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~~Optimization~~ – Example – cost of scrap iron

ex: A steel company wishes to make hot iron from melted scrap. They have various types of scrap to choose from, and they wish to minimize costs.

Let the amounts of scrap be $x_1, \ldots, x_n$.
The cost is $c_s = c_1 x_1 + \cdots + c_n x_n$.

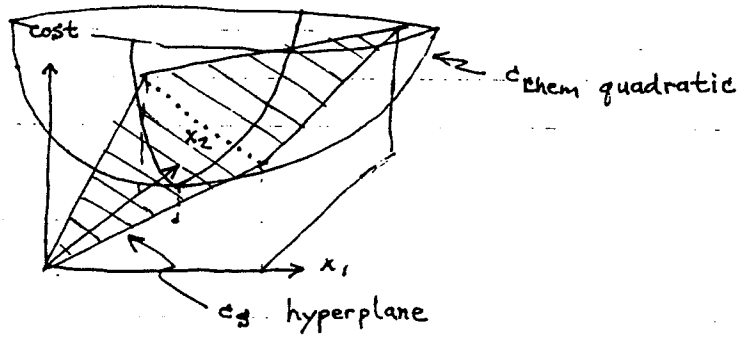
Each type of scrap contains differing amounts of alloys such as Phosphorous or Silicon and carbon. When we combine the scrap we can calculate the content of substances $b_1, \ldots, b_M$

$$b_1 = a_{11} x_1 + \ldots + a_{1n} x_n$$
$$\vdots$$
$$b_M = a_{M1} x_1 + \ldots + a_{Mn} x_n$$

There is an ideal chemistry $(b_1, \ldots, b_M) = (B_1, \ldots, B_n)$.
The cost of missing the ideal chemistry is approximately

$$c_{chem} = k_1 (B_1 - b_1)^2 + \ldots + k_n (B_n - b_n)^2$$

So the ~~total~~ cost is $c_s + c_{chem} = c_{tot}$



c_s is a hyperplane cost surface
c_{chem} is a quadratic bowl cost surface

We can solve for the minimum total cost by using gradient descent.