Homework Assignment
Data Analysis I: Optical/Infrared
Due: 3:30 PM, Wednesday, November 1

For any of the questions involving calculations, you should show the details of these calculations. You will be graded not only on the answers that you provide, but on demonstration of the steps and reasoning involved in deriving those answers. **The shaded regions in tables should include values with appropriate numbers of significant digits.**

1. In the table below, record information about the noise characteristics of the images and the objects detected in those images. In Lab 8, you obtained the information for the J image. Repeat for the H and K images.

	J Image	H Image	K Image
Noise1 [ADU]			
Noise2 [ADU]			
Noise3 [ADU]			
Mean Noise, n [ADU]			
Std. Dev. of Noise, σ_n [ADU]			
Error in Mean Noise, Δn [ADU]			
Adopted Noise, $n \pm \Delta n$			
Intensity Threshold [ADU]			
FWHM estimate [pix]			
Number of Objects Detected			
Number of Objects Rejected by Inspection			
Number of Real Objects			

2. In the table below, record information about the standard star 2MASS 17104567-2715064 and the derived zero point offsets. In Lab 8, you obtained the information for the J image. Repeat for the H and K images. **For the purposes of this assignment, assume that the observed coordinates are known to within 0.00001 deg and the instrumental magnitudes are known to within 0.01 mag. While the 2MASS magnitude errors typically include several non-zero digits, each magnitude error should be considered to have only one significant digit. In turn, the position of this significant digit determines which digits in the 2MASS magnitude are significant.**

	J Image	**H Image**	**K Image**
Observed RA			
Observed Dec.			
mindist **[arcsec]**			
Instrumental Magnitude			
2MASS Magnitude			
2MASS Magnitude Error			
Zero Point Offset			

3. Choose three objects detected in the J image that are fainter at J than the standard star. Be sure that these three objects are also detected in the H and K images. Record their observed WCS coordinates (RA, Dec) and instrumental J magnitudes. Using the J zero point derived in Question 2, calculate the transformed J magnitude. **Adopt the same rules concerning significant digits for Question 2 for values recorded in the tables for Question 3.**

	Object 1	**Object 2**	**Object 3**
Observed RA			
Observed Dec.			
Instrumental J Magnitude			
Transformed J Magnitude			
Transformed J Magnitude Error			

For the *same three objects*, record in the tables below this information from the H and K observations.

	Object 1	Object 2	Object 3
Observed RA			
Observed Dec.			
Instrumental H Magnitude			
Transformed H Magnitude			
Transformed H Magnitude Error			

	Object 1	Object 2	Object 3
Observed RA			
Observed Dec.			
Instrumental K Magnitude			
Transformed K Magnitude			
Transformed K Magnitude Error			

4. Calculate the (J-K) and (H-K) infrared colors and errors of the three objects, and record in the table below. Using the ADS (recall the notes and assignment for Lecture 7), obtain the 1983 paper, "Near-infrared photometry II. Intrinsic colours and the absolute calibration from one to five micron," written by J. Koornneef and published in the **Astronomy & Astrophysics** journal. Assuming each of the three objects is a main-sequence star, refer to Table 3 in that paper to determine the range of spectral types that are consistent (to within the errors) with these observed colors for each object. Finally, for each object, determine the nominal main-sequence spectral type with colors that are most consistent with the observed colors for that object.

	Object 1	Object 2	Object 3
Observed (J – K), and Error			
Observed (H – K), and Error			
Range of Main Sequence Spectral Types			
Nominal Main Sequence Spectral Type			

5. Write an IDL procedure, named *find_source* (i.e., with filename of *find_source.pro*) that takes as input the following:

RA_source: the known RA of an "interesting" object
Dec_source: the known Dec of an "interesting" object
RA_array: an array of observed RA values for detected objects
Dec_array: an array of observed Dec values for detected objects
Mag_array: an array of observed transformed magnitudes for detected objects

The procedure then determines which detected object is nearest the known coordinates of the interesting object, and prints the observed RA (in decimal degrees), Dec (in decimal degrees), and magnitude of this nearest detected object. The procedure should also print the distance (in arcseconds) between the known position of the interesting object and the nearest detected object. **Print the procedure and attach to this homework assignment.**