Discrete Structures, Fall 2013, Homework 3

You must write the solutions to these problems legibly on your own paper, with the problems in sequential order, and with all sheets stapled together.

1. Translate each of the following English sentences into formal language – that is, using the symbols $\forall, \exists, \in$, etc. Use the following predicates: $E(s)$ means "s is an economics major," $C(s)$ means "s is a computer science major," and $M(s)$ means "s is a math major." Use the domain $D =$ the set of all students at Rhodes College.

   (a) There is an economics major who is also a math major.

   (b) Every computer science major is also an economics major.

   (c) No computer science majors also major in economics.

   (d) Some people majoring in CS are also majoring in math.

   (e) Some computer science majors are economics majors as well, but some are not.

2. Translate each of the following English sentences into formal language – that is, using the symbols $\forall, \exists, \in$, etc. You may define any predicates you wish, but you must list out what they mean along with your answers. *(You can define a predicate by saying something like: $J(z)$ means "z likes to play jazz piano.")*

   Then write the negation of each statement in English, then translate the negation into formal language. *(So for each problem below, you should be writing three separate parts.)*

   In your formal language statements, you may only use the domain $P =$ the set of all people. Furthermore, all negation symbols (i.e., $\sim$) must appear immediately in front of a predicate — you may not have a negation symbol immediately in front of a quantifier.

   (a) All people are tall.

   (b) All basketball players are tall.

   (c) Some people speak both English and Spanish. *Use two different predicates in this problem.*

3. Let $P(x, y)$ mean "person x plays instrument y," let S be the set of all people, and let I be the set of all musical instruments.

   Translate each of the following into English statements. Make your sentences as natural-sounding as possible, while still being precise in meaning.

   (a) $\forall x \in S\ \forall y \in I\ P(x, y)$

   (b) $\exists x \in S\ \exists y \in I\ P(x, y)$

   (c) $\forall x \in S\ \exists y \in I\ P(x, y)$

   (d) $\exists x \in S\ \forall y \in I\ P(x, y)$

   (e) $\forall y \in I\ \exists x \in S\ P(x, y)$

   (f) $\exists y \in I\ \forall x \in S\ P(x, y)$