

LING/C SC 581:

Advanced Computational Linguistics

Lecture 5

Administrivia

- `bfs.py` has been updated (*fixed a printing error*)
- has everyone been able to install NetworkX and pygraphviz?

Today's Topics

- Homework 3
- An application of WordNet:
 - A look at *Semantic Opposition*

Homework 3

Let's experiment with a quite *open-ended* homework. Take care to explain your choices.

- The verb *leave* is polysemous
- For example, according to Levin's (1993) *English Verb Classes and Alternations*:

15.2 *Keep* Verbs

Class Members: hoard, keep, **leave**, store

Properties:

- (218) a. Michelle kept the papers in the desk.
b. Michelle kept the papers behind/over/under the desk.
- (219) *Locative Alteration:
 - a. Michelle kept the papers in the desk.
 - b. *Michelle kept the desk with the papers.
- (220) Zero-related Nominal (some verbs):
 - a hoard
 - a store

Comments: These verbs relate to maintaining something at some location. They do not describe the actual putting of an entity at this location.

51.2 *Leave* Verbs

Class Members: abandon, desert, **leave**

Properties:

- (980) We abandoned the area.
- (981) *We abandoned from the area.
- (982) Adjectival Passive Participle (some verbs):
an abandoned house

Comments: These verbs do not specify a manner of motion; they simply indicate that motion away from a location has taken place. The direct object of these verbs is understood to be the location that has been left. The location cannot be expressed in a prepositional phrase.

Homework 3

- Question 1: which WordNet senses of *leave* most closely accord with Levin's class 15.2 and 51.2, respectively? Explain.

Homework 3

In the case of Levin's class 51.2,

- Question 2: other two members of the class are *abandon* and *desert*. Identify the senses most relevant to this class. Explain.
- Question 3: using `bfs.py` compute the relations between the senses of *leave*, *abandon* and *desert* identified in Questions 1 and 2. Show the graph(s).
- **Hint:** you may wish to use:
 - `from itertools import combinations`
 - `... combinations(my_list,2) ...`
- Question 4: can you identify any other verbs that belong to this class?

Using WordNet: Example

Event Template Representation

Change of State Verbs:

John mended the *torn/red* dress

mend: x CAUS y BECOME <STATE (*mended*)>

John CAUS the *torn/red* dress BECOME <STATE (*mended*)>

- Antonym relation between adjective and end state

Semantic Opposition: *mend* vs. *tear/torn*

The verb mend has 2 senses (first 2 from tagged texts)

1. (5) repair#1, **mend**#1, fix#1, bushel#1, doctor#3, furbish up#1, restore#4, touch on#3 -- (restore by replacing a part or putting together what is torn or broken; "She repaired her TV set"; "Repair my shoes please")
2. (1) **mend**#2, heal#1 -- (heal or recover; "My broken leg is mending")

The verb tear has 5 senses (first 4 from tagged texts)

1. (19) **tear**#1, rupture#1, snap#2, bust#3 -- (separate or cause to separate abruptly; "The rope snapped"; "tear the paper")
2. (7) **tear**#2 -- (to separate or be separated by force; "planks were in danger of being torn from the crossbars")
3. (2) **tear**#3, shoot#7, shoot down#1, charge#4, buck#3 -- (move quickly and violently; "The car tore down the street"; "He came charging into my office")
4. (1) pluck#5, pull#14, **tear**#4, deplume#2, deplumate#1, displume#2 -- (strip of feathers; "pull a chicken"; "pluck the capon")
5. **tear**#5 -- (fill with tears or shed tears; "Her eyes were tearing")

The adj torn has 2 senses (first 2 from tagged texts)

1. (5) lacerate#2, lacerated#2, mangled#1, **torn**#1 -- (having edges that are jagged from injury)
2. (2) **torn**#2 -- (disrupted by the pull of contrary forces; "torn between love and hate"; "torn by conflicting loyalties"; "torn by religious dissensions")

