EFREI Master 2

Mini-Project (SCV)

Description

We propose to design, to check formally an emergency care service then to implement it. The injured people will be taken to emergency rooms for immediate treatment. Resources to be modeled include physicians, nurses, and examining rooms, as well as the resource consumers, the patients. When a patient first arrives at emergency room, he/she proceeds to check in. Then, the receptionist checks the resources and number of current patients to determine a waiting time. If the waiting time is bigger than a certain value, then the newly arrived patient would not be admitted into the emergency room. The responsable of the service can decide to ask for more resources from an external resource provider. Otherwise, the patient would check into the emergency room and be given paperwork to fill out. After the patient completes the paperwork, he/she would wait to be treated and an available nurse will start processing the paperwork. When the nurse completes the process and there is an examining room available for the patient, then the patient would enter the room. When a physician becomes available, he/she would start examining the patient in the examining room. After the completion of the treatment, the patient proceeds to check out and leave the emergency room. When there is no client waiting, the responsable of the service can decide to contact the resources provider, to offer a resource (a room or a doctor) in case other services need it. The resource provider, shares with the any service of the hospital the rooms and physicians resources, and communicates with it asynchronously via buffers (namely b_0 and b_1). A message in b_0 is an authorization from the emergency service to the provider to use its resources and to give them to an other service which needs it.

Within this project, you are asked to use the modeling and verification concepts seen during the course in order to implement the above system.

Formal modeling and verification

1. Untimed Petri nets
   - Model the emergency care service with an untimed Petri net
   - Model the resource provider with an untimet Petri net
   - Combine the two previous models in order to model the interaction between the emergency care service and a resource provider through shared resources
   - By varying the number of available resources initially, and using the TINA toolbox model checker, express and check the following properties :
     - Deadlock freeness
     - When a patient is admitted in the service, he/she will eventually be examined by a doctor
     - Each time an examining room is reserved, it will eventually be released
   - Add on or two other models of emergency care services interacting with the provider. Can you check the same properties ? What do you think about eh size of the reachability graph ?

2. Time Petri nets
   — Add reasonable time intervals to the transitions of your initial model.
   — Express, and check some timed properties to answer questions such as :
      — What is the maximum time a patient can spend between the moment it is admitted in the service and the moment he leaves the service ?
      — What is the maximum time the service can wait for an answer from the provider each time it asks for an additionally resource ?
      — —

Implementation

Starting from your formal model, design an implement the emergency system involving one or more emergency services interacting with se resource provider. Your implementation must be inspired from your formal model (and not the opposite). You are expected to have a structured way to perform the translation from the model to the code. You could illustrate/motivate your translation process with UML diagrams (Use case, sequence, activities, class diagrams). Inspired by the formal model established in the first part,

1 Project planning

1. Publication of project subject : November 29th, 2020
2. Project follow-up session December 15th, 2020
3. Project defense : January 5th, 2021
4. Submission of code sources and report (on the moodle) : January 5th, 2021 at 11 :59 pm.

You will work in pairs (at most) and you have to upload your work on the moodle as a compressed folder containing the following elements :

— A structured pdf document containing the description of your method to model (screen shot of the Petri net models using TINA/Romeo toolbox), and to verify (LTL /TCTL formulae + screen shot of the TINA/Romeo model checker) the system. The document should also contain a description of the translation process, a discussion on the encountered difficulties and a conclusion.
— The source code
— The TINA/Romeo Petri net models

Have fun