defilement#1, pollution#2 (the state of being polluted)
  - *direct hypernym / inherited hypernym / sister term*
    - S: (n) dirtiness#1, uncleanliness#1 (the state of being unsanitary)
    - *derivationally related form*
- S: (n) contamination#3, pollution#3 (the act of contaminating or polluting; including (either intentionally or accidentally) unwanted substances or factors)

# Homework 1 Review

3. Find the connection between *dirty* (verb) and *dirty* (adjective). Which senses? Show the links (relations).

## Noun

- S: (n) **dirtiness#1**, **uncleanliness#1** (the state of being unsanitary)
  - *direct hyponym* / *full hyponym*
  - *direct hypernym* / *inherited hypernym* / *sister term*
  - *antonym*
  - *derivationally related form*
    - W: (adj) **dirty#5** [Related to: **dirtiness**] (contaminated with infecting organisms) "dirty wounds"; "obliged to go into infected rooms"—Jane Austen
    - W: (adj) **dirty#1** [Related to: **dirtiness**] (soiled or likely to soil with dirt or grime) "dirty unswept sidewalks"; "a child in dirty overalls"; "dirty slums"; "piles of dirty dishes"; "put his dirty feet on the clean sheet"; "wore an unclean shirt"; "mining is a dirty job"; "Cinderella did the dirty work while her sisters preened themselves"
    - W: (adj) **unclean#1** [Related to: **uncleanliness**] (soiled or likely to soil with dirt or grime) "dirty unswept sidewalks"; "a child in dirty overalls"; "dirty slums"; "piles of dirty dishes"; "put his dirty feet on the clean sheet"; "wore an unclean shirt"; "mining is a dirty job"; "Cinderella did the dirty work while her sisters preened themselves"

# Homework 1 Review

- 12 senses of *dirty* as an adjective!

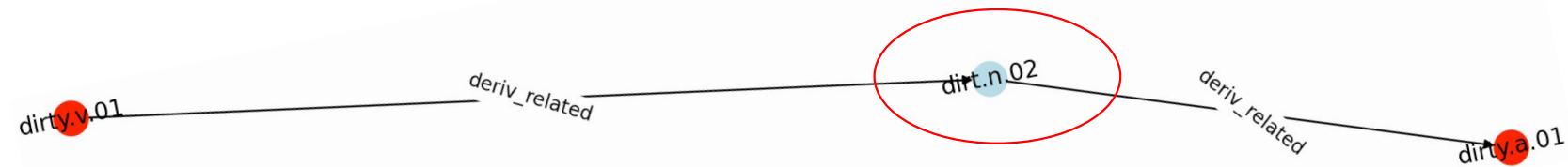
## Adjective

- S: (adj) dirty#1, soiled#1, unclean#1 (soiled or likely to soil with dirt or grime) "dirty unswept sidewalks"; "a child in dirty overalls"; "dirty slums"; "piles of dirty dishes"; "put his dirty feet on the clean sheet"; "wore an unclean shirt"; "mining is a dirty job"; "Cinderella did the dirty work while her sisters preened themselves"
- S: (adj) dirty#2 ((of behavior or especially language) characterized by obscenity or indecency) "dirty words"; "a dirty old man"; "dirty books and movies"; "boys telling dirty jokes"; "has a dirty mouth"
- S: (adj) dirty#3, filthy#2, lousy#3 (vile; despicable) "a dirty (or lousy) trick"; "a filthy traitor"
- S: (adj) dirty#4, contaminating#1 (spreading pollution or contamination; especially radioactive contamination) "the air near the foundry was always dirty"; "a dirty bomb releases enormous amounts of long-lived radioactive fallout"
- S: (adj) dirty#5, pestiferous#1 (contaminated with infecting organisms) "dirty wounds"; "obliged to go into infected rooms"—Jane Austen

