

AppTracker1: MAP analysis for GPAMs

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Interpreting the results. For a given data set, a value for K , and inferred model (either PAM or GPAM), we model check properties for each of the activity patterns. To aid interpretation of the quantitative results, we order them from “best” to “worst”, which is greatest to least value for **VisitProb** and **VisitCount** and the least to greatest value for **StepCount**. We encode the ordering using colours for maximum five activity patterns thus: blue, purple, orange, green, black, ranging from “best” results to “worse” results respectively. If the result of model checking a reward-based property does not produce a number (due to state unreachability, or filter satisfying no states, or the iterative method not converging within 100,000 iterations) this is denoted by “—”.

The unit for the time intervals is days. For simplicity, assume $N = 50$ for all time-bounded properties.

Table 1: Properties VP_{init}^{GPAM} , VC_{init}^{GPAM} and SC_{init}^{GPAM} in GPAM with $K = 2$

Prop.	Time interval	OverallUsage		StackedBars		PeriodSelector		Stats	
		AP1	AP2	AP1	AP2	AP1	AP2	AP1	AP2
VP_{init}^{GPAM}	[0,1]	0.99	0.74	0.66	0.47	0.28	0.47	0.63	0.85
	[0,7]	0.40	0.99	0.51	0.63	0.50	0.30	0.88	0.51
	[0,30]	0.99	0.32	0.69	0.50	0.37	0.51	0.46	0.86
	[30,60]	0.79	0.97	0.92	0.16	0.75	0.06	0.49	0.61
	[60,90]	0.83	0.95	0.89	0.04	0.79	0.06	0.55	0.56
VC_{init}^{GPAM}	[0,1]	7.35	1.54	1.10	0.68	0.42	0.78	1.04	2.29
	[0,7]	0.57	8.93	0.78	0.99	0.89	0.51	2.54	0.74
	[0,30]	8.98	0.41	1.20	0.77	0.73	0.88	0.64	2.31
	[30,60]	1.75	5.63	3.09	0.20	2.27	0.07	0.88	1.33
	[60,90]	1.99	7.50	2.21	0.04	1.88	0.07	1.16	1.63
SC_{init}^{GPAM}	[0,1]	8.47	38.60	46.63	76.78	147.87	75.71	49.53	27.68
	[0,7]	94.61	6.42	67.77	50.53	69.83	135.15	25.15	69.26
	[0,30]	6.29	121.52	42.33	70.24	104.63	69.51	78.02	26.69
	[30,60]	32.76	8.25	21.38	307.87	36.73	599.45	73.62	54.82
	[60,90]	27.23	17.12	19.61	1134.47	31.62	709.70	61.55	59.67

Table 2: Property VPinitGPAM, VCinitGPAM and SCinitGPAM in GPAM with $K = 3$

Prop.	Time interval	OverallUsage				StackedBars				PeriodSelector				Stats			
		AP1	AP2	AP3		AP1	AP2	AP3		AP1	AP2	AP3	AP4	AP1	AP2	AP3	AP4
VPinitGPAM	[0,7]	0.99	0.27	0.88	0.27	0.27	0.25	0.69	0.22	0.34	0.43	0.04	0.79	0.72			
	[0,30]	0.85	0.99	0.27	0.74	0.28	0.28	0.19	0.55	0.24	0.28	0.70	0.01	0.73			
	[30,60]	0.99	0.16	0.37	0.37	0.53	0.53	0.57	0.07	0.16	0.62	0.37	0.00	0.77			
	[60,90]	0.93	0.56	0.48	0.15	0.77	0.77	0.40	0.21	0.12	0.71	0.53	0.30	0.22			
VCinitGPAM	[0,1]	6.70	1.72	0.78	0.31	0.54	0.54	0.90	0.00	0.24	1.01	0.28	0.73	2.55			
	[0,7]	6.27	0.64	2.48	0.30	0.31	0.31	1.30	0.45	0.52	0.61	0.05	1.91	1.43			
	[0,30]	2.00	6.38	0.63	1.46	0.33	0.33	0.22	0.81	0.50	0.38	1.26	0.01	1.63			
	[30,60]	6.88	0.22	0.51	0.42	1.51	1.51	1.14	0.07	0.21	2.04	0.59	0.00	1.82			
	[60,90]	2.54	0.65	2.40	0.10	1.39	1.39	1.02	0.79	0.07	3.36	0.70	0.25	0.72			
SCinitGPAM	[0,1]	7.97	29.80	74.76	168.49	88.95	88.95	58.23	Infinity	186.50	57.60	163.96	69.28	23.27			
	[0,7]	7.69	148.41	26.06	161.32	161.22	161.22	42.98	186.03	113.53	86.14	919.21	32.77	40.11			
	[0,30]	28.25	7.79	148.34	37.29	154.11	154.11	219.27	62.16	168.16	146.50	41.75	2583.99	38.62			
	[30,60]	5.91	272.83	110.64	116.09	65.48	65.48	58.50	636.81	249.39	51.60	—	—	—			
	[60,90]	11.87	68.77	73.08	401.20	34.69	34.69	88.98	169.66	456.95	41.18	76.28	162.03	173.57			

