Artificial Intelligence - Assignment 4

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1 Problem 1

1.1 1a)

1. Gabriel is risk seeking. The more apples he has, the higher utility.
2. Gustav does not care about the amount of apples. He is indifferent, and thus not risk seeking, risk neutral, nor risk averserse
3. Maria is risk averse. When she gains more apples, the utility decreases.
4. Sonja is risk neutral. The utiliy is the same independent of the amount of apples.

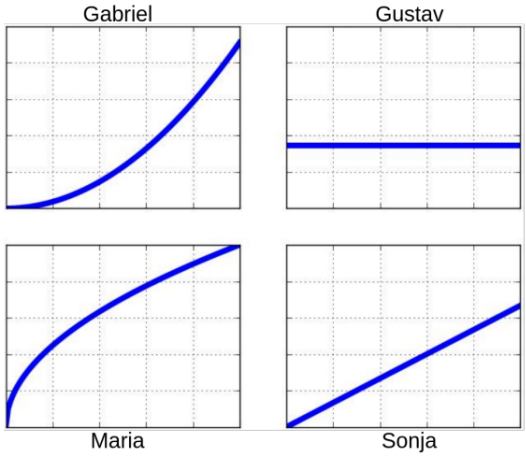

Figure 1: Utilities

1.2 1b

$U(x) = x^3$

	Risk seeking	Risk averse
Lottery	[(0.3, 50) , (0.7, -10)]	[(0.7, 10) , (0.3, -50)]
Expected utility of lottery	$0.3 * 50 + 0.7 * -10 = 8$	$0.7 * 10 + 0.3 * -50 = -8$
Utility of expected monetary value	36800	-36800

Table 1: $U(x) = x^3$ utility

As can be seen in table 1. The utility function is both risk seeking and adverse.

2 Problem 2

2.1 2 a)

I have modelled the decision problem in GeNIe as seen in figure 2. The choice would be to buy the book

2.2 2b

As can be seen in figure 2, the utilities for b is 1620, and for $\neg b$ is 1300 $P(p|b,m) = 0.9$
$P(p|b,\neg m) = 0.5$
$P(p|\neg b,m) = 0.8$
$P(p|\neg b,\neg m) = 0.3$
$P(m|b) = 0.9$
$P(m|\neg b) = 0.7$
$P(p|\neg b) = P(m|\neg b) * P(p|\neg b,m) + p(\neg m|\neg b) * P(p|\neg m,\neg b) = 0.65$
$P(p|b) = P(m|b) * P(p|b,m) + p(\neg m|b) * P(p|m,\neg b) = 0.86$

Utilities: 2000$ for passing, -100$ for buying the book, 0 for not passing, 0 for not buying the book.

Utility for buying the book: 0.86*2000 -100 = 1620
Utility for not buying the book: 0.65*2000 = 1300

2.3 2c

Sam should buy the book, as it is the choice with the highest utility.