- S: (adj) dirty#6, dingy#2, muddied#1, muddy#3 ((of color) discolored by impurities; not bright and clear) "dirty" is often used in combination; "a dirty (or dingy) white"; "the muddied grey of the sea"; "muddy colors"; "dirty-green walls"; "dirty-blonde hair"
- S: (adj) dirty#7, foul#5, marked-up#1 ((of a manuscript) defaced with changes) "foul (or dirty) copy"
- S: (adj) dirty#8, ill-gotten#1 (obtained illegally or by improper means) "dirty money"; "ill-gotten gains"
- S: (adj) dirty#9 (expressing or revealing hostility or dislike) "dirty looks"
- S: (adj) cheating#2, dirty#10, foul#3, unsporting#1, unsportsmanlike#1 (violating accepted standards or rules) "a dirty fighter"; "used foul means to gain power"; "a nasty unsporting serve"; "fined for unsportsmanlike behavior"
- S: (adj) dirty#11, sordid#2, shoddy#2 (unethical or dishonest) "dirty police officers"; "a sordid political campaign"; "shoddy business practices"
- S: (adj) dirty#12 (unpleasantly stormy) "there's dirty weather in the offing"

# Homework 1 Review

4. Would you expect to find a similar connection (to Q3) between *clean* (verb) and *clean* (adjective)?



# Homework 1 Review

4. Would you expect to find a similar connection (to Q3) between *clean* (verb) and *clean* (adjective)?

Verb	10 senses!	Adjective	18 senses!
	<ul style="list-style-type: none"><li>S: (v) <a href="#">clean#1, make clean#1</a> (make clean by removing dirt, filth, or unwanted substances from) "Clean the stove!"; "The dentist cleaned my teeth"</li><li>S: (v) <a href="#">clean#2, pick#6</a> (remove unwanted substances from, such as feathers or pits) "Clean the turkey"</li><li>S: (v) <a href="#">houseclean#1, clean house#1</a>, <a href="#">clean#3</a> (clean and tidy up the house) "She housecleans every week"</li><li>S: (v) <a href="#">cleanse#1</a>, <a href="#">clean#4</a> (clean one's body or parts thereof, as by washing) "clean up before you see your grandparents"; "clean your fingernails before dinner"</li><li>S: (v) <a href="#">clean#5</a> (be cleanable) "This stove cleans easily"</li><li>S: (v) <a href="#">clean#6</a> (deprive wholly of money in a gambling game, robbery, etc.) "The other players cleaned him completely"</li><li>S: (v) <a href="#">clean#7, strip#7</a> (remove all contents or possession from, or empty completely) "The boys cleaned the sandwich platters"; "The trees were cleaned of apples by the storm"</li><li>S: (v) <a href="#">clean#8</a> (remove while making clean) "Clean the spots off the rug"</li><li>S: (v) <a href="#">scavenge#4</a>, <a href="#">clean#9</a> (remove unwanted substances from)</li><li>S: (v) <a href="#">clean#10</a> (remove shells or husks from) "clean grain before milling it"</li></ul>	<ul style="list-style-type: none"><li>S: (adj) <a href="#">clean#1</a> (free from dirt or impurities; or having clean habits) "children with clean shining faces"; "clean white shirts"; "clean dishes"; "a spotlessly clean house"; "cats are clean animals"</li><li>S: (adj) <a href="#">clean#2, clear#12</a> (free of restrictions or qualifications) "a clean bill of health"; "a clear winner"</li><li>S: (adj) <a href="#">clean#3, clear#7, light#10, unclouded#1</a> ((of sound or color) free from anything that dulls or dims) "efforts to obtain a clean bass in orchestral recordings"; "clear laughter like a waterfall"; "clear reds and blues"; "a light lilting voice like a silver bell"</li><li>S: (adj) <a href="#">clean#4, fresh#10</a> (free from impurities) "clean water"; "fresh air"</li><li>S: (adj) <a href="#">clean#5</a> ((of a record) having no marks of discredit or offense) "a clean voting record"; "a clean driver's license"</li><li>S: (adj) <a href="#">clean#6</a> (ritually clean or pure)</li><li>S: (adj) <a href="#">clean#7, uncontaminating#1</a> (not spreading pollution or contamination; especially radioactive contamination) "a clean fuel"; "cleaner and more efficient engines"; "the tactical bomb is reasonably clean"</li><li>S: (adj) <a href="#">clean#8, unobjectionable#1</a> ((of behavior or especially language) free from objectionable elements; fit for all observers) "good clean fun"; "a clean joke"</li><li>S: (adj) <a href="#">uninfected#1, clean#9</a> (free from sepsis or infection) "a clean (or uninfected) wound"</li></ul>	

