Homework 3

Writing a PCFG, a Probabilistic Context Free Grammar
The Grammar rules are written in S1.gr and S2.gr.
The grammar rules written in S1.gr is used to correctly parse the sentence.
weight <tab> non-terminal symbol <tab> child1 <space> child2 <space> . . .
S2.gr is the backoff model(default)

Part 1
Rules written in S1.gr to correctly parse the sentences in den.sen and in MISC is changed to respective POS tag in Vocab.gr

1. Arthur is the king .

```
(START
    (S1
        (@NP-VP
            (NP
                (Proper Arthur))
            (VP
                (VerbT is)
                (NP
                    (Det the)
                    (Nbar
                        (Noun king))))) .))
```

Vocab.gr
1	Proper	Arthur	//Proper Nouns
1	VerbT	is	// Verbs (third person singular present)
1	Det	the	// Determiners
1	Noun	king	// Singular and mass nouns

Grammar rules used which are already in S1.gr
1	S1	NP VP .
1	NP	Proper
1	VP	VerbT NP
20	NP	Det Nbar
20	Nbar	Noun

Explanation
The rules required to parse the sentence is written in S1.gr
No extra rule added to parse the sentence

2. Arthur rides the horse near the castle .

```
(START
   (S1
      (@NP-VP
         (NP
            (Proper Arthur))
         (VP
            (VerbT rides)
            (NP
               (Det the)
               (Nbar
                  (Nbar
                     (Noun horse))
                  (PP
                     (Prep near)
                     (NP
                        (Det the)
                        (Nbar
                           (Noun castle)))))))) .))
```

Vocab.gr

1	Proper	Arthur	// Proper nouns
1	VerbT	rides	// Verbs (third person singular present)
1	Det	the	//Determiners
1	Noun	horse	// Singular and mass nouns.
1	Prep	near	// Prepositions.
1	Det	the	//Determiners
1	Noun	castle	// Singular and mass nouns.

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	NP	Proper
1	VP	VerbT NP
20	NP	Det Nbar
1	Nbar	Nbar PP
20	Nbar	Noun
1	PP	Prep NP

Explanation
The rules required to parse the sentence is written in S1.gr
No extra rule added to parse the sentence.

3. Arthur rides the plodding horse near the castle .

```
(START
   (S1
      (@NP-VP
         (NP
            (Proper Arthur))
         (VP
            (VerbT rides)
            (NP
               (Det the)
               (Nbar
                  (Adj plodding)
                  (Nbar
                     (Nbar
                        (Noun horse))
                     (PP
                        (Prep near)
                        (NP
                           (Det the)
                           (Nbar
                              (Noun castle))))))))) .))
```

Vocab.gr

1	Proper	Arthur	// Proper nouns
1	VerbT	Ride	// Verbs (third person singular present)
1	Det	the	//Determiners
1	Adj	plodding	//Adjectives
1	Noun	horse	// Singular and mass nouns.
1	Prep	near	// Prepositions.
1	Det	the	//Determiners
1	Noun	castle	// Singular and mass nouns.

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	NP	Proper
1	VP	VerbT NP
20	NP	Det Nbar
1	Nbar	Nbar PP
20	Nbar	Noun
1	PP	Prep NP

Extra rule added to correctly parse the sentence

1	Nbar	Adj Nbar

Explanation
The words which are parsed as MISC are changed to respective POS tag. In this example, plodding is considered as Adjective(Adj). The rules required to parse the sentence is written in S1.gr and an extra rule is added added to parse the sentence correctly.

4. the Holy Grail is a chalice .

```
(START
  (S1
    (@NP-VP
      (NP
        (Det the)
        (Nbar
          (Prop Holy) Grail)))
      (VP
        (VerbT is)
        (NP
          (Det a)
          (Nbar
            (Noun chalice))))) .))
```

Vocab.gr

1	Det	the	//Determiners
1	Prop	Holy Grail	// More proper nouns
1	VerbT	is	// Verbs (third person singular present)
1	Det	a	//Determiners
1	Noun	chalice	// Singular and mass nouns.