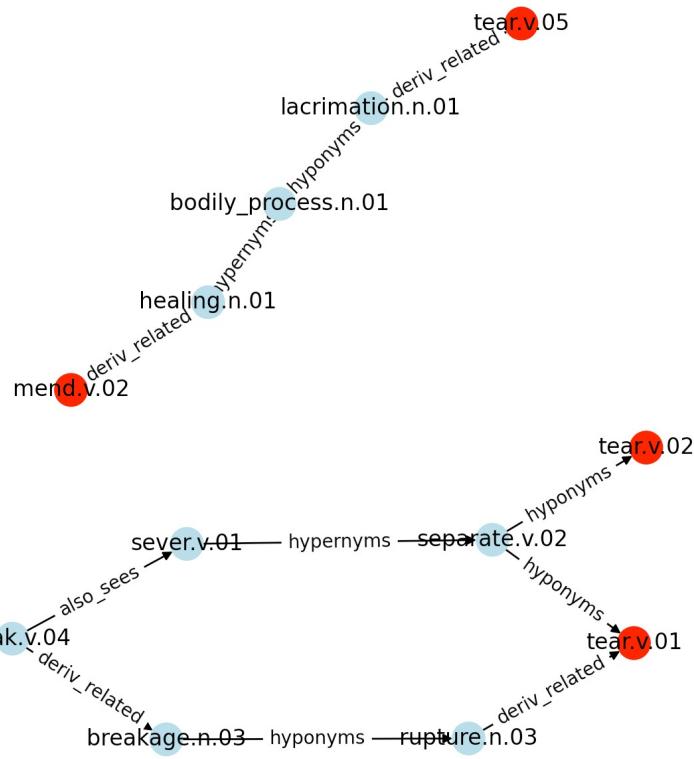
Semantic Opposition: *mend* vs. *tear/torn*

```
python3 -i bfs.py a b
Can't find a!
>>> mend = wn.synsets('mend', pos=wn.VERB)
>>> mend
[Synset('repair.v.01'), Synset('mend.v.02')]
>>> tear = wn.synsets('tear', pos=wn.VERB)
>>> tear
[Synset('tear.v.01'), Synset('tear.v.02'), Synset('tear.v.03'), Synset('pluck.v.05'), Synset('tear.v.05')]
>>> torn = wn.synsets('torn', pos=wn.ADJ)
>>> torn
[Synset('lacerate.s.02'), Synset('torn.s.02')]
>>> for ss1 in mend:
...     for ss2 in tear:
...         lookup2(ss1, ss2)
...         search()
...
Search space complete
DiGraph with 13 nodes and 12 edges
>>> draw_graph()
```

Semantic Opposition: *mend* vs. *tear/torn*

The verb *tear* has 5 senses (first 4 from tagged texts)

1. (19) **tear**#1, rupture#1, snap#2, bust#3 -- (separate or cause to separate abruptly; "The rope snapped"; "tear the paper")
2. (7) **tear**#2 -- (to separate or be separated by force; "planks were in danger of being torn from the crossbars")
3. (2) **tear**#3, shoot#7, shoot down#1, charge#4, buck#3 -- (move quickly and violently; "The car tore down the street"; "He came charging into my office")
4. (1) pluck#5, pull#14, **tear**#4, deplume#2, deplumate#1, displume#2 -- (strip of feathers; "pull a chicken"; "pluck the capon")
5. **tear**#5 -- (fill with tears or shed tears; "Her eyes were tearing")



