

Experiment results

The codes of written in C++ and compiled by g++ with optimization option ‘-O3’. All the experiments are conducted on a computer with a CentOS operating system an Intel 3106 CPU (1.7GHz, 8 cores) with 8G memory.

We appreciate the authors of *LP* (Berlowitz, Cohen, and Kimelfeld 2015), *GP* (Wang et al. 2017) and *D2K* (Conte et al. 2018) for publishing their codes. As far as we know, the three solvers are among the most recent and competitive algorithms for enumerating maximal k -plexes. We also revised the codes of *GP* since it misses maximal k -plexes in certain cases. These algorithms are compiled with their makefiles and executed in single-thread mode. Since *GP* and *LP* are algorithms of enumerating maximal k -plexes, we compare *FaPlexen* with *LP* and *GP*. *D2K* is dedicated to find constrained maximal k -plexes in large graphs, therefore, we compare *CommuPlex* with *D2K* in massive real-life graphs. We set the cut off time for each algorithm as 1 day (86400 seconds) for each tested instance.

Table 1: The running time of enumerating maximal k -plexes in real graph instances.

Graph ($ V $, $ E $)	k	# k -plexes	The running time (s)		
			<i>FaPlexen</i>	<i>GP</i>	<i>LP</i>
CA-GrQc (5242, 28980)	2	13718439	2788.55	inf	inf
celegans (453, 2025)	2	104518	2.09	726.03	5310.93
	3	16053622	254.94	inf	inf
	4	1734552825	26447.71	inf	inf
ia-infect-hyper (113, 2196)	2	175887	1.47	1754.12	inf
	3	6523528	61.68	inf	inf
	4	180196030	1881.7	inf	inf
	5	3845997332	45522.32	inf	inf
web-edu (3031, 6474)	2	4585512	408.94	inf	inf

References

- Berlowitz, D.; Cohen, S.; and Kimelfeld, B. 2015. Efficient enumeration of maximal k -plexes. In *Proceedings of the 2015 ACM SIGMOD International Conference on Management of Data*, 431–444. ACM.
- Conte, A.; De Matteis, T.; De Sensi, D.; Grossi, R.; Marino, A.; and Versari, L. 2018. D2k: Scalable community detection in massive networks via small-diameter k -plexes. In *Proceedings of the 24th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining*, 1272–1281. ACM.
- Wang, Z.; Chen, Q.; Hou, B.; Suo, B.; Li, Z.; Pan, W.; and Ives, Z. G. 2017. Parallelizing maximal clique and k -plex enumeration over graph data. *Journal of Parallel and Distributed Computing* 106:79–91.

Table 2: The running time of enumerating maximal k -plexes in 2^{nd} DIMACS instances.

Graph ($ V $, $ E $)	k	# k -plexes	The running time (s)		
			<i>FaPlexen</i>	<i>GP</i>	<i>LP</i>
hamming6-2 (64, 1824)	2	151254354	6701.14	inf	inf
hamming6-4 (64, 704)	2	22416	0.07	0.60	212.05
	3	359688	1.53	15.38	30783.96
	4	5376544	28.79	349.06	inf
	5	66058576	409.89	3897.66	inf
johnson8-2-4 (28, 210)	2	2625	0.01	0.09	9.11
	3	11707	0.11	1.40	153.61
	4	83186	0.66	12.65	20937.54
	5	179640	2.47	44.19	inf
johnson8-4-4 (70, 1855)	2	17173650	220.70	5977.07	inf
	3	2019828917	41136.81	inf	inf
johnson16-2-4 (120, 5460)	2	57652737	68300.14	inf	inf
keller4 (171, 9435)	2	1792571838	29221.26	inf	inf
MANN-a9 (45, 918)	2	2160546	26.16	48843.19	inf
	3	16619686	1116.06	inf	inf
	4	1953125	14.78	inf	inf
	5	1	0.00	0.00	0.55
c-fat200-1 (200, 1534)	2	18403	0.24	2.03	213.47
	3	2091061	13.26	111.95	inf
	4	78985463	580.40	8352.83	inf
	5	2823759342	20526.93	inf	inf
c-fat200-2 (200, 3235)	2	16683	0.31	2.74	201.50
	3	4982600	27.24	142.28	inf
	4	370282106	1627.41	19342.93	inf
	5	1926077476	61593.89	inf	inf
c-fat200-5 (200, 8473)	2	11434	0.86	22.91	1115.51
	3	18413326	262.43	3989.55	inf
	4	714901477	76496.75	inf	inf
c-fat500-10 (500, 46627)	2	78131	33.73	811.07	57134.82
	3	623174657	32323.44	inf	inf
c-fat500-1 (500, 4459)	2	120371	3.15	30.22	5077.25
	3	28052957	470.70	3008.02	inf
	4	2728490079	49963.88	inf	inf
c-fat500-2 (500, 9139)	2	115651	4.65	32.46	4430.50
	3	54556993	750.16	3569.31	inf
	4	1750438286	82616.59	inf	inf
c-fat500-5 (500, 23191)	2	101575	10.07	91.37	6642.36
	3	221812054	3542.11	14476.98	inf
brock200-2 (200, 9876)	2	39629635	415.08	3214.35	inf
brock200-3 (200, 12048)	2	860820566	14085.18	inf	inf
p.hat1000-1 (1000, 122253)	2	2324553030	44213.04	inf	inf
p.hat300-1 (300, 10933)	2	3064826	23.14	143.67	inf
	3	277328042	2053.86	18445.37	inf
p.hat500-1 (500, 31569)	2	54465877	584.69	3767.44	inf
p.hat700-1 (700, 60999)	2	344713916	4838.13	inf	inf

Table 3: The running time for community detection - Part 1.

