Case studies combining Model Logical embeddings from Action to State labeled Probabilistic Systems

Report containing Experiment Details of the above Paper.

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1 Ant-on-Grid

Table 1: Details of Encoding and Model checking

Grid	ADTMC		Encoding Time		SDTMC		Build	Property	Value	Time
Initial	$\|S\|$	$\|T\|$	Code	MRF	$\|S'\|$	$\|T'\|$	Time			
(8,8) (5,3)	240	240	.0133	.0165	577	1300	.066	1	0.5862	0.009
								2	0.4138	0.011
								3	1.0	0.006
(16,16) (10,6)	1008	1008	.0664	.069	2241	5268	.195	1	0.5387	.043
								2	.4613	.044
								3	1.00	.015
(16,16) (5,3)	1008	1008	.0658	.0675	2241	5268	.192	1	0.697	.047
								2	0.303	.059
								3	1.0	.011
(64,64) (40,24)	16368	16368	15.27	.9998	33729	82836	3.375	1	0.508	4.503
								2	0.4908	4.511
								3	1.0	.113
(64,64) (5,3)	16368	16368	15.19	.9368	32739	82836	3.389	1	0.702	4.547
								2	0.297	4.522
								3	100	.111
(256,256) (160,96)	262128	262128	5134.615	16.8762	528321	1314708	69.75	1	0.4967	1157.645
								2	0.4923	1165.757
								3	1.0	2.788
(256,256) (5,3)	262128	262128	5146.213	17.1123	528321	1314708	71.25	1	0.702	1122.612
								2	0.2974	1119.816
								3	1.0	3.039

Table 2: Details of Rewrad Properties

Grid-Size	Initial Position	Value	Time
8×8	(5,3)	**11.724**	0.008
16×16	(10,6)	57.728	0.045
16×16	(5,3)	27.428	0.043
64×64	(40,24)	1043.041	4.557
64×64	(5,3)	56.681	4.652

2 Airplane Boarding Pass Probelm

Table 3: Results for Lost Boarding Pass Problem

10^N	ADTMC	Encoding Time		SDTMC		Build Time	Value	Time
	$\|S\| = \|T\| + 1$	Code	MRF	$\|S'\|$	$\|T'\|$			
1	71	.0032	.0041	158	191	.0295	0.5	.006
2	791	.036	.0412	1778	2171	0.133	0.5	.039
3	7991	1.351	.3685	17978	21971	1.525	0.5	1.195
4	79991	262.2	3.8421	179978	219971	20.736	0.5	93.031
5	799991	50460.889	39.7816	1799978	2199971	303.93	0.5	38752.431

Table 4: Details of Reward Properties

N	Value	Time
10	9	0.0007
100	99	0.025
1000	999	1.416

When the grid size is 256×256, the default PRISM settings have a maximum iteration of 10000 for which it does not converge. Decreasing the threshold error up to 10000 gives wrong results, hence, we set an upper limit of 1000000 of maximum iterations. The iterations converged in 127167 iterations for all four properties (two each for the two grid models) and the correct values were obtained. This led to higher model checking times as shown in the table 1. Similarly, one needs to increase iterations for the convergence of the airplane ticket problems as well for larger N. The figure below shows the comparison of the encoding times for the generation of the codes and the MRFs for PRISM with the number of ADTMC states. For the cases we have considered in this study, the trend is linear.

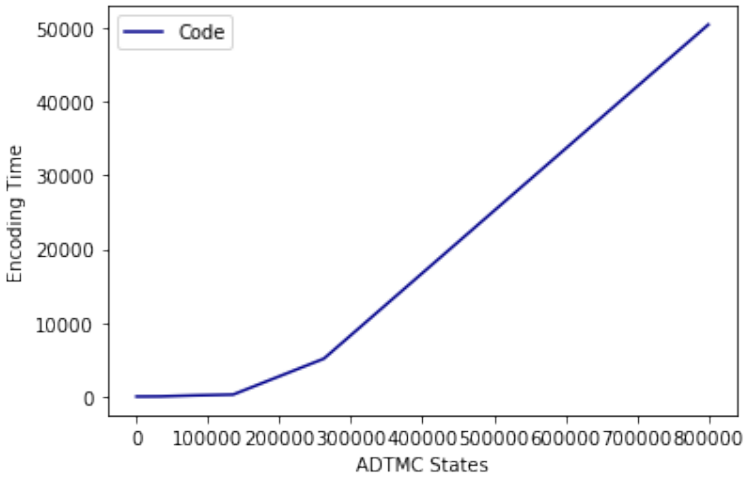
3 Bounded Retransmission Protocol(BRP)

