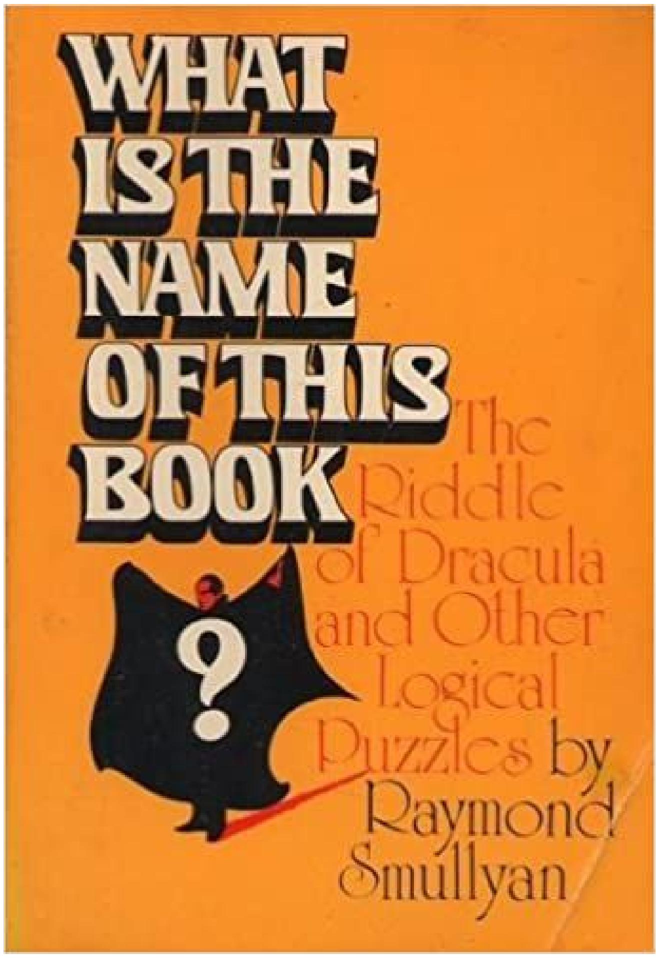
Valter Núñez
A01206138

Final Project Programming Languages

The Problem


WHAT IS THE NAME OF THIS BOOK
?
The Riddle of Dracula and Other Logical Puzzles by Raymond Smullyan

My final project for the Programming Languages course is focused on part of **Chapter 4** of Raymond Smullyan{s book *What is the Name of this Book? The Riddle of Dracula and other Logical Puzzles*.

Chapter 4 is called *Alice in the Forest of Forgetfulness.* The premise is that Alice (probably an Alice based on the one of Alice in Wonderland), is walking through the forest. In the time she does this, she encounters several different creatures that throw riddles at her.

The first creatures she encounters are *The Lion and the Unicorn.* For these set of problems this is the premise:

- The Lion lies on Monday, Tuesday and Wednesday.
- The Unicorn lies on Thursday, Friday and Saturday.

With that in mind, there are 4 puzzles presented (puzzles 47 to 50):

47. **What day is it?**
    a. Lion says *Yesterday was one of my lying days.*
    b. Unicorn says *Yesterday was one of my lying days too.*
48. **What day is it?**
    a. Lion says *I lied Yesterday.*
    b. Lion says *I will lie two days after tomorrow.*
49. **What day is it?**
    a. Lion says *I lied Yesterday*
    b. Lion says *I will lie again tomorrow.*

50. **Which days can this statement be done?**
    a. Lion says *I lied Yesterday and I will lie again tomorrow*.

The second creatures she encounters, and the last presented in this project, are the brothers Tweedledum and Tweedledee (called Dum and Dee in short here). This is the new premise for Dum and Dee:

- One of the brothers lies on Monday, Tuesday and Wednesday.
- The other one lies on Thursday, Friday and Saturday.
- Alice cannot tell which one lies when, and she cannot tell them apart.