Grammar rules used which are already in S1.gr

1	S1	NP VP .
20	NP	Det Nbar
1	VP	VerbT NP
20	NP	Det Nbar
20	Nbar	Noun

Extra rule added to correctly parse the sentence

1	Nbar	Prop

Explanation
The words which are parsed as MISC are changed to respective POS tag. In this example, Holy Grail is considered as Proper Noun (Prop). The rules required to parse the sentence is written in S1.gr and an extra rule is added added to parse the sentence correctly.

5. the sensational Holy Grail is a sacred chalice .

```
(START
  (S1
    (@NP-VP
      (NP
        (Det the)
        (Nbar
          (Adj sensational)
          (Nbar
            (Prop Holy) Grail))))
      (VP
        (VerbT is)
        (NP
          (Det a)
          (Nbar
            (Adj sacred)
            (Nbar
              (Noun chalice)))))) .))
```

Vocab.gr

1	Det	the	//Determiners
1	Adj	sensational	//Adjectives
1	Prop	Holy Grail	// More proper nouns

1	VerbT	is	// Verbs (third person singular present)
1	Det	a	//Determiners
1	Adj	sacred	//Adjectives
1	Noun	chalice	// Singular and mass nouns.

Grammar rules used which are already in S1.gr

1	S1	NP VP .
20	NP	Det Nbar
1	Nbar	Adj Nbar
1	VP	VerbT NP
20	NP	Det Nbar
20	Nbar	Noun
1	Nbar	Prop

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, sensational and sacred are considered as Adjectives(Adj). The rules required to parse the sentence already exists in S1.gr

6. every coconut was carried to the hottest mountains .

```
(START
    (S1
        (@NP-VP
            (NP
                (Det every)
                (Nbar
                    (Noun coconut)))
            (VP
                (@VBD-VBD
                    (VBD was)
                    (VBD carried))
                (PP
                    (TO to)
                    (NP
                        (Det the)
                        (Nbar
                            (Adj hottest)
                            (Nbar
                                (NounS mountains))))))))) .))
```

Vocab.gr

1	Det	every	//Determiners
1	Noun	coconut	// Singular and mass nouns.
1	VBD	was	//Verbs (past tense)
1	VBD	carried	//Verbs (past tense)
1	TO	to	
1	Det	the	//Determiners
1	Adj	hottest	//Adjectives
1	NounS	mountains	//Plural nouns.

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	NP	Det Nbar
1	Nbar	Noun
1	NP	Det Nbar

1	Nbar	Adj Nbar

Extra rule added to correctly parse the sentence

1	VP	VBD VBD PP
1	PP	TO NP
1	Nbar	NounS

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, was as Verbs past tense, carried as verb past tense, hottest as adjective and mountains as plural noun POS tag.

The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

7. sixty strangers are at the Round Table .

```
(START
  (S1
    (@NP-VP
      (NP
        (Num sixty)
        (Nbar
          (NounS strangers)))
      (VP
        (VBT are)
        (PP
          (Prep at)
          (NP
            (Det the)
            (Nbar
              (Prop Round) Table)))))) .))
```

Vocab.gr

1	Num	sixty	//Numbers
1	NounS	strangers	//Plural nouns.
1	VBT	are	//Verbs (third person singular present)
1	Prep	at	//Prepositions
1	Det	the	//Determiners
1	Prop	Round Table	//More proper nouns

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	Nbar	NounS
1	PP	Prep NP
1	NP	Det Nbar
1	Nbar	Prop

Extra rule added to correctly parse the sentence

1	NP	Num Nbar
1	VP	VBT PP

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, sixty as Numbers, stranger as plural nouns, are as verb(thirdperson singular present), Round Table as proper noun.

