Questions on Lambda Notation and Deducing Extensions

(1) **Boring Comprehension Exercises on Lambda Notation [20 Points]**

a. *The following functions are defined in lambda notation. Please write them out as a set of ordered pairs.*

(i) [λx : x ∈ { 1 , 2 , 3, 4 } . x + 23]
(ii) [λx : x ∈ { NY, NJ, MA } . the capital of x]
(iii) [λx : x ∈ { Seth, Kyle } . **IF** x teaches LING 510 **THEN** T **ELSE** F]

b. *The following functions are written out as a set of ordered pairs. Please define them in lambda notation.*

(i) { < 2, 4 >, < 3, 9 >, < 4, 16 >, < 5, 25 > }
(ii) { < Seth, Cable > , <Angelika, Kratzer >, <Rajesh, Bhatt> }
(iii) { < Boston, T > , < New York, T > , < Los Angeles, F > }

c. *Please compute the following values, using the rule of 'Lambda Conversion'.* Make sure to 'show your work' (i.e., show each step of the calculation).

(i) [λx : x ∈ { y : y is a number } . x/4] (44)

(ii) [λx : x ∈ { y : y is a US state } . the capital of x] (Maine)

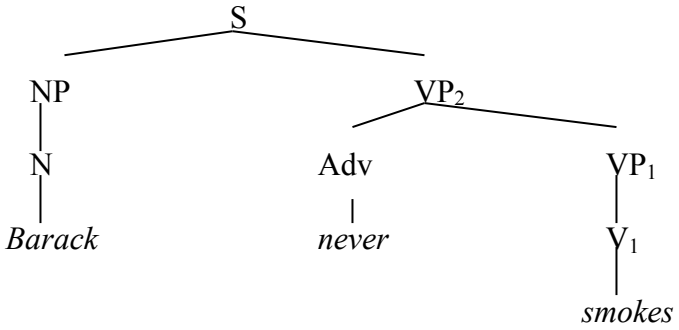
(iii) [λx ∈ D_e : [λy ∈ D_e : **IF** x slew y **THEN** T **ELSE** F]](Cain)(Abel)

(iv) [λf ∈ $D_{<e,e>}$: [λy ∈ D_e: f(y)]]([λx ∈ D_e: the creator of x])(*Harry Potter*)

(2) **An Exercise on Adverbs [30 Points]**

Let's try to add temporal adverbs like *never* into our theory. To begin, a sentence like "*Barack never smokes*" will be assumed to have the structure below.

a.



b. **Question 1 [10 Points]**
What should the semantic type of *never* be?

c. **Question 2 [20 Points]**
Given your answer to Question 1, please devise a lexical entry for *never* that allows us to derive the following (accurate) truth-conditional statements.

(i) "Barack never smokes" is T *iff* there is no time when Barack smokes.
(ii) "Joe never dances" is T *iff* there is no time when Joe dances.

In answering this question, please be sure to do both of the following:
- Provide the lexical entry for *never*
- Provide a proof showing that it derives **one** of the two T-conditional statements above.

Hint! Consider our treatment of the NEG marker *doesn't*.

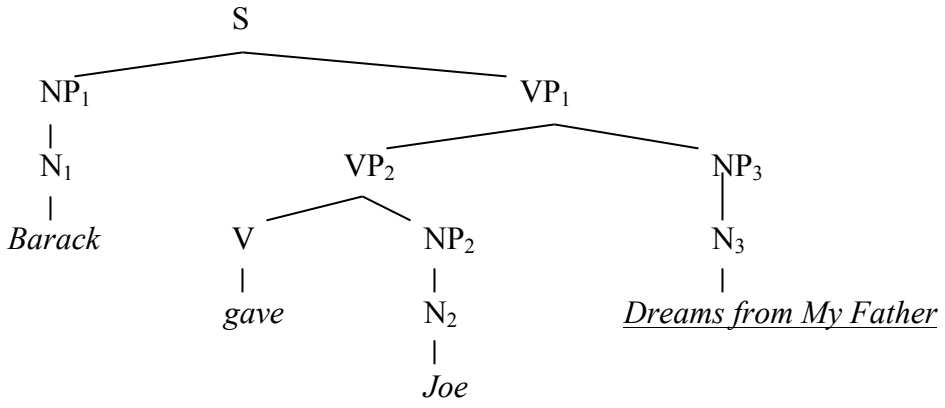
(3) **An Exercise on Ditransitives [20 Points]**

As illustrated below, verbs like "give" select for two internal arguments, a direct object and indirect object. For that reason, such verbs are called 'ditransitives'.

a. Barack$_{\text{subject}}$ gave Joe$_{\text{indirect-object}}$ *Dreams from My Father*$_{\text{direct-object}}$

To begin, let us assume that sentences like (3a) have the structure shown below:

b.



