

# Using Language Models For Knowledge Acquisition in Natural Language Reasoning Problems

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## Abstract

For a natural language problem that requires some non-trivial reasoning to solve, there are at least two ways to do it using a large language model (LLM). One is to ask it to solve it directly. The other is to use it to extract the facts from the problem text and then use a theorem prover to solve it. In this note, we argue for the latter by conducting an experiment using ChatGPT with a series of logic word puzzles.

## 1 Introduction

ChatGPT<sup>1</sup> has taken the world by storm. There has been many anecdotes of how good it is in writing essays, composing poems, answering questions and so on. There was even a report that it could pass a University of Pennsylvania Wharton MBA exam<sup>2</sup>. But there were also many anecdotes of how it failed in solving some simple math problems.

In this note, through a series of logic word puzzles, mainly those adapted from Smullyan’s “Ladies or Tigers?” puzzles (Smullyan 1982), we conclude that the current version of ChatGPT is not capable of non-trivial reasoning. This is to be expected, and does not need a paper to document it. But for us, this is not the right way of using a pure data driven machine learning language model like ChatGPT, however large it is. It is not the role of such a language model to prove theorems, write correct computer programs, or re-invent mathematics and logic. What it could do is as a useful tool to extract knowledge from natural language texts, i.e. a knowledge acquisition tool. Indeed, our experiments showed that ChatGPT did much better when asked to translate the texts in the puzzles to logic sentences. It is not perfect, but the potential is clearly there. It can certainly be improved by some further training or fine-tuning. This compares with training a language model directly for reasoning, for which there has been a large body of work. This includes recent work on chain-of-thought prompting (Wei et al. 2022), a step-by-step explanation of how a conclusion is derived. While useful in many Q&A tasks, it is not enough for tasks that require substantial reasoning to solve. There has also been work on training language models to perform systematic reasoning such as

following some pre-defined rules (e.g. (Talmor et al. 2020; Hahn et al. 2020; Creswell, Shanahan, and Higgins 2023; Creswell and Shanahan 2022; Zhang et al. 2022)). We found the study reported in (Zhang et al. 2022) particularly interesting. It shows that for a simple rule-based logic studied in the paper, BERT can “attains near-perfect accuracy on in-distribution test examples while failing to generalize to other data distributions over the exact same problem space.” Perhaps the title of a recent survey paper by Helwe *et al.* (2021), “Reasoning with Transformer-based Models: Deep Learning, but Shallow Reasoning”, says it all.

The rest of the paper describes our experiments and discusses their results. Before we do that, two general remarks about our experiments are in order. One is that given ChatGPT can remember and make use of the earlier interactions in the same session, we always use a fresh new session whenever necessary. The other is that ChatGPT does not always give the same answer to the same question when asked repeatedly. This always happened with our logic word puzzles. We conjecture that this is in fact an indication of its lack of confidence in any of its answers, as in the end, it all comes down to probabilities. So after trying it out with a couple of “Ladies or Tigers?” puzzles initially, we stopped repeating our queries, and took the first response that we got from it. One can consider our experiments as a sample of how ChatGPT would respond.

## 2 Who’s in the car?

Our first puzzle is about who was in the car, an exam question from an AI course taught by one of the authors. Figure 1 shows the puzzle and a response by ChatGPT. It was asked once and never repeated. The correct answer is that A2 was in the car, but the others may or may not be. ChatGPT’s answer came in three parts. First, for each statement, it determined its fact and any implications from it. We see that it did this part correctly, determined that the driver must be either A1 or A2. The second part outlines its reasoning in its attempt to answer the questions. We see it did not do this part well, drawing problematic conclusions such as “if A2 was the driver, then A1 must have been in the car.” The last part gave its answer which was that not enough information to determine for certain whether A1 or A2 was in the car. The correct reasoning is of course by case analysis: if A1 was in the car, then so was A2; if A1 was not in the car, then

<sup>1</sup><https://chat.openai.com/chat>

<sup>2</sup><https://mackinstitute.wharton.upenn.edu/wp-content/uploads/2023/01/Christian-Terwiesch-Chat-GTP-1.24.pdf>

18 Three friends A1, A2, and A3 share a car. Here is a list of things that we know about them:

1. One of them drove the car yesterday.
2. A3 was not the driver.
3. A1 was in the car only if A2 was.

Also we know that the driver must be in the car. Was A1 in the car? How about A2?

Based on the information given, we can determine the following:

- A3 was not the driver.
- Therefore, the driver must be either A1 or A2.
- A1 was in the car only if A2 was.
- Therefore, if A1 was in the car, then A2 must have been in the car as well.

Given these facts, we can come to the following conclusions:

- A3 was not the driver, so we can eliminate A3 as a possibility.
- If A1 was in the car, then A2 must have been in the car as well.
- Therefore, if A1 was in the car, then A2 could have been the driver.
- If A2 was the driver, then A1 must have been in the car.
- Therefore, if A2 was the driver, then both A1 and A2 were in the car.

We cannot determine for certain whether A1 or A2 was in the car without additional information about who the driver was. However, we do know that if A1 was in the car, then A2 must have been in the car as well.

Figure 1: Who's in the car?

A2 was the driver, thus in the car.

If ChatGPT can understand each statement correctly, why not ask it to just encode it in a logical language and use a theorem prover to draw conclusions. In other words, use it as an encoder, a translator, or a knowledge acquisition tool. Figure 2 shows how we used it for this purpose. To make the task more specific, we provide logical symbols by which the statements are to be encoded. In the beginning of our experiments with the “Ladies or Tigers?” puzzles, we also asked ChatGPT to translate the statements to propositional logic without providing the symbols. Its responses varied too much. So we decided to be more specific by providing symbols to test its ability in using pre-defined symbols. The final generated formula is usable and will indeed give correct answers using any of the current SAT solvers: the formula entails P2 but not P1. However, there is a glitch: its translation of the fact that the driver must be in the car is strange, and wrong strictly speaking. The straightforward encoding is of course the conjunction of  $D_i \rightarrow P_i$ , for each  $i$ . Somehow it decided to enumerate the cases and concluded that P2 goes with D3:  $(D_1 \wedge (P_1 \vee P_2)) \vee (D_2 \wedge (P_1 \vee P_2)) \vee (D_3 \vee P_2)$ .

This shows the importance of checking the generated sentences before submitting the final KB to a theorem prover. Checking the correctness of a translated sentence should be much easier than checking the correctness of an answer to a complex question, and we consider this a key advantage of using ChatGPT as a knowledge acquisition/encoding tool rather than a problem solver.

### 3 Ladies or Tigers?

Our next experiment uses puzzles adapted from Smullyan's “Ladies or Tigers?” puzzles (Smullyan 1982), which were based on the 1882 short story “The Lady, or the Tiger?” by Stockton (1882). The Wikipedia page for it says ““The Lady, or the Tiger?” has entered the English language as an alle-

18 Given the following symbols in propositional logic:  
 Symbols:  
 P1 - A1 was in the car;  
 P2 - A2 was in the car;  
 P3 - A3 was in the car;  
 D1 - A1 was the driver;  
 D2 - A2 was the driver;  
 D3 - A3 was the driver.

Express the following statements in propositional logic:

Three friends A1, A2, and A3 share a car. Here is a list of things that we know about them:

1. One of them drove the car yesterday.
  2. A3 was not the driver.
  3. A1 was in the car only if A2 was.
- Also we know that the driver must be in the car.

Let's express the given statements in propositional logic using the given symbols:

1. One of them drove the car yesterday.  
 This statement can be represented as the disjunction of the three possible drivers:  $D1 \vee D2 \vee D3$ .
2. A3 was not the driver.  
 This statement can be represented as the negation of D3:  $\neg D3$ .
3. A1 was in the car only if A2 was.  
 This statement can be represented as the implication:  $P1 \rightarrow P2$ . We can read it as “if A1 was in the car, then A2 was also in the car.”

Finally, we know that the driver must be in the car. We can express this statement as the conjunction of the three possible cases:  $(D1 \wedge (P1 \vee P2)) \vee (D2 \wedge (P1 \vee P2)) \vee (D3 \wedge P2)$ . This can be read as “either A1 or A2 was in the car with the driver, or A3 was in the car with the driver.”

Combining all of these statements, we can write the complete propositional formula as follows:

$$((D1 \vee D2 \vee D3) \wedge \neg D3 \wedge (P1 \rightarrow P2) \wedge ((D1 \wedge (P1 \vee P2)) \vee (D2 \wedge (P1 \vee P2)) \vee (D3 \wedge P2)))$$

Figure 2: Who's in the car - fact encoding

gorical expression, a shorthand indication or signifier, for a problem that is unsolvable.”<sup>3</sup>

Figure 3 shows the puzzle that corresponds to the First Trial in Smullyan's book, and a response from ChatGPT. The correct answer is that Room II contains a lady. ChatGPT concluded that “if we assume that the true sign leads to the room with the lady, then the lady is in Room II,” a useless conditional answer. For one, the condition is actually false. For another, such a conditional answer is like kicking the can back to the user.

The problem is not just with this wrong type of answer. One can see that ChatGPT made many mistakes in its reasoning. For example, it somehow concluded that if the sign on Room I is true, then the sign on Room II would be false, when the opposite is true: if the sign on Room I is true, then the sign on Room II would be true as well.

ChatGPT's conclusion and the reasoning for this puzzle is puzzling (no puns intended). One possibility is data contamination. Given that the puzzles and their answers have been widely available on internet, they could have been in ChatGPT's training set already. It is a common practice in work on few-shot learning with LLMs to do a test set contamination analysis (e.g. (Brown et al. 2020)). Since we have no access to ChatGPT's training data, there is no way we can do this. But it does not really matter here as ChatGPT per-

<sup>3</sup>[https://en.wikipedia.org/wiki/The\\_Lady,\\_or\\_the\\_Tiger](https://en.wikipedia.org/wiki/The_Lady,_or_the_Tiger), accessed on 5 March, 2023.

18 There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I: in this room there is a lady, and in the other room there is a tiger.

The sign on the door of Room II: in one of these rooms there is a lady, and in one of these rooms there is a tiger.

One of the signs is true but the other one is false.

Which room contains a lady?

Assuming that the true sign leads to the room with the lady, we can reason as follows:

If the sign on Room I is true, then the lady must be in Room I and the tiger must be in Room II. In this case, the sign on Room II would be false, since it claims that there is a lady in one of the rooms, which is true, and a tiger in one of the rooms, which is false.

On the other hand, if the sign on Room II is true, then there are two possibilities: either the lady is in Room I and the tiger is in Room II, or vice versa. If the lady is in Room I, then the sign on Room I would be false, since it claims that there is a tiger in the other room, which is not true. Therefore, in this case, the sign on Room II must be true, and the lady must be in Room II.

If the tiger is in Room I, then the sign on Room I would be true, and the sign on Room II would be false, since it claims that there is a lady in one of the rooms, which is true, and a tiger in one of the rooms, which is not true. Therefore, in this case, the lady must be in Room I.

In conclusion, if we assume that the true sign leads to the room with the lady, then the lady is in Room II.

Figure 3: The first trial

formed badly on the 12 puzzles that correspond to the 12 trials given in Smullyan’s book. Still, we decided to use a completely different story line to create a new puzzle with the same logical structure. The following screenshot shows our session with ChatGPT on the new puzzle.

18 There are two chairs, one green and one red. They belong to either Lisa or Kate. Someone put a post in front of each of the chairs.

The post in front of the green chair says: This is Lisa's chair. The other one is Kate's. The post in front of the red chair says: One of the chairs belongs to Lisa. The other belongs to Kate.

What are said in the posts may or may not be true. We know that one of them is true, and the other is false.

Does Lisa own any of the chairs? If so, which ones?

If we assume that one post is true and the other post is false, we can consider the following possibilities:

- The post in front of the green chair is true and the post in front of the red chair is false. This would mean that Lisa's chair is the green chair, and Kate's chair is the red chair. Therefore, Lisa owns the green chair.
- The post in front of the red chair is true and the post in front of the green chair is false. This would mean that Lisa's chair is the red chair, and Kate's chair is the green chair. Therefore, Lisa owns the red chair.

In either case, Lisa owns one of the chairs. However, we cannot determine which chair Lisa owns with certainty since the information given is ambiguous.

As one can see, ChatGPT’s reasoning is sound but it just could not come to the conclusion that the sign in front of the green chair is false, thus Lisa owns the red chair. This suggests that the “Ladies or Tigers?” one may indeed have been contaminated - it wanted to conclude a lady is in Room

II but could not.

Again we can see that ChatGPT could not perform the required reasoning. We now consider using it for knowledge acquisition. The following screenshot shows how we asked ChatGPT to translate the text of the puzzle to logic using the provided symbols.

18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:  
 L1 - a lady is in Room I  
 L2 - a lady is in Room II  
 T1 - a tiger is in Room I  
 T2 - a tiger is in Room II  
 S1 - the sign on the door of Room I  
 S2 - the sign on the door of Room II

Text:  
 There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both.  
 There is a sign on the door of each room, and they are:  
 The sign on the door of Room I: in this room there is a lady, and in the other room there is a tiger.  
 The sign on the door of Room II: in one of these rooms there is a lady, and in one of these rooms there is a tiger.

One of the signs is true but the other one is false.

Let's represent the facts in propositional logic:

$L1 \vee T1$  - Either a lady or a tiger is in Room I  
 $L2 \vee T2$  - Either a lady or a tiger is in Room II

$\neg(L1 \wedge T1)$  - There cannot be both a lady and a tiger in Room I  
 $\neg(L2 \wedge T2)$  - There cannot be both a lady and a tiger in Room II

$S1 \equiv L1 \wedge T2$  - The sign on the door of Room I says that there is a lady in that room and a tiger in the other room  
 $S2 \equiv (L1 \wedge T2) \vee (L2 \wedge T1)$  - The sign on the door of Room II says that there is a lady and a tiger in different rooms

Let's assume that S1 is true and S2 is false. Then, we can represent this as:

$S1 \wedge \neg S2$

Therefore, in propositional logic, the given facts can be expressed as:

$L1 \vee T1$   
 $L2 \vee T2$   
 $\neg(L1 \wedge T1)$   
 $\neg(L2 \wedge T2)$   
 $S1 \equiv L1 \wedge T2$   
 $S2 \equiv (L1 \wedge T2) \vee (L2 \wedge T1)$   
 $S1 \wedge \neg S2$

As one can see, the result is correct except that it refused to encode the statement “one of the signs is true but the other is false.” Instead, it took the liberty to assume that the sign on room I is true and the one on room II is false, a strange behavior that is consistent with the observations that others have made about reasoning in language models (e.g. (Saparov and He 2023)).

