ENG1060 – Computing Summary Notes

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Functions

Function Handles

A variable that **represents** function.

$$fn\_handle = @ < function\ name >$$

Handle becomes a pointer to/alias of the actual function.

- Allows functions to be input arguments to other functions

Anonymous Functions

Create a function without a separate file. Can only return one output

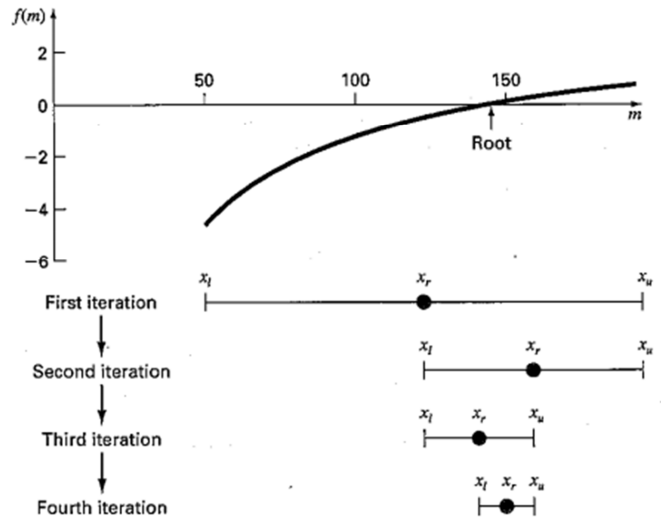
$$fn\_handle = @(inputs) < equation >$$

Root Finding

Bracketing Methods

Requires upper and lower limit x-values surrounding the location of a root in order to operate (use graphical methods).

Bisection Method



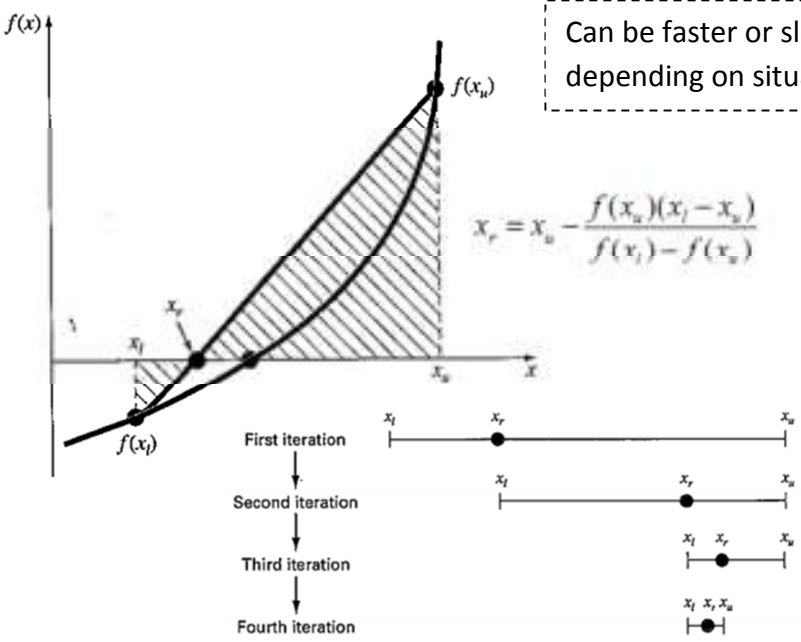
- Two boundary limits chosen, $x_l and\ x_u$.
- Bisected to find $x_r = \frac{x_l + x_u}{2}$
- If $f(x_l) \times f(x_r) < 0$ then root lies between x_l and x_r, so new $x_u = x_r$, then bisect that range and continue.
- Otherwise new $x_l = x_r$
- Repeat as long as $f(x) > precision$

```
while abs(fxr) > precision
    xr = (xu+xl)/2;
    fxr=f(xr);
    iterations = iterations +1;

    if fxl*fxr > 0
        xl = xr;
        fxl = f(xl);
    else
        xu = xr;
    end
end
```

