In general tutorial sessions are to discuss the problems you faced during solving these exercises. Solutions will in general not be presented but discussed during these sessions.

**Exercise 1** Gradiance – Compulsory! Hurdle!
Sign up to the course (if you haven’t already) on Gradiance with Class Token: 8DDCA614. Please log in and complete the assigned homework “Chapter 09: Undecidability”.

**Exercise 2** Universal Turing Machine
Construct a Universal Turing Machine. That is, define a Turing machine \( U \) that takes as input a tuple \((M, x)\) where \( M \) is an encoding of a Turing machine \( M \) and \( x \) is a string such that \( U \) accepts if and only if \( x \in L(M) \).

(a) What is an adequate encoding for Turing machines?

(b) What Turing machine model do we need to use for \( U \)? How many tapes? How many symbols? Do we need nondeterminism?

(c) What Turing machine model do we use for the input machines \( M \)?

(d) Describe the program of \( U \) informally.

**Exercise 3** Turing Reduction
Let \( L \) be a recursive enumerable language. Show that if \( L \) can be reduced to its complement, then \( L \) is decidable.