Assignment 6

1. Let us consider the following feature structures:

$$
\begin{array}{rcl}
F1 & = & \left[A: \ a \right] \\
F2 & = & \left[B: \ \left[A: \ a \right] \right] \\
F3 & = & \begin{bmatrix} A: & a \\ B: & \left[A: \ a \right] \end{bmatrix} \\
F4 & = & \begin{bmatrix} A: & a \\ B: & \boxed{1} \left[A: \ a \right] \end{bmatrix} \\
F5 & = & \begin{bmatrix} A: & \boxed{1} \left[A: \ a \right] \\ B: & \boxed{1} \end{bmatrix} \\
F6 & = & \begin{bmatrix} A: & \boxed{1} \\ B: & \boxed{1} \end{bmatrix}
\end{array}
$$

Which of the following holds true? Explain briefly your answer.

a. F1 ⊔ F2 = F3

b. F1 ⊔ F3 = F4

c. F1 ⊔ F6 = F3

d. F1 ⊔ F6 = F5

e. F2 ⊔ F6 = F5

f. F3 ⊔ F4 = F4

g. F3 ⊔ F4 = F5

h. F4 ⊔ F4 = F5

i. F5 ⊔ F6 = F5

2. Given the following grammar and lexicon:

$$\left[CAT: \ s\right] \ \rightarrow \ \begin{bmatrix} CAT: \ np \\ NUM: \ X \end{bmatrix} \begin{bmatrix} CAT: \ v \\ NUM: \ X \\ SUBCAT: \ <> \end{bmatrix}$$

$$\begin{bmatrix} CAT: \ v \\ NUM: \ X \\ SUBCAT: \ Y \end{bmatrix} \ \rightarrow \ \begin{bmatrix} CAT: \ v \\ NUM: \ X \\ SUBCAT: \ \begin{bmatrix} FIRST: \ Z \\ REST: \ Y \end{bmatrix} \end{bmatrix} \left[CAT: \ Z\right]$$

$$\begin{bmatrix} CAT: \ np \\ NUM: \ X \end{bmatrix} \ \rightarrow \ \begin{bmatrix} CAT: \ d \\ NUM: \ X \end{bmatrix} \begin{bmatrix} CAT: \ n \\ NUM: \ X \end{bmatrix}$$

$$\begin{bmatrix} CAT: \ np \\ NUM: \ X \end{bmatrix} \ \rightarrow \ \begin{bmatrix} CAT: \ pro \\ NUM: \ X \end{bmatrix}$$

$$\begin{bmatrix} CAT: \ np \\ NUM: \ X \end{bmatrix} \ \rightarrow \ \begin{bmatrix} CAT: \ propN \\ NUM: \ X \end{bmatrix}$$

$$loves \ \rightarrow \ \begin{bmatrix} CAT: \ v \\ NUM: \ sg \\ SUBCAT: \ <\left[CAT: \ np\right]> \end{bmatrix}$$

$$swim \ \rightarrow \ \begin{bmatrix} CAT: \ v \\ NUM: \ pl \\ SUBCAT: \ <> \end{bmatrix}$$

$$musician \ \rightarrow \ \begin{bmatrix} CAT: \ n \\ NUM: \ sg \end{bmatrix}$$

$$fish \ \rightarrow \ \begin{bmatrix} CAT: \ n \\ NUM: \ X \end{bmatrix}$$

$$John \ \rightarrow \ \begin{bmatrix} CAT: \ propN \\ NUM: \ sg \end{bmatrix}$$

$$Mary \ \rightarrow \ \begin{bmatrix} CAT: \ propN \\ NUM: \ sg \end{bmatrix}$$

$$she \ \rightarrow \ \begin{bmatrix} CAT: \ pro \\ NUM: \ sg \end{bmatrix}$$

$$he \ \rightarrow \ \begin{bmatrix} CAT: \ pro \\ NUM: \ sg \end{bmatrix}$$

$$him \ \rightarrow \ \begin{bmatrix} CAT: \ pro \\ NUM: \ sg \end{bmatrix}$$

$$this \ \rightarrow \ \begin{bmatrix} CAT: \ d \\ NUM: \ sg \end{bmatrix}$$

$$these \ \rightarrow \ \begin{bmatrix} CAT: \ d \\ NUM: \ pl \end{bmatrix}$$

(a) Augment it with additional features, grammar rules, categories and lexical items such that the grammar generates all the examples in (1), and rejects all the examples in (2) (the starred sentences (*)):

(1) John loves Mary.
She loves him.
Mary thinks that these fish swim.
Mary knows this musician.
Mary knows that these fish swim.
Mary knows that John thinks that she loves this musician.

(2) * This fish swim.
* John loves she.
* Him loves her.
* Mary thinks this musician.
* Mary thinks him.
* Mary thinks John.

(b) Draw the parse tree for the sentence *Mary knows that John thinks she loves him*.

NOTE: Remember that X,Y,Z in feature structures represent variables, which is the same as using the co-index notation $\boxed{1}$ in JM book. For the SUBCAT feature the value <> represents the empty list, not to be confused with the notation [] that represents the empty feature structure (which is the most general feature structure).