

# SOLUTION OF IMPLICIT EQUATIONS

- Objectives: 1) Develop methods that allow us to obtain the root as fast as possible (speed of convergence).
- 2) Develop methods that give solutions (roots) with independence of the equation we have (robustness).

Bisection and Regula-falsi are robust because we ALWAYS obtain a solution. If our initial interval is small, we can reach the root in 3 to 5 iterations, which is fine.

However, these methods are relatively SLOW, because they do not have a large speed of convergence. Regula-falsi is in principle faster, but it may be very slow in some cases. For example, see

$$f(x) = x^{10} - 1.$$

Iteration-of-a-point and Newton-Raphson methods do not show robustness. Depending on the case we may very likely DIVERGE, which means that instead

of moving towards the root, we move AWAY from the root. But are fast if we know an initial good guess.

All methods are relatively easy to code. Thus, sometimes we can combine methods. We can use Bisection or Regula-Falsi for, say, 5 to 7 iterations in order to get close enough to the root, and then we can use <sup>any of</sup> the other two to "refine" the root. If we are close to the root, any of the other two methods is fast.

None of methods is more accurate than the others, simply because we control the accuracy via the stopping criterion. We define how close to the root we want to get.

With Newton-Raphson, we move to the root in 3 to 5 iterations. With Bisection, we need about 20. However, with Newton-Raphson we may very well fail in reaching the root, depending on the function and the initial guess.