Exercises.

1.0 Study Chapter 1 in "First-Order Logic and Automated Theorem Proving" (henceforth "the book").

1. Consider the symbols employed in Chapter 1 to describe the mathematical theory *arithmetic*.

   1.1 Express formally that every natural number is either even or odd.

   1.2 Express formally that for every natural number there exists a larger one. You may use the binary relation symbol $<$, expressing the "greater than" relation.

1.3 What is the truth value of the sentences

$$\forall x \exists y (x > y) \quad \text{and} \quad (\forall x \exists y (x > y)) \wedge \neg(\forall x \exists y (x > y)) ,$$

when interpreted in arithmetic. Explain your answer.

1.4 Give a precise definition of the liveness property and show that the protocol from the lecture does not fulfil the liveness property.

1.5 Can you express the liveness property using the introduced connectives and quantifiers?