Semantic Opposition: *mend* vs. *torn*

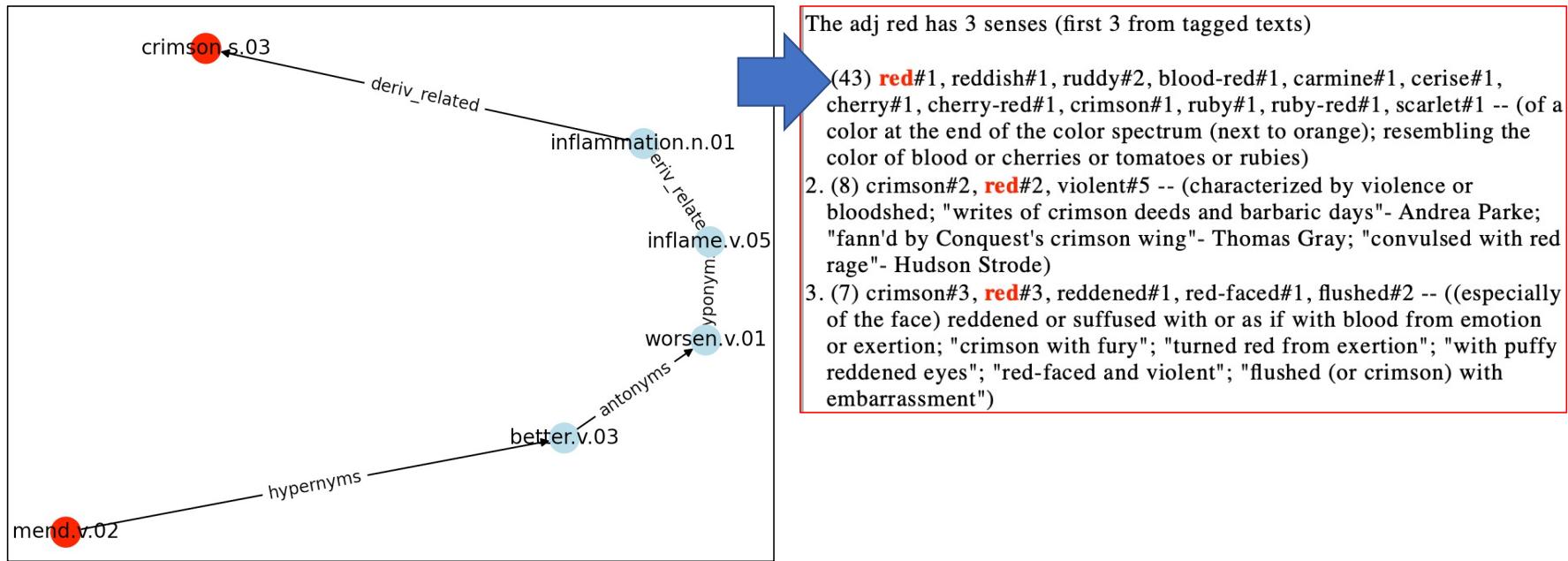
```
>>> for ss1 in mend:  
...     for ss2 in torn:  
...         lookup2(ss1, ss2)  
...         search()  
...  
start: repair.v.01  
end: lacerate.s.02  
True  
Not found (distance 5 and 100021  
nodes expanded)  
start: repair.v.01  
end: torn.s.02  
True  
Not found (distance 5 and 100021  
nodes expanded)  
start: mend.v.02  
end: lacerate.s.02  
True  
Not found (distance 6 and 100022  
nodes expanded)  
start: mend.v.02  
end: torn.s.02  
True  
Not found (distance 6 and 100022  
nodes expanded)
```

Semantic Opposition: *red* vs. *tear/torn*

```
>>> mend = wn.synsets('mend', pos=wn.VERB)
>>> red = wn.synsets('red', pos=wn.ADJ)
>>> red
[Synset('red.s.01'), Synset('crimson.s.02'), Synset('crimson.s.03')]
>>> for ss1 in mend:
...     for ss2 in red:
...         lookup2(ss1, ss2)
...         search()
...
start: repair.v.01
end:  red.s.01
True
Not found (distance 5 and 100021 nodes expanded)
start: repair.v.01
end:  crimson.s.02
True
Not found (distance 5 and 100021 nodes expanded)
start: repair.v.01
end:  crimson.s.01
True
Not found (distance 5 and 100021 nodes expanded)
```

```
True
Not found (distance 5 and 100021 nodes expanded)
start: mend.v.02
end:  red.s.01
True
Not found (distance 6 and 100022 nodes expanded)
start: mend.v.02
end:  crimson.s.02
True
Not found (distance 6 and 100022 nodes expanded)
start: mend.v.02
end:  crimson.s.03
True
Found at distance 5 (15627 nodes expanded)
crimson.s.03 deriv_related inflammation,n.01 deriv_related inflame.v.05
hyponyms worsen.v.01 antonyms better.v.03 hypernyms mend.v.02
Search space complete
DiGraph with 6 nodes and 5 edges
>>> draw_graph()
```

Semantic Opposition: *red* vs. *tear/torn*



Using WordNet: Example

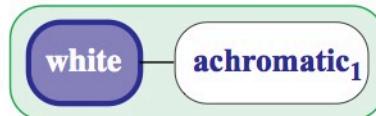
3. Color and Opposition

WORDNET organizes color by chromaticity.

