Mathematics 1110H – Calculus I: Limits, derivatives, and Integrals
TRENT UNIVERSITY, Winter 2021

Assignment #2
Solving Equations
Due on Friday, 5 February.

Submission: Scanned or photographed solutions are fine, so long as they are legible. Please try to make sure that they are oriented correctly – if they are sideways or upside down, they're rather harder to mark!Submission as a single pdf is strongly preferred, but other common formats are probably OK in a pinch. Also, please do not submit a file in one of `Maple`'s (or comparable program's) native format, though a printout of one to pdf would be more than acceptable. Please submit your solutions via Blackboard's Assignments module. If Blackboard does not acknowledge a successful upload, please try again. As a *last* resort, email your solutions to the instructor at: `sbilaniuk@trentu.ca`

The following problem was posed by the Indian mathematician Bhaskara (*c.* 1114–1185 A.D.) in a book dedicated to his daughter Lilavati:

> Seven times half the square root of a flock of geese was observed to march slowly away and two were seen fighting playfully in the water. Say, what was the number of geese?

For those interested in the history of mathematics, Bhaskara developed a number of techniques that anticipated portions of both differential and integral calculus.

1. Restate the problem given above as an equation. *[1]*

2. Solve the equation you obtained in **1** by hand. *[1]*

3. Solve the equation you obtained in **1** using `Maple`. *[1]*

Note: The basic tool you will need to do **3** is `Maple`'s `solve` command, which has many options and variations. Make sure to ask for help if you need it!

The *hyperbolic functions* include:

$$\sinh(x) = \frac{e^x - e^{-x}}{2} \qquad \cosh(x) = \frac{e^x + e^{-x}}{2} \qquad \tanh(x) = \frac{\sinh(x)}{\cosh(x)} = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$

$$\operatorname{csch}(x) = \frac{1}{\sinh(x)} \qquad \operatorname{sech}(x) = \frac{1}{\cosh(x)} \qquad \coth(x) = \frac{\cosh(x)}{\sinh(x)} = \frac{e^x + e^{-x}}{e^x - e^{-x}}$$

The names of these function are usually pronounced something like "sinch", "kosh", "tanch", "co-seech", "seech", and "kotch", respectively. Your main task in the rest of this assignment will be to investigate $\coth(x)$ and find its inverse.

4. Use `Maple` to graph $\coth(x)$. *[1]*

5. Use `Maple`'s ability to solve equations symbolically to find an expression for $\operatorname{arccoth}(x)$, the inverse function of $\coth(x)$. *[3]*

6. Work out an expression for $\operatorname{arccoth}(x)$ yourself. (If this is different from what `Maple` gave you in **5**, you may well be correct, but try to explain, if you can, why they amount to the same thing.) *[3]*