CS 559, Quiz 1

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Problem 1. (True or False)

1. For a 1D Gaussian distribution, a small variance leads to a more flat bell shape.

   -> False

2. For a 1D Gaussian distribution, a small mean leads to a more flat bell shape.

   -> False

3. Rotation is a linear operator.

   -> True

4. Making decisions using posteriors can be treated as a special case of that using losses or risks.

   -> True

5. Let λ_{ij} denote the loss incurred for taking action α_i when the true state is w_j. We always have $\lambda_{ij} = \lambda_{ji}$. (2 points)

   -> False

   For $\lambda ij = \lambda ji$ hold, i = j should hold.

   But this is not the case always. In some situations, the losses incurred will be higher or lower (depending on the situation) for taking action α_i when the state is w_j. Which does not satisfy the condition $\lambda ij = \lambda ji$.

Problem 2. A doctor gives a patient a (D)rug (drug or no drug) dependent on their (A)ge (old or young) and (G)ender (male or female). Whether or not the patient (R) recovers (recovers or doesn't recover) depends on all D, A, and G.

(a) Draw the belief network for the above case.

Nodes in the belief network:-

A -> Age of the patient

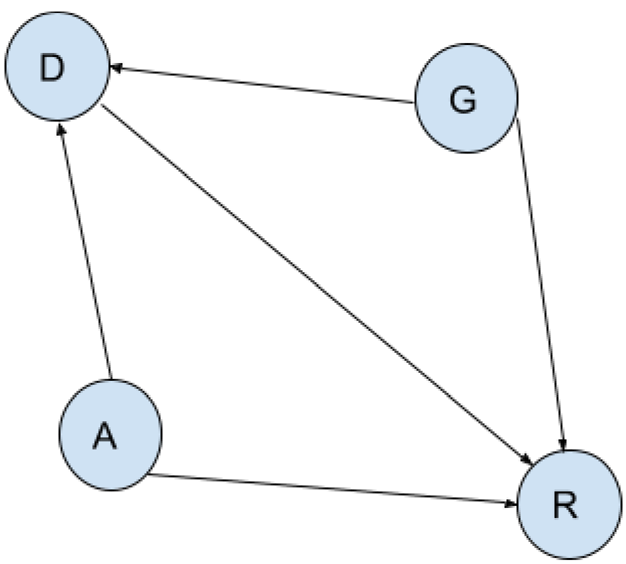
G -> Gender of the patient

D -> Doctor giving the drug to the patient

R -> Recovery of the patient

(D) Doctor giving the drug to a patient, depends on the (A) Age and (G) gender of the patient

(R)Recovery of the patient depends on the (A), (G), (D)



(b) Is it a Directed Acyclic Graph? Why?

Yes, It is a Directed Acyclic Graph, since,

(i) the graph DOES NOT have a cycle.

(ii) node R does not have any outgoing edges, making it a destination node.

(iii) nodes A and G do not have any incoming edges, making them the source nodes.

(iv) nodes R and D have conditions attached

If A, G, and D then R

If A and G then D

(c)Decompose the joint distribution P (A, G, D, R) into four terms, each of which is a probability of conditional probability of only one variable.

Without loss of generality, we can write

$p(R,D,A,G)$

$= p(R|D,A,G)\ p(D,A,G)$

$= p(R|D,A,G)\ p(D|A,G)\ p(A,G)$

$= p(R|D,A,G)\ p(D|A,G)\ p(A|G)\ p(G)$

Age of the patient is not influenced by the Gender of the patient

$p(A|G) = p(A)\ p(G)$

Therefore ,

$p(R,D,A,G) = p(R|D,A,G)\ p(D|A,G)\ p(A)\ p(G)$