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% NAME: ADITYA BARMAN
% UG1, ROLL: 002320601024
% PROBLEM 1. Write a computer code to solve the equation x^2 − 5log10(5x^2 + 2x + 3) = 0 using Bisection↙
method, correct to 6 significant figures.

clc, clearvars, close all

f = @(x) x .^ 2 - 5 * log10(5 * x .^ 2 + 2 * x + 3);
eps = 1e-6;

total_1 = 0;
total_2 = 0;

a_k = 2;
b_k = 3;

n = 0;
difference = 1;
fprintf('                         TABLE\n');
fprintf('k      a_k           b_k          m_(k-1)     f(a_k)f(m_(k-1))\n');

while difference > eps
   c = (a_k + b_k) / 2;
   if (f(a_k) * f(c)) < 0
      b_k = c;
   elseif (f(a_k) * f(c)) > 0
      a_k = c;
   else
      fprintf("The root of the equation is: %.7f\n", c);
   end
   total_1 = total_2;
   total_2 = c;
   difference = abs(total_1 - total_2);
   fprintf("%d      %f       %f      %f     %f\n", n, a_k, b_k, c, (f(a_k) * f(c)));
   n = n + 1;
end

fprintf("The root of the equation is: %.5f\n", total_2);

% ========================= OUTPUT ===================================

%                         TABLE
% k      a_k           b_k          m_(k-1)     f(a_k)f(m_(k-1))
% 0      2.500000       3.000000      2.500000     2.955643
% 1      2.750000       3.000000      2.750000     0.586742
% 2      2.875000       3.000000      2.875000     0.054110
% 3      2.875000       2.937500      2.937500     -0.011183
% 4      2.906250       2.937500      2.906250     0.008730
% 5      2.921875       2.937500      2.921875     0.000528
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% 6      2.921875      2.929688      2.929688     -0.000287
% 7      2.925781      2.929688      2.925781      0.000028
% 8      2.925781      2.927734      2.927734     -0.000019
% 9      2.926758      2.927734      2.926758      0.000001
% 10     2.926758      2.927246      2.927246     -0.000001
% 11     2.926758      2.927002      2.927002     -0.000000
% 12     2.926880      2.927002      2.926880      0.000000
% 13     2.926880      2.926941      2.926941     -0.000000
% 14     2.926910      2.926941      2.926910      0.000000
% 15     2.926926      2.926941      2.926926      0.000000
% 16     2.926933      2.926941      2.926933      0.000000
% 17     2.926937      2.926941      2.926937      0.000000
% 18     2.926939      2.926941      2.926939      0.000000
% 19     2.926940      2.926941      2.926940      0.000000
% The root of the equation is: 2.92694

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% NAME: ADITYA BARMAN
% UG1, ROLL: 002320601024
% PROBLEM 2. Write a computer code to solve the equation log10(x) − 2x^2 + 8 = 0 using Regula-Falsi method, ↙
correct to 8 significant figures.
% DATE: 27/02/24

clc, clearvars, close all

f = @(x) log10(x) - 2 * x.^2 + 8;
eps = 1e-9;

total_1 = 0;
total_2 = 0;

a_k = 2;
b_k = 3;
n = 1;
difference = 1;
fprintf('                          TABLE\n');
fprintf('k      a_k              b_k              m_(k-1)       f(a_k)f(m_(k-1))\n');

while difference > eps
   c = (a_k * (f(b_k)) - b_k * (f(a_k))) / (f(b_k) - f(a_k));
   if (f(a_k) * f(c)) < 0
      b_k = c;
   elseif (f(a_k) * f(c)) > 0
      a_k = c;
   else
      fprintf("The root of the equation is: %.7f\n", c);
   end
   total_1 = total_2;
   total_2 = c;
   difference = abs(total_1 - total_2);
   fprintf("%d      %0.9f      %0.9f      %0.9f     %0.9f\n", n, a_k, b_k, c, (f(a_k) * f(c)));
   n = n + 1;
end

fprintf("The root of the equation is: %.7f\n", total_2);


% ================================== ↙
OUTPUT====================================

%                          TABLE
% k      a_k              b_k              m_(k-1)       f(a_k)f(m_(k-1))
% 1      2.030642589      3.000000000      2.030642589     0.003674159
% 2      2.036773698      3.000000000      2.036773698     0.000145168
% 3      2.037990856      3.000000000      2.037990856     0.000005706
% 4      2.038232111      3.000000000      2.038232111     0.000000224
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% 5      2.038279916      3.000000000      2.038279916      0.000000009
% 6      2.038289388      3.000000000      2.038289388      0.000000000
% 7      2.038291265      3.000000000      2.038291265      0.000000000
% 8      2.038291637      3.000000000      2.038291637      0.000000000
% 9      2.038291710      3.000000000      2.038291710      0.000000000
% 10      2.038291725      3.000000000      2.038291725      0.000000000
% 11      2.038291728      3.000000000      2.038291728      0.000000000
% 12      2.038291729      3.000000000      2.038291729      0.000000000
The root of the equation is: 2.0382917

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% NAME: ADITYA BARMAN
% UG1, ROLL: 002320601024
% PROBLEM 3. Write a computer code to solve the equation 2x^2 + 5 = e^x using Newton-Raphson's method,↙
accurate to six decimal places in the interval [3,4].
% DATE: 05/03/24

clc, clearvars, close all

f = @(x) 2 * (x .^ 2) + 5 - exp(x)
d_f = @(x) 4 * x - exp(x);

xk(1, 1) = 3;
eps = 1e-7;
difference = 1;
counter = 2;

while difference > eps
   xk(1, counter) = xk(1, counter - 1) - (f(xk(1, counter - 1))) / d_f(xk(1, counter - 1));
   difference = abs(xk(counter) - xk(1, counter - 1));
   counter = counter + 1;
end

len_xk = length(xk);
k = 1 : len_xk;

fprintf("          TABLE\n");
fprintf("    k       xk        f(xk)\n");

for num = 1: len_xk
   fprintf("%5d    %10.6f  %10.6f\n", k(num), xk(num), f(xk(num)));
end

fprintf("The root of the equation is %.6f\n", xk(len_xk));

% ================= OUTPUT ================

% f =

%   @(x)2*(x.^2)+5-exp(x)

%          TABLE
%   k       xk        f(xk)
%   1     3.000000    2.914463
%   2     3.360454   -1.216960
%   3     3.281227   -0.075500
%   4     3.275628   -0.000354
%   5     3.275601   -0.000000
%   6     3.275601   -0.000000
% The root of the equation is 3.275601
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