This motivates us to ask ChatGPT to encode the statements one at a time. For this example, the response that we got from ChatGPT was correct (screenshot given in Appendix as supplementary materials)

The following table summarizes our experiments with ChatGPT using the 12 puzzles that correspond to the 12 trials in Chapter 2 “Ladies or Tigers?” in (Smullyan 1982). The screenshots of all the interactions with ChatGPT are in-

cluded in Appendix.

Trials	QA	QR	T2L	S2L
1	no	no	6/7	4/4
2	no	no	3/5	3/4
3	incomplete	no	6/6	4/4
4	yes	no	4/5	5/5
5	yes	no	6/6	3/5
6	no	no	2/6	3/5
7	no	no	4/6	3/5
8	no	no	3/6	3/4
9	no	no	6/6	3/3
10	no	no	7/11	4/5
11	no	no	3/9	6/7
12	no	no	6/12	12/13

Legends: QA - whether ChatGPT’s final answer to the puzzle is correct; QR - whether the reasoning is correct; T2L - the ratio of correct sentences when the puzzle is given as a text for it to translate; S2L - the ratio of correct sentences when the text is broken into statements and asked one at a time.

#### 4 Translating statements to logic

To further evaluate ChatGPT’s ability in encoding natural language statements to propositional logic, we created 15 example sentences about three balls and their colors. They were given as a single query by asking ChatGPT to encode each of them in propositional logic using the provided symbols. The results given below were the first response from ChatGPT and we did not repeat the query. The screenshot of our query to ChatGPT and its response is included in Appendix

Task: Given the following propositional symbols:

- X1 - A is a red ball
- X2 - A is a green ball
- X3 - A is a white ball
- Y1 - B is a red ball
- Y2 - B is a green ball
- Y3 - B is a white ball
- Z1 - C is a red ball
- Z2 - C is a green ball
- Z3 - C is a white ball

express each of the following statements in propositional logic:

1. There are three balls: A, B, and C. Exactly one of them is red.  
ChatGPT (wrong):  $(X1 \text{ XOR } X2) \text{ XOR } X3 \text{ AND NOT } (X1 \text{ AND } X2)$
2. There are three balls: A, B, and C. At least one of them is red.  
ChatGPT (wrong):  $X1 \text{ OR } X2 \text{ OR } X3$
3. There are two balls: A and C. One of them is red, the other is white.  
ChatGPT (correct):  $(X1 \text{ AND } Z3) \text{ OR } (X3 \text{ AND } Z1)$
4. There are two balls: A and C. A is green. The other one is white.  
ChatGPT (correct):  $X2 \text{ AND } Z3$
5. If A is a red ball, so is B and C.  
ChatGPT (correct):  $X1 \rightarrow Y1 \text{ AND } Z1$

6. If A is a red ball and B is a green ball, then C is a white ball.  
ChatGPT (correct):  $X1 \text{ AND } Y2 \rightarrow Z3$
7. If A is not a green ball, then it is a red ball.  
ChatGPT (correct):  $\text{NOT } X2 \rightarrow X1$
8. A is a red ball if and only if B is a green ball.  
ChatGPT (correct):  $X1 \leftrightarrow Y2$
9. There are three balls: A, B, and C. It cannot be the case that all these three balls are red.  
ChatGPT (correct):  $\text{NOT } (X1 \text{ AND } Y1 \text{ AND } Z1)$
10. The ball A is both red and green.  
ChatGPT (correct):  $X1 \text{ AND } X2$
11. The ball B is neither red nor green.  
ChatGPT (correct):  $\text{NOT } (Y1 \text{ OR } Y2)$
12. Among the possible colors red, green and white, the ball C can have at most two colors.  
ChatGPT (wrong):  $(Z1 \text{ AND } Z2) \text{ OR } (Z1 \text{ AND } Z3) \text{ OR } (Z2 \text{ AND } Z3)$
13. There are three balls, A, B, and C. Any of them can be white but none of them is green.  
ChatGPT (wrong?):  $(X3 \text{ OR } Y3 \text{ OR } Z3) \text{ AND NOT } (X2 \text{ OR } Y2 \text{ OR } Z2)$
14. The balls A and B are of different colors.  
ChatGPT (wrong):  $(X1 \text{ AND } Y2) \text{ OR } (X2 \text{ AND } Y1)$
15. If A is a red ball, then B and C are balls of the same color.  
ChatGPT (wrong):  $X1 \rightarrow Y2 \text{ AND } Z2$

One can see that ChatGPT did poorly on statements with the terms “exactly one”, “at most two”, and “at least one”. It did well on the others. Its answers to statements (13) - (15) are interesting. We put a question mark “wrong?” on (13): does “any of them can be white” implies “one of them is white?” We think not, but ChatGPT apparently assumed that. ChatGPT’s answers to (14) and (15) are interesting because they revealed that it took the liberty to assume that there are only two colors (for 14) or the same color means color “green” (for 15), the same type of presumption that we saw earlier with the “Ladies or Tigers?” puzzle.

#### 5 Concluding remarks

Again the main point of this paper is that one should not use a LLM like ChatGPT for tasks that require non-trivial reasoning. Instead, one should consider using it as a tool for knowledge acquisition from natural language texts. Thus the research direction that we are advocating is two fold - to use ChatGPT and possibly other LLMs as a front end for complex reasoning tasks and to train better LLMs for this purpose.

What we are advocating here is in line with neuro-symbolic AI, reliable and explainable AI, and in general the need to have high-level cognitive reasoning in any general AI systems. Our specific call for training better language models for capturing facts in a text is related to work on pronoun resolution, relation and entity extraction, abstract meaning representation, and others. The connections are clear but it is beyond the scope of this short note to discuss them in detail here.

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## An Update

While our experiments were done on ChatGPT, the message is really on pure data driven machine learning language models. On the date of the submission deadline (March 15 HKT), OpenAI released the next iteration of their language model, GPT4, and claimed that it is better for solving more complex problems. We did a quick test, repeating some of our experiments using GPT4. Indeed, it is better than ChatGPT but the conclusion is still the same: language models should be used for acquiring facts from texts, not for solving problems that require some in depth precise reasoning.

For the experiments described in the main text of the paper, GPT4 solved the “who’s in the car” puzzle correctly, both in terms of the final answer and the reasoning behind it. For the trial 1 of the “Ladies or Tigers?” puzzle, it gave a correct final answer (a lady in Room II) but an incorrect reasoning: it considered only two out of four possible scenarios of what the two rooms can contain. It also performed better in translating statements to propositional logic. The texts in these two puzzles were translated correctly to logic, and for the 15 statements in Section 4, the first two (involving exactly one and at most one phrases) and the last one are translated correctly now, but 12 (at most two) is still wrong, 13 is still problematic, and 14 is also problematic in assuming that a ball must have one of the given colors. Screenshots are given in Appendix as supplementary materials.

Using GPT4, the summary table for the “Ladies or Tigers?” puzzles are now as follows (we did not have time to do a statement by statement translation, thus no data for the last column):

Trials	QA	QR	T2L	S2L
1	yes	no	5/5	-
2	no	no	4/5	-
3	incomplete	no	4/4	-
4	yes	yes	5/5	-
5	yes	no	5/5	-
6	yes	yes	8/8	-
7	yes	yes	6/6	-
8	yes	no	4/6	-
9	yes	no	6/7	-
10	no	no	4/6	-
11	no	no	10/10	-
12	no	no	27/29	-

# A GPT4

OpenAI released GPT4 on March 14, 2023, and we tried it a few hours later (March 15 HKT). The following are screenshots of the sessions for the puzzles discussed in the main text of the paper.

Model: GPT-4

- 18 Three friends A1, A2, and A3 share a car. Here is a list of things that we know about them:
1. One of them drove the car yesterday.
  2. A3 was not the driver.
  3. A1 was in the car only if A2 was.

Also we know that the driver must be in the car. Was A1 in the car? How about A2?

Let's examine the given information:

1. One of them drove the car yesterday.
2. A3 was not the driver.
3. A1 was in the car only if A2 was.

Since A3 was not the driver, we are left with two possibilities for the driver: A1 or A2.

If A1 was the driver, then A1 was in the car. According to statement 3, if A1 was in the car, then A2 must also have been in the car. In this case, both A1 and A2 were in the car.

If A2 was the driver, then A2 was in the car. However, we don't have any information that states A1 must be in the car when A2 is. In this case, A2 was in the car, but A1 could have been either in or not in the car.

In conclusion, A2 was definitely in the car, but we cannot be certain whether A1 was in the car or not.

Model: GPT-4

- 18 Given the following symbols in propositional logic:

Symbols:

- P1 - A1 was in the car;
- P2 - A2 was in the car;
- P3 - A3 was in the car;
- D1 - A1 was the driver;
- D2 - A2 was the driver;
- D3 - A3 was the driver.

Express the following statements in propositional logic:

Three friends A1, A2, and A3 share a car. Here is a list of things that we know about them:

1. One of them drove the car yesterday.
2. A3 was not the driver.
3. A1 was in the car only if A2 was.

Also we know that the driver must be in the car.

To express these statements in propositional logic, we can use the symbols given and logical connectives (such as  $\wedge$  for AND,  $\vee$  for OR,  $\rightarrow$  for IMPLIES, and  $\neg$  for NOT). Here's how to represent the statements:

1. One of them drove the car yesterday.  
( $D1 \vee D2 \vee D3$ )
2. A3 was not the driver.  
( $\neg D3$ )
3. A1 was in the car only if A2 was.  
( $P1 \rightarrow P2$ )

We also know that the driver must be in the car. We can represent this information as:  
( $D1 \rightarrow P1$ )  $\wedge$  ( $D2 \rightarrow P2$ )  $\wedge$  ( $D3 \rightarrow P3$ )

To combine all of these statements into one expression, we can use the  $\wedge$  (AND) connective:

( $D1 \vee D2 \vee D3$ )  $\wedge$  ( $\neg D3$ )  $\wedge$  ( $P1 \rightarrow P2$ )  $\wedge$  (( $D1 \rightarrow P1$ )  $\wedge$  ( $D2 \rightarrow P2$ )  $\wedge$  ( $D3 \rightarrow P3$ ))

Model: GPT-4

- 18 There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I: in this room there is a lady, and in the other room there is a tiger.

The sign on the door of Room II: in one of these rooms there is a lady, and in one of these rooms there is a tiger.

One of the signs is true but the other one is false.

Which room contains a lady?

Let's consider the possible scenarios and analyze the truthfulness of each sign.

Scenario 1:

Room I: Lady

Room II: Tiger

If this scenario is true, the sign on the door of Room I would be true and the sign on the door of Room II would also be true. However, we know that only one sign can be true, so this scenario is not possible.

Scenario 2:

Room I: Tiger

Room II: Lady

If this scenario is true, the sign on the door of Room I would be false and the sign on the door of Room II would be true. This satisfies the condition that one sign is true and the other is false.

Based on the given information, the only possible scenario is that Room I contains a tiger and Room II contains a lady.

Model: GPT-4

- 18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:

- L1 - a lady is in Room I
- L2 - a lady is in Room II
- T1 - a tiger is in Room I
- T2 - a tiger is in Room II
- S1 - the sign on the door of Room I
- S2 - the sign on the door of Room II

Text:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both.

There is a sign on the door of each room, and they are:

The sign on the door of Room I: in this room there is a lady, and in the other room there is a tiger.

The sign on the door of Room II: in one of these rooms there is a lady, and in one of these rooms there is a tiger.

One of the signs is true but the other one is false.

Let's represent the facts in propositional logic:

1. There is either a lady or a tiger in each room, but not both:

( $L1 \wedge \neg T1$ )  $\vee$  ( $\neg L1 \wedge T1$ ) [for Room I]

( $L2 \wedge \neg T2$ )  $\vee$  ( $\neg L2 \wedge T2$ ) [for Room II]

2. The sign on the door of Room I (S1):

$S1 \leftrightarrow (L1 \wedge T2)$

3. The sign on the door of Room II (S2):

$S2 \leftrightarrow (L1 \vee L2) \wedge (T1 \vee T2)$

4. One of the signs is true but the other one is false:

( $S1 \wedge \neg S2$ )  $\vee$  ( $\neg S1 \wedge S2$ )

18

Let:

- X1 be the proposition "A is a red ball"
- X2 be the proposition "A is a green ball"
- X3 be the proposition "A is a white ball"
- Y1 be the proposition "B is a red ball"
- Y2 be the proposition "B is a green ball"
- Y3 be the proposition "B is a white ball"
- Z1 be the proposition "C is a red ball"
- Z2 be the proposition "C is a green ball"
- Z3 be the proposition "C is a white ball"

Using these symbols, express each of the following statements in propositional logic:

- There are three balls: A, B, and C. Exactly one of them is red.
- There are three balls: A, B, and C. At least one of them is red.
- There are two balls: A and C. One of them is red, the other is white.
- There are two balls: A and C. A is green. The other one is white.
- If A is a red ball, so is B and C.
- If A is a red ball and B is a green ball, then C is a white ball.
- If A is not a green ball, then it is a red ball.
- A is a red ball if and only if B is a green ball.
- There are three balls: A, B, and C. It cannot be the case that all these three balls are red.
- The ball A is both red and green.
- The ball B is neither red nor green.
- Among the possible colors red, green and white, the ball C can have at most two colors.
- There are three balls, A, B, and C. Any of them can be white but none of them is green.
- The balls A and B are of different colors.
- If A is a red ball, then B and C are balls of the same color.