False Position Method

Similar but instead of just bisecting, makes more educated guess by finding intercept of line joining the two boundary points.



$$x_r = x_u - \frac{f(x_u)(x_l - x_u)}{f(x_l) - f(x_u)}$$

Can be faster or slower at finding root, depending on situation

Bracketing Method Function:

Inputs:

- Function handle of equation
- Lower Limit
- Upper Limit
- Precision

Output:

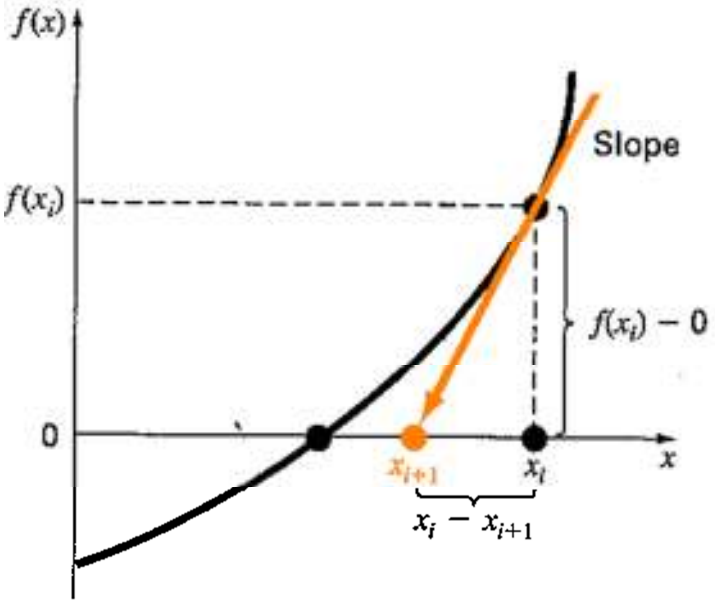
- Root

Open Methods

If no idea where root of function lies.

- Requires one initial guess
- Can sometimes diverge instead of converge on root

Newton-Raphson Method



- Initial guess point x_i
- Draw tangent to curve at that point
- Point where crosses x-axis is improved estimate of root

$$x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$$

Inputs:

- Function handle of **equation**
- Function handle of **derivative** of equation
- Initial guess
- Precision

Output:

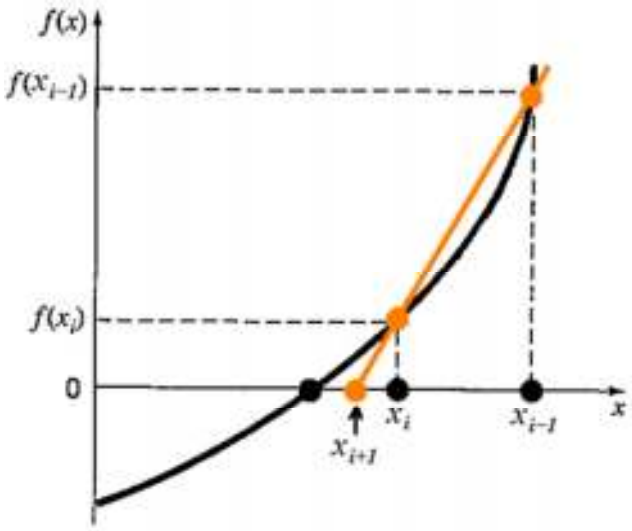
- Root

- Needs derivative of equation
- Does not converge well in some situations
- Converges slowly or fails if gradient close to zero at point

```
while abs(dfxi) > precision
    iter = iter + 1;
    xi = xi-(dfxi/ddfxi);
    fxi = f(xi);
    dfxi = df(xi);
    ddfxi = ddf(xi);
end
```

Secant Method

Requires two guesses, but do not need to bracket (surround) root.



$$x_{i+1} = x_i - \frac{f(x_i)(x_{i-1} - x_i)}{f(x_{i-1}) - f(x_i)}$$

Inputs:

- Function handle of equation
- Initial guess, x_i
- Initial guess, x_{i-1}
- Precision

Output:

- Root

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