Stanford University
Probabilistic Graphical Models

Daphne Koller
Professor of Computer Science

Home

Video Lectures

Discussion Forums

Problem Sets

Programming Assignments

Assignment Questions

Lecture Slides

Course Schedule

Course Logistics

Course Information

FAQ

Course Staff

Octave Installation

Feedback — PA2 Quiz

You achieved a score of 20.00 out of 22.00

Question 1

James and Rene come to a genetic counselor because they are deciding whether to have another child or ad want to know the probability that their un-born child will have cystic fibrosis.

Consider the Bayesian network for cystic fibrosis. We consider a person's phenotype variable to be "observe person's phenotype is known. Order the probabilities of their un-born child having cystic fibrosis in the followi situations from smallest to largest: (1) No phenotypes are observed (nothing clicked), (2) Jason has cystic fil Sandra has cystic fibrosis.

Your Answer		Score	Explanation
(1), (3), (2)	✔	2.00	Since Benjamin's phenotype and genotype are not observed in all of th situations, the probability that he will have cystic fibrosis (CF) is equiva the probability that James and Rene's unborn child will have CF. Obse Benjamin's cousin has CF makes Benjamin more likely to have CF bec is a genetic disease. Observing that Benjamin's brother has CF makes Benjamin more likely to have CF than when observing that Benjamin's has CF because Benjamin's brother is a more closely-related relative t cousin is.
Total		2.00 / 2.00	

Question 2

James never knew his father Ira because Ira passed away in an accident when James was a few n Now James comes to the genetic counselor wanting to know if Ira had cystic fibrosis. The genetic c wants your help in determining the probability that Ira had cystic fibrosis. Consider the Bayesian net cystic fibrosis. We consider a person's phenotype variable to be "observed" if the person's phenotyp known. Order the probabilities of Ira having had cystic fibrosis in the following situations from smalle largest: (1) No phenotypes are observed (nothing clicked), (2) Benjamin has cystic fibrosis, (3) Benj Robin have cystic fibrosis.

Your Answer		Score	Explanation
(1), (3), (2)	✔	2.00	Observing that Ira's grandson has cystic fibrosis (CF) makes Ira more have CF because CF is a genetic disease. Observing that Ira's wife als CF partially explains away why Ira has CF.

Total	2.00 / 2.00

Question 3

Recall that for a trait with 2 alleles, the CPD for genotype given parents' genotypes has 27 entries. entries would be in the CPD if the trait had 3 alleles instead of 2?

216

Your Answer		Score	Explanation
216	✔	2.00	There are 6 possible genotypes for each parent and for the child, so t of the CPD is $6 \times 6 \times 6 = 216$.
Total		2.00 / 2.00	

Question 4

You will now gain some intuition for why decoupling a Bayesian network can be worthwhile. Consic **decoupled** Bayesian network for cystic fibrosis with **3 alleles** over the pedigree that was used in se and 3.3. How many CPD entries are there in total, across all the CPDs in the network?

201

Your Answer		Score	Explanation
201	✖	0.00	
Total		0.00 / 2.00	

Question 5

Now consider the **decoupled** Bayesian network for cystic fibrosis with **3 alleles** over the pedigree t used in section 2.4 and 3.3. How many CPD entries are there in total, across all the CPDs in the ne

456

Your Answer		Score	Explanation
456	✔	2.00	There are 18 entries in each phenotype given genotype factor (there a factors), 3 entries in each copy of gene given allele frequency factor (th such factors), and 27 entries in each child copy of gene given parent's gene factor (there are 10 such factors).

Total	2.00 / 2.00

Question 6

Consider the **decoupled** Bayesian network for cystic fibrosis with three alleles that you constructed in sectic consider a person's gene copy variable to be "observed" if the person's allele for that copy of the gene is kno

James and Rene are debating whether to have another child or adopt a child. They are concerned that, if they child, the child will have cystic fibrosis because both of them have one F allele observed (their other gene co observed), even though neither of them have cystic fibrosis. You want to give them advice, but they refuse t whether anyone else in their family has cystic fibrosis. What is the probability that their unborn child will have fibrosis?

Round your answer to 2 decimal places. If the probability is between 0 and 1, put a 0 in front of the decim

0.47

Your Answer		Score	Explanation
0.47	✔	2.00	Knowing that James and Rene each have at least one F allele makes t more likely to have cystic fibrosis, even though neither of them have CI
Total		2.00 / 2.00	

Question 7

Consider a Bayesian network for spinal muscular atrophy (SMA), in which there are multiple genes and 2 phe

Let n be the number of genes involved in SMA and m be the maximum number of alleles per gene. How ma parameters are necessary if we use a table CPD for the probabilities for phenotype given copies of the genes parents?

