

Newton-Raphson for Systems

input : function $\{f\} : \mathbb{R}^n \rightarrow \mathbb{R}^n$ and its Jacobian $[J]$ (with $J_{ij} = \partial f_i / \partial x_j$), initial guess $\{x\}_0$, tolerance ε_s , maximum iterations N

output: estimate $\{x\}_r$ of the root

$\{x\}_r \leftarrow \{x\}_0$

for $i \leftarrow 1$ **to** N **do**

$\{x\}_{r,\text{old}} \leftarrow \{x\}_r$

 solve $[J](\{x\}_{r,\text{old}}) \{\Delta x\} = -\{f(\{x\}_{r,\text{old}})\}$

$\{x\}_r \leftarrow \{x\}_{r,\text{old}} + \{\Delta x\}$

$\varepsilon_a \leftarrow \frac{\|\{x\}_r - \{x\}_{r,\text{old}}\|}{\|\{x\}_r\|} \cdot 100\%$

if $\varepsilon_a < \varepsilon_s$ **then**

 | **return** $\{x\}_r$

end

end

return $\{x\}_r$ // did not converge in N iterations