1. There are three balls: A, B, and C. Exactly one of them is red.  
 $(X1 \wedge \neg Y1 \wedge \neg Z1) \wedge (\neg X1 \wedge Y1 \wedge \neg Z1) \wedge (\neg X1 \wedge \neg Y1 \wedge Z1)$
2. There are three balls: A, B, and C. At least one of them is red.  
 $X1 \vee Y1 \vee Z1$
3. There are two balls: A and C. One of them is red, the other is white.  
 $(X1 \wedge Z3) \vee (X3 \wedge Z1)$
4. There are two balls: A and C. A is green. The other one is white.  
 $X2 \wedge Z3$
5. If A is a red ball, so is B and C.  
 $X1 \rightarrow (Y1 \wedge Z1)$
6. If A is a red ball and B is a green ball, then C is a white ball.  
 $(X1 \wedge Y2) \rightarrow Z3$
7. If A is not a green ball, then it is a red ball.  
 $\neg X2 \rightarrow X1$
8. A is a red ball if and only if B is a green ball.  
 $X1 \leftrightarrow Y2$
9. There are three balls: A, B, and C. It cannot be the case that all these three balls are red.  
 $\neg(X1 \wedge Y1 \wedge Z1)$
10. The ball A is both red and green.  
 $X1 \wedge X2$
11. The ball B is neither red nor green.  
 $\neg Y1 \wedge \neg Y2$
12. Among the possible colors red, green, and white, the ball C can have at most two colors.  
 $(\neg Z1 \vee \neg Z2) \wedge (\neg Z1 \vee \neg Z3) \wedge (\neg Z2 \vee \neg Z3)$
13. There are three balls, A, B, and C. Any of them can be white but none of them is green.  
 $\neg X2 \wedge \neg Y2 \wedge \neg Z2 \wedge (X3 \vee Y3 \vee Z3)$
14. The balls A and B are of different colors.  
 $(X1 \wedge \neg Y1) \vee (X2 \wedge \neg Y2) \vee (X3 \wedge \neg Y3) \vee (\neg X1 \wedge Y1) \vee (\neg X2 \wedge Y2) \vee (\neg X3 \wedge Y3)$
15. If A is a red ball, then B and C are balls of the same color.  
 $X1 \rightarrow ((Y1 \wedge Z1) \vee (Y2 \wedge Z2) \vee (Y3 \wedge Z3))$

## B Ladies or Tigers?

This appendix contains the screenshots of our sessions with ChatGPT (February 28, 2023) on the 12 “Ladies or Tigers?” puzzles.

### Trial I

Direct query to ChatGPT:

18 There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I: in this room there is a lady, and in the other room there is a tiger.

The sign on the door of Room II: in one of these rooms there is a lady, and in one of these rooms there is a tiger.

One of the signs is true but the other one is false.

Which room contains a lady?

Assuming that the true sign leads to the room with the lady, we can reason as follows:

If the sign on Room I is true, then the lady must be in Room I and the tiger must be in Room II. In this case, the sign on Room II would be false, since it claims that there is a lady in one of the rooms, which is true, and a tiger in one of the rooms, which is false.

On the other hand, if the sign on Room II is true, then there are two possibilities: either the lady is in Room I and the tiger is in Room II, or vice versa. If the lady is in Room I, then the sign on Room I would be false, since it claims that there is a tiger in the other room, which is not true. Therefore, in this case, the sign on Room II must be true, and the lady must be in Room II.

If the tiger is in Room I, then the sign on Room I would be true, and the sign on Room II would be false, since it claims that there is a lady in one of the rooms, which is true, and a tiger in one of the rooms, which is not true. Therefore, in this case, the lady must be in Room I.

In conclusion, if we assume that the true sign leads to the room with the lady, then the lady is in Room II.

### Asking it to translate the text to logic:

18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I

L2 - a lady is in Room II

T1 - a tiger is in Room I

T2 - a tiger is in Room II

S1 - the sign on the door of Room I

S2 - the sign on the door of Room II

Text:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both.

There is a sign on the door of each room, and they are:

The sign on the door of Room I: in this room there is a lady, and in the other room there is a tiger.

The sign on the door of Room II: in one of these rooms there is a lady, and in one of these rooms there is a tiger.

One of the signs is true but the other one is false.

Let's represent the facts in propositional logic:

L1  $\vee$  T1 - Either a lady or a tiger is in Room I

L2  $\vee$  T2 - Either a lady or a tiger is in Room II

$\neg(L1 \wedge T1)$  - There cannot be both a lady and a tiger in Room I

$\neg(L2 \wedge T2)$  - There cannot be both a lady and a tiger in Room II

S1  $\equiv L1 \wedge T2$  - The sign on the door of Room I says that there is a lady in that room and a tiger in the other room

S2  $\equiv (L1 \wedge T2) \vee (L2 \wedge T1)$  - The sign on the door of Room II says that there is a lady and a tiger in different rooms

Let's assume that S1 is true and S2 is false. Then, we can represent this as:

S1  $\wedge$   $\neg$ S2

Therefore, in propositional logic, the given facts can be expressed as:

L1  $\vee$  T1

L2  $\vee$  T2

$\neg(L1 \wedge T1)$

$\neg(L2 \wedge T2)$

S1  $\equiv L1 \wedge T2$

S2  $\equiv (L1 \wedge T2) \vee (L2 \wedge T1)$

S1  $\wedge$   $\neg$ S2

## Asking it to translate the statements in the text one at a time:

18 Given the following symbols in propositional logic:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Express the following statements in propositional logic:  
There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both.

Let's represent the statement "a lady is in Room I" with the symbol L1 and "a tiger is in Room I" with the symbol T1. Similarly, let's represent the statement "a lady is in Room II" with the symbol L2 and "a tiger is in Room II" with the symbol T2.

Now we can express the given statement in propositional logic as follows:

$(L1 \wedge \neg T1) \vee (\neg L1 \wedge T1) \wedge (L2 \wedge \neg T2) \vee (\neg L2 \wedge T2)$

This can be read as "either a lady is in Room I and a tiger is not, or a tiger is in Room I and a lady is not, and either a lady is in Room II and a tiger is not, or a tiger is in Room II and a lady is not."

The use of the  $\wedge$  (and) and  $\vee$  (or) connectives in the expression allows us to combine the different propositions in a logical manner.

18 One of the signs is true but the other one is false.

Let's represent the statement "the sign on the door of Room I is true" with the symbol S1, and "the sign on the door of Room II is true" with the symbol S2.

Now we can express the given statement in propositional logic as follows:

$(S1 \wedge \neg S2) \vee (\neg S1 \wedge S2)$

This can be read as "either the sign on the door of Room I is true and the sign on the door of Room II is false, or the sign on the door of Room I is false and the sign on the door of Room II is true."

The use of the  $\wedge$  (and) and  $\vee$  (or) connectives in the expression allows us to combine the different propositions in a logical manner.

18 The sign on the door of Room I is: in this room there is a lady, and in the other room there is a tiger.

Let's represent the statement "in this room there is a lady" with the symbol L1, and "in the other room there is a tiger" with the symbol T2.

Now we can express the given statement in propositional logic as follows:

$S1 \leftrightarrow (L1 \wedge T2)$

This can be read as "the sign on the door of Room I is true if and only if there is a lady in Room I and a tiger in Room II."

The use of the  $\leftrightarrow$  (if and only if) connective in the expression allows us to express the equivalence between the sign on the door of Room I and the statement about the presence of a lady and a tiger in the two rooms.

18 The sign on the door of Room II is: in one of these rooms there is a lady, and in one of these rooms there is a tiger.

Let's represent the statement "in one of these rooms there is a lady" with the symbol  $(L1 \vee L2)$ , and "in one of these rooms there is a tiger" with the symbol  $(T1 \vee T2)$ .

Now we can express the given statement in propositional logic as follows:

$S2 \leftrightarrow ((L1 \vee L2) \wedge (T1 \vee T2))$

This can be read as "the sign on the door of Room II is true if and only if there is a lady in one of the rooms and a tiger in one of the rooms."

The use of the  $\leftrightarrow$  (if and only if) connective in the expression allows us to express the equivalence between the sign on the door of Room II and the statement about the presence of a lady and a tiger in the two rooms.

## Trial II

### Direct query to ChatGPT:

18 There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I: at least one of these rooms contains a lady.

The sign on the door of Room II: a tiger is in the other room.

The signs are either both true or both false.

Which room contains a lady?

Let's consider the two possibilities:

Case 1: Both signs are true.

If both signs are true, then there must be a lady in Room I, because the sign on the door of Room I says "at least one of these rooms contains a lady." This means that Room II must contain a tiger, because the sign on the door of Room II says "a tiger is in the other room." Therefore, Room I contains a lady.

Case 2: Both signs are false.

If both signs are false, then there is no lady in Room I, and there is no tiger in Room II. This means that there must be a tiger in Room I, because if there were a lady in Room I, then the sign on the door of Room I would be true. But this contradicts the fact that there is no tiger in Room II, because the sign on the door of Room II says "a tiger is in the other room." Therefore, both signs cannot be false.

Conclusion: Room I contains a lady, and Room II contains a tiger.

### Asking it to translate the text to logic:

18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Text:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I is: at least one of these rooms contains a lady.

The sign on the door of Room II is: a tiger is in the other room.

The signs are either both true or both false.

Let:

- P1 be the proposition "a lady is in Room I"
- P2 be the proposition "a lady is in Room II"
- Q1 be the proposition "a tiger is in Room I"
- Q2 be the proposition "a tiger is in Room II"
- S1 be the proposition "the sign on the door of Room I is true"
- S2 be the proposition "the sign on the door of Room II is true"

Using these symbols, we can express the facts in propositional logic as follows:

1.  $P1 \text{ XOR } Q1$  (Either a lady or a tiger is in Room I, but not both)
2.  $P2 \text{ XOR } Q2$  (Either a lady or a tiger is in Room II, but not both)
3.  $S1 \leftrightarrow (P1 \text{ OR } P2)$  (The sign on the door of Room I is true if and only if at least one of the rooms contains a lady)
4.  $S2 \leftrightarrow (Q1 \text{ XOR } Q2)$  (The sign on the door of Room II is true if and only if a tiger is in the other room)

The last statement can be expressed more simply as:

5.  $S1 \leftrightarrow \neg S2$  (The signs are either both true or both false)

## Asking it to translate the statements in the text one at a time:

18 Given the following symbols in propositional logic:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Express the following statements in propositional logic:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both.

Let's define the following propositional variables:

- L1: "a lady is in Room I"
- L2: "a lady is in Room II"
- T1: "a tiger is in Room I"
- T2: "a tiger is in Room II"

We can express the fact that each room contains either a lady or a tiger but not both using the exclusive or (XOR) operator:

- (L1 XOR T1): "either a lady or a tiger is in Room I, but not both"
- (L2 XOR T2): "either a lady or a tiger is in Room II, but not both"

To express that there are only two rooms, we can use the AND operator:

- (L1 XOR T1) AND (L2 XOR T2): "Each of the two rooms contains either a lady or a tiger, but not both"

Therefore, the complete propositional statement is:

"Each of the two rooms contains either a lady or a tiger, but not both": (L1 XOR T1) AND (L2 XOR T2)

18 The signs are either both true or both false.

Let's define the following propositional variables:

- S1: "the sign on the door of Room I is true"
- S2: "the sign on the door of Room II is true"

To express that the signs are either both true or both false, we can use the biconditional (if and only if) operator:

- (S1 AND S2) OR (NOT S1 AND NOT S2): "the signs are both true or both false"

Alternatively, we can express the same statement using an implication:

- (S1 IMPLIES S2) AND (S2 IMPLIES S1): "if one sign is true, then the other sign is also true, and if one sign is false, then the other sign is also false"

Therefore, the complete propositional statement is:

"The signs are either both true or both false": (S1 AND S2) OR (NOT S1 AND NOT S2) or (S1 IMPLIES S2) AND (S2 IMPLIES S1)

## Asking it to translate the statements in the text one at a time: (continued)

18 The sign on the door of Room I is: at least one of these rooms contains a lady.

Let's define the following propositional variables:

- L1: "a lady is in Room I"
- L2: "a lady is in Room II"

To express the statement "the sign on the door of Room I is 'at least one of these rooms contains a lady'", we can use the OR operator:

- (L1 OR L2): "at least one of these rooms contains a lady"

Therefore, the complete propositional statement is:

"The sign on the door of Room I is 'at least one of these rooms contains a lady'": (L1 OR L2)

18 The sign on the door of Room II is: a tiger is in the other room.

Let's define the following propositional variables:

- L1: "a lady is in Room I"
- L2: "a lady is in Room II"
- T1: "a tiger is in Room I"
- T2: "a tiger is in Room II"

To express the statement "the sign on the door of Room II is 'a tiger is in the other room'", we can use the XOR operator:

- (T1 XOR L2): "a tiger is in the other room"

Therefore, the complete propositional statement is:

"The sign on the door of Room II is 'a tiger is in the other room'": (T1 XOR L2)

## Trial III

### Direct query to ChatGPT:

18 There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I: either a tiger is in this room or a lady is in the other room.

The sign on the door of Room II: a lady is in the other room.

The signs are either both true or both false.

Which room contains a lady?

If the sign on Room I is true, then either a tiger is in Room I or a lady is in Room II. But since the signs are either both true or both false, the sign on Room II must also be true. Therefore, a lady must be in Room II.

If the sign on Room I is false, then a lady must be in Room I, which means the sign on Room II is false. However, this contradicts the given condition that the signs are either both true or both false. Therefore, we can conclude that the sign on Room I is true, and a lady is in Room II.

## Asking it to translate the text to logic:

18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Text:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I is: either a tiger is in this room or a lady is in the other room.

The sign on the door of Room II is: a lady is in the other room.

The signs are either both true or both false.

Let's represent the given facts in propositional logic using the provided symbols:

L1 V T1 : Either a lady is in Room I or a tiger is in Room I  
L2 V T2 : Either a lady is in Room II or a tiger is in Room II

$\sim(L1 \wedge T1)$  : It cannot be the case that there is both a lady and a tiger in Room I simultaneously

$\sim(L2 \wedge T2)$  : It cannot be the case that there is both a lady and a tiger in Room II simultaneously

S1 : The sign on the door of Room I is "either a tiger is in this room or a lady is in the other room."

S2 : The sign on the door of Room II is "a lady is in the other room."

Now, we need to use the information given in the signs to determine whether they are both true or both false.

Let's consider the sign on Room I. We know that it must be true if either a tiger is in Room I or a lady is in Room II. We can represent this using the following propositional logic statement:

$(S1 \leftrightarrow (T1 \vee L2))$

Similarly, the sign on Room II must be true if a lady is in Room I. We can represent this using the following statement:

$(S2 \leftrightarrow L1)$

Now, let's evaluate the truth values of the signs under the assumption that they are either both true or both false.

Case 1: Both signs are true  
If both signs are true, then we have:

$T1 \vee L2 = \text{true}$  (from S1)  
 $L1 = \text{true}$  (from S2)

From the first equation, we know that either a tiger is in Room I or a lady is in Room II. However, we also know that there cannot be both a lady and a tiger in Room I, so it must be the case that a lady is in Room II. Therefore, we have:

$L2 = \text{true}$   
 $T1 = \text{false}$

From the second equation, we know that a lady is in Room I, which means that:

$L1 = \text{true}$   
 $T2 = \text{false}$

This satisfies all the given conditions, and we have a consistent solution.

Case 2: Both signs are false  
If both signs are false, then we have:

$T1 \vee L2 = \text{false}$  (from S1)  
 $L1 = \text{false}$  (from S2)

From the first equation, we know that neither a tiger is in Room I nor a lady is in Room II. This means that both a tiger and a lady are in the same room, which contradicts the given condition that each room contains either a lady or a tiger, but not both. Therefore, this case is impossible, and we do not have a consistent solution.

