ĐẠI HỌC QUỐC GIA TP.HỒ CHÍ MINH
TRƯỜNG ĐẠI HỌC CÔNG NGHỆ THÔNG TIN

BÁO CÁO THỰC HÀNH

MÔN C106.M21: TRÍ TUỆ NHÂN TẠO

LAB: Assignment 2 - Solving Knapsack Problems Using Google OR Tools

Giảng viên hướng dẫn: TS. Lương Ngọc Hoàng

Sinh viên thực hiện:

Họ và tên	**MSSV**
1. Trương Thế Tấn	19522180

TP. Hồ Chí Minh, tháng 4, năm 2022

- Thời gian tối đa cho mỗi test case là: 7 phút ~ 420s.
- Thử nghiệm với 10 test case từ n00050 – n10000 của 13 nhóm testcase đã cho. Nhóm Test case n00500 và n10000 thử nghiệm với 2 test case thuộc nhóm R01000 và R10000. Tổng cộng 130 test case.
- Kết quả được cho là tối ưu khi test case được giải trong thời gian giới hạn đặt ra ở hàm set_time_limit(420).

Nhóm	Tên testcase	Giá trị lời giải	Tổng trọng lượng	Thời gian chạy (s)	Tối ưu
00 Uncorrelated 0.875s	n00050/R10000/s002.kp	205492	137.567	0	☑
	n00100/R10000/s003.kp	434159	240.141	0	☑
	n00200/R10000/s005.kp	859760	475490	0	☑
	n00500/R10000/s008.kp	2062200	1218272	0	☑
	n00500/R01000/s008.kp	206336	121939	0	☑
	n01000/R01000/s013.kp	392980	253440	0	☑
	n02000/R01000/s021.kp	812697	492924	0.015625	☑
	n05000/R01000/s034.kp	2002220	1239358	0.09375	☑
	n10000/R01000/s055.kp	4053038	2471231	0.375	☑
	n10000/R10000/s055.kp	40507109	24690192	0.390625	☑
01 Weakly Correlated 0.71875s	n00050/R10000/s002.kp	150517	135598	0	☑
	n00100/R10000/s003.kp	290405	267889	0	☑
	n00200/R10000/s005.kp	576879	530567	0.015625	☑
	n00500/R10000/s008.kp	1401704	1282423	0	☑
	n00500/R01000/s008.kp	140335	128354	0	☑
	n01000/R01000/s013.kp	269899	243197	0.015625	☑
	n02000/R01000/s021.kp	548590	497414	0	☑
	n05000/R01000/s034.kp	1361922	1232334	0.078125	☑
	n10000/R01000/s055.kp	2741440	2479611	0.296875	☑
	n10000/R10000/s055.kp	27380175	24774073	0.3125	☑
02 Strongly Correlated 2082.172s	n00050/R10000/s002.kp	169607	135607	0.015625	☑
	n00100/R10000/s003.kp	336913	267913	0.296875	☑
	n00200/R10000/s005.kp	668613	530613	0.21875	☑
	n00500/R10000/s008.kp	1629426	1282426	250.5156	☑
	n00500/R01000/s008.kp	163054	128354	233.8906	☑
	n01000/R01000/s013.kp	313797	243197	0	☑
	n02000/R01000/s021.kp	637376	496976	392.7656	☑
	n05000/R01000/s034.kp	1584295	1232095	411.7344	☑
	n10000/R01000/s055.kp	3182561	2479061	420.4531	☐

	n10000/R10000/s055.kp	31810592	24773592	372.2813	☑
03 Inverse Strongly Correlated **2676.000025s**	n00050/R10000/s002.kp	143359	160359	0.265625	☑
	n00100/R10000/s003.kp	284418	317418	415.4531	☑
	n00200/R10000/s005.kp	564475	629475	0.1875	☑
	n00500/R10000/s008.kp	1366131	1527131	251.5469	☑
	n00500/R01000/s008.kp	136693	152793	197.3594	☑
	n01000/R01000/s013.kp	261048	292348	225.2188	☑
	n02000/R01000/s021.kp	532973	596173	325.8281	☑
	n05000/R01000/s034.kp	1322457	1479757	419.75	☑
	n10000/R01000/s055.kp	2659426	2974526	420.1875	☐
	n10000/R10000/s055.kp	26573296	29723296	420.2031	☐
04 Almost Strongly Correlated **1519.8438s**	n00050/R10000/s002.kp	169704	135605	0.015625	☑
	n00100/R10000/s003.kp	336950	267913	0.09375	☑
	n00200/R10000/s005.kp	668480	530607	0.015625	☑
	n00500/R10000/s008.kp	1629483	1282426	319.5938	☑
	n00500/R01000/s008.kp	163062	128354	0.3125	☑
	n01000/R01000/s013.kp	313820	243197	9.5	☑
	n02000/R01000/s021.kp	637553	497097	338.5469	☑
	n05000/R01000/s034.kp	1584569	1232334	31.1875	☑
	n10000/R01000/s055.kp	3183138	2479587	400.1406	☑
	n10000/R10000/s055.kp	31805562	24769489	420.4375	☐
05 SubsetSum **0.5625s**	n00050/R10000/s002.kp	135607	135607	0	☑
	n00100/R10000/s003.kp	267913	267913	0	☑
	n00200/R10000/s005.kp	530613	530613	0	☑
	n00500/R10000/s008.kp	1282426	1282426	0	☑
	n00500/R01000/s008.kp	128354	128354	0	☑
	n01000/R01000/s013.kp	243197	243197	0	☑
	n02000/R01000/s021.kp	497414	497414	0.015625	☑
	n05000/R01000/s034.kp	1232334	1232334	0.046875	☑
	n10000/R01000/s055.kp	2479611	2479611	0.203125	☑
	n10000/R10000/s055.kp	24774074	24774074	0.296875	☑
06 Uncorrelated WithSimilar Weights **2004.640675s**	n00050/R10000/s002.kp	19477	2401507	0.03125	☑
	n00100/R10000/s003.kp	39436	4902473	0.5	☑
	n00200/R10000/s005.kp	79002	9904796	0	☑
	n00500/R10000/s008.kp	189628	24712220	254.8906	☑
	n00500/R01000/s008.kp	189628	24712220	266.6563	☑
	n01000/R01000/s013.kp	366294	49525757	0.015625	☑
	n02000/R01000/s021.kp	746569	99049110	338.1875	☑

	n05000/R01000/s034.kp	1853391	247624825	303.7656	☑
	n10000/R01000/s055.kp	3730750	495247320	420.2969	☐
	n10000/R10000/s055.kp	3730750	495247320	420.2969	☐
07 Spanner Uncorrelated **2555.67193s**	n00050/R10000/s002.kp	155287	9987	0.15625	☑
	n00100/R10000/s003.kp	116306	129351	10.54688	☑
	n00200/R10000/s010.kp	298162	191546	198.4531	☑
	n00500/R10000/s008.kp	787654	525776	247.3594	☑
	n00500/R01000/s008.kp	78060	52300	297.0313	☑
	n01000/R01000/s013.kp	150350	186725	263.3594	☑
	n02000/R01000/s021.kp	346868	271510	300.8125	☑
	n05000/R01000/s034.kp	702674	1073898	400.5469	☑
	n10000/R01000/s055.kp	1391082	1083777	417.2656	☑
	n10000/R10000/s055.kp	14073778	10946344	420.1406	☐
08 Spanner Weakly Correlated **2780.468825s**	n00050/R10000/s002.kp	24490	133455	0.015625	☑
	n00100/R10000/s003.kp	204450	101164	244.1563	☑
	n00200/R10000/s005.kp	773220	330260	224.9531	☑
	n00500/R10000/s008.kp	1136213	751846	312.3281	☑
	n00500/R01000/s008.kp	113124	74559	0	☑
	n01000/R01000/s013.kp	346266	113102	341.8594	☑
	n02000/R01000/s021.kp	565946	207790	395.9844	☑
	n05000/R01000/s034.kp	1798709	690707	420.125	☐
	n10000/R01000/s055.kp	2157287	1273354	420.75	☐
	n10000/R10000/s055.kp	21333062	12814882	420.2969	☐
09 Spanner Strongly Correlated **2977.0627s**	n00050/R10000/s002.kp	286794	132794	186.6563	☑
	n00100/R10000/s003.kp	500196	101196	216.5	☑
	n00200/R10000/s005.kp	904284	330284	233.3438	☑
	n00500/R10000/s008.kp	2671156	753156	270.9844	☑
	n00500/R01000/s008.kp	266820	74620	269.1719	☑
	n01000/R01000/s013.kp	471402	113102	267.9688	☑
	n02000/R01000/s021.kp	961523	207523	337.4375	☑
	n05000/R01000/s034.kp	2126719	690919	354.3125	☑
	n10000/R01000/s055.kp	5237292	1273392	420.3281	☐
	n10000/R10000/s055.kp	52428254	12815254	420.3594	☐
10 Multiple Strongly Correlated	n00050/R10000/s002.kp	213558	135558	0	☑
	n00100/R10000/s003.kp	419912	267912	0.0625	☑
	n00200/R10000/s005.kp	832610	530610	417.7031	☑
	n00500/R10000/s008.kp	2043422	1282422	289.0313	☑
	n00500/R01000/s008.kp	205452	128352	221.25	☑

2481.922s	n01000/R01000/s013.kp	399592	243192	224.6563	☑
	n02000/R01000/s021.kp	806389	497389	262.2813	☑
	n05000/R01000/s034.kp	2009134	1232334	415.5156	☑
	n10000/R01000/s055.kp	4025108	2479608	230.9844	☑
	n10000/R10000/s055.kp	40261190	24772190	420.4375	☐
11 Profit Ceiling **2567.9377s**	n00050/R10000/s002.kp	135603	135606	0	☑
	n00100/R10000/s003.kp	267894	267911	167.5313	☑
	n00200/R10000/s005.kp	530589	530611	224.7813	☑
	n00500/R10000/s008.kp	1282380	1282424	188.4844	☑
	n00500/R01000/s008.kp	128319	128354	114.2969	☑
	n01000/R01000/s013.kp	243129	243196	214.5625	☑
	n02000/R01000/s021.kp	497220	497412	397.6719	☑
	n05000/R01000/s034.kp	1231875	1232332	420.1094	☐
	n10000/R01000/s055.kp	2478696	2479610	420.25	☐
	n10000/R10000/s055.kp	24773124	24774073	420.25	☐
12Circle **3104.85965s**	n00050/R10000/s002.kp	9040009	135607	3.8125	☑
	n00100/R10000/s003.kp	17859964	267913	328.4063	☑
	n00200/R10000/s005.kp	35372412	530613	0.03125	☑
	n00500/R10000/s008.kp	85490739	1282426	365.2969	☑
	n00500/R01000/s008.kp	2704535	128354	347.5313	☑
	n01000/R01000/s013.kp	5124386	243197	392.2813	☑
	n02000/R01000/s021.kp	10480972	497414	407.0625	☑
	n05000/R01000/s034.kp	25966424	1232334	420.0469	☐
	n10000/R01000/s055.kp	52247732	2479611	420.2344	☐
	n10000/R10000/s055.kp	1651521412	24774074	420.1563	☐

Dựa vào bảng thống kê trên, em tóm gọn lại kết quả và xếp các nhóm test case theo mức độ dễ tới khó, qua đó chọn ra nhóm test case dễ nhất và khó nhất.

Kết luận		**Nhóm Test case**	**Kết quả**	
			Thời gian	Tối ưu
Các test case được sắp xếp theo thứ tự tăng dần của thời gian và độ khó	**DỄ**	05 SubsetSum **(Dễ nhất)**	0.5625s	10/10
		01 WeaklyCorrelated	0.71875s	10/10
		00 Uncorrelated	0.875s	10/10
	KHÓ	04 AlmostStronglyCorrelated	1519.8438s	9/10
		06 UncorrelatedWithSimilarWeights	2004.640675s	8/10

		02StronglyCorrelated	2082.172s	9/10
		10 MultipleStronglyCorrelated	2481.922s	9/10
		07 SpannerUncorrelated	2555.67193s	9/10
		11 ProfitCeiling	2567.9377s	7/10
		03 InverseStronglyCorrelated	2676.000025s	8/10
		08 SpannerWeaklyCorrelated	2780.468825s	7/10
		09 SpannerStronglyCorrelated	2977.0627s	8/10
		12 Circle (**Khó nhất)**	3104.85965s	7/10