Vertex of the Quadratic

Given a quadratic $r(k) = a k^2 + b k + c$ compute its value at
$k_1 = -\frac{b}{2a}$ namely $r(k_1) = c - \frac{b^2}{4a}$

Now compute the same quadratic at k_1+h, namely

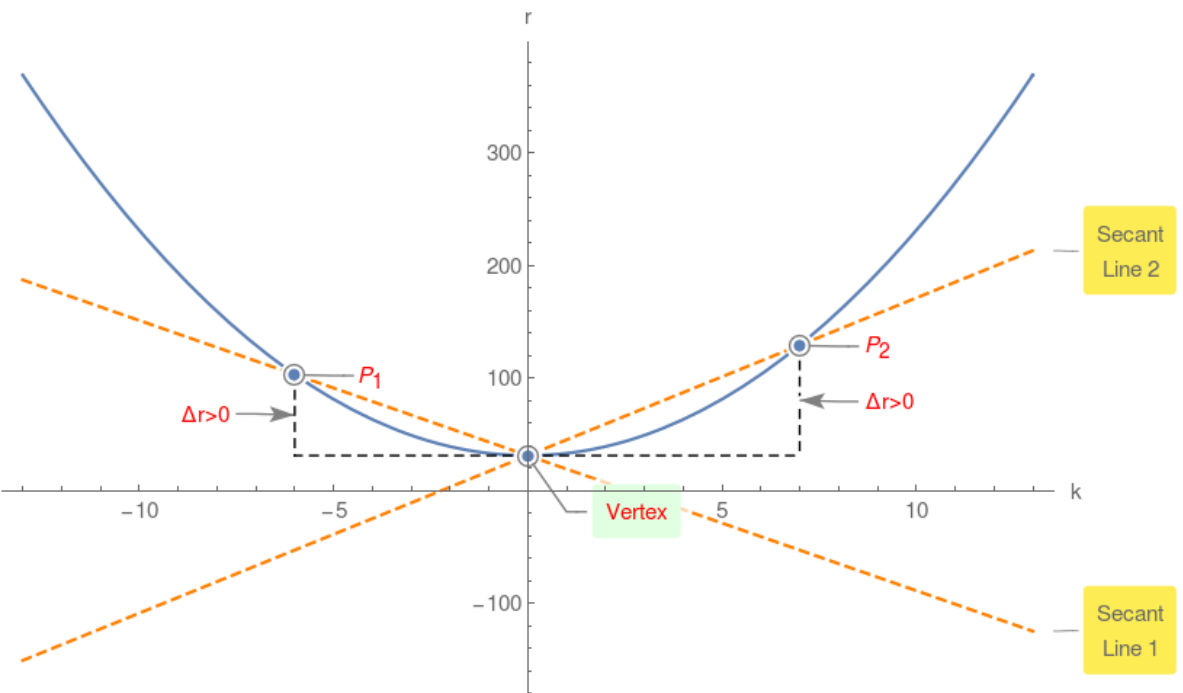$r(k_1+h) = -\frac{b^2}{4a} + a h^2 + c$

Compute $\triangle = r(k_1+h) - r(k_1) = a h^2$

Since $h^2 > 0$, therefore if $a>0$ then $\triangle > 0$ or vertex is the
global minimum!

Example 1.
$r(k) = 2 k^2 + 31$

However if $a<0$ then $\triangle < 0$ or vertex is the global maximum!

Example 2.
$r(k) = -4 k^2 - 8 k - 57$