Universidad Carlos III de Madrid

Planning and Learning Group

Selecting goals in oversubscription planning using relaxed plans

Angel García-Olaya, Tomás de la Rosa, Daniel Borrajo

Corresponding author: Angel García-Olaya (agolaya@inf.uc3m.es)

Introduction

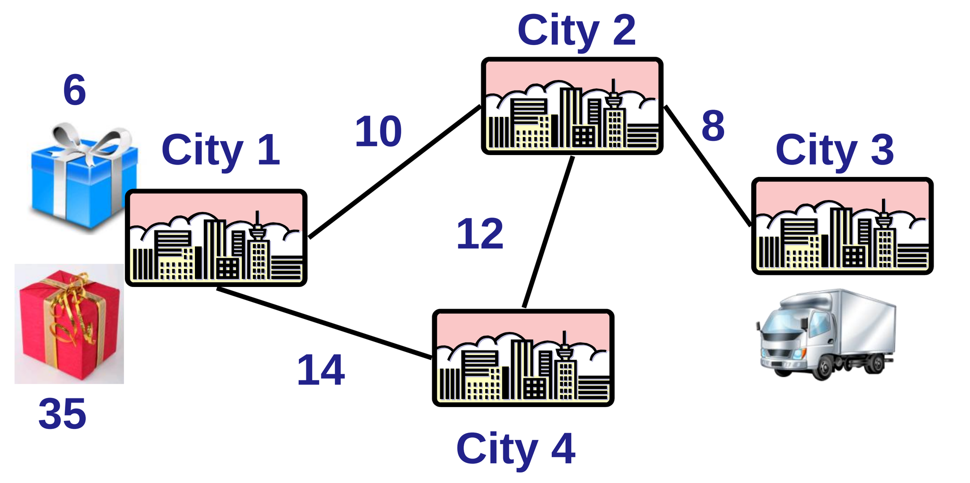
In OSP a limited resource makes achieving all goals impossible.

Most papers in the literature generalize the problem by representing the insufficient resource as a cost-bound of the plan.

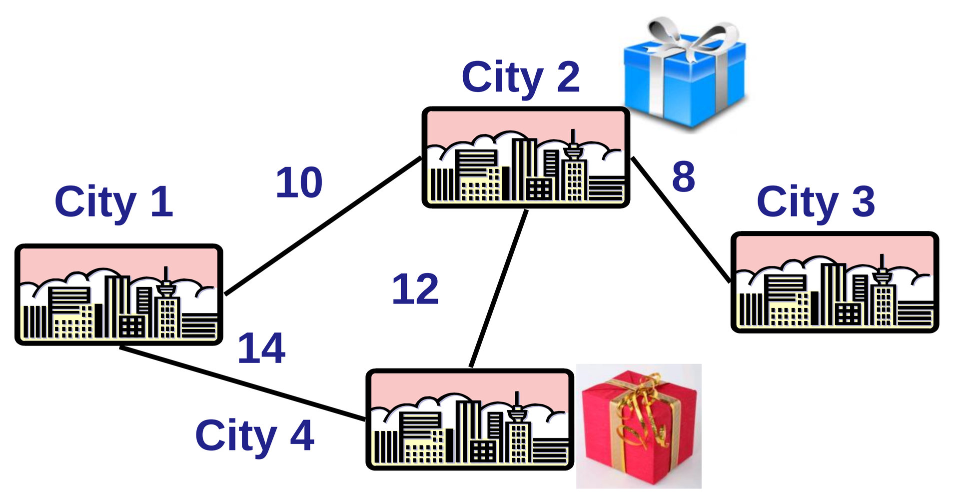
Goals are given a utility and the objective is to find a plan maximizing the utility with cost less or equal than the cost-bound.

We present a sub-optimal algorithm to solve OSP problems, with the key advantage of being **planner independent**.

