Spacecraft Mission Design
Assignment #2 Space Environment, Time Systems, Reference Frames

1) General Questions

a) Where is the geographic location (in Latitude, Longitude) of the Earth's magnetic North Pole?

b) What is the altitude range (in kilometers) of the Earth's Ionosphere? At what altitude is nearly all of the Earth's atmosphere below (>> 99%)?

c) What is the difference in seconds between the UNIX time epoch and the GPS time epoch?
Hint – How many of the years between the epochs were leap years?

d) What reference system do interplanetary probes often use?

2) Programming Exercises

Use the Program written for assignment 1 as a baseline and make the following changes.

a) Every 5 minutes collect 5 data points instead of 1.

b) Calculate and store the checksum of the data collected (the 5 points above) immediately after the collection only and store this value with the data.

c) Consider the possibility of data corruption as the satellite passes through the South Atlantic Anomaly. Let's say every second the satellite spends in this radiation environment holds a 0.001% chance that one of the data points will be corrupted. Assume the satellite spends 10 minutes in the SAA twice a day and use the binornd() function in Octave to determine how many data point are corrupted. Then corrupt this many data points from those collected.

d) In a separate program analyze the downlink file and identify any data collections that have been corrupted.

This assignment requires that you start looking at your simulation in 3 separate parts: 1) The spacecraft itself, 2) The ground station and 3) the external simulation environment. The external environment is often built into the spacecraft simulation but as separate functions. Design the "radiation error injector" above as a separate function that acts on spacecraft data without the spacecraft "knowing" what is happening.