Candidate Pair	Shortest Chain	Semantic Opposition	Search Space
blue-white	-	No*	24431

(WordNet 2.1)

only one sense for achromatic in 3.0



John painted the **red** door **blue**
Mary painted the white tiles grey



Using WordNet: Example

Searches for chromatic: Adjective ▾ Senses: ▾

Sense 3

chromatic (vs. achromatic) -- (being or having or characterized by hue)

- => amber, brownish-yellow, yellow-brown -- (of a medium to dark brownish yellow color)
- => amber-green -- (of green tinged with amber)
- => amethyst -- (of a moderate purple color)
- => auburn -- ((of hair) colored a moderate reddish-brown; "auburn hair")
- => aureate, gilded, gilt, golden -- (having the deep slightly brownish color of gold; "long aureate (or golden) hair"; "a gold carpet")
- => avocado -- (of the dull yellowish green of the meat of an avocado)
- => azure, cerulean, sky-blue, bright blue -- (of a deep somewhat purplish blue color similar to that of a clear October sky; "October's bright blue weather")
- => beige -- (of a light greyish-brown color)
- => blackish-brown -- (of brown tinged with black)
- => blackish-red -- (red tinged with black)
- => blae -- (of bluish-black or grey-blue)
- => blue, bluish, blueish -- (of the color intermediate between green and violet; having a color similar to that of a clear unclouded sky; "October's bright blue weather"- Helen Hunt Jackson; "a blue flame"; "blue haze of tobacco smoke")
- => bluish green, blue-green, cyan, teal -- (of a bluish shade of green)
- => blue-lilac, bluish-lilac -- (of lavender tinged with blue)
- => blue-purple, bluish-purple -- (of purple tinged with blue)
- => blue-violet, bluish-violet -- (of violet tinted with blue)
- => bluishful, rosy -- (of blush color; "blushful mists")
- => bottle-green -- (of a dark to moderate greyish green color)
- => bright-red, raspberry-red -- (of the red of fresh raspberries)
- => bronze, bronzy -- (of the color of bronze)
- => bronze-red -- (of red tinged with bronze)
- => brown, brownish, chocolate-brown, dark-brown -- (of a color similar to that of wood or earth)
- => brown-green, brownish-green -- (of green tinged with brown)
- => brown-purple, brownish-purple -- (of dark purple tinted with brown)
- => buff -- (of the yellowish-beige color of buff leather)
- => buff-brown -- (of brown tinged with buff)
- => canary, canary-yellow -- (having the color of a canary; of a light to moderate yellow)
- => caramel, caramel brown -- (having the color of caramel; of a moderate yellow-brown)
- => carnation -- (pink or pinkish)
- => chartreuse -- (of something having the yellowish green color of Chartreuse liqueur)
- => chestnut -- ((of hair or feathers) of a golden brown to reddish brown color; "a chestnut horse"; "chestnut hair")

"Synonyms" search for adjective "chromatic"

Searches for achromatic: Adjective ▾ Senses: ▾

achromatic (vs. chromatic), neutral -- (having no hue; "neutral colors like black or white")

