

# CS 323 Homework 3

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For all theoretical assignments, you can turn in as either handwriting or typing in. For all programming assignments, please turn in your code along with a solution document. You can discuss questions with others, but the solutions/codes you submit must be entirely your own work, and please mention who you collaborated with in your homework.

**Software:** MATLAB / C++ /Python/Java (or any language that you are familiar)

**Due date:** Rutgers time: Mon March 29 2021 23:59 pm

**Theoretical assignment** Consider hyperbolic tangent function

$$\tanh(x) = \frac{\exp(x) - \exp(-x)}{\exp(x) + \exp(-x)}$$

where  $x \in [-2, 2]$ . Use 5 nodes to uniformly cut the interval  $[-2, 2]$  into 4 sub-intervals.

1. Note:
  - (a) Truncate all numbers to 3 decimal places (5 pts).
  - (b) Please submit only one single file (Pdf or word), including all the results (5 pts).
  - (c) To simplify the evaluation, such as inversion and all arithmetic calculations, you can use Matlab or the like as a calculator.
2. Show these 5 nodes  $(x, \tanh(x))$  (5 pts)
3. Use these 5 nodes as given data to form the Van der Monde matrix (10 pts.) and find a polynomial to interpolate these 5 nodes (10 pts). The specific procedure of formulating the Van der Monde Matrix is required.
4. Write down the the cardinal functions for these 5 nodes (20 pts), and use the Lagrange polynomials to interpolate these 5 nodes, show the polynomial (15 pts).

5. Based on these 5 nodes, use linear spline function to approximate  $f(x) = \tanh(x)$ ,  $x \in [-2, 2]$  (25 pts). The specific linear splines for each sub-intervals are required.
6. Based on these 5 nodes, use cubic spline function to approximate  $f(x) = \tanh(x)$ ,  $x \in [-2, 2]$  (25 pts). The specific cubic splines for each sub-intervals are required.