# Assignment 1

**Due:** This assignment is due one week after the beginning of the term.

Answer the following questions to the best of your ability with or without consulting reference materials. When in doubt, make an intelligent guess. The goal is to stimulate thought, and to provide a yardstick against which you can compare your knowledge and way of thinking at the end of the term. Provide your answers in the space provided below each question.

1. Explain how a bicycle works. Does this have to do with navigation, or with guidance and control? Why do cyclists like lightweight wheels? What is the disadvantage of lightweight wheels? What does this have to do with the operation of a Segway scooter?
2. Name ten stars and five constellations.
3. If the moon rises at 6 PM on Monday, when does it rise on Tuesday?
4. What is UTC? How does it differ from GPS time?
5. How long is a year? How long does a bank think a year is?
6. What error did Microsoft make concerning the last February 29th leap day in early releases of key software packages?
7. Go outside on a clear night and sketch the positions of Cassiopeia and Ursa Major with respect to Polaris. Repeat this an hour later.
8. When you tie a necktie, and have to make several attempts to get it right (in terms of length), how fast does the error in length converge in terms of number of attempts and the residual error?
9. The same question, posed differently: A circuit board has 100 uniformly arranged power lines. If one of these lines is shorted, how many of the lines need to be disconnected in order to localize the fault? Assume that a single bus links the lines together, and this bus can be interrupted in places that disconnect all of the lines to the right of the point of interruption. (This will be explained in class.) What might this have to do with the distance an aircraft must be from a runway before it begins an instrument approach?
10. What is the relationship between a nautical mile and the circumference of the earth? How does this relate to a statute mile? Is there an analogous situation for how time is defined (seconds as part of a year, as opposed to seconds as a prescribed number of atomic vibrations)? What is a "knot" in terms of speed?
11. Is the earth spherical? What common mathematical technique used by electrical engineers to model perturbations to the earth’s gravitational field that result from deviations from the earth’s being a perfect sphere?
12. Who are July and August named after? What are the other months named after?
13. Why does an aircraft, in general, not point the direction in which it is flying?
14. When landing an aircraft, what does a pilot do to eliminate the crab angle?
15. What colors are the navigation lights on an airplane?
16. What is a "coordinated turn" in an aircraft?
17. Why can't you see Orion in July?
18. What is the Zodiac?
19. What effect was measured to obtain range information from Sputnik?
20. How many thunderstorms are there at any given instant on the planet?
21. Have navigation errors been blamed for any major plane crashes?
22. Why do pilots refer to altitudes as "flight levels"?
23. How many stars are considered suitable for navigation?
24. How might cell phones be tracked for purposes of improving the 911 system?
25. What general rule of designing a good mathematical algorithm does GPS routinely violate?
26. Why do navigators like Mercator projections? Why do aviators like Lambeth projections? What is the difference?
27. What effect do humans use for range-finding?
28. Where in the sky and at what time should you attempt to view the planet Mercury?
29. Why do the local weather reports include information on tides?
30. Look at the North star, and if visible: Venus, Mercury, Jupiter, its moons, Saturn, and if you have a telescope, its moons. Also plan to look at the International Space Station. Can you see Venus before the sun sets?