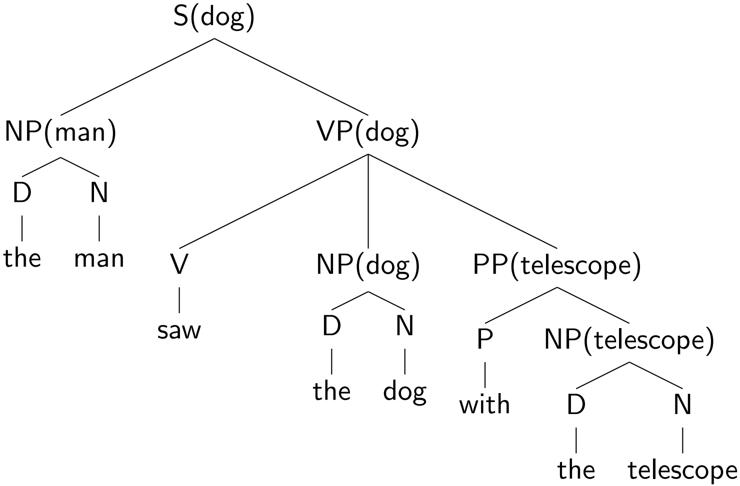
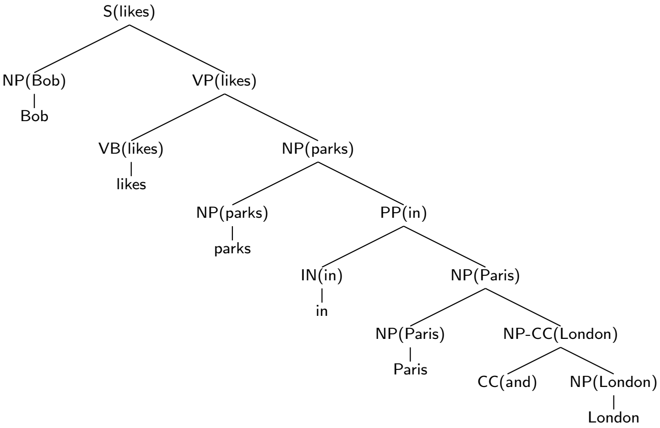
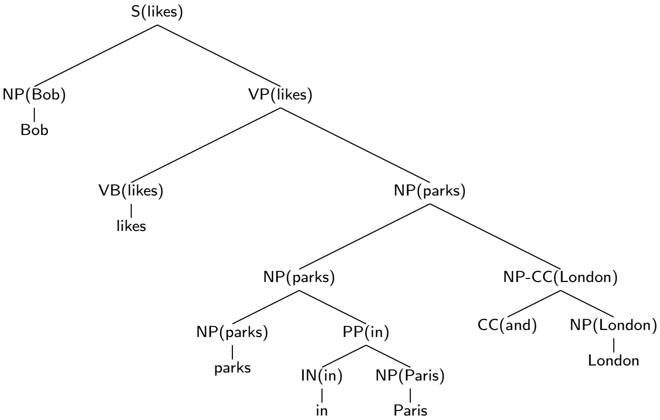
Question 1


S(dog)
NP(man)
VP(dog)
D
N
the
man
V
saw
NP(dog)
D
N
the
dog
PP(telescope)
P
with
NP(telescope)
D
N
the
telescope

Question 2


S(likes)
NP(Bob)
Bob
VP(likes)
VB(likes)
likes
NP(parks)
NP(parks)
parks
PP(in)
IN(in)
in
NP(Paris)
NP(Paris)
Paris
NP-CC(London)
CC(and)
NP(London)
London

Question 2 (continued)

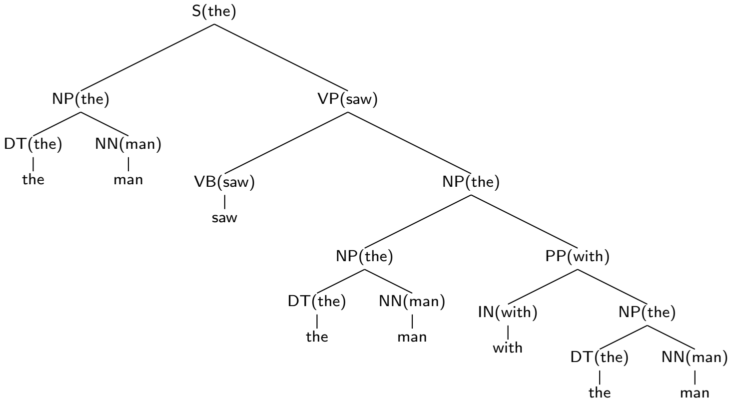


Question 3 (Part 1)

One grammar (there are many possibilities) is as follows:

S(the) $\rightarrow$ NP(the) VP(saw)
VP(saw) $\rightarrow$ VB(saw) NP(the)
NP(the) $\rightarrow$ DT(the) NN(man)
NP(the) $\rightarrow$ NP(the) PP(with)
PP(with) $\rightarrow$ IN(with) NP(the)
DT(the) $\rightarrow$ the
NN(man) $\rightarrow$ man
IN(with) $\rightarrow$ with
VB(saw) $\rightarrow$ saw

Question 3 (Part 1)



Question 3 (Part 2)

- Base case definition: for all $i = 1 \ldots n$, for $X \in N$

$$\pi[i, i, X] = q(X(w_i) \to w_i)$$

(note: define $q(X(w_i) \to w_i) = 0$ if $X(w_i) \to w_i$ is not in the grammar)

- Recursive definition: for all $i = 1 \ldots n$, $j = (i+1) \ldots n$, $X \in N$,

$$\pi(i, j, X) = \max_{\substack{s \in \{i \ldots (j-1)\}, \\ X(w_i) \to Y(w_i) Z(w_{s+1}) \in R}} \left(q(X(w_i) \to Y(w_i) Z(w_{s+1})) \times \pi(i, s, Y) \times \pi(s+1, j, Z) \right)$$

Question 4

$\gamma(S,a) = q(a|*)$
$\gamma(S,b) = q(b|*)$

S(a) $\rightarrow_1$ A(a) C(STOP)	$q(STOP\|a)$
S(a) $\rightarrow_1$ A(a) S(a)	$q(a\|a)$
S(a) $\rightarrow_1$ A(a) S(b)	$q(b\|a)$
S(b) $\rightarrow_1$ B(b) C(STOP)	$q(STOP\|b)$
S(b) $\rightarrow_1$ B(b) S(a)	$q(a\|b)$
S(b) $\rightarrow_1$ B(b) S(b)	$q(b\|b)$
A(a) $\rightarrow$ a	1
B(b) $\rightarrow$ b	1
C(STOP) $\rightarrow$ STOP	1