HOMEWORK #4
Due date: Oct 8, 2025

1. We want to figure out how bad this precession business really is. Estimate (roughly) by how much did right ascension and declination of the vernal equinox change since the discovery of precession in 120 B.C. Note that you cannot use the linearized equations we derived in class (why?).

2. If $\mathbb{N}$ and $\mathbb{E}$ are the equatorial and ecliptic poles, and X is the position of the star such that the angle $\mathbb{N}\hat{X}\mathbb{E} = 90°$, show that X has no precession in right ascension.

3. Say you need an additional 15 minutes to complete this assignment, but you are worried that, due to weather, you'll loose power and you won't be able to see. At what latitude should you go today to gain those 15 minutes of daytime due to refraction?

4. Tonight (Oct 1, 2025) we are going to observe the star Vega ($\alpha = 18^{\mathrm{h}}36^{\mathrm{m}}56.3^{\mathrm{s}}$, $\delta = 38°47'1''$) with a telescope located at Villanova ($\varphi = 40.0377°$ N, $\lambda = 75.3811°$ W). We will start observing when Vega crosses the meridian; when is that exactly? How high in the sky is Vega at that time? Do not forget to account for atmospheric refraction.

5. Show that the Sun is the shape of an ellipse if you assume a simple refraction law ($R = k \tan \zeta$).

6. *Extra credit:* I challenge you to a programming contest: write a program that will provide atmosphere-corrected alt-az and equatorial coordinates for a non-circumpolar star of choice from star-rise to star-set.