CENG 466 – Homework 4

1- **(60 points)** Given the following Wumpus world:

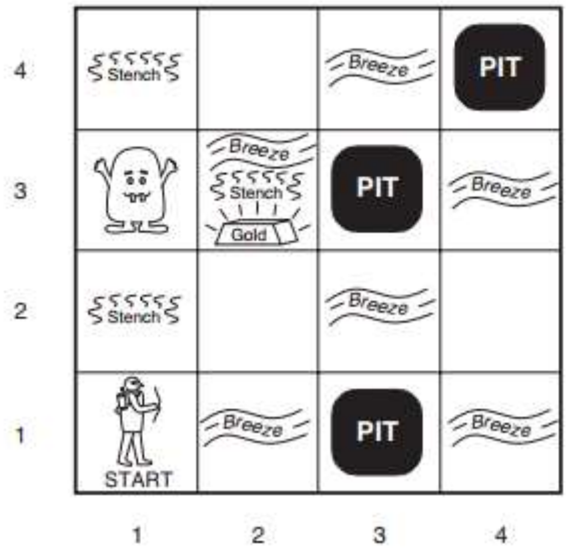


Figure 1- The Wumpus world

Suppose that agent started from [1,1], moved to [2,1] and received *Breeze*, then moved back to starting position [1,1] and finally moved to [1,2], received *Stench*. Final representation of world is shown in Figure 2;

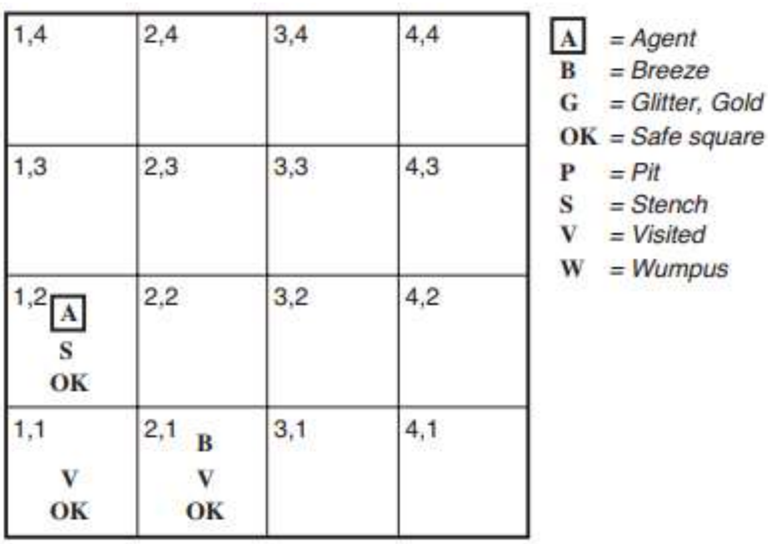


Figure 2- The Current state of the Wumpus world

The agent is now concerned with the contents of [1,3], [2,2], [3,1]. Each of these can contain a pit, and at most one can contain a wumpus.

Construct the set of possible worlds.

(Hint: there are 32 of them)

(Another hint: an example of possible worlds for similar problem is shown in Figure 7.5 in the book).

Mark the worlds in which **KB is true** and those in which each of the following **sentences** is **true**:

α2 = "There is not a pit in [2,2]"

α3 = "There is a wumpus in [1,3]"

Hence show that KB |= α2 and KB |= α3.

2- (40 points)

Ali, Bora, Ceren, and Doğa are making plans for spring break. They go to the travel agency, but;

i. There are only 2 tickets left.
ii. Ali will only go if Bora goes too.
iii. Doğa will only go if Ceren goes too.
iv. Bora has found out that he has to work on the AI project, so he cannot go.

Let A, B, C, and D denote that Ali, Bora, Ceren, and Doğa will go, respectively.

a- Using four literals (A, B, C, D), write the propositional logic formulas corresponding to this text (for each i, ii, iii and iv)

b- Find (through a formal proof) who will go on vacation.

