



JNIESTRT'S
SMT. INDIRA GANDHI COLLEGE OF ENGINEERING
GHANSOLI, NAVI MUMBAI – 400701
(Approved by AICTE New Delhi & Govt. of Maharashtra, Affiliated to University of Mumbai)
COMPUTER ENGINEERING DEPARTMENT

ACADEMIC YEAR :- 2021-22(EVEN SEM)

Deepak

NAME- DEEPAK H CHOURASIYA
ROLL NO - 77
YEAR - TE SEM - VI
BRANCH - COMPUTER

EXPERIMENT NO : 08

TITLE:- IMPLEMENTING BAYESIAN BELIEF NETWORK : BURGLARY
ALARM PROBLEM.

Date of Performance	Date of Evaluation	Marks (10)					Sign / Remark
		A	B	C	D	E	
		2	3	2	2	1	
22/03/22	29/03/22						
		Total Marks					



Date: _____

Date	Experiment	Sign:
22-03-2022	Exp-8: Implementing Bayesian Belief Network: Burglary Alarm Problem	Grade:

Aim: Implement Burglary Alarm Problem, in Bayesian Belief Network.

Theory: A belief network is a graph with the following:

1. Nodes: Set of random variables

2. Directed links: The intuitive meaning of a link from node X to node Y is that X has a direct influence on Y .

3. Each node has a conditional probability table that quantifies the effect that the parent have on the node.

4. The graph has no directed cycles (DAG).

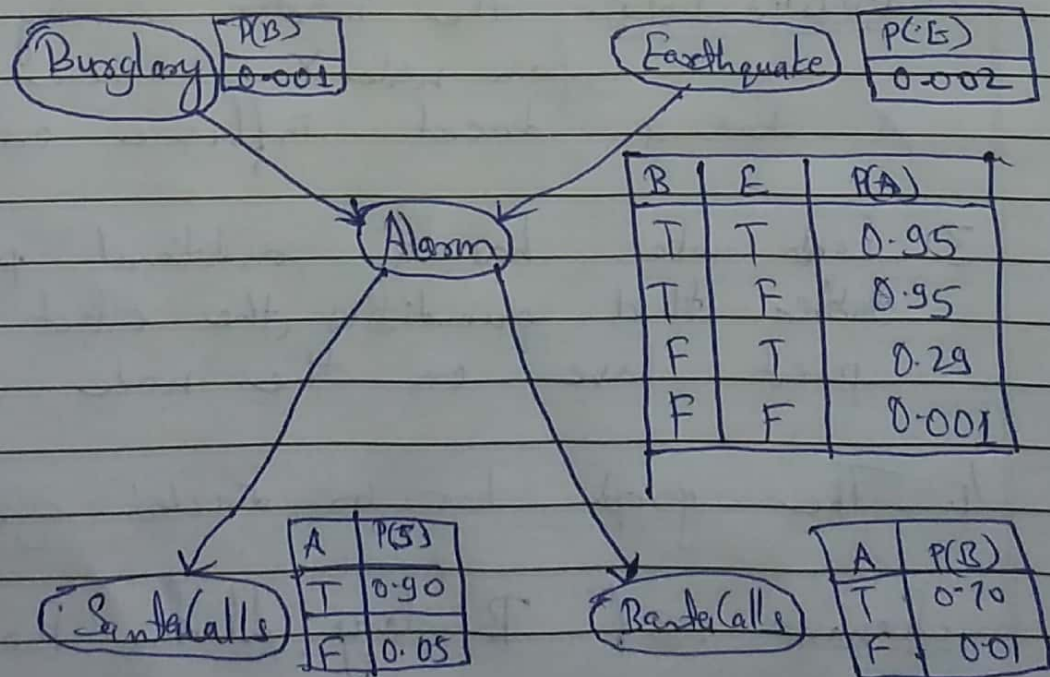
Scenario of Burglary Alarm Problem:

i. You have a new burglar alarm installed at home.



