# Solution of non linear equations

1. Solve the system of non linear equations

$x^2+y=11$ ; $y^2+x=7$

Sol: $y=11-x^2$ ; $y^2=7-x$

$\Rightarrow y^2=(11-x^2)^2$

$\Rightarrow 7-x = 11^2+x^4-22x^2$

$\Rightarrow x^4-22x^2+x+121-7=0$.

$\Rightarrow x^4-22x^2+x+114=0$.

$x=3$ is one of the root of $x^4-22x^2+x+114=0$.

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|---|---|---|---|---|---|
| 3 | 1 | 0 | -22 | 1 | 114 |
| | | 3 | 9 | -39 | -114 |
| | 1 | 3 | -13 | -38 | 0 |

$x=3$ and $x^3+3x^2-13x-38=0$.

Let $f(x)=x^3+3x^2-13x-38$

$f(3)$ = -ve ; $f(4)$ = +ve

Root lies between 3 and 4

Let $x_0=3.5$ $f'(x)=3x^2+6x-13$

Newton Raphson's formula is

$$x_{n+1}=x_n-\frac{f(x_n)}{f'(x_n)}$$

when $n=0$, $x_1=x_0-\frac{f(x_0)}{f'(x_0)}$

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

$$= 3.5 - \frac{f(3.5)}{f'(3.5)}$$

$$= 3.5 - \left[\frac{(3.5)^2 + 3(3.5)^2 - 13(3.5) - 38}{3(3.5)^2 + 6(3.5) - 13}\right]$$

$$= 3.584$$

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)} = 3.5844$$

Given $y = 11 - x^2$

$$y = 11 - (3.5844)^2$$

$$= -1.848$$

$x = 3.5844$

$y = -1.848$

Solve the system of non linear equations

$x^2 + y = 5$ ; $y^2 + x = 3$

Ans: $x = -1.683$; $y = 2.164$