Department of Engineering Mathematics

EMAT20920: Numerical Methods in MATLAB

COURSEWORK ASSESSMENT

Jake Bowhay (UP19056)

All figures in this report have been saved using `saveFigPDF` function as it automatically resizes the paper to the correct size.

```
function saveFigPDF(fileName)
   % saveFigPDF saves open figure as a PDF file
   %
   % Inputs:
   %   fileName = File name to save figure as
   % Usage:
   %   saveFigPDF("polynomial") -> Saves current figure as polynomial.pdf

   % Get current figure handle
   figureHandle = gcf;
   % Resize paper
   set(figureHandle,'PaperPosition',3*[0 0 6 4]);
   set(figureHandle,'PaperSize',3*[6 4]);
   set(figureHandle,'PaperUnits','centimeters');

   print(fileName,'-dpdf');
end
```

Question 1: Root-finding

(a) To find how many solutions each equation has in the given domain I will rearrange all the equations to be equal to zero and then looks for the zeros of the rearranged equations. As a corollary to the intermediate value theorem, if a function is continuous and changes sign in a bracket then that bracket must contain a zero. So I will plot each of the rearranged equation and I look for appropriate brackets. I will use the `pltFunc` function to plot the functions as it removes values outside a defined limit which prevents MATLAB plotting discontinuous functions as continuous.

```
function pltFunc(f, xLim, discontLim)
   %pltFunc plots function f between values of xLim removing any values
   % that are greater than discontLim to prevent MATLAB plotting
   % discontinuous functions as continous
   %
   % Input:
   %   f = function handle to plot
   %   xLim = domain of function to plot
   %   discountLim = absolute values of the function greater than this are
   %   changed to NaN. Setting to inf will plot all values of the function
   %
   % Usage:
   %   pltFunc(@(x) 1./x, [-10 10], 5) -> Plots 1/x between -10 and 10
   %   changing the values where |1/x|>5 to Nan


   % Check xLim is the correct dimensions
   assert(isequal(size(xLim), [1 2]), "xLim must be a 1x2 array")
```

```
    %% Generate values to plot
    x = linspace(xLim(1), xLim(2));
    y = f(x);

    % Remove large values of y to prevent MATLAB plotting discontinuous
    % functions as continuous
    y(abs(y)>discontLim) = NaN;

    %% Plot function
    plot(x, y);
    xlabel("x");
    ylabel("f(x)");
    title("Plot of f(x)");
    grid on;
end
```

(i) test