Ex. 1 transmitter $x_1 = (-2,-4)$, distance between tx and rx

$P(x) \propto \frac{1}{d^2}$

Following constraints in the euclidean plane:

$c_1(x) = -x_1^2 - (x_2+4)^2 + 16 \geq 0$, $c_2(x) = x_1 - x_2 - 6 \geq 0$

a) Formulate the optimization problem. Is the optimization problem convex?

$f_0(x) = d^2 = |x_r - x_t|^2 = (x_{r_1} - (-2))^2 + (x_{r_2} - (-4))^2$ Cost function

$$\begin{cases} \min f_0(x) \\ \text{s.t } x_r \in R \end{cases} \quad R = \{x_r \in \mathbb{R}^2 \mid c_1(x_r), c_2(x_r)\}$$

Optimization Problem

NoTe: PSD = positiv Semi Definite

$H(f(x)) = \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$, $H(c_1(x)) = \begin{bmatrix} -2 & 0 \\ 0 & -2 \end{bmatrix}$, $H(c_2(x)) = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

PSD ND PSD

However the constraint are $c_i \geq 0$ meaning it needs be concave to be convex

general rule for contraint to be convex

$f(x) \leq 0$	f(x) is convex
$f(x) \geq 0$	f(x) is concave

ex showing this, rewrite $c_1(x) = x_1^2 + (x_2+4)^2 \leq 16$

$H(c_1(x)) = \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$

PSD

b) use rule $c_3(x) = x_1^2 + (x_2+6)^2 \geq 2$

$c_3(x) = x_1^2 + (x_2+6)^2 \rightarrow H = \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$

however the function is convex but constraint concave because $f(x) \geq 2$

NoT convex seen by $c_3(x) = -x_1^2 - (x_2+6)^2 - 2 \rightarrow H = \begin{bmatrix} -2 & 0 \\ 0 & -2 \end{bmatrix}$

(look at sum of squares) RnC