Math 131 Midterm 1

Martin Urueta

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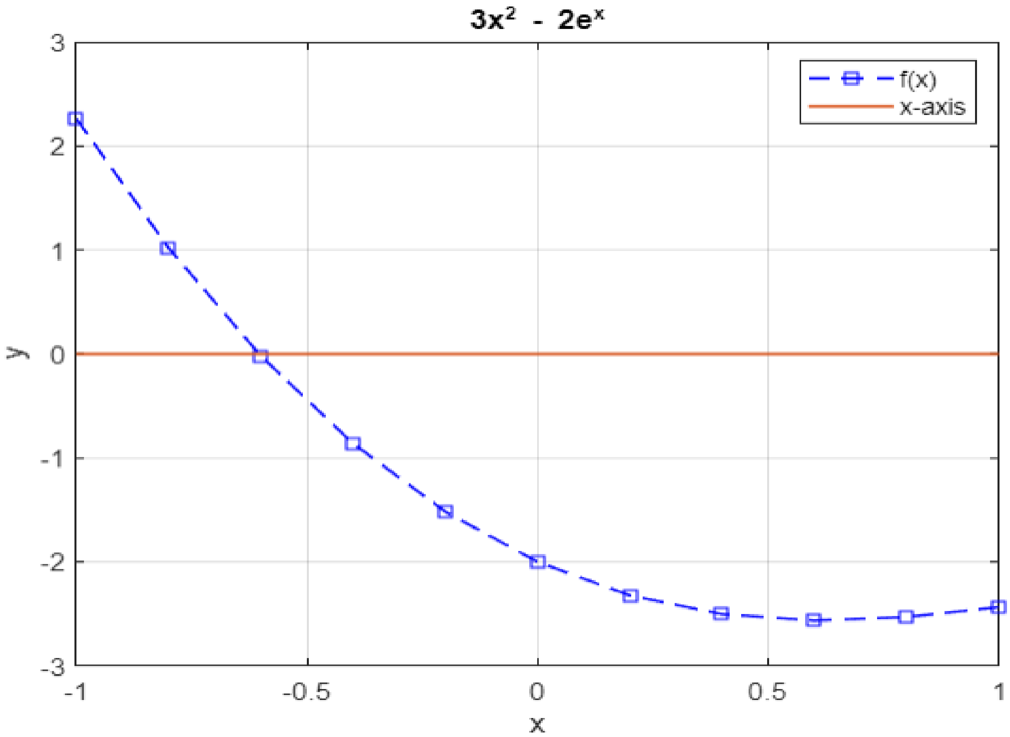
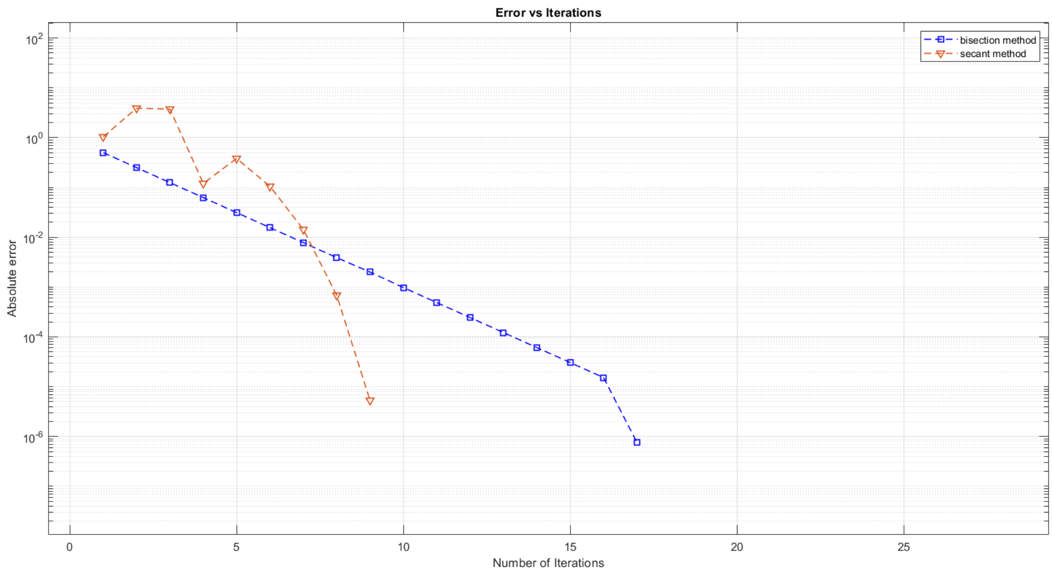
1.

