An example of using CG without knowing A explicitly

Matrix-free Newton's method for solving nonlinear system of equations

$$F(x) = 0$$

$$x^{(k+1)} = x^{(k)} - J^{-1}(x^{(k)})F(x^{(k)})$$

In many applications, the Jacobian matrix

$$J(x) = F'(x)$$

is very difficult to calculate. If CG is used to compute $J^{-1}v$, one can approximate

$$J(x)v \approx \frac{F(x + \delta v) - F(x)}{\delta}$$