The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

8. Sir Lancelot might have spoken .

```
(START
   (S1
      (@NP-VP
         (NP
            (Nbar
               (Proper Sir) Lancelot)))
         (VP
            (@MD-VB
               (MD might)
               (VB have))
            (VBD spoken))) .))
```

Vocab.gr

1	Proper	Sir Lancelot	// Proper nouns
1	MD	might	// Modals
1	VB	have	//Verbs (base forms)
1	VBD	spoken	// Verbs (past tense)

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	NP	Nbar
1	Nbar	Proper

Extra rule added to correctly parse the sentence

1	VP	MD VB VBD

Explanation
The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, might is considered as modals, have as verb base forms, spoken as verb past tense.
The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

9. Guinevere had been riding with Patsy for five weary nights .

```
(START
    (S1
        (@NP-VP
            (NP
                (Nbar
                    (Proper Guinevere)))
            (VP
                (@VBD-VBD
                    (VBD had)
                    (VBD been))
                (VP
                    (VBP riding)
                    (PP
                        (Prep with)
                        (NP
                            (@Proper-Prep
                                (Proper Patsy)
                                (Prep for))
                            (Nbar
                                (Num five)
                                (Nbar
                                    (Adj weary)
                                    (Nbar
                                        (NounS nights)))))))))) .))
```

Vocab.gr

1	Proper	Guinevere	// Proper nouns
1	VBD	had	// Verbs (past tense)
1	VBD	been	// Verbs (past tense)
1	VBP	riding	// Verbs (present participles)
1	Prep	with	// Prepositions
1	Proper	Patsy	// Proper nouns
1	Prep	for	// Prepositions
1	Num	five	//Numbers
1	Adj	weary	//Adjectives
1	NounS	nights	//Plural nouns

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	NP	Nbar
1	Nbar	Proper
1	PP	Prep NP
1	Nbar	Num Nbar
1	Nbar	Adj Nbar
1	Nbar	NounS

Extra rule added to correctly parse the sentence

1	VP	VBD VBD VP
1	VP	VBP PP
1	NP	Proper Prep Nbar

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, had is considered as verb past tense, been as verb past tense, riding as verb present participles, five as numbers, weary as adjectives, nights as plural nouns.

The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

10. Sir Bedevere might have been suggesting this quest .

```
(START
    (S1
        (@NP-VP
            (NP
                (Nbar
                    (Proper Sir) Bedevere)))
            (VP
                (@MD-VB
                    (MD might)
                    (VB have))
                (VP
                    (@VBD-VBP
                        (VBD been)
                        (VBP suggesting))
                    (NP
                        (Det this)
                        (Nbar
                            (Noun quest)))))) .))
```

Vocab.gr

1	Proper	Sir Bedevere	// Proper nouns
1	MD	might	// Modals
1	VB	have	// Verbs (base form)
1	VBD	been	// Verbs (past tense)
1	VBP	suggesting	// Verbs (present participles)
1	Det	this	//Determiners
1	Noun	quest	// Singular and mass nouns.

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	NP	Nbar
1	Nbar	Proper
1	NP	Det Nbar
1	Nbar	Noun

Extra rule added to correctly parse the sentence

1	VP	MD VB VP
1	VP	VBD VBP NP

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, might is considered as modals, have as verb base form, been as verb past tense, suggesting as verb present participles.

The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

11. the Britons migrate south frequently .

```
(START
   (S1
      (@NP-VP
         (NP
            (Det the)
            (Nbar
               (NPS Britons)))
         (VP
            (VB migrate)
            (ADVB
               (RB south)
               (RB frequently)))) .))
```

Vocab.gr

1	Det	the	//Determiners
1	NPS	Britons	// Plural proper nouns
1	VB	migrate	// Verbs (base form)
1	RB	south	// Adverbs
1	RB	frequently	// Adverbs

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	NP	Det Nbar

Extra rule added to correctly parse the sentence

1	VP	VB ADVB
1	ADVB	RB RB
1	Nbar	NPS

Explanation
The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, Britons as considered as plural proper norn, migrate as verb base form, south and frequently as adverbs.
The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

