

# Experimental Results for HIPP-DEC and HIPP

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With the formulations available at <http://people.sabanciuniv.edu/~esraerdem/benchmarks/hipp.html>, we tried to solve some instances of **HIPP**, randomly chosen amongst the ones generated by Brown and Harrower, using CLASP (Version 1.0.4) and ILOG OPL (Version 5.5) with CP-OPTIMIZER (Version 1.1), on a machine with Intel Centrino 1.8GHz CPU and 1 GB of RAM running on Windows XP. For each instance of **HIPP**, we present results for two instances of **HIPP-DEC**: one with the optimal value of  $k$ , and the other with 1 less than the optimal. Tables below summarize the results of these experiments. In the tables comparing the computation times, a dash - indicates that the problem could not be solved in 900 sec.s.

**Table 1.** Experimental results for **HIPP-DEC** with respect to Gusfield's definition (straightforward formulations): computation times

Problem	$n$	$m$	$k$	CPU time (sec.)		
				CP – OPL	ILP – OPL	ASP – CLASP
P0	5	4	5	0.01	8.85	0.01
			4	0.03	34.20	0.01
P1	5	10	8	0.14	-	0.06
			7	390.6	-	0.27
P2	8	9	8	0.19	-	0.07
			7	98.85	-	0.19
P3	13	12	12	1.74	-	0.42
			11	-	-	-

**Table 2.** Experimental results for **HIPP-DEC** with respect to Gusfield's definition (straightforward formulations): program size

Problem	$n$	$m$	$k$	CP – OPL		ILP – OPL		ASP – CLASP	
				# of variables	# of constraints	# of variables	# of constraints	# of variables	# of rules
P0	5	4	5	220	69	4145	630	531	535
			4	216	69	2656	405	381	394
P1	5	10	8	555	167	26000	3525	2885	2880
			7	545	167	19915	2700	2289	2293
P2	8	9	8	800	257	37448	5128	3177	3151
			7	791	257	28679	3928	2560	2549
P3	13	12	12	1676	541	181728	24349	15341	15199
			11	1664	541	152713	20462	13143	13026

**Table 3.** Experimental results for **HIPP-DEC** with respect to Gusfield’s definition: computation times

Problem	$n$	$m$	$k$	Straightforward formulation			Alternative formulation		
				CP – OPL	ASP – CLASP	ILP – OPL	CP – OPL	ASP – CLASP	ILP – OPL
I0	10	41	16	1.65	3.17	-	0.71	1.01	1.03
			15	-	-	-	20.25	1.01	133.37
I1	10	41	15	0.82	2.63	-	1.25	0.96	1.52
			14	-	-	-	11.35	0.99	1.28
I2	15	48	22	102.29	10.99	-	3.64	5.58	4.05
			21	-	-	-	-	8.74	-
I3	20	54	26	-	608.99	-	58.03	11.07	-
			25	-	-	-	-	109.84	-

**Table 4.** Experimental results **HIPP-DEC** with respect to Gusfield’s definition (straightforward formulation): program size

Problem	$n$	$m$	$k$	CP – OPL		ASP – CLASP		ILP – OPL	
				# of var.s	# of constraints	# of var.s	# of constraints	# of var.s	# of rules
I0	10	41	16	4416	1333	88138	87796	-	-
I1	10	41	15	4465	1369	70457	70135	-	-
I2	15	48	22	7551	2299	302462	301770	-	-
I3	20	54	26	11194	3469	612646	611564	-	-

**Table 5.** Experimental results **HIPP-DEC** relative to Gusfield’s definition (alternative formulation): program sizes

Problem	$n$	$m$	$k$	CP – OPL		ASP – CLASP		ILP – OPL	
				# of var.s	# of constraints	# of var.s	# of rules	# of var.s	# of constraints
I0	10	41	16	17351	19695	49071	25432	4110	17641
I1	10	41	15	17387	19695	49089	25432	4110	17641
I2	15	48	22	45017	49175	129734	66452	7410	45571
I3	20	54	26	89387	95605	259899	132322	11360	90201

**Table 6.** Experimental results for **HIPP-DEC** with respect to Brown & Harrower’s definition (straightforward formulations): computation times

Problem	$n$	$m$	$k$	CPU time (sec.)		
				CP – OPL	ILP – OPL	ASP – CLASP
P0	5	4	5	0.01	0.83	0.08
			4	0.02	5.43	0.02
P1	5	10	8	0.12	-	0.38
			7	511.62	-	1.12
P2	8	9	8	0.01	-	0.48
			7	77.03	-	0.92
P3	13	12	12	1.0	-	3.14
			11	-	-	-

**Table 7.** Experimental results for **HIPP-DEC** with respect to Brown & Harrower’s definition (straightforward formulations): program size

Problem	$n$	$m$	$k$	CP – OPL		ILP – OPL		ASP – CLASP	
				# of variables	# of constraints	# of variables	# of constraints	# of variables	# of rules
P0	5	4	5	150	21	645	130	1496	1520
			4	146	21	416	85	963	1013
P1	5	10	8	390	51	3600	325	8899	9033
			7	380	51	2765	250	6822	6987
P2	8	9	8	520	73	5192	520	13169	13327
			7	511	73	3983	400	10069	10281
P3	13	12	12	1106	157	24480	1885	62451	62378
			11	1094	157	20581	1586	52420	52519

