Prof. Wolfgang Nejdl
M.Sc. Ambreen Zaina, M.Sc. Jeff Reimer
Department of Knowledge-based Systems (KBS)

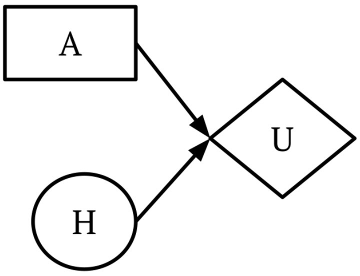
December 09, 2019

Artificial Intelligence II

Exercise 5

Q1. Decision Networks

After years of battles between the ghosts and Pacman, the ghosts challenge Pacman to a winner-take-all showdown, and the game is a coin flip. Pacman has a decision to make: whether to accept the challenge (*accept*) or decline (*decline*). If the coin comes out heads (+*h*) Pacman wins. If the coin comes out tails (-*h*), the ghosts win. No matter what decision Pacman makes, the outcome of the coin is revealed.



H	$P(H)$
+h	0.5
-h	0.5

H	A	U(H,A)
+h	$accept$	100
-h	$accept$	-100
+h	$decline$	-30
-h	$decline$	50

(a) Maximum Expected Utility

Compute the following quantities:

$EU(accept) = P(+h)U(+h, accept) + P(-h)U(-h, accept) = 0.5 \cdot 100 + 0.5 \cdot -100 = 0$

$EU(decline) = P(+h)U(+h, decline) + P(-h)U(-h, decline) = 0.5 \cdot -30 + 0.5 \cdot 50 = 10$

$MEU(\{\}) = max(0, 10) = 10$

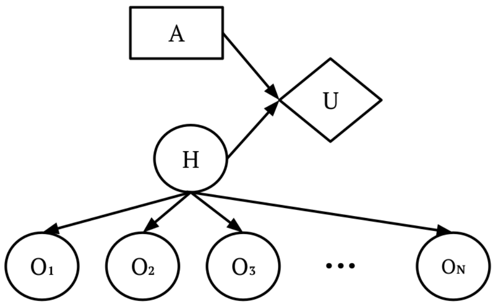
Action that achieves $MEU(\{\})$ = *decline*

(b) **VPI relationships**

When deciding whether to accept the winner-take-all coin flip, Pacman can consult a few fortune tellers that he knows. There are N fortune tellers, and each one provides a prediction O_n for H.

For each of the questions below, select **all** of the VPI relations that are guaranteed to be true, or select *None of the above*.

(i) In this situation, the fortune tellers give perfect predictions.
Specifically, $P(O_n = +h|H = +h) = 1$, $P(O_n = -h|H = -h) = 1$, for all n from 1 to N.



□ $VPI(O_1, O_2) \geq VPI(O_1) + VPI(O_2)$

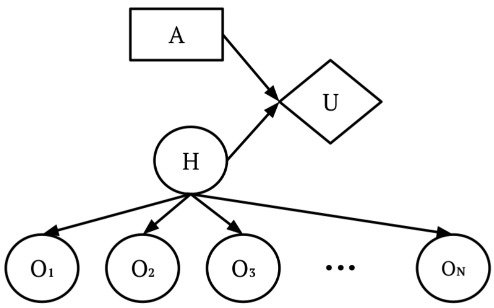
■ $VPI(O_i) = VPI(O_j)$ where $i \neq j$

□ $VPI(O_3|O_2, O_1) > VPI(O_2|O_1)$

□ $VPI(H) > VPI(O_1, O_2, ...O_N)$

□ None of the above.

(ii) In another situation, the fortune tellers are pretty good, but not perfect.
Specifically, $P(O_n = +h|H = +h) = 0.8$, $P(O_n = -h|H = -h) = 0.5$, for all n from 1 to N.



□ $VPI(O_1, O_2) \geq VPI(O_1) + VPI(O_2)$

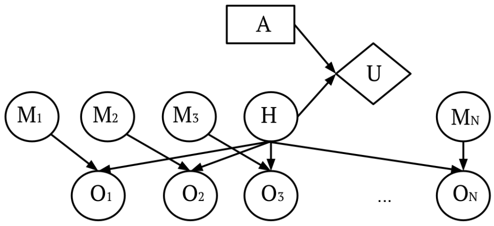
■ $VPI(O_i) = VPI(O_j)$ where $i \neq j$

□ $VPI(O_3|O_2, O_1) > VPI(O_2|O_1)$

■ $VPI(H) > VPI(O_1, O_2, ...O_N)$

□ None of the above.

(iii) In a third situation, each fortune teller's prediction is affected by their mood. If the fortune teller is in a good mood (+m), then that fortune teller's prediction is guaranteed to be correct. If the fortune teller is in a bad mood (-m), then that teller's prediction is guaranteed to be incorrect. Each fortune teller is happy with probability $P(M_n = +m) = 0.8$.



- ☐ $VPI(M_1) > 0$
- ■ $\forall i \; VPI(M_i|O_i) > 0$
- ☐ $VPI(M_1, M_2, ..., M_N) > VPI(M_1)$
- ■ $\forall i \; VPI(H) = VPI(M_i, O_i)$
- ☐ None of the above.