Your Answer		Score	Explanation
◉ $O(m^{2n})$	✔	2.00	There are two alleles per gene, so there are $O(m^2)$ allele combinati gene. Therefore, there are $O(m^{2n})$ parameters for n genes.
Total		2.00 / 2.00	

Question 8

Consider the Bayesian network for spinal muscular atrophy (SMA), in which there are multiple genes and two phenotypes.

Let n be the number of genes involved in SMA and m be the maximum number of alleles per gene. How ma parameters are necessary if we use a sigmoid CPD for the probabilities for phenotype given copies of the ge both parents?

Your	Score	Explanation

Answer			
$O(mn)$	✔	2.00	Each gene has up to m alleles, and there is an indicator for each allele copy of the gene. Therefore, if there were one gene, there would be $O(2m) = O(m)$ parameters. Since there are n genes, there are O possible parameters.
Total		2.00 / 2.00	

Question 9

Consider genes A and B that might be involved in spinal muscular atrophy. Assume that A has 2 all and A_2, and B has 2 alleles, B_1 and B_2. Which of the following relationships between A and B ca sigmoid CPD capture?

Your Answer		Score	Explanation
☑ Gene A contributes to SMA, but gene B does not contribute to SMA and thus does not affect the effects of gene A on SMA.	✔	0.29	A sigmoid CPD can capture this by the alleles for copies of gene A pos weights and the alleles for copies o zero weights.
☐ When the alleles are A_1 and B_2 or A_2 and B_1 the person has SMA; otherwise the person does not have SMA.	✔	0.29	This XOR relationship means that t of the allele for gene A depends on allele for gene B is present; since th sigmoid CPD does not have interac terms, it will not be able to capture
☐ Allele A_1 and allele B_1 make a person equally more likely to have SMA, but when both are present the effect on SMA is the same as when only one is present.	✔	0.29	This OR relationship cannot be cap a sigmoid CPD because interactior between the alleles are not present
☑ Alleles A_1 and B_1 each independently make a person likely to have SMA.	✔	0.29	Since their contributions are indepe sigmoid CPD that weights the allele each gene based on the extent of t contribution would capture this perf
☑ Allele A_1 makes a person more likely to have SMA, while allele B_1 independently makes a person less likely to have SMA.	✔	0.29	A sigmoid CPD can capture this by the weights for the inidicators for al positive while making the weights f indicators for allele B_1 negative.
☐ Allele A_1 and allele B_1 make a person more likely to be have SMA when both of these alleles are present, but neither affect SMA otherwise.	✔	0.29	This AND relationship cannot be ca by a sigmoid CPD because interac between the alleles are not present
☑ Neither gene A nor gene B contribute to SMA.	✔	0.29	A sigmoid CPD can capture this by alleles for copies of gene A as well for copies of gene B weights with v zero.
Total		2.00 / 2.00	

Question 10

Consider the Bayesian network for spinal muscular atrophy that we provided in spinalMuscularAtrophyBayes consider a person's gene copy variable to be "observed" if the person's allele for that copy of that gene is kn

Now say that Ira and Robin come to the genetic counselor because they are debating whether to have a biol or adopt and are concerned that their child might have spinal muscular atrophy. They have some genetic inf because sequencing is still far too expensive to be affordable for everyone, their information is limited to onl genes and to only 1 chromosome in each pair of chromosomes.

Order the probabilities of their un-born child having spinal muscular atrophy in the following situations from sr largest: (1) No genetic information or phenotypes are observed (nothing clicked), (2) Ira and Robin each have M allele, (3) Ira and Robin each have at least 1 M allele and at least 1 B allele.

Your Answer		Score	Explanation
(1), (2), (3)	✔	2.00	Since James is unobserved, the probability that he will have spinal mus atrophy (SMA) is equivalent to the probability that Ira and Robin's unb will have SMA. Observing that Ira and Robin each have an allele that i in causing SMA makes James more likely to have SMA than if no varia were observed. Observing that Ira and Robin each have alleles for 2 g are involved in causing SMA makes James even more likely to have S if only 1 allele for 1 gene were observed.
Total		2.00 / 2.00	

Question 11

Consider the Bayesian network for spinal muscular atrophy that we provided in spinalMuscularAtrophyBayes

No longer interested in finding out whether his father had cystic fibroisis, James comes to the genetic couns another question: Did his father have spinal muscular atrophy? The genetic counselor now wants your help ir this out. This time, however, James has other information for you: both he and Robin have spinal muscular a

What is the probability that Ira had spinal muscular atrophy?

Round your answer to 2 decimal places. If the probability is between 0 and 1, put a 0 in front of the decim

0.35

Your Answer		Score	Explanation
0.35	✔	2.00	Since Ira's wife has spinal muscular atrophy (SMA), this helps explain why his child has SMA, so Ira is more likely to have SMA than he woul phenotypes were observed but is less likely to have SMA than he woul only James were observed to have SMA.
Total		2.00 / 2.00	