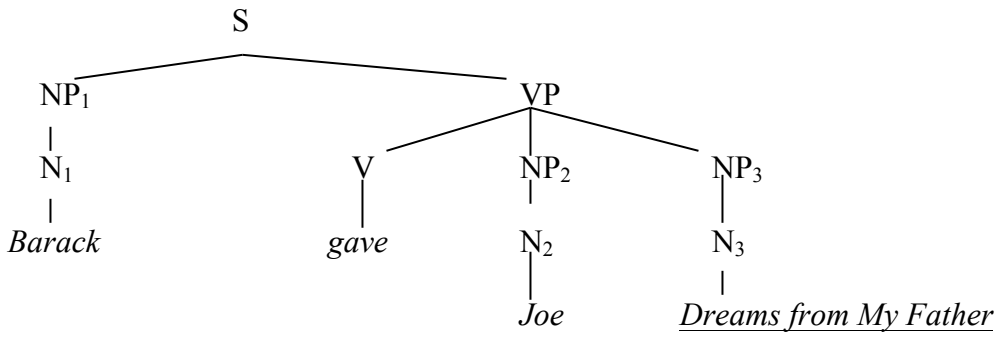
c. **<u>QUESTION (10 pts):</u>**
Please provide a lexical entry for "gave" which will derive the truth-conditional statement below:

[[S]] = T *iff* Barack gave Joe *Dreams from My Father*

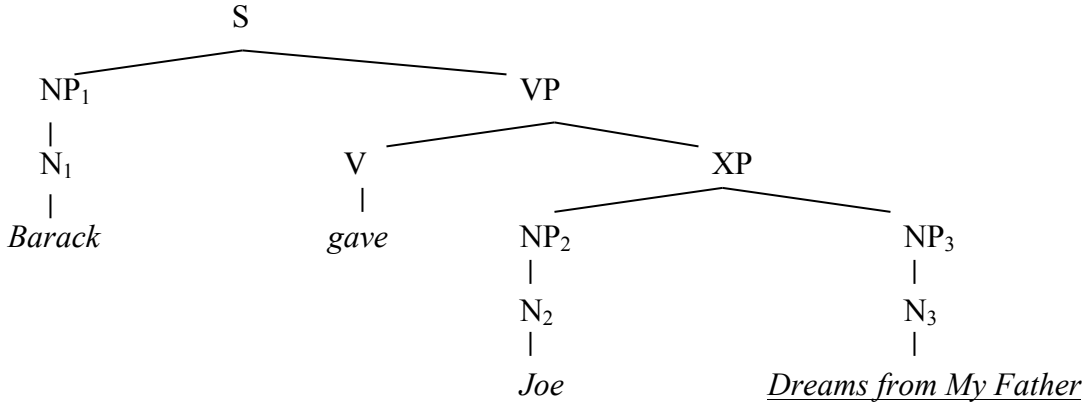
<u>Note:</u>
You don't have to write out a truth-conditional derivation for this problem, but it would be wise to do one on your own, just to check whether your solution works as intended.

Unfortunately, the syntax in (3b) has never been seriously proposed by syntacticians as the structure of (3a). Instead, for many decades the structure in (3d) below was the prevailing theory, while more recently (3e) has been found to be more accurate.

d. *Classic, Ternary-Branching Structure for Ditransitives* (ca. 1970s)



e. *More Realistic, Binary-Branching Structure for Ditransitives* (ca. 1990s)



f. **QUESTION (10 pts):**
Is there any lexical entry you could write for "gave" that would allow our system to interpret the structures in (3d) or (3e)? If yes, then what's the lexical entry? If not, then why not?