Date: _____

- ii. It is fairly reliable at detecting burglary, but also sometimes responds to minor earth quakes.
- iii. You have two neighbors, Santa and Banta, who promised to call you at work when they hear the alarm.
- iv. Santa always call when he hears the alarm, but sometimes confuses telephone ringing with the alarm and call too.
- v. Banta likes loud music and sometimes missed the alarm.
- vi. Given the evidence of who has or has not called, we would like to estimate the probability of a burglary.



Bayesian Network



Date: _____

The joint probability distribution:

A generic entry in the joint probability distribution $P(x_1, x_2, \dots, x_n)$ is given by:

$$P(x_1, \dots, x_n) = \prod_{i=1}^n P(x_i | \text{Parents}(x_i))$$

The Probability event of the event that alarm has sounded but neither a burglary nor an earthquake has occurred, and both Santa and Banta call:

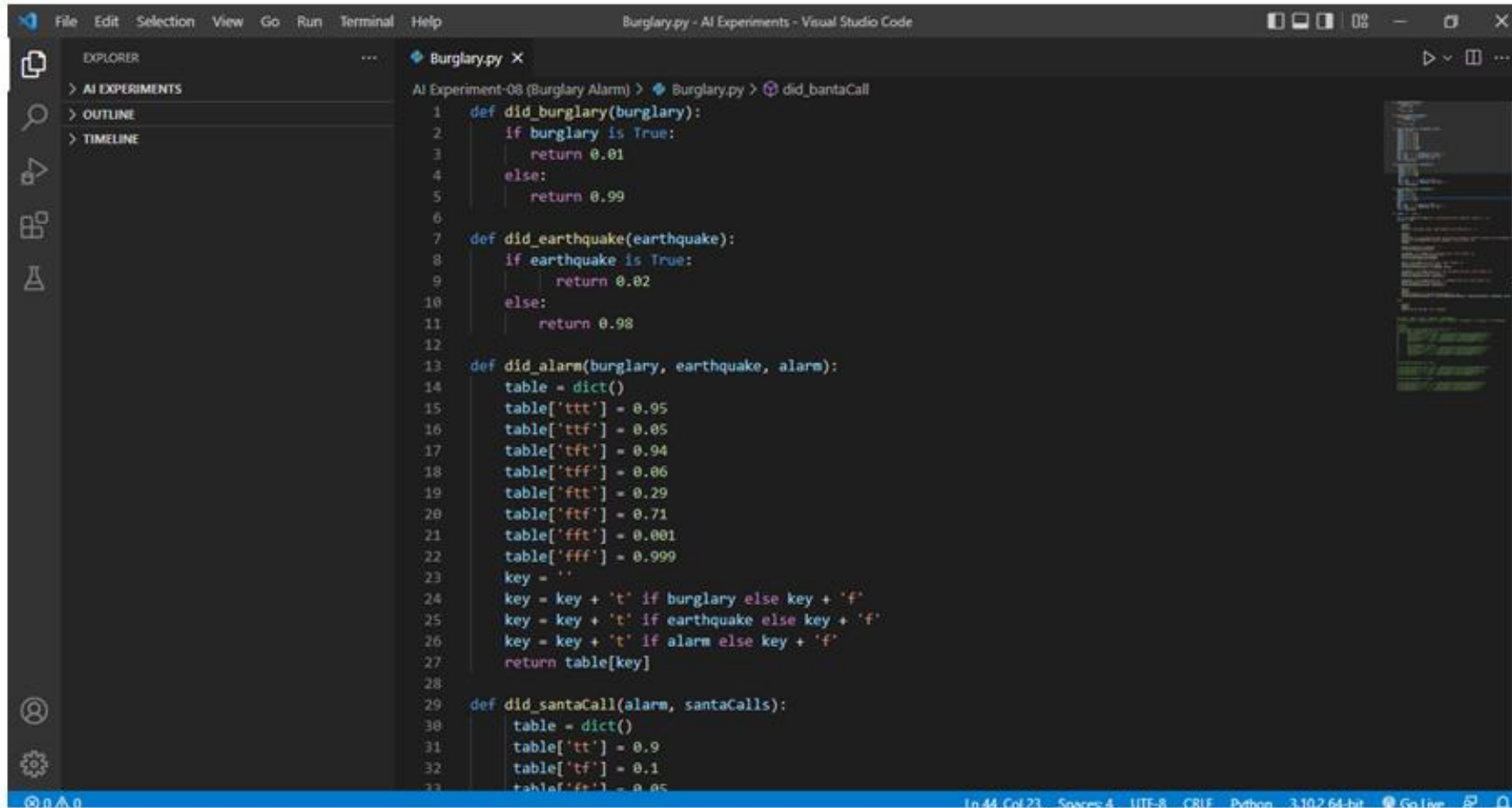
$$P(S \wedge B \wedge A \wedge \neg B \wedge \neg E)$$