In conclusion, we have found that the signs must be both true for there to be a consistent solution.

## Asking it to translate the statements in the text one at a time:

18 Given the following symbols in propositional logic:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Express the following statements in propositional logic:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both.

We can express the given statements in propositional logic as:

1.  $L1 \text{ XOR } T1$  - There is either a lady or a tiger in Room I, but not both.
2.  $L2 \text{ XOR } T2$  - There is either a lady or a tiger in Room II, but not both.
3.  $(L1 \text{ OR } T1) \text{ AND } (L2 \text{ OR } T2)$  - Each room contains either a lady or a tiger.
4.  $\text{NOT}(L1 \text{ AND } T1)$  - A lady and a tiger cannot be in the same room.
5.  $\text{NOT}(L2 \text{ AND } T2)$  - A lady and a tiger cannot be in the same room.

Note: XOR (exclusive or) is a logical operator that returns true if and only if one of the operands is true and the other is false. The OR operator returns true if at least one of the operands is true. The AND operator returns true if both operands are true. The NOT operator negates the value of a proposition.

18 The signs are either both true or both false.

We can express the given statement in propositional logic as:

$(S1 \text{ AND } S2) \text{ OR } (\text{NOT } S1 \text{ AND } \text{NOT } S2)$

This statement means that either both signs are true (indicating that the same type of animal, either a lady or a tiger, is in both rooms) or both signs are false (indicating that different types of animals, a lady in one room and a tiger in the other, are in the two rooms).

Note: AND and OR are logical operators used in propositional logic. AND returns true if both operands are true, and OR returns true if at least one of the operands is true. NOT negates the value of a proposition.

18 The sign on the door of Room I is: either a tiger is in this room or a lady is in the other room.

We can express the given statement in propositional logic as:

$S1 \leftrightarrow (T1 \text{ OR } L2)$

This statement means that the sign on the door of Room I is true if and only if either a tiger is in Room I (and therefore a lady must be in Room II) or a lady is in Room II (and therefore a tiger must be in Room I). The " $\leftrightarrow$ " symbol denotes a logical biconditional, which means that both propositions have the same truth value.

Note: OR is a logical operator used in propositional logic. It returns true if at least one of the operands is true.

18 The sign on the door of Room II is: a lady is in the other room.

We can express the given statement in propositional logic as:

$S2 \leftrightarrow L1$

This statement means that the sign on the door of Room II is true if and only if a lady is in Room I (and therefore a tiger must be in Room II). The " $\leftrightarrow$ " symbol denotes a logical biconditional, which means that both propositions have the same truth value.

Note: " $\leftrightarrow$ " is a logical operator used in propositional logic. It returns true if and only if both propositions have the same truth value.

## Trial IV

### Direct query to ChatGPT:

18 There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I: both rooms contain ladies.  
The sign on the door of Room II: both rooms contain ladies.

For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false. For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.

Which room contains a lady?

Assume that Room I contains a lady. Then the sign on its door is true, which means Room II cannot contain a lady since the sign on its door says both rooms contain ladies. But this leads to a contradiction, as it would mean both rooms contain a lady, which is impossible according to the problem statement. Hence, we must conclude that Room I contains a tiger.

Now, consider Room II. If a lady is in it, then the sign on its door is false, which means Room I cannot contain a lady. But we know that Room I contains a tiger, so Room II must contain a lady. Therefore, the answer is:

Room I contains a tiger, and Room II contains a lady.

### Asking it to translate the text to logic:

18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Text:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I is: both rooms contain ladies.  
The sign on the door of Room II is: both rooms contain ladies.

For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false. For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.

Let L1 be the proposition "a lady is in Room I".  
Let L2 be the proposition "a lady is in Room II".  
Let T1 be the proposition "a tiger is in Room I".  
Let T2 be the proposition "a tiger is in Room II".  
Let S1 be the proposition "the sign on the door of Room I is true".  
Let S2 be the proposition "the sign on the door of Room II is true".

Using these symbols, we can express the facts in the following propositional logic statements:

- $(L1 \oplus T1) \wedge (L2 \oplus T2)$   
(Either a lady or a tiger is in each room, but not both)
- $S1 \leftrightarrow (L1 \wedge L2)$   
(The sign on Room I's door is true if and only if both rooms contain ladies)
- $S2 \leftrightarrow (T1 \wedge T2)$   
(The sign on Room II's door is true if and only if both rooms contain tigers)
- $(L1 \rightarrow S1) \wedge (T1 \rightarrow \neg S1)$   
(If a lady is in Room I, then the sign on its door is true, but if a tiger is in it, the sign is false)
- $(L2 \rightarrow \neg S2) \wedge (T2 \rightarrow S2)$   
(If a lady is in Room II, then the sign on its door is false, but if a tiger is in it, the sign is true)

### Asking it to translate the statements in the text one at a time:

18 Given the following symbols in propositional logic:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Express the following statements in propositional logic:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both.

We can express the given statements in propositional logic using the following symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II

To represent the fact that each room contains either a lady or a tiger, we can use the exclusive disjunction (xor) operator. The xor operator evaluates to true when one of its operands is true and the other is false, and false otherwise. Using this, we can represent the given condition as:

$(L1 \text{ xor } T1) \text{ and } (L2 \text{ xor } T2)$

This expression evaluates to true when exactly one of L1 and T1 is true, and exactly one of L2 and T2 is true.

Therefore, the given statements in propositional logic are:

"There are two rooms, Room I and Room II" : S1 and S2

"Each of them contains either a lady or a tiger, but not both":  $(L1 \text{ xor } T1) \text{ and } (L2 \text{ xor } T2)$

18 For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false.

We can represent the given statement in propositional logic using the following symbols:

L1 - a lady is in Room I  
T1 - a tiger is in Room I  
S1 - the sign on the door of Room I

To represent the fact that if a lady is in Room I, then the sign on its door is true, we can use the conditional operator. The conditional operator evaluates to false only when its antecedent is true and the consequent is false. Using this, we can represent the first part of the given condition as:

$L1 \rightarrow S1$

This expression evaluates to true when either L1 is false or S1 is true, or both are true.

To represent the fact that if a tiger is in Room I, then the sign on its door is false, we can use negation. We can write this as:

$T1 \rightarrow \neg S1$

This expression evaluates to true when either T1 is false or  $\neg S1$  (not S1) is true, or both are true.

Therefore, the given statement in propositional logic is:

"For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false":  $(L1 \rightarrow S1) \text{ and } (T1 \rightarrow \neg S1)$

18

For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.



We can represent the given statement in propositional logic using the following symbols:

L2 - a lady is in Room II  
T2 - a tiger is in Room II  
S2 - the sign on the door of Room II

To represent the fact that if a lady is in Room II, then the sign on its door is false, we can use negation. We can write this as:

$L2 \rightarrow \neg S2$

This expression evaluates to true when either L2 is false or  $\neg S2$  (not S2) is true, or both are true.

To represent the fact that if a tiger is in Room II, then the sign on its door is true, we can use the conditional operator. We can write this as:

$T2 \rightarrow S2$

This expression evaluates to true when either T2 is false or S2 is true, or both are true.

Therefore, the given statement in propositional logic is:

"For Room II, a lady in it means the sign on its door is false, and a tiger in it means the sign is true":  $(L2 \rightarrow \neg S2)$  and  $(T2 \rightarrow S2)$

18

The sign on the door of Room I is: both rooms contain ladies.



We can represent the given statement in propositional logic using the following symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
S1 - the sign on the door of Room I

To represent the fact that the sign on the door of Room I is "both rooms contain ladies", we can use conjunction (and) operator. We can write this as:

$S1 = (L1 \wedge L2)$

This expression evaluates to true only when both L1 and L2 are true, and false otherwise.

Therefore, the given statement in propositional logic is:

"The sign on the door of Room I is: both rooms contain ladies":  $S1 = (L1 \wedge L2)$

18

The sign on the door of Room II is: both rooms contain ladies.



We can represent the given statement in propositional logic using the following symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
S2 - the sign on the door of Room II

To represent the fact that the sign on the door of Room II is "both rooms contain ladies", we can use conjunction (and) operator. We can write this as:

$S2 = (L1 \wedge L2)$

This expression evaluates to true only when both L1 and L2 are true, and false otherwise.

Therefore, the given statement in propositional logic is:

"The sign on the door of Room II is: both rooms contain ladies":  $S2 = (L1 \wedge L2)$

## Trial V

### Direct query to ChatGPT:

18

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I: at least one room contains a lady.

The sign on the door of Room II: the other room contains a lady.

For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false. For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.

Which room contains a lady?

Assuming that the sign on the door of each room is true if and only if the corresponding statement is true, we can reason as follows:

Suppose that Room I contains a tiger. Then the sign on its door is false, which implies that the other room (Room II) contains a tiger. But this contradicts the fact that each room contains either a lady or a tiger. Therefore, Room I must contain a lady.

Since Room I contains a lady, the sign on its door is true. According to the sign on the door of Room II, the other room (Room I) contains a lady. But we already know that Room I contains a lady, so Room II must contain a tiger.

Therefore, Room I contains a lady, and Room II contains a tiger.

### Asking it to translate the text to logic:

18

Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Text:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I: at least one room contains a lady.

The sign on the door of Room II: the other room contains a lady.

For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false. For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.

Let L1 denote "a lady is in Room I", L2 denote "a lady is in Room II", T1 denote "a tiger is in Room I", T2 denote "a tiger is in Room II", S1 denote "the sign on the door of Room I", and S2 denote "the sign on the door of Room II".

Using these symbols, we can express the facts in the text as follows:

- $(L1 \vee T1) \wedge \neg(L1 \wedge T1)$  - This means that either a lady or a tiger is in Room I, but not both.
- $(L2 \vee T2) \wedge \neg(L2 \wedge T2)$  - This means that either a lady or a tiger is in Room II, but not both.
- $S1 \leftrightarrow L1 \vee L2$  - This means that the sign on the door of Room I is true if and only if at least one of the rooms contains a lady.
- $S2 \leftrightarrow L1$  - This means that the sign on the door of Room II is true if and only if the other room (i.e., Room I) contains a lady.
- $(L1 \rightarrow S1) \wedge (T1 \rightarrow \neg S1)$  - This means that if a lady is in Room I, then the sign on its door is true, but if a tiger is in Room I, the sign is false.
- $(L2 \rightarrow \neg S2) \wedge (T2 \rightarrow S2)$  - This means that if a lady is in Room II, then the sign on its door is false, but if a tiger is in Room II, the sign is true.

## Asking it to translate the statements in the text one at a time:

18 Given the following symbols in propositional logic:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Express the following statements in propositional logic:

There are two rooms, Room I and Room II. Each of them contains either a lady, but not both.



One possible way to express this statement in propositional logic is:

$(L1 \wedge \neg T1) \wedge (\neg L2 \wedge T2) \wedge ((L1 \vee T1) \wedge (\neg L1 \vee \neg T1)) \wedge ((L2 \vee T2) \wedge (\neg L2 \vee \neg T2))$

The first two conjuncts state that there is a lady in Room I and a tiger in Room II. The third and fourth conjuncts state that each room contains either a lady or a tiger, but not both. Specifically, the third conjunct says that if there is a lady in Room I, then there cannot be a tiger in Room I, and vice versa. The fourth conjunct says the same thing for Room II. Note that the fourth conjunct is redundant, since it follows from the first two conjuncts and the third conjunct, but including it explicitly can make the logic more transparent.



18 For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false.



One possible way to express this statement in propositional logic is:

$((L1 \rightarrow S1) \wedge (T1 \rightarrow \neg S1))$

This statement can be read as: if a lady is in Room I, then the sign on its door is true (i.e., there is a lady in Room I if and only if the sign on the door of Room I is true); and if a tiger is in Room I, then the sign on its door is false (i.e., there is a tiger in Room I if and only if the sign on the door of Room I is false).

Note that this statement assumes that the sign on the door of Room I can only be either true or false, and that there are no other possibilities. If there were other possibilities, such as the sign being unknown or ambiguous, the statement would need to be modified accordingly.



18 For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.



One possible way to express this statement in propositional logic is:

$((L2 \rightarrow \neg S2) \wedge (T2 \rightarrow S2))$

This statement can be read as: if a lady is in Room II, then the sign on its door is false (i.e., there is a lady in Room II if and only if the sign on the door of Room II is false); and if a tiger is in Room II, then the sign on its door is true (i.e., there is a tiger in Room II if and only if the sign on the door of Room II is true).

Again, this statement assumes that the sign on the door of Room II can only be either true or false, and that there are no other possibilities. If there were other possibilities, such as the sign being unknown or ambiguous, the statement would need to be modified accordingly.

## Asking it to translate the statements in the text one at a time: (continued)



18 The sign on the door of Room I is: at least one room contains a lady.



One possible way to express this statement in propositional logic is:

$S1 \equiv (L1 \vee L2)$

This statement can be read as: the sign on the door of Room I is true if and only if at least one of the rooms contains a lady.

The "=" symbol indicates equivalence, which means that the truth value of the sign on the door of Room I is the same as the truth value of the statement "at least one of the rooms contains a lady."

Note that this statement assumes that the sign on the door of Room I can only be either true or false, and that there are no other possibilities. If there were other possibilities, such as the sign being ambiguous or unknown, the statement would need to be modified accordingly.



18 The sign on the door of Room II is: the other room contains a lady.



One possible way to express this statement in propositional logic is:

$S2 \equiv (L1 \leftrightarrow \neg L2)$

This statement can be read as: the sign on the door of Room II is true if and only if the statement "the lady is in Room I if and only if there is no lady in Room II" is true, which means that if there is a lady in Room I, then there is no lady in Room II, and if there is no lady in Room II, then there is a lady in Room I.

The "=" symbol indicates equivalence, which means that the truth value of the sign on the door of Room II is the same as the truth value of the statement "the lady is in Room I if and only if there is no lady in Room II."

Note that this statement assumes that the sign on the door of Room II can only be either true or false, and that there are no other possibilities. If there were other possibilities, such as the sign being ambiguous or unknown, the statement would need to be modified accordingly.

## Trial VI

### Direct query to ChatGPT:



18 There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I: the two occupants are the same.

The sign on the door of Room II: there is a lady in the other room.

For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false. For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.

Which room contains a lady?



Let's consider the possibilities for each room:

- If Room I contains a lady, then the sign on its door is true. This means that Room I and Room II both contain a lady. However, this would make the sign on the door of Room II false (since there is not a lady in both rooms), which is a contradiction.
- If Room I contains a tiger, then the sign on its door is false. This means that Room I and Room II have different occupants. Since the sign on the door of Room II says there is a lady in the other room, and the occupants of the two rooms are different, we can conclude that Room II contains a tiger.

