1 Linear Algebra

We will start with matrix multiplication. This is from the course Linear Algebra. To not throw you completely into the deep, there is an explanation below.

$$\begin{pmatrix} A1 & B1 \\ A2 & B2 \end{pmatrix} \cdot \begin{pmatrix} X1 & Y1 \\ X2 & Y2 \end{pmatrix} = \begin{pmatrix} A1 \cdot X1 + B1 \cdot X2 & A1 \cdot Y1 + B1 \cdot Y2 \\ A2 \cdot X1 + B2 \cdot X2 & A2 \cdot Y1 + B2 \cdot Y2 \end{pmatrix}$$

With matrix multiplication we will multiple each row of matrix 1 with each column of matrix 2. In the explanation above you see that row 1 from matrix 1 will be multiplied with column 1 from matrix 2. The final value from this multiplication will be filled into the new matrix at the left upper corner. Below is an example of multiplication with real numbers.

$$\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} 3 & 2 \\ 1 & 2 \end{pmatrix} = \begin{pmatrix} 1 \cdot 3 + 2 \cdot 1 & 1 \cdot 2 + 2 \cdot 2 \\ 0 \cdot 3 + 1 \cdot 1 & 0 \cdot 2 + 1 \cdot 2 \end{pmatrix} = \begin{pmatrix} 5 & 6 \\ 1 & 2 \end{pmatrix}$$

Now it's your turn to apply matrix multiplication:

$$\begin{pmatrix} 3 & 4 & 1 \\ 2 & -1 & 2 \\ 0 & -2 & 5 \end{pmatrix} \cdot \begin{pmatrix} 2 & 2 & 4 \\ -3 & 1 & 6 \\ 1 & 3 & 5 \end{pmatrix}$$

2 Assert and prove

Imagine there is exactly 1 suitcase with gold and 3 empty suitcases in this room. The suitcase with gold will be yours if you can guess which suitcase holds the gold. To find out which suitcase holds the gold, each suitcase has an expression on it. From these 4 expressions exactly one is true.

- The expression of suitcase 1 is: "The gold is in suitcase 2."
- The expression of suitcase 2 is: "All other suitcases are empty."
- The expression of suitcase 3 is: "This suitcase contains the gold."
- The expression on suitcae 4 is: "This suitcase is empty."

The question at hand is: which suitcase contains the true expression and which suitcase holds the gold?

3 Programming

To understand programming a little bit better we present to you two small codes and outputs below.

```
public class PC {

   public static void main(String[] args) {
      int x = 7;
      int y = 0;

      if(x < 3){
         y = 2*4-x;
      } else {
         y = 2*4+x;
      }

      System.out.println(y);
   }

}
```

1. Which number will be printed by this code?
2. Imagine we change x to 3. What will be printed in this situation?
3. What will be printed if x will be equal to -2?

```
public class PC2 {

   public static void main(String[] args) {
      int x = 7;
      int y = 0;

      for(int i = 0; i < x; i++){
         y += 2;
         System.out.println(y);
      }

      System.out.println("End of output");
   }

}
```

1. How many times will y be printed?
2. What will be the final output of this code?

4 Formal reasoning

Formal Reasoning is a course which treats multiple sections of logic. Propositional logic is one of those sections. Below is a short explanation of how propositional logic works.

There are multiple connectives which are used in the normal English language. English connectives are for example “and, “or”, “not” and “if”. Below is a table of how we define these connectives in propositional logic.

$\neg$ A	not A
A $\wedge$ B	A and B
A $\vee$ B	A or B
A $\rightarrow$ B	if A, then B

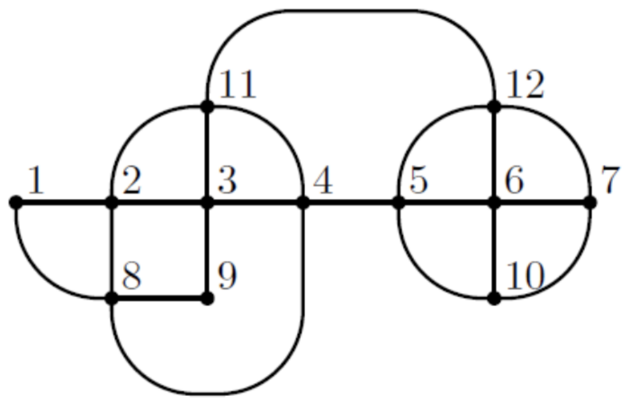
For this assignment we use the following dictionary, which contains the meaning of multiple symbols:

R	it’s raining
S	the sun is shining
RB	there is a rainbow
W	I’m getting wet
O	I’m outside

An example: R $\vee$ S means: ”It rains or the sun is shining.”

1. Translate the following sentence to a normal English sentence:
   $(\neg R \wedge \neg S) \vee RB$
2. Translate the following English sentence to propositional logic using the dictonary and the connectives given above:
   “If it rains and I’m outside then I get wet”.

The course Formal Reasoning also includes graph theory. The picture on the next page is an example of one of these graphs. This graph represents a small village where the streets are indicated by the lines. Also, on each corner is a bar. These bars are indicated by the points numbered from 1 to 12.



1. Is it possible to walk a route which contains each street exactly once? If so, give an example of such a route.
2. Is it possible to walk a route which contains each street exactly once and begins and ends at bar 3? If so, indicate the numbers (in order) of this route.
3. Does there exist a route which contains each bar exactly once? If so, give an example of such a route.