12. Arthur and Guinevere ride frequently near the castle .

```
(START
   (S1
      (@NP-VP
         (NP
            (@Nbar-CON
               (Nbar
                  (Proper Arthur))
               (CON and))
            (Nbar
               (Proper Guinevere)))
         (VP
            (VB ride)
            (ADVB
               (RB frequently)
               (PP
                  (Prep near)
                  (NP
                     (Det the)
                     (Nbar
                        (Noun castle))))))))  .))
```

Vocab.gr

1	Proper	Arthur	// Proper nouns
1	CON	and	// Coordinating conjunctions.
1	Proper	Guinevere	//Proper nouns
1	VB	ride	// Verbs (base form)
1	RB	frequently	// Adverbs
1	Prep	near	// Prepositions
1	Det	the	//Determiners
1	Noun	castle	// Singular and mass nouns

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	Nbar	Proper
1	VP	VB ADVB
1	PP	Prep NP
1	NP	Det Nbar
1	Nbar	Noun

Extra rule added to correctly parse the sentence

1	NP	Nbar CON Nbar
1	ADVB	RB PP

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, Britons as considered as plural proper noun, migrate as verb base form, south and frequently as adverbs.

The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

13. he suggests to grow fruit at home .

```
(START
  (S1
    (@NP-VP
      (NP
        (PN he))
      (VP
        (@VBZ-TO
          (VBZ suggests)
          (TO to))
        (VP
          (VBT grow)
          (NP
            (@Nbar-Prep
              (Nbar
                (Noun fruit))
              (Prep at))
            (Nbar
              (Noun home)))))) .))
```

Vocab.gr

1	PN	he	// Personal pronouns.
1	VBZ	suggests	// More third person singular verbs.
1	TO	to	
1	VBT	grow	// Verbs (present, plural, third person)
1	Noun	fruit	// Singular and mass nouns

1	Prep	at	//Prepositions
1	Noun	home	// Singular and mass nouns

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	Nbar	Noun

Extra rule added to correctly parse the sentence

1	NP	PN
1	VP	VBZ TO VP
1	VP	VBT NP
1	NP	Nbar Prep Nbar

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, he is considered as personal pronoun, suggests as More third person singular verbs, to as TO, grow as verb present plural third person.

The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

14. riding to Camelot is not hard .

```
(START
  (S1
    (@VP-VP
      (VP
        (VBP riding)
        (PP
          (TO to)
          (NP
            (Nbar
              (Prop Camelot)))))
      (VP
        (@VerbT-RB
          (VerbT is)
          (RB not))
        (Adj hard))) .))
```

Vocab.gr

1	VBP	riding	//Verbs (present participles)
1	TO	to	
1	Prop	Camelot	//More proper nouns
1	VerbT	is	//Verbs (third person singular present).
1	RB	not	//Adverbs
1	Adj	hard	//Adjectives

Grammar rules used which are already in S1.gr

1	VP	VBP PP
1	PP	TO NP
1	NP	Nbar
1	Nbar	Prop

Extra rule added to correctly parse the sentence

1	S1	VP VP .
1	VP	VerbT RB Adj

Explanation
The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, riding is considered as verb present participles, to as TO, not as adverb, hard as adjective.
The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

15. do coconuts speak ?

```
(START
   (S1
      (@NP-VP
         (NP
            (VERB do)
            (Nbar
               (NounS coconuts)))
         (VP
            (VB speak))) ?))
```

Vocab.gr
1	VERB	do	// Verb, non3rd person singular present
1	NounS	coconuts	//Plural nouns
1	VB	speak	// Verb, base form

Grammar rules used which are already in S1.gr
1   Nbar   NounS

Extra rule added to correctly parse the sentence
1	S1	NP VP ?
1	NP	VERB Nbar
1	VP	VB

Explanation
The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, do is considered as Verb, non3rd person singular present, coconuts as plural nouns, speak as verb base form.
The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

16. why does England have a king ?

```
(START
   (S1
      (@NP-VP
         (NP
            (@WHRB-VBZ
               (WHRB why)
               (VBZ does))
            (Nbar
               (Prop England)))
         (VP
            (VB have)
            (NP
               (Det a)
               (Nbar
                  (Noun king))))) ?))
```

