Table of Contents

Assignemnt - 4

Secant

```
% Name         : Mohamed Mafaz
% Roll Number : AM25M009
% Department   : Applied Mechanics

clc;
clear;
close all;
```

Part 1 (Preprocessing)

```
x0 = 10;
x1 = 9;
tol = 1e-6;

root_true = 1;

syms x
f = @(x) (x-1) * (exp(x-1) - 1);

rel_error = inf;
loop = 0;
iter_arr = [];
err_arr = [];
```

Part 2 (Processing)

```
while rel_error > tol
    x2 = x1 - (f(x1) * (x1 - x0)) / (f(x1) - f(x0));

    rel_error = abs((x2 - x1) / x2);

    % Update values for next iteration
    x0 = x1;
    x1 = x2;
    loop = loop + 1;

    iter_arr(loop) = loop;
    err_arr(loop) = abs(x2 - root_true);
```

```
    fprintf("Loop: %d | c: %f\n", loop, x2);
end
```

```
Loop: 1 | c: 8.514260
Loop: 2 | c: 7.849599
Loop: 3 | c: 7.263247
Loop: 4 | c: 6.657108
Loop: 5 | c: 6.070337
Loop: 6 | c: 5.490465
Loop: 7 | c: 4.925553
Loop: 8 | c: 4.377068
Loop: 9 | c: 3.850557
Loop: 10 | c: 3.352014
Loop: 11 | c: 2.889406
Loop: 12 | c: 2.471689
Loop: 13 | c: 2.107762
Loop: 14 | c: 1.804321
Loop: 15 | c: 1.563650
Loop: 16 | c: 1.382442
Loop: 17 | c: 1.252555
Loop: 18 | c: 1.163307
Loop: 19 | c: 1.103994
Loop: 20 | c: 1.065527
Loop: 21 | c: 1.040999
Loop: 22 | c: 1.025536
Loop: 23 | c: 1.015859
Loop: 24 | c: 1.009831
Loop: 25 | c: 1.006087
Loop: 26 | c: 1.003766
Loop: 27 | c: 1.002329
Loop: 28 | c: 1.001440
Loop: 29 | c: 1.000890
Loop: 30 | c: 1.000550
Loop: 31 | c: 1.000340
Loop: 32 | c: 1.000210
Loop: 33 | c: 1.000130
Loop: 34 | c: 1.000080
Loop: 35 | c: 1.000050
Loop: 36 | c: 1.000031
Loop: 37 | c: 1.000019
Loop: 38 | c: 1.000012
Loop: 39 | c: 1.000007
Loop: 40 | c: 1.000004
Loop: 41 | c: 1.000003
Loop: 42 | c: 1.000002
Loop: 43 | c: 1.000001
```

Part 3 (Post Processing / Plotting)

