# Problem 2

Aerospace engineers sometimes compute the trajectories of projectiles such as rockets. A related problem deals with the trajectory of a thrown ball. The trajectory of a ball thrown by a right fielder is defined by the (x, y) coordinates as displayed in Fig. 1. The trajectory can be model

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A diagram of a curve

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1. Find the appropriate initial angle θ0, if v0 = 30 m/s, and the distance to the catcher is 90 m. Note that the throw leaves the right fielder’s hand at an elevation of 1.8 m and the catcher receives it at 1 m. Use 𝜀𝑠 = 0.01%

Given:

v0 = 30/ms

y0 = 1.8m

y = 1m

g = 9.81 m/s2

We can use the following code to find our first initial angle for θ0:

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Using these as our θ0:

[xL, xu] = [0.661967, 0.663540]

For the Bisection method, we get the following:

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We can se here that both the root and the error are able to converge.

For the False Position method, we get the following: A screenshot of a computer

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For the fixed-point iteration method, we have to derive our g(x) first before using the method. The following code is used for the g(x) of the equation:

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This equation will then be used for the fixed-point iteration method, along side the same initial value for x0:

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Moving on, for the newton method, we first need to find the derivative of the equation. After that, we can plug it into code like so:

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Then, we just pass the same initial guess as always:

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Using the secant method:

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Using Modified Secant:

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Using `fzero` from Octave:

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Lastly, the Muller method:

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1. Repeat part a using different initial guesses (3 different values where applicable).

Using a different initial guess:

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Using a second value closer to the first initial guess using in (a):

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1. Plot a graph of the approximation percentage error for all the used algorithms in part a.

All plots in (a) and (b) include Root Estimation plot and Error Approximation plot.

1. Which algorithm is the fastest?

The fastest algorithm is the Newton algorithm as it is the fastest to reduce the error to approximate a value, and the one that takes the least amount of iterations.