# Homework 6

Deadline: November 13th.

**Problem 1.** Compute the subdifferentials of the following functions

(a) $f(\mathbf{x}) = \|\mathbf{x}\|_2$

(b) Given a closed convex set $\mathcal{C}$, define

$$f(\mathbf{x}) = \begin{cases} 0 & \text{if } \mathbf{x} \in \mathcal{C} \\ +\infty & \text{otherwise.} \end{cases}$$

**Problem 2.** If function $f$ is convex, Show that $\partial f(\mathbf{x}) \neq \emptyset$ for all $\mathbf{x} \in dom\ f$.

**Problem 3.** If function $f$ is $\mu$-strongly convex, and $\mathbf{g}$ is a subgradient of $f$ at $\mathbf{x}$. Show that for any $\mathbf{y} \in dom\ f$,

$$f(\mathbf{y}) \geq f(\mathbf{x}) + \langle \mathbf{g}, \mathbf{y} - \mathbf{x} \rangle + \frac{\mu}{2} \|\mathbf{y} - \mathbf{x}\|_2^2 .$$