CSC 384, Variable Elimination Example, Fall 2014

Overview

The following is an example of a relaxed planning graph for a problem. The relaxed planning graph is useful for extracting approximations to h^+, the optimal delete relaxed heuristic. h^+ itself is admissible, but if you use an approximation you may lose the admissibility property.

Note that h^+ is difficult (np-hard) to calculate, being similar to other difficult problems such as hitting set and set cover. This makes approximations necessary. While the resulting heuristic may not be admissible, the heuristic is valid for any problem formulation providing a domain independent heuristic.

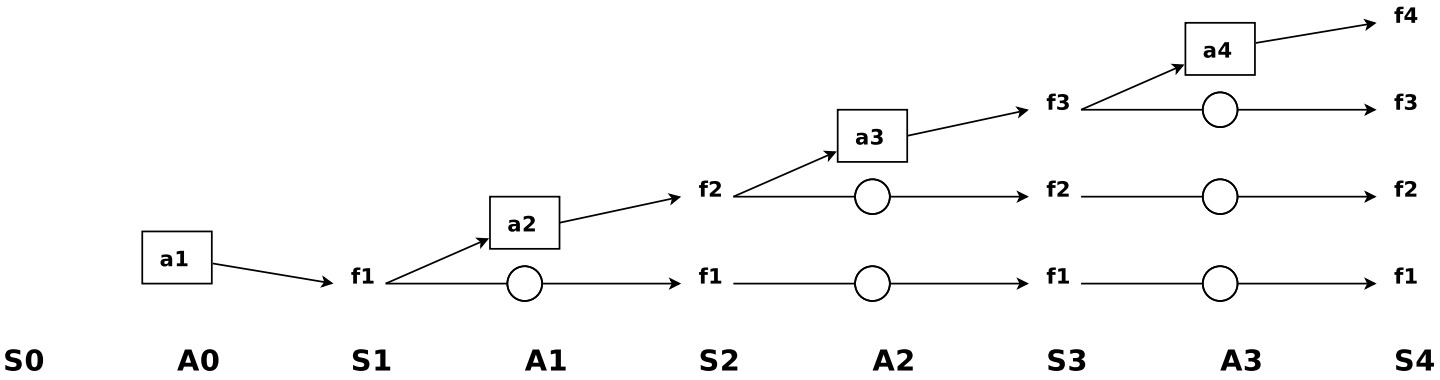
Problem Description

Consider a simple problem with 4 fluents $\{f_1, f_2, f_3, f_4\}$ and 4 actions:

Action	Preconditions	Add	Delete
a_1		f_1	
a_2	f_1	f_2	f_1
a_3	f_1, f_2	f_3	f_1, f_2
a_4	f_1, f_2, f_3	f_4	f_1, f_2, f_3

Given initial state $\{\}$ and goal state $\{f_1, f_2, f_3, f_4\}$ create the relaxed planning graph for this problem.

Relaxed planning graph



Note that you can extract a relaxed plan of length 4 from this graph ($h^+(S_0) = 4$). The actual optimal length solution to the original problem is 15 ($h^*(S_0) = 15$).

Circles have been used during action layers to indicate persistence actions, maintaining the presence of a fluent. Actions which produce a fluent already present have been omitted, as they are not necessary in the delete relaxed planning graph in which fluents are never removed.