- => argent, silver, silvery, silverish -- (of lustrous grey; covered with or tinged with the color of silver; "silvery hair")
- => ash-grey, ash-gray, ashy -- (of a light grey)
- => blackish -- (of something that is somewhat black; "blackish clouds")
- => black-grey, black-gray, blackish-grey, blackish-gray -- (of dark grey)
- => blue-white, bluish-white, cool-white -- (of white tinged with blue)
- => blue-grey, blue-gray, bluish-grey, bluish-gray -- (of grey tinged with blue)
- => blue-black, bluish black -- (of black tinged with blue)
- => brown-black, brownish-black -- (of black tinged with brown)
- => brown-grey, brown-gray, brownish-grey, brownish-gray -- (of grey tinged with brown)
- => canescence -- (of greyish white; "the canescence moon")
- => chalky -- (of something having the color of chalk; "she turned chalky white")
- => charcoal, charcoal-grey, charcoal-gray -- (of a very dark grey)
- => coal-black, jet, jet-black, pitchy, sooty -- (of the blackest black; similar to the color of jet or coal)
- => cottony-white -- (of something as white as cotton; "cottony-white clouds")
- => dull-white -- (of a dull shade of white)
- => ebon, ebony -- (of a very dark black)
- => grey, gray, greyish, grayish -- (of an achromatic color of any lightness intermediate between the extremes of white and black; "the little grey cells"; "gray flannel suit"; "a man with greyish hair")
- => grey-black, gray-black, greyish-black, grayish-black -- (of black tinged with grey)
- => grey-white, gray-white, greyish-white, grayish-white -- (of white tinged with grey)
- => greenish-grey, greenish-gray -- (of grey tinged with green)
- => green-white, greenish-white -- (of white flowers tinged with green)
- => hueless -- (of something totally lacking in saturation and therefore having no hue)
- => ink-black, inky, inky-black -- (of the color of black ink)
- => iron-grey, iron-gray -- (of the grey color of iron)
- => lily-white -- (of a pure white color)
- => milk-white -- (of a white the color of fresh milk)
- => olive-grey, olive-gray -- (of grey tinged with olive)
- => oxford-grey, oxford-gray, dark-grey, dark-gray -- (of a dark shade of grey)
- => pearl grey, pearl gray -- (of a grey with a pearly tinge)
- => pearly, pearly-white -- (of a white the color of pearls)
- => pinkish-white -- (of white tinged with pink)
- => purple-black, purplish-black -- (of black tinged with purple)
- => purple-white, purplish-white -- (of white tinged with purple)
- => red-grey, red-gray, reddish-grey, reddish-gray -- (of grey tinged with red)
- => sable -- (of a dark somewhat brownish black)

"Synonyms" search for adjective "achromatic"

Semantic Opposition: *clean* vs. *dirty*

Mary cleaned the <i>dirty</i> table	Change of State
The waiter filled every <i>empty</i> glass	
Mary fixed the <i>flat</i> tire	
Bill swept the <i>dirty</i> floor	Activity
Bill swept the <i>dirty</i> floor clean	Accomplishment
	resultative

The verb clean has 10 senses (first 4 from tagged texts)

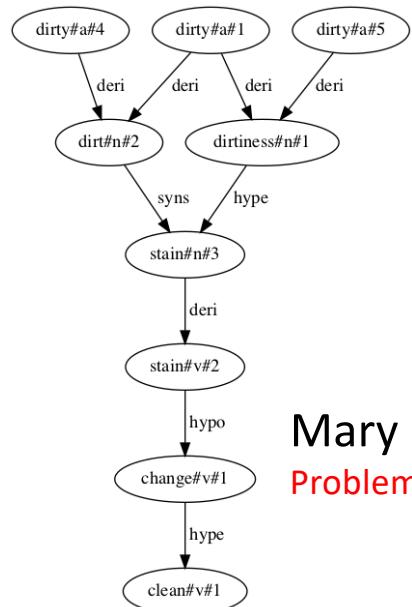
1. (16) **clean**#1, make clean#1 -- (make clean by removing dirt, filth, or unwanted substances from; "Clean the stove!"; "The dentist cleaned my teeth")
2. (3) **clean**#2, pick#6 -- (remove unwanted substances from, such as feathers or pits; "Clean the turkey")
3. (2) houseclean#1, clean house#1, **clean**#3 -- (clean and tidy up the house; "She housecleans every week")
4. (1) cleanse#1, **clean**#4 -- (clean one's body or parts thereof, as by washing; "clean up before you see your grandparents"; "clean your fingernails before dinner")
5. **clean**#5 -- (be cleanable; "This stove cleans easily")
6. **clean**#6 -- (deprive wholly of money in a gambling game, robbery, etc.; "The other players cleaned him completely")
7. **clean**#7, strip#7 -- (remove all contents or possession from, or empty completely; "The boys cleaned the sandwich platters"; "The trees were cleaned of apples by the storm")
8. **clean**#8 -- (remove while making clean; "Clean the spots off the rug")
9. scavenge#4, **clean**#9 -- (remove unwanted substances from)
10. **clean**#10 -- (remove shells or husks from; "clean grain before milling it")

More examples

- *Event-based Models of Change and Persistence in Language* (Pustejovsky, 2000).
- Adapted examples:
 1. The waiter filled every empty glass
 2. Mary fixed the flat tire
 3. Mary fixed the leaky tire
 4. John comforted the crying child
 5. John rescued the drowning man
 6. The nurse mixed the powdered milk
- Which ones work?
- Can you think of others?

