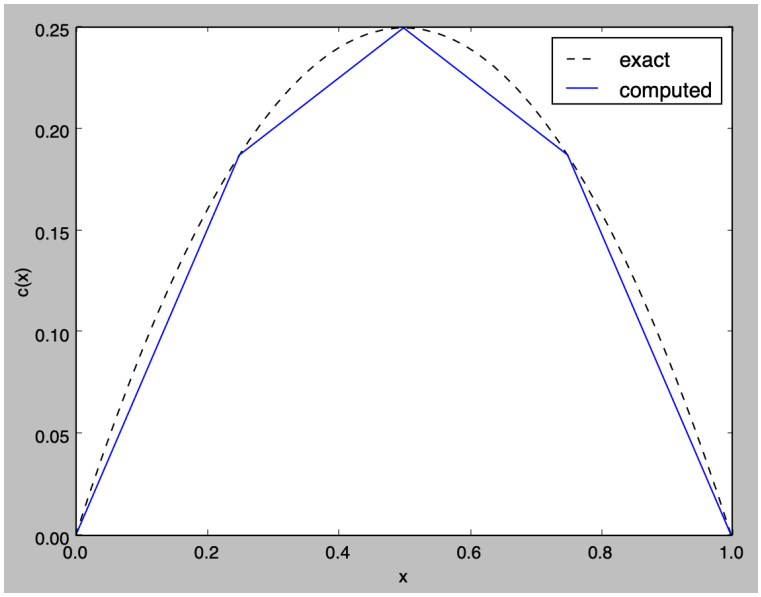
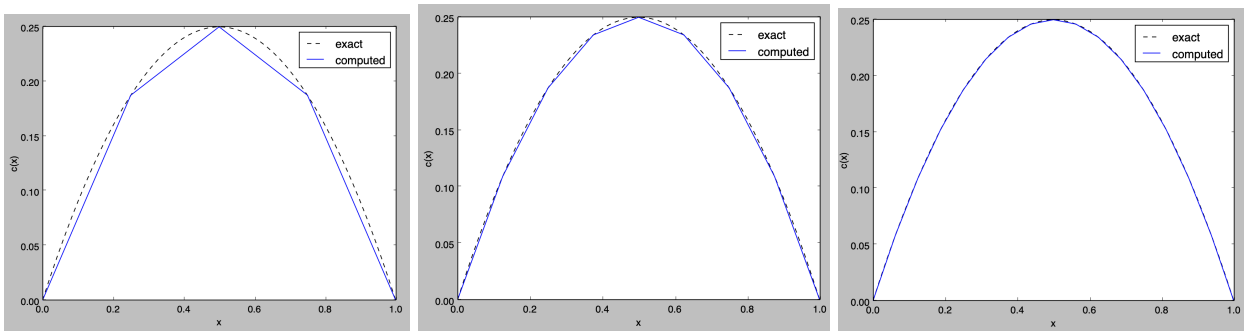
3. a) For mesh given in uniform4.npy and m = 2, the exact composition profile and the FEM solution:



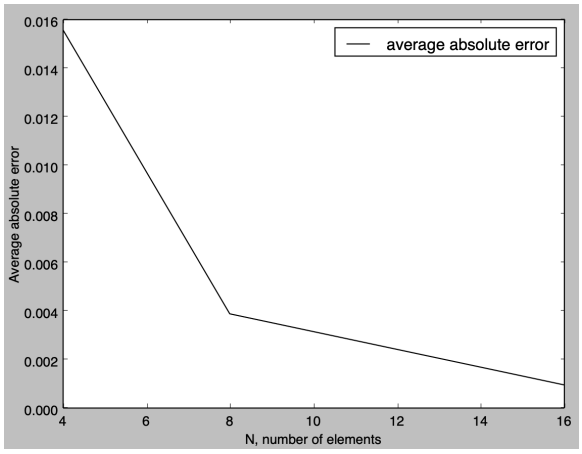
The average absolute error = 0.015625

b) Plot of exact composition profile and the FEM solution (uniform4.npy, uniform8.npy, uniform16.npy):



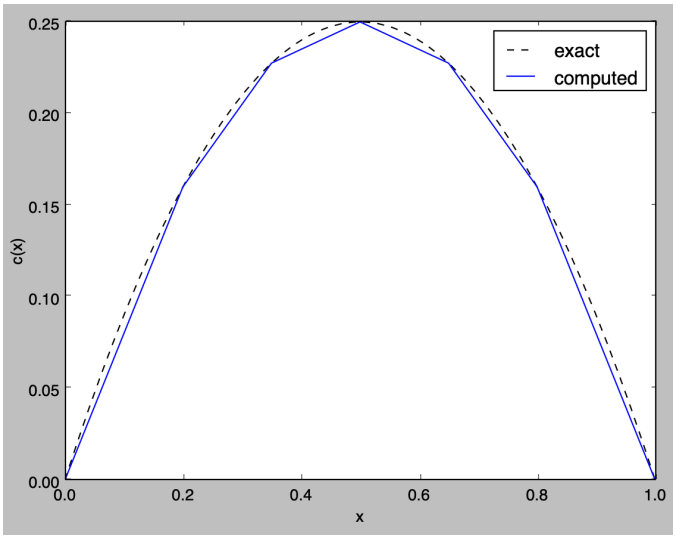
By inspection, we can see that the FEM solution approaches the exact solution as N increases; the FEM solution seems to be converging on the exact solution.

Plot of average absolute error as a function of the number of elements, N:



The error decreases as the number of elements increases. The average absolute error is decreasing by a factor of 4 as the number of elements are doubled.

c) For mesh given in nonuniform.npy, the plot is shown below:



The average absolute error is = 0.00708333333333.
From the plot in part (b), we can estimate that the average absolute error when we have 6 uniform elements is around 0.01. The average absolute error for 6 nonuniform elements is significantly lower.

d) The average absolute error for uniform16.npy is 0.0009765625.
[I couldn't get a solution with fewer than 16 elements]

deltX_i = [0.1, 0.08, 0.06, 0.06, 0.07, 0.03, 0.03, 0.03, 0.04, 0.04, 0.08, 0.08, 0.05, 0.05, 0.05, 0.07, 0.08]
Average absolute error = 0.000970588235294
Plot of exact composition profile and the FEM solution: