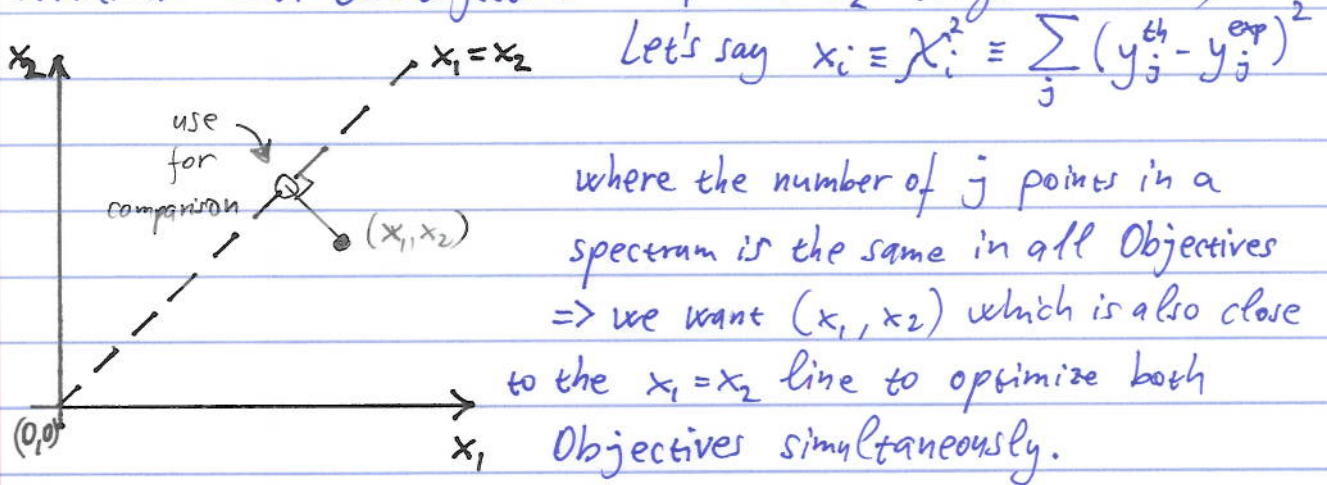Goal :: get_fitness

Convert a set of fitnesses from multiple Objectives into a single (Goal) value for the purpose of overall comparison and ordering.

Illustration with two objectives - x_1 and x_2 (larger is better)

Let's say $x_i \equiv X_i^2 \equiv \sum_j (y_j^{th} - y_j^{exp})^2$

where the number of j points in a spectrum is the same in all Objectives

$\Rightarrow$ we want (x_1, x_2) which is also close to the $x_1 = x_2$ line to optimize both Objectives simultaneously.

For N Objectives the overall fitness can be defined as the parameter t defining the point on the line with direction vector $(1, 1, ..., 1)$ that is closest to point with $(x_1, x_2, ..., x_N)$ individual fitnesses:

$$\frac{d}{dt} \sum_{i=1}^{N} (t - x_i)^2 \overset{!}{=} 0$$

$$2 \sum_{i=1}^{N} (t - x_i) = 0 \Rightarrow \sum_{i=1}^{N} t = \sum_{i=1}^{N} x_i = Nt$$

$$t = \frac{1}{N} \sum_{i=1}^{N} x_i \qquad (1)$$

This is a very simple scalarization assuming that all Objectives are "equally important". More sophisticated schemes exist (Pareto fronts, etc.).