8.1 Derive the *most general unifier* (MGU), if it exists, for the following pairs of logical sentences. State clearly your assumptions, if any.

   (i)   P(A, B, y, z) and P(x, y, z, B)

   (ii)   Knows(x, x) and Knows(Father(y), y).

8.2 The six logical sentences listed hereafter describe how and when certain people get sick during the year. Determine who will be sick in 2006 by repeatedly applying the Modus Ponens rule of inference in a backward chaining manner to the query: Sick(x, 2006)? Show in detail all successful as well as unsuccessful inference steps along with the necessary variable bindings.

   (1)   Sick(John, 2006)
   (2) $\forall y$, Sick(Mary, y)
   (3)   SitsNextTo(Ginger, Mary, 2006)
   (4) $\forall a,b,y$, SitsNextTo(a, b, y) $\wedge$ Sick(b, y) $\Rightarrow$ Sick(a, y)
   (5) $\forall a,b,y$, Parent(a, b) $\wedge$ HasCold(b, y) $\Rightarrow$ HasCold(a, y)
   (6) $\forall a,y$, HasCold(a, y) $\Rightarrow$ Sick(a, y)

8.3 You are to develop a rule-based expert system for locating faults in an electric network. You are told that: All devices are on if there is power and off otherwise. If the room is hot, the heater is working. If a device is on, connected to a fuse and the fuse is intact, but the device is not working, then it is broken. A fuse is intact if a device connected to it is working. If two different devices connected to the same fuse are on but not working, the fuse is not intact. A working device is clearly on.

   (a)   Translate the above statements first into First Order Logic sentences and then into conjunctive normal forms (CNF).

   (b)   The sample electric network illustrated below shows all available devices and how they are connected. In addition, it has been observed that all lights except Light-2 are working and the room is hot. Translate this information into facts and add them to your CNF knowledge base from part (a).
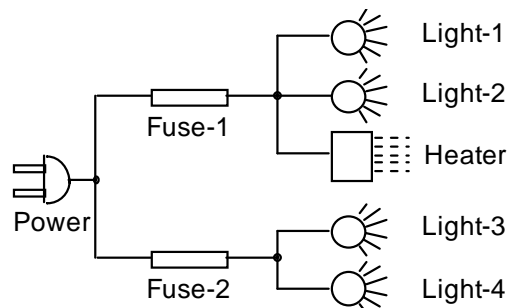
   (c)   Apply the resolution inference rule to your knowledge base from parts (a-b) and show a detailed proof for the query: Is Light-2 broken?