

Gradient-Based Optimisation (10 Points)

Consider the problem of minimising the function $f(x) = x^2(x - 1)(x + 2)$ using gradient descent.

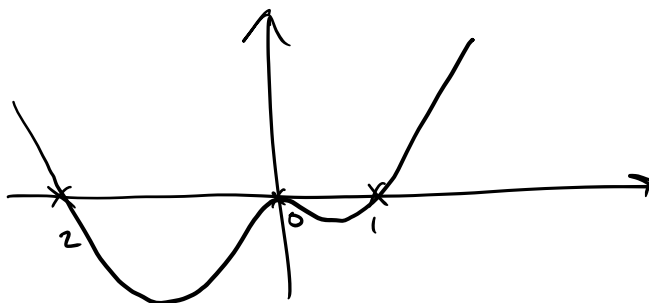
Problem 1 - 3 Points

Given a guess of the minimum of $f(x)$ at iteration k denoted x_k , state the formula for the next guess x_{k+1} using gradient descent with a rate of α .

$$x_{k+1} = x_k - \alpha f'(x_k)$$

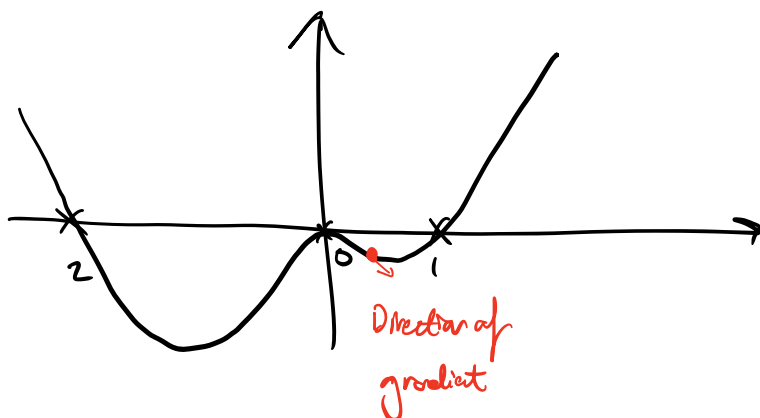
Problem 2 - 4 Points

Sketch the function.



Problem 3 - 4 Points

Let $x_0 = 0.5$, $\alpha = 0.1$. Do you expect gradient descent to converge to the absolute minimum of the function? Include a diagram in your explanation.

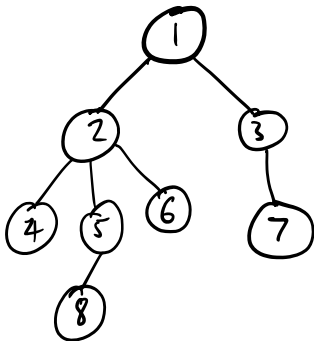


Gradient Descent will converge as it will get trapped in a local minimum.

Short Answer Questions (10 Points)

Problem 3 - 3 Points

State a possible ordering for depth-first search on the following graph:



1, 2, 4, 5, 8, 6, 3, 7
+ Many possibilities

Problem 6 - 2 Points

Write some mathematica code to plot the function $f(x) = x^2(x-1)(x+2)$.

Plot [$x^2 (x-1) (x+2)$, {x, -2, 2}]

Problem 7 - 2 Points

Write some mathematica code to plot the derivative of the function $f(x) = x^2(x-1)(x+2)$.

df [x] = D [$x^2 (x-1) (x+2)$, x]
Plot [df [x], {x, -2, 2}]

Problem 8 - 3 Points

What is your favourite and least favourite topics of this course? No wrong answers!

Hope you've enjoyed the semester!