Optimization Assignment

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1 Question

-Investigate for the maxima and minima of the function $f(x) = \int_1^x t(e^t - 1)(t-1)(t-2)^3(t-3)^5\,dx$

2 Solution

STEP-1 The given function **f(x)** can be written as

$$\text{f(x)}=(t-3)^5\,(t-2)^3\,(t-1)\,t\cdot(\text{e}^t-1)$$

$$\text{f(x)}=\{11\Big(420\left(t^{10}-32t^9+501t^8-5198t^7+40609t^6-253512t^5\right.\cdot 30890052\big)\text{e}$$

$$420\,(t-3)^{11}\,4620$$

$$\text{f(x)}=\text{x}(\text{e}^x-1)(x-1)(x-2)^3(x-1)^5$$

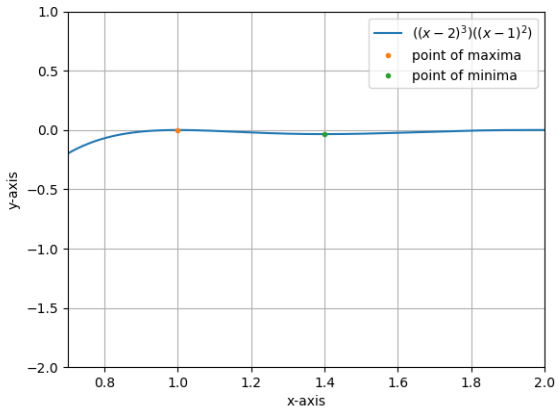

Figure 1: plot of f(x) with maxima and minima points

STEP-2 we can find the maxima of eq(1) by using gradient ascent method

$$\implies x_{n+1} = x_n + \alpha\nabla f(x_n)$$

$$\implies x_{n+1} = x_n + \alpha\left((x_n-1)(x_n-2)^2(5x_n-7)\right) \quad (1)$$

Taking $x_0 = 0.5, \alpha = 0.001$ and precision $= 0.00000001$, values obtained using python are:

$$\boxed{\text{Maxima} = -2.4985e^{-}11} \quad (2)$$

$$\boxed{\text{Maxima Point} = 1} \quad (3)$$

STEP-3 we can find the minima of eq(1) by using gradient descent method

$$\implies x_{n+1} = x_n - \alpha\nabla f(x_n)$$

$$\implies x_{n+1} = x_n - \alpha\left((x_n-1)(x_n-2)^2(5x_n-7)\right) \quad (4)$$

Taking $x_0 = 1.5, \alpha = 0.001$ and precision $= 0.00000001$, values obtained using python are:

$$\boxed{\text{Minima} = -0.03455} \quad (5)$$

$$\boxed{\text{Minima Point} = 1.4} \quad (6)$$

Get the python code of the figures from

`https://github.com/Dsrinivas-sudo/fwc-1`