1.   sentence = "John J. Smith travelled to Omaha."

IO tagging: [('John', 'NNP', 'I-NP'), ('J.', 'NNP', 'I-NP'), ('Smith', 'NNP', 'I-NP'), ('travelled', 'VBD', 'O'), ('to', 'TO', 'O'), ('Omaha', 'NNP', 'I-NP'), ('.', '.', 'O')]

IOB tagging: [('John', 'NNP', 'B-NP'), ('J.', 'NNP', 'I-NP'), ('Smith', 'NNP', 'I-NP'), ('travelled', 'VBD', 'O'), ('to', 'TO', 'O'), ('Omaha', 'NNP', 'B-NP'), ('.', '.', 'O')]

If you consider IO tagging, there are 3 continuous chunks ('John', 'NNP', 'I-NP'), ('J.', 'NNP', 'I-NP'), ('Smith', 'NNP', 'I-NP'), there is no information whether to consider them separately or as one, there is chance of losing data.

But If you consider IOB tagging, we have a begin tag for each chunk, so it will specify the start of every chunk and all the words with 'I-NP' is part of that chunk until we find next begin tag. So, there is no chance of losing any data {('John', 'NNP', 'B-NP'), ('J.', 'NNP', 'I-NP'), ('Smith', 'NNP', 'I-NP')}.

2.
```
grammar = """NP: {(<DT>*<CD>*)?<JJ>*<NNS>}
             {<DT>?<JJ>*<NN>}
          """
```
Parsed simple sentence: (S (NP Many/JJ little/JJ dogs/NNS) barked/VBD at/IN (NP cats/NNS))

3.

Part a. Evaluation of the chunker developed in question 2.

ChunkParse score:

   IOB Accuracy: 60.1%%

   Precision: 40.8%%

   Recall: 32.6%%

   F-Measure: 36.2%%

Part b. Evaluation of Base Line chunker:

ChunkParse score:

   IOB Accuracy: 37.8%%

   Precision: 0.0%%

   Recall: 0.0%%

   F-Measure: 0.0%%

Developed chunkparse is around 25% more accurate than Baseline chunkparse.

Part c. The extended grammar is:
```
grammar = """NP : {<[RCDJNP].*>*<NNS>}
             {<[CDJNP].*>*<NNS>}
             {(<DT>*<CD>*)?<JJ>*<NNS>}
             {<DT>?<JJ>*<NN>}
          """
```
Chunk Parse score:

   IOB Accuracy: 65.9%%

   Precision: 51.9%%

   Recall: 36.0%%

   F-Measure: 42.5%%

The extended grammar is 6% more accurate than the developed grammar.