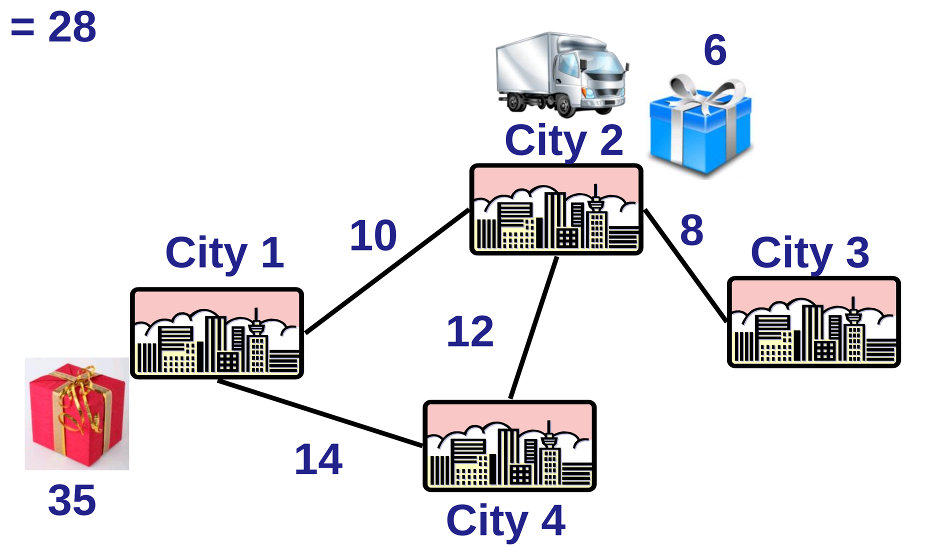
Initial state **cost-bound = 30**



Goals



Optimal plan
cost = 28

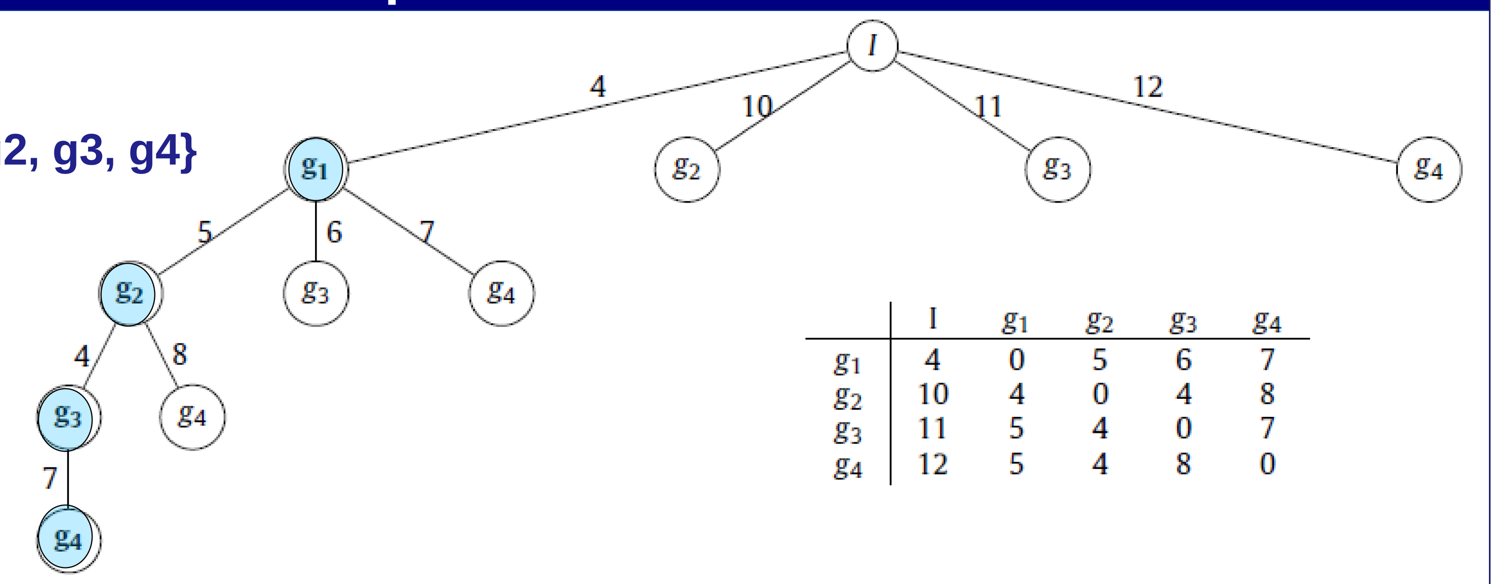


Approach: Relaxed-Plan Linear Distances (RPLD)

1. Estimate cost of achieving each goal using the cost of a relaxed plan (FF style)
2. Apply the relaxed plan for each goal to reach a new state where the goal is achieved.
3. Estimate the cost of achieving each other goal using the cost of a relaxed plan.
4. Use Depth First Branch and Bound (DFBnB) search to select sets of goals with estimated cost under the cost-bound.
5. Use a external planner to look for a plan (90 seconds) for all terminal nodes (nodes where no more goals can be added) or their ancestors if no plan for them is found.
6. Prune branches where no plan is found.
7. Keep searching until time-out. If no set is found, relax cost-bound.