B P S W G V O

1) when moved [2,1], in [2,1]:

$R_1 = B_{21}, -P_{21}, -S_{21}, -W_{21}$

$R_2 = B_{21} \Leftrightarrow (\underbrace{P_{31}}_{True} \cup \underbrace{P_{22}}_{false} \cup \underbrace{P_{11}}_{False})$

$R_3 = -S_{21} \Leftrightarrow (-W_{31} \wedge -W_{22} \wedge -W_{11})$

when moved [1,2], in [1,2]:

$R_5 = -B_{12}, -P_{12}, S_{12}, -W_{12}$

$R_6 = -B_{12} \Leftrightarrow (\underbrace{-P_{22}}_{\text{so true}} \wedge \underbrace{-P_{13}}_{true} \wedge \underbrace{-P_{11}}_{True})$ } → we infer that with R_9

$R_7 = S_{12} \Leftrightarrow (\underbrace{W_{11}}_{False} \cup \underbrace{W_{13}}_{\text{must be true}} \cup \underbrace{W_{22}}_{false})$

inference

we know that $-W_{22}$ with inference from R_3 so that $W_{22} = \text{false}$:

$R_8 = W_{13}$ (α_3)

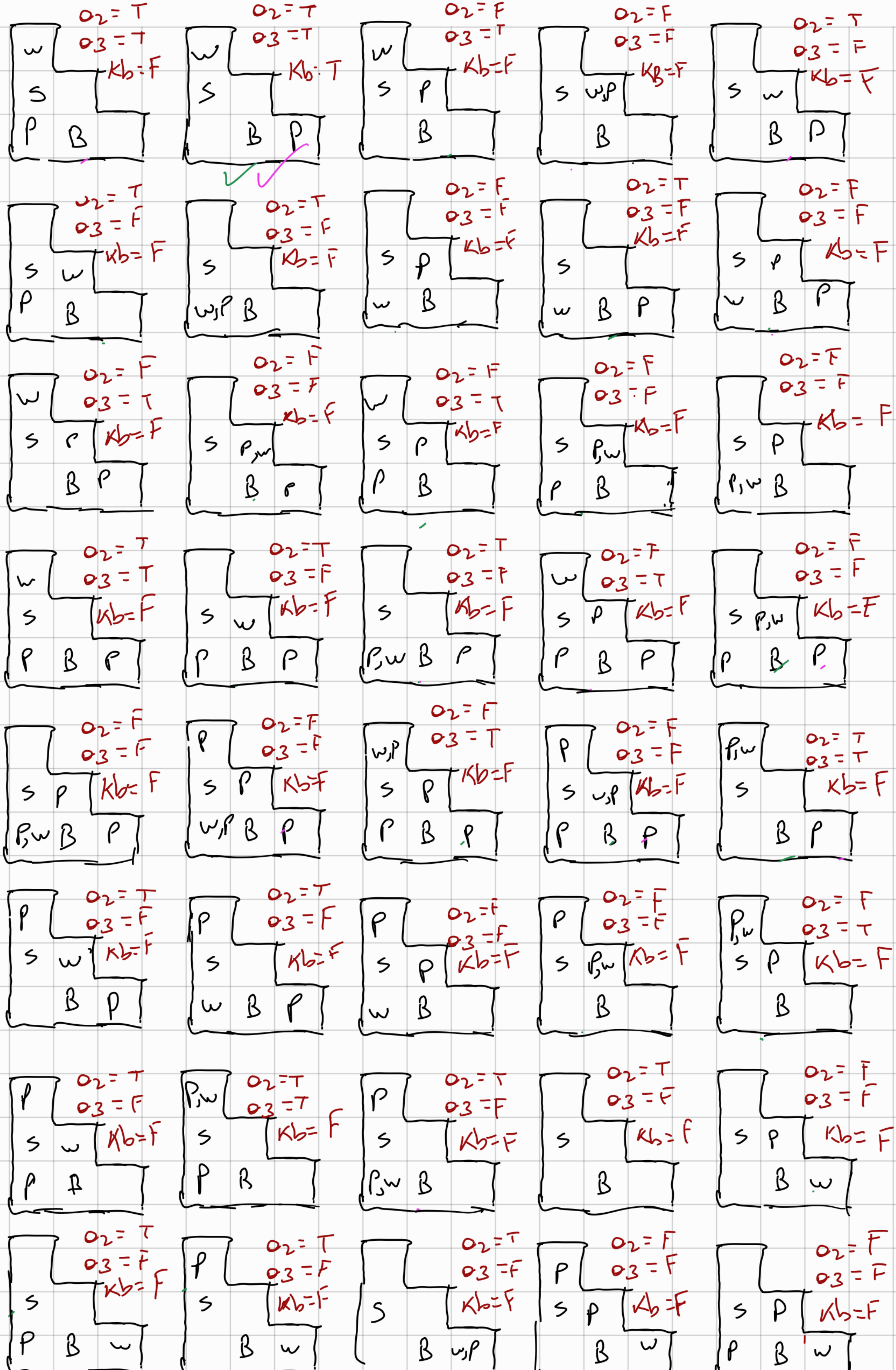
we know that $-B_{12}$ from R_5 and we can say, $-P_{13}$ from R_6 so:

