

(CS5020, Jul-Nov 2023) Nonlinear Optimisation: Theory and Algorithms
Worksheet - 1

- (1) Given two points $a, b \in \mathbb{R}$, with $a < b$, consider $f(x) = \max\{|x - a|, |x - b|\}$. Find
 - (a) $f_* = \min_{x \in \mathbb{R}} f(x)$
 - (b) $x_* = \arg \min_{x \in \mathbb{R}} f(x)$
 - (c) Is the minimiser x_* unique?
- (2) The per Kg cost of potato is Rs.20/–, tomato is Rs.25/– and Onion is Rs.30/–. We have Rs.100/– in hand we want to buy as much as possible. *We have to buy at least two different items.* Express this as an optimisation problem. (Hint: First decide the number of variables, the domain of each variable and number of constraints).
- (3) Express the following five (Fig (1), ..., Fig (5) in the next page) constraint sets algebraically.
- (4) Consider the following functions
 - (1) $f(x) = x_1 + x_2$
 - (2) $f(x) = -x_1 + x_2$
 - (3) $f(x) = x_1 - x_2$
 - (4) $f(x) = -x_1 - x_2$
 - (5) $f(x) = 2x_1 + x_2$
 - (6) $f(x) = (x_1 - 1)^2 + (x_2 - 2)^2$
 - (7) $f(x) = (x_1 + 3)^2 + (x_2 + 2)^2$
 - (8) $f(x) = 5(x_1 - 1)^2 + 2(x_2 - 2)^2$
 - (9) $f(x) = x_1^2 + 2x_2^2 + x_1 - x_2 + 4$
 - (10) $f(x) = x_1^2 + x_2^2 + 2x_1x_2$

For these functions

- (a) maximum and maximiser(s) for each of the constraint sets in Fig (1) to Fig (5). Is the maximiser unique?
- (b) minimiser and minimiser(s) for each of the constraint sets in Fig (1) to Fig (5). Is the minimiser unique?

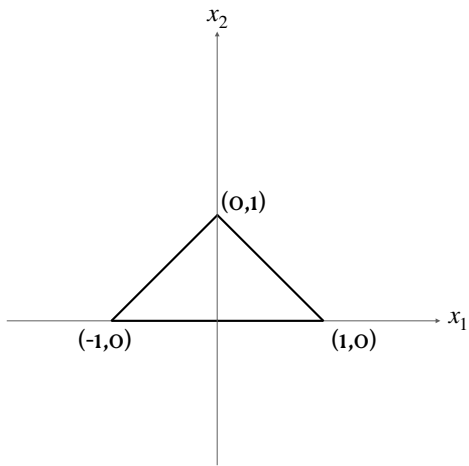


Fig (1)

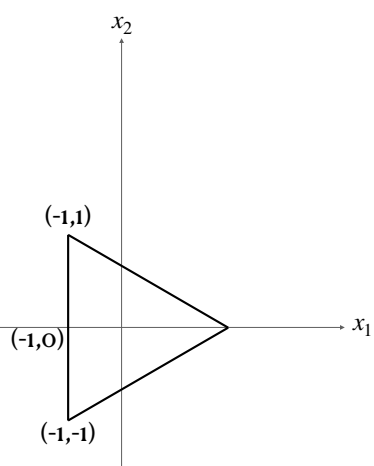


Fig (2)

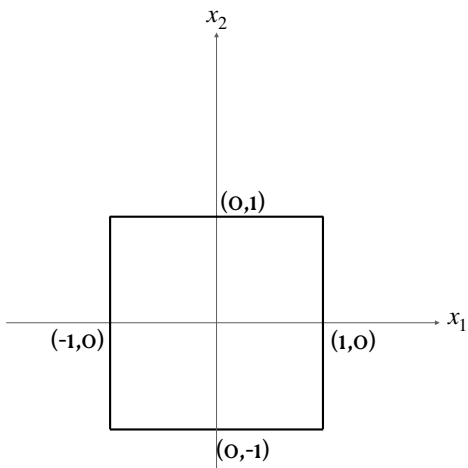


Fig (3)

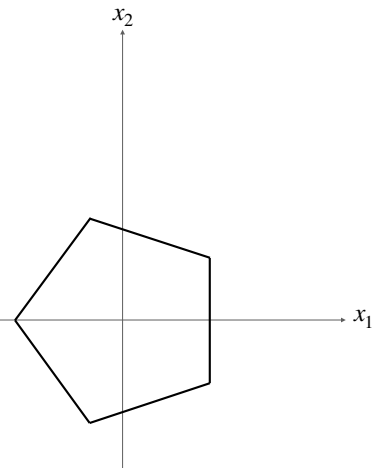


Fig (4)

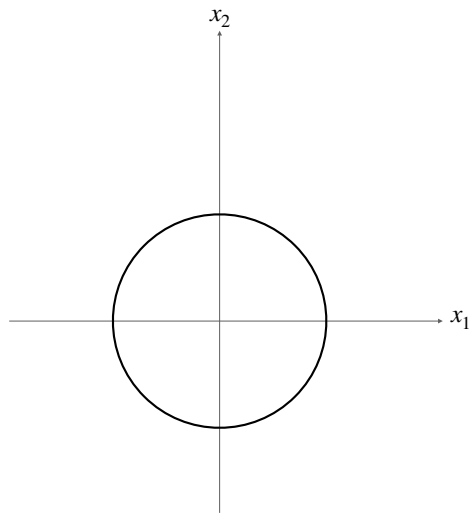


Fig (5)

In Fig(2) and Fig (4) assume unit length for each segment.