1. Lambda terms and Modifiers

We have seen in class the *intrsective* analysis of modification, which assumes equivalences like the following one.

(1) a. John [is [a [tall man]]]
    \[\equiv\]
    b. [John [is tall]] [and [John [is [a man]]]]

In this approach, we assume that the adjective "tall" in (1a) denotes an (et)(et) function TALL-M (M for "modification") defined by using the (et) denotation TALL of the adjective "tall" in (1b).

Q1: Define the denotation TALL-M as a lambda term of type (et)(et) that uses the denotation TALL of type et and the function \(\Lambda\) of type t(tt) for propositional conjunction between sentences.

Q2: Write down the compositional analyses of (1a) and (1b) using the functions TALL, TALL-M and \(\Lambda\), and the identity functions for "is" and "a".

Q3: Simplify the terms you get and make sure that you see why this leads to equivalent analyses for (1a) and (1b).

2. Generalized Quantifiers

In class we discussed the denotation of sentences as in A-C and expressed it using a GQ denotation for the NP. The VP denotation is required to be a member of the GQ. As a result the sentences express relations between the set denotation of the noun and the set denotation of the VP:

A. Every man ran – run \(\in\) \(\{B \subseteq E : \text{man} \subseteq B\}\) \(\iff\) man \(\subseteq\) ran - the set of runners is an element of the set of sets that contain the set of men \(\iff\) the set of men is contained in the set of runners

B. Some man ran – run \(\in\) \(\{B \subseteq E : \text{man} \cap B \neq \emptyset\}\) \(\iff\) man \(\cap\) ran \(\neq\) \(\emptyset\) - ... \(\iff\) the set of men has a non-empty intersection with the set of runners

C. No man ran - run \(\in\) \(\{B \subseteq E : \text{man} \cap B = \emptyset\}\) \(\iff\) man \(\cap\) ran = \(\emptyset\) - ... \(\iff\) the set of men has an empty intersection with the set of runners

Answer the following questions:

a. Replace the “…”s in (B) and (C) by full sentences that reflect the GQ analysis, following the example in (A).

b. Write the semantic type of each word in sentence (A). Hint: we now assume type \((et)t\) for NPs. You should analyze the required type of the determiner in the noun phrase every man, so that the NP ends up having the \((et)t\) type.

c. Describe the functions in the domain \((et)((et)t)\) in informal mathematical language (the functions that send every ... to ...)
d. These functions characterize binary relations between functions of type X. What is X?

e. Following these observations conclude: these functions characterize binary relations between sets of _____

f. For the following sentences, write down an analysis similar to the analyses in A-C.
   i. Exactly one man ran.
   ii. More than one man ran.
   iii. At most one man ran.
   iv. Between three and eleven men ran.
   v. All the men except John ran.
   vi. No man except John ran.

Note: for the sake of this question you may assume that the denotation of the plural noun men is man, like the singular noun man.

3. Generalized Quantifiers Monotonicity

Consider the following sentences

(1) Every man but no woman ran
(2) Every man but no woman ran quickly

Q1. Show that every man but no woman is non-monotonic in the following way:

i. Give set denotations to man, woman, ran and quickly(ran) in which (1) denotes 1 and (2) denotes 0
ii. Give set denotations to man, woman, ran and quickly(ran) in which (1) denotes 0 and (2) denotes 1

Q2. Write down the *denotation* of the noun phrase every man but no woman as a set intersection of the denotations for the noun phrases every man and no woman

Q3. Specify the sets intersected in the QC given a domain of entities and set denotations as follows:
   E = {john, bill, mary, sue, mitsy, fritsy }
   man = {john, bill}
   woman = {mary, sue}