$$= P(S|A) P(B|A) P(A|\neg B \wedge \neg E) P(\neg B) P(\neg E)$$

$$= 0.9 \times 0.7 \times 0.001 \times 0.999 \times 0.998$$

$$= \underline{0.00062 \dots}$$

Implementation:



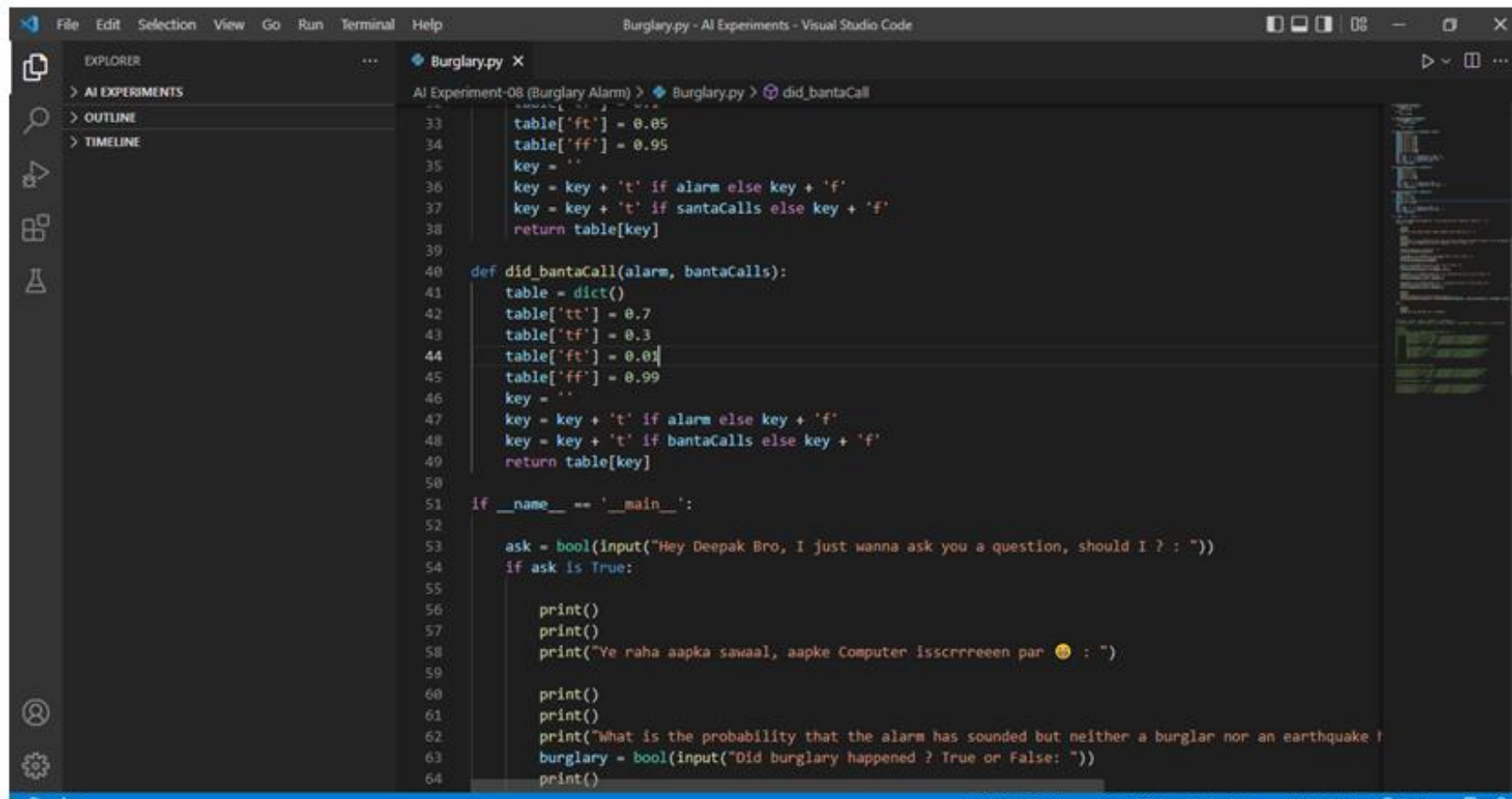
```
File Edit Selection View Go Run Terminal Help
Burglary.py - AI Experiments - Visual Studio Code

EXPLORER
> AI EXPERIMENTS
> OUTLINE
> TIMELINE

Burglary.py X
AI Experiment-08 (Burglary Alarm) > Burglary.py > did_bantaCall

1 def did_burglary(burglary):
2     if burglary is True:
3         return 0.01
4     else:
5         return 0.99
6
7 def did_earthquake(earthquake):
8     if earthquake is True:
9         return 0.02
10    else:
11        return 0.98
12
13 def did_alarm(burglary, earthquake, alarm):
14     table = dict()
15     table['ttt'] = 0.95
16     table['ttf'] = 0.05
17     table['tft'] = 0.94
18     table['tff'] = 0.06
19     table['ftt'] = 0.29
20     table['ftf'] = 0.71
21     table['fft'] = 0.001
22     table['fff'] = 0.999
23     key = ''
24     key = key + 't' if burglary else key + 'f'
25     key = key + 't' if earthquake else key + 'f'
26     key = key + 't' if alarm else key + 'f'
27     return table[key]
28
29 def did_santaCall(alarm, santaCalls):
30     table = dict()
31     table['tt'] = 0.9
32     table['tf'] = 0.1
33     table['ft'] = 0.05
```

