CSCI 544 – Applied Natural Language Processing

Homework 7

Due: April 16, 2017, at 23:59 Pacific Time (11:59 PM)

Total: 7 pages, 50 points. This homework counts for 5% of the course grade.
Assignments turned in after the deadline but before April 19 are subject to a 30% grade penalty.

General instructions

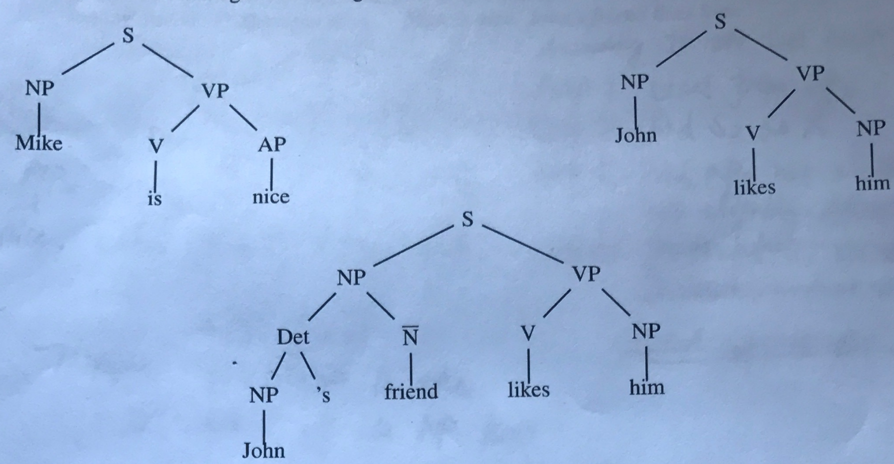
1. Do not write your name on any sheet.
2. Each student receives a personalized download copy of the assignment. You should download, print, write your answers and upload the finished copy only through the link provided.
3. The assignment must be submitted through the personalized link provided. Do not share the link with others. It is linked to your email.
4. Write concisely: enough space is provided to write your answers. Long and rambling answers will be penalized. You cannot add additional sheets.
5. The completed assignments will be accepted only through the online system. In person/email submissions will not be considered.

Simple tree-walking algorithm for pronoun reference resolution. (adapted from Hobbs 1978, Resolving Pronoun References, *Lingua* 44:311–338)

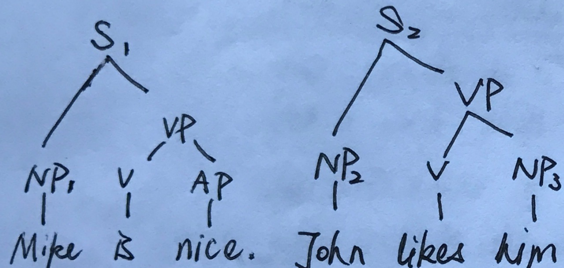
1. Begin at the NP node immediately dominating the pronoun.
2. Go up the tree to the first NP or S node encountered. Call this node X, and call the path used to reach it p.
3. Traverse all branches below node X to the left of path p in a left-to-right, breadth-first fashion. Propose as the antecedent any NP node that is encountered which has an NP or S node between it and X.
4. If node X is the highest S node in the sentence, traverse the surface parse trees of previous sentences in the text in the order of recency, the most recent first; each tree is traversed left-to-right, breadth-first manner, and when an NP node is encountered, it is proposed as antecedent. If X is not the highest S node in the sentence, continue to step 5.

   (We ignore the remainder of the algorithm for now)

Problem 1. Assume a grammar that gives the following parse trees.



a. (5 points) What does the algorithm predict as the antecedent for the pronoun *him* in the following discourse? Show the steps. ***Mike is nice. John likes him.***



According to the tree walking algorithm.

Step 1 start from NP_3

Step 2. Find $X = S_2$

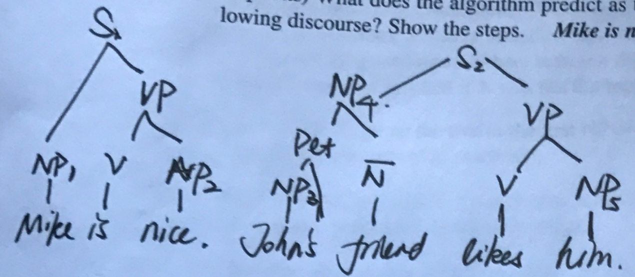
Step 3. NP_2 is not eligible because there is no NP or S node between

Step 4 start from the previous sentence S_1 and conduct breath-first search from the left.

Find NP_1 elagible.

Therefore, NP_1 (Mike) is the antecedent for the pronoun him ~~th the following dis~~

b. (5 points) What does the algorithm predict as the antecedent for the pronoun *him* in the following discourse? Show the steps. ***Mike is nice. John's friend likes him.***



According to the tree walking algorithm

Step 1. start from NP5

Step 2. find S2 as X

Step 3. Find NP4 not eligible. Find NP3 ~~not~~ eligible. ~~Move to Step 4~~

~~Step 4 recognized S1 as the previous sentence, conduct BFS and~~

~~find NP1 is the antecedent~~

Therefore, NP3 (John) ~~NP1 (Mike)~~ is the antecedent of the NP him

c. (5 points) Does the algorithm find the most plausible antecendent in each case? Why or why not?