With this in mind, there are 8 puzzles presented (puzzles 51-58):

51. **Which brother is Dum and which one is Dee?**
    a. 1st says I'm Tweedledum
    b. 2nd says I'm Tweedledee
52. **Which brother is Dum and which one is Dee?**
    a. 1st says I'm Tweedledum
    b. 2nd says If that's really true, then I'm Tweedledee
53. **What did the other brother answer?**
    a. Alice asked the first brother: Do you lie on Sundays?
        i. He replied yes.
54. **What day of the week was it?**
    a. 1st says I lie on Sundays.
    b. 1st says I lie on Saturdays.
    c. 2nd says I will lie tomorrow.
55. **Who was speaking?**
    a. 1st says I am lying today and I am Tweedledee.
56. **Who was speaking?**
    a. 1st says I am lying today or I am Tweedledee.
57. **Which brother is Dum and which one is Dee? Which day is it?**
    a. 1st says if I am Tweedledum then he is Tweedledee
    b. 2nds says if he is Tweedledee then I am Tweedledum.
58. **Which brother is Dum and which one is Dee? Which day is it? Who lies like the Lion and who lies like the Unicorn?**
    a. 1st says today is not Sunday
    b. 2nds says in fact, today is Monday.
    c. 1st says Tomorrow is one of Tweedledee's lying days.
    d. 2nd says The Lion lied Yesterday.

The Solution

The solution to these puzzles are based on the concept of backtracking and logic. As such, the paradigm to be used is the Logic Paradigm, utilizing Prolog as the chosen programming language.

Now, there will be an explanation of the solution for each of the puzzles.

47

In order to solve this problem, you need to go through each of the days and check for the statements of the *Lion*. If that is *true*, you will go to the one of the *Unicorn*. If both of them are *true*, the result is the day evaluated. If any of the two statements are *false*, you will move to the next day, until you finish the week or get a *true* result.

48

In order to solve this problem, you will have to go through each of the days and check for both statements of the *Lion*. If the first one is *true*, you will go to the next statement. If both are *true*, the result is the evaluated day. If any of them is false, you will move to the next day until you finish the week or get a *true* result.

49

To solve this problem, you will have to go through each of the days and check both statements of the *Lion*. If the first one is *true*, you will go to the next statement. If both are *true*, the result is the evaluated day. If any of them is false, you will move to the next day until you finish the week or get a *true* result.

50

This problem is different from the other ones. Here you will only check one statement. If any part of that statement is false, the whole statement will be *false*. Only if everything is *true*, will the whole statement be *true*. You will have to go through all days of the week until the end, as you will get more than one result.

51

In this part, both of the brothers are making a statement that does not contradict the other one. As such there are only two options. Either both are lying or both are telling the truth. You need to check for a day where any of these options happen. If they are telling the truth, the names are right. If not, the names are the other way around.

52

This puzzle uses some logic statements about true and false. The second statement is always true. If that is the case, and the day is not Sunday, then the first one must be lying.

53

In order to solve this problem, you know that no brother lies on Sunday and that they do not lie the same day. As such, the answer to the question is the truth.

54

Using the same knowledge as before, that no brother lies on Sunday, the first one is certainly lying. The second one, then, is telling the truth. The only other option presented, is that the second one must be telling the truth today but not tomorrow, which is one of the set of lying days that include the lie the first one told.

55

The statement is obviously false. If he is lying, then he is not Dee. However, if he is telling the truth, then he couldn’t be lying. As a result, the brother is Dum.

56

If the brother is lying, then the statement would be true, which can’t happen. As such, he is telling the truth. Therefore, because of the ‘or’ he is either lying or he is Dee, and we know he is not lying today.

57

Since the names of each other are depending on the other’s response, you cannot say which brother is which. However, you know that both of them have to be either lying or telling the truth for the statements to work.