Table 3: Property VPinitGPAM, VCinitGPAM and SCinitGPAM in GPAM with $K = 4$, $N = 50$

Prop.	Time interval	OverallUsage				StackedBars				PeriodSelector				Stats			
		AP1	AP2	AP3	AP4	AP1	AP2	AP3	AP4	AP1	AP2	AP3	AP4	AP1	AP2	AP3	AP4
VPinitGPAM	[0,1]	0.96	0.99	0.76	0.17	0.22	0.14	0.77	0.00	0.19	0.02	0.61	0.13	0.14	0.93	0.45	0.09
	[0,7]	0.96	0.17	0.98	0.80	0.30	0.00	0.00	0.79	0.09	0.21	0.24	0.58	0.93	0.08	0.14	0.42
	[0,30]	0.97	0.98	0.78	0.20	0.08	0.24	0.79	0.07	0.13	0.28	0.59	0.21	0.92	0.10	0.38	0.05
	[30,60]	0.31	0.62	0.99	0.22	0.55	0.05	0.51	0.67	0.29	0.53	0.44	0.12	0.77	0.33	0.28	0.00
	[60,90]	0.27	0.64	0.93	0.46	0.47	0.64	0.21	0.38	0.15	0.00	0.23	0.63	0.32	0.29	0.50	0.24
VCinitGPAM	[0,1]	3.18	4.13	1.31	0.21	0.26	0.16	1.51	0.00	0.27	0.02	0.97	0.15	0.19	2.64	0.58	0.09
	[0,7]	3.15	0.38	3.89	1.61	0.34	0.00	0.00	1.62	0.10	0.28	0.47	0.90	2.54	0.11	0.32	0.78
	[0,30]	3.37	3.81	1.45	0.38	0.08	0.28	1.60	0.08	0.15	0.54	0.87	0.27	2.45	0.14	0.48	0.08
	[30,60]	0.74	0.91	5.40	0.37	0.90	0.05	0.84	1.75	0.35	0.69	0.99	0.17	1.56	0.37	0.59	0.00
	[60,90]	0.20	0.90	2.36	2.50	0.48	0.76	0.15	1.09	0.11	0.00	0.70	3.20	0.23	0.23	0.57	0.86
SCinitGPAM	[0,1]	14.85	12.45	35.92	236.55	195.50	297.57	34.78	Infinity	216.05	1809.58	52.85	303.67	287.88	19.87	80.13	489.73
	[0,7]	16.35	244.29	11.17	32.11	—	—	—	—	450.44	194.36	165.68	56.97	20.35	558.43	287.72	88.24
	[0,30]	15.47	11.59	33.94	206.91	548.08	180.79	33.16	557.75	307.99	143.55	56.15	186.53	20.82	406.51	97.89	811.47
	[30,60]	132.17	51.72	6.05	195.10	61.00	888.02	69.32	44.92	139.54	65.43	81.73	398.79	34.15	122.64	146.61	Infinity
	[60,90]	193.52	54.18	12.35	76.19	89.43	54.00	279.73	92.52	329.66	Infinity	170.68	49.42	149.23	177.19	86.44	154.69