Vocab.gr

1	WHRB	why	// Wh-adverbs
1	VBZ	does	// More third person singular verbs
1	Prop	England	// More proper nouns
1	VB	have	// Verbs (base form)
1	Det	a	//Determiners
1	Noun	king	// Singular and mass nouns

Grammar rules used which are already in S1.gr

1	S1	NP VP ?
1	Nbar	Prop
1	NP	Det Nbar
1	Nbar	Noun

Extra rule added to correctly parse the sentence

1	NP	WHRB VBZ Nbar
1	VP	VB NP

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, why is considered as WH- adverb, does as more third person singular verb, have as verb base form. The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

Challenge sentences

17. it is Sir Lancelot who knows Zoot !

```
(START
  (S1
    (@NP-VP
      (NP
        (PN it))
      (VP
        (VP
          (VerbT is)
          (NP
            (Nbar
              (Proper Sir) Lancelot))))
        (Sbar
          (@WHPN-VBZ
            (WHPN who)
            (VBZ knows))
          (NP
            (Nbar
              (Proper Zoot)))))) !))
```

Vocab.gr

1	PN	it	//Personal pronouns
1	VerbT	is	//Verbs (third person singular present)
1	Proper	Sir Lancelot	//Proper nouns
1	WHPN	who	// Wh-pronouns
1	VBZ	knows	//More third person singular verbs
1	Proper	Zoot	//Proper nouns

Grammar rules used which are already in S1.gr

1	NP	PN

1	VP	VerbT NP
1	NP	Nbar
1	Nbar	Proper

Extra rule added to correctly parse the sentence

1	S1	NP VP !
1	VP	VP Sbar
1	Sbar	WHPN VBZ NP

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, it is considered as personal pronouns,who as WH-pronouns, knows as more third person singular verbs.

The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

18. either Arthur knows or Patsy does .

```
(START
  (S1
    (@NP-VP
      (NP
        (CON either)
        (Nbar
          (Proper Arthur)))
      (VP
        (@VBZ-NP
          (VBZ knows)
          (NP
            (CON or)
            (Nbar
              (Proper Patsy))))
        (VBZ does))) .))
```

Vocab.gr

1	CON	either	//Coordinating conjunctions
1	Proper	Arthur	//Proper nouns
1	VBZ	knows	//More third person singular verbs
1	CON	or	//Coordinating conjunctions
1	Proper	Patsy	//Proper nouns
1	VBZ	does	//More third person singular verbs

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	Nbar	Proper

Extra rule added to correctly parse the sentence

1	VP	VBZ NP VBZ
1	NP	CON Nbar

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, either and or sre considered as coordinating conjunctions, knows and does as more third person singular verb.

The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

19. neither Sir Lancelot nor Guinevere will speak of it .

```
(START
    (S1
        (@NP-VP
            (NP
                (NP
                    (CON neither)
                    (Nbar
                        (Proper Sir) Lancelot)))
                (NP
                    (CON nor)
                    (Nbar
                        (Proper Guinevere))))
            (VP
                (@MD-VB
                    (MD will)
                    (VB speak))
                (PP
                    (Prep of)
                    (NP
                        (PN it))))) .))
```

Vocab.gr
1	CON	neither	// Coordinating conjunctions
1	Proper	Sir Lancelot	// Proper nouns
1	CON	nor	// Coordinating conjunctions
1	Proper	Guinevere	// Proper nouns
1	MD	will	// Modals
1	VB	speak	// Verbs (base form)
1	Prep	of	// Prepositions
1	PN	it	// Personal pronouns

Grammar rules used which are already in S1.gr
1	S1	NP VP .
1	NP	CON Nbar
1	Nbar	Proper
1	PP	Prep NP
1	NP	PN

Extra rule added to correctly parse the sentence
1	NP	NP NP
1	VP	MD VB PP

Explanation
The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, neither and nor are considered as Coordinating conjunctions, will as modals, speak as verb base forms, it as personal pronouns.
The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

