Homework #4 **Solution**
Geology 4113 (Remote Sensing)
Assigned Feb 16, 2018
Due February 23, 2018

1) Sabins #8.01: (10 points)

As shown in Fig. 8-1 a Landsat image has 5667 ×6167 pixels = 34.9×10^6 pixels per band, × 7 bands = 244.3×10^6 pixels per scene, using 30m×30m pixels. If the pixel size is reduced to 10m×10m then there will be 9 times as many pixels, giving 314×10^6 pixels per band and 2.20×10^9 pixels per scene. You can calculate those numbers either by just multiplying the original Sabins Landsat numbers by 9, or by dividing scene width and breadth by the 10m.

2) Sabins #8.02: (10 points) For #8.02 Sabin's doesn't actually tell you how many bytes AVIRIS uses per pixel. Assume it uses two bytes per pixel.

(The original pre-1994 version of the instrument actually used 10 bits (so 2^{10} = 1024 gray levels) per pixel while a later version used 12 bits (so 2^{12} = 4096) gray levels per pixel. Therefore if you allocate two 8-bit bytes = 16 bits per pixel total you will waste some storage space. However since most computers handle data in multiples of bytes it usually isn't worth the computational expense to repack the data int of fractions of bytes.

An AVIRIS image which covers 10.5 km × 10.5 km at 20 m resolution will have 10.5 km / 20 m = 10500 m / 20 m = 525 pixels on a side. This is a total of 525^2 = 275,625 pixels in an image. Most of the early data systems digitized the intensities using 8 bits (1 byte) per pixel, giving 256 gray levels. If AVIRIS used one byte per pixel (in a given wavelength band) then it would require 275,625 bytes per band, and since it has 224 spectral bands, it would require 275625 × 224 = 61,740,000 bytes (~62 megabytes) per image. However since it actually uses two bytes per pixel the data requirements will be twice the above, or 123,480,000 bytes ~ 123 megabytes.

The calibrated data is often stored in floating point format which requires 4 bytes per word, or 248 megabytes total. The AVIRIS data for the Goldfield NV. scene we will use in a later lab will occupy 412 megabytes.

A typical Landsat TM scene is 185 km EW × 170 km NS (numbers close to this are acceptable), so to cover this with AVIRIS would require 185 / 10.5 = 17.6 AVIRIS fields EW and 170 / 10.5 = 16.2 AVIRIS fields NS. In other words it would require 17.6 ×16.2 = 285 AVIRIS fields to cover the TM scene, giving a total of 123 megabytes × 285 = 35,055 megabytes ≈ 35.1 gigabytes, which would occupy 54 CDROM's.