1) (8 pts) Sort the following Medium access layer protocols in terms of increasing network throughput: ALOHA, 0.5 persistent CSMA, slotted ALOHA, 0.1 persistent CSMA

ALOHA, slotted aloha, persistent CSMA, .5 persistent CSMA, .1 persistent CSMA

2) (10 pts) Answer the following questions concerning the differences between Shortest Path First and Link State Protocol?

Which uses more router memory? **Link state**

Which handles link additions better than failures? **SPF**

Which is typically used for local area 802.3 networks? **SPF**

Which generates more network traffic overhead? **Link State**

Which protocol handles router and link failures better? **Link State**

3) (6 pts) Which transmission media (copper, fiber, satellite, radio) would you use for the following network connections:

Data connection running through an electric arc scrap metal smelting yard **fiber or coax**

Periodic temperature measurements from automated equipment in Antarctica **polar satellite**

Underground pipe repair robot commands **wireless. Robots move and pipe makes great transmission waveguide.**

4) (4 pts) Would you use error detection or error correction bits in the following situations:
Satellite communications  *Error correction to avoid long RTT associated with retransmission.*

Local area network  *Error detection since retransmission is fast and cheap.*
5) When aircraft fly in clouds, they use navigational radios which have certain well defined accuracies and the radios are checked regularly to be sure they are operating within those known accuracies. In normal weather, an aircraft may be “flying blind” in clouds enroute to its destination, but typically it will descend below the clouds at the arrival airport, so for the last few minutes, while the airplane is closest to the maximum number of other airplanes near the airport, pilots can avoid each other by looking out the window. In particular, when aircraft are landing at a major airport, like Ohare, on parallel runways, ground controllers will identify other aircraft landing on the parallel runways to the pilots involved, who will verify they have each other in sight and then be responsible for not running into each other.

The problem with all this is that when the weather gets so bad that the clouds go all the way to the ground or there is fog, unless the parallel runways are further apart than the maximum operational inaccuracy of the radio navigation instruments, which is a very small number of parallel runways, airports must discontinue parallel approaches. This is the chief cause of “weather delays” when you are flying. It is not that modern commercial airliners can’t fly through, over or around weather, it is that landing operations have to be restricted to keep aircraft far enough apart that electronic navigational inaccuracies don’t cause them to bump into each other. The FAA is trying a solution to this now in which parallel landing operations are allowed within the typical navigational accuracies of the approach electronics, but beyond the maximum navigational inaccuracy. They are doing this by having a special controller who does nothing but stare at a radar screen and watch the separation between parallel approaching aircraft. This controller has the authority to order those aircraft to instantly turn away from the airport (normally pilots have the option of refusing a controller instruction.)

Let’s suppose this doesn’t work out and it is determined that an automated system is needed. Another engineer has designed a radar device which tells you when the airplanes are getting too close together. You are to design a system which transmits this information to the airplane and causes it to turn away from the airport. You will be using packet data radio transmission, which are not always reliable. You will create a program which runs on the ground and one which runs in the air. Assume that the packet data transmission circuit exists already, but is not reliable.

a) (10 pts) Draw a finite state automata which will handle the problem in a safe way.

b) (12) Write pseudo code for the airplane and the ground, which will take the output from the “emergency” radar box and transmit it to the airplanes so that at least one aircraft discontinues its approach when things go wrong. Be sure to handle the situation in which no data packets get through for an arbitrary amount of time. Since different runways are different distances apart, assume you are given a value SAFE_TIME, which will be the number of seconds for which an aircraft can safely fly without indication from the ground that things are ok.

I did one of these in class.