

## Homework 2a - puzzle

Verify (find a solution of) this game:

There are two teams of 3 people each. They are standing in a row on 7 slots such that the left team is facing right and the right team is facing left. In the middle there is an empty slot.

The goal is to swap the teams. Allowed moves are:

- A) A player can do one step forward only if there is an empty slot.
- B) A player can jump two steps forward over a player only if the next slot is occupied and the slot after is empty.
- C) Each moving player has to go only forward (players are not allowed to turn around).

Example of allowed moves (players are depicted by arrows):

```
>>> <<< initial
>> ><<<
>><> <<
>><>< <
...
<<< >>> final
```

1. Make a model of this problem in NuSMV (nuXmv) and verify that there is a solution - a sequence of allowed step swapping the teams.
2. Write a false formula such that its counter example demonstrates the moves leading to the successful swap of the teams.
3. Write formulae checking that you construction is correct. This can vary depending on your construction. Do not check properties that are obvious by the construction. Focus on those that could be source of an error. E.g., all moves satisfy A), B), and C); the number of players is constant during all runs; no player can step outside the 7 slots.
4. Search the NuSMV User manual and write a special NuSMV formula computing directly the minimal number of steps to the successful swap of the teams.

Note that when running NuSMV (nuXmv) with parameter '-pre cpp', you can use C preprocessor macros in your model.

Submit two files. One with extension .smv containing your model and all the formulae, and a PDF report explaining your construction of both the model and the formulae (including the verification results).