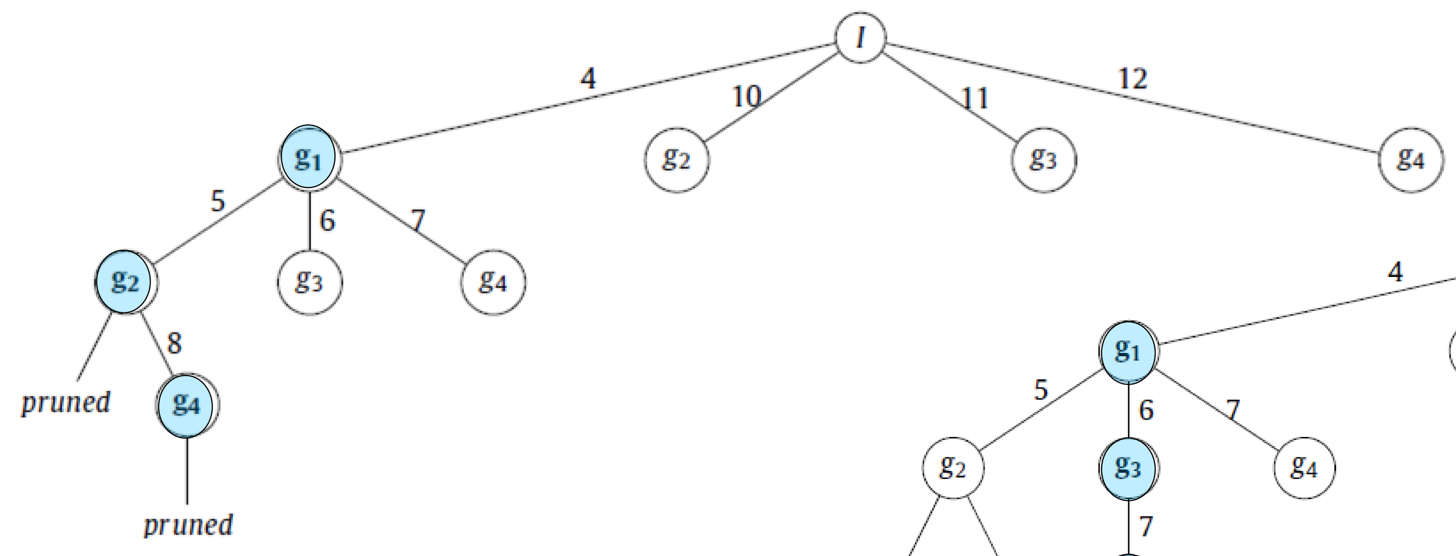
Example

- Cost-bound = 20, $u(g_i) = 1$
- First search: No plan found for {g1, g2, g3, g4} and {g1, g2, g3}
- Plan for {g1, g2}
- $u_{max} = 2$

