Q1.

Write a lambda term that will apply to a subject generalized quantifier interpretation and turn it into a generalized quantifier interpretation that would appear as the object of a transitive verb.

Solution: We solved this question in class. Here we repeat the story, in case you missed it then.

Here is the definition of a subject position generalized quantifier (GQ), for instance the universal quantifier *every*:

(i) every $:= \quad S/(S\backslash NP) \quad : \quad \lambda p\lambda q.\forall x.px \rightarrow qx$

As we know from our previous discussions, this definition is not suitable for interpreting expressions where the GQ is at the object position, like in *John read every book*. In such cases, we were using the definition below:

(ii) every $:= \quad (S\backslash NP)\backslash(S\backslash NP/NP)/N \quad : \quad \lambda p\lambda q\lambda z.\forall x.px \rightarrow qxz$

In this formulation, the subject versus object status is encoded on the quantifier itself. A nicer formulation would first obtain the NP, say *every book*, as a subject category by default, and then change the case – in our system this would mean changing the category – of the NP, to suit the position it will be inserted. In such a formulation, there is only one *every*, which is (ii). The default for *every book* would be:

(iii) every book $= \quad S/(S\backslash NP) \quad : \quad \lambda q.\forall x.book'x \rightarrow qx$

For NPs appearing at the object position of a transitive verb, this category needs to be changed to:

(iv) every book $= \quad (S\backslash NP)\backslash(S\backslash NP/NP) \quad : \quad \lambda q\lambda z.\forall x.book'x \rightarrow qxz$

Now, the question is how to carry out this transformation. One way to do it is to posit an inaudible case marker category that would apply to a GQ at an object position — remember that in English some pronouns visibly carry case marking, *he* versus *him*, *she* versus *her*, and so on. Let's call this case marker ACC. It's definition would be:

(v) ACC $:= \quad (S\backslash NP)\backslash(S\backslash NP/NP)/(S/(S\backslash NP)) \quad : \quad \lambda t\lambda v\lambda z.t(\lambda x.vxz)$

By the way, the solution to the present question is the interpretation part of the definition (v). It is also OK to transform the subject position *every* to object position *every* by a similar operation. But, as we said above, loading subject versus object status to the quantifier itself is not very desirable since what is a subject or an object is the NP, not the quantifier.

To complete the picture, we need one final assumption about the way ACC gets inserted into a sentence. Here, the most basic option is to assume that transitive verbs in English come with ACC on their right. We leave it as an exercise to derive the interpretation of the following sentence.

(vi) John reads ACC every book.

Q2.

Let us take the definite article *the* into our repertoire. There is a gigantic literature on the meaning of the definite article. We will take a simple analysis, which covers most uses of the article. We will assume the following lexical entry:

(1) the $:= \quad S/(S\backslash NP)/N \quad : \quad \lambda p\lambda q.q(the'p) \quad :: \quad et(ett)$

The interpretation of the lexical item *the* has a function *the′* in its interpretation. This function maps properties (or sets) to their most salient element. When one says *Pass me the book*, the sentence does not make much sense if there is a book uniquely identifiable both by the speaker and the hearer. The function the' is aimed to model this behavior. Give the type of the function the'.

> **Solution:** You need to be careful about not taking the' as a direct translation of the word *the*. By inspecting the category definition, you should be able to see that p is of type et and $the'p$ is of type e. Therefore, the' must be of type ete.

Q3.

Adjectives can be used both attributively (*the blue book*) and predicatively (*the book is blue*). Recall from the previous assignment that the attributive form of an adjective is defined as follows:

(2) blue $:=$ N/N : $\lambda p\lambda x.blue'x \wedge px$

This definition is not suitable for deriving predicative readings. What we mean as a predicative reading is interpreting *The book is blue* as $blue'(the'(\lambda x.book'x))$, or *Every book is blue* as $\forall x.book'x \rightarrow blue'x$.

Assuming that the copula *is* is an identity function — it gives back what it takes as an argument, we can propose another definition for adjectives as follows:

(3) blue $:=$ A : $\lambda x.blue'x$

which has A as a new syntactic category. Assuming that this is the basic category for adjectives, we need a way to derive the adjective category for attributive uses. Write a lambda term that transforms interpretations like in (3) to those like in (2).

> **Solution:** First let us observe how the basic assumptions work. We include types in definition for further clarification:
>
> (i) blue $:=$ A : $\lambda x.blue'x$ :: et
>
> The copula is:
>
> (ii) is $:=$ $(S\backslash NP)/A$: $\lambda x.x$ et(et)
>
> With these assumptions,
>
> (iii) is blue $=$ $S\backslash NP$: $\lambda x.blue'x$ :: et
>
> From here on you can proceed as if you have a verb phrase, say, like *walks* or *loves Mary*.
>
> Now, if the predicative category we used above is the default one, we need something that will transform this into the category that will be used attributively. Let's call this abstract transformer MOD. Here is the definition you need:
>
> (iv) MOD $:=$ $(N/N)/A$: $\lambda p\lambda q\lambda x.px \wedge qx$
>
> The answer to the question is the interpretation part of this definition. Again, we leave it as an exercise to derive the interpretation of the following expression:
>
> (v) the MOD blue book

Q4.

(Bonus question!) Can we take the category in (2) as basic, and derive the predicative reading by assigning the copula a category different than the identity function? If yes, how? (Hint: if you cannot obtain (3) directly, aim for something logically equivalent to it.)

Solution:

Now we take,

(i) blue := N/N : $\lambda p \lambda x.blue' x \wedge px$

as basic, and are asked to derive the predicative category from this.

An approximation would be to replace px with a tautologous formula. We do this by using the copula:

(ii) is := $(S\backslash NP)/(N/N)$: $\lambda q.q(\lambda x.x = x)$

With these definitions, the sentence,

(iii) The book is blue.

will receive the interpretation,

(iv) $blue'(the' book') \wedge (the' book') = (the' book')$

which is logically equivalent to,

(v) $blue'(the' book')$