



### Definition

An optimization problem is  $(X, f)$  is an *inequality constrained space optimization problem* if  $X \subset \mathbf{R}^n$ ,  $f : \mathbf{R}^n \rightarrow \mathbf{R}$ , and there exists  $g : \mathbf{R}^n \rightarrow \mathbf{R}^m$  so that

$$X = \{x \in \mathbf{R}^n \mid g(x) \leq 0\}$$

For this reason,  $(f, g)$  is sometimes called the *problem data* (*abstract problem data*) of the problem.

### Notation

We often write such problems as: given  $f : \mathbf{R}^n \rightarrow \mathbf{R}$  and  $g : \mathbf{R}^n \rightarrow \mathbf{R}^m$ , find  $x \in \mathbf{R}^n$  to

$$\begin{aligned} & \text{minimize} && f(x) \\ & \text{subject to} && g(x) \leq 0 \end{aligned}$$

Some authors abbreviate inequality constrained space optimization problem as ICP.

### Handles equality constraints

Suppose  $f : \mathbf{R}^n \rightarrow \mathbf{R}$  and  $h : \mathbf{R}^n \rightarrow \mathbf{R}^m$  are the (abstract) problem data for an *equality* constrained space optimization problem. Define  $g : \mathbf{R}^n \rightarrow \mathbf{R}^{2m}$  so that

$$g(x) = (h(x), -h(x)) \quad \text{for all } x \in \mathbf{R}^n$$

Then the ECP  $(f, h)$  and ICP  $(f, g)$  have the same feasible set and optimal solutions. In other words, given an equality constrained problem we can always write it as an inequality constrained problem.