Table 5: Details of Encoding and Model checking

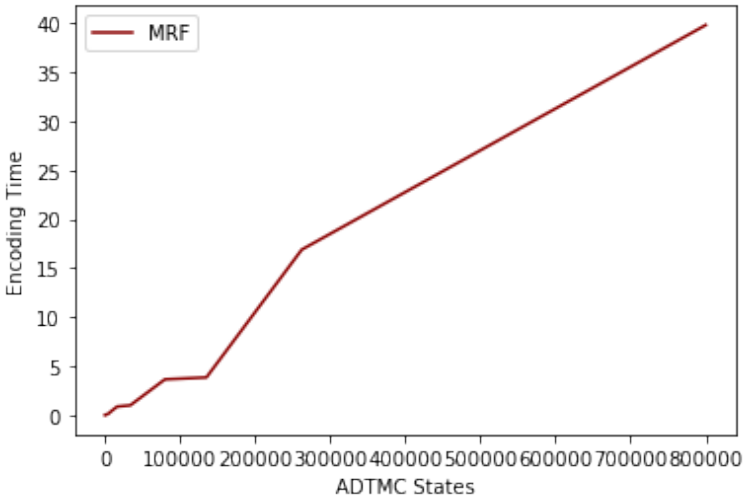
(N,MAX)	ADTMC		Encoding Time		SDTMC		Build	Property	Value	Time
	$\|S\|$	$\|T\|$	Code	MRF	$\|S'\|$	$\|T'\|$	Time			
(4,2)	99	99	.0028	.0035	132	156	.027	1	.988	.006
								2	1.0	.001
(4,3)	127	127	.0033	.0043	168	200	.03	1	0.998	.007
								2	1.0	.001
(16,2)	387	387	.0101	.0122	516	612	.051	1	0.952	.016
								2	1.0	.005
(16,3)	499	499	.0129	.015	660	788	.063	1	0.993	.024
								2	1.0	.008
(16,4)	611	611	.0187	.0187	804	964	.067	1	0.999	.025
								2	1.0	.01
(16,5)	723	723	.0187	.0222	948	1140	.084	1	1.0	.031
								2	1.0	.015
(32,2)	771	771	.0201	.0236	1028	1220	.085	1	0.907	.021
								2	1.0	.01
(32,3)	995	995	.0261	.0299	1316	1572	.101	1	0.986	.049
								2	1.0	.029
(32,4)	1219	1219	.0327	.0374	1604	1924	.125	1	0.998	.046
								2	1.0	.029
(32,5)	1443	1443	.0398	.0442	1892	2276	.164	1	1.0	.049
								2	1.0	.023
(64,2)	1539	1539	.0430	.0474	2052	2436	.218	1	0.822	.101
								2	1.0	.071
(64,3)	1987	1987	.0599	.0613	2628	3140	.217	1	0.972	.105
								2	1.0	.071
(64,4)	2435	2435	.0790	.0740	3204	3844	.225	1	0.996	.112
								2	1.0	.065
(64,5)	2883	2883	.0956	.0876	3780	4548	.305	1	1.0	.152
								2	1.0	.111
(64,8)	4227	4227	.1862	.1153	5508	6660	.45	1	1.0	.177
								2	1.0	.135
(512,8)	33795	33795	4.594	.8733	44036	53252	3.925	1	1.0	2.842
								2	1.0	1.321
(2048,8)	135171	135171	148.4	3.649	176132	212996	18.05	1	1.0	41.578
								2	1.0	6.059

