CSC 425/525 Homework #10 (Speech recognition and chapter 15)
Due: Wednesday, April 26

Word process all answers. Figures may be hand drawn. Undergraduate students answer question numbers 3 and 4 and any four other questions. Graduate students answer all eight questions.

1. HEARSAY used a simple grammar of a 1011x1011 binary matrix while HWIM and other HMM speech recognition systems use bigrams. Explain how both of these work and whether you feel these are adequate approaches to implementing a grammar for speech recognition systems.

2. Look at the headlines on slide 4 of the chapter 15 notes. Select 3 of the headlines and explain what type(s) of knowledge would be required to interpret the sentence.

3. Read problem 1 on page 667. Now do this problem on the following sentences (that is, classify them and explain where in the understanding process any potential problem is detected).
    a. My mother's black cat is white.
    b. The green apple ate a juicy bug.
    c. Alive and unfettered Paris man free a was I.
    d. The current king of France is bald.
    e. Happy you are here today I am.
    f. Twas brillig and the slithy toves did gyre and gymble in the wabe. (if you are unfamiliar with this quote, see https://en.wikipedia.org/wiki/Jabberwocky)
    g. The rat the cat killed ate the cheese.

4. Similar to the figure on slide 18 of the notes, provide the parse, semantic interpretation and contextual interpretation for the following sentences. Provide 1 parse tree per sentence, 1 conceptual graph per sentence, and then a combined conceptual graph for the contextual interpretation.
    Frank Zappa was a great guitarist.
    Guitarists can play guitar and bass.
    Frank Zappa owned dozens of guitars.

5. Provide semantic markers for each of the following nouns and for each, what types of clues you would look for in a sentence to determine which interpretation is correct.
    a. block
    b. string
    c. tree

6. Provide case grammars for the following verbs.
    a. to infer
    b. to destroy
    c. to inhale
    d. to dream

7. Similar to the probabilistic rule-based grammar of slide 45, derive the probabilistic rules for the following sentences. All sentences are of the form S → NP VP. There are a few different versions of NPs and VPs. Leave your rules at the level of grammatical constituents rather than specific words. For instance, do not use a rule that says N → car but instead leave rules with such categories as N, Prep, Article, Adj, Verb, Aux, etc.
    - The big red ball bounced over the car.
    - The car is black.
    - The little girl played near the big house.
    - The house is by a small park
    - The man drives the car to the park near a church. NOTE: "near a church" modifies "the park"
    - The park has green trees.
    - The girl climbs up a small tree.
    - The man watches the girl in the tree.

8. On slide 47 is an example of disambiguating the word plant based on words or the grammatical role of words near it. The word bass can be a fish, a low note (or the lowest register in singing) or an instrument (bass guitar). Make up some sentences that use each of these three definitions for bass and then build a table like the lower half of the figure on this slide. Provide the feature type, feature pattern, the majority sense. Do not include f(M) or f(L). Try to come up with at least 4 entries for each of the three definitions of bass.