Table 4: Property VPinit_{GPAM}, VCinit_{GPAM}, and SCinit_{GPAM} in GPAM with $K = 5$

Prop.	Time	OverallUsage					StackedBars				
	interval	AP1	AP2	AP3	AP4	AP5	AP1	AP2	AP3	AP4	AP5
VPinitGPAM	[0,1]	0.83	0.69	0.97	0.94	0.25	0.01	0.54	0.01	0.35	0.43
	[0,7]	0.75	0.43	0.31	0.15	0.99	0.18	0.40	0.17	0.54	0.13
	[0,30]	0.75	0.81	0.56	0.19	0.99	0.66	0.18	0.03	0.18	0.40
	[30,60]	0.14	0.58	0.99	0.16	0.13	0.86	0.12	0.40	0.00	0.41
	[60,90]	0.91	0.57	0.31	0.41	0.25	0.36	0.02	0.51	0.00	0.40
VCinitGPAM	[0,1]	1.81	1.12	3.07	2.70	0.35	0.01	0.79	0.01	0.44	0.58
	[0,7]	1.56	0.64	0.66	0.17	6.76	0.19	0.45	0.20	0.81	0.14
	[0,30]	1.94	1.83	0.92	0.27	4.38	1.17	0.22	0.04	0.22	0.45
	[30,60]	0.13	0.71	5.18	0.38	0.37	1.86	0.12	0.52	0.00	1.46
	[60,90]	0.77	0.50	0.11	0.22	2.65	0.12	0.01	0.26	0.00	3.46
SCinitGPAM	[0,1]	30.12	42.76	12.81	17.26	160.32	2375.33	62.81	4257.20	116.98	85.25
	[0,7]	37.20	85.34	122.51	282.06	6.83	245.10	100.18	240.83	62.96	317.33
	[0,30]	36.85	30.37	59.86	225.29	7.62	46.15	241.77	1138.42	223.80	101.29
	[30,60]	315.49	57.29	6.17	279.49	327.27	26.31	360.19	97.26	Infinity	91.66
	[60,90]	18.07	91.63	220.83	135.26	134.32	202.19	3999.16	108.40	Infinity	88.78

Table 5: Property VPinit_{GPAM}, VCinit_{GPAM}, and SCinit_{GPAM} in GPAM with $K = 5$

Prop.	Time interval	PeriodSelector					Stats				
		AP1	AP2	AP3	AP4	AP5	AP1	AP2	AP3	AP4	AP5
VPinit _{GPAM}	0.58	0.16	0.13	0.09	0.01	0.47	0.37	0.90	0.09	0.10	
	[0,7]	0.12	0.05	0.48	0.02	0.23	0.33	0.08	0.82	0.49	0.32
	[0,30]	0.30	0.38	0.36	0.02	0.25	0.55	0.11	0.55	0.46	0.35
	[30,60]	0.08	0.48	0.37	0.30	0.15	0.14	0.34	0.21	0.74	0.01
	[60,90]	0.35	0.00	0.36	0.29	0.38	0.32	0.23	0.47	0.28	0.10
VCinit _{GPAM}	0.86	0.18	0.14	0.10	0.01	0.63	0.45	2.09	0.12	0.11	
	[0,7]	0.13	0.04	0.86	0.02	0.40	0.40	0.09	1.90	0.80	0.57
	[0,30]	0.38	0.62	0.51	0.02	0.38	0.84	0.14	0.80	0.68	0.48
	[30,60]	0.13	0.60	0.84	0.36	0.39	0.14	0.34	0.48	1.42	0.01
	[60,90]	0.31	0.00	0.30	0.16	2.90	0.18	0.10	0.17	0.08	0.58
SCinit _{GPAM}	57.33	242.20	319.89	497.06	3011.45	78.96	101.72	23.46	423.33	430.34	
	[0,7]	333.09	991.32	73.16	1780.28	183.13	121.82	496.54	30.13	70.98	119.69
	[0,30]	127.85	101.75	105.52	1506.24	160.80	62.02	374.37	61.52	81.01	109.95
	[30,60]	456.52	75.71	98.26	134.65	271.53	307.83	120.39	194.36	37.46	3761.32
	[60,90]	159.31	10131.72	153.29	190.66	90.69	201.86	285.42	140.65	267.54	309.20