Table 6: Details of Reward Properties

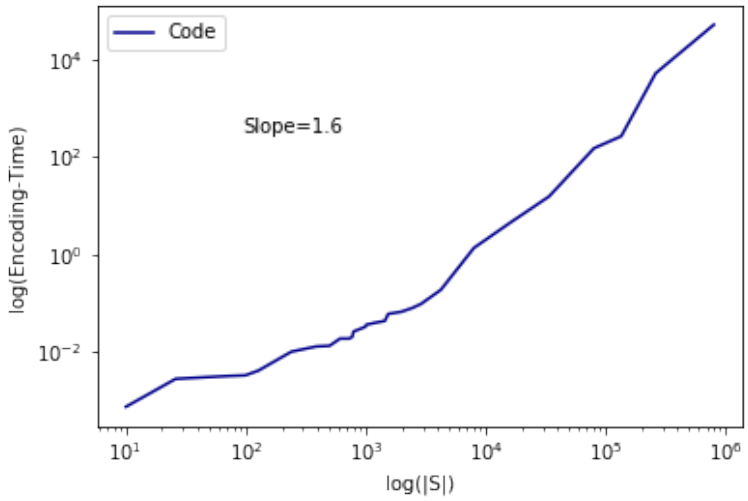
(N,MAX)	Reward Structures					
	"success-frame"		"fail-transmission"		"c-aF"	
	Value	Time	Value	Time	Value	Time
(4,2)	3.018	0.003	0.012	0.001	4.7	0.002
(4,3)	3.002	0.005	0.002	0.002	4.68	0.002
(16,2)	15.372	0.009	0.050	0.005	19.148	0.005
(16,3)	15.053	0.015	0.007	0.009	18.776	0.009
(16,4)	15.007	0.017	0.0001	0.011	18.721	0.01
(16,5)	15.007	0.024	0	0.013	18.71	0.014
(32,2)	32.5621	0.021	0.102	0.015	39.254	0.014
(32,3)	31.219	0.039	0.014	0.028	37.683	0.027
(32,4)	31.032	0.04	0.002	0.029	37.464	0.027
(32,5)	31.002	0.045	0	0.036	37.43	0.035
(64,2)	69.562	0.077	0.216	0.065	82.53	0.056
(64,3)	63.892	0.105	0.029	0.081	75.896	0.065
(64,4)	63.129	0.95	0.004	0.095	75.003	0.075
(64,5)	63.01	0.995	0	0.097	74.861	0.095



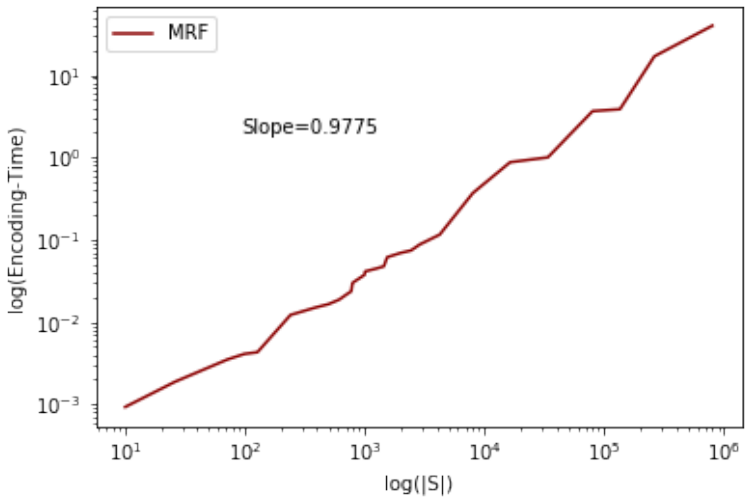
(a) Code Encoding Time



(b) MRF Encoding Time



(c) Code Slope



(d) MRF Slope

Figure 1: Comparison of the ADTMC state space and encoding time(in seconds)