

CS 4501: Optimization - Assignment 1

Shangtong Zhang

Use Newton's method to minimize $f(x)$ starting from a given x_0 for n iterations.

$$x_{n+1} = x_n - \frac{f'(x_n)}{f''(x_n)}.$$

Task 1

Minimize $f(x) = x^4$. Implement

```
def minimize_f1(self, x0, n):
```

Task 2

Minimize $f(x) = \ln(\exp(x) + \exp(-x))$. Implement

```
def minimize_f2(self, x0, n):
```

Task 3

Minimize $f(x)$ without knowing the analytical expression of f . Implement

```
def minimize_f(self, f, x0, n):
```

Here the argument f is a unknown lambda function, e.g.,

```
f = lambda x: 2 ** x
```

Hint: use the definition of derivative.

$$f'(x) = \lim_{\delta \rightarrow 0} \frac{f(x + \delta) - f(x)}{\delta}.$$

Notes

1. Do not use any third-party package other than numpy.
2. Raise `NewtonException` when $f''(x_n)$ is 0 for some x_n .
3. Do not use your solution for Task 3 to solve Task 1 and Task 2 – it will not have enough accuracy.