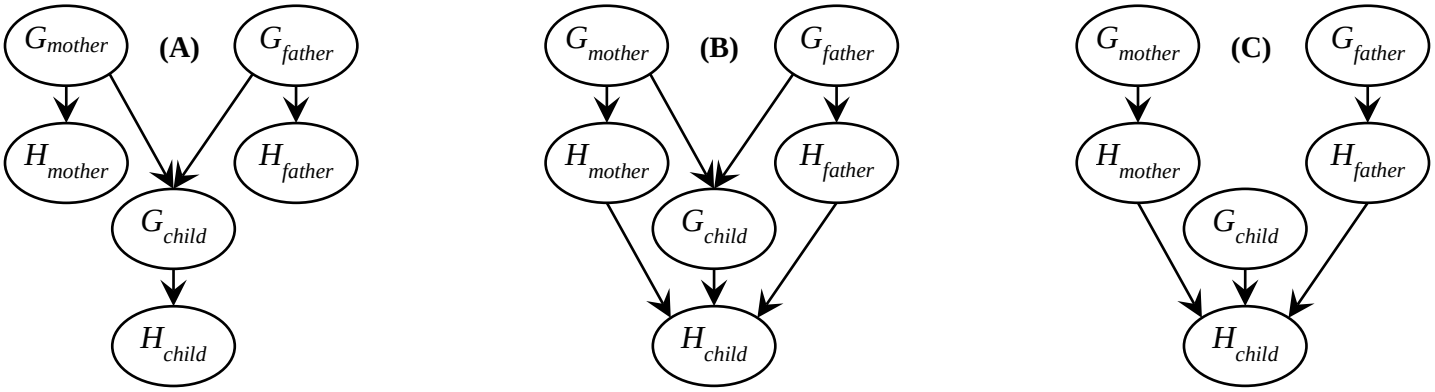
CS-171, Intro to A.I. — Quiz#4 — Winter Quarter, 2018 — 20 minutes

YOUR NAME AND EMAIL ADDRESS: _____

YOUR ID: _____ ID TO RIGHT: _____ ROW: _____ SEAT: _____

1. (35 pts total, 5 pts each) Bayesian Networks. (Adapted from Exercise 14.6 in R&N.) Let H_x be a random variable denoting the handedness of an individual x, with possible values l or r. A common hypothesis is that left- or right-handedness is inherited by a simple mechanism; that is, perhaps there is a gene G_x, also with values l or r, and perhaps actual handedness turns out mostly the same (with some probability s) as the gene an individual possesses. Furthermore, perhaps the gene itself is equally likely to be inherited from either of the individual's parents, with a small nonzero probability m of a random mutation flipping the handedness. Consider these three networks:



1.a. (5 pts) Which networks above claim that $\mathbf{P}(G_{father}, G_{mother}, G_{child}) = \mathbf{P}(G_{father})\ \mathbf{P}(G_{mother})\ \mathbf{P}(G_{child})$?

Write as many of the letters A, B, and C as apply. _____

1.b. (5 pts) Which networks make independence claims that are consistent with the stated hypothesis?

Write as many of the letters A, B, and C as apply. _____

1.c. (5 pts) Which single network is the best description of the hypothesis?

Write **one** of the letters A, B, and C. _____

1.d. (5 pts) How many parameters (probabilities) are needed for the joint distribution $\mathbf{P}(G_{father}, G_{mother}, G_{child})$?

Write your answer as a positive integer. _____

1.e. (5 pts) How many parameters are needed for network A? Write an integer. _____

1.f. (5 pts) How many parameters are needed for network B? Write an integer. _____

1.g. (5 pts) How many parameters are needed for network C? Write an integer. _____

****** TURN PAGE OVER. QUIZ CONTINUES ON THE REVERSE. ******

2. (35 pts total, 5 pts each) The Knowledge Engineering process. Your book identifies seven sequential steps in the knowledge engineering process, which are given below. Unfortunately, the order of the steps has been scrambled. Please, straighten them out.

A. Pose queries to the inference procedure and get answers
B. Encode a description of the specific problem instance
C. Identify the task
D. Encode general knowledge about the domain
E. Decide on a vocabulary of predicates, functions, and constants
F. Debug the knowledge base
G. Assemble the relevant knowledge

Fill in the blanks with the letters A, B, C, D, E, F, and G, all in the proper sequence.

_____ _____ _____ _____ _____ _____ _____.

3. (30 pts total, 5 pts each) Logic-To-English. For each of the following FOPC sentences on the left, write the letter corresponding to the best English sentence on the right. Use these intended interpretations:

(1) "Butterfly(x)" is intended to mean "x is a butterfly."
(2) "Flower(x)" is intended to mean "x is a flower."
(3) "FeedsOn(x, y)" is intended to mean "x feeds on y."

	$\forall b\ \exists f$ Butterfly(b) $\Rightarrow$ [Flower(f) $\wedge$ FeedsOn(b, f)]	A	Every butterfly feeds on every flower.
	$\exists f\ \forall b$ Flower(f) $\wedge$ [Butterfly(b) $\Rightarrow$ FeedsOn(b, f)]	B	For every flower, there is some butterfly who feeds on that flower.
	$\forall f\ \exists b$ Flower(f) $\Rightarrow$ [Butterfly(b) $\wedge$ FeedsOn(b, f)]	C	There is some butterfly who feeds on some flower.
	$\exists b\ \forall f$ Butterfly(b) $\wedge$ [Flower(f) $\Rightarrow$ FeedsOn(b, f)]	D	For every butterfly, there is some flower that the butterfly feeds on.
	$\forall b\ \forall f$ [Butterfly(b) $\wedge$ Flower(f)] $\Rightarrow$ FeedsOn(b, f)	E	There is some butterfly who feeds on every flower.
	$\exists b\ \exists f$ Butterfly(b) $\wedge$ Flower(f) $\wedge$ FeedsOn(b, f)	F	There is some flower that every butterfly feeds on.

Scratch Paper (1) Please Do Not Detach From Test

Scratch Paper (2) Please Do Not Detach From Test