Golden-Section Search

input : function f, bracket $[x_l, x_u]$ containing a single minimum, tolerance ε_s
output: estimate x_{opt} of the minimizer

$R \leftarrow (\sqrt{5}-1)/2$ `// golden ratio,` ≈ 0.618
$d \leftarrow R\,(x_u - x_l)$
$x_1 \leftarrow x_l + d; \quad x_2 \leftarrow x_u - d$
$f_1 \leftarrow f(x_1); \quad f_2 \leftarrow f(x_2)$
repeat
  $d \leftarrow R\,d$
  `// keep the subinterval with the smaller interior value`
  if $f_1 < f_2$ **then**
    $x_l \leftarrow x_2$
    $x_2 \leftarrow x_1; \quad f_2 \leftarrow f_1$
    $x_1 \leftarrow x_l + d; \quad f_1 \leftarrow f(x_1)$
    $x_{\text{opt}} \leftarrow x_1$
  else
    $x_u \leftarrow x_1$
    $x_1 \leftarrow x_2; \quad f_1 \leftarrow f_2$
    $x_2 \leftarrow x_u - d; \quad f_2 \leftarrow f(x_2)$
    $x_{\text{opt}} \leftarrow x_2$
  end
  $\varepsilon_a \leftarrow (1-R)\left|\dfrac{x_u - x_l}{x_{\text{opt}}}\right| \cdot 100\%$
until $\varepsilon_a < \varepsilon_s$
return x_{opt}