20. the king drank to the castle that was his home .

```
(START
    (S1
        (@NP-VP
            (NP
                (Det the)
                (Nbar
                    (Noun king)))
            (VP
                (VBD drank)
                (PP
                    (TO to)
                    (NP
                        (@NP-Det
                            (NP
                                (Det the)
                                (Nbar
                                    (Noun castle)))
                            (Det that))
                        (S
                            (VBD was)
                            (NP
                                (PN his)
                                (Nbar
                                    (Noun home)))))))))) .))
```

Vocab.gr

1	Det	the	//Determiners
1	Noun	king	//Singular and mass nouns
1	VBD	drank	//Verbs (past tense)
1	TO	to	
1	Det	the	//Determiners
1	Noun	castle	//Singular and mass nouns
1	Det	that	//Determiners
1	VBD	was	//Verbs (past tense)
1	PN	his	//Personal pronouns
1	Noun	home	//Singular and mass nouns

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	NP	Det Nbar
1	Nbar	Noun
1	PP	TO NP
1	NP	PN

Extra rule added to correctly parse the sentence

1	VP	VBD PP
1	NP	NP Det S
1	S	VBD NP
1	NP	PN Nbar

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, drank is considered as verb past tense, to as TO, was as verb past tense, his personal pronouns, The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

21. Arthur rode to Camelot and drank from his chalice .

```
(START
    (S1
        (@NP-VP
            (NP
                (Nbar
                    (Proper Arthur)))
            (VP
                (@VP-CON
                    (VP
                        (VBD rode)
                        (PP
                            (TO to)
                            (NP
                                (Nbar
                                    (Prop Camelot)))))
                    (CON and))
                (VP
                    (@VBD-Prep
                        (VBD drank)
                        (Prep from))
                    (NP
                        (PN his)
                        (Nbar
                            (Noun chalice)))))) .))
```

Vocab.gr

1	Proper	Arthur	// Proper nouns
1	VBD	rode	// Verbs (past tense)
1	TO	to	
1	Proper	Camelot	// Proper nouns
1	CON	and	// Coordinating conjunctions
1	VBD	drank	// Verbs (past tense)
1	Prep	from	//Prepositions
1	PN	his	// Personal pronouns
1	Noun	chalice	// Singular and mass nouns

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	NP	Nbar
1	Nbar	Proper
1	VP	VBD PP
1	PP	TO NP
1	Nbar	Prop
1	NP	PN Nbar
1	Nbar	Noun

Extra rule added to correctly parse the sentence

1	VP	VP CON VP
1	VP	VBD Prep NP

Explanation
The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, rode and drank as considered as verb past tense, to as TO, and as coordinating conjunctions, his as personal pronouns.
The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

22. do not speak again !

```
(START
    (S1
        (@VP-VP
            (VP
                (VERB do)
                (RB not))
            (VP
                (VB speak)
                (RB again))) !))
```

Vocab.gr

1	VERB	do	// Verb, non3rd person singular present
1	RB	not	//Adverbs
1	VB	speak	//Verb (base forms)
1	RB	again	//Adverbs

Extra rule added to correctly parse the sentence

1	S1	VP VP !
1	VP	VERB RB
1	VP	VB RB

Explanation

The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, do is considered as verb, non3rd person singular present, not and again as adverb, speak as verb base form.

The grammar rules doesn't get any existing rules. Thus extra rules added to correctly parse this sentence and it's listed above.

23. when the king drinks , Patsy drinks .

```
(START
    (S1
        (@Sbar-,
            (Sbar
                (@WHRB-NP
                    (WHRB when)
                    (NP
                        (Det the)
                        (Nbar
                            (Noun king))))
                (VP
                    (VerbT drinks))) ,)
            (S1
                (@NP-VP
                    (NP
                        (Nbar
                            (Proper Patsy)))
                    (VP
                        (VerbT drinks))) .)))
```

Vocab.gr

1	WHRB	when	// Wh-adverbs
1	Det	the	//Determiners
1	Noun	king	// Singular and mass nouns
1	VerbT	drinks	// Verbs (third person singular present)
1	Proper	Patsy	// Proper nouns
1	VerbT	drinks	// Verbs (third person singular present)

Grammar rules used which are already in S1.gr
1   S1   NP VP .
1   NP   Det Nbar
1   Nbar   Noun
1   Nbar   Proper

Extra rule added to correctly parse the sentence
1   S1   Sbar , S1
1   Sbar   WHRB NP VP
1   VP   VerbT

Explanation
The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example,
when is considered as WH-adverb.
The grammar rules used which are already in S1.gr and extra rules added to correctly parse this
sentence is listed above.

