Assignment Guidelines.

- This assignment covers material in Module 2.
- Submission details:
  - Solutions to these questions must be placed in files a1q1.rkt, a1q2.rkt, and a1q3.rkt, respectively, and must be completed using Racket.
  - All solutions must be submitted to MarkUs. No solutions will be accepted through email, even if you are having issues with MarkUs.
  - Verify using MarkUs and your basic test results that your files were properly submitted and are readable on MarkUs.
  - For full style marks, your program must follow the CS115 Style Guide.
  - Be sure to review the Academic Integrity policy on the Assignments page.
  - Helper functions need design recipe elements but not examples and tests.
- When a function returns an inexact answer, use a tolerance of 0.0001 in your tests.
- Restrictions:
  - Unless the question specifically describes exceptions, you are restricted to using the functions and special forms covered in or before Module 2.
  - Read each question carefully for additional restrictions.
- 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.
Write your design recipe carefully.
  • Consider any restrictions on the input.
  • Use helper functions appropriately.

1. Quadratic Equation. The roots of a quadratic equation of the form \( y = ax^2 + bx + c \) are given by

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

The portion \( b^2 - 4ac \) is sometimes called the discriminant.

Exercise

Write two functions: `(root-plus a b c)` and `(root-minus a b c)`. Each function consumes three `Num`, and returns a `Num`. `root-plus` returns the more positive root of the equation, and `root-minus` returns the more negative root.

For example,

- `(root-plus 1 -8 15)` => 5
- `(root-minus 1 -8 15)` => 3
- `(root-plus 3 -6 1)` => #i1.81649658...
- `(root-minus 3 -6 1)` => #i0.183503419...

2. Bernoulli Equation. The Bernoulli equation describes the behaviour of incompressible fluids. In any given streamline,

\[
\frac{v^2}{2} + gz + \frac{p}{r} = \text{constant}
\]

Suppose for a given streamline that the constant is 12.3.

Exercise

Write a function `(bernoulli-p v g z r)` that consumes four `Num`, and returns the value of \( p \) for this streamline.

For example, if \( v = z = 0 \), \( r = 2 \), and \( g = 9.8 \),

- `(bernoulli-p 0 9.8 0 2)` => 24.6

3. Str. Read the documentation in DrRacket on the functions `min` and `max`, and review the documentation on `Str`. Some of these functions will be required to complete this question.

Exercise

Write a function `(pad3 n)` that consumes a `Nat` and returns a `Str`. The `Str` contains the digits of \( n \), with zeros added at the front to make it of length 3. Only the first three digits of numbers 1000 or greater are retained.

For example,

- `(pad3 7)` => "007"
- `(pad3 42)` => "042"
- `(pad3 245)` => "245"
- `(pad3 3141592)` => "314"

We will not discuss `cond` until Module 4. Do not use it on this assignment. The necessary effects can be achieved using some combination of `min`, `max`, and `Str` functions.

The `Str` documentation is on the course website, listed under `general resources`.