# Homework 2

Install NetworkX and pygraphviz modules

- Do it to run my program `bfs.py`

# NetworkX

- <https://networkx.github.io/documentation/stable/index.html>

## Overview of NetworkX

NetworkX is a Python package for the creation, manipulation, and study of the structure, dynamics, and functions of complex networks.

```
>>> import networkx as nx  
>>> G = nx.Graph()
```

```
>>> G.add_node(1)
```

```
>>> G.add_edge(1, 2)  
>>> e = (2, 3)  
>>> G.add_edge(*e) # unpack edge tuple*
```

```
G.number_of_nodes()  
G.number_of_edges()  
>>> G.nodes  
NodeView(('1', '2'))  
>>> list(G.nodes)  
['1', '2']
```

# NetworkX

- <https://networkx.github.io/documentation/stable/index.html>

## Overview of NetworkX

NetworkX is a Python package for the creation, manipulation, and study of the structure, dynamics, and functions of complex networks.

```
pip3 install networkx
Collecting networkx
  Downloading networkx-2.4-py3-none-any.whl (1.6 MB)
    |████████| 1.6 MB 1.2 MB/s
Collecting decorator>=4.3.0
  Downloading decorator-4.4.2-py2.py3-none-any.whl (9.2 kB)
Installing collected packages: decorator, networkx
Successfully installed decorator-4.4.2 networkx-2.4
```

# Pygraphviz

<https://pygraphviz.github.io/documentation/stable/install.html>

The screenshot shows the 'Install' section of the PyGraphviz documentation. On the left, there's a sidebar with links to 'Project Homepage', 'Source Code', 'PyGraphviz 1.8', a search bar, and navigation options like 'Install', 'Recommended', 'Advanced', 'FAQ', 'Tutorial', 'Gallery', 'Reference', and 'Contributor Guide'. The main content area has a header 'Install' and a sub-header 'PyGraphviz requires:' followed by a bulleted list: 'Python (version 3.8, 3.9, or 3.10)', 'Graphviz (version 2.42 or later)', and 'C/C++ Compiler'. Below this is a 'Note' section with the text 'These instructions assume you have Python and a C/C++ Compiler on your computer.' A 'Warning' section at the bottom cautions against using the default channels and recommends the conda-forge channel, with the command 'conda install --channel conda-forge pygraphviz' shown. It also lists compatibility status for 'conda-forge-ubuntu', 'conda-forge-macos', and 'conda-forge-windows'.

Project Homepage | Source Code

PyGraphviz 1.8

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FAQ

Tutorial

Gallery

Reference

Contributor Guide

» Install

## Install

PyGraphviz requires:

- Python (version 3.8, 3.9, or 3.10)
- Graphviz (version 2.42 or later)
- C/C++ Compiler

**Note**

These instructions assume you have Python and a C/C++ Compiler on your computer.

**Warning**

Do not use the default channels to install pygraphviz with `conda`. The `conda-forge` channel should be used instead:

```
conda install --channel conda-forge pygraphviz
```

- conda-forge-ubuntu passing
- conda-forge-macos passing
- conda-forge-windows passing

- a 2D graphics layout package (pre-dates Python)

# Pygraphviz

## Windows

Historically, installing Graphviz and PyGraphviz on Windows has been challenging.

Fortunately, the Graphviz developers are working to fix this and their recent releases have much improved the situation.

For this reason, PyGraphviz 1.7 only supports Graphviz 2.46.0 or higher on Windows. We recommend either manually installing the official binary release of Graphviz or using [Chocolatey](#), which has been updated to Graphviz 2.46.0.

