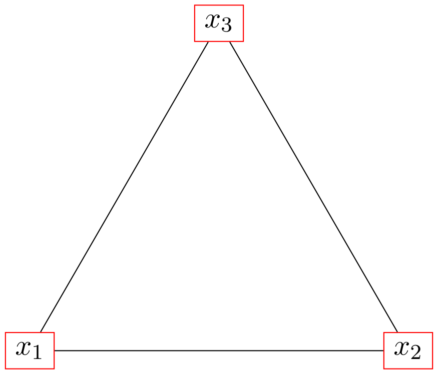

Figure 1: A simplex is a generalization of a triangle to higher numbers of dimensions, but here the 2-dimensional simplex is illustrated and this is just a triangle. A simplex is not regular in general. In the description of the downhill simplex algorithm the vertices is ordered so $f(\mathbf{x}_1) \leq f(\mathbf{x}_2) \leq \ldots f(\mathbf{x}_{n+1})$.

13 - downhill simplex

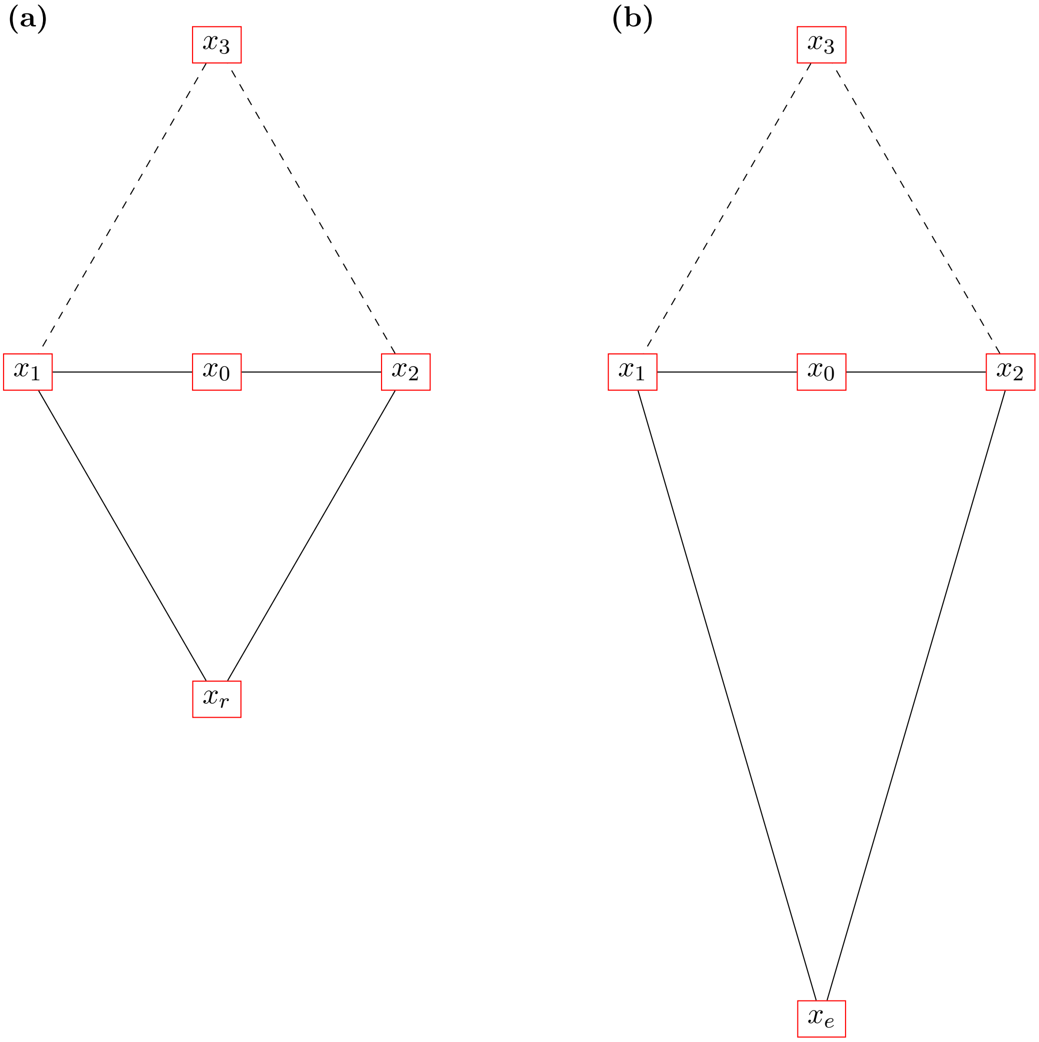

Figure 2: This illustates reflection **(a)** and expansion **(b)**. In reflection the worst point is reflected through $\mathbf{x}_0$, the center of the remaining points to give a new point $\mathbf{x}_r$. Expansion goes from $\mathbf{x}_0$ to $\mathbf{x}_r$ and continues the same distance again in the same direction to give $\mathbf{x}_e$

