CSE574 Planning and Learning Methods in AI (Fall 2023)

Assignment 1: Part 1 [30/100 marks]

Last name, first name: _____

A multi-objective Bayesian optimization (MOBO) algorithm has returned the samples shown in Table 1 after 8 iterations.

Table 1

Sample #	**p1**	p2	**p3**	p4	p5	**p6**	**p7**	p8
x	**2.0**	1.0	**5.0**	4.0	8.0	**5.5**	**6.0**	7.5
f1(x)	**3.5**	7.0	**6.0**	8.0	5.5	**3.0**	**4.5**	4.5
f2(x)	**5.0**	5.0	**3.0**	6.5	6.0	**6.0**	**3.5**	5.0
0.9f1+0.1f2	**3.65**	6.8	**5.7**	7.85	5.55	**3.3**	**4.4**	4.55

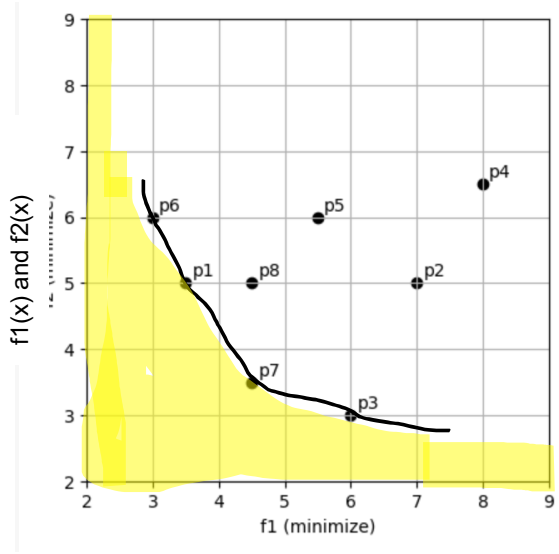

Fig. 1a

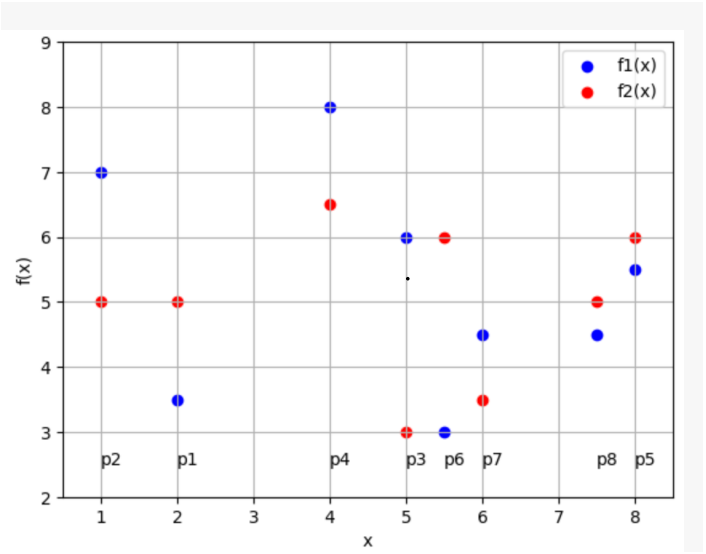

Fig. 1b

1. Use data in Table 1 to complete the scatter plots in Fig 1a [*2 marks*] and Fig 1b [*2 marks*]. Mark all the points as p1, p2, …, p8 [*1 mark*].

2. Based on these samples, draw the Pareto front in Fig. 1b. [*5 marks*]

3. Assuming the approximate Pareto front you drew is indeed the true Pareto front,
    a. Shade the area where the solutions are infeasible [*3 marks*]
    b. Which samples are Pareto optimal? [*4 marks*] p1, p3, p6, p7
    c. If you care about minimizing objective 1 90% and objective 2 10%, which solution would you pick out of all the Pareto optimal solutions? [*2 marks*] Show your calculations in the empty cell provided in Table 1. [*3 marks*] p6

4. By looking at Fig 1 a and b you completed, has the MOBO algorithm made an attempt to balance exploration-exploitation trade-off? [*2 marks*] Provide the reason for your answer in one short sentence. [*3 marks*]
   If yes, it has explored the entire space with more samples near the possible minima. Or, the diversity of samples along the pareto front as well as the outside is satisfactory.
   If no, it hasn't explored certain areas e.g., $x \in (2,4)$. Or, it should have taken more samples around x=4 because of high variation in f(x) values.

5. For a different problem, which of the plots in Fig. 2 represent potentially correct Pareto fronts? [*3 marks*]
    a. A only *b.* B only *c.* <u>Both A and B</u> *d.* Neither A nor B

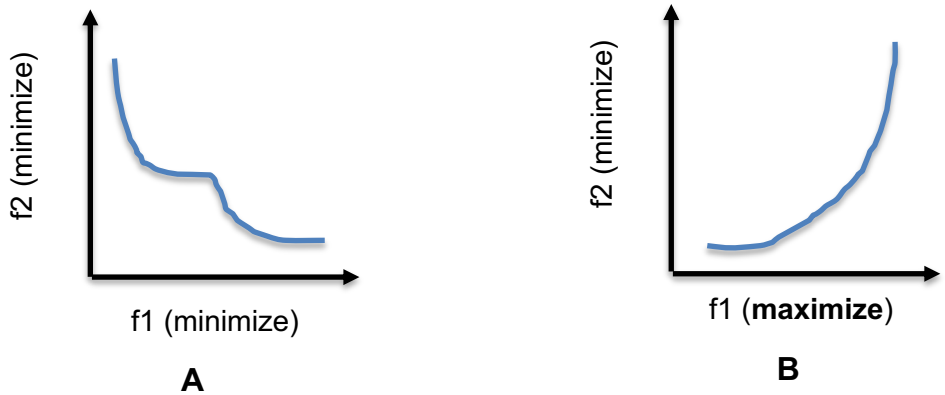

Fig. 2