Project 03: Golomb Ruler
Project Report
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We have modelled the problem of finding a Golomb ruler of a fixed length L for M marks as a CSP problem. The techniques used for solving the CSP problem involve –

1) Plain Backtracking (BT)
2) BT + Forward Checking (FC)
3) BT + Constraint Propagation (CP)

For the inputs (L, M) our code returns the minimum value L*, and the position of marks such that (L* , M) is an optimal Golomb Ruler. If no solution exists for (L, M) then -1, [] is returned.

Value of M	Least value of L such that (L, M) is a Golomb Ruler	Length, Position of Marks on the ruler (as given by the program)
4	6	6 [0, 1, 4, 6]
5	11	11 [0, 1, 4, 9, 11]
6	17	17 [0, 1, 4, 10, 12, 17]
7	25	25 [0, 1, 4, 10, 18, 23, 25]
8	34	34 [0, 1, 4, 9, 15, 22, 32, 34]

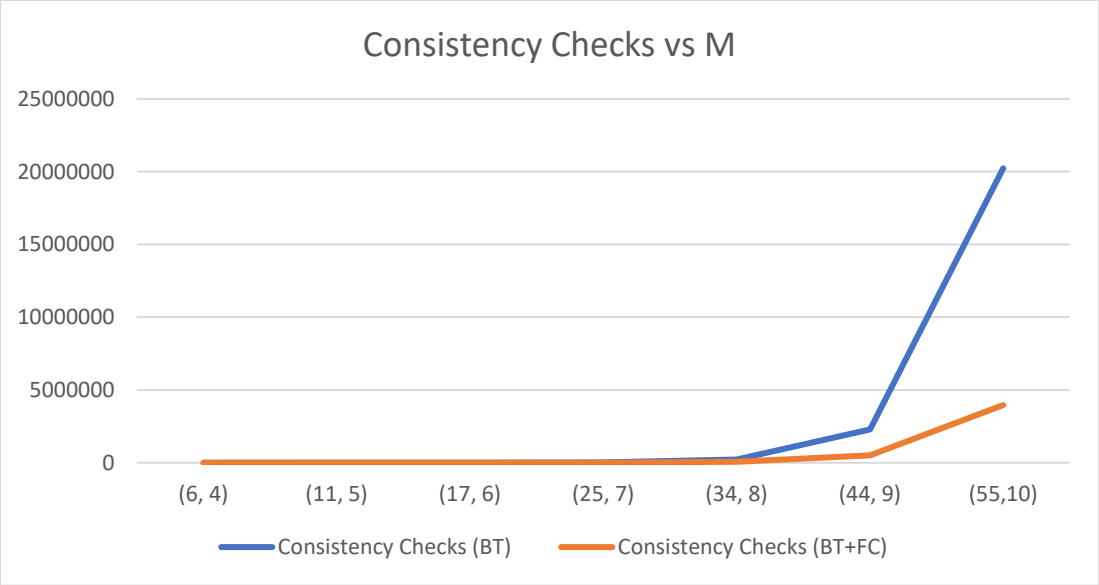
Case Study –

Below are the **Number of Consistency checks**, **time taken** for the Plain Backtracking, BT+FC and BT+CP scenarios, for different inputs.

Input (L, M)	Consistency Checks (BT)	Consistency Checks (BT+FC)	Time taken in Seconds (BT)	Time taken in Seconds (BT+FC)	Time taken in Seconds (BT+CP)
(6, 4)	30	17	0.000999927520752	0.0019998550415	0.00200009346008
(11, 5)	249	111	0.00899982452393	0.0019998550415	0.0190000534058
(17, 6)	2076	780	0.0380001068115	0.0210001468658	0.680000066757
(25, 7)	22837	6972	0.0499999523163	0.0810000896454	4.89800000191
(34, 8)	228991	59898	0.483000040054	0.917999982834	87.1399918245
(44, 9)	2292168	515444	6.71100020409	13.2380001545	
(55,10)	20233041	3964683	44.9050002098	87.2269999981	

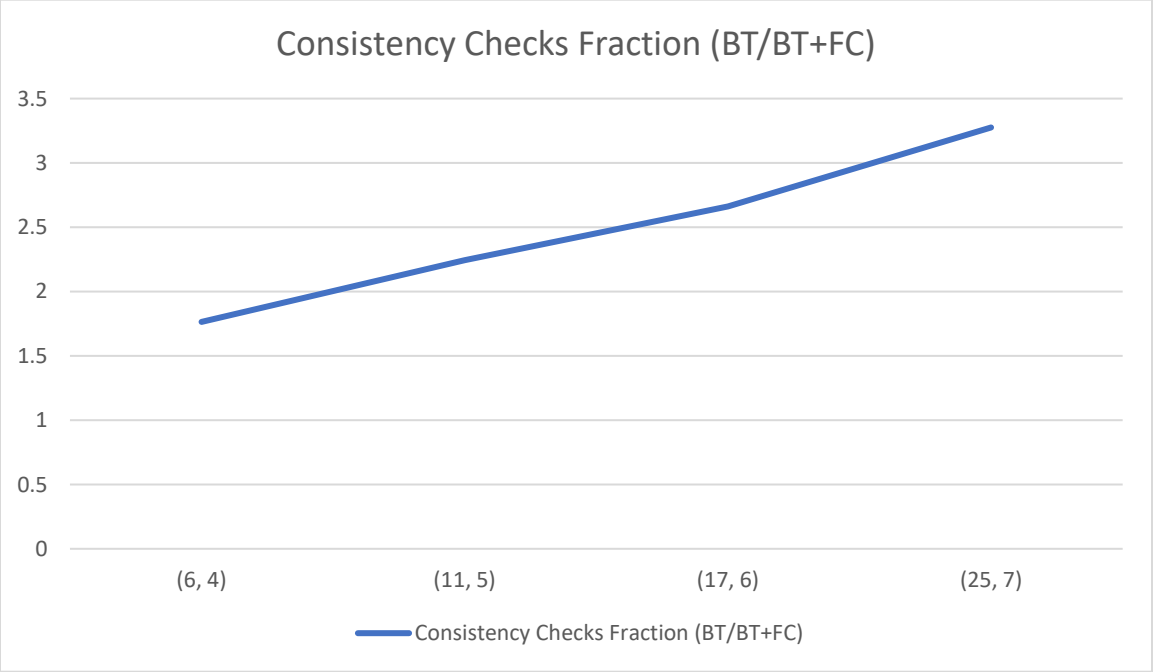
Observations –

1) Consistency checks seem to have an exponential growth with M



We can see that as the value of M increases by 1, the number of consistency checks made to find the solution increases by a factor of 10 approximately.

2) The number of consistency checks made in case of BT divided by the number of consistency checks made in case of BT+FC follows a linear curve. This shows that BT performs much more checks that BT+FC as M increases.



3) For the input (55,10), the time taken for the BT+FC program to complete is in the order of minutes, which means that the computation is not real time.
For the input (34, 8), the time taken for BT+CP program to complete is in the order of minutes