Duality Theory

Let $f : X \times Y \to \mathbb{R}$. We define

$$\sup(x) := \sup_{y \in Y} f(x,y)$$
$$\inf(y) := \inf_{x \in X} f(x,y)$$

together with their associated problems, i.e.

(P)	$\inf_x \sup(x)$	primal
(D)	$\sup_y \inf(y)$	dual.

Weak duality theorem:

$$\underbrace{\sup_{y \in Y} \inf(y)}_{=: d^*} \leq \underbrace{\inf_{x \in X} \sup(x)}_{=: p^*}$$