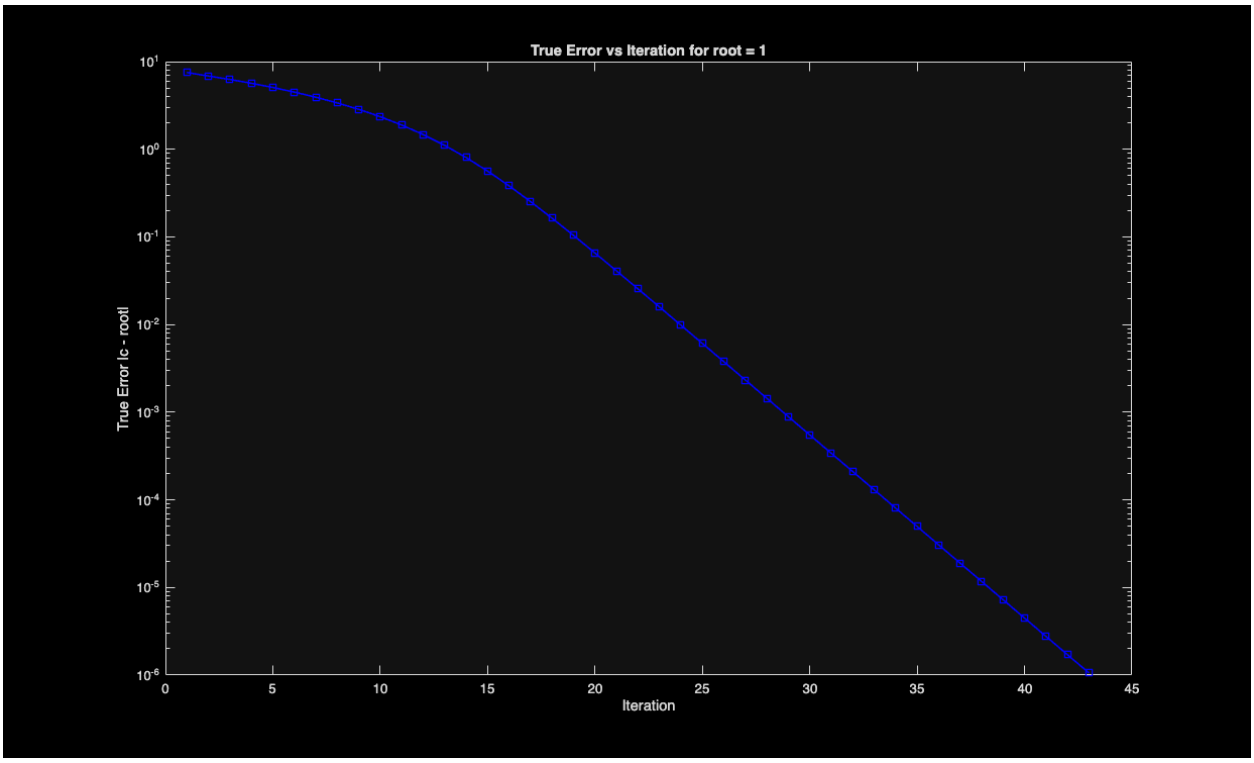
```
% Plot true error in semilog scale
semilogy(iter_arr, err_arr, 'b-s', 'LineWidth',1.2);
xlabel('Iteration');
```

```
ylabel('True Error |c - root|');
title("True Error vs Iteration for root = 1");

% Estimate order R from last few iterations
Rvals = zeros(1,length(err_arr)-2);
for k = 3:length(err_arr)
    Rvals(k-2) = log(err_arr(k)/err_arr(k-1)) / log(err_arr(k-1)/
err_arr(k-2));
end

R_est = mean(Rvals);  % mean of last few
fprintf('\n\nEstimated order R = %.4f\n', R_est);
```

Estimated order R = 1.0425



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Assignemnt - 4

Newton Ralphson

```
% Name         : Mohamed Mafaz
% Roll Number : AM25M009
% Department   : Applied Mechanics

clc;
clear;
close all;
```

Part 1 (Preprocessing)

```
x0 = 10;
tol = 1e-6;
max_loop = 100;

root_true = 1;

syms x
f_sym = (x-1) * (exp(x-1) - 1);
% f_sym = (x-1)*(x-2);
df_sym = diff(f_sym);

% Convert back to function
f = matlabFunction(f_sym);
df = matlabFunction(df_sym);

rel_error = inf;
loop = 0;

iter_arr = [];  err_arr = [];
```

Part 2 (Processing)

```
while rel_error > tol
    x1 = x0 - f(x0)/df(x0);

    rel_error = abs((x1 - x0) / x1);

    x0 = x1;
```

```
    loop = loop + 1;

    iter_arr(loop) = loop;
    err_arr(loop)  = abs(x1 - root_true);


    fprintf("Loop: %d | c: %f\n", loop, x1)
end
```