58

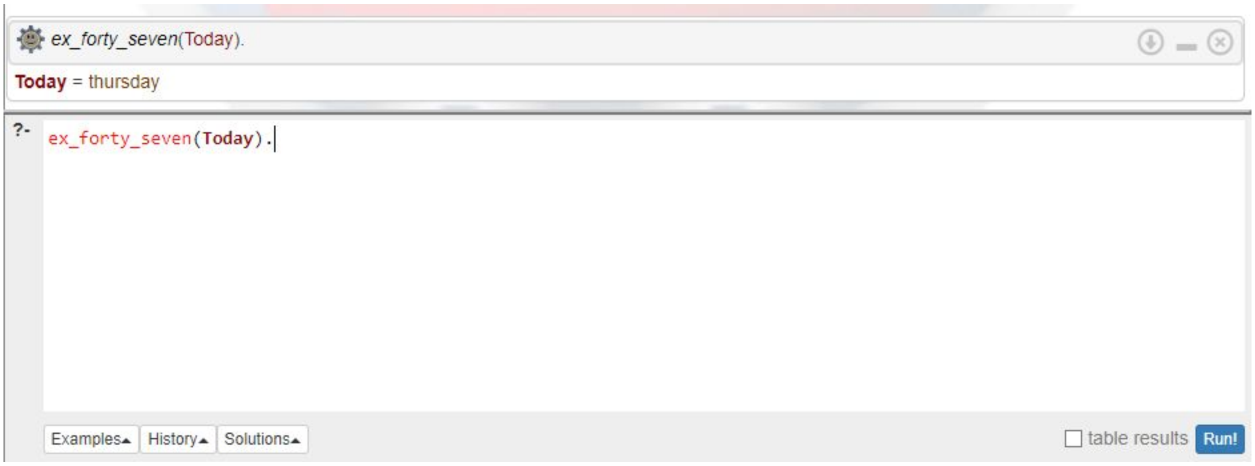
First, we know that it cannot be Sunday, as both of them don't lie that day and there is a contradiction in the first 2 statements. Because of that, we know the first one is telling the truth, as he said it is not Sunday. It is not Monday either, as the Second One is lying. The second one said that the Lion lied yesterday, and because that is a lie the Lion told the truth yesterday. So, we narrowed the days to 2 days now: Friday and Saturday. The First One said that tomorrow is one lying day (and that's the truth) but since Sundays nobody lies, it is Friday. Also we know that Dee lies Thursday, Friday and Saturday and Dum Monday, Tuesday and Wednesday. And since today is Friday, Dum is the first one speaking.

Results

The results of the implementation of the solutions of the puzzles can be seen in the following GitHub Repository:
https://github.com/valternunez/Prolog-Alice-in-the-Forest-of-Forgetfullness

In these section you will be able to see the results of each query done in order to get the answer to each exercise.

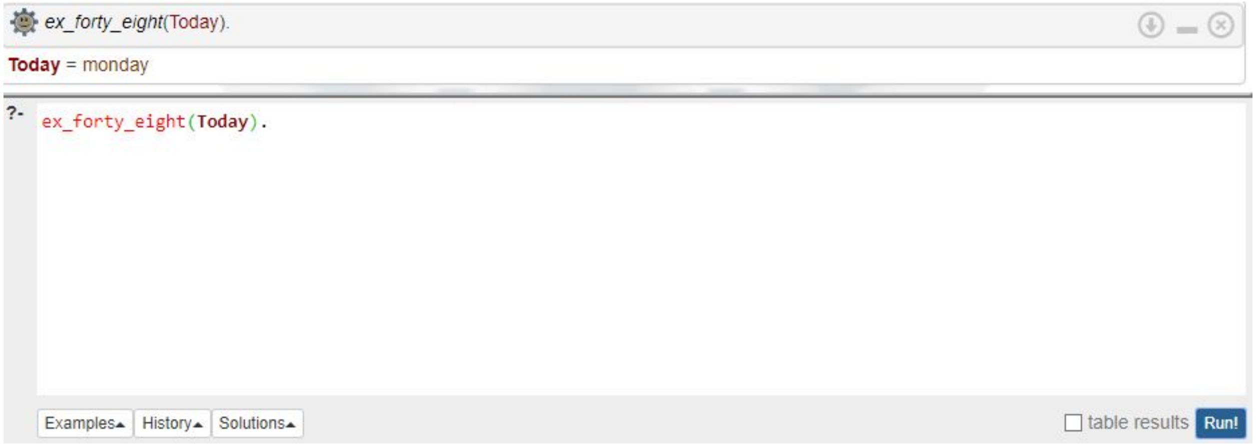
47



```
ex_forty_seven(Today).
Today = thursday
```

```
?- ex_forty_seven(Today).
```

