6.892 Machine learning seminar

http://www.ai.mit.edu/courses/6.892-ml

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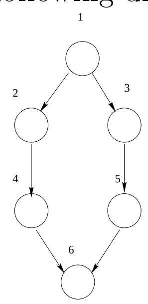
March 8, 1999

This assignment is due **March 15**. You can either email the assignment to me as plain text (use subject "HOMEWORK 5") or give it to me in class.

1. a) Create a junction tree for the following directed graph:



   b) Are there alternative trees?
   c) Would global conditioning result in a more efficient inference algorithm in this case? Why?
   d) Describe how you can compute $P(x_1, x_6)$ using the junction tree algorithm.
   e) How much more expensive is it to compute $P(x_1, x_6)$ than $P(x_1, x_2)$ assuming all the variables can take on m different values?

2. a) Show that global conditioning for undirected graphs is in general no more efficient than the junction tree algorithm.
   b) Can you extend this result to directed graphs? In other words, show that even if we apply global conditioning to a directed graph, the corresponding inference algorithm is no more efficient in general than the junction tree algorithm resulting from this graph.

3. **Research level:** The inference algorithms for graphical models rely heavily on the graph structure. The graph structure, however, does not explicate the strength of the dependencies or more generally their relevance to any particular inference calculation. Provide an additional level of representation that allows a more efficient structuring of computations. For example, one could define a nested set of graph structures where the difference between successive structures would correspond to weaker dependencies that are added. For this to be a useful representation, one would have to characterize the difference between the joint distributions associated with the successive structures. Ideally, the nested structures should be created on the fly in response to a query.