Assignment Guidelines.

- This assignment covers material in Module 10.

Submission details:
- Solutions to these questions must be placed in files a10q1.rkt, a10q2.rkt, a10q3.rkt, and a10q4.rkt, respectively, and must be completed using Racket.
- Unless otherwise indicated in the question you may use only 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 at https://www.student.cs.uwaterloo.ca/~cs115/built_in
- 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.
- 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.
- For the design recipe, helper functions only require a purpose, a contract and an example.

It is impossible to write tests for local functions. local functions only require a purpose and contract.

Restrictions:
- Read each question carefully for additional restrictions.

Do not compute any value more than once. For example, if \( n \) is the length of \( L \), the following code computes \( (\text{length } L) \) \( n \) times:

\[
(\text{define} \ (\text{addlen } L))
(\text{local} \ [(\text{define} \ (\text{add-len } x) (+ x (\text{length } L)))])
(\text{map} \ \text{add-len} \ L))
\]

Do not do this kind of thing; instead, use local constants.

Do not use lambda on this assignment. Use local helper functions instead.

Do not write any non-local helper functions on this assignment.

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.
1. Local Lists.

Write a function \((\text{add-max-min \ L})\) that consumes a non-empty \((\text{listof Int})\), and adds the smallest and largest value to each value in \(\text{L}\).

For example, in \((\text{list 2 3 5 7})\), the smallest value is 2, and the largest is 7, so we add \(2 + 7 = 9\) to each value, and return \((\text{list 11 12 14 16})\).

2. Zero-padding. You may use the built-in function \((\text{replicate \ n \ c})\) in this question.

\((\text{replicate 4 "0"}) \Rightarrow "0000"

Write a function \((\text{zero-pad \ L})\) that consumes a non-empty \((\text{listof Nat})\) and returns a \((\text{listof Str})\) where each value has been converted to a \(\text{Str}\), then enough zeros have been added so all the values are of equal length.

\((\text{zero-pad \ (\text{list 6 1245 42})}) \Rightarrow \text{(list "0006" "1245" "0042")}\)

Hint: Recall the \text{number->string} function.

3. \(z\)-score. The \(z\)-score is the number of standard deviations a value is from the mean.

Hint: Code to compute the mean and standard deviation is included in the notes for this module. You are encouraged to use this code as the basis for this assignment.
Since we are not using \text{lambda} on this assignment, start with code to compute standard deviation that does not use \text{lambda}.

Write a function \((\text{z-scores \ L})\) that consumes a \((\text{listof Num})\) and returns a \((\text{listof Num})\) representing the \(z\)-scores of the values in the list.

For example, the mean of \((\text{list 5 5 8 8 8 8 11 11})\) is 8. The standard deviation is \(\sqrt{\frac{(5-8)^2 + (5-8)^2 + (8-8)^2 + (8-8)^2 + (8-8)^2 + (11-8)^2 + (11-8)^2}{9}} = \sqrt{\frac{36}{9}} = \sqrt{4} = 2\)

Since the mean is 8 and the standard deviation is 2, the \(z\)-score of the 5s is \(-1.5\). So \(\text{(z-scores \ (list 5 5 8 8 8 8 11 11))} \Rightarrow \text{(list -1.5 -1.5 0 0 0 0 0 0 1.5 1.5)}\)

Further examples:
\(\text{(z-scores \ (list 8 4 8 4))} \Rightarrow \text{(list 1 -1 1 -1)},\) since the mean is 6 and the standard deviation is 2.

You may assume the standard deviation of the values is non-zero (include this as a requirement for your function). That is, it is OK if your function does not work for a list containing only one value, such as \((\text{list 8 8 8 8})\).

Hint: Create two \text{local} constants: the mean, and the standard deviation.