HOMEWORK 5, CPSC 303, SPRING 2020

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Please note:

(1) You must justify all answers; no credit is given for a correct answer without justification.
(2) Proofs should be written out formally.
(3) Homework that is difficult to read may not be graded.
(4) You may submit homework in groups of 1-3. You must acknowledge any sources (e.g., Wikipedia, other books, other articles) you have used beyond the textbook and the article(s) on the class website.

In these exercises, "the handout" refers to the article "CPSC 303: Remarks on Divided Differences," on the CPSC 303 homepage.

Write you solutions to the following problems concisely. Marks will be deducted if you submit 80 values—or even 40 values—of any output the MATLAB code below produces.

Note that from this point in class and on the homework, we identify

$$(v_1, \dots, v_n) \in \mathbb{R}^n$$

with the $n \times 1$ "column vector"

$$\begin{bmatrix} v_1 \\ \vdots \\ v_n \end{bmatrix}$$

(1) Run the MATLAB code:

```
for i=300:330, i, 10^(-i), end
```

   (a) For which i does MATLAB report 1.0000e-i for 10^{-i}?
   (b) For which i does MATLAB report 0 for 10^{-i}?

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(c) Why does MATLAB report 10^{-323} as 9.8813e-324 as opposed to 1.0000e-323 ? [Hint: Is 10^{-323} a normal number or a subnormal number in double precision?]

(d) One can check (but you don't have to) that MATLAB report

```
10^(-217) * 10^20 * 10^197 - 1
```

as 0, and if $217,197$ above are replaced with $n, n-20$ with $n = 1,\ldots,300$ then MATLAB reports this values as within $\pm 2.2204 \times 10^{-16}$; this seems reasonable, since this reflects roughly 53-bits of precision. But why does MATLAB report

```
10^(-317) * 10^20 * 10^297 - 1
```

as 2.3069e-07? [Hint: Are any of the numbers in this line of code subnormal?]

(2) Problem 2 (in the Exercise section) of the handout "Remarks on Divided Differences."

[You might also want to glance at Problem 1 to make sure that you understand the MATLAB code in Problems 2–4.]

(3) Problem 3 of the handout.

(4) Problem 4 of the handout.

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