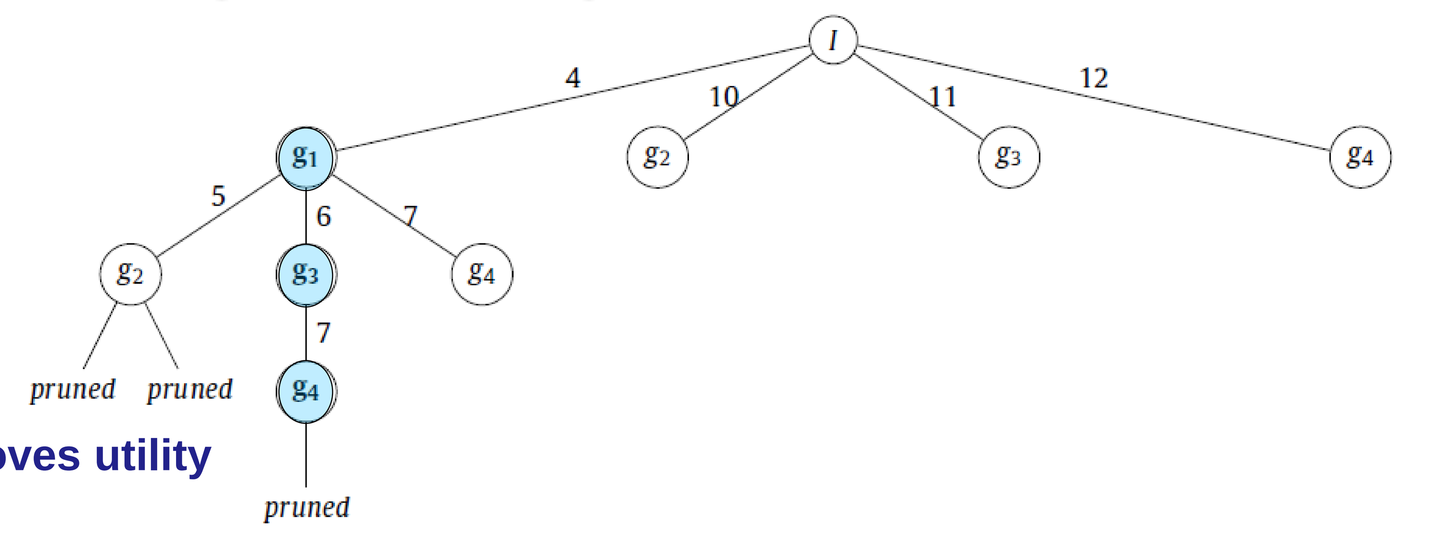


	I	g_1	g_2	g_3	g_4
g_1	4	0	5	6	7
g_2	10	4	0	4	8
g_3	11	5	4	0	7
g_4	12	5	4	8	0

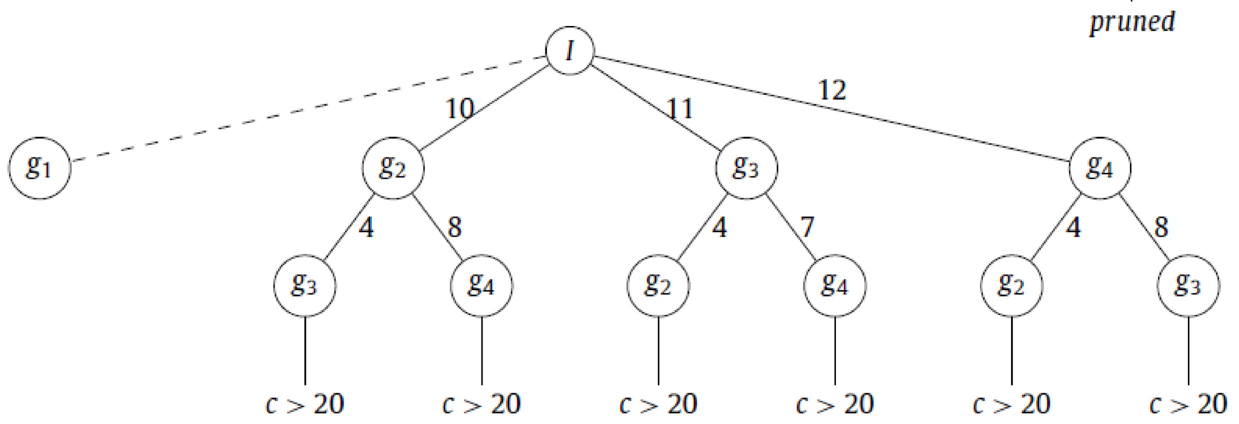
Second search: no plan for {g1, g2, g4}



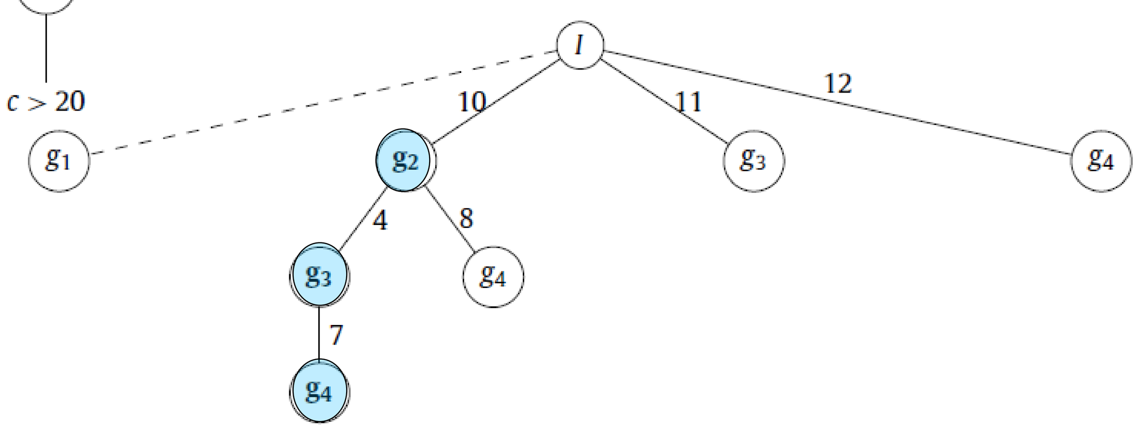
Third search: no plan for {g1, g3, g4}



Fourth search: no achievable set improves utility



Last search: ignoring cost-bound



Evaluation

IPC2011 domains. For each problem six variations:

1. Cost-budget: 25%-50%-75% of best known cost
2. Goals with utility = 1 or random utility (1,10)

Planner	util1 High	util1 Medium	util1 Low	util10 High	util10 Medium	util10 Low
BASELINE-BFWS	185.0	184.0	181.5	218.8	215.7	211.8
COMPILED-BFS(f)	131.2	131.9	127.2	127.9	120.0	121.9
COMPILED-BFWS	109.1	106.4	112.1	143.5	129.9	122.9
COMPILED-CBP2	161.5	129.3	108.2	161.2	129.0	109.4
RPLD-CBP2	225.7	208.1	188.4	226.1	214.9	202.2
RPLD-BFWS$_{first}$	203.5	196.1	198.9	191.5	200.2	204.5
RPLD-BFWS	**230.8**	**227.7**	**226.5**	**236.2**	**235.3**	**234.5**
EMPTY	48.2	39.5	34.9	46.2	38.1	33.9
KATZ-SAT	181.9	154.8	137.9	190.4	163.4	147.0
OPTIMAL	96.0	68.0	51.0	96.0	68.0	54.0
MIPS-XXL	94.2	73.8	63.9	94.7	77.5	68.4
OPTIC	176.8	158.2	151.8	177.0	156.1	149.4