Graph ($ V , E $)	k	q	# k -plexes	The running time (s)	
				<i>CommuPlex</i>	<i>D2K</i>
Amazon0505 (410236, 3356824)	2	12	376	3.43	1.43
		20	0	0.31	1.27
		30	0	0.34	1.32
	3	12	6347	17.06	1.60
		20	0	0.30	1.36
		30	0	0.35	1.30
	4	12	105649	44.38	8.40
		20	0	0.56	1.22
		30	0	0.32	1.41
Email-EuAll (265214, 420045)	2	12	412779	9.12	24.87
		20	0	2.08	1.25
		30	0	1.05	0.28
	3	12	32639016	858.41	1981.38
		20	2637	10.05	98.62
		30	0	1.12	0.263
	4	20	1707177	833.36	6008.21
		30	0	1.26	0.224
		3	12	682947338	9246.57
cit-Patents (3774768, 16518948)	2	20	0	366.19	7788.29
		30	0	37.13	3021.57
		30	0	13097.24	inf
	3	12	12544	27.20	0.897
		20	5049	2.05	0.82
		30	889	0.89	0.73
	4	12	3003588	83.12	28.72
		20	2141932	42.00	24.49
		30	60677	2.74	1.88
com-dblp (317080, 1049866)	2	12	610150817	9026.70	5816.95
		20	492253045	9456.36	5889.76
		30	12088200	223.93	513.92
	3	12	7679906	5949.84	437.61
		20	94184	1629.28	46.50
		30	3	543.99	9.92
	4	12	520888893	17759.73	33085.17
		20	5911456	1909.81	1360.47
		30	5	851.52	14.50
soc-pokec -relationships (1632803, 30622564)	2	20	318035938	37716.04	inf
		30	4515	1125.52	225.57
		30	4515	1125.52	225.57
	3	12	2467621	594.46	32.30
		20	81504	28.77	5.36
		30	5921	1.50	3.18
	4	12	165936084	6540.10	7175.82
		20	1901073	58.30	82.92
		30	102634	3.49	4.137
web-Google (875713, 5105039)	2	20	45289539	1293.39	2430.00
		30	899440	25.30	36.23
		30	899440	25.30	36.23
	3	12	582312	16.08	19.35
		20	7370	3.97	1.01
		30	0	0.63	0.18
	4	12	25913121	497.01	1111.63
		20	362977	13.04	32.70
		30	0	0.85	0.154
Cit-HepPh (34546, 421578)	2	12	991102305	26656.34	63641.29
		20	8506496	331.94	1524.02
		30	9	1.14	0.29
	3	12	49823056	1412.64	2018.64
		20	3322167	165.00	476.02
		30	0	11.38	28.131
	4	20	548634119	28538.47	75171.24
		30	16066	222.50	5071.63
		30	13172906	53793.02	inf

Table 4: The running time for community detection - Part 2.

Graph ($ V , E $)	k	q	# k -plexes	The running time (s)	
				<i>CommuPlex</i>	<i>D2K</i>
CA-GrQc (5241, 14484)	2	12	166	0.01	0.01
		20	118	0.01	0.01
		30	9	0.00	0.01
	3	12	9654	0.07	0.06
		20	1568	0.02	0.02
		30	7	0.00	0.01
	4	12	128932	1.00	1.13
		20	9167	0.09	0.07
		30	6724	0.06	0.05
Wiki-Vote (8298, 100761)	2	12	2919931	121.09	262.06
		20	52	4.60	24.71
		30	0	1.52	0.07
	3	12	458153396	17187.20	44178.64
		20	156727	331.76	4365.72
		30	0	1.45	341.17
	4	12	9773156	inf	11682.45
		20	46729532	84180.32	inf
		30	0	5.97	0.20
caida (26475, 53381)	2	12	5336	0.18	0.49
		20	0	0.02	0.04
		30	0	0.00	0.03
	3	12	281251	7.45	29.54
		20	0	0.02	0.04
		30	0	0.01	0.03
	4	12	15939883	448.64	1788.25
		20	331	0.09	0.85
		30	0	0.00	0.06
celegans (354, 1501)	2	12	0	0.00	0.00
		20	0	0.00	0.00
		30	0	0.00	0.00
	3	12	0	0.00	0.00
		20	0	0.00	0.00
		30	0	0.00	0.00
	4	12	78	0.01	0.01
		20	0	0.00	0.00
		30	0	0.00	0.00
jazz (198, 2742)	2	12	2990	0.05	0.07
		20	2	0.00	0.00
		30	1	0.00	0.00
	3	12	93969	1.23	1.88
		20	2	0.00	0.00
		30	1	0.00	0.00
	4	12	2745953	49.63	77.33
		20	479	0.02	0.03
		30	1	0.00	0.00
Slashdot090221 (82144, 500480)	2	12	27208777	683.57	743.43
		20	11411028	351.91	459.81
		30	453	14.06	41.65
	3	12	2807943240	79641.40	76759.21
		20	1303148522	46292.76	42227.49
		30	1679468	429.96	5117.93
	4	12	502699966	77217.32	inf