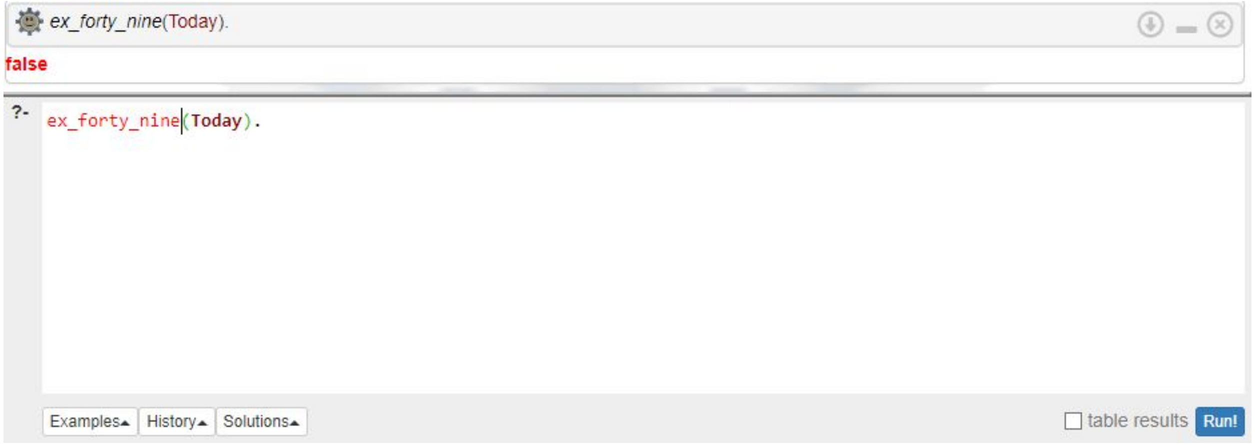
48



```
ex_forty_eight(Today).
Today = monday
```

```
?- ex_forty_eight(Today).
```

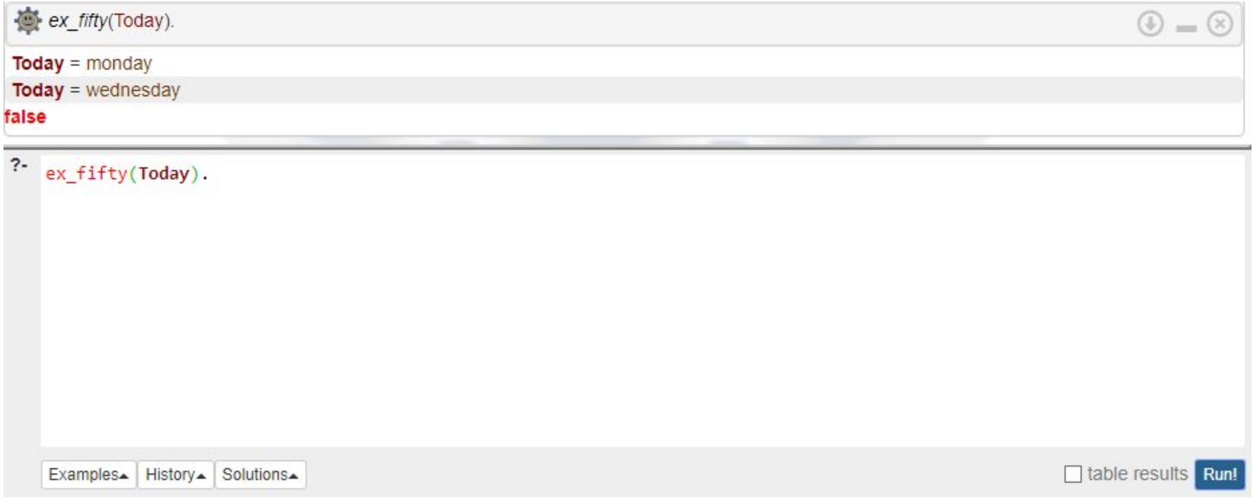
49



```
ex_forty_nine(Today).
false
```

```
?- ex_forty_nine(Today).
```

