AI exam, 2015. 12. 2. **NAME:**
TOTAL POINTS:60 (minimum to pass: 24) **NEPTUN ID:**

1) Two kinds of candy, lime and cherry flavoured, can be in a bag and there are three bags: mostly cherry (C) with 90% cherry, equally mixed (M) with 50% cherry-50% lime and mostly lime (L) with 90% lime (ratios do not change after drawing candies). Your *a priori* beliefs that your bag for drawing samples is the C, M or L bag are as follows: p(Bag=C)= p(Bag=L)=0.25, p(Bag=M)=0.5. After drawing 4 lime candies answer the following questions:
   a) What are the *a posteriori* probabilities for the bags?
   b) Which is the *maximum a posteriori* bag?
   c) Which is the *maximum likelihood* bag?
   d) What is the probability of drawing cherry candy for the fifth draw?

15p

2) For the following probability distribution:

X	Y	Z	P(x,y,z)
0	0	0	0.504
0	0	1	0.056
0	1	0	0.216
0	1	1	0.024
1	0	0	0.126
1	0	1	0.014
1	1	0	0.054
1	1	1	0.006

   a) enumarate the valid (conditional) independencies,
   b) construct a Bayesian network (with minimum number of parameters),
   c) give a corresponding factorization and explain its relation to the Bayesian network structure.

15p

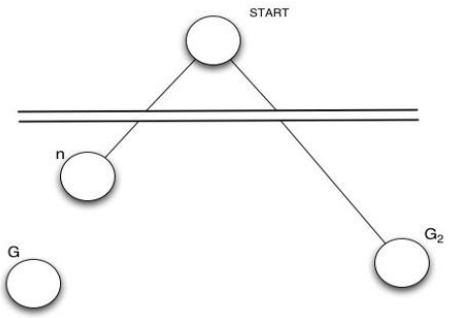
3) For a binary outcome the costs of our binary actions are denoted by $C_{0|1}$ and $C_{1|0}$, corresponding to the decision 0 in case of outcome 1 (o_1)and respectively to the decision 1 in case of outcome 0 (o_0). Our unconditional belief in outcome 1 is denoted by p. Assume that a test is available for cost C_t with sensitivity 0.95 and specificity 0.8.

	outcome:0	outcome:1
decision:0	0	$C_{0\|1}$
decision:1	$C_{1\|0}$	0

Derive and explain the equation for the value of this test. Define the equation/inequality for selecting optimal actions.

10p

4) 4. Prove that A* never terminates with the suboptimal goal G_2 (see figure and use the following notation f(n)=g(n)+h(n)).



(5p)

5) In a diagnostic problem three devices can be faulty A, B, C (A,B,C denote respectively that A, B, C is faulty). The devices cannot be investigated separately, but we know the following facts about their system (knowledge base KB).

S1: The system is fault tolerant, which means that it works with one faulty device, but it breaks down with two or more faulty devices.

S2: A and B cannot be faulty at the same time.

S3:The system breaks down.

a) Define the statements S1, S2, S3 using the propositions A, B, C.
b) Convert the KB to conjunctive normal form (CNF).
c) Indicate the models of the knowledge base.
d) Show with truth-table that the knowledge base KB entails that C is faulty.
e) Prove that C is faulty with resolution assuming the knowledge base KB.

(15p)