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SECANT METHOD

This method is like a Regula falsi Method.

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

But the main difference between them are

(i) There is no need to check the sign of $f(x_0) f(x_2)$ in each iteration

(ii) There is not necessary that the each roots lies in the interval taken

Algorithm

Step 1.) Taking the interval $[x_0, x_1]$

Step 2.) Find $x_2 = \frac{x_0 f(x_1) - x f(x_0)}{f(x_1) - f(x_0)}$

Step 3) If $f(x_2) = 0$, then x_2 is the desired root.
Otherwise, we take the interval $[x_1, x_2]$
then find x_3. If x_3 is desired then stop
Otherwise going on and on upto desired root with the appro. taking interval $[x_i, x_{i+1}]$

Eg: $x - e^{-x} = 0$

$f(x) = x - e^{-x}$

$x_0 = 0$, $x_1 = 1$, $f(x_0) = -1$, $f(x_1) = 0.63212$

$f(0) < 0$, $f(1) > 0$

$$x_2 = \frac{x_0 f(x_1) - x_1 f(x_0)}{f(x_1) - f(x_0)}$$

$$= \frac{0 \times 0.63212 - 1 \times (-1)}{0.63212 - (-1)}$$

$$\boxed{x_2 = 0.61270}$$

$f(x_2) = 0.07081$

$$x_3 = \frac{x_1 f(x_2) - x_2 f(x_1)}{f(x_2) - f(x_1)}$$

$$= \frac{1 \times (0.07081) - 0.61270 \times (0.63212)}{0.07081 - 0.63212}$$

$$\boxed{x_3 = 0.56384}$$

$f(x_3) = -0.00518$

$$x_4 = \frac{x_2 f(x_3) - x_3 f(x_2)}{f(x_3) - f(x_2)}$$

$$= \frac{0.61270 \times (-0.00518) - 0.5638 \times (0.07081)}{-0.00518 - (0.07081)}$$

$$\boxed{x_4 = 0.56692}$$

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$f(x_4) = -0.00035$

$$x_5 = \frac{x_3 f(x_4) - x_4 f(x_3)}{f(x_4) - f(x_3)}$$

$$= \frac{(\cancel{0.00518}\ (0.56384) \times -0.00035) - [(0.56692) \times (-0.00518)]}{-0.00035 - (-0.00518)}$$

$$\boxed{x_5 = 0.56729}$$

Ques: (i) $x^4 - x - 10 = 0$

(ii) $x^3 - x - 4 = 0$

(iii) $xe^x - 1 = 0$