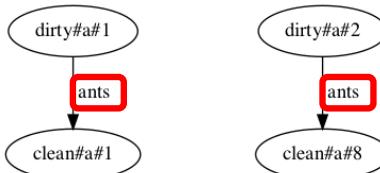
Semantic Opposition: *clean* vs. *dirty*

clean#v ➤ dirty#a



Mary cleaned the dirty table
Problem: no ants (antonym) relation

clean#a ➤ dirty#a



Two cases of direct ants link

clean#a ➤ dirty#a

clean#a: 18 senses

The adj clean has 18 senses (first 5 from tagged texts)

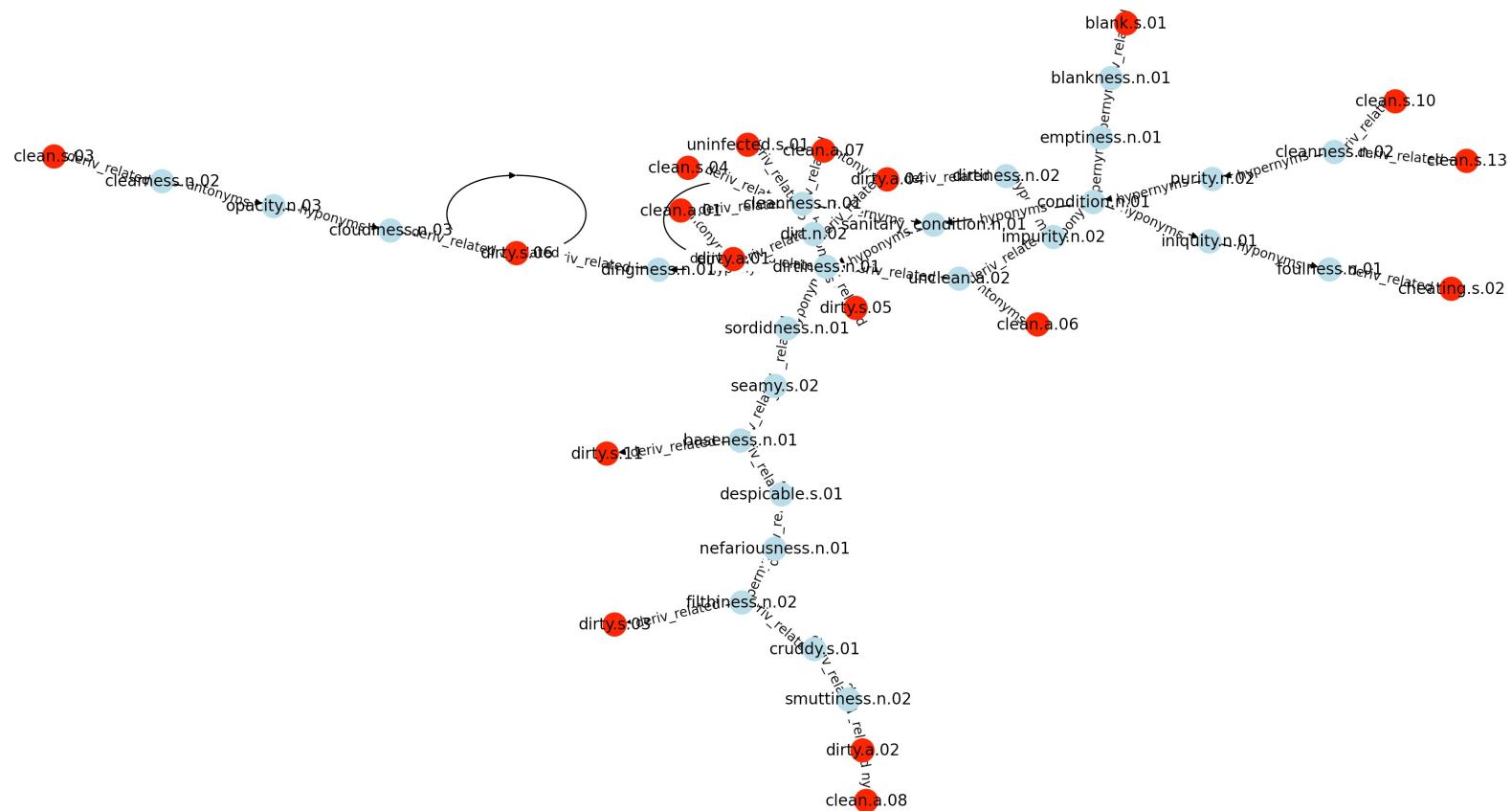
1. (17) **clean** -- (free from dirt or impurities; or having clean habits; "children with clean shining faces"; "clean white shirts"; "clean dishes"; "a spotlessly clean house"; "cats are clean animals")
2. (2) **clean**, clear -- (free of restrictions or qualifications; "a clean bill of health"; "a clear winner")
3. (1) **clean**, clear, light, unclouded -- ((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")
4. (1) **clean**, fresh -- (free from impurities; "clean water"; "fresh air")
5. (1) **clean** -- ((of a record) having no marks of discredit or offense; "a clean voting record"; "a clean driver's license")
6. **clean** -- (ritually clean or pure)
7. **clean**, uncontaminating -- (not spreading pollution or contamination; especially radioactive contamination; "a clean fuel"; "cleaner and more efficient engines"; "the tactical bomb is reasonably clean")
8. **clean**, unobjectionable -- ((of behavior or especially language) free from objectionable elements; fit for all observers; "good clean fun"; "a clean joke")
9. uninfected, **clean** -- (free from sepsis or infection; "a clean (or uninfected) wound")
10. **clean**, clean-living -- (morally pure; "led a clean life")
11. **clean**, fair -- ((of a manuscript) having few alterations or corrections; "fair copy"; "a clean manuscript")
12. blank, **clean**, white -- ((of a surface) not written or printed on; "blank pages"; "fill in the blank spaces"; "a clean page"; "wide white margins")
13. **clean**, sporting, sporty, sportsmanlike -- (exhibiting or calling for sportsmanship or fair play; "a clean fight"; "a sporting solution of the disagreement"; "sportsmanlike conduct")
14. **clean** -- (without difficulties or problems; "a clean test flight")
15. **clean** -- (thorough and without qualification; "a clean getaway"; "a clean sweep"; "a clean break")
16. **clean** -- (not carrying concealed weapons)
17. **clean**, neat -- (free from clumsiness; precisely or deftly executed; "he landed a clean left on his opponent's cheek"; "a clean throw"; "the neat exactness of the surgeon's knife")
18. **clean** -- (free of drugs; "after a long dependency on heroin she has been clean for 4 years")

