Exercise 1: LTL equivalences
Which of the following equivalences are correct? If it is not, please provide a counterexample that illustrates that the formula on the left and the formula on the right are not equivalent. If you still consider it is, try to provide a proof.

(a) □\varphi \rightarrow \Diamond \psi \equiv \varphi U (\psi \lor \neg \varphi)
(b) \Diamond \Box \varphi \rightarrow \Box \Diamond \psi \equiv \Box (\varphi U (\psi \lor \neg \varphi))
(c) \Box \Box (\varphi \lor \neg \psi) \equiv \neg \Diamond (\neg \varphi \land \psi)
(d) \Diamond (\varphi \land \psi) \equiv \Diamond \varphi \land \Diamond \psi
(e) \Box \varphi \land \Diamond \Diamond \varphi \equiv \Diamond \Box \varphi
(f) \Diamond \varphi \land \Box \Diamond \varphi \equiv \Diamond \varphi
(g) \Box \Diamond \varphi \rightarrow \Box \Diamond \psi \equiv \Box (\varphi \rightarrow \Diamond \psi)
(h) \neg (\varphi_1 U \varphi_2) \equiv \neg \varphi_2 W (\neg \varphi_1 \land \neg \varphi_2)
(i) \Diamond \Diamond \varphi_1 \equiv \Diamond \Diamond \varphi_2
(j) \Diamond (\Box \varphi_1) \land (\Diamond \Box \varphi_2) \equiv \Diamond (\Diamond \varphi_1 \land \Box \varphi_2)
(k) (\varphi_1 U \varphi_2) U \varphi_2 \equiv \varphi_1 U \varphi_2

Exercise 2: Mutex in LTL
Suppose we have two users, Peter and Betsy, and a single printer device Printer. Both users perform several tasks, and every now and then they want to print their results on the Printer. Since there is only a single printer, only one user can print a job at a time. Suppose we have the following atomic propositions for Peter at our disposal:

- \text{Peter.request} ::= indicates that Peter requests usage of the printer;
- \text{Peter.use} ::= indicates that Peter uses the printer;
- \text{Peter.release} ::= indicates that Peter releases the printer.

For Betsy, similar predicates are defined. Specify in LTL the following properties:

(a) Mutual exclusion, i.e., only one user at a time can use the printer.
(b) Finite time of usage, i.e., a user can print only for a finite amount of time.

(c) Absence of individual starvation, i.e., if a user wants to print something, he/she eventually is able to do so.

(d) Absence of blocking, i.e., a user can always request to use the printer.

(e) Alternating access, i.e., users must strictly alternate in printing.