Numerical Methods Runtime Table

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We have used the same 10 problems with each method and run each method (Bisection, False Position, and Hybrid) 500 times for each problem and then we have calculated the average time. We have also calculated the number of iterations each method have taken for each problem.

We have also used the same accuracy for each problem which is 10^{-10}

These are the problems that we have used for each method:

Table 1: Problem Set

No	Equation	Equation Code	Interval
$P1$	$f(x) = x^3 + 4x^2 - 10 = 0$	`x**3 + 4*x**2 - 10`	[0, 4]
$P2$	$f(x) = x^2 - 4$	`x**2 - 4`	[0, 4]
$P3$	$f(x) = e^x - 2$	`math.exp(x) - 2`	[0, 2]
$P4$	$f(x) = \sin(x)$	`math.sin(x)`	[2, 6]
$P5$	$f(x) = x^3 - 6x^2 + 11x - 6$	`x**3 - 6*x**2 + 11*x - 6`	[1, 2.5]
$P6$	$f(x) = x^2 + 3x + 2$	`x**2 + 3*x + 2`	[-2.5, -1.5]
$P7$	$f(x) = \cos(x) - x$	`math.cos(x) - x`	[0, 1]
$P8$	$f(x) = 2^x - 8$	`2**x - 8`	[2,4]
$P9$	$f(x) = \tan(x)$	`math.tan(x)`	[-1, 1]
$P10$	$f(x) = x^4 - 8x^3 + 18x^2 - 9x + 1$	`x**4 - 8*x**3 + 18*x**2 - 9*x + 1`	[2, 4]
$P11$	$f(x) = x^2 - 3$	`x**2 - 3`	[1,2]
$P12$	$f(x) = x^2 - 5$	`x**2 - 5`	[2,7]
$P13$	$f(x) = x^2 - 10$	`x**2 - 10`	[3,4]
$P14$	$f(x) = x^2 - x - 2$	`x**2 - x - 2`	[1,4]
$P15$	$f(x) = x^2 + 2x - 7$	`x**2 + 2*x - 7`	[1,3]
$P16$	$f(x) = x^3 - 2$	`x**3 - 2`	[0,2]
$P17$	$f(x) = xe^x - 7$	`x * math.exp(x) - 7`	[0,2]
$P18$	$f(x) = x - \cos(x)$	`x - math.cos(x)`	[0,1]
$P19$	$f(x) = x\sin(x) - 1$	`x * math.sin(x) - 1`	[0,2]

No	Equation	Equation Code	Interval
$P20$	$f(x) = x\cos(x) + 1$	`x * math.cos(x) + 1`	[-2,4]
$P21$	$f(x) = x^{10} - 1$	`x**10 - 1`	[0,1.3]
$P22$	$f(x) = x^2 + e^{x/2} - 5$	`x**2 + (2.71828**(x/2)) - 5`	[1,2]
$P23$	$f(x) = \sin(x)\sinh(x) + 1$	`math.sin(x) * math.sinh(x) + 1`	[3,4]
$P24$	$f(x) = e^x - 3x - 2$	`(2.71828**x) - 3*x - 2`	[2,3]
$P25$	$f(x) = \sin(x) - x^2$	`math.sin(x) - x**2`	[0.5,1]

Table 2: Bisection Table

Problem	Iter	Avg CPU Time	Root
$P1$	37	5.7437896728515626e-05s	1.3652300134126563
$P2$	1	0.0s	2.0
$P3$	36	0.00013828516006469726s	0.6931471805728506
$P4$	37	9.968948364257812e-05s	3.1415926536137704
$P5$	35	3.628253936767578e-05s	1.999999999985448
$P6$	1	0.0s	-2.0
$P7$	35	0.0004040045738220215s	0.7390851332165767
$P8$	1	0.0s	3.0
$P9$	1	0.0s	0.0
$P10$	36	6.400394439697266e-05s	3.111748656287091

Table 3: False Position Table

Problem	Iter	Avg CPU Time	Root
$P1$	60	0.00018867158889770508s	1.3652300134095658
$P2$	25	0.00013594388961791993s	1.999999999985837
$P3$	37	0.00042249441146850584s	0.6931471805263113
$P4$	7	3.332376480102539e-05s	3.1415926535899232
$P5$	2	0.0s	1.0
$P6$	22	5.1965713500976564e-05s	-1.999999999904401
$P7$	9	6.48040771484375e-05s	0.7390851331710709
$P8$	23	4.136466979980469e-05s	2.9999999999941527
$P9$	2	0.0s	0.0
$P10$	9	3.2056331634521486e-05s	3.1117486563093983

Table 4: Hybrid Method Table

Problem	Iter	Avg CPU Time	a	Root	b	$f(x)$
$P1$	9	1.7926692962646484e-05	1.3652300132710436	1.3652300134137713	1.369770382783838	-5.25091081726714e-12
$P2$	1	0.0	0	2.0	4	0
$P3$	8	1.8086910247802734e-05	0.6931471790929861	0.6931471805540398	0.7812092856565997	-1.1810996625172265e-11
$P4$	5	4.081249237060547e-06	3.1415903579556914	3.1415926536048838	3.1847874957380742	-1.5094913867333564e-11
$P5$	1	1.857757568359375e-06	1	1.0	2.5	0
$P6$	1	1.9383430480957033e-06	-2.5	-2.0	-1.5	0.0
$P7$	6	6.016731262207031e-06	0.7390851296377037	0.7390851332051975	0.7516528968220136	1.8505463662497277e-11
$P8$	1	1.956939697265625e-06	2	3.0	4	0.0
$P9$	1	0.0	-1	0.0	1	0.0
$P10$	6	1.7911911010742188e-05	3.0989059994429341	3.1117486563146391	3.111748659071221	-4.8132164920389187e-11