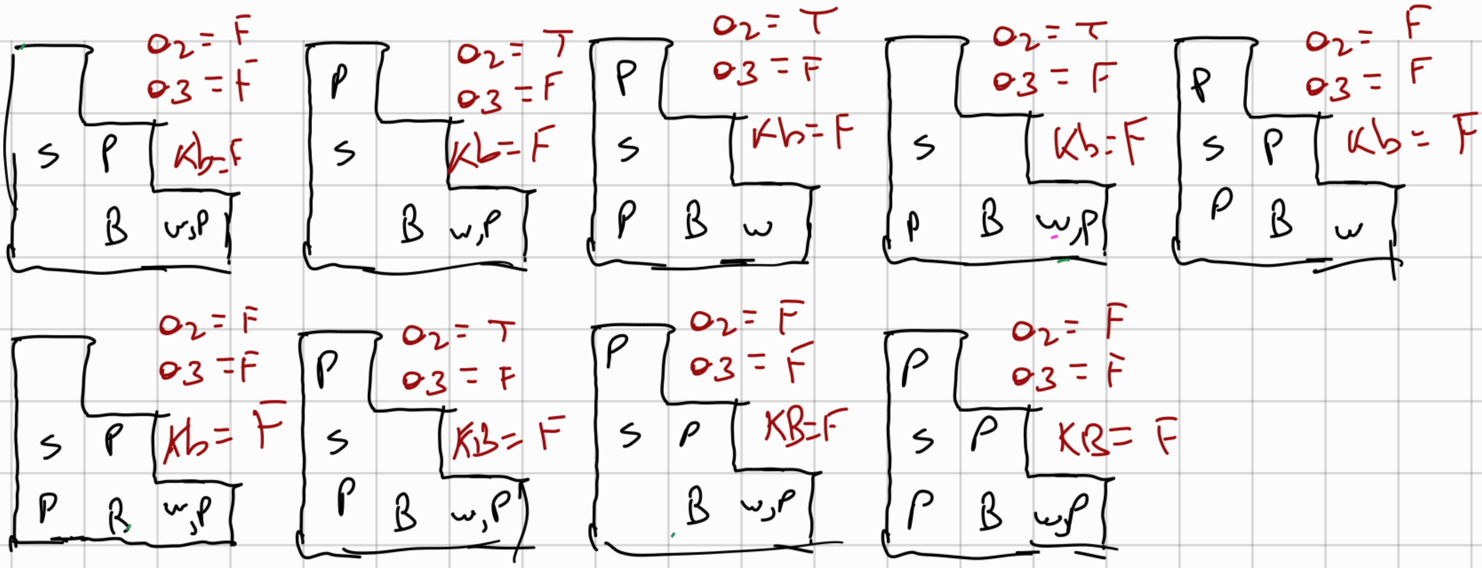
$R_9 = -P_{13}$ $R_{10} = -P_{22}$ (α_2)

if $KB \models \alpha_3$ is true ; use ("✓") with this color.
if $KB \models \alpha_2$ is true ; use ("✓") with this color.

$KB \models \underbrace{R_8}_{\alpha_3}$ and $KB \models \underbrace{R_{10}}_{\alpha_2}$ → there is not a pit in [2,2]

→ there is wumpus in [1,3]