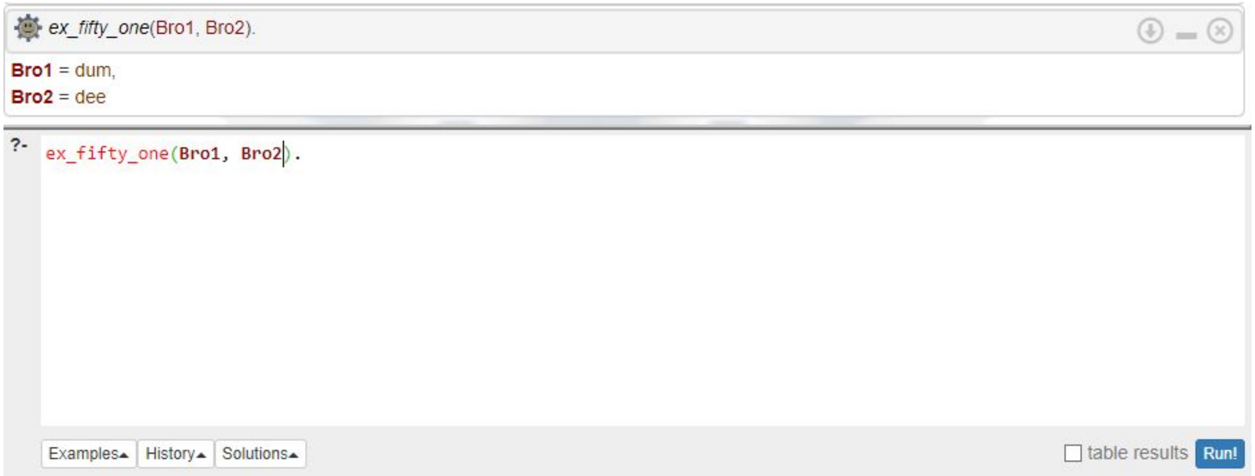
50



```
ex_fifty(Today).
Today = monday
Today = wednesday
false
```

```
?- ex_fifty(Today).
```

51

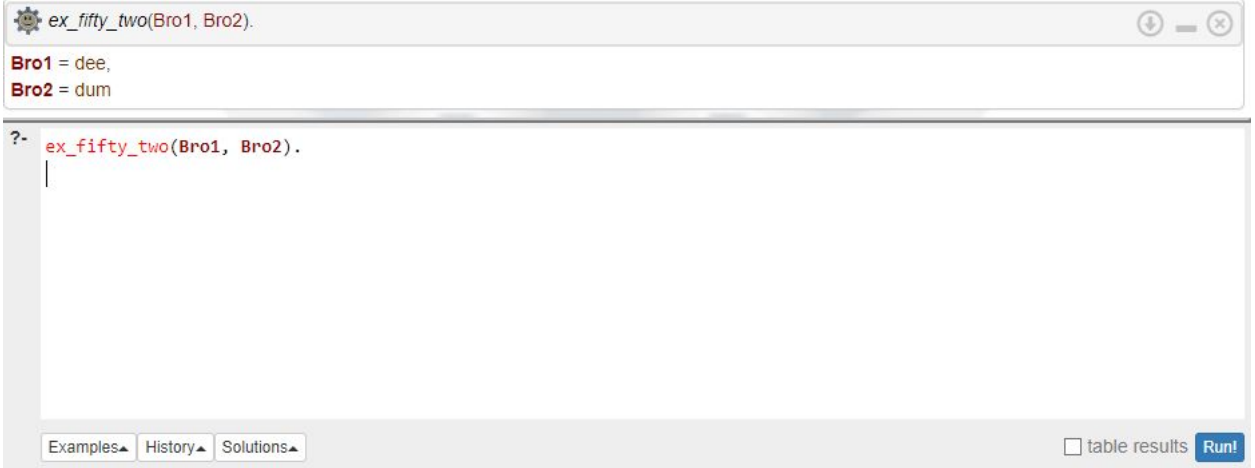


ex_fifty_one(Bro1, Bro2).

```
Bro1 = dum,
Bro2 = dee
```

```
?- ex_fifty_one(Bro1, Bro2).
```