dirty#a: 12 senses

The adj dirty has 12 senses (first 3 from tagged texts)

1. (12) **dirty**, soiled, unclean -- (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")
2. (2) **dirty** -- ((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")
3. (1) **dirty**, filthy, lousy -- (vile; despicable; "a dirty (or lousy) trick"; "a filthy traitor")
4. **dirty**, contaminating -- (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")
5. **dirty**, pestiferous -- (contaminated with infecting organisms; "dirty wounds"; "obliged to go into infected rooms" - Jane Austen)
6. **dirty**, dingy, muddied, muddy -- ((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")
7. **dirty**, foul, marked-up -- ((of a manuscript) defaced with changes; "foul (or dirty) copy")
8. **dirty**, ill-gotten -- (obtained illegally or by improper means; "dirty money"; "ill-gotten gains")
9. **dirty** -- (expressing or revealing hostility or dislike; "dirty looks")
10. cheating, **dirty**, foul, unsporting, unsportsmanlike -- (violating accepted standards or rules; "a dirty fighter"; "used foul means to gain power"; "a nasty unsporting serve"; "fined for unsportsmanlike behavior")
11. **dirty**, sordid -- (unethical or dishonest; "dirty police officers"; "a sordid political campaign")
12. **dirty** -- (unpleasantly stormy; "there's dirty weather in the offing")

clean#a ➤ dirty#a (all WordNet senses)



clean#a ➤ dirty#a (all WordNet senses)