Therefore, Room II contains a tiger, which means that Room I contains a lady.

## Asking it to translate the text to logic:

18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Text:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:  
The sign on the door of Room I: the two occupants are the same.  
The sign on the door of Room II: there is a lady in the other room.  
For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false. For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.



L1 ⊕ T1 # Room I contains either a lady or a tiger but not both  
L2 ⊕ T2 # Room II contains either a lady or a tiger but not both  
S1 ≡ L1 ∧ T1 # The sign on the door of Room I is true if and only if there is a lady in Room I  
S1 ≡ ¬L1 ∧ ¬T1 # The sign on the door of Room I is false if and only if there is a tiger in Room I  
S2 ≡ L1 ∨ T2 # The sign on the door of Room II is true if and only if there is a lady in Room I or a tiger in Room II  
S2 ≡ ¬L1 ∧ ¬T2 # The sign on the door of Room II is false if and only if there is a tiger in Room I and a lady in Room II

## Asking it to translate the statements in the text one at a time:

18 Given the following symbols in propositional logic:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Express the following statements in propositional logic:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both.



We can represent the given statements in propositional logic as:

- L1 ⊕ T1 : Either a lady or a tiger is in Room I (but not both)
- L2 ⊕ T2 : Either a lady or a tiger is in Room II (but not both)
- (L1 ∨ T1) ∧ (L2 ∨ T2) : Each room contains either a lady or a tiger

The symbol ⊕ represents the exclusive or (XOR) operation, which is true when one of the operands is true and the other is false. The symbol ∧ represents the logical AND operation, which is true only when both operands are true. The symbol ∨ represents the logical OR operation, which is true when at least one of the operands is true.

18

For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false.



We can represent the given statement in propositional logic as:

- (L1 → S1) ∧ (T1 → ¬S1)

The symbol → represents the logical implication operation, which means "if...then". The statement "A → B" is true when A implies B, that is, when either A is false or B is true.

So, the first part of the statement (L1 → S1) can be read as "If a lady is in Room I, then the sign on its door is true." The second part of the statement (T1 → ¬S1) can be read as "If a tiger is in Room I, then the sign on its door is false." The ∧ symbol represents the logical AND operation, so the entire statement is true only when both parts are true.

## Asking it to translate the statements in the text one at a time: (continued)

18

For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.



We can represent the given statement in propositional logic as:

- (L2 → ¬S2) ∧ (T2 → S2)

The first part of the statement (L2 → ¬S2) can be read as "If a lady is in Room II, then the sign on its door is false." The second part of the statement (T2 → S2) can be read as "If a tiger is in Room II, then the sign on its door is true." The ∧ symbol represents the logical AND operation, so the entire statement is true only when both parts are true.

18

The sign on the door of Room I is: the two occupants are the same.



We can represent the given statement in propositional logic as:

- S1 ↔ (L1 ∧ ¬T1) ∨ (¬L1 ∧ T1)

The symbol ↔ represents the logical biconditional operation, which means "if and only if". The statement "A ↔ B" is true when A and B have the same truth value. In this case, the statement means "the sign on the door of Room I is true if and only if the two occupants are the same".

The right-hand side of the biconditional expression is a logical OR operation between two cases, each of which represents one of the possible occupancies of the room. The first case (L1 ∧ ¬T1) represents the situation where a lady is in Room I and a tiger is not, and the second case (¬L1 ∧ T1) represents the situation where a tiger is in Room I and a lady is not. In both cases, the occupants are not different, which is equivalent to saying that they are the same.

18

The sign on the door of Room II: there is a lady in the other room.



We can represent the given statement in propositional logic as:

- S2 ↔ L1 ∨ L2

The symbol ↔ represents the logical biconditional operation, which means "if and only if". The statement "A ↔ B" is true when A and B have the same truth value. In this case, the statement means "the sign on the door of Room II is true if and only if there is a lady in the other room".

The right-hand side of the biconditional expression is a logical OR operation between the statements "there is a lady in Room I" (L1) and "there is a lady in Room II" (L2). If either of these statements is true, then the sign on the door of Room II is also true, which indicates that there is a lady in the other room.

## Trial VII

### Direct query to ChatGPT:

18 There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I: the two occupants are different.

The sign on the door of Room II: there is a lady in the other room.

For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false. For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.

Which room contains a lady?

Let's consider the possibilities for each room based on the given information:

- If there is a lady in Room I, then the sign on its door ("the two occupants are different") is true. This means that there is a tiger in Room II, and the sign on its door ("there is a lady in the other room") is false. So we know that there is a lady in Room II.
- If there is a tiger in Room I, then the sign on its door ("the two occupants are different") is false. This means that there is a lady in Room II, and the sign on its door ("there is a lady in the other room") is true. So we know that there is a tiger in Room II.

Therefore, based on the given information, we can conclude that there is a lady in Room II.

### Asking it to translate the text to logic:

18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Text:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There is a sign on the door of each room, and they are:

The sign on the door of Room I: the two occupants are different.

The sign on the door of Room II: there is a lady in the other room.

For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false. For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.

L1 XOR T1 // Either a lady or a tiger is in Room I, but not both.  
L2 XOR T2 // Either a lady or a tiger is in Room II, but not both.  
S1 =  $\neg(L1 = T1)$  // The sign on the door of Room I indicates that the occupants are different.  
S2 = L1 XOR L2 // The sign on the door of Room II indicates that there is a lady in the other room.

$(L1 \rightarrow S1) \wedge (T1 \rightarrow \neg S1)$  // If a lady is in Room I, then the sign on its door is true. If a tiger is in Room I, then the sign on its door is false.

$(L2 \rightarrow \neg S2) \wedge (T2 \rightarrow S2)$  // If a lady is in Room II, then the sign on its door is false. If a tiger is in Room II, then the sign on its door is true.

### Asking it to translate the statements in the text one at a time:

18 Given the following symbols in propositional logic:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Express the following statements in propositional logic:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both.

One possible way to express this in propositional logic is:

$(L1 \wedge \neg T1) \vee (\neg L1 \wedge T1) \wedge (L2 \wedge \neg T2) \vee (\neg L2 \wedge T2)$

This formula states that in Room I, either there is a lady (L1) and there is no tiger ( $\neg T1$ ), or there is a tiger (T1) and there is no lady ( $\neg L1$ ). Similarly, in Room II, either there is a lady (L2) and there is no tiger ( $\neg T2$ ), or there is a tiger (T2) and there is no lady ( $\neg L2$ ). The  $\wedge$  symbol represents the logical AND operator, and the  $\vee$  symbol represents the logical OR operator.

18 For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false.

One possible way to express this in propositional logic is:

$(L1 \rightarrow S1) \wedge (T1 \rightarrow \neg S1)$

This formula states that if there is a lady in Room I (L1), then the sign on the door of Room I is true (S1), represented by the conditional statement  $L1 \rightarrow S1$ . Similarly, if there is a tiger in Room I (T1), then the sign on the door of Room I is false ( $\neg S1$ ), represented by the conditional statement  $T1 \rightarrow \neg S1$ . The  $\rightarrow$  symbol represents the conditional or implication operator.

18 For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.

One possible way to express this in propositional logic is:

$(L2 \rightarrow \neg S2) \wedge (T2 \rightarrow S2)$

This formula states that if there is a lady in Room II (L2), then the sign on the door of Room II is false ( $\neg S2$ ), represented by the conditional statement  $L2 \rightarrow \neg S2$ . Similarly, if there is a tiger in Room II (T2), then the sign on the door of Room II is true (S2), represented by the conditional statement  $T2 \rightarrow S2$ . The  $\rightarrow$  symbol represents the conditional or implication operator.

18 The sign on the door of Room I is: the two occupants are different.

One possible way to express this in propositional logic is:

$(S1 \leftrightarrow (L1 \wedge \neg T1) \vee (\neg L1 \wedge T1))$

This formula states that the sign on the door of Room I (S1) is true (represented by the  $\leftrightarrow$  symbol) if and only if there is a lady in Room I and no tiger, or there is a tiger in Room I and no lady. The  $\vee$  symbol represents the logical OR operator. This statement essentially means that the two occupants of Room I are different. The  $\leftrightarrow$  symbol represents the logical biconditional or equivalence operator, which means that both the left-hand side and the right-hand side must have the same truth value.

18 The sign on the door of Room II is: there is a lady in the other room.

One possible way to express this in propositional logic is:

$(S2 \leftrightarrow L1 \vee L2)$

This formula states that the sign on the door of Room II (S2) is true (represented by the  $\leftrightarrow$  symbol) if and only if there is a lady in either Room I (L1) or Room II (L2). This statement essentially means that there is a lady in the other room. The  $\vee$  symbol represents the logical OR operator, which means that if either L1 or L2 is true, then S2 is also true. The  $\leftrightarrow$  symbol represents the logical biconditional or equivalence operator, which means that both the left-hand side and the right-hand side must have the same truth value.

## Trial VIII

### Direct query to ChatGPT:

18 There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both. There are two signs, given as below:

Sign I: this room contains a tiger.  
Sign II: both rooms contain tigers.

One of the signs is on the door of Room I, and the other the door of Room II.

For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false. For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.

Which room contains a lady?

Let's analyze each sign:

- Sign I says that Room I contains a tiger. If we assume that Sign I is true, then Room I contains a tiger, and so the lady must be in Room II. If we assume that Sign I is false, then Room I does not contain a tiger, which means that Room I must contain a lady. So we can conclude that Sign I is false.
- Sign II says that both rooms contain tigers. If we assume that Sign II is true, then both rooms contain tigers, which contradicts the initial statement that one room contains a lady. Therefore, we can conclude that Sign II is false.

Now we know that Sign I is false, which means that Room I does not contain a tiger. Therefore, Room I must contain a lady. And since we know that Sign II is false, Room II does not contain a tiger, which means that Room II also contains a lady.

So the answer to the puzzle is: both rooms contain a lady.

### Asking it to translate the text to logic:

18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Text:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both.

One of the signs is on the door of Room I, and the other the door of Room II. We don't know which sign goes on which door.

Two signs are given as below:  
Sign I: this room contains a tiger.  
Sign II: both rooms contain tigers.

For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false. For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.

Propositional logic statements for the given text are as follows:

Let L1 be "A lady is in Room I"  
Let L2 be "A lady is in Room II"  
Let T1 be "A tiger is in Room I"  
Let T2 be "A tiger is in Room II"  
Let S1 be "The sign on the door of Room I"  
Let S2 be "The sign on the door of Room II"

- Each room contains either a lady or a tiger, but not both:  
 $((L1 \wedge \neg T1) \vee (T1 \wedge \neg L1)) \wedge ((L2 \wedge \neg T2) \vee (T2 \wedge \neg L2))$
- One sign is on the door of Room I and the other the door of Room II, and we don't know which sign goes on which door:  
 $(S1 \wedge \neg S2) \vee (\neg S1 \wedge S2)$
- Sign I says "This room contains a tiger":  
 $(T1 \wedge S1) \vee (T2 \wedge \neg S1)$
- Sign II says "Both rooms contain tigers":  
 $(T1 \wedge T2 \wedge S2) \vee (L1 \wedge T2 \wedge \neg S2) \vee (T1 \wedge L2 \wedge \neg S2)$
- If a lady is in Room I, then the sign on its door is true, but if a tiger is in it, the sign is false:  
 $(L1 \rightarrow S1) \wedge (T1 \rightarrow \neg S1)$
- For Room II, a lady in it means the sign on its door is false, and a tiger in it means the sign is true:  
 $(L2 \rightarrow \neg S2) \wedge (T2 \rightarrow S2)$

### Asking it to translate the statements in the text one at a time:

18 Given the following symbols in propositional logic:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II

Express the following statements in propositional logic:

There are two rooms, Room I and Room II. Each of them contains either a lady or a tiger, but not both.

We can express the statement "Each of the two rooms contains either a lady or a tiger, but not both" using the exclusive or (XOR) operator. This means that if one of the statements is true, then the other must be false, and vice versa. Using this, we can write:

$(L1 \text{ XOR } T1) \text{ AND } (L2 \text{ XOR } T2)$

This statement ensures that each room contains either a lady or a tiger, but not both.

We can also add the assumption that there are only two rooms, Room I and Room II, by using the logical AND operator:

$((L1 \text{ XOR } T1) \text{ AND } (L2 \text{ XOR } T2)) \text{ AND NOT } ((L1 \text{ AND } T1) \text{ OR } (L2 \text{ AND } T2))$

This statement ensures that each room contains either a lady or a tiger, but not both, and that there are only two rooms.

18 For Room I, if a lady is in it, then the sign on its door is true, but if a tiger is in it, the sign is false.

We can express this statement as follows:

$((L1 \rightarrow S1) \text{ AND } (T1 \rightarrow \text{NOT } S1))$

This statement ensures that if there is a lady in Room I, then the sign on its door is true, and if there is a tiger in Room I, then the sign on its door is false. Note that " $\rightarrow$ " denotes the conditional operator, which means "if...then". So, for example, " $L1 \rightarrow S1$ " means "If a lady is in Room I, then the sign on its door is true". Similarly, " $T1 \rightarrow \text{NOT } S1$ " means "If a tiger is in Room I, then the sign on its door is false".

18 For Room II, the situation is the opposite: a lady in it means the sign on its door is false, and a tiger in it means the sign is true.

We can express this statement as follows:

$((L2 \rightarrow \text{NOT } S2) \text{ AND } (T2 \rightarrow S2))$

This statement ensures that if there is a lady in Room II, then the sign on its door is false, and if there is a tiger in Room II, then the sign on its door is true. Note that " $\rightarrow$ " denotes the conditional operator, which means "if...then". So, for example, " $L2 \rightarrow \text{NOT } S2$ " means "If a lady is in Room II, then the sign on its door is false". Similarly, " $T2 \rightarrow S2$ " means "If a tiger is in Room II, then the sign on its door is true".

18 One of the signs is on the door of Room I, and the other the door of Room II. We don't know which sign goes on which door.  
Signs are: this room contains a tiger; both rooms contain tigers.