(Implementation Part – 01)

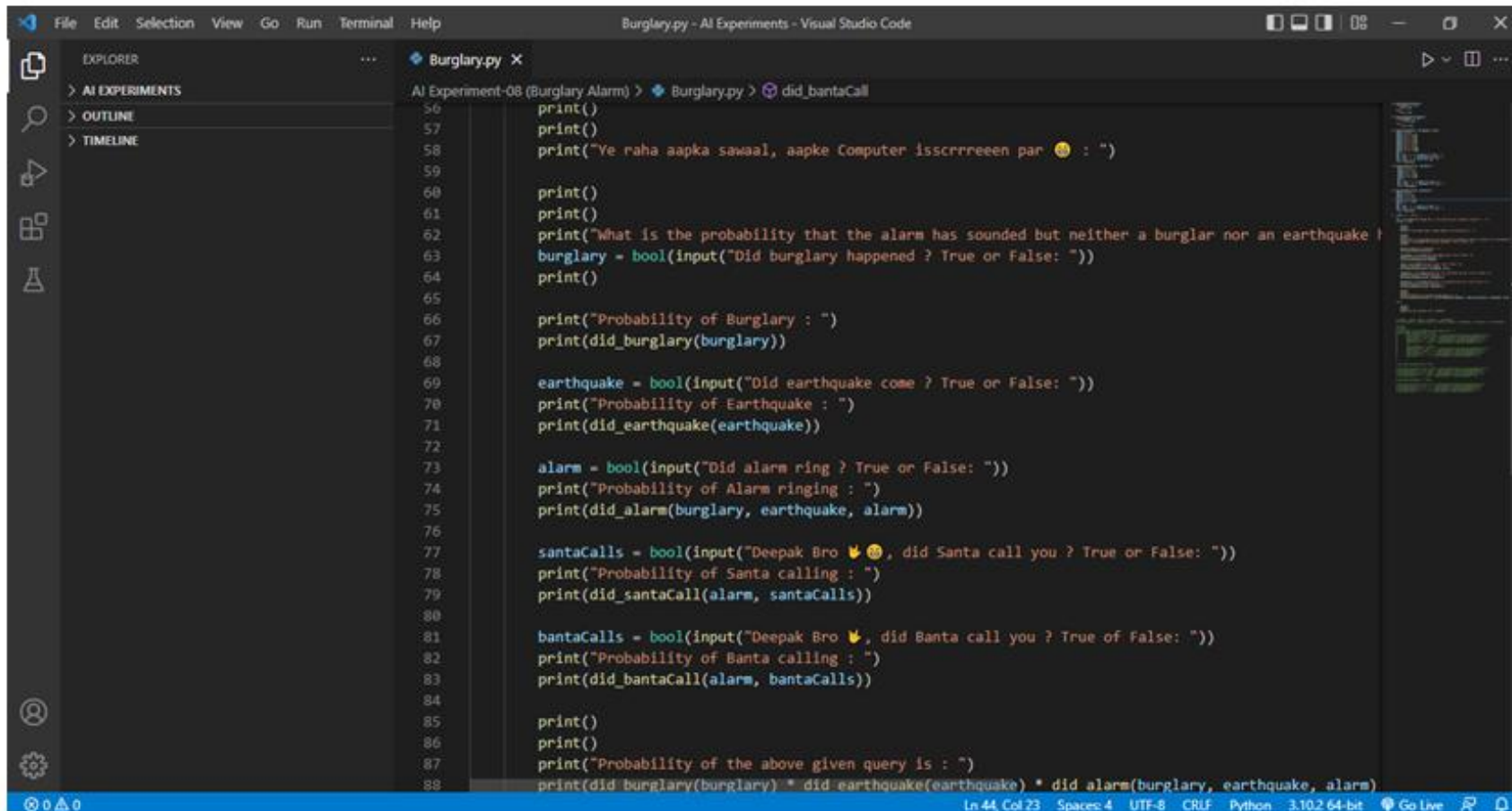


```
File Edit Selection View Go Run Terminal Help
Burglary.py - AI Experiments - Visual Studio Code

EXPLORER
  AI EXPERIMENTS
  > OUTLINE
  > TIMELINE

Burglary.py X
  AI Experiment-08 (Burglary Alarm) > Burglary.py > did_bantaCall
  33 table['ft'] = 0.05
  34 table['ff'] = 0.95
  35 key = ''
  36 key = key + 't' if alarm else key + 'f'
  37 key = key + 't' if santaCalls else key + 'f'
  38 return table[key]
  39
  40 def did_bantaCall(alarm, bantaCalls):
  41     table = dict()
  42     table['tt'] = 0.7
  43     table['tf'] = 0.3
  44     table['ft'] = 0.01
  45     table['ff'] = 0.99
  46     key = ''
  47     key = key + 't' if alarm else key + 'f'
  48     key = key + 't' if bantaCalls else key + 'f'
  49     return table[key]
  50
  51 if __name__ == '__main__':
  52
  53     ask = bool(input("Hey Deepak Bro, I just wanna ask you a question, should I ? : "))
  54     if ask is True:
  55
  56         print()
  57         print()
  58         print("Ye raha aapka sawaal, aapke Computer Isscrrreeen par 🤖 : ")
  59
  60         print()
  61         print()
  62         print("What is the probability that the alarm has sounded but neither a burglar nor an earthquake ?")
  63         burglary = bool(input("Did burglary happened ? True or False: "))
  64         print()
```

(Implementation Part – 02)