**Table 8.** Experimental results for **HIPP-DEC** relative to Brown & Harrower’s definition: computation times (CPU sec.s)

Problem	$n$	$m$	$k$	Straightforward formulation			Alternative formulation		
				CP – OPL	ASP – CLASP	ILP – OPL	CP – OPL	ASP – CLASP	ILP – OPL
I0	10	41	16	2.16	40.58	-	0.52	4.12	1.02
			15	-	-	-	19.3	4.2	24.29
I1	10	41	15	3.24	27.97	-	1.18	4.2	0.59
			14	-	-	-	10.79	4.2	1.3
I2	15	48	22	93.92	-	-	3.67	23.22	3.34
			21	-	-	-	-	23.03	-
I3	20	54	26	-	-	-	57.89	81.7	-
			25	-	-	-	-	86.11	-

**Table 9.** Experimental results **HIPP-DEC** relative to Brown & Harrower’s definition (straightforward formulation): program sizes

Problem	$n$	$m$	$k$	CP – OPL		ASP – CLASP		ILP – OPL	
				# of var.s	# of constraints	# of var.s	# of rules	# of var.s	# of constraints
I0	10	41	16	3136	411	279230	278786	108176	2570
I1	10	41	15	3095	411	249272	249275	108176	2570
I2	15	48	22	5406	721	910958	909957	-	-
I3	20	54	26	7924	1081	1910134	1909390	-	-

**Table 10.** Experimental results **HIPP-DEC** relative to Brown & Harrower’s definition (alternative formulation): program sizes

Problem	$n$	$m$	$k$	CP – OPL		ASP – CLASP		ILP – OPL	
				# of var.s	# of constraints	# of var.s	# of rules	# of var.s	# of constraints
I0	10	41	16	16839	17235	48405	24612	1240	17231
I1	10	41	15	16839	17235	48405	24612	1240	17231
I2	15	48	22	44159	44855	128585	65012	2370	44851
I3	20	54	26	88079	89125	258165	130162	3800	89121

**Table 11.** Experimental results for **HIPP-DEC** with S1 (straightforward formulations): computation times

Problem	$n$	$m$	$k$	CPU time (sec.)					
				wrt Gusfield's definition			wrt Brown & Harrower's definition		
				CP	ILP	ASP	CP	ILP	ASP
P1	5	10	8	0.03	-	0.09	0.02	-	0.33
			7	613.03	-	0.52	760.79	-	1.30
P2	8	9	8	0.26	-	0.10	0.17	-	0.44
			7	129.50	-	0.41	95.37	-	0.88

**Table 12.** Experimental results for **HIPP-DEC** with S1 (straightforward formulations): program size

Problem	$n$	$m$	$k$	wrt Gusfield's definition						wrt Brown & Harrower's definition					
				CP – OPL		ILP – OPL		ASP – CLASP		CP – OPL		ILP – OPL		ASP – CLASP	
				# of var.s	# of constraints	# of var.s	# of constraints	# of var.s	# of rules	# of var.s	# of constraints	# of var.s	# of constraints	# of var.s	# of rules
P1	5	10	8	1804	1066	28752	5573	3753	3804	1639	950	6352	2373	10327	10517
			7	1484	856	22022	4268	2940	2986	1319	740	4872	1818	7893	8100
P2	8	9	8	1937	1092	39944	6984	3961	3991	1657	908	7688	2376	14457	14671
			7	1646	897	30590	5349	3148	3179	1366	713	5894	1821	11035	11289

**Table 13.** Experimental results for **HIPP** (obtained from the straightforward formulations of **HIPP-DEC**): computation times

Problem	$n$	$m$	CPU time (sec.)					
			wrt Gusfield's definition			wrt Brown & Harrower's definition		
			CP – OPL	ILP – OPL	ASP – CLASP	CP – OPL	ILP – OPL	ASP – CLASP
P1	5	10	-	-	355.9	635.7	-	695.8
P2	8	9	-	-	557.42	-	-	-

**Table 14.** Experimental results for **HIPP** (obtained from the straightforward formulations of **HIPP-DEC**): Effects of various symmetry breaking constraints

Program	CPU time (sec.) for Problem P2		
	no symmetry	S1	S2
CP formulation wrt Gusfield's definition	-	378.01	389.68
ASP formulation wrt Gusfield's definition	557.42	-	0.68
CP formulation wrt Brown & Harrower's definition	-	278.35	164.49
ASP formulation wrt Brown & Harrower's definition	-	-	6.85

**Table 15.** Experimental results for **HIPP** (alternative formulation): computation times

Problem	$n$	$m$	Gusfield's formulation			Brown & Harrower's formulation		
			CP – OPL	ASP – CLASP	ILP – OPL	CP – OPL	ASP – CLASP	ILP – OPL
P2	8	9	3.94	0.23	0.53	3.91	1.46	0.50
P3	13	12	69.69	0.57	1.08	67.47	8.65	1.06
I0	10	41	124.92	2.01	3.06	121.5	22.04	2.55
I1	10	41	140.55	1.77	2.04	131.4	22.67	1.29
I2	15	48	-	13.25	-	-	117.82	-
I3	20	54	-	-	-	-	-	-