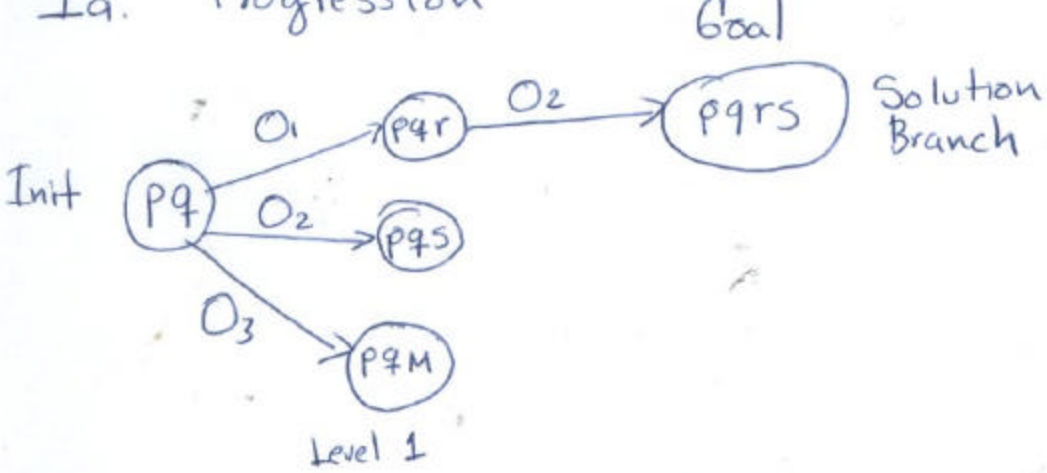
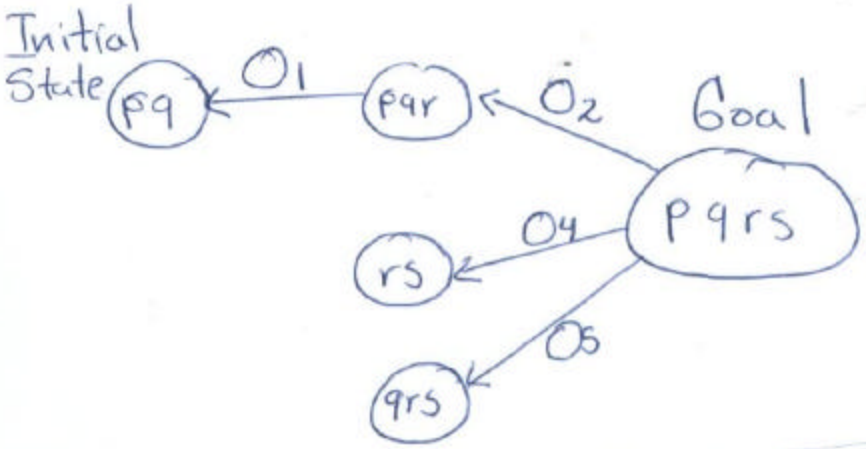
Homework II Solutions

1a. Progression



1b



1c - Set of partial plans to resolve the Flaw "p"

Initial Plan

Ao
P Q

PQRS

Aα

O: { Ao < Aα }

OC: { P@Aα, Q@Aα, R@Aα, S@Aα }

A: { Ao, Aα }

CL: { }

UL = { }

O = Orderings
Oc = Open Conditions
A = Actions
CL = Causal Links
UL = Unsafe Links

Homework 2.
Assigned [Sep 28, 2004]
Due [October 11th, 2004]

Qn I. Consider the planning problem from the first question of the first homework (reproduced below for your convenience)