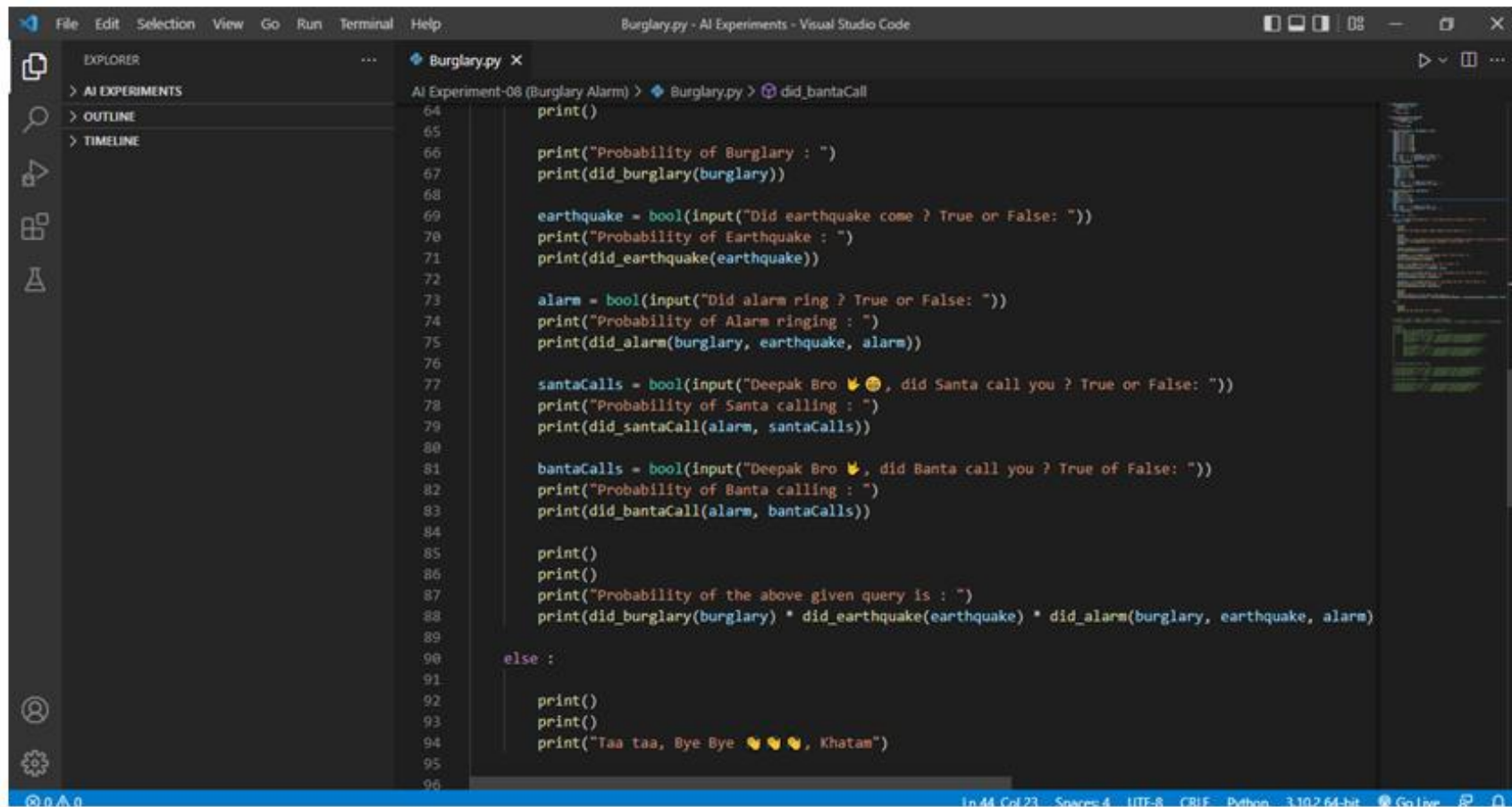
```
File Edit Selection View Go Run Terminal Help
Burglary.py - AI Experiments - Visual Studio Code

EXPLORER
  > AI EXPERIMENTS
  > OUTLINE
  > TIMELINE

Burglary.py X
AI Experiment-08 (Burglary Alarm) > Burglary.py > did_bantaCall
56 print()
57 print()
58 print("Ye raha aapka sawaal, aapke Computer isscrreeen par 😊 : ")
59
60 print()
61 print()
62 print("What is the probability that the alarm has sounded but neither a burglar nor an earthquake ?")
63 burglary = bool(input("Did burglary happened ? True or False: "))
64 print()
65
66 print("Probability of Burglary : ")
67 print(did_burglary(burglary))
68
69 earthquake = bool(input("Did earthquake come ? True or False: "))
70 print("Probability of Earthquake : ")
71 print(did_earthquake(earthquake))
72
73 alarm = bool(input("Did alarm ring ? True or False: "))
74 print("Probability of Alarm ringing : ")
75 print(did_alarm(burglary, earthquake, alarm))
76
77 santaCalls = bool(input("Deepak Bro 🙌🏻😊, did Santa call you ? True or False: "))
78 print("Probability of Santa calling : ")
79 print(did_santaCall(alarm, santaCalls))
80
81 bantaCalls = bool(input("Deepak Bro 🙌🏻, did Banta call you ? True or False: "))
82 print("Probability of Banta calling : ")
83 print(did_bantaCall(alarm, bantaCalls))
84
85 print()
86 print()
87 print("Probability of the above given query is : ")
88 print(did_burglary(burglary) * did_earthquake(earthquake) * did_alarm(burglary, earthquake, alarm))

Ln 44 Col 23 Spaces: 4 UTF-8 CRLF Python 3.10.2 64-bit Go Live
```

