Math 43603/53803 – Numerical Analysis Fall 2024

Program 3

Due Friday, October 18, 2024

Write a subroutine to evaluate the Lagrange interpolant $P(x)$ for a set of knots $(x_i, y_i),\ i = 1 : n+1$, at the set of independent values $u_i,\ i = 1 : k$. The subroutine should take as input the knots as vectors x and y and the evaluation points as the vector u. Your code should return the values $P(u_i),\ i = 1 : k$ in the vector p. Your first line should be

```
function p = lagrangeval(x,y,u)
```

Notes

1. As usual, make sure you document your code and be careful about division by zero.
2. The test routine will use various values of n and k.
3. You will need to use Matlab's size (or length) function to find n and k.
4. You can use any method you like to find p, but there is pseudocode for Neville's method in section 3.2, and Divided differences in 3.3. You can directly evaluate the Lagrange expression if you like (using barycentric coordinates is fast and stable). While I don't recommend it, you can solve the Vandermonde system using the Matlab operator \, and evaluate the resulting polynomial using the built-in function polyval.
5. Matlab vectors begin with a first element, but our theory has been indexing with a zeroth; if you use our text or my notes, you will need to increment your indices by 1.
6. Optional: feel free to play with Matlab's plot routine to visualize your output.