A Matlab program for the nested multiplication method

Math 471

Once in Matlab, click on file - new - Mfile. A window will open and you should make the following function file and save it as nested.m in a directory where where you can access it. Matlab can access it anywhere, you may have to change directories in matlab to get to the file location. Ask me if you need help doing this. Everything after a **%** (per line) is ignored by matlab, however, the first set will be printed if you type **help nested**.

The first line: **function sol = nested(a,x)** tells matlab that this is a function file, all variables remain local, it accepts two input variables, and returns **R** to the calling location.

- Input:
  - a = $[a_o, a_1, a_2, \ldots, a_n]$ an n-vector of the coefficients of the polynomial
  - x = a real number at which to evaluate the polynomial
- Output: $P_n(x) = a_n x^n + a_{n-1}x^{n-1} + \ldots + a_1 x + a_0$

```
function R = nested(a,x)
% Input - a is a vector of coeffients of a polynomial P in increasing order
%         - x is the value at which to evaluate P
% Output - P(x)
%
n = length(a);                          % this finds the length of the a vector
b = zeros(1,n);                         %this builds an n-vector of all zeros
i = n-1                                 % initializes the index variable i
while i > 0                             % starts the while loop
   b(i) = a(i+1) + x*b(i+1);            % computes b(i) values
   i = i - 1;                           % reduces the index by 1
end                                     % ends the while loop
Q = b(1:n-1);                           % the coefficients of Q_{n-1}
R = a(1) + x * b(1);                    % the remainder term = P(x)
```

Go back to matlab and use this function to evaluate a few polynomials. Also type **help nested**. You should get the first set of comments. Notice, the line; **Q = ...**, which gets the first n-1 terms in b and places then in Q, is unecessary. However, if you replace the first line with **function [Q,R] = nested(a,x)** the function would then return a 2-vector: the first term being a vector of the coeffiecients of Q_{n-1} and the second term being $P_n(x)$. This is how you return multiple elements from a function.

Now download the file sample.m from the class website and put it in the same location of nested.m. In matlab, type **sample**. This will run the program file sample.m, which requests user input, calculates $P_n(x_1)$ using traditional and nested multiplication (calling the above function), requests some graphing input from the user and plots the polynomial. This particular file is intended to show you examples of the useful commands you will want to use in the future. Read over it and make sure you understand what each command is doing. Ask me if you are unsure of any of these commands.

There is a difference between a program file such as sample.m and a function file such as nested.m. A program file is just a list of commands and matlab goes through these commands as if they had been typed at the cursor. Specifically, the variables are no longer local to the function. Therefore, the command **clear** precedes all other commands so that previous results do not interfere with current calculations.