

1 Statement Logic

- 1.1 Translate into statement logic. Be sure and represent all the connectives of statement logic explicitly. (\rightarrow , \wedge , \vee , \neg , \leftrightarrow). For Example:

Bill did not smile at Mary

p = Bill smiled at Mary $\neg p$

If Bill did not smile at Mary, Mary danced a jig

p = Bill smiled at Mary q = Mary danced a jig. $\neg p \rightarrow q$

- (a) Bill will leave only if Mary resigns.
 - (b) Bill will leave only if Mary doesn't resign.
 - (c) Mary will resign only if Bill leaves.
 - (d) Bill will not leave unless Mary resigns.
 - (e) Bill will leave unless Mary resigns.
- 1.2 Write a rule for the interpretation of "p only if q" sentences. The rule should just be a logical translation. That is, it should look like this:

$$\llbracket p \text{ only if } q \rrbracket = \neg q \rightarrow \neg p$$

This answer may or may not be right. Even if it is right, there's a simpler answer which uses fewer symbols on the right hand side of the "=". Your answer should use the same left hand side and insert some translation on the right hand side which uses only p , q , and one or more of the logical connectives (\rightarrow , \wedge , \vee , \neg , \leftrightarrow).

- 1.3 Write a rule for the interpretation of "p unless q". Same rules as above except your Left-hand side will be:

$$\llbracket p \text{ unless } q \rrbracket = \text{-----}$$

2 Relations and arguments

2.1 Last week we stressed that you want to try to use a single relation consistently and as much as possible for each verb meaning.

We considered a simple account of sentences (a) and (b)

- (a) John embraced Marcia.
- (b) John and Marcia embraced.

a. John embraced Marcia.	embrace (j , m)
b. John and Marcia embraced.	embrace (j , m) & embrace (m , j)

This account says that the two sentences are not equivalent and translates *John and Mary embraced* with a conjunction that captures the reciprocity of the embrace. We will evaluate this account for *embrace* below.

Your immediate problem for this assignment is to apply this same account to the following examples: pairs:

- (a) John and Mary met.
- (b) John met Mary.
- (c) John and Mary married.
- (d) John married Mary.
- (e) The truck and the Volkswagen collided.
- (f) The truck collided with the Volkswagen.

2.2 First give the 6 translations that would be given for the 6 sentences above, if we gave each of these three verbs the same kind of account we gave *embrace*.

2.3 Now consider the following fact:

- (i) The truck collided with the lamppost.
- (ii) # The truck and the lamppost collided.

What this pair of sentences shows is that pairs like (i) and (ii) are not always paraphrases. There can be a semantic difference. Here's a potential explanation. Suppose we assume the following is an entailment of *collide*:

$$c. \text{ collide}(x, y) \implies \text{move}(x)$$

This says, if x collides with y , x is moving. Notice it only goes one way. Only x has to be moving. Thus the truck can collide with the lamppost without the lamppost moving. Notice also that we're not saying that y can't be moving. Thus, (f) above requires the truck to be moving, but it is consistent with the truck and the Volkswagen both moving. Now, suppose we apply the same method we used for translating sentences like *John and Mary embraced* to this one. Your task, use that translation and the entailment in (c) to explain why (ii) is odd.

- 2.4 We need to explain why *meet* and *collide* are not alike. The following entailment seems to be true of the *meet* predicate:

$$\forall x, y \text{ meet}(x, y) \iff \text{meet}(y, x) \tag{1}$$

Is (1) true also of *collide*? How is the contrast between (i) and (ii) relevant to answering this question? Is (1) true of *marry*? Is *marry* like *meet* or *collide*? Explain.

3 More translations

Translate the following. When you do these translations, keep in mind what you learned from doing part 2 of this assignment.

3.1 Jerry is Ben's brother.

3.2 Ben is Jerry's brother.

3.3 Ben and Jerry are brothers.

3.4 Jerry is Sheila's brother.

3.5 # Jerry and Sheila are brothers. [Note: you want a translation into logic that explains the anomaly of this sentence. But you will need to

assume some entailment is true of the predicate *brother*, as we did in 2.3c above. Give the translation, and write the entailment.]