24. Arthur knows Patsy , the trusty servant .

```
(START
  (S1
    (@Sbar-NP
      (Sbar
        (@NP-VP
          (NP
            (Nbar
              (Proper Arthur)))
          (VP
            (VBZ knows)
            (Nbar
              (Proper Patsy)))) ,)
      (NP
        (Det the)
        (Nbar
          (Adj trusty)
          (Nbar
            (Noun servant))))) .))
```

Vocab.gr
1   Proper Arthur   // Proper nouns
1   VBZ   knows   // More third person singular verbs
1   Proper Patsy   // Proper nouns
1   Det   the   //Determiners
1   Adj   trusty   //Adjectives
1   Noun   servant   // Singular and mass nouns

Grammar rules used which are already in S1.gr
1   NP   Nbar
1   Nbar   Proper
1   NP   Det Nbar
1   Nbar   Adj Nbar
1   Nbar   Noun

Extra rule added to correctly parse the sentence
1   Sbar   NP VP ,
1   S1   Sbar NP .

1	VP	VBZ Nbar

Explanation
The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, knows is considered as more third person singular verbs, trusty as adjective.
The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

25. unfortunately , Sir Lancelot speaks again .

```
(START
   (S1
      (@RB-,
         (RB unfortunately) ,)
      (S1
         (@NP-VP
            (NP
               (Nbar
                  (Proper Sir) Lancelot)))
            (VP
               (VBZ speaks)
               (RB again))) .)))
```

Vocab.gr

1	RB	unfortunately	//Adverbs
1	Proper	Sir Lancelot	// Proper nouns
1	VBZ	speaks	// More third person singular verbs
1	RB	again	//Adverbs

Grammar rules used which are already in S1.gr

1	S1	NP VP .
1	NP	Nbar
1	Nbar	Proper

Extra rule added to correctly parse the sentence

1	S1	RB , S1
1	VP	VBZ RB

Explanation
The words which are parsed as MISC are changed to respective POS tag in Vocab.gr . In this example, unfortunately and again are considered as adverb, speaks as more third person singular verb.
The grammar rules used which are already in S1.gr and extra rules added to correctly parse this sentence is listed above.

Thus all the sentences given in dev.sen and 9 challenge sentences given in challenge.sen are correctly parsed using the grammar rules written in S1.gr

Part 2
The sentence with same words present in Vocab.gr and is an actual English sentence, but not parsed by the existing rules.
Exemplar sentence 1-
Sir Lancelot , Sir Bedevere and Arthur are from England .

```
(START
   (S2
      (_Proper
         (Proper Sir) Lancelot)
         (_Misc
            (Misc ,)
            (_Proper
               (Proper Sir) Bedevere)
               (_CON
                  (CON and)
                  (_Proper
                     (Proper Arthur)
                     (_VBT
                        (VBT are)
                        (_Prep
                           (Prep from)
                           (_Prop
                              (Prop England)
                              (_Misc
                                 (Misc .)))))))))))))
```

Explanation

This sentence is not parsed because there is no rule that supports 3 proper nouns (first and second comma separated, second and third separated by coordinating conjunctions)

But the same sentence with 2 proper nouns which is separated by coordinating conjunction 'and' gets parsed.

For example, consider the sentence "Sir Bedevere and Arthur are from England . "

```
(START
   (S1
      (@NP-VP
         (NP
            (@Nbar-CON
               (Nbar
                  (Proper Sir) Bedevere))
               (CON and))
            (Nbar
               (Proper Arthur)))
         (VP
            (VBT are)
            (PP
               (Prep from)
               (NP
                  (Nbar
                     (Prop England)))))) .))
```

Parsed using the existing rules, no additional rules added.