52

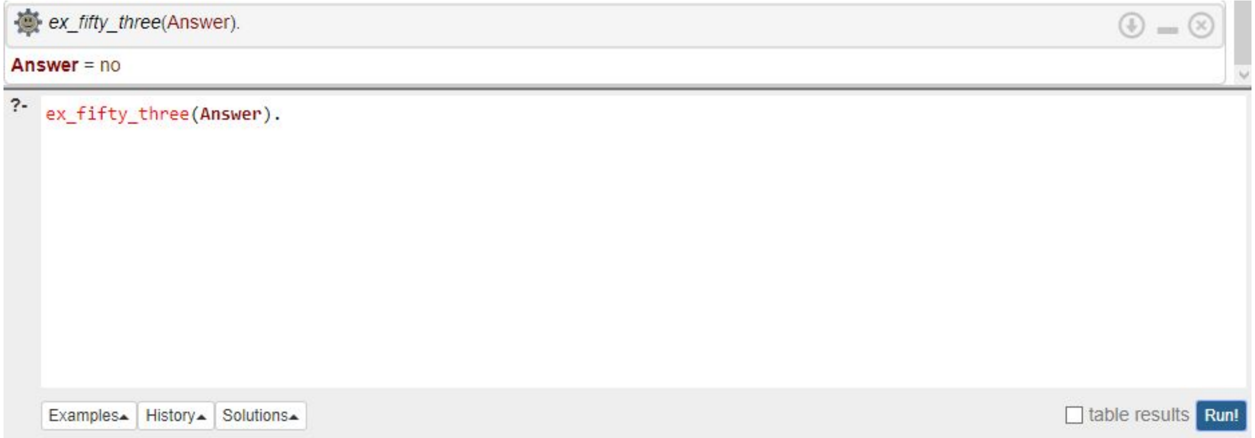


ex_fifty_two(Bro1, Bro2).

```
Bro1 = dee,
Bro2 = dum
```

```
?- ex_fifty_two(Bro1, Bro2).
```

53



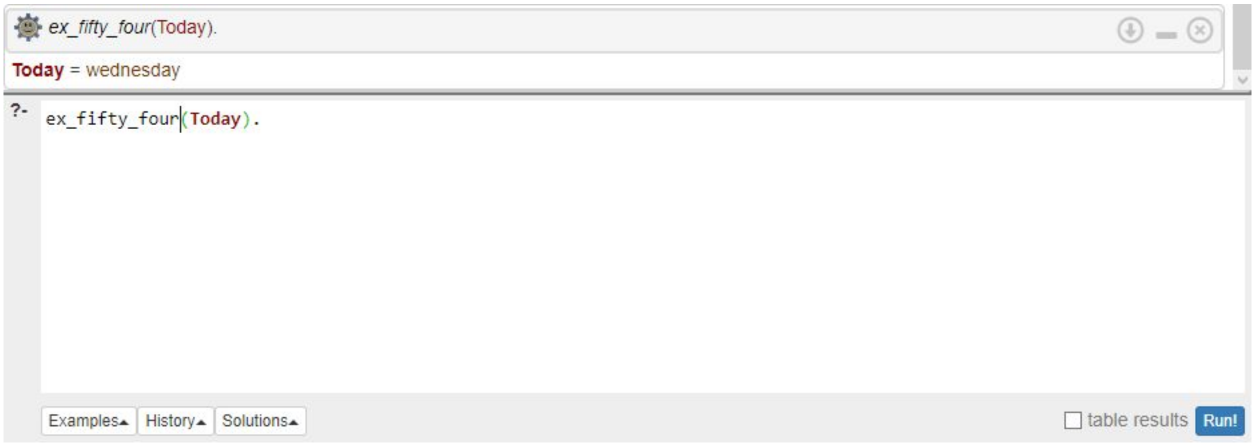
ex_fifty_three(Answer).

```
Answer = no
```

```
?- ex_fifty_three(Answer).
```

Valter Núñez
A01206138

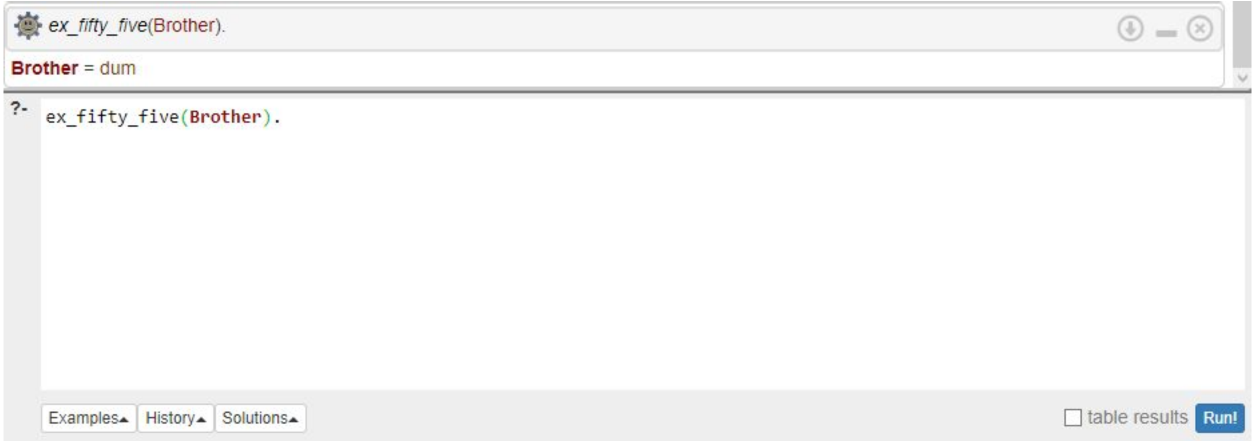
54



```
ex_fifty_four(Today).
Today = wednesday
```

```
?- ex_fifty_four(Today).
```

