Algorithm for NLP: Homework 5

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Bowen Low blow

Answer:

Answer:

1. 2.1 CCG Syntactic analysis

(a)

```
John and   Mary like       Bob
NP   CONJ  NP   (S\NP)/NP  NP
-------------- CONJ
      NP
                 -------------FA
                 S\NP
     --------------- BA
            S
```

(b)

```
Alan gave         Bob some  slides
NP   (S\NP)/NP/NP NP  NP/N  N
                      --------FA
                      NP
     ---------------FA
        (S\NP)/NP
     --------------------FA
         S\NP
-------------BA
      S
```

(c)

```
John likes      Mary but   Mary dislikes      John
NP   (S\NP)/NP  NP   CONJ  NP   (S\NP)/NP/NP  NP
     -------------FA            ----------------FA
         (S\NP)                        (S\NP)
```

```
---------------BA          ------------------BA
       S                            S
       -------------------------------CONJ
                          S
```

(d)

(e)

2. 2.2 CCG Semantic Analysis

(a)
```
Bob grades                                      the                  exam
NP:b  (S\NP)/NP:lambdaY.lambdaX.grades(X,Y)     NP/N:lambdaX.the(X)  N:e
                                                ----------------------FA
                                                      NP:the(e)
      ------------------------------------------------------------FA
                          (S\NP):lambdaX.grades(X,the(e))
---------------------------------------------------------------BA
                            S:grades(b, the(e))
```

(b)
```
Alan gave                                                  Bob   some                   slides
NP:a (S\NP)/NP/NP:lambdaZ.lambdaY.lambdaX.gave(X,Y,Z)      NP:b  NP/N:lambdaX.some(X)   N:s
                                                                 -------------------------FA
                                                                 NP:some(s)
     ------------------------------------------------------------FA
         (S\NP)/NP:lambdaY.lambdaX.gave(X,Y,b)
         ---------------------------------------------------------------------FA
                       S\NP: lambdaX.gave(X,some(s),b)
---------------------------------------------------BA
             S:gave(a,some(s),b)
```

(c)
```
John and   Mary  like                                  Bob
NP:j CONJ  NP:m  (S\NP)/NP:lambdaY.lambdaX.like(X,Y)   NP:b
--------------- CONJ
 NP:lambdaS.(j.S & m.S)
                 ------------------------------------------FA
                       S\NP:lambdaX.like(X,b)
 ---------------------------------------------BA
      S: (like(j,b) & like(m,b))
```

(d) lambda is written as l here.

```
John likes                        Mary but  Mary dislikes                        John  and
NP:j (S\NP)/NP:lY.lX.likes(X,Y) NP:m CONJ NP:m (S\NP)/NP:lY.lX.dislikes(X,Y)  NP:j  CONJ
                                             ----------------------------------FA
                                             (S\NP):lX.dislikes(X,j)

likes                          Bob
(S\NP)/NP:lY.lX.likes(X,Y)     NP:b
```

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```
---------------------------------FA
(S\NP):lX.likes(X,b)



NP:j (S\NP):lY.lX.likes(X,Y) NP:m CONJ
NP:m  (S\NP):lX.dislikes(X,j) CONJ (S\NP):lX.likes(X,b)
      ------------------------------------------------FA
      (S\NP):lS.(lX.dislikes(X,j).S & lX.likes(X,b).S)
-------------------------------------------------------BA
S:(dislikes(m,j) & likes(m,b))



NP:j (S\NP):lY.lX.likes(X,Y) NP:m CONJ S:(dislikes(m,j) & likes(m,b))
     ----------------------------FA
     S\NP:lX.likes(X,m)
----------------------BA
   S: likes(j,m)
   ------------------------------------------------------------------------CONJ
             S:lS.(likes(j.m).S & (dislikes(m,j) & likes(m,b)).S)
                S: (likes(j.m) & (dislikes(m,j) & likes(m,b)))
```

3. 2.3 Categorical Unification Grammar

```
he    : [cat:np num:sg]
I     : [cat:np num:pl]
you   : [cat:np num:pl]
like  : ([cat:s]\[cat:np num:pl])/[cat:np]
likes : ([cat:s]\[cat:np num:sg])/[cat:np]
walk  : [cat:s]/[cat:np num:pl]
walks : [cat:s]/[cat:np num:sg]
walked: [cat:s]/[cat:np num:!X]
movie : [cat:n num:sg]
movies: [cat:n num:pl]
boy   : [cat:n num:sg]
boys  : [cat:n num:pl]
the   : [cat:np num:!X]/[cat:n num:!X]
```

(a)
(b)
(c)
(d)
(e)
(f)

Acknowledgement: