```
%matplotlib inline
import pandas as pd
import numpy as np
import matplotlib
from matplotlib import pyplot as plt
import string
from collections import defaultdict
```

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plt.rcParams["font.size"] = 16
SHOW_RG = False
```

```
with open("/Users/saharshbarve/Work/uiuc/study/Semester_3/cs511/project-bao/breakingBao/sample_queries_logs/pg_run.txt") as f:
    data = f.read().split("\n")[2:]
data = [x.split(" ") for x in data if len(x) > 1 and (x[0] in string.digits or x[0] == "x")]

data = [(x[0], x[1], float(x[2]), x[3], float(x[4])) for x in data]
pg_data = data
pg_times = np.array([x[2] for x in pg_data])
pg_times -= np.min(pg_times)
pg_times /= 60


def read_bao_data(fp):
    with open(fp) as f:
        data = f.read().split("\n")[2:]

    training_times = []
    for idx in range(len(data)):
        if data[idx].strip().startswith("Initial input channels"):
            prev_line = data[idx-1].split(" ")
            if prev_line[0] == "Retry":
                continue
            training_times.append(float(prev_line[2]))


    training_times = np.array(training_times)

    data = [x.split(" ") for x in data if len(x) > 1 and (x[0] in string.digits or x[0] == "x")]
    data = [(x[0], x[1], float(x[2]), x[3], float(x[4])) for x in data]
    bao_data = data

    bao_times = np.array([x[2] for x in bao_data])
    training_times -= np.min(bao_times)
    bao_times -= np.min(bao_times)

    bao_times /= 60
    training_times /= 60
    return bao_data, bao_times, training_times

bao_data, bao_times, training_times = read_bao_data("/Users/saharshbarve/Work/uiuc/study/Semester_3/cs511/project-bao/breaking
if SHOW_RG:
    bao_rb_data, bao_rb_times, training_rb_times = read_bao_data("bao_with_regblock.txt")
```

```
queries_complete = np.arange(0, len(pg_times))

fig, ax = plt.subplots(1, 1, constrained_layout=True)


train_y = []
train_rb_y = []
for tt in training_times:
    idx = np.searchsorted(bao_times, tt)
    train_y.append(idx)

if SHOW_RG:
    for tt in training_rb_times:
        idx = np.searchsorted(bao_rb_times, tt)
        train_rb_y.append(idx)

plt.scatter(training_times, train_y, s=45, color="red", label="Training")

ax.plot(pg_times, queries_complete, label="PostgreSQL", lw=3)
ax.plot(bao_times, queries_complete, label="Bao", lw=3)

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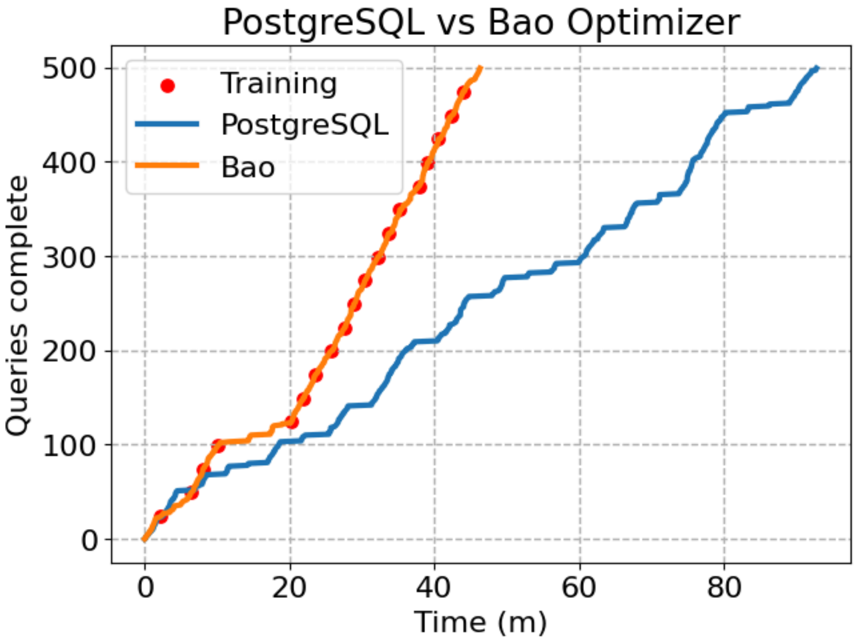
if SHOW_RG:
    plt.scatter(training_rb_times, train_rb_y, s=45, color="red")
    ax.plot(bao_rb_times, queries_complete, label="Bao (w/ exploration)", lw=3)

ax.set_xlabel("Time (m)")
ax.set_ylabel("Queries complete")
ax.set_title("PostgreSQL vs Bao Optimizer")

ax.grid(linestyle="--", linewidth=1)
ax.legend()
fig.savefig("queries_vs_time.svg")
```



```
all_pg_times = sorted([x[4] for x in pg_data])
all_bao_times = sorted([x[4] for x in bao_data])

if SHOW_RG:
    all_bao_rb_times = sorted([x[4] for x in bao_rb_data])


fig, axes = plt.subplots(1, 2, figsize=(10, 4), constrained_layout=True)

ax = axes[0]
ax.plot(np.linspace(0, 1, len(all_pg_times)), all_pg_times, lw=3, label="PostgreSQL")
ax.plot(np.linspace(0, 1, len(all_pg_times)), all_bao_times, lw=3, label="Bao")

if SHOW_RG:
    ax.plot(np.linspace(0, 1, len(all_pg_times)), all_bao_rb_times, lw=3, label="Bao (w/ exploration)")

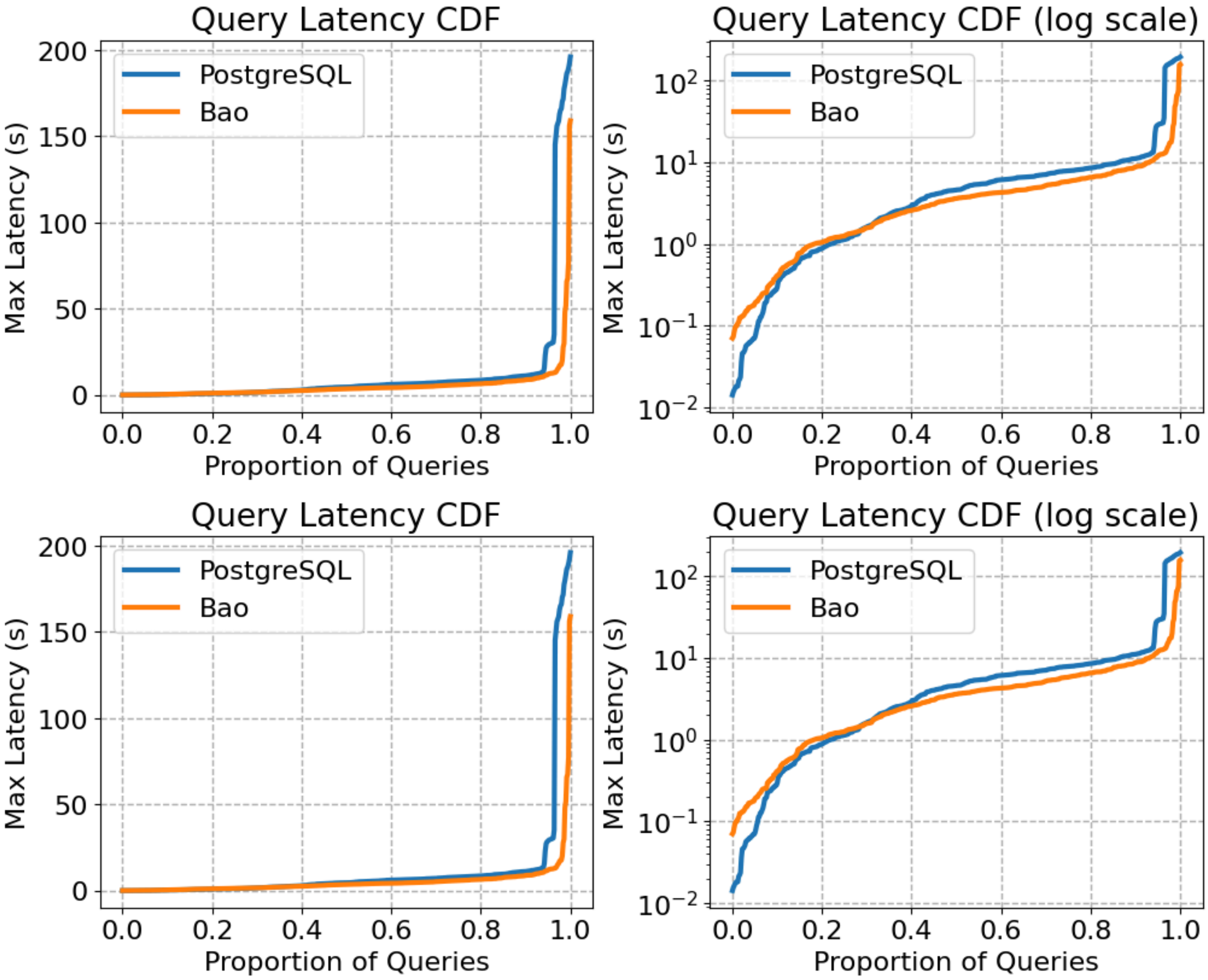
ax.grid(linestyle="--", linewidth=1)
ax.set_xlabel("Proportion of Queries")
ax.set_ylabel("Max Latency (s)")
ax.set_title("Query Latency CDF")
ax.legend()
#ax.set_yscale("log")