We can use the propositional variables S1 and S2 to represent the two signs, and use the logical OR operator to express the fact that one of the signs is on the door of Room I and the other is on the door of Room II. We can also use the propositional variables T1 and T2 to represent the presence of a tiger in each room. Then we can express the two signs as follows:

Sign 1: "This room contains a tiger"  
T1

Sign 2: "Both rooms contain tigers"  
(T1 AND T2)

Putting it all together, we can express the given statement as follows:

$((S1 \text{ AND NOT } S2) \text{ OR } (\text{NOT } S1 \text{ AND } S2)) \text{ AND } ((S1 \rightarrow \text{NOT } T1) \text{ AND } (S2 \rightarrow (\text{NOT } T2 \text{ AND NOT } T1)))$

The first part of the statement ensures that one sign is on the door of Room I and the other is on the door of Room II. The second part ensures that the signs are consistent with the presence of tigers in the rooms: if Sign 1 is on the door of Room I, then Room I cannot contain a tiger (NOT T1), and if Sign 2 is on the door of Room II, then Room I and Room II both cannot contain tigers (NOT T1 AND NOT T2). Note that " $\rightarrow$ " denotes the conditional operator, which means "if...then". So, for example, " $S1 \rightarrow \text{NOT } T1$ " means "If Sign 1 is on the door of Room I, then Room I does not contain a tiger".

## Trial IX

### Direct query to ChatGPT:

18 There are three rooms, Room I, Room II, and Room III. Each of them contains either a lady or a tiger, but not both. Furthermore, one of the rooms contains a lady and the other two tigers.

There is a sign on the door of each room, and they are:

The sign on the door of Room I: a tiger is in this room.  
The sign on the door of Room II: a lady is in this room.  
The sign on the door of Room III: a tiger is in Room II.

At most one of the three signs is true.

Which room contains a lady?

Let's consider each room one by one:

- If the sign on Room I is true, then Room I contains a tiger. But since at most one sign is true, the sign on Room II cannot be true, which means that Room II does not contain a lady. Therefore, the sign on Room III must be true, which means that Room II contains a tiger. But this contradicts the fact that one of the rooms contains a lady and the other two tigers. Therefore, this case is not possible.
- If the sign on Room III is true, then Room II contains a tiger, and Room I must contain a lady (because the other two rooms both contain tigers). But this contradicts the fact that at most one sign is true (since both the signs on Room I and Room III would be true in this case). Therefore, this case is not possible either.
- This leaves us with only one possibility: the sign on Room II is true, which means that Room II contains a lady. In this case, the signs on Room I and Room III are both false, and the room that contains a tiger must be Room I or Room III. Since we know that one of these two rooms contains a tiger and the other a lady, the room that contains a lady must be the remaining one, which is Room III.

Therefore, Room III contains a lady.

### Asking it to translate the text to logic:

18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
L3 - a lady is in Room III  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
T3 - a tiger is in Room III  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II  
S3 - the sign on the door of Room III

Text:

There are three rooms, Room I, Room II, and Room III. Each of them contains either a lady or a tiger, but not both. Furthermore, one of the rooms contains a lady and the other two tigers.

There is a sign on the door of each room, and they are:  
The sign on the door of Room I is: a tiger is in this room.  
The sign on the door of Room II is: a lady is in this room.  
The sign on the door of Room III is: a tiger is in Room II.  
At most one of the three signs is true.

L1 XOR T1  
L2 XOR T2  
L3 XOR T3

$L1 \oplus L2 \oplus L3 = 1$  and  $T1 \oplus T2 \oplus T3 = 2$

$(S1 \leftrightarrow T1) \wedge (S2 \leftrightarrow L2) \wedge (S3 \leftrightarrow (T2 \wedge \neg S2))$

At most one of S1, S2, S3 is true:

$(S1 \wedge \neg S2 \wedge \neg S3) \vee (\neg S1 \wedge S2 \wedge \neg S3) \vee (\neg S1 \wedge \neg S2 \wedge S3) \vee (\neg S1 \wedge \neg S2 \wedge \neg S3)$

### Asking it to translate the statements in the text one at a time:

18 Given the following symbols in propositional logic:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
L3 - a lady is in Room III  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
T3 - a tiger is in Room III  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II  
S3 - the sign on the door of Room III

Express the following statements in propositional logic:

There are three rooms, Room I, Room II, and Room III. Each of them contains either a lady or a tiger, but not both. Furthermore, one of the rooms contains a lady and the other two tigers.

We can express the given statements in propositional logic as follows:

1. Each room contains either a lady or a tiger, but not both:

$(L1 \wedge \neg T1) \vee (T1 \wedge \neg L1)$  // for Room I

$(L2 \wedge \neg T2) \vee (T2 \wedge \neg L2)$  // for Room II

$(L3 \wedge \neg T3) \vee (T3 \wedge \neg L3)$  // for Room III

2. One of the rooms contains a lady and the other two tigers:

$(L1 \wedge T2 \wedge T3) \vee (L2 \wedge T1 \wedge T3) \vee (L3 \wedge T1 \wedge T2)$

Therefore, combining the above statements, we get:

$[(L1 \wedge \neg T1) \vee (T1 \wedge \neg L1)] \wedge [(L2 \wedge \neg T2) \vee (T2 \wedge \neg L2)] \wedge [(L3 \wedge \neg T3) \vee (T3 \wedge \neg L3)] \wedge [(L1 \wedge T2 \wedge T3) \vee (L2 \wedge T1 \wedge T3) \vee (L3 \wedge T1 \wedge T2)]$

This is the propositional logic representation of the given statements.

18 At most one of the three signs is true.

We can express the statement "At most one of the three signs is true" in propositional logic as follows:

Let S1, S2, and S3 be the propositions "the sign on the door of Room I is true", "the sign on the door of Room II is true", and "the sign on the door of Room III is true", respectively.

Then, we can use the exclusive disjunction (XOR) operator to express that at most one of the three propositions is true:

$(S1 \oplus S2 \oplus S3)$

This statement is true if and only if exactly one of S1, S2, and S3 is true, and false otherwise.

18 There is a sign on the door of each room, and they are:

The sign on the door of Room I is: a tiger is in this room.  
The sign on the door of Room II is: a lady is in this room.  
The sign on the door of Room III is: a tiger is in Room II.

We can express the given information in propositional logic using the following symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
L3 - a lady is in Room III  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
T3 - a tiger is in Room III  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II  
S3 - the sign on the door of Room III

Using these symbols, we can express the given information in propositional logic as follows:

$S1 \equiv T1$  // The sign on the door of Room I is: a tiger is in this room.

$S2 \equiv L2$  // The sign on the door of Room II is: a lady is in this room.

$S3 \equiv T2$  // The sign on the door of Room III is: a tiger is in Room II.

The symbol " $\equiv$ " represents logical equivalence, which means that the propositions on both sides of the symbol have the same truth value in all cases. Therefore, these three statements mean that the sign on the door of Room I is true if and only if there is a tiger in Room I, the sign on the door of Room II is true if and only if there is a lady in Room II, and the sign on the door of Room III is true if and only if there is a tiger in Room II.

# Trial X

## Direct query to ChatGPT:

18 There are three rooms, Room I, Room II, and Room III. Each of them contains either a lady or a tiger, but not both. Furthermore, one of the rooms contains a lady and the other two tigers.

There is a sign on the door of each room, and they are:

The sign on the door of Room I: a tiger is in Room II.  
The sign on the door of Room II: a tiger is in this room.  
The sign on the door of Room III: a tiger is in Room I.

The sign on the door of the room containing the lady is true, and at least one of the other two signs is false.

Which room contains a lady?

Let's consider each sign one by one and see what it implies:

- Sign on the door of Room I: a tiger is in Room II.  
If this sign is true, then there must be a tiger in Room II. But we are also given that one of the rooms contains a lady, which means that Room I cannot contain a tiger. Therefore, this sign must be false, and there is no tiger in Room II.
- Sign on the door of Room II: a tiger is in this room.  
If this sign is true, then Room II must contain a tiger. But we already know that there is no tiger in Room II from the first sign, which means that this sign must be false, and there is no tiger in Room II.
- Sign on the door of Room III: a tiger is in Room I.  
If this sign is true, then there must be a tiger in Room I. But we are also given that one of the rooms contains a lady, which means that Room I must contain a lady. Therefore, this sign must be false, and there is no tiger in Room I.

So, we have determined that there is no tiger in Room I or Room II, and there is no lady in Room II. Therefore, the lady must be in Room III.

## Asking it to translate the text to logic:

18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
L3 - a lady is in Room III  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
T3 - a tiger is in Room III  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II  
S3 - the sign on the door of Room III

Text:

There are three rooms, Room I, Room II, and Room III. Each of them contains either a lady or a tiger, but not both. Furthermore, one of the rooms contains a lady and the other two tigers.

There is a sign on the door of each room, and they are:  
The sign on the door of Room I is: a tiger is in Room II.  
The sign on the door of Room II is: a tiger is in this room.  
The sign on the door of Room III is: a tiger is in Room I.

The sign on the door of the room containing the lady is true, and at least one of the other two signs is false.

The propositional logic statements for the given text are:

$L1 \vee T1$  # There is a lady or a tiger in Room I  
 $L2 \vee T2$  # There is a lady or a tiger in Room II  
 $L3 \vee T3$  # There is a lady or a tiger in Room III

$L1 \wedge \sim L2 \wedge \sim L3$  # One of the rooms has a lady and the other two have tigers

$S1 \Leftrightarrow T2$  # The sign on the door of Room I says a tiger is in Room II  
 $S2 \Leftrightarrow T2$  # The sign on the door of Room II says a tiger is in this room  
 $S3 \Leftrightarrow T1$  # The sign on the door of Room III says a tiger is in Room I

$L1 \Rightarrow S1$  # If there is a lady in Room I, the sign on its door is true  
 $L2 \Rightarrow \sim S2$  # If there is a lady in Room II, the sign on its door is false  
 $L3 \Rightarrow \sim S3$  # If there is a lady in Room III, the sign on its door is false

$(S1 \wedge \sim S2) \vee (S1 \wedge \sim S3) \vee (\sim S2 \wedge \sim S3)$

# At least one of the other two signs is false and the sign on the door of the lady's room is true.

Note: " $\wedge$ " represents "and", " $\vee$ " represents "or", " $\sim$ " represents "not", and " $\Leftrightarrow$ " represents "if and only if".

## Asking it to translate the statements in the text one at a time:

18 Given the following symbols in propositional logic:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
L3 - a lady is in Room III  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
T3 - a tiger is in Room III  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II  
S3 - the sign on the door of Room III

Express the following statements in propositional logic:

There are three rooms, Room I, Room II, and Room III. Each of them contains either a lady or a tiger, but not both. Furthermore, one of the rooms contains a lady and the other two tigers.

We can use propositional logic to represent the given statements using the following symbols:

- L: "A lady is in Room I" (i = 1, 2, 3)
- T: "A tiger is in Room I" (i = 1, 2, 3)
- S: "The sign on the door of Room I" (i = 1, 2, 3)

Using these symbols, we can express the given statements in propositional logic as follows:

1. "Each of the rooms contains either a lady or a tiger, but not both."  
 $(L1 \text{ XOR } T1) \text{ AND } (L2 \text{ XOR } T2) \text{ AND } (L3 \text{ XOR } T3)$
2. "One of the rooms contains a lady and the other two tigers."  
 $(L1 \text{ AND } T2 \text{ AND } T3) \text{ OR } (T1 \text{ AND } L2 \text{ AND } T3) \text{ OR } (T1 \text{ AND } T2 \text{ AND } L3)$

Note: XOR stands for "exclusive or", which means that only one of the two statements can be true at the same time.

18 The sign on the door of Room I is: a tiger is in Room II.

We can use the following propositional statement to express the given information:

$S1 = (T2)$

Here, S1 represents the sign on the door of Room I, and the statement (T2) means that a tiger is in Room II. Therefore, the sign on the door of Room I is "a tiger is in Room II".

18 The sign on the door of Room II is: a tiger is in this room.

We can use the following propositional statement to express the given information:

$S2 = (T2)$

Here, S2 represents the sign on the door of Room II, and the statement (T2) means that a tiger is in Room II. Therefore, the sign on the door of Room II is "a tiger is in this room".

18 The sign on the door of Room III is: a tiger is in Room I.

We can use the following propositional statement to express the given information:

$S3 = (T1)$

Here, S3 represents the sign on the door of Room III, and the statement (T1) means that a tiger is in Room I. Therefore, the sign on the door of Room III is "a tiger is in Room I".

18 The sign on the door of the room containing the lady is true, and at least one of the other two signs is false.

We can use the following propositional statements to express the given information:

- If a lady is in Room I, then the sign on the door of Room I is true:

```
javascript Copy code
(L1 => S1)
```

- If a lady is in Room II, then the sign on the door of Room II is true:

```
javascript Copy code
(L2 => S2)
```

- If a lady is in Room III, then the sign on the door of Room III is true:

```
javascript Copy code
(L3 => S3)
```

- At least one of the other two signs is false:

```
scss Copy code
NOT(S1 AND S2) OR NOT(S1 AND S3) OR NOT(S2 AND S3)
```

Putting these statements together, we can express the given information in propositional logic as follows:

$[(L1 \Rightarrow S1) \text{ AND } \text{NOT}(S2 \text{ AND } S3)] \text{ OR } [(L2 \Rightarrow S2) \text{ AND } \text{NOT}(S1 \text{ AND } S3)] \text{ OR } [(L3 \Rightarrow S3) \text{ AND } \text{NOT}(S1 \text{ AND } S2)]$

# Trial XI

## Direct query to ChatGPT:

There are three rooms, Room I, Room II, and Room III. One of them contains a lady only. Another contains a tiger only. The third one is empty.

There is a sign on the door of each room, and they are:

The sign on the door of Room I: Room III is empty.

The sign on the door of Room II: The tiger is in Room I.

The sign on the door of Room III: This Room is empty.

The sign on the door of the room containing a lady is true, the sign on the door of the room containing a tiger is false, and the sign on the door of the empty room could be either true or false.

Which room contains a lady?

The lady must be in Room II. Here's why:

- If the lady were in Room I, then the sign on Room I would be true, which would mean Room III is empty. But the sign on Room III says it is empty, which would make the sign on Room I true and therefore there could not be a lady in Room I.
- If the lady were in Room III, then the sign on Room III would be true, which would mean the sign on Room I would also be true (since it says Room III is empty). But the sign on Room I says that Room III is empty, which would mean there could not be a lady in Room I.
- Therefore, the lady must be in Room II. If she is in Room II, then the sign on Room II is false (since it says the tiger is in Room I, which is not true). This means that the sign on Room III could be either true or false (since it doesn't give any information about the contents of the rooms). Therefore, the sign on Room I must be false, which means that Room III is not empty. Since we know the lady is not in Room I or Room III, she must be in Room II.

## Asking it to translate the text to logic:

Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
L3 - a lady is in Room III  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
T3 - a tiger is in Room III  
E1 - Room I is empty  
E2 - Room II is empty  
E3 - Room III is empty  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II  
S3 - the sign on the door of Room III

Text:

There are three rooms, Room I, Room II, and Room III. One of them contains a lady only. Another contains a tiger only. The third one is empty.

