ASTR 8060
Homework 1

Learning goals: become familiar with astronomical coordinate systems; Practice positional conversions in sexigesimal format; practice figuring out what is observable when; become familiar with common telescope facilities. Equip yourself as an observational astronomer with common calibration papers that will come in handy at an observatory.

1. Compute starting from their RA and Dec. the angular distance in arcseconds between Alcor and Mizar starting from their Right Ascension and Declination. Also compute their position angle, usually defined east of north (make the assumption of plane geometry, given that their separation is small, so no need to do spherical trigonometry).

2. Derive the law of cosines (Chromey equation 3.1) and then rewrite it in terms of RA and declination. Use this to determine the separations for which the assumption of plane geometry is valid. To do this, make a plot comparing separations calculated with the law of cosines and the plane geometry assumption and see where they diverge from one-to-one.

3. Using a tool such as the NASA/IPAC Extragalactic Database (NED) Coordinate Calculator, find the RA and DEC of:

   - Galactic Center
   - Galactic anti-center
   - Galactic North Pole
   - Galactic South Pole
   - The location(s) where the ecliptic crosses the Galactic Plane

   Commit these, roughly, to memory.

4. You're going observing on January 1, 2026 at Kitt Peak to follow up several binary supermassive black hole candidates from Charisi et al. (2016).

   Without resorting to any software, estimate approximately when, local time, the following objects will rise and set to within a couple hours. Use what you know about the Sun's track across the sky, and how its declination varies with seasons. Give the minimum airmass achieved by each object during that 24-hour period.

   - UM 269
   - SDSS J024442.77−004223.2
   - 2QZ J095344.7+010354

5. When you have completed the previous problem, check your answers using appropriate software. I recommend `pyskycalc` from ThorSky or this website. In either case, you should create a coordinate list including all the bold (i.e. significantly periodic) objects in Table 2 of Charisi et al. (2016). Then set the site, date, and time in the software and generate airmass (or altitude) plots for each target. Use these to check your answers for the objects in the previous problem.

6. Create a table of vital stats for NOIRLab telescope/imager combinations. This should be in a Google Sheet or similar online spreadsheet that everyone can access, and each student should contribute one telescope/instrument combination to it for this homework assignment. Possible telescopes are listed in Table 4.1 of NOIRLab's call for proposals, but be sure to include imagers for at least Magellan, Gemini North and South, the Blanco 4m, and SOAR. For each telescope/imager combination, include at least the following:

   - telescope full name (i.e. not the acronym)
   - location
   - aperture size
   - instrument full name
   - operational wavelength range or photometric bands
   - field of view
   - scale (arcsec/pix)
   - is there an exposure time calculator?
   - website link

7. Create an "observational notebook". This should include a directory on your computer where you can store useful references to access them at the telescope[1] and an electronic format for saving your notes (e.g., with software like Google Docs). For each paper below, write up a 2–3 sentence summary of the usefulness and contents of each paper in the context of this class. Are there other papers you'd recommend be in this list? For the websites, include a link and short description.

   - The Kitt Peak Direct Imaging Manual
   - Photometric Standards: Landolt, 1992, AJ, 104, 340
   - A User's Guide to Stellar CCD Photometry with IRAF: Massey & Davis, 1992
   - A User's Guide to CCD Reductions with IRA: Massey, 1997
   - Spanish Virtual Observatory (SVO) filter service

[1] Never assume that you'll have working internet at a telescope!