ax = axes[1]
ax.plot(np.linspace(0, 1, len(all_pg_times)), all_pg_times, lw=3, label="PostgreSQL")
ax.plot(np.linspace(0, 1, len(all_pg_times)), all_bao_times, lw=3, label="Bao")

if SHOW_RG:
    ax.plot(np.linspace(0, 1, len(all_pg_times)), all_bao_rb_times, lw=3, label="Bao (w/ exploration)")

ax.grid(linestyle="--", linewidth=1)
ax.set_xlabel("Proportion of Queries")
ax.set_ylabel("Max Latency (s)")
ax.set_title("Query Latency CDF (log scale)")
ax.legend()
ax.set_yscale("log")
```

```
fig.savefig("cdf.svg")
fig
```



```
# get the last PG time for each query
pg_query_time = {}
for itm in pg_data:
    pg_query_time[itm[3]] = itm[4]

# get each Bao time
bao_query_times = defaultdict(list)
for itm in bao_data[50:]:
    bao_query_times[itm[3]].append(itm[4])

if SHOW_RG:
    # get each Bao time
    bao_rb_query_times = defaultdict(list)
    for itm in bao_rb_data[50:]:
        bao_rb_query_times[itm[3]].append(itm[4])

max_repeats = max(len(x) for x in bao_query_times.values())

def extract_q_number(x):
    return int(x[x.find("/q")+2:x.find("_", x.find("/q"))])

q_order = sorted(bao_query_times.keys(), key=extract_q_number)

grid = [bao_query_times[x] for x in q_order]

if SHOW_RG:
    grid_rb = [bao_rb_query_times[x] for x in q_order]


```

```
reg_data = []
for idx, q in enumerate(q_order):
    if SHOW_RG:
        reg_data.append({"Q": f"q{extract_q_number(q)}",
                         "PG": pg_query_time[q],
                         "Bao worst": max(grid[idx]),
                         "Bao best": min(grid[idx]),
                         "Bao + E worst": max(grid_rb[idx]),
                         "Bao + E best": min(grid_rb[idx])})
    else:
        reg_data.append({"Q": f"q{extract_q_number(q)}",
                 "PG": pg_query_time[q],
                 "Bao worst": max(grid[idx]),
                 "Bao best": min(grid[idx])})



def color_regression(col):
    def c_for_diff(diff):
        if diff < 2 and diff > -2:
            return "background-color: white"
        elif diff > 0.5:
            return "background-color: #f27281"
        else:
            return "background-color: #9ee3ad"

    to_r = [""]

    if SHOW_RG:
        pg, bao_worst, bao_best, bao_rg_worst, bao_rg_best = col
    else:
        pg, bao_worst, bao_best = col


    to_r.append(c_for_diff(bao_worst - pg))
    to_r.append(c_for_diff(bao_best - pg))

    if SHOW_RG:
        to_r.append(c_for_diff(bao_rg_worst - pg))
        to_r.append(c_for_diff(bao_rg_best - pg))

    return to_r

reg_data = pd.DataFrame(reg_data).set_index("Q")
reg_data.style.apply(color_regression, axis=1)
```

	PG	Bao worst	Bao best
Q			
q1	163.064547	158.983912	3.328682
q2	7.417123	77.108864	4.578537
q3	2.455395	6.306287	0.783668
q4	4.385511	3.505902	1.090580
q5	7.951572	7.767956	0.953749
q6	15.868932	12.638412	3.848472
q7	0.576398	1.923568	0.969627
q8	13.274254	17.145444	3.681245
q9	6.706770	7.939929	3.306558
q10	4.129116	7.198245	3.371864
q11	11.056884	9.934232	4.316425
q12	10.686120	8.459121	2.086978
q13	9.749876	12.738298	3.342513
q14	4.949042	6.804738	1.243044
q15	5.387557	4.313359	1.773006
q16	35.209722	4.922490	3.426899
q17	1.592361	2.163676	1.145918
q18	7.902101	8.362709	2.790702
q19	7.839482	13.023417	5.509710
q20	0.097441	0.297108	0.171410
q21	0.678879	4.779582	0.414285
q22	4.694102	8.418917	3.686255
q23	5.402349	5.978222	4.603229
q24	0.018049	0.177170	0.131393
q25	1.790386	2.940906	0.981303
q26	5.917564	6.194259	2.498921
q27	0.652844	1.569108	0.251617
q28	0.590007	1.157195	0.788079
q29	0.056677	0.150718	0.073399
q30	3.546492	4.771712	2.868398
q31	1.009325	2.540264	0.527929