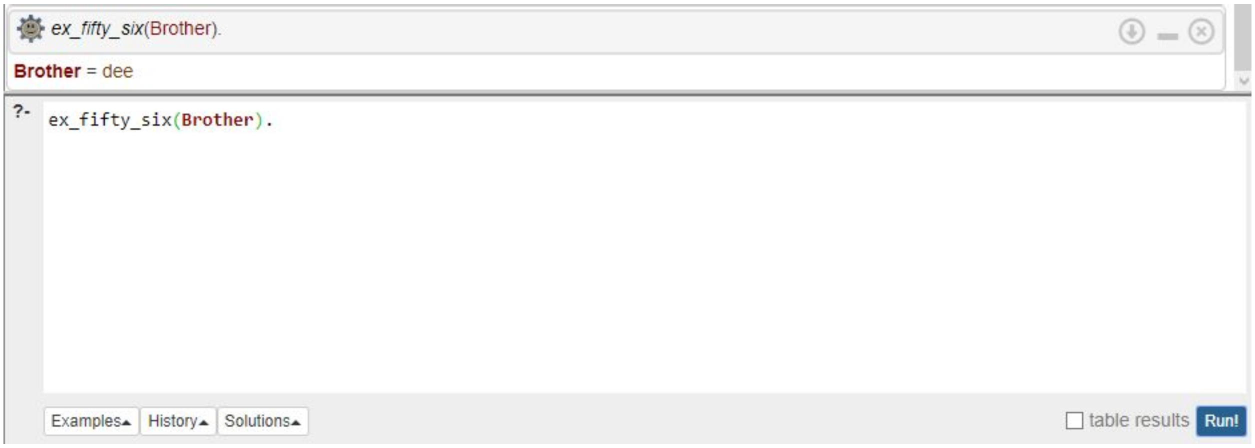
55



```
ex_fifty_five(Brother).
Brother = dum
```

```
?- ex_fifty_five(Brother).
```

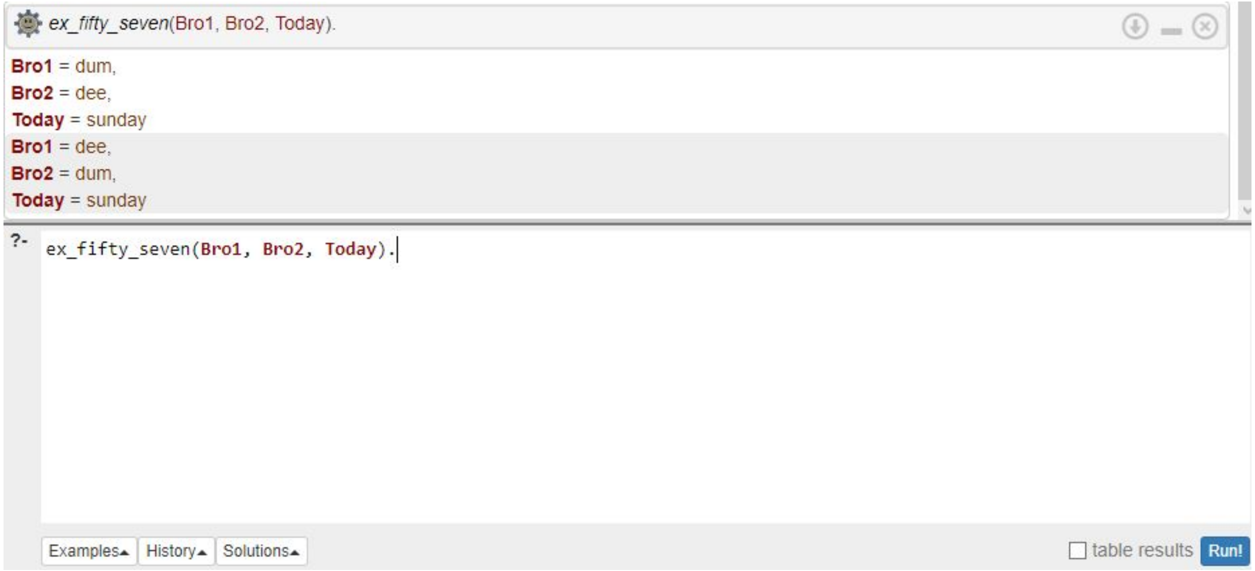
56



```
ex_fifty_six(Brother).
Brother = dee
```

```
?- ex_fifty_six(Brother).
```

