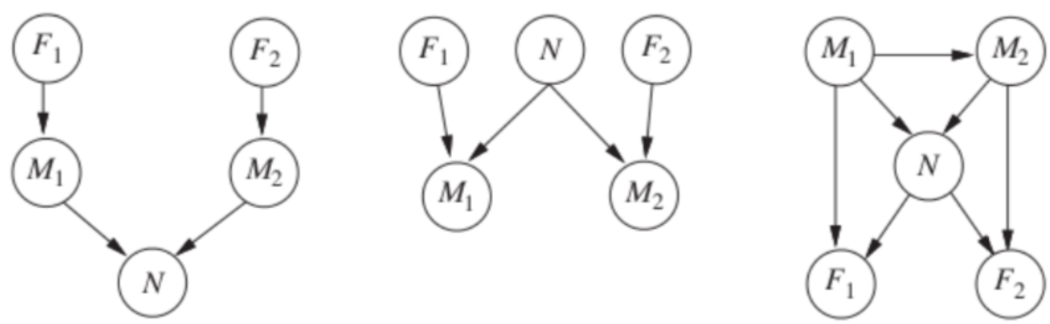
Name: ID:

1. (14 points) Two astronomers are making measurements M_1 and M_2 of the number of stars N in a small region of sky using telescopes. The measurements are noisy, so there is a probability of e that the measurements are off by ±1. Besides this, the telescope might be out of focus with probability f (F_i = true means the i-th astronomers telescope is out of focus, i = 1,2). If it is out of focus, then the measurement will undercount N by at least 3 (or if N < 3, then M_i will just be 0). Consider the following.



(i) (ii) (iii)

a. (2 points) Which is the best network? Explain. (Hint: Accuracy and efficiency)

Best network: Reason:

b. (9 points) Assuming using network (ii), and N ∈ {1,2,3} and M_1 ∈ {0,1,2,3,4}, write out the conditional distribution for $P(M_1|N)$ in terms of e and f . (Fill the blanks and equation)

$P(M_1|N) = P(M_1|N, F_1)P(\quad\quad) + P(\quad\quad)P(\neg F_1|N)$
$= P(\quad\quad)P(F_1) + P(M_1|N, \neg F_1)P(\quad\quad)$

$P(M_1\|N)$	$N = 1$	$N = 2$	$N = 3$
$M_1 = 0$			
$M_1 = 1$			
$M_1 = 2$			
$M_1 = 3$			
$M_1 = 4$			

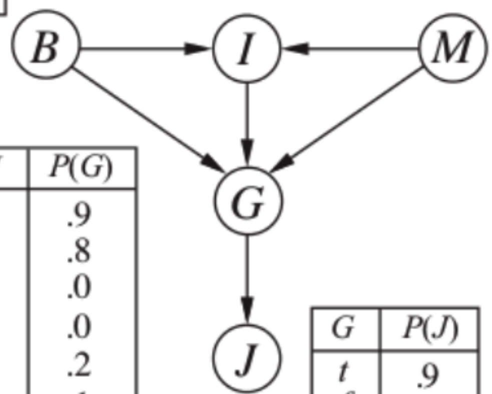
c. (3 points) Suppose M1 = 1 and M2 = 3, and assume no prior constraint on N. What are the possible numbers that N can be? Why? (Hint: fix M1 = 1, M2 = 3, try each possibility of F1, F2 and get all possible values of N.)

2. (6 points) Consider this figure for the next problem.

P(B)
.9

B	M	P(I)
t	t	.9
t	f	.5
f	t	.5
f	f	.1

P(M)
.1



B	I	M	P(G)
t	t	t	.9
t	t	f	.8
t	f	t	.0
t	f	f	.0
f	t	t	.2
f	t	f	.1
f	f	t	.0
f	f	f	.0

G	P(J)
t	.9
f	.0

a. (3 points) Which of the following (if any) are asserted by the network structure (ignoring the conditional probability tables)? (Hint: Write "Yes" or "No" following each equation)

$P(B,\ I,\ M)\ =\ P(B)P(I)P(M);$

$P(J,\ G)\ =\ P(J|G,\ I);$

$P(M|G,\ B,\ I)\ =\ P(M|G,\ B,\ I,\ J);$

b. (3 points) Calculate the value of $P(b, i, m, \neg g, j)$. (Fill the blanks and compute the result)

$P(b, i, m, \neg g, j)\ =\ \ P(\quad\ )P(m)P(i|b, m)P(\qquad\quad)P(j|\neg g)\ =$