(Implementation Part – 03)



```
File Edit Selection View Go Run Terminal Help
Burglary.py - AI Experiments - Visual Studio Code

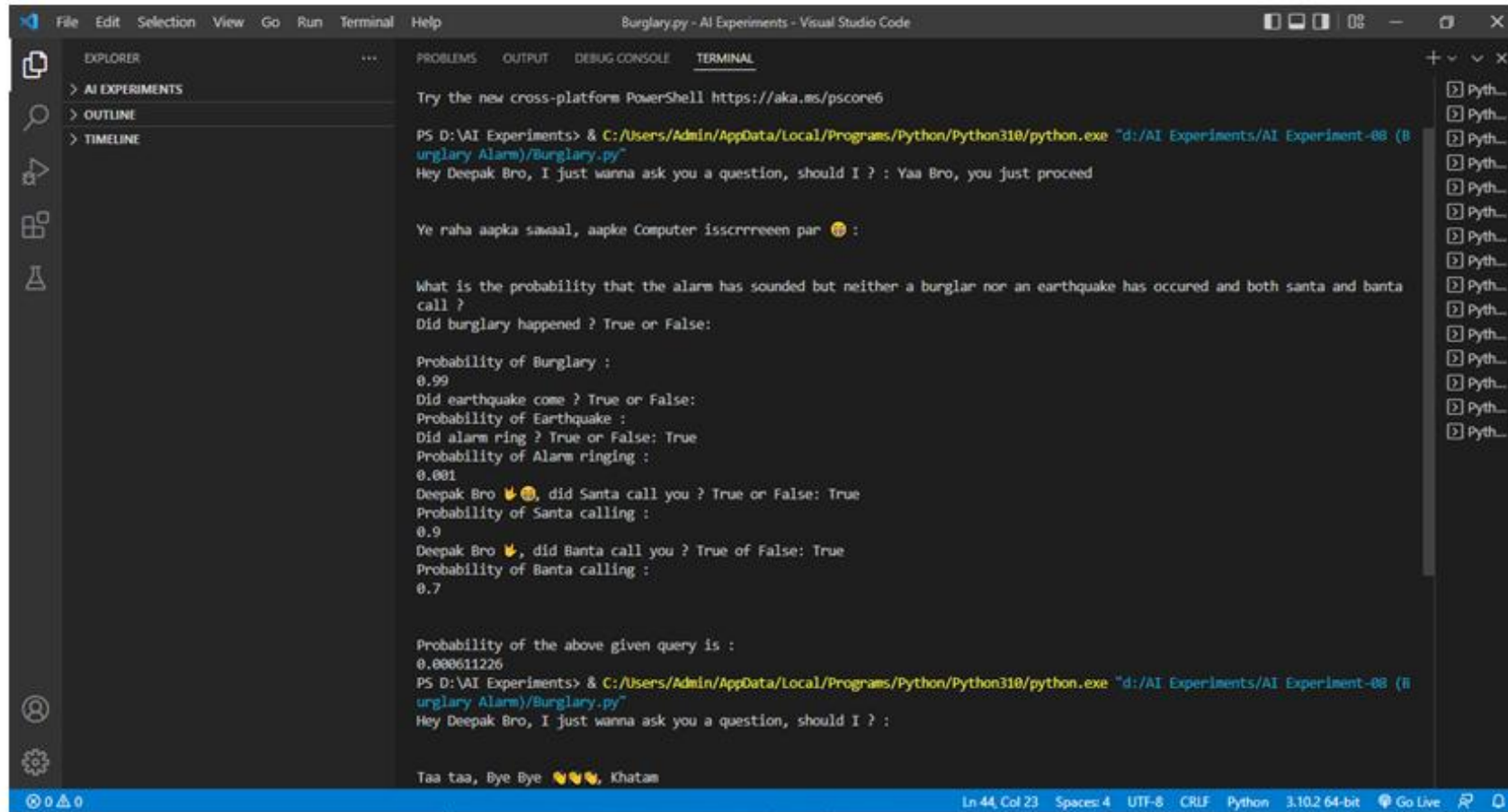
EXPLORER
> AI EXPERIMENTS
> OUTLINE
> TIMELINE

Burglary.py X
AI Experiment-08 (Burglary Alarm) > Burglary.py > did_bantaCall

64 print()
65
66 print("Probability of Burglary : ")
67 print(did_burglary(burglary))
68
69 earthquake = bool(input("Did earthquake come ? True or False: "))
70 print("Probability of Earthquake : ")
71 print(did_earthquake(earthquake))
72
73 alarm = bool(input("Did alarm ring ? True or False: "))
74 print("Probability of Alarm ringing : ")
75 print(did_alarm(burglary, earthquake, alarm))
76
77 santaCalls = bool(input("Deepak Bro 🙋🏻, did Santa call you ? True or False: "))
78 print("Probability of Santa calling : ")
79 print(did_santaCall(alarm, santaCalls))
80
81 bantaCalls = bool(input("Deepak Bro 🙋🏻, did Banta call you ? True or False: "))
82 print("Probability of Banta calling : ")
83 print(did_bantaCall(alarm, bantaCalls))
84
85 print()
86 print()
87 print("Probability of the above given query is : ")
88 print(did_burglary(burglary) * did_earthquake(earthquake) * did_alarm(burglary, earthquake, alarm))
89
90 else :
91
92 print()
93 print()
94 print("Taa taa, Bye Bye 🙋🏻🙋🏻🙋🏻, Khatam")
95
96
```

