Assignment 01

Due: Wednesday, May 17, 2017 at 10:00 a.m.

- Unless otherwise indicated by the question you may only use the built-in functions and special forms introduced in the lecture slides from CS115 up to and including the modules covered by this assignment. A list of functions described in each module of the lecture slides can be found on Learn.
- **For this assignment only, you are not required to use the entire design recipe when writing functions. In each case, you are only required to include the function header and body. You are *not* required to include the purpose, contract, examples or tests.**
- The solutions you submit must be entirely your own work. Do not look up either full or partial solutions on the Internet or in printed sources. Do not discuss assignment questions with classmates.
- Do not send any code files by email to your instructors or tutors. Course staff will not accept them as an assignment submission. Course staff will not debug code emailed to them.
- Test data for all questions will always meet the stated assumptions for consumed values.
- Read each question carefully for restrictions.
- Download the interface file from the course Web page to ensure that all function names are spelled correctly, and each function has the correct number and order of parameters.
- Check MarkUs and your basic test results to ensure that your files were properly submitted. In most cases, solutions that do not pass the basic tests will not receive any correctness marks.
- Read the course Web page for more information on assignment policies and how to organize and submit your work. Follow the instructions in the Style Guide. Your solutions should be placed in files a01qY.rkt, where Y is a value from 1 to 3.

Language level: Beginning Student
Coverage: Module 1

For this assignment you will be given mathematical formulae that you must convert into Racket functions. The file `a01interface.rkt` *contains the function header for each question. Define constants where appropriate.*

1. In algebra, a quadratic equation is any equation having the form

$$ax^2 + bx + c = 0$$

where *x* represents an unknown, and *a*, *b*, and *c* represent known numbers such that *a* is not equal to 0. The numbers *a*, *b*, and *c* are the *coefficients* of the equation, and may be distinguished by calling them, respectively, the *quadratic coefficient*, the *linear coefficient* and the *constant* or *free term*. The quadratic formula for the roots of the general quadratic equation is of the form:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Write the function `quadratic` that consumes the values of *a*, *b*, and *c* and produces a value of *x* according to the formula below. You may assume $b^2 > 4ac$.

$$x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

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2. The Lift Formula (*L*) in aerodynamics is given by the equation below. *L* is the lift, *c* is the lift coefficient, ρ is the density of the air, *A* is the surface area over which the air flows, and *V* is the velocity – a vector quantity based on the speed and direction.

$$L = c * \frac{\rho * V^2}{2} * \mathrm{A}$$

Write a Racket function `lift` that consumes a lift coefficient *c*, air density *rho*, velocity *V*, and surface area *A*, and produces the lift value.

3. In general relativity, the perihelion shift σ, expressed in radians per revolution, is approximately given by:

$$\sigma = \frac{24\pi^3 L^2}{T^2 c^2 (1 - e^2)}$$

where *L* is the semi-major axis, *T* is the orbital period, *c* is the speed of light, and *e* is the orbital eccentricity. The orbit is circular when *e* is 0; elliptic when 0 < *e* < 1; parabolic when *e* = 1, and hyperbolic when *e* > 1.

Write a function `perihelion` that consumes the values of *L*, *T*, *c*, and *e* and produces the perihelion shift value according to the given formula.

Note:

- **DO NOT USE** the inbuilt function *pi*.
- You should define *pi* (π) as a constant value of *3.141592*. Since *pi* is a Racket built-in constant, you should use a different name.