**EE257/GP258** **Lab/Homework #1**
Applied Optimization Laboratory Handout #4
**Due: Thurs., Jan. 17**

We will be combining laboratory exercises with homework problems in the lab sessions for this course. In the scheduled lab times, begin working the set of material for each week. Complete as much as possible during the scheduled time, and finish the remaining material for homework. Both homework and lab results are to be written up and turned in each week, with electronic submission of data files as needed as we have discussed in class. The class web site is http://www.stanford.edu/class/ee257.

When you complete the exercise, turn it in using the submit script as described on the web page.

Problem 0 – Some introductory fortran90 examples. NOTE: you do not need to hand in this problem. These examples are intended to get you started with fortran 90. You can also do this in C or C++ if you wish to get started in the programming environment.

i. Download the zip file f90_examples.zip from the web page. The link on the web page is labeled 'Fortran 90 examples'. Unzip the archive.

ii. Start with the program helloworld.f90. Display the file, it should look like:

```
!  hello world in fortran 90

implicit none     ! make sure all variables must be declared

print *,'Hello world - fortran 90 version'

end
```

iii. Compile and link the program as follows:

```
gfortran helloworld.f90 –o helloworld
```

iv. Once you are satisfied with this program, try to run the other programs in the archive: helloworld_ntimes.f90, string_IO.f90, and binary_IO.f90. This should help you get started with fortran 90 coding.

Problem 1 – A raster display.

The file lab1prob1.dat contains a raster image file, but you do not know the number of lines, samples, or whether or not there are any header bytes for the file. For this problem,

determine these quantities and display the image. Save the result as a tiff image and turn in the tiff format file.

You may find it useful to use the disbyte and disbytefile programs for this problem.

Specifically,

i. Download the byte file lab1prob1.dat from the class web site.

ii. Determine the number of data bytes in each line, and the size of the header area.

iii. Display the image. Convert to tiff format and turn in the result.

Problem 2 - Quantization.

i. Read in the image file lab1prob2.dat from the web site.

ii. The file contains an image with 600 lines of 800 samples each, quantized to 5 bits. Convert this to an 8-bit image scaled properly for the computer display and examine the image for correctness.

iii. Convert to a tiff format and turn in.

Problem 3 – A laser altimeter map of Mars.

The file ‘delays’ in the web site contains a stream of data acquired by a laser altimeter orbiting Mars and measuring its topography. Each entry is the number of nanoseconds of delay referenced to a nominal reference Mars sphere of radius 3396200 m. Entries are measured every 20 seconds along the orbit.

The satellite is in a circular orbit around Mars at an altitude of 400 km. Mars’ day lasts 24 hours, 39 minutes, and 35.24 seconds. Mars’ mass is 0.64185 x 10^24 kg, and the gravitational constant is 6.67259 x 10^-11.

i. What are the period and velocity of the satellite orbit ?

ii. Download the file "delays" from the class web site, and create a topographic map of Mars.

iii. Display the resulting map as a shaded relief image.

For this exercise, submit two files: a topo map showing the elevations and a shaded relief map, both in tiff format. You may want to let the topo data “wrap” around the color table to form a contour map, as this displays the elevation data more clearly. If you create contours, be sure to specify what the contour interval is.