

src/biii\_2.pyMon Mar 25 16:42:08 20241

```
1: import week6
2: import sgd
3: import pandas as pd
4: import matplotlib.pyplot as plt
5: import numpy as np
6: import sys
7:
8: def run_constant(alpha=1, n=5):
9:     T = pd.read_csv("data/T.csv").values
10:    fg = week6.generate_optimisation_functions(
11:        T, minibatch_size=n, seed=None)
12:    o = sgd.StochasticGradientDescent()
13:    o.alg("constant")
14:    o.step_size(alpha)
15:    o.function_generator(fg)
16:    xs = []
17:    fs = []
18:    start = np.array([3, 3])
19:    o.start(start)
20:    xs.append(o._x_value)
21:    fs.append(week6.f(o._x_value, T))
22:    for i in range(15):
23:        o.step()
24:        print(f"alpha={alpha}:", o._x_value)
25:        xs.append(o._x_value)
26:        fs.append(week6.f(o._x_value, T))
27:    return {
28:        "x1": [x[0] for x in xs],
29:        "x2": [x[1] for x in xs],
30:        "f": fs,
31:    }
32:
33: np.random.seed(int(sys.argv[1]))
34:
35: T = pd.read_csv("data/T.csv").values
36:
37: x_min, x_max, y_min, y_max = [-5, 5, -5, 5]
38: # Generate data for wireframe plot
39: resolution = 100
40: x_range = np.linspace(x_min, x_max, resolution)
41: y_range = np.linspace(y_min, y_max, resolution)
42: X, Y = np.meshgrid(x_range, y_range)
43:
44: # Plot wireframe
45: fig = plt.figure(figsize=(12, 6))
46: resolution = 100
47: Z_contour = np.zeros_like(X)
48: for i in range(resolution):
49:     for j in range(resolution):
50:         Z_contour[i, j] = week6.f([X[i, j], Y[i, j]], T)
51:
52: # Plot contour
53: ax_contour = fig.add_subplot(122)
54: contour = ax_contour.contourf(X, Y, Z_contour, levels=20, cmap='viridis')
55: plt.colorbar(contour, ax=ax_contour, label='$f_T(x)$')
56: ax_contour.set_xlabel('$x_1$')
57: ax_contour.set_ylabel('$x_2$')
58: ax_contour.set_xlim([-5, 5])
59: ax_contour.set_ylim([-5, 5])
60: plt.suptitle('Stochastic Gradient Descent on $f_T(x)$ with different mini-batch sizes')
61:
62: ax_f = fig.add_subplot(121)
63:
64: for n in [1, 3, 5, 7, 9, 11, 13, 15]:
65:     alpha = 0.5
66:     run = run_constant(alpha, n=n)
67:     label = f"$\\alpha={alpha}$, $n={n}$, final $f_T(x)={run['f'][-1]:.3f}$, best $f_T(x)={min(run['f']):.3f}$"
68:     ax_contour.plot(run["x1"], run["x2"], label=label)
69:     ax_f.plot(run['f'], label=label)
70:
71: ax_f.set_yscale('log')
72: ax_f.set_xlabel("iteration $t$")
73: ax_f.set_ylabel("$f_T(x_t)$")
74: ax_f.legend(loc="upper right")
75: plt.savefig("fig/biii_2.pdf")
76: plt.show()
```