Problem Set 5

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Question 2

Matlab Code:

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% ------------------------------------------------------------------------
% Matlab code for Problem Set 5 - Question 2
% Bi-sectioning algorithm
% ------------------------------------------------------------------------
% Bisectioning algorithm -
a = -10^6; % Start of interval
b = 10^6; % End of interval, adjust based on your knowledge of the function
tol = 10^-6; % Tolerance for the root's accuracy
maxIter = 1000; % Maximum number of iterations
root = bisectionMethod(a, b, tol, maxIter);
fprintf('Root found at: %f\n', root);
function root = bisectionMethod(a, b, tol, maxIter)
   % Define the function whose root we are trying to find
   f = @(x) ((exp(x / 200) * (sin((pi * x) / 500) + 2)) - 25);

   % Check if the initial interval is valid
   if f(a) * f(b) >= 0
       error('f(a) and f(b) must have different signs');
   end

   % Initialize the number of iterations
   iter = 0;

   % Main bisection algorithm
   while (b - a) / 2 > tol
       % Increment iteration count
       iter = iter + 1;

       % Prevent infinite loop
       if iter > maxIter
           error('Maximum iterations exceeded');
       end

       % Find midpoint
       c = (a + b) / 2;

       % Check if we have found the root or if the root is in the left or
right half
       if f(c) == 0
           a = c;
           break; % Exact root found
       elseif f(a) * f(c) < 0
           b = c; % Root is in left half
```

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        else
            a = c; % Root is in right half
        end
    end

    % Return the approximate root
    root = (a + b) / 2;
end
```

Output:

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>> q2
Root found at: 514.375738
```

Explanation:

The bi-sectioning algorithm is implemented from the algorithm mentioned in class. The limits are from -10^6 to 10^6 to include all possible roots of the given equation. I have used a tolerance of 10^-6 to ensure that the results are accurate.
Once the code returned the answer, I verified the same by substituting in the final equation.