Supplementary Material

1 SUPPLEMENTARY DATA

1.1 Number of colors

	N_V	p	LDF		GLPK		Gurobi		SimCIM	
			mean	std	mean	std	mean	std	mean	std
1	10	0.1	3.0	0.000	2.50	0.527	2.5	0.527	2.5	0.527
2	10	0.2	3.0	0.000	3.00	0.000	3.0	0.000	3.0	0.000
3	10	0.3	3.1	0.316	3.10	0.316	3.1	0.316	3.1	0.316
4	10	0.4	3.6	0.516	3.50	0.527	3.5	0.527	3.5	0.527
5	10	0.5	4.0	0.471	4.00	0.471	4.0	0.471	4.0	0.471
6	10	0.6	4.7	0.675	4.50	0.527	4.5	0.527	4.5	0.527
7	10	0.7	5.2	0.422	5.00	0.667	5.0	0.667	5.0	0.667
8	10	0.8	5.9	0.994	5.90	0.994	5.9	0.994	5.9	0.994
9	10	0.9	7.6	0.843	7.60	0.843	7.6	0.843	7.6	0.843
10	20	0.1	3.0	0.000	3.00	0.000	3.0	0.000	3.0	0.000
11	20	0.2	3.7	0.675	3.50	0.527	3.5	0.527	3.5	0.527
12	20	0.3	4.4	0.516	4.10	0.316	4.1	0.316	4.1	0.316
13	20	0.4	5.6	0.516	5.00	0.000	5.0	0.000	5.0	0.000
14	20	0.5	6.3	0.949	5.70	0.483	5.7	0.483	5.7	0.483
15	20	0.6	7.5	0.527	6.80	0.422	6.8	0.422	6.8	0.422
16	20	0.7	8.4	0.843	7.40	0.516	7.4	0.516	7.4	0.516
17	20	0.8	10.0	0.816	9.20	0.632	9.2	0.632	9.2	0.632
18	20	0.9	12.5	0.850	12.50	0.850	12.5	0.850	12.5	0.850
19	30	0.1	3.6	0.516	3.00	0.000	3.0	0.000	3.0	0.000
20	30	0.2	4.7	0.483	4.00	0.000	4.0	0.000	4.0	0.000
21	30	0.3	6.0	0.000	5.00	0.000	5.0	0.000	5.0	0.000
22	30	0.4	7.2	0.422	6.00	0.000	6.0	0.000	6.0	0.000
23	30	0.5	8.3	0.675	7.20	0.422	7.2	0.422	7.2	0.422
24	30	0.6	9.8	0.919	8.60	0.516	8.5	0.527	8.5	0.527
25	30	0.7	11.5	0.850	10.50	0.972	10.1	0.738	10.1	0.738
26	30	0.8	13.7	0.949	13.40	0.966	12.6	0.699	12.6	0.699
27	30	0.9	16.5	1.509	16.25	1.669	15.8	1.398	15.8	1.398
28	40	0.1	4.0	0.000	-	-	3.1	0.316	3.1	0.316
29	40	0.2	5.3	0.483	-	-	4.5	0.527	4.5	0.527
30	40	0.3	7.1	0.568	-	-	6.0	0.000	6.0	0.000
31	40	0.4	8.5	0.527	-	-	6.9	0.316	6.9	0.316
32	40	0.5	10.1	0.738	-	-	***8.3***	0.483	8.4	0.516
33	40	0.6	12.3	0.823	-	-	9.9	0.316	9.9	0.316
34	40	0.7	13.8	0.919	-	-	11.8	0.632	11.8	0.632
35	40	0.8	16.9	0.738	-	-	***14.9***	0.738	15.0	0.816

36	40	0.9	20.3	1.160	-	-	19.0	0.943	19.0	0.943
37	50	0.1	4.4	0.516	-	-	4.0	0.000	4.0	0.000
38	50	0.2	6.2	0.422	-	-	5.0	0.000	5.0	0.000
39	50	0.3	7.8	0.422	-	-	***6.5***	0.527	6.7	0.483
40	50	0.4	10.2	0.422	-	-	7.9	0.316	7.9	0.316
41	50	0.5	11.9	0.568	-	-	9.8	0.422	***9.7***	0.483
42	50	0.6	14.1	0.568	-	-	***11.3***	0.483	11.5	0.527
43	50	0.7	16.2	0.789	-	-	***13.8***	0.632	14.2	0.632
44	50	0.8	20.2	0.632	-	-	***17.1***	0.568	17.2	0.422
45	50	0.9	24.2	1.229	-	-	22.5	1.179	22.5	1.179
46	60	0.1	5.3	0.483	-	-	4.0	0.000	4.0	0.000
47	60	0.2	7.3	0.483	-	-	***5.7***	0.483	5.8	0.422
48	60	0.3	8.7	0.675	-	-	7.0	0.000	7.0	0.000
49	60	0.4	11.4	0.699	-	-	9.0	0.000	9.0	0.000
50	60	0.5	13.8	0.632	-	-	10.9	0.316	10.9	0.316
51	60	0.6	16.3	1.160	-	-	12.9	0.316	12.9	0.316
52	60	0.7	18.8	1.135	-	-	***15.8***	0.422	16.1	0.568
53	60	0.8	23.2	0.789	-	-	***19.4***	0.516	19.9	0.568
54	60	0.9	28.7	1.059	-	-	***25.8***	0.789	26.0	0.816
55	70	0.1	5.4	0.516	-	-	4.0	0.000	4.0	0.000
56	70	0.2	7.7	0.675	-	-	6.0	0.000	6.0	0.000
57	70	0.3	9.7	0.675	-	-	8.0	0.000	***7.9***	0.316
58	70	0.4	12.3	0.675	-	-	***10.1***	0.316	10.5	1.269
59	70	0.5	15.2	0.632	-	-	***12.3***	0.483	12.5	0.527
60	70	0.6	18.4	0.516	-	-	14.9	0.316	***14.6***	0.699
61	70	0.7	22.0	1.247	-	-	***17.8***	0.422	17.9	0.316
62	70	0.8	26.4	1.713	-	-	***21.6***	0.699	22.1	0.568
63	70	0.9	32.5	1.269	-	-	***28.6***	0.966	29.2	0.789
64	80	0.1	5.7	0.483	-	-	***4.3***	0.483	4.8	0.422
65	80	0.2	8.3	0.483	-	-	***6.4***	0.516	6.8	0.422
66	80	0.3	11.2	0.632	-	-	8.9	0.316	8.9	0.316
67	80	0.4	13.5	0.527	-	-	11.6	0.516	***11.0***	0.000
68	80	0.5	16.9	0.994	-	-	14.2	0.632	***13.6***	0.516
69	80	0.6	20.5	0.972	-	-	***16.6***	0.516	16.9	1.853
70	80	0.7	23.5	0.972	-	-	***20.0***	0.667	20.2	0.632
71	80	0.8	29.5	1.650	-	-	***24.6***	0.699	24.9	0.738
72	80	0.9	36.6	2.119	-	-	***31.5***	1.179	32.5	1.354
73	90	0.1	5.9	0.316	-	-	***4.9***	0.316	5.0	0.000
74	90	0.2	9.2	0.632	-	-	7.0	0.000	7.0	0.000
75	90	0.3	12.2	0.632	-	-	9.7	0.483	***9.5***	0.527
76	90	0.4	15.2	0.632	-	-	12.9	0.316	***12.0***	0.471
77	90	0.5	18.3	0.949	-	-	15.6	0.699	***15.1***	0.568
78	90	0.6	22.2	0.919	-	-	19.8	0.789	***18.3***	0.483

