Assignment 1: Introduction

ETH Zurich

1 Prisoners: Synchronization

A group of \( n \) prisoners are told that they will all be put in isolation cells and then will be interrogated one by one in a room containing a light with an on/off switch. The prisoners may communicate with one another by toggling the light-switch. There is no fixed order of interrogation, or interval between interrogations. Each prisoner will be interrogated arbitrarily often. More precisely, for any \( p \), eventually each of the prisoners will be interrogated at least \( p \) times. When interrogated, a prisoner can take exactly one of the following actions.

- The prisoner can do nothing.
- The prisoner can toggle the light switch.
- The prisoner can announce that all prisoners have been interrogated. If the announcement is true then all of the prisoners will be set free. Otherwise all of them will be executed.

Before the prisoners go back to their isolation cells they have the opportunity to devise a winning strategy.

1.1 Task

- Describe a winning strategy under the assumption that the light is initially switched off.
- Describe a winning strategy under the assumption that it is initially unknown whether the light is switched on or off.

2 Safety vs. Liveness

Consider the following properties.

- Patrons are served in the order they arrive.
- What goes up must come down.
- If two or more processes are waiting to enter their critical sections, at least one succeeds.
- If an interrupt occurs, then a message is printed within one second.
- If an interrupt occurs, then a message is printed.
- The cost of living never decreases.
- Two things are certain: death and taxes.
- You can always tell a Harvard man.
2.1 Task
For each of the above properties, state whether it is a safety or liveness property. Identify the bad or good thing of interest.

3 Amdahl’s Law
You have a choice between buying one uniprocessor that executes five billion instructions per second, or a ten-core multiprocessor where each processor executes one billion instructions per second.

3.1 Task
Using Amdahl’s Law, explain how you would decide which one to buy for a particular application.