Math 151A Project 1 Report

Jerry Liu, 404474229

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1 Function Documentation

1.1 Purpose

The purpose of this function is to use *Brent's Method* to *solve the root* in a given interval of some function f. The performance of *Brent's Method* is usually as good as *Secant Method*, although it performs worse than *Bisection Method* in worst cases.

1.2 Input

The function `brent` took 4 arguments `f, a, b, epsilon`. `f` is the function on which we want to work; `a, b` are the left and right interval such that $f(a)f(b) < 0$; `epsilon` is the desired accuracy.

1.3 Output

The function `brent` returns two variables, `p` and `hist`. `p` returns the history of the right bound `b`, and its last element is the result of the root that is within a radius of `epsilon` of the true solution. `hist` returns the history of all variables `a, b, c` needed for section 2 in the report.

1.4 Calling Syntax

Let `f, a, b, epsilon` be the input specified in section 1.2, the calling syntax will be:

```
[p, hist] = brent(f, a, b, epsilon);
```

For example, for application 1, we do:

```
f = @(x) (x + 3) * (x - 1)^4;
a = -4;
b = 4/3;
epsilon = 10^(-15);
[p, hist] = brent(f, a, b, epsilon);
```

After the function returns, `p` will contain a history of the right bound b in each iteration and the satisfactory root, and `hist` will contain a history of variables `a, b, c` in each iteration. To display the the root:

```
p(size(p, 2))
```

This will print out the root returned by the function.

2 Application No. 1

2.1 Results

$f(x) = (x+3)(x-1)^4, x \in [-4, \frac{4}{3}]$, result is $p = -3$. `fzero` returns -3.

2.2 History

Iteration Number	History of `a`	History of `b`	History of `c`
1	-4.000000000000000	1.333333333333333	-4.000000000000000
2	-4.000000000000000	1.332876856631202	1.333333333333333
3	-4.000000000000000	1.251405832084316	1.332876856631202
4	-4.000000000000000	-1.374297083957842	1.251405832084316
5	-4.000000000000000	-2.687148541978921	-1.374297083957842
6	-3.343574270989460	-2.687148541978921	-2.687148541978921
7	-2.687148541978921	-3.015361406484191	-2.687148541978921
8	-3.015361406484191	-2.994159144461673	-3.015361406484191
9	-3.015361406484191	-2.999910810083186	-2.994159144461673
10	-2.999910810083186	-3.000000012886975	-2.999910810083186
11	-3.000000012886975	-2.999999999998851	-3.000000012886975
12	-2.999999999998851	-3.000000000000000	-2.999999999998851
13	-3.000000000000000	-3.000000000000000	-3.000000000000000

