

Grp B4 Gradient Descent

October 19, 2023

0.1 Group B Machine Learning

0.2 Assignment 5

0.2.1 Implement Gradient Descent Algorithm to find the local minima of a function.

0.2.2 For example, find the local minima of the function $y=(x+3)^2$ starting from the point $x=2$.

Step 1 : Initialize parameters

```
[1]: cur_x = 2 # The algorithm starts at x=2
     iters = 0 #iteration counter
     max_iters = 10000 # maximum number of iterations
     learning_rate = 0.01 # Learning rate
     precision = 0.000001 #This tells us when to stop the algorithm
     previous_step_size = 1
     df = lambda x: 2*(x+3) #Gradient of our function
```

```
[2]: print(cur_x)
```

2

Step 2 : Run a loop to perform gradient descent :

```
[3]: x_history =[cur_x]
     while previous_step_size > precision and iters < max_iters:
         prev_x = cur_x #Store current x value in prev_x
         cur_x = cur_x - learning_rate * df(prev_x) #Grad descent
         x_history.append(cur_x)
         previous_step_size = abs(cur_x - prev_x) #Change in x
         iters = iters+1 #iteration count
         print("Iteration",iters,"\nX value is",cur_x) #Print iterations

     print("The local minimum occurs at", cur_x)
```

Iteration 1

X value is 1.9

Iteration 2

X value is 1.8019999999999998

Iteration 3

X value is 1.70596

Iteration 4

X value is 1.6118408
Iteration 5
X value is 1.519603984
Iteration 6
X value is 1.42921190432
Iteration 7
X value is 1.3406276662336
Iteration 8
X value is 1.253815112908928
Iteration 9
X value is 1.1687388106507495
Iteration 10
X value is 1.0853640344377344
Iteration 11
X value is 1.0036567537489798
Iteration 12
X value is 0.9235836186740002
Iteration 13
X value is 0.8451119463005202
Iteration 14
X value is 0.7682097073745098
Iteration 15
X value is 0.6928455132270196
Iteration 16
X value is 0.6189886029624792
Iteration 17
X value is 0.5466088309032295
Iteration 18
X value is 0.4756766542851649
Iteration 19
X value is 0.40616312119946163
Iteration 20
X value is 0.3380398587754724
Iteration 21
X value is 0.27127906159996296
Iteration 22
X value is 0.2058534803679637
Iteration 23
X value is 0.14173641076060442
Iteration 24
X value is 0.07890168254539233
Iteration 25
X value is 0.017323648894484484
Iteration 26
X value is -0.04302282408340521
Iteration 27
X value is -0.10216236760173711
Iteration 28

X value is -0.16011912024970237
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X value is -0.21691673784470833
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X value is -0.27257840308781417
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X value is -0.432972612359026
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X value is -0.4843131601118455
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X value is -2.999949112973614
Iteration 570
X value is -2.999950130714142
Iteration 571
X value is -2.999951128099859
The local minimum occurs at -2.999951128099859

```

```
[4]: print("The local minimum occurs at", cur_x)
```

```
The local minimum occurs at -2.999951128099859
```

```
[5]: print(len(x_history))
```

```
572
```

```
[6]: import matplotlib.pyplot as plt
import numpy as np
```

```
[7]: # Create a range of x values to plot
x_vals = np.linspace(-10, 4, 100)
y = lambda x: x**2 + 6*x + 9

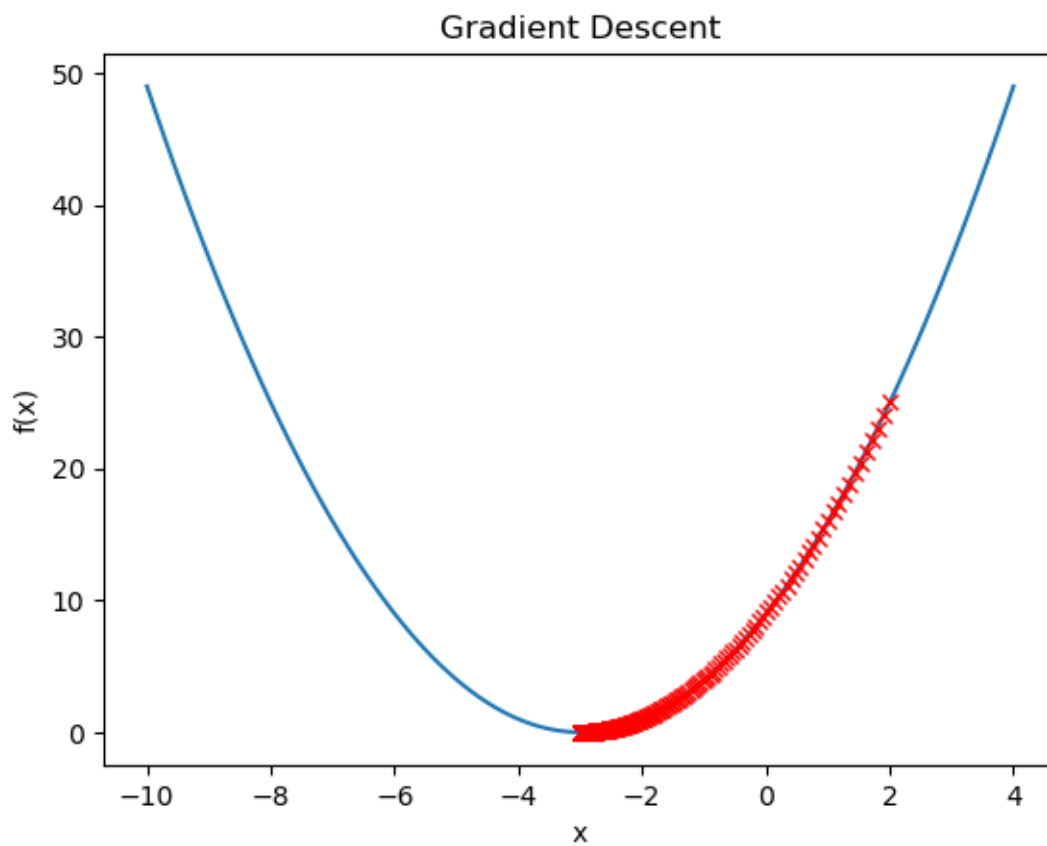
# Plot the lamda function y
```

```
plt.plot(x_vals, y(x_vals))

# Plot the values of x at each iteration
plt.plot(x_history, y(np.array(x_history)), 'rx')

# Label the axes and add a title
plt.xlabel('x')
plt.ylabel('f(x)')
plt.title('Gradient Descent')

# Show the plot
plt.show()
```



[]: