HW#6: Chapters 13 – 16

Problem #1 *(5 pts. each)*

a) P(a) = 0.1+0.01+0.05+0.2 = 0.36

b) P(C) = <0.10 + 0.20 + 0.05 + 0.15, 0.01 + 0.04 + 0.20 + 0.25> = <0.5,0.5>

c) P(¬a∧b) = 0.2+0.04 = 0.24

d) P(¬c∨a) = 0.1+0.01+0.04+0.05+0.20+0.25 = 0.65

e) P(a| ¬b∧c) = P(a∧¬b∧c)/P(¬b∧c) = 0.05/(0.05+0.15) = 0.05/0.20 = 0.25

Problem #2

a) *(5 pts.)* $P(a \wedge \neg b \wedge c \wedge d)$

$= P(a) * P(\neg b \mid a) * P(c \mid a) * P(d \mid \neg b \wedge c)$

= 0.7 * 0.7 * 0.2 * 0.9

= 0.0882

b) *(10 pts.)* $\mathbf{P}(A \mid b \wedge \neg c \wedge \neg d)$

$= \alpha\ \mathbf{P}(A, b, c, \neg d)$

$= \alpha\ (\mathbf{P}(A)\ \mathbf{P}(b \mid A)\ \mathbf{P}(\neg c \mid A)\ \mathbf{P}(\neg d \mid b \wedge \neg c))$

= α (<0.7, 0.3> * <0.3, 0.8> * <0.8, 07> * 0.4)

= α <0.0672, 0.00672>

=> α = 7.4405

So, < 0.5, 0.5>

c) *(25 pts.)*

$\mathbf{P}(B \mid c \wedge \neg d) = \alpha\ \mathbf{P}(B, c, \neg d)$

$= \alpha\ \langle P(b \wedge c \wedge \neg d), P(\neg b \wedge c \wedge \neg d) \rangle$

$P(b \wedge c \wedge \neg d) = \sum_{â} P(â) * P(b|â) * P(c|â) * P(\neg d|\ b \wedge c)$

$= P(\neg d \mid b \wedge c)\ (\sum_{â} P(â) * P(b|â) * P(c|â))$

$= P(\neg d \mid b \wedge c)\ (P(a) * P(b|a) * P(c|a) + P(\neg a) * P(b|\neg a) * P(c|\neg a))$

$= 0.9 * (0.7 * 0.3 * 0.2 + 0.3 * 0.8 * 0.3)$

$= 0.9 * (0.042 + 0.072)$

$= 0.1026$

$P(\neg b \wedge c \wedge \neg d) = \sum_{â} P(â) * P(\neg b|â) * P(c|â) * P(\neg d|\neg b \wedge c)$

$= P(\neg d|\neg b \wedge c)\ (\sum_{â} P(â) * P(\neg b|â) * P(c|â))$

$= P(\neg d|\neg b \wedge c)\ (P(a) * P(\neg b|a) * P(c|a) + P(\neg a) * P(\neg b|\neg a) * P(c|\neg a))$

$= 0.1 * (0.7 * 0.7 * 0.2 + 0.3 * 0.2 * 0.3)$

$= 0.1 * (0.098 + 0.018)$

$= 0.0116$

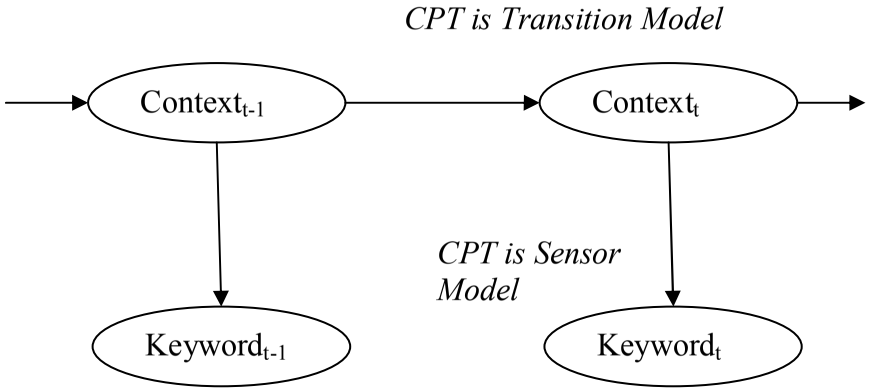
So, $\mathbf{P}(B \mid \neg c \wedge d) = \alpha\ \langle 0.1026, 0.0116 \rangle$

$\Rightarrow \alpha = 8.7566$

So, $\underline{\langle 0.8984, 0.1016 \rangle}$

.

Problem #3 *(15 pts.)*



Prior Probability of State at Time 0

	P(Context$_0$)
Cars	0.7
Football	0.2
Animals	0.1

Transition Model

	P(Context$_t$ |Context$_{t-1}$)		
Context$_{t-1}$	Cars	Football	Animals
Cars	0.8	0.1	0.1
Football	0.1	0.8	0.1
Animals	0.1	0.1	0.8

Sensor Model

	P(Keyword$_t$|Context$_t$)													
Context$_t$	auto	cat	defense	dog	doors	ecosystem	ford	herbivore	jaguar	quarterback	sedan	team	touchdown	other
Cars	0.15	0.02	0.02	0.02	0.15	0.02	0.15	0.02	0.15	0.02	0.15	0.02	0.02	0.09
Football	0.02	0.02	0.15	0.02	0.02	0.02	0.02	0.02	0.15	0.15	0.02	0.15	0.15	0.09
Animals	0.02	0.15	0.02	0.15	0.02	0.15	0.02	0.15	0.15	0.02	0.02	0.02	0.02	0.09

Problem #4 *(20 pts.)*

List of utility functions

Utility(*keep control*) = 10

Utility(*pass to teammate*) = 20

Utility(*score*) = 100

Utility(*loose control to opponent*) = -30

Actions (A)	**Effect P**(A)		**Utility**
	loose control to opponent	success	
dribble (D)	<0.2, 0 (*out of bound*),	0.8 (*keep control*)>	-30 * (0.2 + 0) + 10 * 0.8 = 2
pass (P)	<0.2, 0.1 (*out of bound*),	0.7 (*pass to teammate*)>	-30 * (0.2 + 0.1) + 20 * 0.7 = 5
shoot (S)	<0.6, 0.2 (*out of bound*),	0.2 (*score*)>	-30 * (0.6 + 0.2) + 100* 0.2 = -4

Maximum Utility(A) is when A = *pass*, so the robot will choose *pass* action