79	90	0.7	26.0	1.333	-	-	22.9	1.197	***22.6***	0.516
80	90	0.8	31.8	0.789	-	-	***27.5***	1.080	27.6	0.516
81	90	0.9	40.1	2.132	-	-	***34.6***	0.843	36.3	1.160
82	100	0.1	6.6	0.516	-	-	5.0	0.000	5.0	0.000
83	100	0.2	10.1	0.568	-	-	***7.5***	0.527	7.9	0.316
84	100	0.3	13.0	0.471	-	-	11.1	0.316	***10.2***	0.422
85	100	0.4	16.5	0.850	-	-	14.5	0.850	***13.2***	0.422
86	100	0.5	19.9	0.738	-	-	18.4	0.699	***16.2***	0.422
87	100	0.6	24.1	0.568	-	-	22.5	0.707	***19.9***	0.568
88	100	0.7	28.5	1.269	-	-	27.0	1.054	***24.2***	0.632
89	100	0.8	35.1	1.370	-	-	32.7	1.337	***30.5***	0.850
90	100	0.9	44.3	1.703	-	-	***38.1***	0.738	40.2	0.919

Average number of colors
(lower is better)

Table S1: Numerical results obtained with largest degree first (LDF) heuristics, open-source mixed integer programming solver (GLPK), Gurobi optimization software, and SimCIM quantum-inspired optimization on number of colors averaged by 10 graph with different number of nodes (N_V) and edge probability (p). The best result is highlighted in bold. SimCIM shows the best results in the p range $[0.3, \cdots, 0.7]$.

1.2 Time to solution

	N_V	p	**GLPK**		**Gurobi**		**SimCIM**	
			mean	**std**	**mean**	**std**	**mean**	**std**
1	10	0.1	0.001	0.001	0.001	0.000	0.198	0.056
2	10	0.2	0.002	0.000	0.001	0.000	0.232	0.007
3	10	0.3	0.003	0.002	0.001	0.000	0.238	0.015
4	10	0.4	0.007	0.004	0.001	0.000	0.229	0.021
5	10	0.5	0.012	0.006	0.001	0.000	0.222	0.011
6	10	0.6	0.032	0.022	0.002	0.000	0.239	0.022
7	10	0.7	0.080	0.073	0.002	0.001	0.265	0.044
8	10	0.8	1.907	4.984	0.002	0.001	0.325	0.121
9	10	0.9	13.901	24.658	0.003	0.002	0.371	0.041
10	20	0.1	0.006	0.001	0.002	0.000	0.254	0.005
11	20	0.2	0.034	0.029	0.003	0.001	0.296	0.038
12	20	0.3	0.192	0.306	0.006	0.001	0.346	0.026
13	20	0.4	0.875	0.390	0.012	0.007	0.440	0.015
14	20	0.5	10.721	12.125	0.019	0.013	0.498	0.047
15	20	0.6	124.385	91.853	0.023	0.012	0.591	0.034
16	20	0.7	199.375	115.200	0.034	0.015	0.667	0.060
17	20	0.8	300.065	0.010	0.034	0.018	0.840	0.061
18	20	0.9	300.094	0.015	0.040	0.014	1.056	0.063
19	30	0.1	0.019	0.008	0.006	0.003	1.720	0.035

