

# CBNST LAB PRACTICAL

Date: September 22, 2021

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## Secant Method

### Algorithm:

1. Start
2. Define function as  $f(x)$
3. Input:
  - a. Initial guess  $x_0, x_1$
  - b. Tolerable Error  $e$
  - c. Maximum Iteration  $N$
4. Initialize iteration counter  $step = 1$
5. Do
  - If  $f(x_0) = f(x_1)$ 
    - Print "Mathematical Error"
    - Stop
  - End If
  - $x_2 = x_1 - (x_1 - x_0) * f(x_1) / (f(x_1) - f(x_0))$
  - $x_0 = x_1$
  - $x_1 = x_2$
  - $step = step + 1$
  - If  $step > N$ 
    - Print "Not Convergent"
    - Stop
  - End If

While  $abs\ f(x_2) > e$
6. Print root as  $x_2$
7. Stop

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## Code :

```
#include <stdio.h>
#include <math.h>
#include <stdlib.h>

#define phi(x) (x * x + 4 * sin(x))

double differential(double x0)
{
    const double delta = 1.0e-10;
    double x1 = x0 - delta;
    double x2 = x0 + delta;

    double y1 = phi(x1);
    double y2 = phi(x2);

    // printf("gradient= %f\n", grad);
    return (y2 - y1) / (x2 - x1);
    // return (pow(-2.718282, -1*x)-cos(x));
}

int main()
{
    int k = 0;
    double x0, x1, x2, f0, f1, f2, g0;
    int step = 1, N;
    double allErr;
    printf("Enter the allowed Error: ");
    scanf(" %lf", &allErr);
    printf("Enter the interval lower limit: ");
    scanf(" %lf", &x0);
    printf("Enter the interval upper limit: ");
    scanf(" %lf", &x1);

    printf("Enter maximum iteration: ");
    scanf("%d", &N);
    {
        {
```

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```
printf("\nStep\t\t\t\t\tx0\t\t\t\t\tx1\t\t\t\t\tf(x0)\t\t\t\t\tf(x1)\t\t\t\t\tx2=(x0  
f1-x1f0)/(f1-f0)\t\t\t\t\tf(x2)\n");  
  
do  
{  
    f0 = phi(x0);  
    f1 = phi(x1);  
    if (f0 == f1)  
    {  
        printf("Mathematical Error.");  
        exit(0);  
    }  
}
```

```
x2 = x1 - (x1 - x0) * f1 / (f1 - f0);  
f2 = phi(x2);
```

[illegible]

```
x0 = x1;  
f0 = f1;  
x1 = x2;  
f1 = f2;
```

```
step = step + 1;
```

```
if (step > N)
{
    printf("Not Convergent.");
    exit(0);
}
while (fabs(f2) > allErr);
```

```
        printf("\nRoot is: %f\n", x1);
    }
}
```

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The screenshot displays the Visual Studio Code interface with the file `05_SecantMethod.cpp` open. The code implements a function `differential(double)` that uses the Secant Method to find the root of the function  $\phi(x) = x^2 + 4 \sin(x)$ . The program prompts the user for the allowed error, interval limits, and maximum iterations. The output shows the iterative process converging to a root of approximately -1.933754.

```
1 #include <stdio.h>
2 #include <math.h>
3 #include <stdlib.h>
4
5 #define phi(x) (x * x + 4 * sin(x))
6
7 double differential(double x0)
8 {
```

Windows PowerShell  
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```
PS E:\03 Semester\CBNST\Unit 01> cd "e:\03 Semester\CBNST\Unit 01\" ; if ($?) { g++ 05_SecantMethod.cpp -o 05_SecantMethod } ; if ($?) { .\05_SecantMethod }
Enter the allowed Error: 0.00001
Enter the interval lower limit: -2
Enter the interval upper limit: -1
Enter maximum iteration: 10
```

Step	x0	x1	f(x0)	f(x1)	x2=(x0f1-x1f0)/(f1-f0)	f(x2)
1	-2.000000	-1.000000	0.362810	-2.365884	-1.867839	-0.339926
2	-1.000000	-1.867839	-2.365884	-0.339926	-2.012515	0.434146
3	-1.867839	-2.012515	-0.339926	0.434146	-1.938923	-0.014943
4	-2.012515	-1.938923	0.434146	-0.014943	-1.933638	-0.000610
5	-1.938923	-1.933638	-0.014943	-0.000610	-1.933754	0.000001

Root is: -1.933754  
PS E:\03 Semester\CBNST\Unit 01> []