You may also need to install Visual C/C++, e.g. from here:

<https://visualstudio.microsoft.com/visual-cpp-build-tools/>

Assuming you have Python and Visual C/C++ installed, we believe the following should work on Windows 10 (64 bit) using PowerShell.

# Pygraphviz

## macOS

We recommend installing Graphviz using the Homebrew package manager or MacPorts for macOS.

### Homebrew

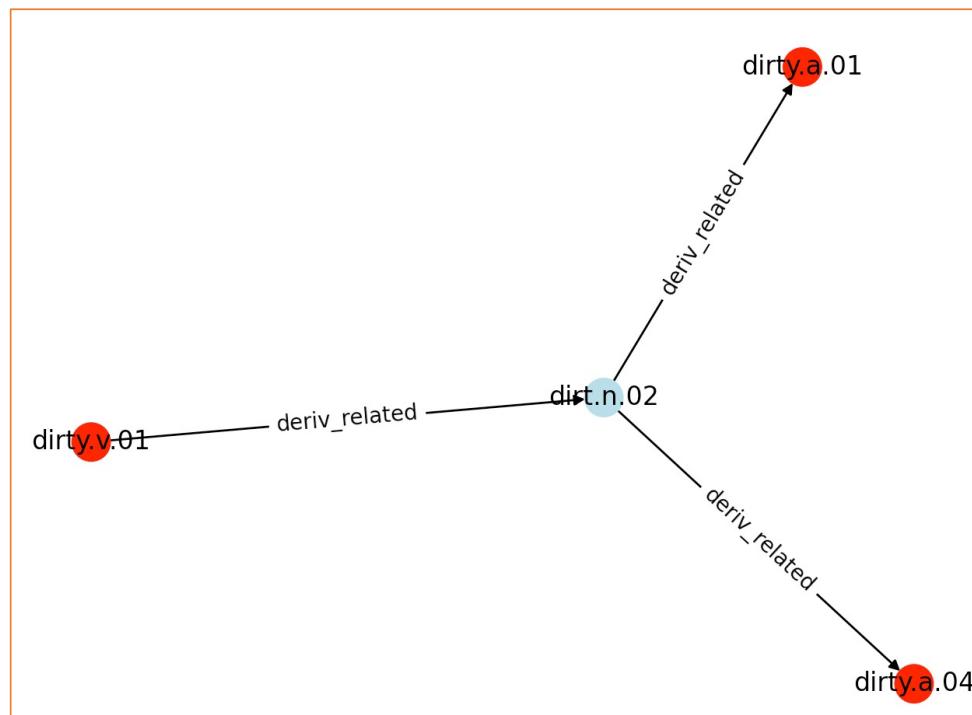
```
$ brew install graphviz  
$ pip install pygraphviz
```

### MacPorts

```
$ port install graphviz  
$ pip install pygraphviz  
$ pip install --global-option=build_ext \  
    --global-option="-I/opt/local/include/" \  
    --global-option="-L/opt/local/lib/" \  
    pygraphviz
```

# Pygraphviz

```
python3 bfs.py dirty.v.01 dirty.a.4 dirty.v.01 dirty.a.1
```



# bfs.py

```
1# Example of breadth-first search of WordNet relations in Python,¶
2# based on my single-threaded Perl code: bfs4.perl¶
3# Sandiway Fong, University of Arizona (2021)¶
4#¶
5# usage: python3 bfs.py word.pos.sense word.pos.sense [-m max]¶
6# synopsis: finds the shortest semantic links between two word senses¶
7# looks for all paths of minimum length (up to max number of nodes visited)¶
8# prints the list of relations connecting the two word senses¶
9# nltk format:¶
10# Synset: word.pos.nn, nn = sense number, e.g. minibike.n.01¶
11# Lemma: word.pos.nn.lemma, e.g. minibike.n.01.motorbike¶
12¶
13import math¶
14from collections import deque¶
15import itertools¶
16import networkx as nx¶
17from networkx.drawing.nx_agraph import graphviz_layout¶
18import matplotlib.pyplot as plt¶
19import argparse¶
```

# bfs.py

**python3 bfs.py --help**

usage: bfs.py [-h] [-nd] [-m MAX] start end [others ...]

breadth-first search of nltk WordNet relations with 2D and 3D graphing.

positional arguments:

start word sense pair start

end word sense pair end

others optional additional pairs to search

optional arguments:

-h, --help show this help message and exit

-nd, --nodraw don't draw anything, use with -i flag to drop into the interpreter.