Exemplar sentence 2-
unfortunately , Arthur drank and rode the horse to England .

```
(START
  (S2
    (_RB
      (RB unfortunately)
      (_Misc
        (Misc ,)
        (_Proper
          (Proper Arthur)
          (_VBD
            (VBD drank)
            (_CON
              (CON and)
              (_VBD
                (VBD rode)
                (_Det
                  (Det the)
                  (_Noun
                    (Noun horse)
                    (_TO
                      (TO to)
                      (_Prop
                        (Prop England)
                        (_Misc
                          (Misc .)))))))))))))))
```

Explanation-

Though the grammar rules support sentences like "unfortunately , Sir Lancelot speaks again ."
because of this existing grammar rule in S1.gr "1   S1   RB , S1", the above sentence doesn't get
parsed for reasons like grammar rules are not very generalized.

Briefly, there is a rule that supports "1   VP   VP CON VP".

But there's no rule that generalizes VP as VBD (1   VP   VBD)

String of words that is not an actual English sentence.(English sentence with grammar mistake being parsed).

Exemplar sentence 1-

king was suggested by the Sir Lancelot .

```
(START
  (S1
    (@NP-VP
      (NP
        (Nbar
          (Noun king)))
      (VP
        (@VBD-VBD
          (VBD was)
          (VBD suggested))
        (PP
          (Prep by)
          (NP
            (Det the)
            (Nbar
              (Proper Sir) Lancelot)))))) .))
```

Vocab.gr

1	Noun	king	//Singular and mass nouns
1	VBD	was	//Verbs (past tense)
1	VBD	suggested	//Verbs (past tense)
1	Prep	by	//Prepositions
1	Det	the	//Determiners
1	Proper	Sir Lancelot	//Proper nouns

Grammar rules used which are already in S1.gr
1	S1	NP VP .
1	NP	Nbar
1	Nbar	Noun
1	VP	VBD VBD PP
1	PP	Prep NP
1	NP	Det Nbar
1	Nbar	Proper

Explanation

No Additional rules added to S1.gr . No additional word in Vocab.gr is changed from MISC to respective POS tag.

The sentence is not grammatically correct and is still getting parsed.

Grammar mistake- the Sir Lancelot. For example the professor, the horse, the king are correct but the Ram, the Sir Lancelot, the Arthur are not correct.

Reason why it's getting parsed- some rules are generalised so that they can be reused.

In the example given,

1	NP	Nbar
1	Nbar	Noun
1	Nbar	Proper

This implies Nbar can be both Noun and Proper depending on the sentence to be parsed.

Proper noun preceded by the Determinant is not grammatically correct.

Exemplar sentence 2-

master and servant rides horse .

```
(START
  (S1
    (@NP-VP
      (NP
        (@Nbar-CON
          (Nbar
            (Noun master))
          (CON and))
        (Nbar
          (Noun servant)))
      (VP
        (VerbT rides)
        (NP
          (Nbar
            (Noun horse))))) .))
```

Vocab.gr
1	Noun	master	// Singular and mass nouns
1	CON	and	//Coordinating Conjunctions
1	Noun	servant	//Singular and mass nouns
1	VerbT	rides	// Verbs (third person singular present)
1	Noun	horse	// Singular and mass nouns

Grammar rules used which are already in S1.gr
1	S1	NP VP .
1	NP	Nbar CON Nbar
1	Nbar	Noun
1	VP	VerbT NP

Explanation

No Additional rules added to S1.gr . No additional word in Vocab.gr is changed from MISC to respective POS tag.

The sentence is not grammatically correct and is still getting parsed.

Grammar mistake- it should be the horse.

Reason why it's getting parsed- some rules are generalised so that they can be reused.

In the example given,

1   NP   Det Nbar
1   NP   Nbar

This implies the grammar rules support both "the horse" and "horse" which supports grammatical mistake.