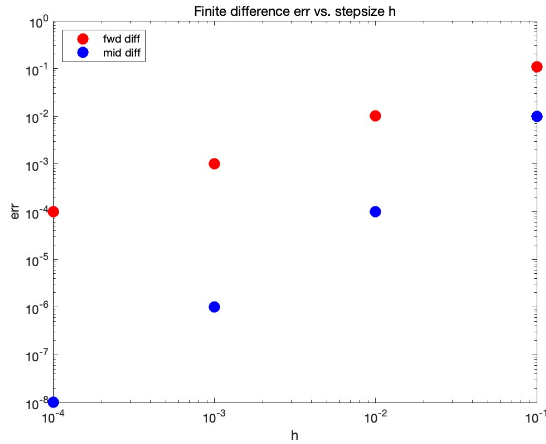

Figure 1: Plot of P2

Problem 1.

- $p'(x) = 3x^2 - 10x + 7$ and we have $p'(2) = 3 \times 2^2 - 10 * 2 + 7 = -1$
- Using $\epsilon^2 = 0$, we have

$$\begin{aligned} p(2+\epsilon) &= -2 + 7(2+\epsilon) - 5(2+\epsilon)^2 + (2+\epsilon)^3 \\ &= -2 + (7 \times 2 + 7\epsilon) - (5 \times 2^2 + 5 \times 4\epsilon) + (8 + 3 \times 4\epsilon) \\ &= (-2 + 7 \times 2 - 5 \times 2^2 + 2^3) + \epsilon(7 - 5 \times 4 + 3 \times 4) \\ &= 0 - \epsilon \end{aligned}$$

So we have $p'(x_0 = 2) = -1$

Problem 2.

In this problem, the main function is comparePlot.m. And the test is included in this function. The testing and plotting program is **P2test.m**. I used 1×10^{-5} as tolerance, so some of the tests failed. And I got the figure 1.

Problem 3.

- We have $y = \tanh(x)$ then $y' = 1 - \tanh(x)^2$

$$f'(x) = \tanh\left(\frac{x - x_0}{\sigma}\right) + \frac{x}{\sigma}\left[1 - \tanh^2\left(\frac{x - x_0}{\sigma}\right)\right]$$

- We have

$$f'(x) = \frac{2(x - x_0)}{\sigma}\exp\left(\frac{-(x - x_0)^2}{\sigma}\right)$$

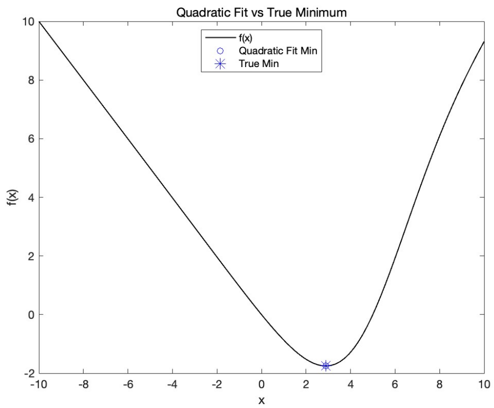

Figure 2: P3 Nice

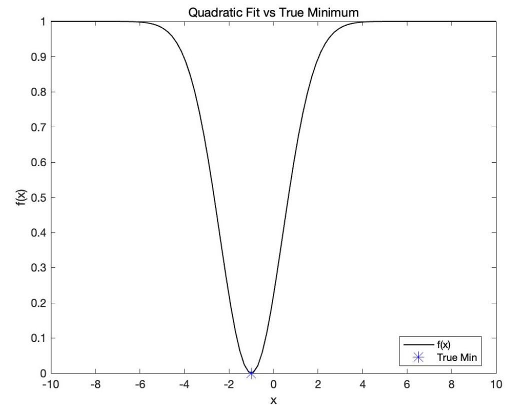

Figure 3: P3 nasty

In this problem, the main function is quadratic_fit.m. Two working program is **test_nice.m** and **test_nasty.m**. In test_nasty.m, if it fail to get a number, it will just plot the true value by fsolve(). It should looks like 2 and 3.

Problem 4.

In this problem, the main function is brents_method.m. And the working and testing program is **P4_test.m**. The result should be like figure 4 and 5.

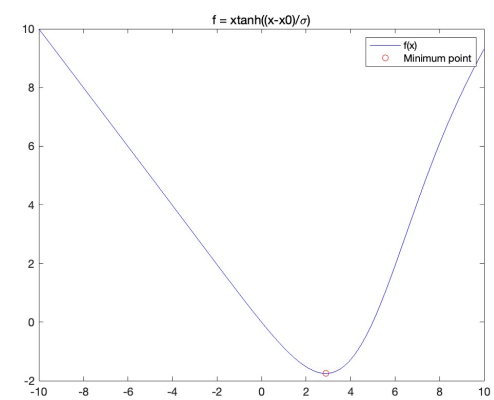

Figure 4: P4 Nice

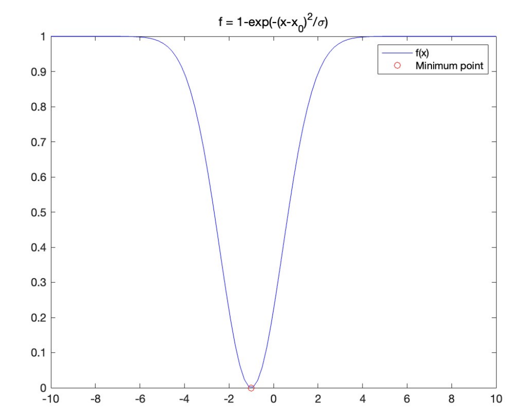

Figure 5: P4 nasty