a. Plotting the function, we can see there is one root that is equal to zero



i. Using the bisection method, on f(x) in interval [-1, 1] results in finding the root -0.6037 in 17 iterations

ii. Using the secant method, on f(x) in interval[-1, 1] results in finding the root -0.6037 in 8 iterations



b. For the interval [-1, 1] and the tolerance 10^-5 the minimum iterations estimate is 18 iterations for bisection method but the method converged in 17

$$\frac{|b-a|}{2^N} < \epsilon$$

$$\frac{|1-(-1)|}{2^N} < 10^{-5}$$

$$\frac{log(2*10^5)}{log(2)} < N$$

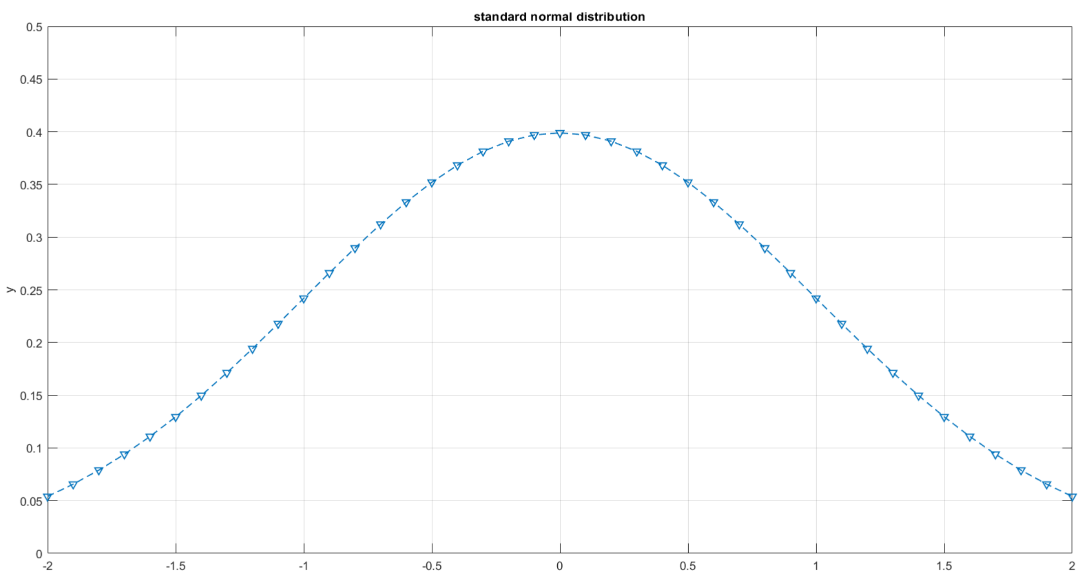
$$17.61 < N$$

$$18 \approx < N$$

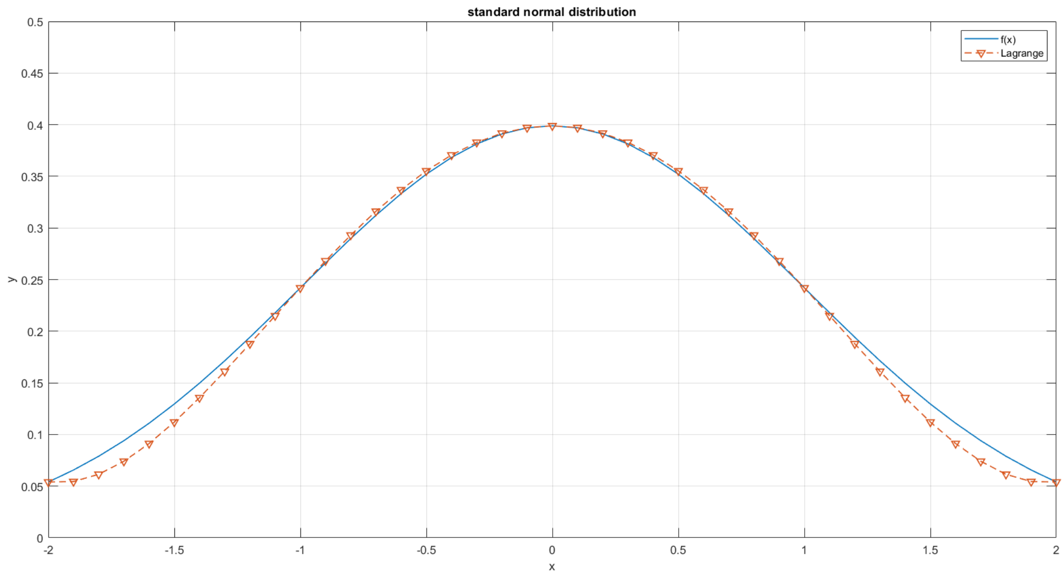
