Bisection Method With Different Termination Conditions

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1 Problem a) xe^x

1.1 Parameters

start_point :	-1
end_point :	2
increment :	3
ϵ :	10^{-9};

1.2 Convergence for different termination conditions

root	$\lvert f(mid)\rvert < \epsilon$	$\lvert b-a\rvert < \epsilon$	$\frac{\lvert b-a\rvert}{\lvert b\rvert} < \epsilon$	$\lvert f(b)-f(a)\rvert < \epsilon$
0	32	35	did not converge	35
Total	33	36	541	36

Table 1: function evaluations for different termination criteria

1.3 Observations

For termination condition $\frac{|b-a|}{|b|} < \epsilon$ the algorithm did not converge because the values of b and a become very close to zero near the root and the division by b gives a larger number than ϵ.

2 Problem b) $x^3 - 2x + 1$

2.1 Parameters

start_point :	-2
end_point :	2
increment :	0.5
ϵ :	10^{-9};

2.2 Convergence for different termination conditions

root	$\|f(mid)\| < \epsilon$	$\|b-a\| < \epsilon$	$\frac{\|b-a\|}{\|b\|} < \epsilon$	$\|f(b) - f(a)\| < \epsilon$
-1.61803	32	32	32	35
0.618034	64	67	68	70
1	93	not produced	99	101
Total	95	99	101	103

Table 2: function evaluations for different termination criteria

2.3 Observations

- The function evaluations are cumulative.
- For termination condition $\frac{|b-a|}{|b|} < \epsilon$ the mid point itself become the root but points a and b are far so in next iteration the a becomes mid and the algorithm do not find the zero.

3 Problem c) $sin(x) - \frac{1}{x}$

3.1 Parameters

start_point :	1
end_point :	3
increment :	0.5
ϵ :	10^{-9};

3.2 Convergence for different termination conditions

root	$\|f(mid)\| < \epsilon$	$\|b - a\| < \epsilon$	$\frac{\|b-a\|}{\|b\|} < \epsilon$	$\|f(b) - f(a)\| < \epsilon$
1.11414	24	32	32	33
Total	29	36	36	37

Table 3: function evaluations for different termination criteria

3.3 Observations

- The termination condition $|f(mid)| < \epsilon$ do not converge at poles and is caught in an infinite loop.
- The termination condition $|b - a| < \epsilon$ gives poles as root and a check for function value can be used to eliminate such points from solution.