Not always. if the sentence is change to

"Mike is nice. John's friend Jack from Canada likes him"

Since Canada is N̄ (NP), the algorithm will stop at Step 3 and finds the NP (Jack) eligible ~~for~~ as the antecedent of him

Jack (NP) Canada (NP) him (NP)

Because there might be other NP appear between.

d. (5 points) What is the purpose of the requirement in step 3 that there be an intervening NP or S node between the antecedent and X?

Because generally the English grammar set rule that most of time, sentence goes in the format Subject V Subject. The ~~NP~~ antecedent of a NP doesn't necessarily to be the NP immediately ahead ~~of~~ it, but the NP IS one further ahead.

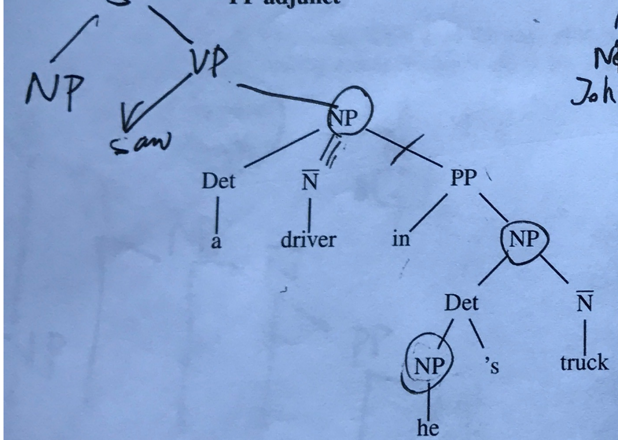
It's a rule interpreted from English grammar on identifying antecedent.

Tree-walking algorithm, continued. We now look at the remainder of Hobbs's algorithm. Note the specific assumptions it makes about syntax, namely that the grammar provides a special non-terminal symbol $\overline{\text{N}}$ (pronounced N-bar) between the NP (noun phrase) and noun level. Recall that the following steps are invoked if X was not the highest S node in the sentence.

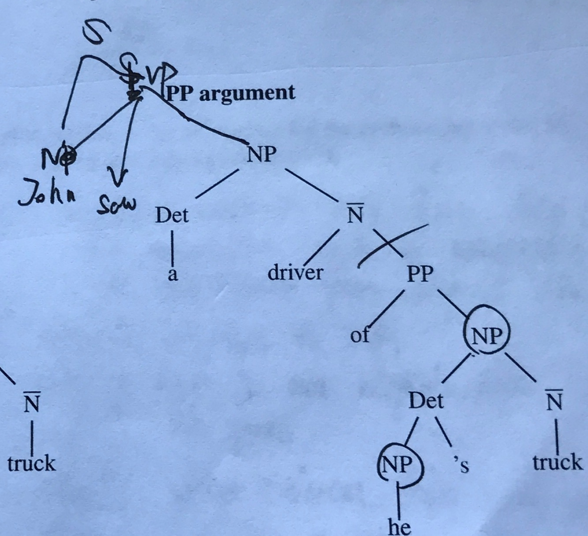
5. From node X, go up the tree to the first NP or S node encountered. Call this new node X, and call the path traversed to reach it p.
6. If X is an NP node and if the path p to X did not pass through the $\overline{\text{N}}$ node that X immediately dominates, propose X as the antecedent.
7. Traverse all branches below node X to the *left* of path p in a left-to-right, breadth-first manner. Propose any NP node encountered as the antecedent.
8. If X is an S node, traverse all branches of node X to the *right* of path p in a left-to-right, breadth-first manner, but do not go below any NP or S node encountered. Propose any NP node encountered as the antecedent.
9. Go to step 4.

The algorithm assumes a difference between structures where a PP (preposition phrase) is an *adjunct* to the noun and structures where a PP is an *argument* of the noun. The respective structures are shown below.

PP adjunct

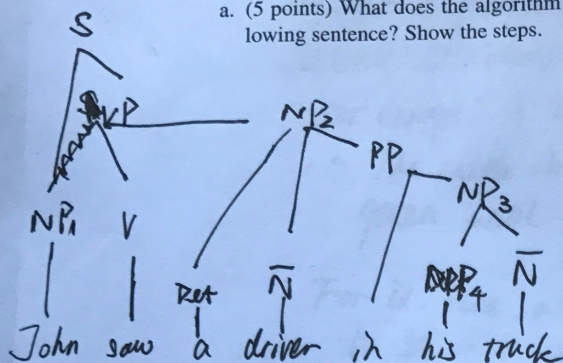


PP argument



Problem 2. Assume a grammar that gives the above structures (with the obvious extension for adding a subject and verb before these structures).

a. (5 points) What does the algorithm predict as the antecedent for the pronoun *his* in the following sentence? Show the steps. ***John saw a driver in his truck.***



From step 1-4. an ancetendent of NP4 can't be identified and we shall start from step 5 while X = NP3

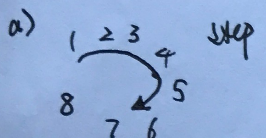
Step 5. X = NP2. X rises to NP2

Step 6. Since X → NP3 doesn't pass any N̄ node NP2 is identified as antecedent.

