Armijo Backtracking Line Search

input : current point $\vec{x}_k$, descent direction $\vec{p}_k$, initial step α_{init} (1 for Newton), sufficient decrease factor μ_1 (e.g. 10^{-4}), backtracking factor ρ (e.g. 0.5)

output: step size α_k

$\phi(\alpha) \leftarrow f(\vec{x}_k + \alpha\,\vec{p}_k)$ `// f along the line`

$\phi'(0) \leftarrow \nabla f(\vec{x}_k)^{\mathsf{T}} \vec{p}_k$ `// slope at the start, < 0`

$\alpha \leftarrow \alpha_{\text{init}}$

while $\phi(\alpha) > \phi(0) + \mu_1\,\alpha\,\phi'(0)$ **do**

  $\alpha \leftarrow \rho\,\alpha$ `// shrink the step`

end

return $\alpha_k = \alpha$