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1: import week6
2: import sgd
3: import pandas as pd
4: import matplotlib.pyplot as plt
5: import numpy as np
6:
7: def run_constant(alpha=1):
8:     T = pd.read_csv("data/T.csv").values
9:     fg = week6.generate_optimisation_functions(
10:         T, minibatch_size=len(T), shuffle=False)
11:     o = sgd.StochasticGradientDescent()
12:     o.alg("constant")
13:     o.step_size(alpha)
14:     o.function_generator(fg)
15:     xs = []
16:     fs = []
17:     start = np.array([3,3])
18:     o.start(start)
19:     xs.append(o._x_value)
20:     for i in range(200):
21:         o.step()
22:         print(f"alpha={alpha}:", o._x_value)
23:         xs.append(o._x_value)
24:         fs.append(o._function(o._x_value))
25:     return {
26:         "x1": [x[0] for x in xs],
27:         "x2": [x[1] for x in xs],
28:         "f": fs,
29:     }
30:
31:
32: T = pd.read_csv("data/T.csv").values
33:
34: x_min, x_max, y_min, y_max = [-5, 5, -5, 5]
35: # Generate data for wireframe plot
36: resolution = 100
37: x_range = np.linspace(x_min, x_max, resolution)
38: y_range = np.linspace(y_min, y_max, resolution)
39: X, Y = np.meshgrid(x_range, y_range)
40:
41: # Plot wireframe
42: fig = plt.figure(figsize=(12, 6))
43: resolution = 100
44: Z_contour = np.zeros_like(X)
45: for i in range(resolution):
46:     for j in range(resolution):
47:         Z_contour[i, j] = week6.f([X[i, j], Y[i, j]], T)
48:
49: # Plot contour
50: ax_contour = fig.add_subplot(122)
51: contour = ax_contour.contourf(X, Y, Z_contour, levels=20, cmap='viridis')
52: plt.colorbar(contour, ax=ax_contour, label=f'$f_T(x)$')
53: ax_contour.set_xlabel('$x_1$')
54: ax_contour.set_ylabel('$x_2$')
55: ax_contour.set_xlim([-5,5])
56: ax_contour.set_ylim([-5,5])
57: plt.suptitle('Gradient Descent on $f_T(x)$ with constant step')
58:
59: ax_f = fig.add_subplot(121)
60:
61: for alpha in [0.79, 0.72, 0.5, 0.1, 0.01]:
62:     run = run_constant(alpha)
63:     ax_contour.plot(run["x1"], run["x2"], label=f"$\\alpha={alpha}$, best $f_T(x_1)=\\min(run['f']):.3f$")
64:     ax_f.plot(run['f'])
65:
66: ax_f.set_yscale('log')
67: ax_f.set_xlabel("iteration $t$")
68: ax_f.set_ylabel("$f_T(x_t)$")
69: ax_contour.legend(loc="upper left")
70: plt.savefig("fig/bi.pdf")
71: plt.show()
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