Maths are everywhere

Denis TRYSTRAM

HomeWork **Maths for Computer Science** – *MOSIG 1 – november 2024*

Guidelines

- This work can be prepared by groups of maximum 3 students, but each student should send a personal report in pdf at

  Denis.Trystram@univ-grenoble-alpes.fr

- The reports do not need to be typed electronically, they can be scanned from handwritten notes.

- Please, indicate the names of the other members of your group and detail clearly the credit of each (percentage in designing, proving, writing code, doing experiments, etc.).

- I don't encourage you to look at Internet, but in case, indicate also all sources you used.

- Use your professional email address and clearly indicate:

  subject: **Homework MCS**

  The file should be named **Homework-name.pdf**

  your last name only with no capital letters

- The strict deadline is **novembre 17, 23:59**, a penalty will be applied in case of delay.

Presentation

The goal of this homework is to study a problem, modeling and analysis of successive steps that lead to a conclusion. All results must be accompanied by clear mathematical proofs.

At the beginning, we don't really know what to prove, thus, you will have to experiment! Here is the problem:

The director of a penitentiary believes in the rehabilitation of inmates. His prison has 500 inmates. Each inmate has a locker, which are located one after the other in a very long corridor. The lockers are numbered with the same number as the cells.

The director believes that sport is necessary to stay in shape. He thinks it is necessary to keep prisoners' minds occupied, especially the most dangerous ones. To keep the inmates busy, he suggests the following activity:

He asks a first inmate running for opening all the locker doors.

Then, a second inmate runs and closes every other locker door, starting from the second locker, and so on with the others going through the lockers.

the third inmate reverses the states of the doors from 3 to 3 (he closes the locker when it is opened and opens it when it is closed). He does not change the other doors.

the 500th inmate runs to the end of the corridor and changes the state of the last locker door.

Here are some interesting questions

1. What is the state of the door of the last locker when the last inmate has passed through?

2. Moreover, could you determine the state of all the lockers?

3. What happens if the corridor is circular?

   In other words, each inmate makes a complete turn starting at the locker corresponding to his cell, stopping when he comes across a locker whose door he has already changed.