Week 2

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Reading

After the first week, now is the time to amp up our efforts a little bit. To make sure you know enough about the coordinate systems to work with the projects, please try to solve these problems. We will have a discussion session on Zoom where you can put forward how you solved it (remember that the only wrong answer is "I don't know", so try as much as you can, and put up what you have):

1. The star Sirius has a declination of -17°. At what latitudes will it (at some point in the course of one year)
   (a) Just be visible at the horizon (and never rise up beyond this)
   (b) Pass directly overhead
   (c) Never set (be circumpolar)

2. The four stars comprising the body of Pegasus (The Square) in the sky are:

Name	**RA**	**Dec**
α And	00^h08^m	+29°05'
β Peg	23^h04^m	+28°05'
α Peg	23^h05^m	+15°12'
γ Peg	00^h13^m	+15°11'

   Find the lengths of the diagonal of The Square.

3. A geosynchronous satellite orbits the Earth with a period equal to the period of rotation of the Earth. The height of these satellites is 35,786 km above the surface of the Earth. A satellite is put at an inclined synchronous orbit with inclination θ=6.69°to the equatorial plane. Calculate the value of maximum possible altitude of the satellite for an observer at a latitude of ϕ=51.49°.

   [**Taken from IOAA 2017**]

4. An observer in the Northern Hemisphere noticed that on the same day, the length of the shortest and longest shadow of a stick of length 1.00 m was 1.732 m and 5.67 m respectively. Find the latitude of the observer and the declination of the Sun on that day. Assume the Sun to be a point source, and neglect any atmospheric effects. [**Taken from IOAA 2016**]

5. Prove that the Celestial Equator cuts the horizon at azimuth 90°and 270°at any latitude (except the poles; what happens at the poles?). At what angle does the celestial equator cut the horizon at latitude ϕ?

Programming

1. Try to implement the solutions of the above questions using the ‘SkyCoord‘ class of ‘astropy.coordinates‘.

2. Write a function that takes in the latitude, time and equatorial coordinates and returns the horizontal coordinates. You may use ‘astropy.coordinates‘. If you write your own function, take care that you return angles in the correct quadrant (for RA/Azimuth). We will use this function later on in the project extensively.