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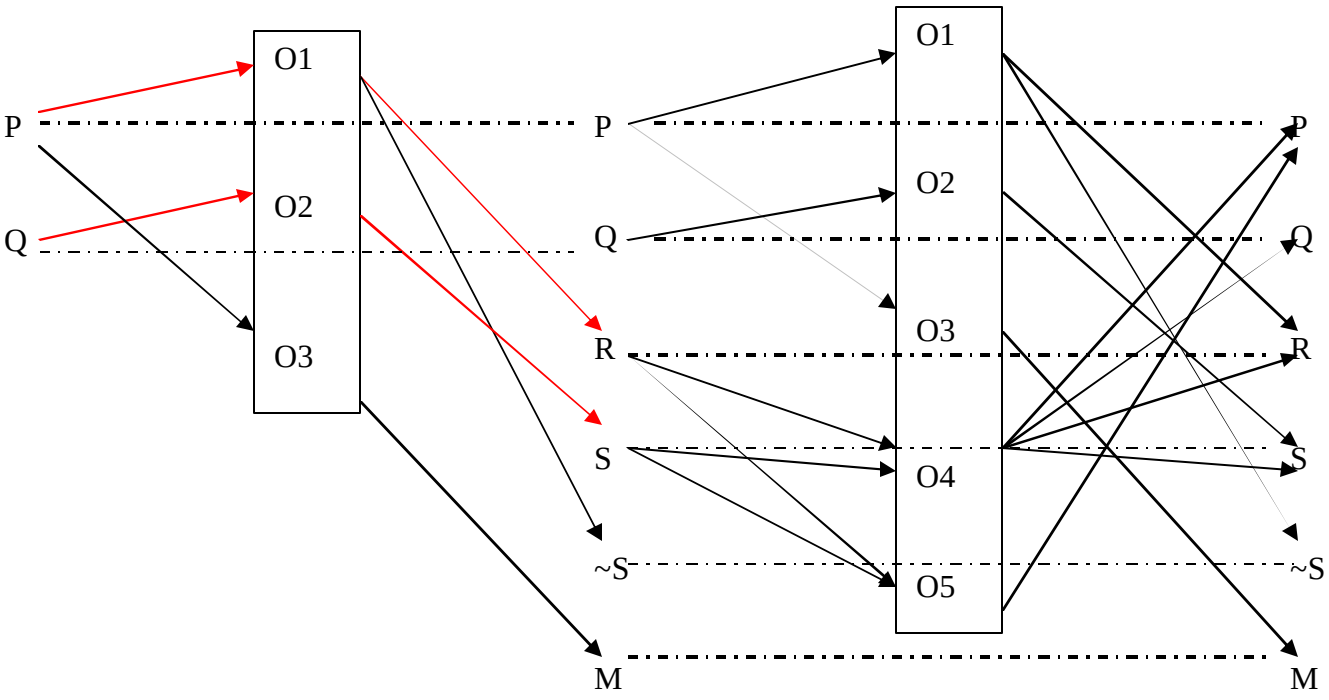
operator O1 prec: P Eff: R, ~S	operator O2 prec: Q Eff: S	operator O3 prec: P Eff: M	operator O4 prec: R,S Eff: P,Q,R,S	operator O5 prec: R,S Eff: P

The **initial state** is **{P,Q}** and the desired **goals** are **{P,Q,R,S}**

I.A Draw the "relaxed planning graph" for this problem (relaxed planning graph ignores negative interactions--ie, no mutexes).

I.A.1 Answer: Planning Graph Without Mutexes.



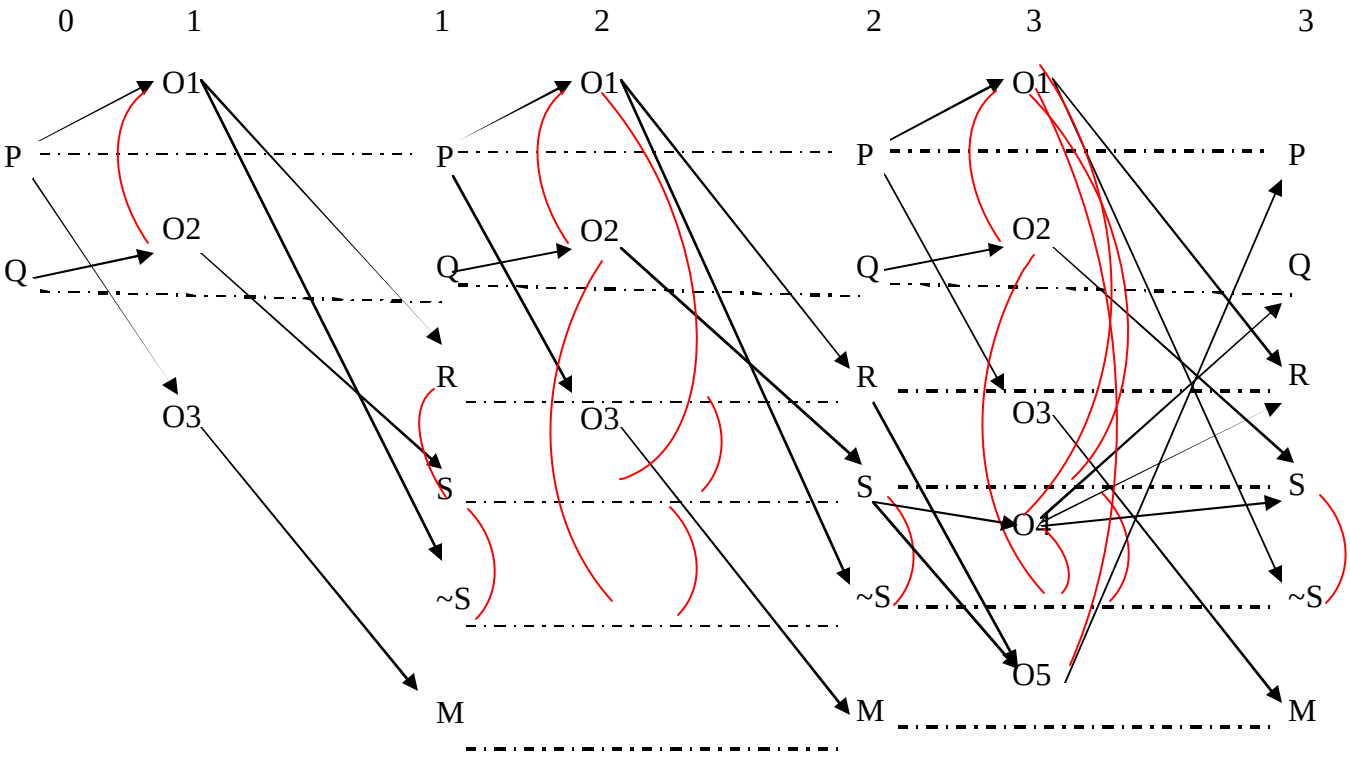
Mark a relaxed plan that supports the top level goals in this relaxed planning graph.

