Name: _____

Date: _____

Collaborators: _____

(Collaborators submit their individually written assignments together, in class, in person)

| Question: | 1 | 2 | Total |
|---|---|---|---|
| Points: | 15 | 55 | 70 |
| Score: | | | |

**Instructor/grader comments:**

1. (15 points) I completed the tutorial Communicate using Markdown which is a part of Homework 2 assignment.

   Sign and date here: _____

2. Chebyshev polynomials is a particular form of *special functions* that are important in approximation theory and in numerical analysis in general.

   Chebyshev polynomials (of the first kind) are defined as follows:

   $$T_n(x) = \cos(n \arccos x), \quad -1 \le x \le 1. \tag{1}$$

   The polynomials are named after a mathematician Pafnuty Chebyshev. The letter $T$ is used because of the alternative transliterations of the name Chebyshev as Tchebycheff or Tchebyshev.

   Chebyshev polynomial $T_n(x)$ satisfy the following recurrence relations:

   $$T_{n+1}(x) = 2x\,T_n(x) - T_{n-1}(x), \quad n = 1, 2, \ldots, \quad T_0(x) = 1,\ T_1(x) = x. \tag{2}$$

   (a) (5 points) Accept the assignment in GitHub Classroom, launch the codespace, open the template of the notebook for the assignment `chebyshevplot.ipynb`.

   (b) (10 points) Use Markdown to fill in the blanks in the introductory part of the notebook.

   (c) (20 points) Write a function `mychebyshev(n,x)` that uses recurrence relations (2) and the values of $T_0(x)$ and $T_1(x)$ to calculate the value of a Chebyshev polynomial $T_n(x)$, $n = 2, 3, \ldots$. Use `for` loop in your code. Make sure that your function returns the correct values when called to calculate $T_0(x)$ and $T_1(x)$.

   Measure the time it takes to calculate $T_{50}(1.0)$. Repeat the calculations several times. If the time you measured is always larger than 0.01 seconds, you wrote the code wrong. (Refer to the class discussion on performance.) Do not proceed with the assignment until you fixed the performance problem.

   (d) (15 points) In the same notebook, use your function to plot, in one figure, the graphs of $T_2(x)$, $T_3(x)$, and $T_5(x)$ for $-1.0 \le x \le 1.0$. Use 200 data points per graph. Provide the legend, grid, title, and axes labels for the plot.

   Your plot should look similar to the sample below.

(e) (5 points) Clean the cells of your jupyter notebook, save and close the notebook. Delete unneeded notebooks if you created any (e.g. `Untitled.ipynb`). Commit all your changes to the project and push them to the assignment's GitHub repository.

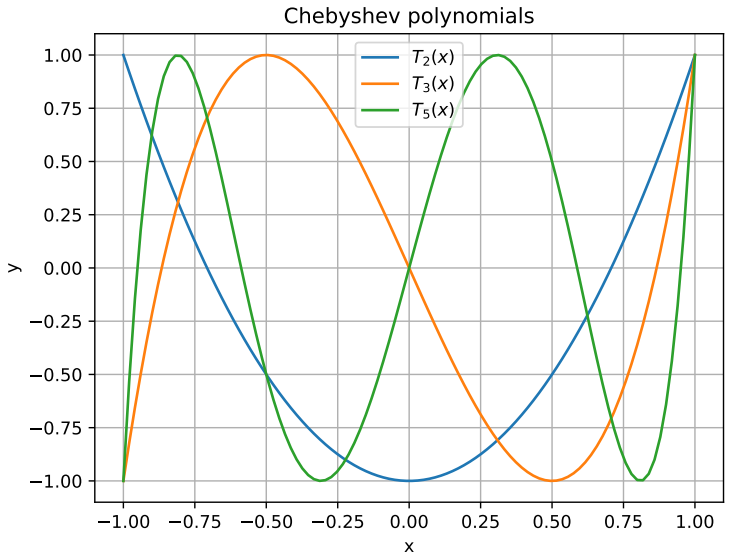


Figure 1: Expected graph in Problem 1. (colors online)