RESOURCE RESERVATION PROBLEM (RRP)

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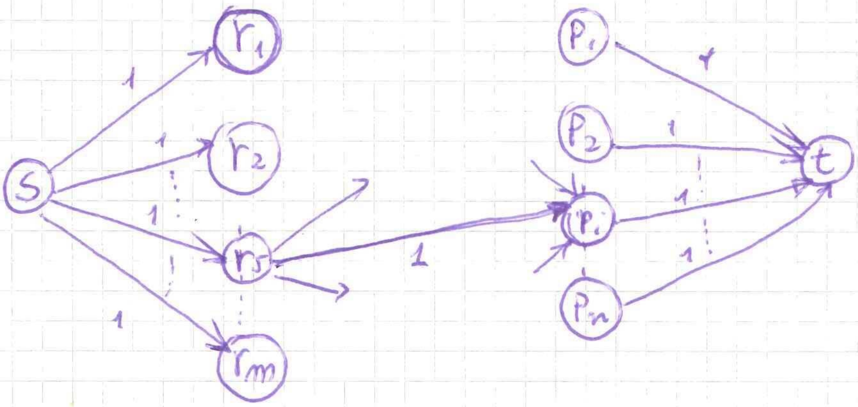
In a Real-Time systems there are:

- n asynchronous Processes $p_1, \dots, p_n$
- m Resources, $r_1, \dots, r_m$
- Each ~~p_i~~ request a set R_i of resources
- Each r_i can be used by at-most 1 process at a time.
- If a ~~pro~~ p_i is allocated $\boxed{\text{at least an } r_J \in R_i}$ then p_i is ACTIVE ~~BLOCKED~~, otherwise, it is BLOCKED. ← important assumption

Problem 1: It is possible to allocate r_J to p_i so that at-least K processes will be active?

Sol:



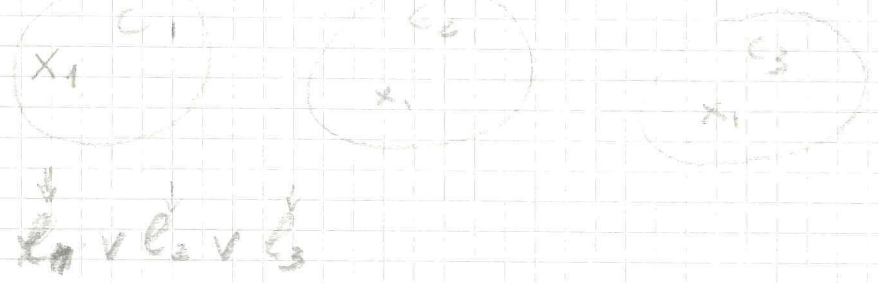
- There is a node for each r_i & p_J
- There is an edge f (r_i, p_J) if $r_i \in R_J$
- capacities are all set to 1

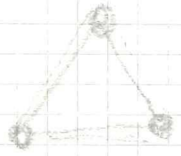
The problem has a solution iff $val(f_{max}) \geq K$

Problem 2: We change the definition of ACTIVE: A process p_i is ACTIVE if it is allocated ALL resources in R_i.

SoL. We can model as an ~~[illegible]~~ independent set problem.
- The graph contains just processes nodes
- There is an edge (p_i, p_J) if $R_i \cap R_J \neq \emptyset$

Problem 3. Show that RRP is NP-complete.





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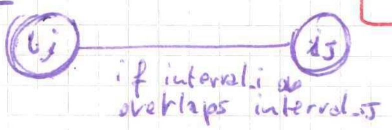

[Interval Overlapping. Given n intervals on a line, and a number K, does the collection contain a subset of non-overlapping intervals of size at-least K?]

We construct a graph G, such that,

- ~~m~~ There is a node for each interval
- There is an edge (u, v) if interval-u overlaps interval-v

G has an independent-set of size at least **K** iff there is a collection of atleast K-intervals non-overlapping, i.e.,

$$\text{Interval-Overlapping} \leq_p \text{Independent-Set}$$

~~Show also that viceverse size,~~ Viceverse: IS the case that: Independent-Set $\leq_p$ Interval-Overlapping?

Answer: No, since Interval Overlapping $\in$ P-time. (See book, Section 6.1 for a P-Time algorithm)

- DIGRAPH $G=(V,E)$
- $P_1, \dots, P_m$ set of paths in G
- number K

Q: Is it possible to place Adv. on at most K nodes so that each path P_i contains at least a node with an Adv.

~~Adva~~

- ~~n~~ n members : $M = \{m_1, m_2, \dots, m_n\}$
- t different issues : $i_1, i_2, \dots, i_t$
- Votes: Y/N/Ab

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EX 8.20

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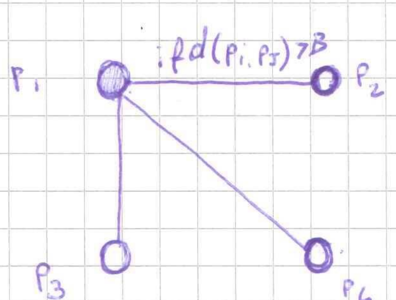
- n obj : $P = \{p_1, p_2, \dots, p_m\}$
- $d(p_i, p_j) > 0$ if $p_i \neq p_j$, $\forall p_i, p_j \in P$, $d(p_i, p_j) = d(p_j, p_i)$
  $= 0$ otherwise
- Bound, B

~~LOW CLUSTERING~~

$\boxed{\text{LOW-DIAMETER CLUSTERING}}$

Q: can the obj be partitioned into K sets, $S_1, \dots, S_K$, such that $\forall p_i, p_j \in S_q \Rightarrow d(p_i, p_j) \leq B$?



G must be K-colorable

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1 - Low-Diameter Clustering $\leq_p$ K-col

2 - Show also that L

- Simulation of the Dynamic Programming Algorithm for Knapsack. (Input: see next page).

Extract also the solution.

Knapsack problem: bottom-up dynamic programming demo

i	v_i	w_i
1	\$1	1 kg
2	\$6	2 kg
3	\$18	5 kg
4	\$22	6 kg
5	\$28	7 kg

$$OPT(i, w) = \begin{cases} 0 & \text{if } i = 0 \\ OPT(i-1, w) & \text{if } w_i > w \\ \max\{OPT(i-1, w),\ v_i + OPT(i-1, w - w_i)\} & \text{otherwise} \end{cases}$$

weight limit w

subset of items 1, …, i	0	1	2	3	4	5	6	7	8	9	10	11
{ }	0	0	0	0	0	0	0	0	0	0	0	0
{ 1 }	0	1	1	1	1	1	1	1	1	1	1	1
{ 1, 2 }	0	1	6	7	7	7	7	7	7	7	7	7
{ 1, 2, 3 }	0	1	6	7	7	18	19	24	25	25	25	25
{ 1, 2, 3, 4 }	0	1	6	7	7	18	22	24	28	29	29	40
{ 1, 2, 3, 4, 5 }	0	1	6	7	7	18	22	28	29	34	35	40

OPT(i, w) = max-profit subset of items 1, …, i with weight limit w.