(Implementation Part – 04)

Output:



```
File Edit Selection View Go Run Terminal Help
Burglary.py - AI Experiments - Visual Studio Code

EXPLORER
> AI EXPERIMENTS
> OUTLINE
> TIMELINE

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
Try the new cross-platform PowerShell https://aka.ms/powershell

PS D:\AI Experiments> & C:/Users/Admin/AppData/Local/Programs/Python/Python310/python.exe "d:/AI Experiments/AI Experiment-08 (Burglary Alarm)/Burglary.py"
Hey Deepak Bro, I just wanna ask you a question, should I ? : Yaa Bro, you just proceed

Ye raha aapka sawaal, aapke Computer isscrreen par 🤖 :

What is the probability that the alarm has sounded but neither a burglar nor an earthquake has occurred and both santa and banta call ?
Did burglary happened ? True or False:

Probability of Burglary :
0.99
Did earthquake come ? True or False:
Probability of Earthquake :
Did alarm ring ? True or False: True
Probability of Alarm ringing :
0.001
Deepak Bro 🙋🏻, did Santa call you ? True or False: True
Probability of Santa calling :
0.9
Deepak Bro 🙋🏻, did Banta call you ? True or False: True
Probability of Banta calling :
0.7

Probability of the above given query is :
0.000611226
PS D:\AI Experiments> & C:/Users/Admin/AppData/Local/Programs/Python/Python310/python.exe "d:/AI Experiments/AI Experiment-08 (Burglary Alarm)/Burglary.py"
Hey Deepak Bro, I just wanna ask you a question, should I ? :

Taa taa, Bye Bye 🙋🏻🙋🏻🙋🏻, Khatam

Ln 44, Col 23 Spaces: 4 UTF-8 CRLF Python 3.10.2 64-bit Go Live
```



Date: _____

Conclusion: I have successfully implemented and understood about Bayesian Belief Network with an example of Burglary Alarm Problem.