ECS 170 Problem set 4

1a. V_i is the best network b/c it is the most accurate the true number of Ns is first, and they are all independent. It is the most efficient b/c there is not many conditional probabilities needed and the structure is simple

1b. $P(M_1|N) = P(M_1|N, F_1)\,P(F_1|N) + P(M_1|N_1, \neg F_1)\,P(\neg F_1|N)$
$= P(M_1|F_1)\,P(F_1) + P(M_1|\neg F_1)\,P(\neg F_1)$

$P(M_1\|N)$	$N=1$	$N=2$	$N=3$
$M_1=0$	$f+(1-f)e$	f	f
$M_1=1$	$(1-f)(1-2e)$	$(1-f)e$	0
$M_1=2$	$(1-f)e$	$(1-f)(1-2e)$	$(1-f)e$
$M_1=3$	0	$(1-f)e$	$(1-f)(1-2e)$
$M_1=4$	0	0	$(1-f)e$

1c. if $N=1$, the readings can only be 0, 1, or 2, so $M_2=3$ is not possible. Additionally, if it is out of focus, the probability is zero anyway.
if $N=2$, the only possible value is $N=2$ because $M_1=1$ and $M_2=3$, and since the out-of-focus probability is 0, both must be in focus
if $N=3$, then a reading of 1 is already impossible

2a No, looking at the structure, there are both indirect and direct connections between them.
Yes, J is connected to G, and J is seperated from the rest. It follows the Markov blanket, so it is independent.
Yes, M is connected to J through G. When G is known, M is separated from J, meaning B doesn't matter, so it is independent.

2b $P(b, i, m, \neg g, j) = P(b)\,P(m)\,P(i|b,m)\,P(\neg g)\,P(j|\neg g)$