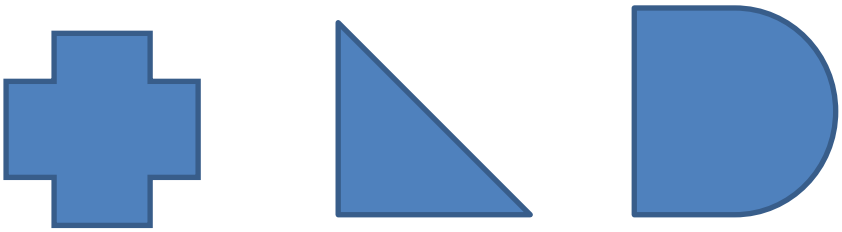
Indian Institute of Technology Jodhpur

Tutorial sheet -1 **Optimization for Data Science**

1. Which of the following sets are convex sets?



2. Which of the following sets are convex sets?

- $\{ (x, y) \mid x \geq 0, y \geq 0, x \leq 1, y \leq 1 \}$
- $\{ (x, y) \mid x \geq 0, y \geq 0, x + y \leq 4 \} \cup \{ (1,1) \}$
- $\{ (x, y) \mid x \geq 0, y \geq 0, x + y \leq 1 \} \cup \{ (1,1) \}$
- $\{ (x, y) \mid x \geq 0, y \leq 1, y \geq 4 \}$

3. Which of the following vectors are convex combinations of { (2,0,0), (0,2,0), (0,0,2)}?
   - $(1,1,1)$
   - $(1,1,0)$
   - $(2,2,-2)$

4. **<u>Convex Hull of a set: Let A be a subset of R^n. The intersection of all convex subsets containing A is called Convex Hull of set A.</u>**
   1. Show that Convex Hull of a set A is smallest convex set containing A.
   2. Show that if A is convex set that convex Hull of A is same as A.
   3. Find the convex Hull of the following sets :
      (a) The set of three points $\{ (0,0), (1,0), (0,1) \}$.
      (b) $\{ (x, y) \mid x \geq 0, y \geq 0, x \leq 1, y \leq 1 \} \cup \{ (2,0) \}$

5. Prove or Disprove:
   1. $\{ (1,0), (1,1), (1,-1) \}$ is a basis for vector space R^2 over R?
   2. $\{ (1,0,0), (1,1,0), (1,1,1) \}$ is a basis for vector space R^3 over R?