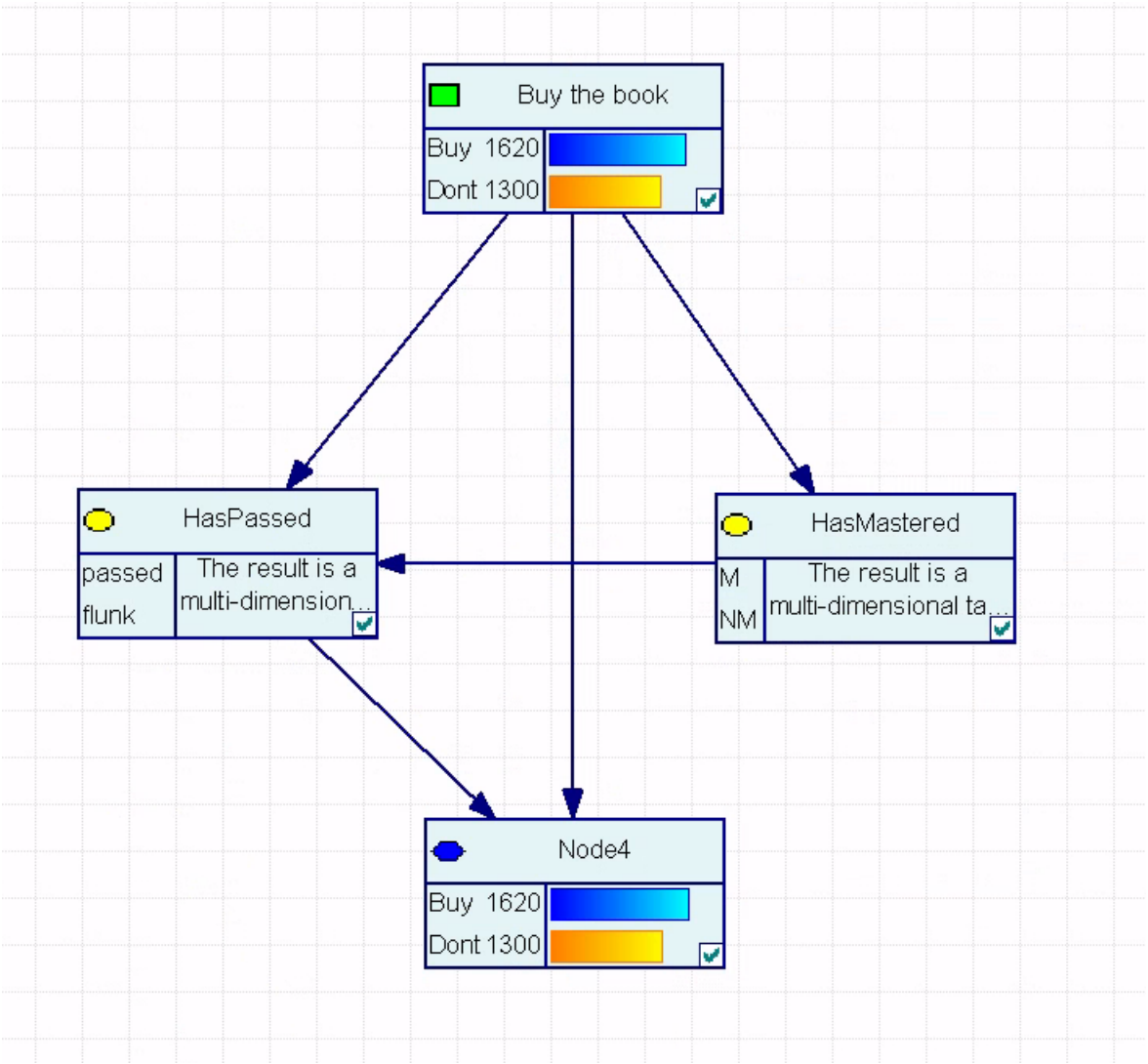

Figure 2: Decision system

3 Problem 3

	Moving To		
	State 1	State 2	State 3
Going from state 1	0	1/4	3/4
Going from state 2	3/4	0	1/4
Going from state 3	3/4	1/4	0

Table 2: Transition model for action L

	Moving To		
	State 1	State 2	State 3
Going from state 1	0	3/4	1/4
Going from state 2	1/4	0	3/4
Going from state 3	1/4	3/4	0

Table 3: Transition model for action R

3.1 3a)

Initial	U[1] = 0	U[2] = 0	U[3] = 0
Iteration 1	U[1] = 0	U[2] = 1	U[3] = 0
Iteration 2	U[1] = 3/8	U[2] = 1	U[3] = 3/8
Iteration 3	U[1] = 0.42187	U[2] = 1.1875	U[3] = 0.42187
Iteration 4	U[1] = 0.4980	U[2] = 1.210	U[3] = 0.4980

Table 4: Transition model for action R

$U(s) = R(s) + \gamma * max \sum_{a_i \in A} P(s'|s,a)U(s')$

U(1-3) = 0 in the first iteration.
$U(1) = 0 + 0.5 * 0 = 0$
$U(2) = 1 + 0.5 * 0 = 1$
$U(3) = 0 + 0.5 * 0 = 0$
Iteration 2:
$U(1) = 0 + 0.5 * (3/4 * 1 + 1/4 * 0) = 3/8$ - Action L
$U(2) = 1 + 0.5 * (0)$ both actions gives the same result
$U(3) = 0 + 0.5 * (3/4 * 1 + 1/4 * +) = 3/8$ - Action R
Iteration 3:
$U(1) = 0 + 0.5 * (3/4 * 1 + 1/4 * 3/8) = 0.42187$ - Action L
$U(2) = 1 + 0.5 * (3/4 + 1/4) * 3/8 = 1.1875$ both actions gives the same result
$U(3) = 0 + 0.5 * (3/4 * 1 + 1/4 * 3/8) = 0.42187$ - Action R
Iteration 4:
$U(1) = 0 + 0.5 * (3/4 * 1.1875 + 1/4 * 3/8) = 0.4980$ - Action L
$U(2) = 1 + 0.5 * (3/4 + 1/4) * 0.42187 = 1.210$ both actions gives the same result
$U(3) = 0 + 0.5 * (3/4 * 1.1875 + 1/4 * 0.42187) = 0.4980$ - Action R

3.2 3b

$U_1 = 0.5 \mid U_2 = 1.25 \mid U_3 = 0.5$
When in state 1:
The best action would be R, which would give an utility of 3/4 *1.25 + 1/4*0.5 = 1.0625
Taking action L would give (3/4*0.5 +1/4 *0.5) = 0.6875.

4 Problem 4

a &b) The utility values are displayed in figure 4. c) The actions are displayed in figure 4. Some nodes are hole-nodes, such as 6, 8, 12, 13, and their actions should be ignored. Node 16 is a goal node, and the action should also be ignored.

```
1.0857528627200002    |  1.646878976            |  2.4262208            |  1.646878976
-------------------------------------------------------------------------------------
1.646878976           |  -9.999999999999995     |  3.5086399999999993   |  -9.999999999999995
-------------------------------------------------------------------------------------
2.4262208             |  3.5086399999999993     |  5.011999999999999    |  -9.999999999999995
-------------------------------------------------------------------------------------
-9.999999999999995    |  5.011999999999999      |  7.099999999999997    |  9.999999999999995


state : 1 down
state : 2 up
state : 3 down
state : 4 up
state : 5 left
state : 6 left
state : 7 down
state : 8 left
state : 9 right
state : 10 down
state : 11 down
state : 12 left
state : 13 left
state : 14 right
state : 15 right
state : 16 left
Henriks-MacBook-Pro-6:Ai-methods HenrikGruner$
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Figure 3: Results