-m MAX, --max MAX maximum number of nodes to be explored (default: 100000)

Word sense: word.pos.sense, e.g. minibike.n.01 or minibike.n.1; pos = [asrnv]

Run in interactive mode (-i): use lookup(sense1, sense2) then search() to add to the graph. Plot using draw\_graph().

# nltk wordnet

pos=wn.VERB The other parts of speech are NOUN, ADJ and ADV

`synsets(lemma, pos=None, lang='eng', check_exceptions=True)`

[source]

Load all synsets with a given lemma and part of speech tag. If no pos is specified, all synsets for all parts of speech will be loaded. If lang is specified, all the synsets associated with the lemma name of that language will be returned.

```
>>> import nltk
>>> from nltk.corpus import wordnet as wn
>>> wn.synsets('clean', pos=wn.VERB)
[Synset('clean.v.01'), Synset('clean.v.02'), Synset('houseclean.v.01'),
Synset('cleanse.v.01'), Synset('clean.v.05'), Synset('clean.v.06'), Synset('clean.v.07'),
Synset('clean.v.08'), Synset('scavenge.v.04'), Synset('clean.v.10')]
>>> wn.synsets('clean', pos=wn.ADJ)
[Synset('clean.a.01'), Synset('clean.s.02'), Synset('clean.s.03'), Synset('clean.s.04'),
Synset('clean.s.05'), Synset('clean.a.06'), Synset('clean.a.07'), Synset('clean.a.08'),
Synset('uninfected.s.01'), Synset('clean.s.10'), Synset('clean.s.11'),
Synset('blank.s.01'), Synset('clean.s.13'), Synset('clean.s.14'), Synset('clean.s.15'),
Synset('clean.s.16'), Synset('clean.s.17'), Synset('clean.s.18')]
```

# bfs.py

- There are two functions that initialize the search

```
46def lookup(sense1, sense2):          # look up word senses in WordNet¶
47    global start¶
48    try:¶
49        start = wn.synset(sense1)¶
50    except Exception:¶
51        print("Can't find {}".format(sense1))¶
52        return False¶
53    global end¶
54    try:¶
55        end = wn.synset(sense2)¶
56    except Exception:¶
57        print("Can't find {}".format(sense2))¶
58        return False¶
59    global sname¶
60    sname = start.name()¶
61    global ename¶
62    ename = end.name()¶
63    print('start:', args.start, 'is in synset', sname, '\nend: ', ¶
64        args.end, 'is in synset', ename)¶
65    global sname_list¶
66    sname_list.append(sname)¶
67    global ename_list¶
68    ename_list.append(ename)¶
69    return True¶
```

sense1 = start, e.g. 'dirty.v.01'  
sense2 = end

```
71def lookup2(ss1, ss2):           # already looked up synsets ss1,2¶
72    global start¶
73    start = ss1¶
74    global end¶
75    end = ss2¶
76    global sname¶
77    sname = start.name()¶
78    global ename¶
79    ename = end.name()¶
80    print('start:', sname, '\nend: ', ename)¶
81    global sname_list¶
82    sname_list.append(sname)¶
83    global ename_list¶
84    ename_list.append(ename)¶
85    return True¶
```

ss1 = start synset  
ss2 = end synset

just for this class

# bfs.py

```
python3 -i bfs.py clean.v.1 clean.a.1
start: clean.v.1 is in synset clean.v.01
end: clean.a.1 is in synset clean.a.01
Not found (distance 4 and 100234 nodes
expanded)
>>> list1 = wn.synsets('dirty', pos=wn.VERB)
>>> list2 = wn.synsets('dirty', pos=wn.ADJ)
>>> for s1 in list1:
...     for s2 in list2:
...         lookup2(s1, s2)
...         search()
...
...
```