20	30	0.2	0.340	0.282	0.015	0.010	2.427	0.036
21	30	0.3	9.814	4.160	0.035	0.012	3.181	0.054
22	30	0.4	267.903	70.468	0.070	0.024	3.985	0.049
23	30	0.5	300.103	0.012	0.138	0.083	5.017	0.331
24	30	0.6	300.186	0.038	0.163	0.040	6.124	0.287
25	30	0.7	300.254	0.042	0.173	0.054	7.397	0.534
26	30	0.8	300.403	0.057	0.189	0.077	9.811	0.697
27	30	0.9	300.556	0.122	0.304	0.111	12.687	1.312
28	40	0.1	-	-	0.021	0.009	2.366	0.267
29	40	0.2	-	-	0.067	0.038	3.753	0.340
30	40	0.3	-	-	0.191	0.104	5.472	0.367
31	40	0.4	-	-	0.753	0.932	6.545	0.542
32	40	0.5	-	-	***0.867***	0.631	8.526	0.695
33	40	0.6	-	-	1.306	1.014	10.350	0.448
34	40	0.7	-	-	1.557	2.098	13.801	2.007
35	40	0.8	-	-	***1.162***	0.431	17.844	1.989
36	40	0.9	-	-	1.155	0.159	24.713	3.280
37	50	0.1	-	-	0.027	0.014	3.607	0.053
38	50	0.2	-	-	0.333	0.245	5.174	0.192
39	50	0.3	-	-	4.990	5.810	7.463	0.453
40	50	0.4	-	-	4.757	4.187	9.495	0.510
41	50	0.5	-	-	7.071	4.687	14.036	1.771
42	50	0.6	-	-	66.279	61.284	25.216	5.909
43	50	0.7	-	-	38.152	46.330	25.096	3.382
44	50	0.8	-	-	***7.727***	8.428	33.786	8.187
45	50	0.9	-	-	2.372	0.257	42.495	4.156
46	60	0.1	-	-	0.129	0.087	4.421	0.129
47	60	0.2	-	-	***0.872***	1.026	7.734	1.722
48	60	0.3	-	-	16.930	11.034	11.445	1.823
49	60	0.4	-	-	51.511	82.086	18.106	4.262
50	60	0.5	-	-	68.744	68.795	21.368	3.984
51	60	0.6	-	-	95.411	88.234	48.351	13.262
52	60	0.7	-	-	66.161	44.420	40.763	11.270
53	60	0.8	-	-	42.528	68.171	56.013	10.085
54	60	0.9	-	-	***7.724***	1.407	72.302	7.284
55	70	0.1	-	-	0.461	0.291	6.458	1.655
56	70	0.2	-	-	4.822	4.982	9.977	1.664
57	70	0.3	-	-	28.828	14.424	***15.687***	2.101
58	70	0.4	-	-	78.486	63.512	38.800	14.893
59	70	0.5	-	-	114.880	70.768	38.288	14.127
60	70	0.6	-	-	103.728	71.210	***54.067***	11.507
61	70	0.7	-	-	133.313	72.464	63.095	10.184
62	70	0.8	-	-	110.066	77.881	96.272	17.250

63	70	0.9	-	-	***19.536***	4.820	134.355	28.658
64	80	0.1	-	-	***1.309***	1.599	7.324	0.592
65	80	0.2	-	-	52.218	78.163	15.138	2.710
66	80	0.3	-	-	67.343	36.356	26.198	6.943
67	80	0.4	-	-	116.747	111.805	***37.085***	9.220
68	80	0.5	-	-	96.057	37.923	***49.570***	7.162
69	80	0.6	-	-	167.210	66.138	159.555	81.808
70	80	0.7	-	-	202.061	65.897	112.915	18.953
71	80	0.8	-	-	***162.988***	45.676	167.062	37.764
72	80	0.9	-	-	***53.323***	18.095	227.224	50.657
73	90	0.1	-	-	1.058	1.224	9.336	0.726
74	90	0.2	-	-	34.024	38.601	18.623	3.323
75	90	0.3	-	-	162.527	97.995	***32.050***	9.461
76	90	0.4	-	-	143.790	114.855	***48.503***	4.782
77	90	0.5	-	-	167.725	63.551	***67.405***	14.039
78	90	0.6	-	-	157.333	100.262	***81.155***	17.398
79	90	0.7	-	-	252.613	37.275	***90.603***	16.960
80	90	0.8	-	-	258.383	18.204	141.974	29.896
81	90	0.9	-	-	***120.630***	47.417	219.341	43.442
82	100	0.1	-	-	1.571	0.714	11.952	2.225
83	100	0.2	-	-	90.416	70.264	23.365	2.986
84	100	0.3	-	-	106.807	100.061	***48.057***	10.612
85	100	0.4	-	-	127.184	107.183	***60.967***	10.674
86	100	0.5	-	-	92.338	108.744	112.470	12.526
87	100	0.6	-	-	171.188	79.565	***105.843***	17.305
88	100	0.7	-	-	138.741	106.281	155.752	41.929
89	100	0.8	-	-	184.035	128.311	214.694	59.357
90	100	0.9	-	-	***233.650***	54.277	281.240	33.966

Table S2: Mean time to solution (seconds) depends on number of nodes (N_V) and edge probability (p) for open source solver GLPK, Gurobi and quantum inspired SimCIM. The best result in average number of colors and time to solution is highlighted in bold.