End of loop

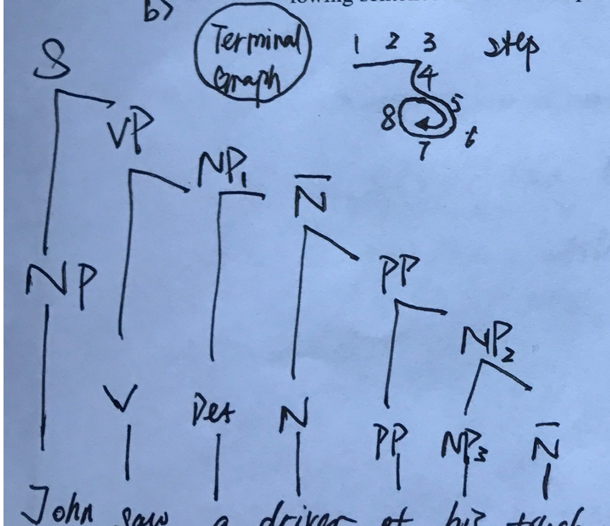
Therefore, ~~NP2, which refers to N̄ (driver)~~ is identified as the antecedent to his.

a)



b. (5 points) What does the algorithm predict as the antecedent for the pronoun *his* in the following sentence? Show the steps. ***John saw a driver of his truck.***

b)



X starts with X=NP3 From step 1-4, an antecedent can't be identified, so we will start from step 5 when X=NP2.

Step 5. X rises to NP1

Step 6. NP1 is not eligible since N̄ exist in the path

Step 7. after traversal, there is no NP eligible

Step 8. doesn't qualify

Step 9 start from step 4.

Step 4 doesn't qualify since X= NP

Step 5 X rises to S

Step 6 doesn't qualify since X=S

Step 57. Travels and find NP (John)

Therefore, NP (John) is the antecedent of his

Problem 2.

C. Does the algorithm find the most plausible antecedent in each case? Why or Why not?

For the above Two case, Yes it's able to find the most plausible one.

But not always on all the cases.

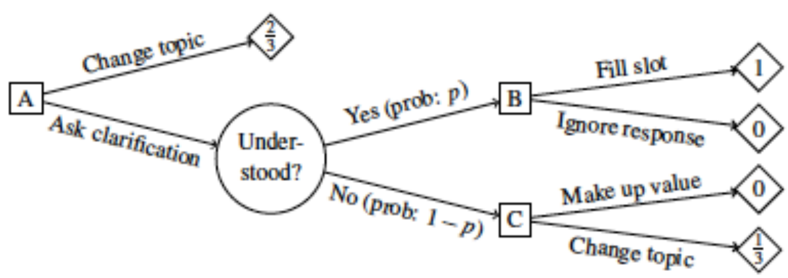
For example. if the sentence is complicated and embedded with singular / plural NP words, it might get confused

eg. "The castle in Norway remained the residence of the queen until 536 whe she moved it to Spanish"

For "it" the above algorithm find its antecedent to be 536 without selection constrains.

D. Step 6 can't be removed and we can still acquire the same results

Problem 3. A dialogue agent has the following information for making decisions, shown as a decision tree. Square nodes are places the agent can make a choice about which action to take. Circle nodes represent observations by the agent based on the informartion received; each observation has a probability. The diamond-shaped leaf nodes represent the utility (or reward) for going down a certain path.



a. (3 points) Assume that the agent decided to ask a clarification question at node A. What is the best policy at this point, that is, the policy that maximizes the expected utility? (Write it as a set of if-then statements, dependent on the observation.)

b. (3 points) What is the expected utility of this policy, as a function of the probability p?

c. (4 points) For which values of p is the policy of changing topic at node A optimal?

Problem:

a) if understood (p):
   move to square node B and choose to fill slot (1)
else if not understood (1-p):
   move to square node C and choose to change topic (1/3

B) The expected utility of this policy, as a function of p is

$$P_{policy} = (p \cdot 1) + (1-p) \cdot \frac{1}{3}$$
$$= \frac{1}{3} + \frac{2}{3}p$$

c) The action of change Topic at A is optimal when ~~both of~~ the below equation is ~~are~~ satisfied.

$$\frac{1}{3} + \frac{2}{3}p < \frac{2}{3}$$
$$p < \frac{1}{2}$$

$$0 < p < \frac{1}{2}$$