Exercise 1

Given this grammar and lexicon

Lexicon
$Det \rightarrow that \mid this \mid the \mid a$
$Noun \rightarrow book \mid flight \mid meal \mid money$
$Verb \rightarrow book \mid include \mid prefer$
$Pronoun \rightarrow I \mid she \mid me$
$Proper\text{-}Noun \rightarrow Houston \mid NWA$
$Aux \rightarrow does$
$Preposition \rightarrow from \mid to \mid on \mid near \mid through$

$\mathscr{L}_1$ in CNF
$S \rightarrow NP\ VP$
$S \rightarrow X1\ VP$
$X1 \rightarrow Aux\ NP$
$S \rightarrow book \mid include \mid prefer$
$S \rightarrow Verb\ NP$
$S \rightarrow X2\ PP$
$S \rightarrow Verb\ PP$
$S \rightarrow VP\ PP$
$NP \rightarrow I \mid she \mid me$
$NP \rightarrow TWA \mid Houston$
$NP \rightarrow Det\ Nominal$
$Nominal \rightarrow book \mid flight \mid meal \mid money$
$Nominal \rightarrow Nominal\ Noun$
$Nominal \rightarrow Nominal\ PP$
$VP \rightarrow book \mid include \mid prefer$
$VP \rightarrow Verb\ NP$
$VP \rightarrow X2\ PP$
$X2 \rightarrow Verb\ NP$
$VP \rightarrow Verb\ PP$
$VP \rightarrow VP\ PP$
$PP \rightarrow Preposition\ NP$

From Jurafsky, D and Martin, J, “Speech and Language Processing,” 2018, ch 13

Exercise 1

Parse the following sentence

Book	the	flight	through	Houston

From Jurafsky, D and Martin, J, “Speech and Language Processing,” 2018, ch 13

Exercise 2

Retrieve all possible parse trees

Book	the	flight	through	Houston

Exercise 3

Given this corpus, show its complete PCFG:

```
( (S
    (NP-SBJ (DT The) (NN move))
    (VP (VBD followed)
      (NP
        (NP (DT a) (NN round))
        (PP (IN of)
          (NP
            (NP (JJ similar) (NNS increases))
            (PP (IN by)
              (NP (JJ other) (NNS lenders)))
            (PP (IN against)
              (NP (NNP Arizona) (JJ real) (NN estate) (NNS loans))))))
      (, ,)
      (S-ADV
        (NP-SBJ (-NONE- *))
        (VP (VBG reflecting)
          (NP
            (NP (DT a) (VBG continuing) (NN decline))
            (PP-LOC (IN in)
              (NP (DT that) (NN market)))))))
    (. .)))
```

T =

N =

S =

R =

q =

Exercise 4 - The CKY algorithm for PCFG

Example by Michael Collins

Given the grammar:

S	⇒	NP	VP	1.0
VP	⇒	Vi		0.4
VP	⇒	Vt	NP	0.4
VP	⇒	VP	PP	0.2
NP	⇒	DT	NN	0.3
NP	⇒	NP	PP	0.7
PP	⇒	IN	NP	1.0

Vi	⇒	sleeps	1.0
Vt	⇒	saw	1.0
NN	⇒	man	0.7
NN	⇒	woman	0.2
NN	⇒	telescope	0.1
DT	⇒	the	1.0
IN	⇒	with	0.5
IN	⇒	in	0.5

Generate the best parse tree for the sentence:

The woman saw the man with the telescope

Exercise 4 – The CKY algorithm for PCFG

Example by Michael Collins

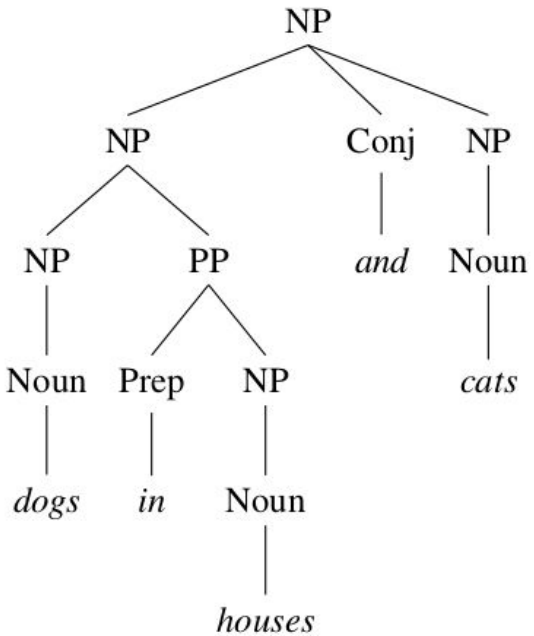
Generate the best parse tree for the sentence:

The woman saw the man with the telescope

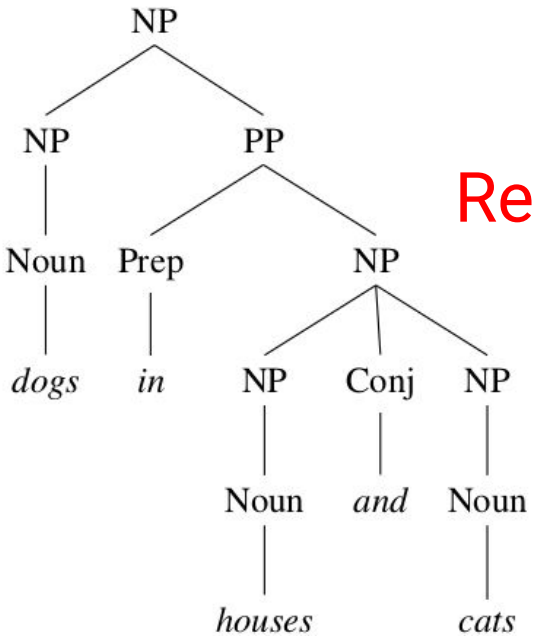
Exercise 5

- Given the hyp and ref parse trees below, compute recall, precision and f-measure

Hyp



Ref



Exercise 6 - Lexicalised CFG

Given the following CFG grammar, convert it into LCFG

S → NP VP
VP → V NP
VP → VP PP
PP → P NP
P → with
V → saw

NP → NP PP
NP → astronomers
NP → ears
NP → saw
NP → stars
NP → telescope