57

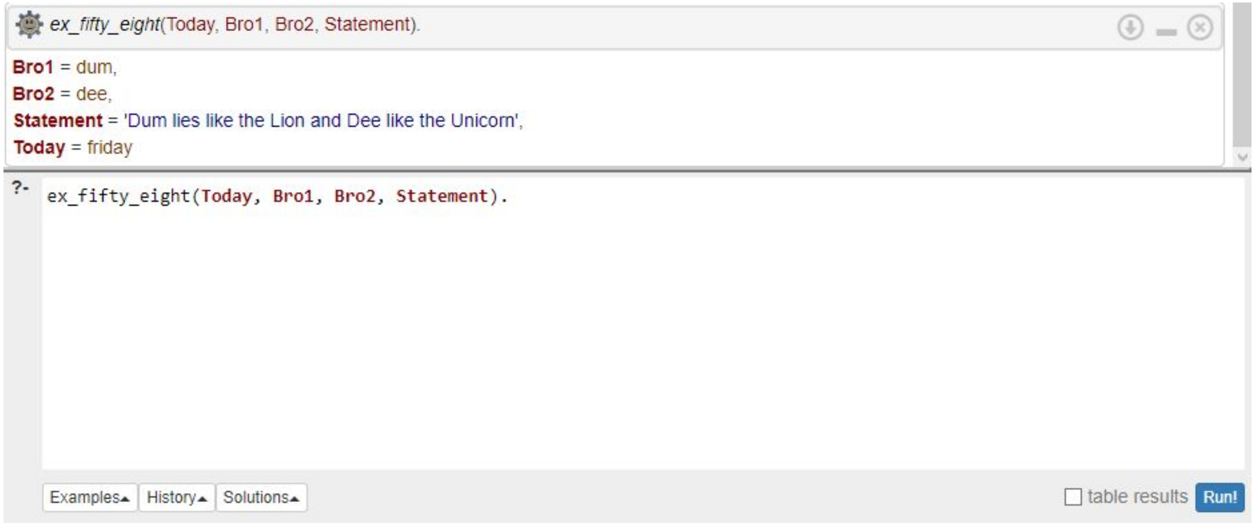


```
ex_fifty_seven(Bro1, Bro2, Today).

Bro1 = dum,
Bro2 = dee,
Today = sunday
Bro1 = dee,
Bro2 = dum,
Today = sunday

?- ex_fifty_seven(Bro1, Bro2, Today).
```

58



```
ex_fifty_eight(Today, Bro1, Bro2, Statement).

Bro1 = dum,
Bro2 = dee,
Statement = 'Dum lies like the Lion and Dee like the Unicorn',
Today = friday

?- ex_fifty_eight(Today, Bro1, Bro2, Statement).
```

Conclusion

For most of these problems the solution was reached by the use of logic and backtracking. The usage of a database of days and which days were lying days and which were not was specially useful in the solving of these puzzles.

Even though both sets of problems were similar in the rules, the set of Dee and Dum proved far more difficult to solve and implement.

Almost all cases had a concise answer, except for 2. Number 49 had a false result. This happened because there is no way to obtain the information desired with what was given. The second case was Number 57, because it showed 2 results for the name of the brothers. As explained before in the Solution Section, there is no way to determine which brother is which. As such, the answer is that both of them are Dee and Dum at the same time.

Set Up Instructions

Simply get the Prolog file (.pl) ready for compilation and use the following format:

ex_number_of_exercise_in_letters(Variables).

After that, just run it.

References

AayushChaturvedi (2018, December 10). Backtracking: Introduction. Retrieved May 28, 2020, from https://www.geeksforgeeks.org/backtracking-introduction/

Smullyan, R. (1988). *What is the name of this book?: the riddle of Dracula and other logical puzzles*. Harmondsworth: Penguin Books.