2.3 Plot

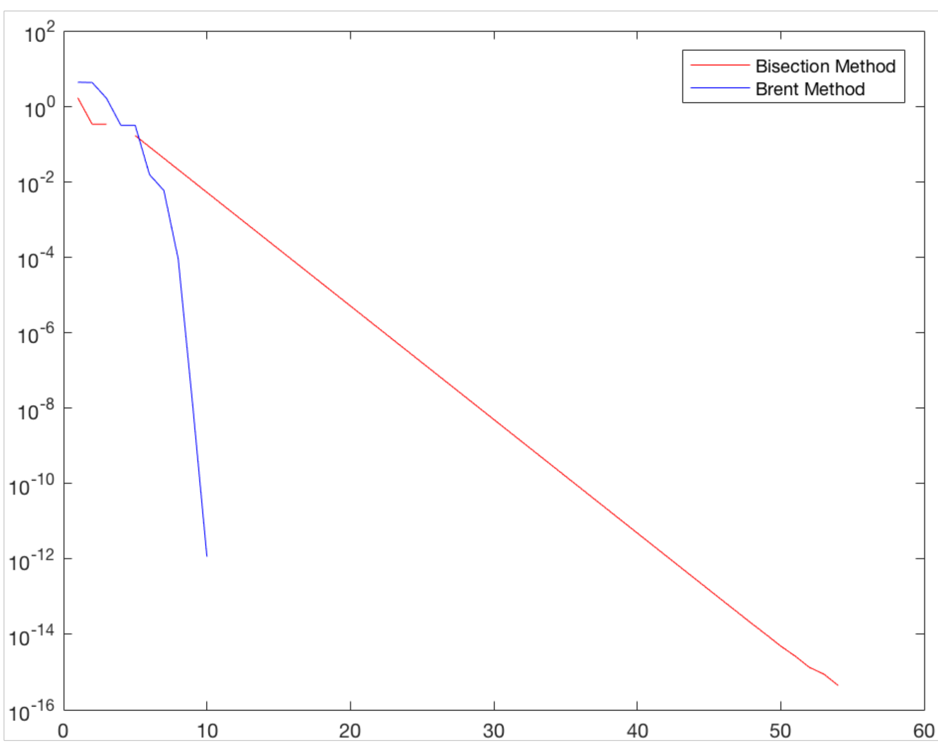

Figure 1: Plot of $|b - \widehat{p}|$ for Brent's Method and $|p_n - \widehat{p}|$ for Bisection Method with `semilogy`

3 Application No. 2

3.1 Results

$f(x) = \cos(x^2) - \frac{1}{2}x, x \in [0, 2]$, result is $p = 1.018171830298774$. `fzero` returns 1.018171830298774.

3.2 History

Iteration Number	History of `a`	History of `b`	History of `c`
1	2.000000000000000	0	2.000000000000000
2	2.000000000000000	0.753680706887503	0
3	1.267009148940082	0.753680706887503	0.753680706887503
4	1.267009148940082	0.964654556963560	0.753680706887503
5	1.115831852951821	0.964654556963560	0.964654556963560
6	0.964654556963560	1.040243204957690	0.964654556963560
7	1.040243204957690	1.017138541935834	1.040243204957690
8	1.040243204957690	1.018152816403197	1.017138541935834
9	1.018152816403197	1.018171830948416	1.018152816403197
10	1.018171830948416	1.018171830298764	1.018171830948416
11	1.018171830298764	1.018171830298774	1.018171830298764
12	1.018171830298764	1.018171830298774	1.018171830298774
13	1.018171830298764	1.018171830298774	1.018171830298774
14	1.018171830298769	1.018171830298774	1.018171830298774
15	1.018171830298772	1.018171830298774	1.018171830298774
16	1.018171830298773	1.018171830298774	1.018171830298774
17	1.018171830298774	1.018171830298774	1.018171830298774

3.3 Plot

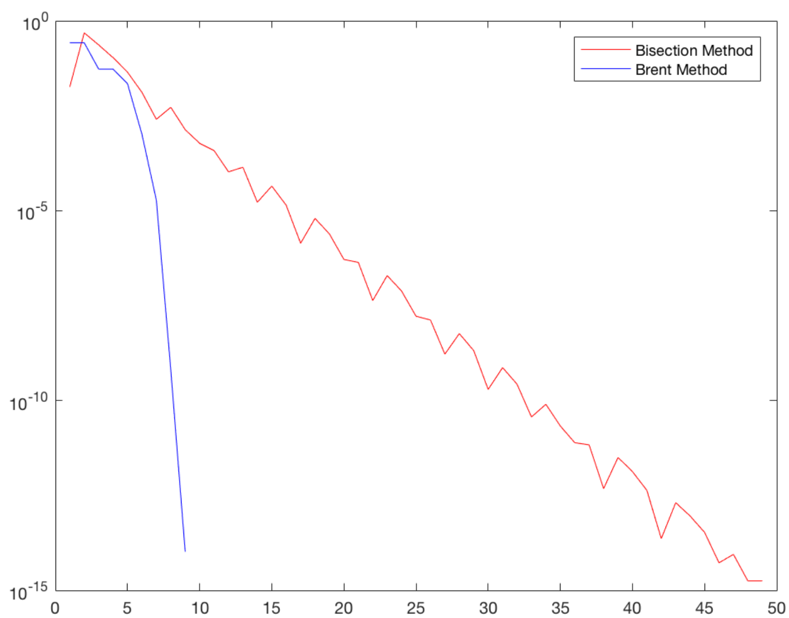

Figure 2: Plot of $|b - \widehat{p}|$ for Brent's Method and $|p_n - \widehat{p}|$ for Bisection Method with `semilogy`