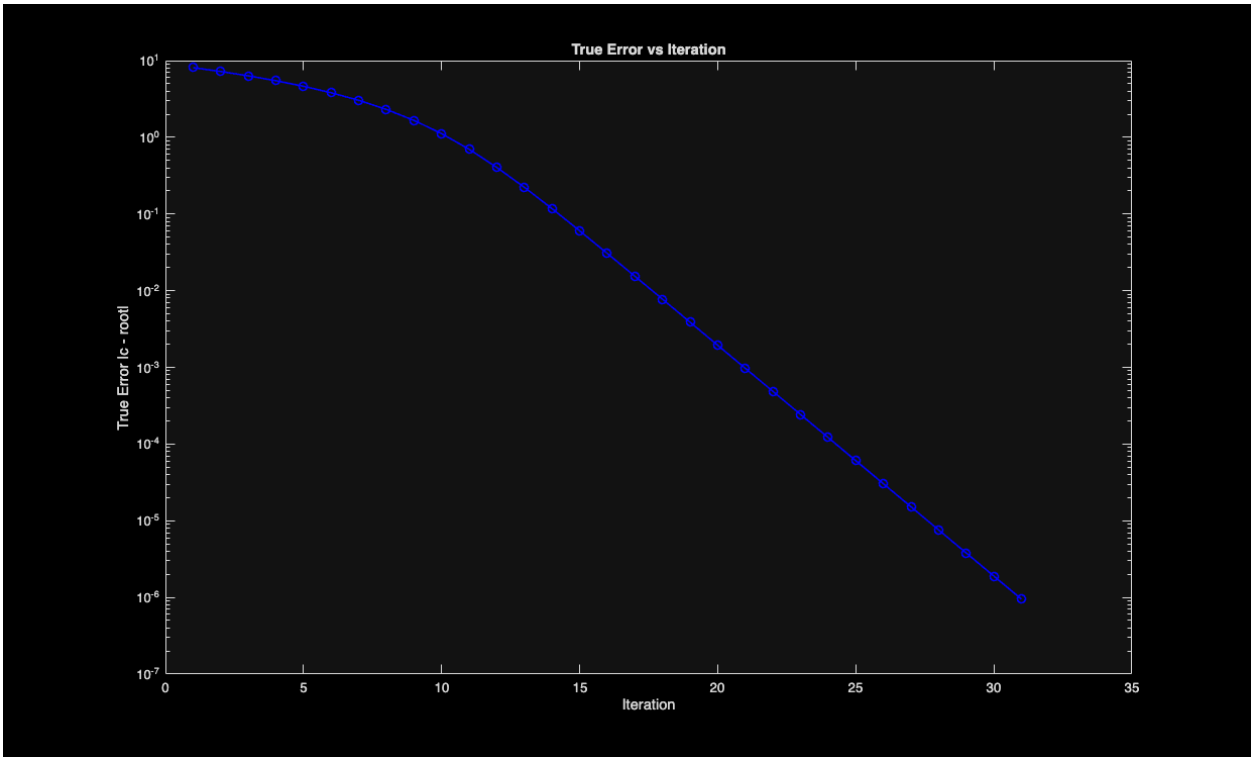
```
Loop: 1 | c: 9.100100
Loop: 2 | c: 8.210229
Loop: 3 | c: 7.332599
Loop: 4 | c: 6.470302
Loop: 5 | c: 5.627865
Loop: 6 | c: 4.812174
Loop: 7 | c: 4.033914
Loop: 8 | c: 3.309364
Loop: 9 | c: 2.661401
Loop: 10 | c: 2.116820
Loop: 11 | c: 1.697003
Loop: 12 | c: 1.405207
Loop: 13 | c: 1.222372
Loop: 14 | c: 1.117247
Loop: 15 | c: 1.060324
Loop: 16 | c: 1.030615
Loop: 17 | c: 1.015424
Loop: 18 | c: 1.007742
Loop: 19 | c: 1.003878
Loop: 20 | c: 1.001941
Loop: 21 | c: 1.000971
Loop: 22 | c: 1.000486
Loop: 23 | c: 1.000243
Loop: 24 | c: 1.000121
Loop: 25 | c: 1.000061
Loop: 26 | c: 1.000030
Loop: 27 | c: 1.000015
Loop: 28 | c: 1.000008
Loop: 29 | c: 1.000004
Loop: 30 | c: 1.000002
Loop: 31 | c: 1.000001
```

Part 3 (Post Processing / Plotting)

```
semilogy(iter_arr, err_arr, 'b-o', 'LineWidth',1.2); hold on;
xlabel('Iteration');
ylabel('True Error |c - root|');
title('True Error vs Iteration');


% R = [ ln(e_n+1 / e_n) ] / [ ln(e_n / e_n-1) ]

Rvals = zeros(1,length(err_arr)-2);
```

```
for k = 3:length(err_arr)
    % Rvals(k-2) = log(err_arr(k)/err_arr(k-1)) / log(err_arr(k-1)/
err_arr(k-2));
    Rvals(k-2) = abs(log(err_arr(k)/err_arr(k-1)) / log(err_arr(k-1)/
err_arr(k)));
end

R_est = mean(Rvals);  % mean of last few
fprintf('\n\nEstimated order R = %.4f\n', R_est);
```

Estimated order R = 1.0000



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