Satisficing domains total score

Domain	25% opt.	25% score	50% opt.	50% score	75% opt.	75% score	100% opt.	100% score
BARMAN	12/16	96%	6/8	98%	4/8	92%	0/8	88%
ELEVATORS	20/20	100%	18/19	100%	15/19	97%	9/17	94%
FLOORTILE	6/9	98%	3/6	95%	2/4	97%	2/2	100%
NOMYSTERY	15/18	91%	11/16	95%	9/10	99%	9/9	100%
OPENSTACKS	18/20	98%	15/20	96%	10/17	89%	11/17	87%
PARCPRINTER	10/14	99%	6/9	97%	6/9	98%	8/8	100%
PARKING	5/12	92%	0/3	83%	0/1	90%	0/0	0%
PEGSOL	4/20	92%	4/20	93%	5/19	96%	16/18	99%
SCANALYZER	9/12	88%	9/9	100%	7/9	98%	5/9	96%
SOKOBAN	19/20	99%	14/20	97%	14/20	97%	10/19	95%
TIDYBOT	20/20	100%	17/20	99%	10/19	91%	9/14	92%
TRANSPORT	9/14	96%	10/11	99%	8/11	96%	4/8	93%
VISITALL	9/17	98%	9/12	99%	8/9	99%	8/9	99%
WOODWORKING	7/19	85%	2/11	87%	3/6	98%	3/4	99%

Optimal domains: % of optimal utility

Conclusions

- ❑Planner independent approach
- ❑ Best results if goals have equal utility
- ❑Good results even with the first shot
- ❑ Most selected sets still oversubscribed
- ❑Results not far away from optimal

Future Work

- ❑Consider both hard and soft goals
- ❑Use other heuristics to calculate distances
- ❑Use learning to predict if a set will be achievable
- ❑Update distances as we look for plans