# 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?

The operation of a bicycle, I think, requires a hint of navigation but more so guidance and control. When a human operates a bicycle, he or she performs navigation through path planning which involves data input through the eyes to calculate things such as distance, curve, incline of a path, etc. Guidance and control are tightly coupled when operating the bicycle. The operator uses multiple feedback control systems internally to keep the bicycle upright and stable, relying on the concept of angular momentum as the key to balance. In addition, other sources of input to the operator feed other internal control loops such as the vestibular system for balance as well as eyes, ears, and touch to determine approximate speed.

I think lighter weighted wheels give you an overall less mass in the entire system, allowing for faster acceleration and looser handling. However, heavier wheels add more mass to the overall system which can slow a rider’s acceleration, but also increase traction and ultimately provide better control.

1. Name ten stars and five constellations.

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| Stars  - Sagittarius A \* (my favorite)  - Northern Star  - The Sun  - Alpha Centauri A  - Alpha Centauri B  - Betelgeuse  - Calvera  - Aldebaran  - Rigel  - VY Canis Majoris | Constellations  - Sagittarius  - Ursa Major  - Orion  - Cygnus  - Gemini |

1. If the moon rises at 6 PM on Monday, when does it rise on Tuesday?

According to <https://www.almanac.com/content/when-will-moon-rise-tonight> the moon rises approximately 50 minutes after the time it did the day before. Therefore, the moon would rise at about 6:50PM on Tuesday.

1. What is UTC? How does it differ from GPS time?

UTC stands for Universal Time Coordinated. This is the time that is gradually adjusted to include “leap seconds” as a way to stay in line with the Universal Solar Time. GPS time began on January 6th, 1980 and are controlled by atomic clocks.

1. How long is a year? How long does a bank think a year is?

A year, the Earth’s full single rotation around the Sun, is technically 365 days, 5 hours, 48 minutes, and 46 seconds (or roughly 365.25 days). As researched, a “Banker’s Year” is 12 x 30 days which is 360 days, something I did not know before!

1. What error did Microsoft make concerning the last February 29th leap day in early releases of key software packages?

Before looking it up, I thought Microsoft’s beta release of software had completely ignored leap years all together. Interestingly enough, this seems to have been a bug in their Excel applications where it incorrectly assumes the year 1900 is a leap year when it is not.

1. Go outside on a clear night and sketch the positions of Cassiopeia and Ursa Major with respect to Polaris. Repeat this an hour later.
2. 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?

For myself, there is rarely convergence… There are probably more methodical ways to putting on a tie that I should follow (eg. actually taking note of the starting length of the tie and adjusting accordingly).

1. 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?
2. 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?
3. 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?
4. Who are July and August named after? What are the other months named after?
5. Why does an aircraft, in general, not point the direction in which it is flying?
6. When landing an aircraft, what does a pilot do to eliminate the crab angle?
7. What colors are the navigation lights on an airplane?
8. What is a "coordinated turn" in an aircraft?
9. Why can't you see Orion in July?
10. What is the Zodiac?
11. What effect was measured to obtain range information from Sputnik?
12. How many thunderstorms are there at any given instant on the planet?
13. Have navigation errors been blamed for any major plane crashes?
14. Why do pilots refer to altitudes as "flight levels"?
15. How many stars are considered suitable for navigation?
16. How might cell phones be tracked for purposes of improving the 911 system?
17. What general rule of designing a good mathematical algorithm does GPS routinely violate?
18. Why do navigators like Mercator projections? Why do aviators like Lambeth projections? What is the difference?
19. What effect do humans use for range-finding?
20. Where in the sky and at what time should you attempt to view the planet Mercury?
21. Why do the local weather reports include information on tides?
22. 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?