There is a sign on the door of each room, and they are:

The sign on the door of Room I is: Room III is empty.  
The sign on the door of Room II: The tiger is in Room I.  
The sign on the door of Room III: This Room is empty.

The sign on the door of the room containing a lady is true, the sign on the door of the room containing a tiger is false, and the sign on the door of the empty room could be either true or false.

$L1 \vee L2 \vee L3$  (There is a lady in one of the rooms)  
 $T1 \vee T2 \vee T3$  (There is a tiger in one of the rooms)  
 $E1 \vee E2 \vee E3$  (One of the rooms is empty)

$S1 \equiv E3$  (The sign on Room I implies that Room III is empty)  
 $S2 \equiv T1$  (The sign on Room II implies that the tiger is in Room I)  
 $S3$  (The sign on Room III is not informative)

$L1 \wedge \neg L2 \wedge \neg L3$  (The room with a lady is Room I and the others are not)  
 $\neg T1 \wedge T2 \wedge \neg T3$  (The room with a tiger is Room II and the others are not)  
 $(E1 \wedge \neg E2 \wedge \neg E3) \vee (\neg E1 \wedge E2 \wedge \neg E3) \vee (\neg E1 \wedge \neg E2 \wedge E3)$   
(One room is empty and the others are not)

Note that we use  $\equiv$  instead of  $\Rightarrow$  to express the sign-door relationships because it is given that the sign is true for the room with a lady and false for the room with a tiger, but the sign on the empty room could be either true or false.

## Asking it to translate the statements in the text one at a time:

Given the following symbols in propositional logic:

L1 - a lady is in Room I  
L2 - a lady is in Room II  
L3 - a lady is in Room III  
T1 - a tiger is in Room I  
T2 - a tiger is in Room II  
T3 - a tiger is in Room III  
E1 - Room I is empty  
E2 - Room II is empty  
E3 - Room III is empty  
S1 - the sign on the door of Room I  
S2 - the sign on the door of Room II  
S3 - the sign on the door of Room III

Express the following statements in propositional logic:

There are three rooms, Room I, Room II, and Room III. One of them contains a lady only. Another contains a tiger only. The third one is empty.

Let's define the following propositions:

- A lady is in Room I: L1
- A lady is in Room II: L2
- A lady is in Room III: L3
- A tiger is in Room I: T1
- A tiger is in Room II: T2
- A tiger is in Room III: T3
- Room I is empty: E1
- Room II is empty: E2
- Room III is empty: E3

We can express the statement "One of the rooms contains a lady only" as follows:

- Either L1 is true and both L2 and L3 are false, or
- L2 is true and both L1 and L3 are false, or
- L3 is true and both L1 and L2 are false.

Using logical operators, we can write this statement as:

$(L1 \wedge \neg L2 \wedge \neg L3) \vee (\neg L1 \wedge L2 \wedge \neg L3) \vee (\neg L1 \wedge \neg L2 \wedge L3)$

Similarly, we can express the statement "One of the rooms contains a tiger only" as:

$(T1 \wedge \neg T2 \wedge \neg T3) \vee (\neg T1 \wedge T2 \wedge \neg T3) \vee (\neg T1 \wedge \neg T2 \wedge T3)$

Finally, we can express the statement "The third one is empty" as:

$E1 \vee E2 \vee E3$

Putting all these statements together using logical operators, we can express the overall statement as:

$[(L1 \wedge \neg L2 \wedge \neg L3) \vee (\neg L1 \wedge L2 \wedge \neg L3) \vee (\neg L1 \wedge \neg L2 \wedge L3)]$   
 $\wedge$   
 $[(T1 \wedge \neg T2 \wedge \neg T3) \vee (\neg T1 \wedge T2 \wedge \neg T3) \vee (\neg T1 \wedge \neg T2 \wedge T3)]$   
 $\wedge$   
 $(E1 \vee E2 \vee E3)$

The sign on the door of Room I is: Room III is empty.

We can represent the statement "The sign on the door of Room I is: Room III is empty" in propositional logic as:

$S1 \leftrightarrow E3$

This statement uses the biconditional ( $\leftrightarrow$ ) logical operator to assert that the sign on the door of Room I is equivalent to the proposition that Room III is empty. That is, if the sign on the door of Room I says "Room III is empty," then the proposition E3 is true, and vice versa.

The sign on the door of Room II is: The tiger is in Room I.

We can represent the statement "The sign on the door of Room II is: The tiger is in Room I" in propositional logic as:

$S2 \leftrightarrow T1$

This statement uses the biconditional ( $\leftrightarrow$ ) logical operator to assert that the sign on the door of Room II is equivalent to the proposition that the tiger is in Room I. That is, if the sign on the door of Room II says "The tiger is in Room I," then the proposition T1 is true, and vice versa.

18

The sign on the door of Room III is: This Room is empty.



We can represent the statement "The sign on the door of Room III is: This Room is empty" in propositional logic as:

$$S3 \leftrightarrow E3$$

This statement uses the biconditional ( $\leftrightarrow$ ) logical operator to assert that the sign on the door of Room III is equivalent to the proposition that Room III is empty. That is, if the sign on the door of Room III says "This Room is empty," then the proposition E3 is true, and vice versa.

18

The sign on the door of the room containing a lady is true



Based on the information provided in the original problem, we know that exactly one of the rooms contains a lady, one contains a tiger, and one is empty. Let's assume that the sign on the door of the room containing a lady is "true" (meaning that it correctly describes the contents of the room).

To represent this statement in propositional logic, we first need to determine which room contains the lady. We can express the proposition "the lady is in Room I" as L1, "the lady is in Room II" as L2, and "the lady is in Room III" as L3. Since we know that exactly one of these propositions is true, we can use the exclusive or (XOR) operator to connect them.

Therefore, the statement "The sign on the door of the room containing a lady is true" can be represented as:

$$(S1 \wedge L1) \text{ XOR } (S2 \wedge L2) \text{ XOR } (S3 \wedge L3)$$

This statement says that either the sign on the door of Room I is true and Room I contains a lady (i.e., L1 is true), or the sign on the door of Room II is true and Room II contains a lady (i.e., L2 is true), or the sign on the door of Room III is true and Room III contains a lady (i.e., L3 is true). This captures the idea that the sign on the door of the room containing a lady is true if and only if that room is the one that actually contains the lady.

18

the sign on the door of the room containing a tiger is false



Based on the information provided in the original problem, we know that exactly one of the rooms contains a lady, one contains a tiger, and one is empty. Let's assume that the sign on the door of the room containing a tiger is "false" (meaning that it incorrectly describes the contents of the room).

To represent this statement in propositional logic, we first need to determine which room contains the tiger. We can express the proposition "the tiger is in Room I" as T1, "the tiger is in Room II" as T2, and "the tiger is in Room III" as T3. Since we know that exactly one of these propositions is true, we can use the exclusive or (XOR) operator to connect them.

Therefore, the statement "the sign on the door of the room containing a tiger is false" can be represented as:

$$(\neg S1 \wedge T1) \text{ XOR } (\neg S2 \wedge T2) \text{ XOR } (\neg S3 \wedge T3)$$

This statement says that either the sign on the door of Room I is false and Room I contains a tiger (i.e., T1 is true), or the sign on the door of Room II is false and Room II contains a tiger (i.e., T2 is true), or the sign on the door of Room III is false and Room III contains a tiger (i.e., T3 is true). This captures the idea that the sign on the door of the room containing a tiger is false if and only if that room is the one that actually contains the tiger.

18

the sign on the door of the empty room could be either true or false



To represent the statement "the sign on the door of the empty room could be either true or false" in propositional logic, we can use the disjunction (OR) logical operator to combine the propositions that represent the sign on the door of each empty room being either true or false.

Let's use the propositions S1, S2, and S3 to represent the sign on the door of Room I, Room II, and Room III respectively, and let's use the propositions E1, E2, and E3 to represent the emptiness of each room.

Therefore, the statement can be represented as:

$$(S1 \wedge E1) \text{ OR } (\neg S1 \wedge E1) \text{ OR } (S2 \wedge E2) \text{ OR } (\neg S2 \wedge E2) \text{ OR } (S3 \wedge E3) \text{ OR } (\neg S3 \wedge E3)$$

This statement says that the sign on the door of the empty room (i.e., the room that is not occupied by the lady or the tiger) can be either true or false. Specifically, it can be true if the proposition that represents the sign being true is true (e.g.,  $S1 \wedge E1$ ), or it can be false if the proposition that represents the sign being false is true (e.g.,  $\neg S1 \wedge E1$ ). Similarly, for Room II and Room III. This captures the idea that the statement is true regardless of whether the sign on the door of the empty room is accurate or not.

## Trial XII

### Direct query to ChatGPT:

18

There are nine rooms, Room I, Room II, Room III, Room IV, Room V, Room VI, Room VII, Room VIII, and Room IX. One of them contains a lady only, and the others are either empty or contain a tiger only.

There is a sign on the door of each room, and they are:

The sign on the door of Room I: the lady is in an odd-numbered room.

The sign on the door of Room II: this room is empty.

The sign on the door of Room III: either sign V is right or sign VII is wrong.

The sign on the door of Room IV: sign 1 is wrong.

The sign on the door of Room V: either sign II or sign IV is right.

The sign on the door of Room VI: sign III is wrong.

The sign on the door of Room VII: the lady is not in Room I.

The sign on the door of Room VIII: this room contains a tiger and Room IX is empty.

The sign on the door of Room IX: this room contains a tiger and VI is wrong.

If a room contains a lady, then the sign on its door is true. If a room contains a tiger, then the sign on its door is false. If a room is empty, then the sign on its door is either true or false.

Which room contains a lady?



Let's analyze each sign one by one:

The sign on the door of Room I: the lady is in an odd-numbered room.

This sign implies that the lady is in either Room I, Room III, Room V, Room VII, or Room IX.

The sign on the door of Room II: this room is empty.

This sign tells us that Room II is empty.

The sign on the door of Room III: either sign V is right or sign VII is wrong.

This sign implies that the lady is in Room III or Room V, and also that either sign V is true or sign VII is false.

The sign on the door of Room IV: sign 1 is wrong.

This sign implies that the lady is not in Room I, so the lady is in Room III, Room V, Room VII, or Room IX.

The sign on the door of Room V: either sign II or sign IV is right.

This sign implies that the lady is in Room III or Room V, and also that either Room II is empty or sign 1 is wrong. Since we know that Room II is empty, sign 1 must be wrong.

The sign on the door of Room VI: sign III is wrong.

This sign implies that the lady is not in Room III, so the lady is in Room V, Room VII, or Room IX.

The sign on the door of Room VII: the lady is not in Room I.

This sign tells us that the lady is not in Room I, so the lady is in Room III, Room V, Room VII, or Room IX.

The sign on the door of Room VIII: this room contains a tiger and Room IX is empty.

This sign implies that Room VIII contains a tiger and Room IX is empty.

The sign on the door of Room IX: this room contains a tiger and VI is wrong.

This sign implies that Room IX contains a tiger and the lady is not in Room VI. Since we know that the lady is not in Room VI, the lady must be in either Room V or Room VII.

From the above analysis, we can conclude that the lady is either in Room V or Room VII. However, we need to check whether the signs are consistent with each other. If the lady is in Room V, then sign V is true, which means that either sign II or sign IV is right. However, we know that sign II is false because Room II is empty, which means that sign IV must be true. But sign IV implies that either sign I or sign III is right, and both signs I and III are false, which contradicts sign IV. Therefore, the lady cannot be in Room V.

If the lady is in Room VII, then sign VII is true, which means that the lady is not in Room I. This is consistent with all the other signs, so the lady must be in Room VII.

Therefore, the answer is that the lady is in Room VII.

## Asking it to translate the text to logic:

18 Express the facts in the following text in propositional logic using the following symbols:

Symbols:

L1 - a lady is in Room I  
 L2 - a lady is in Room II  
 L3 - a lady is in Room III  
 L4 - a lady is in Room IV  
 L5 - a lady is in Room V  
 L6 - a lady is in Room VI  
 L7 - a lady is in Room VII  
 L8 - a lady is in Room VIII  
 L9 - a lady is in Room IX  
 T1 - a tiger is in Room I  
 T2 - a tiger is in Room II  
 T3 - a tiger is in Room III  
 T4 - a tiger is in Room IV  
 T5 - a tiger is in Room V  
 T6 - a tiger is in Room VI  
 T7 - a tiger is in Room VII  
 T8 - a tiger is in Room VIII  
 T9 - a tiger is in Room IX  
 E1 - Room I is empty  
 E2 - Room II is empty  
 E3 - Room III is empty  
 E4 - Room IV is empty  
 E5 - Room V is empty  
 E6 - Room VI is empty  
 E7 - Room VII is empty  
 E8 - Room VIII is empty  
 E9 - Room IX is empty  
 S1 - the sign on the door of Room I  
 S2 - the sign on the door of Room II  
 S3 - the sign on the door of Room III  
 S4 - the sign on the door of Room IV  
 S5 - the sign on the door of Room V  
 S6 - the sign on the door of Room VI  
 S7 - the sign on the door of Room VII  
 S8 - the sign on the door of Room VIII  
 S9 - the sign on the door of Room IX

Text:

There are nine rooms, Room I, Room II, Room III, Room IV, Room V, Room VI, Room VII, Room VIII, and Room IX. One of them contains a lady only, and the others are either empty or contain a tiger only.

There is a sign on the door of each room, and they are:

The sign on the door of Room I: the lady is in an odd-numbered room.

The sign on the door of Room II: this room is empty.

The sign on the door of Room III: either sign V is right or sign VII is wrong.

The sign on the door of Room IV: sign I is wrong.

The sign on the door of Room V: either sign II or sign IV is right.

The sign on the door of Room VI: sign III is wrong.

The sign on the door of Room VII: the lady is not in Room I.

The sign on the door of Room VIII: this room contains a tiger and Room IX is empty.

The sign on the door of Room IX: this room contains a tiger and VI is wrong.

If a room contains a lady, then the sign on its door is true. If a room contains a tiger, then the sign on its door is false. If a room is empty, then the sign on its door is either true or false.



$L1 \vee L2 \vee L3 \vee L4 \vee L5 \vee L6 \vee L7 \vee L8 \vee L9$  - There is a lady in one of the nine rooms.

$E1 \vee E2 \vee E3 \vee E4 \vee E5 \vee E6 \vee E7 \vee E8 \vee E9$  - One of the nine rooms is empty.