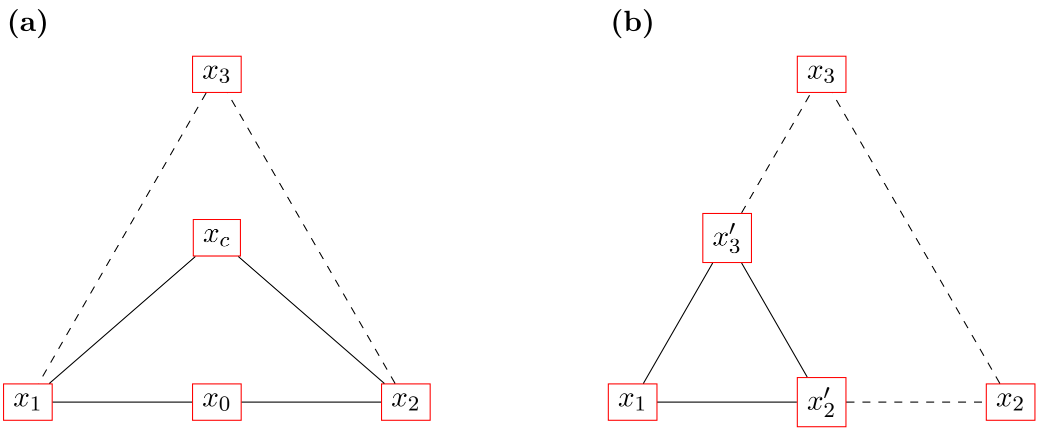

Figure 3: Contraction **(a)** and reduction **(b)**. In contraction a new point $\mathbf{x}_c$ is chosen which is half way between the worst point $\mathbf{x}_{n+1}$ and $\mathbf{x}_0$, the centre of the remaining points. In reduction the triangle is shrunk to half its size while keeping the best point.

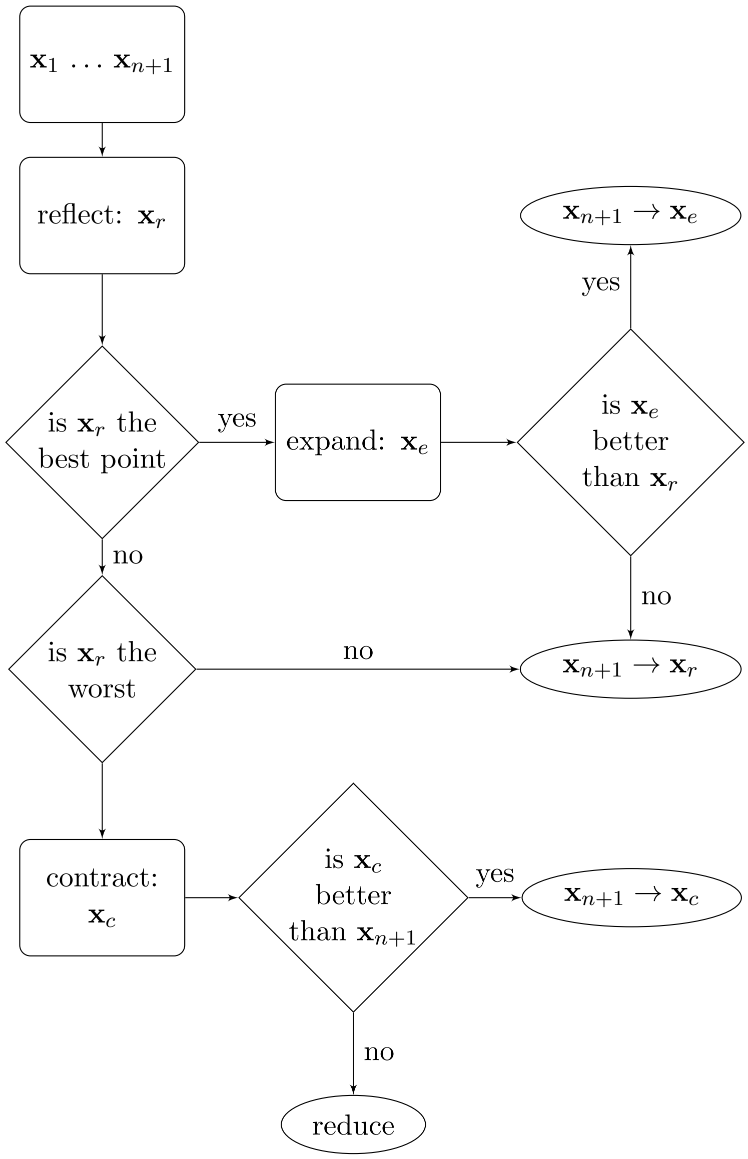

Figure 4: A flow chart for the downhill simplex algorithm. At the start, at the top, the points are put in order so that $\mathbf{x}_{n+1}$ is the worst point and $\mathbf{x}_1$ is the best. Next the reflected point is calculated to give $\mathbf{x}_r$ and $f(\mathbf{x}_r)$ is calculated. By comparing to the $f(\mathbf{x_i})$ it can be decided if $\mathbf{x}_r$ is the best point, that is $f(\mathbf{x}_r) < f(\mathbf{x}_1)$ and the flow chart has two branches depending on the answer. This carries out until an oval is reached, one or more points are changed and the process repeats.