I.A.2 Answer: Relaxed plan is: **P = {O1, O2}**

I.A.3. What is the heuristic value of the goal set {P,Q,R,S} in terms of:
i. Sum heuristic ii. Level heuristic iii. relaxed plan heuristic

STATE	SUM	SET LEVEL	RELAXED PLAN
P,Q,R,S	2	1	2

I.B. Now draw the standard mutex graph (as described in the text and used by planning graph--don't need to use serial graph).



With respect to this standard graph, what is the heuristic cost of goal set{P,Q,R,S} using SUM and Level heuristics? What is the value of the adjusted sum heuristic (recall that it is equal to relaxed plan length + -ve interaction penalty).

STATE	SUM	SET LEVEL	ADJSUM
P,Q,R,S	2	2	3

ADjsum = 2 (relaxplan) + 1 (2 non-mutex level – 1 first level in the graph) = 3

Qn II

Consider the following problem. There are two actions: A1 and A2

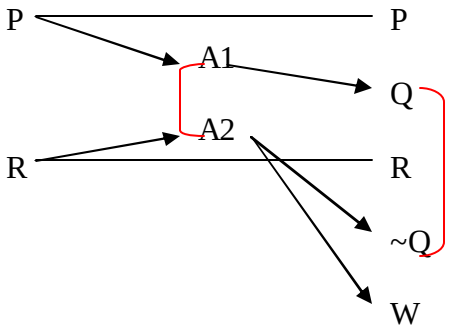
A1: prec: p eff: q

A2 prec: r eff: ~q,w

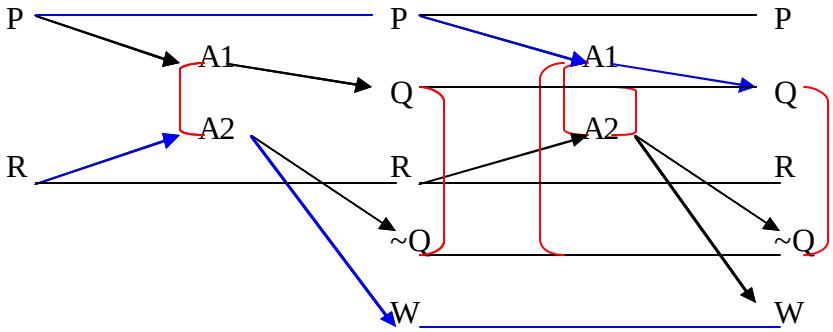
We start with init state where p and r are true.

**and our goals are q and w.

II.a. Show how graphplan solves this problem--assuming that only static interference relations are marked. No mutex propagation is done. Show all the steps in the graph construction, search and memo finding. This is a really small problem.

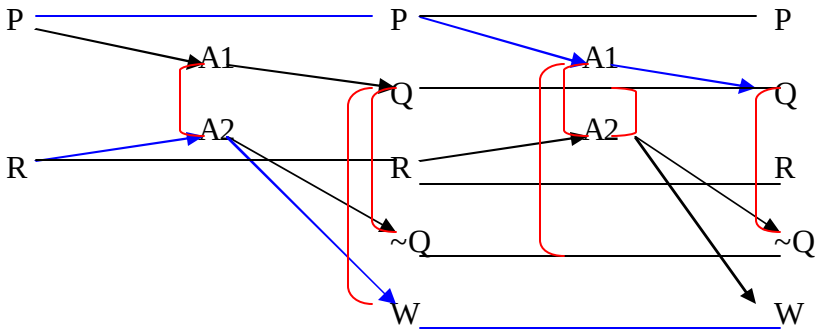


Since only static interference is considered we stop at level 1 of the graph construction phase, and start searching for a solution. Given that Q and W are not mutexes. So, we can support Q with A1, and W with A2. At this time we stop since A1 and A2 are mutex with each other. Given that there are no more choices for the subgoals, we write a memo at level 1 {Q,W: 1} giving the explanation for the failure.



At level 2, we can search again for a solution. This time, we can choose to support Q with A1, and W with its persistent action. We have to satisfy then the preconditions of such actions, subgoals P and W. P can only be supported by its persistent action, and W by A2. This time we have regressed to the initial state, and we have found a solution to our problem: **A2-A1.**

II.b. Now do this problem assuming that mutex propagation using the normal rules of Graphplan is done: With normal mutex propagation, we have to build our planning graph up to level 2, without search because even tough our goals are present at level 1, they are also mutex to each other.



The search is conducted in a similar way to that one of II.a , finding the same solution. **A2-A1**.