$(T1 \vee T2 \vee T3 \vee T4 \vee T5 \vee T6 \vee T7 \vee T8 \vee T9) \wedge (\neg L1 \vee \neg L2 \vee \neg L3 \vee \neg L4 \vee \neg L5 \vee \neg L6 \vee \neg L7 \vee \neg L8 \vee \neg L9)$  - Each room contains either a tiger or a lady, but not both.

$S1 \rightarrow ((L1 \wedge (\neg T1)) \vee (L3 \wedge (\neg T3)) \vee (L5 \wedge (\neg T5)) \vee (L7 \wedge (\neg T7)) \vee (L9 \wedge (\neg T9)))$  - If the sign on Room I is true, then the lady is in an odd-numbered room.

$S2 \rightarrow E2$  - If the sign on Room II is true, then the room is empty.

$S3 \rightarrow ((S5 \wedge \neg S7) \vee (\neg S5 \wedge S7))$  - If the sign on Room III is true, then either the sign on Room V is true and the sign on Room VII is false, or the sign on Room V is false and the sign on Room VII is true.

$S4 \rightarrow \neg(L1 \wedge (\neg T1))$  - If the sign on Room IV is true, then the sign on Room I is false.

$S5 \rightarrow ((\neg S2 \wedge \neg E2) \vee (\neg S4 \wedge \neg(L1 \wedge (\neg T1))))$  - If the sign on Room V is true, then either the sign on Room II is false and Room II is not empty, or the sign on Room IV is false and the sign on Room I is false.

$S6 \rightarrow \neg S3$  - If the sign on Room VI is true, then the sign on Room III is false.

$S7 \rightarrow \neg L1$  - If the sign on Room VII is true, then the lady is not in Room I.

$S8 \rightarrow ((T8 \wedge E9) \wedge \neg S9)$  - If the sign on Room VIII is true, then Room VIII contains a tiger and Room IX is empty, and the sign on Room IX is false.

$S9 \rightarrow (T9 \wedge \neg S6)$  - If the sign on Room IX is true, then Room IX contains a tiger and the sign on Room VI is false.

## Asking it to translate the statements in the text one at a time:

18 Given the following symbols in propositional logic:

L1 - a lady is in Room I  
 L2 - a lady is in Room II  
 L3 - a lady is in Room III  
 L4 - a lady is in Room IV  
 L5 - a lady is in Room V  
 L6 - a lady is in Room VI  
 L7 - a lady is in Room VII  
 L8 - a lady is in Room VIII  
 L9 - a lady is in Room IX  
 T1 - a tiger is in Room I  
 T2 - a tiger is in Room II  
 T3 - a tiger is in Room III  
 T4 - a tiger is in Room IV  
 T5 - a tiger is in Room V  
 T6 - a tiger is in Room VI  
 T7 - a tiger is in Room VII  
 T8 - a tiger is in Room VIII  
 T9 - a tiger is in Room IX  
 E1 - Room I is empty  
 E2 - Room II is empty  
 E3 - Room III is empty  
 E4 - Room IV is empty  
 E5 - Room V is empty  
 E6 - Room VI is empty  
 E7 - Room VII is empty  
 E8 - Room VIII is empty  
 E9 - Room IX is empty  
 S1 - the sign on the door of Room I  
 S2 - the sign on the door of Room II  
 S3 - the sign on the door of Room III  
 S4 - the sign on the door of Room IV  
 S5 - the sign on the door of Room V  
 S6 - the sign on the door of Room VI  
 S7 - the sign on the door of Room VII  
 S8 - the sign on the door of Room VIII  
 S9 - the sign on the door of Room IX

Express the following statements in propositional logic:

There are nine rooms, Room I, Room II, Room III, Room IV, Room V, Room VI, Room VII, Room VIII, and Room IX. One of them contains a lady only, and the others are either empty or contain a tiger only.



One way to express the given statements in propositional logic is:

$(L1 \wedge \neg T1 \wedge E2 \wedge T3 \wedge E4 \wedge T5 \wedge E6 \wedge T7 \wedge E8 \wedge T9) \vee (\neg L1 \wedge E1 \wedge \neg T2 \wedge E3 \wedge \neg T4 \wedge E5 \wedge \neg T6 \wedge E7 \wedge \neg T8 \wedge E9)$

This can be read as "Either Room I contains a lady and the other rooms contain tigers or are empty, or Room I is empty and one of the other rooms contains a tiger and the rest are empty." The use of conjunctions ( $\wedge$ ) and negations ( $\neg$ ) are used to express the various possibilities for each room.

18

The sign on the door of Room I is: the lady is in an odd-numbered room.



One way to express the given statement in propositional logic is:

$S1 \leftrightarrow (L1 \vee L3 \vee L5 \vee L7 \vee L9)$

This can be read as "The sign on the door of Room I is equivalent to the statement that the lady is in an odd-numbered room." The biconditional ( $\leftrightarrow$ ) is used to express the equivalence between the sign on the door and the statement about the lady's location. The disjunction ( $\vee$ ) is used to express that the lady is in at least one of the odd-numbered rooms.

18 The sign on the door of Room II is: this room is empty.

One way to express the given statement in propositional logic is:

$$S2 \leftrightarrow E2$$

This can be read as "The sign on the door of Room II is equivalent to the statement that Room II is empty." The biconditional ( $\leftrightarrow$ ) is used to express the equivalence between the sign on the door and the statement about the room's occupancy. The proposition E2 represents the statement that Room II is empty.

18 The sign on the door of Room III is: either sign V is right or sign VII is wrong.

One way to express the given statement in propositional logic is:

$$S3 \leftrightarrow (S5 \vee \neg S7)$$

This can be read as "The sign on the door of Room III is equivalent to the statement that either sign V is correct or sign VII is incorrect." The biconditional ( $\leftrightarrow$ ) is used to express the equivalence between the sign on the door and the statement about the other signs. The disjunction ( $\vee$ ) is used to express that at least one of the statements is true. The negation ( $\neg$ ) is used to express the falsehood of the statement about sign VII.

18 The sign on the door of Room IV is: sign 1 is wrong.

One way to express the given statement in propositional logic is:

$$S4 \leftrightarrow \neg S1$$

This can be read as "The sign on the door of Room IV is equivalent to the statement that sign 1 is incorrect." The biconditional ( $\leftrightarrow$ ) is used to express the equivalence between the sign on the door and the statement about sign 1. The negation ( $\neg$ ) is used to express the falsehood of the statement about sign 1.

18 The sign on the door of Room V is: either sign II or sign IV is right.

One way to express the given statement in propositional logic is:

$$S5 \leftrightarrow (S2 \vee S4)$$

This can be read as "The sign on the door of Room V is equivalent to the statement that either sign II is correct or sign IV is correct." The biconditional ( $\leftrightarrow$ ) is used to express the equivalence between the sign on the door and the disjunction of the two statements about signs II and IV. The disjunction ( $\vee$ ) is used to express that at least one of the statements is true.

18 The sign on the door of Room VI is: sign III is wrong.

One way to express the given statement in propositional logic is:

$$S6 \leftrightarrow \neg S3$$

This can be read as "The sign on the door of Room VI is equivalent to the statement that sign III is incorrect." The biconditional ( $\leftrightarrow$ ) is used to express the equivalence between the sign on the door and the statement about sign III. The negation ( $\neg$ ) is used to express the falsehood of the statement about sign III.

18 The sign on the door of Room VII is: the lady is not in Room I.

One way to express the given statement in propositional logic is:

$$S7 \leftrightarrow \neg L1$$

This can be read as "The sign on the door of Room VII is equivalent to the statement that the lady is not in Room I." The biconditional ( $\leftrightarrow$ ) is used to express the equivalence between the sign on the door and the statement about the lady's location. The negation ( $\neg$ ) is used to express the falsehood of the statement about the lady being in Room I.

18 The sign on the door of Room VIII is: this room contains a tiger and Room IX is empty.

One way to express the given statement in propositional logic is:

$$S8 \leftrightarrow (T8 \wedge E9)$$

This can be read as "The sign on the door of Room VIII is equivalent to the statement that Room VIII contains a tiger and Room IX is empty." The biconditional ( $\leftrightarrow$ ) is used to express the equivalence between the sign on the door and the conjunction of the statements about the occupancy of Rooms VIII and IX. The proposition T8 represents the statement that Room VIII contains a tiger, and the proposition E9 represents the statement that Room IX is empty. The conjunction ( $\wedge$ ) is used to express that both statements are true.

18 The sign on the door of Room IX is: this room contains a tiger and VI is wrong.

One way to express the given statement in propositional logic is:

$$S9 \leftrightarrow (T9 \wedge \neg S6)$$

This can be read as "The sign on the door of Room IX is equivalent to the statement that Room IX contains a tiger and Room VI's sign is incorrect." The biconditional ( $\leftrightarrow$ ) is used to express the equivalence between the sign on the door and the conjunction of the statements about the occupancy of Room IX and the falsehood of the statement about Room VI's sign. The proposition T9 represents the statement that Room IX contains a tiger, and the negation ( $\neg$ ) of the proposition S6 represents the falsehood of the statement about Room VI's sign. The conjunction ( $\wedge$ ) is used to express that both statements are true.

18 If a room contains a lady, then the sign on its door is true.

One way to express the given statement in propositional logic is:

$$(L1 \rightarrow S1) \wedge (L2 \rightarrow S2) \wedge (L3 \rightarrow S3) \wedge (L4 \rightarrow S4) \wedge (L5 \rightarrow S5) \wedge (L6 \rightarrow S6) \wedge (L7 \rightarrow S7) \wedge (L8 \rightarrow S8) \wedge (L9 \rightarrow S9)$$

This can be read as "If a room contains a lady, then the sign on its door is true for each of the nine rooms." The implication ( $\rightarrow$ ) is used to express the conditional statement that if the left-hand side is true (i.e., the room contains a lady), then the right-hand side is also true (i.e., the sign on the door is true). The proposition S1 through S9 represents the sign on each room's door.

18 If a room contains a tiger, then the sign on its door is false.

One way to express the given statement in propositional logic is:

$$(T1 \rightarrow \neg S1) \wedge (T2 \rightarrow \neg S2) \wedge (T3 \rightarrow \neg S3) \wedge (T4 \rightarrow \neg S4) \wedge (T5 \rightarrow \neg S5) \wedge (T6 \rightarrow \neg S6) \wedge (T7 \rightarrow \neg S7) \wedge (T8 \rightarrow \neg S8) \wedge (T9 \rightarrow \neg S9)$$

This can be read as "If a room contains a tiger, then the sign on its door is false for each of the nine rooms." The implication ( $\rightarrow$ ) is used to express the conditional statement that if the left-hand side is true (i.e., the room contains a tiger), then the right-hand side is false (i.e., the sign on the door is false). The proposition  $\neg S1$  through  $\neg S9$  represents the negation of the sign on each room's door, indicating that the sign is false.

18 If a room is empty, then the sign on its door is either true or false.

One way to express the given statement in propositional logic is:

$$(E1 \rightarrow (S1 \vee \neg S1)) \wedge (E2 \rightarrow (S2 \vee \neg S2)) \wedge (E3 \rightarrow (S3 \vee \neg S3)) \wedge (E4 \rightarrow (S4 \vee \neg S4)) \wedge (E5 \rightarrow (S5 \vee \neg S5)) \wedge (E6 \rightarrow (S6 \vee \neg S6)) \wedge (E7 \rightarrow (S7 \vee \neg S7)) \wedge (E8 \rightarrow (S8 \vee \neg S8)) \wedge (E9 \rightarrow (S9 \vee \neg S9))$$

This can be read as "If a room is empty, then the sign on its door is either true or false for each of the nine rooms." The implication ( $\rightarrow$ ) is used to express the conditional statement that if the left-hand side is true (i.e., the room is empty), then either the sign on the door is true or false (i.e., the sign is not undefined). The disjunction ( $\vee$ ) is used to express that at least one of the statements is true. The negation ( $\neg$ ) is used to express the falsehood of the sign if it is not true.

## C Translating statements to logic

The following is the screenshot of our session with ChatGPT (March 7, 2023) asking it to translate the 15 statements in Section 4 to propositional logic:

AR

Let:

- X1 be the proposition "A is a red ball"
- X2 be the proposition "A is a green ball"
- X3 be the proposition "A is a white ball"
- Y1 be the proposition "B is a red ball"
- Y2 be the proposition "B is a green ball"
- Y3 be the proposition "B is a white ball"
- Z1 be the proposition "C is a red ball"
- Z2 be the proposition "C is a green ball"
- Z3 be the proposition "C is a white ball"

Using these symbols, express each of the following statements in propositional logic:

- There are three balls: A, B, and C. Exactly one of them is red.
- There are three balls: A, B, and C. At least one of them is red.
- There are two balls: A and C. One of them is red, the other is white.
- There are two balls: A and C. A is green. The other one is white.
- If A is a red ball, so is B and C.
- If A is a red ball and B is a green ball, then C is a white ball.
- If A is not a green ball, then it is a red ball.
- A is a red ball if and only if B is a green ball.
- There are three balls: A, B, and C. It cannot be the case that all these three balls are red.
- The ball A is both red and green.
- The ball B is neither red nor green.
- Among the possible colors red, green and white, the ball C can have at most two colors.
- There are three balls, A, B, and C. Any of them can be white but none of them is green.
- The balls A and B are of different colors.
- If A is a red ball, then B and C are balls of the same color.



1.  $(X1 \text{ XOR } X2) \text{ XOR } X3 \text{ AND NOT } (X1 \text{ AND } X2)$
2.  $X1 \text{ OR } X2 \text{ OR } X3$
3.  $(X1 \text{ AND } Z3) \text{ OR } (X3 \text{ AND } Z1)$
4.  $X2 \text{ AND } Z3$
5.  $X1 \rightarrow Y1 \text{ AND } Z1$
6.  $X1 \text{ AND } Y2 \rightarrow Z3$
7.  $\text{NOT } X2 \rightarrow X1$
8.  $X1 \leftrightarrow Y2$
9.  $\text{NOT } (X1 \text{ AND } Y1 \text{ AND } Z1)$
10.  $X1 \text{ AND } X2$
11.  $\text{NOT } (Y1 \text{ OR } Y2)$
12.  $(Z1 \text{ AND } Z2) \text{ OR } (Z1 \text{ AND } Z3) \text{ OR } (Z2 \text{ AND } Z3)$
13.  $(X3 \text{ OR } Y3 \text{ OR } Z3) \text{ AND NOT } (X2 \text{ OR } Y2 \text{ OR } Z2)$
14.  $(X1 \text{ AND } Y2) \text{ OR } (X2 \text{ AND } Y1)$
15.  $X1 \rightarrow Y2 \text{ AND } Z2$