O2 = T
O3 = T
Kb = F
W S P B
O2 = T
O3 = T
Kb : T
W S B P
O2 = F
O3 = T
Kb = F
W S P B
O2 = F
O3 = F
Kb = F
S W,P B
O2 = T
O3 = F
Kb = F
S W B P
O2 = T
O3 = F
Kb = F
S W P B
O2 = T
O3 = F
Kb = F
S W,P B
O2 = F
O3 = F
Kb = F
S P W B
O2 = T
O3 = F
Kb = F
S W B P
O2 = F
O3 = F
Kb = F
S P W B P
O2 = F
O3 = T
Kb = F
W S P B P
O2 = F
O3 = F
Kb = F
S P,W B P
O2 = F
O3 = T
Kb = F
W S P P B
O2 = F
O3 = F
Kb = F
S P,W P B
O2 = F
O3 = F
Kb = F
S P P,W B
O2 = T
O3 = T
Kb = F
W S P B P
O2 = T
O3 = F
Kb = F
S W P B P
O2 = T
O3 = F
Kb = F
S P,W B P
O2 = F
O3 = T
Kb = F
W S P P B P
O2 = F
O3 = F
Kb = F
S P,W P B P
O2 = F
O3 = F
Kb = F
S P P,W B P
O2 = F
O3 = F
Kb = F
P S P W,P B P
O2 = F
O3 = T
Kb = F
W,P S P P B P
O2 = F
O3 = F
Kb = F
P S W,P P B P
O2 = T
O3 = T
Kb = F
P,W S B P
O2 = T
O3 = F
Kb = F
P S W B P
O2 = T
O3 = F
Kb = F
P S W B P
O2 = F
O3 = F
Kb = F
P S P W B
O2 = F
O3 = F
Kb = F
P S P,W B
O2 = F
O3 = T
Kb = F
P,W S P B
O2 = T
O3 = F
Kb = F
P S W P B
O2 = T
O3 = T
Kb = F
P,W S P B
O2 = T
O3 = F
Kb = F
P S P,W B
O2 = T
O3 = F
Kb = F
S B
O2 = F
O3 = F
Kb = F
S P B W
O2 = T
O3 = F
Kb = F
S P B W
O2 = T
O3 = F
Kb = F
P S B W
O2 = T
O3 = F
Kb = F
S B W,P
O2 = F
O3 = F
Kb = F
P S P B W
O2 = F
O3 = F
Kb = F
S P P B W



Ali Boro Ceren Doga

2 - i)

$$A \land B \land \neg C \land \neg D$$
$$\cup$$
$$A \land \neg B \land C \land \neg D$$
$$\cup$$
$$A \land \neg B \land \neg C \land D$$
$$\cup$$
$$\neg A \land B \land C \land \neg D$$
$$\cup$$
$$\neg A \land B \land \neg C \land D$$
$$\cup$$
$$\neg A \land \neg B \land C \land D$$

Possibilities

A	B	C	D
✓	✓	✗	✗
✓	✗	✓	✗
✓	✗	✗	✓
✗	✓	✓	✗
✗	✓	✗	✓
✗	✗	✓	✓

ii)

$$A \land B \land \neg C \land \neg D$$
$$\cup$$
$$\neg A \land B \land C \land \neg D$$
$$\cup$$
$$\neg A \land B \land \neg C \land D$$
$$\cup$$
$$\neg A \land \neg B \land C \land D$$

Possibilities

A	B	C	D
✓	✓	✗	✗
✗	✓	✓	✗
✓	✓	✗	✓
✗	✗	✓	✓

iii) $A \wedge B \wedge \neg C \wedge \neg D$

$\cup$

$A \wedge \neg B \wedge C \wedge \neg D$

$\cup$

$\neg A \wedge B \wedge C \wedge \neg D$

$\cup$

$\neg A \wedge \neg B \wedge C \wedge D$

Possibilities

A	B	C	D
✓	✓	x	x
✓	x	✓	x
x	✓	✓	x
x	x	✓	✓

iv)

$A \wedge \neg B \wedge C \wedge \neg D$

$\cup$

$A \wedge \neg B \wedge \neg C \wedge D$

$\cup$

$\neg A \wedge \neg B \wedge C \wedge D$

Possibilities

A	B	C	D
✓	x	✓	x
✓	x	x	✓
x	x	✓	✓

b) ii) $B \Rightarrow A$ iii) $C \Rightarrow D$ iv $\Rightarrow$ $B \Rightarrow$ false

so $(\underbrace{B'}_{\text{True}} \vee A) \wedge (\underbrace{C' \vee D)}_{\text{must be true}}$

B	A
1	1
0	0

$\Downarrow$

$C = D$

$\rightarrow$ so A = false

C	D
1	1
0	0

$\Downarrow$

$C = D$

so

$\Downarrow$

$C' \vee D = \underbrace{C' \vee C}_{\text{True}}$

$\Rightarrow C' \vee D =$ True

~~AB~~ So we say that C and D will go to the vocation.