Homework:

1. Here are two formulae in the language of first-order logic:

   (A): $\forall X \exists Y (X \geq Y)$

   (B): $\exists Y \forall X (X \geq Y)$

   (a) Assume that the variables range over all the natural numbers 0, 1, ..., ∞ and that the "$\geq$" predicate means "is greater than or equals to." Under this interpretation, translates (A) and (B) into English.

   (b) Is (A) true under this interpretation?

   (c) How about (B)?

   (d) Does (A) logically entail (B)?

   (e) Does (B) logically entail (A)?

   (f) Using resolution, try to prove that (A) follows from (B).

   (g) Using resolution, try to prove that (B) follows from (A).

2. Consider the robot in the delivery robot world.

   (a) Assume that in the initial situation, the door $door1$ is locked. What do we need to change in its situation calculus theory representation?

   (b) Assume that there are some renovation in the hallway along the rooms $r117, r115, r113$ which make these three rooms inaccessible to the robot (the robot cannot move there) and block the connection between the location $o109$ and *storage* (the robot cannot move from $o109$ to *storage*. Let us use the fluent $accessible(R)$ and $block(X, Y)$ to represent the fact that the room R is accessible to the robot and the path between X and Y is blocked. Modify the situation calculus theory of the delivery robot world to take into consideration of these new fluents. In particular, we assume that in the initial situation, the room $r117, r115, r113$ are inaccessible to the robot and the path between any $o109$ and *storage* is blocked. Assume also that we have the CWA. It would be helpful if you do this in the two steps:

      i. List all the changes that need to be made.

      ii. Make the changes.