For the secant method converges quadratically, that means that it is expected to converge faster compared to bisection. From the red line we can see the error decreases faster within each iteration. It converges 2 times faster than bisection.

2.

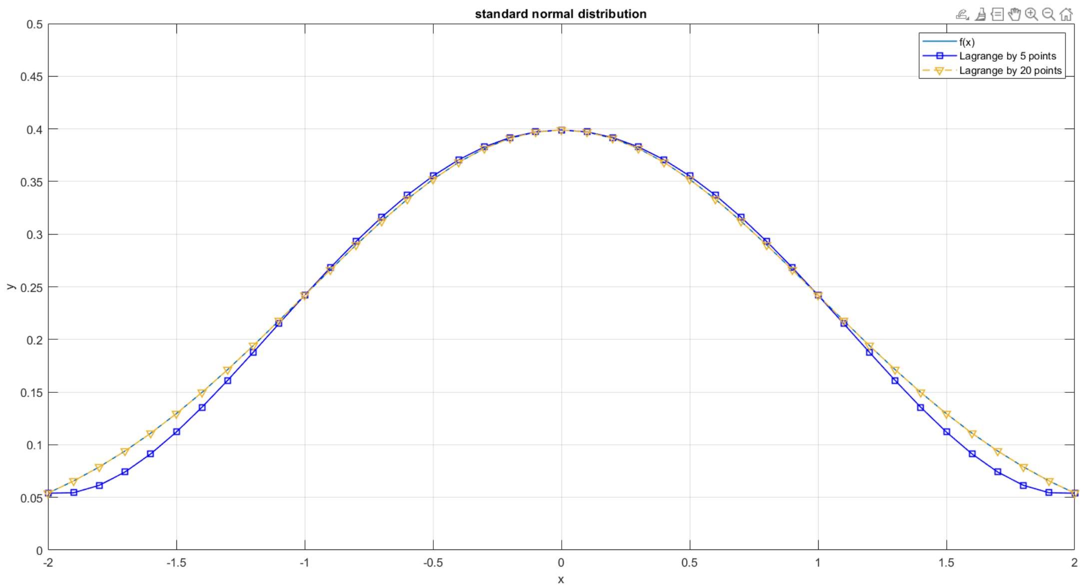
a.



b. Using Lagrange with 4 subintervals on the interval [-2,2]. The interpolating points we used is [-2, -1,0,1,2] and evaluated at x = [-2:.1:2] for plotting



c. Using Lagrange with 20 subintervals on the interval [-2,2]. The interpolating points we used is [-2, -1.8,-1.6,-1.4,......,1.4,1.6,1.8,2] and evaluated at x = [-2:.1:2] for plotting. As we increase the subintervals, we get a good approximation of f(x), but as we decrease the subintervals, we can observe Runge's phenomenon. From this graph we can see that it is overall a good approximation of f(x).



3.

a.