Table 6: Properties VPinitGPAM, VCinitGPAM, and SCinitGPAM for UseStop in GPAM

Prop.	Time	K=2			K=3			K=4				K=5				
		AP1	AP2	AP3	AP1	AP2	AP3	AP1	AP2	AP3	AP4	AP1	AP2	AP3	AP4	AP5
VPinitGPAM	cut															
	[0,1]	0.19	0.99	0.99	0.06	0.01	0.63	0.10	0.63	0.20	0.99	0.02	0.00	0.63	0.02	0.99
	[0,7]	0.99	0.26	0.17	0.06	0.99	0.17	0.70	0.99	0.07	0.00	0.00	0.31	0.99	0.83	0.30
	[0,30]	0.22	0.99	0.05	0.27	0.05	0.99	0.60	0.08	0.02	0.99	0.02	0.26	0.59	0.99	0.06
	[30,60]	0.95	0.91	0.98	0.52	0.52	0.98	0.99	0.05	0.37	0.60	0.58	0.13	0.31	0.98	0.50
	[60,90]	0.93	0.92	0.63	0.86	0.79	0.77	0.25	0.86	0.57	0.45	0.58	0.72	0.23	0.44	
VCinitGPAM	[0,1]	0.21	5.59	5.88	0.07	0.01	0.94	0.11	0.94	0.22	4.44	0.02	0.00	0.93	0.02	4.77
	[0,7]	5.92	0.30	0.19	0.06	6.30	4.96	1.19	4.96	0.07	0.00	0.00	0.41	3.95	1.68	0.36
	[0,30]	0.25	6.02	6.07	0.31	0.05	0.08	0.88	0.08	0.02	5.18	0.02	0.31	0.95	4.97	0.07
	[30,60]	3.66	2.83	4.42	0.78	1.36	0.06	4.82	0.06	0.43	1.40	0.87	0.13	0.33	3.90	1.59
	[60,90]	2.54	3.71	2.19	1.75	1.46	0.20	1.20	0.20	1.58	2.28	0.19	0.47	0.48	0.14	4.73
SCinitGPAM	[0,1]	226.50	9.04	8.92	636.65	4178.94	49.58	395.91	211.85	11.46	1663.87	Infinity	50.30	1800.56	10.81	
	[0,7]	8.31	155.51	247.96	700.52	8.73	10.64	41.63	611.76	Infinity	11932.37	122.94	12.88	29.44	131.81	
	[0,30]	185.15	8.01	8.89	153.27	833.80	513.04	53.85	2103.42	10.10	2261.43	154.33	55.53	10.72	653.11	
	[30,60]	18.45	18.04	11.61	67.11	66.88	799.73	10.55	103.74	54.56	57.21	348.70	131.11	11.31	70.92	
	[60,90]	16.77	21.71	49.93	21.90	32.49	183.38	35.26	22.57	56.97	128.98	88.08	55.41	252.23	80.84	

Table 7: Property LongRunPatternGPAM

Time interval	K=2		K=3		K=4		K=5	
	AP1	AP2	AP1	AP2	AP1	AP2	AP1	AP2
[0, 1]	0.55	0.44	0.39	0.21	0.39	0.23	0.16	0.19
[0, 7]	0.44	0.55	0.37	0.37	0.26	0.23	0.13	0.11
[0, 30]	0.55	0.44	0.27	0.36	0.24	0.25	0.20	0.21
[30, 60]	0.65	0.34	0.43	0.18	0.38	0.14	0.10	0.12
[60, 90]	0.53	0.46	0.25	0.25	0.49	0.12	0.11	0.14