Software Requirements Specification

for

Simulation tool for computing platform

Version 1.0 approved

Prepared by Augustin Reille

Cranfield University

20/12/2017

Table of Contents

Revision History

Name	Date	Reason For Changes	Version
Reille	7/12/2017		1

1.   Introduction

1.1   Purpose

The purpose of this document is to give a detailed description of the requirements for the HPC simulation software. It will illustrate the purpose and complete declaration for the development of system. It will also explain system constraints, interface and interactions with other external applications. This document is primarily intended to be proposed to a customer for its approval and a reference for developing the first version of the system for the development team

1.2   Product Scope

The software is a simulator of an HPC computing/job control system. It will be used by IT department. All parameters for the simulation can be chosen by the user.

1.3   Definitions, acronyms and abbreviations

Term	Definition
User	Someone who interacts with the software
DESC	Description
RAT	Rational
DEP	Dependencies

2.   Overall Description

2.1   Product Perspective

The product is a web application, which allows the user to run simulation about queuing system and resources attribution on an HPC system.
This product is divided in two parts : an interface, and a Typescript piece of software.

The interface allows the user to input all data necessary for the simulation, and output all the results at the end of the simulation.

The piece of software simulates the HPC job submission system : each simulated user will submit jobs to the HPC system.

2.2 Product Functions

The major functions this product must perform for the user are :
- take an input of data for the simulation
- give an output with the results of the simulation

2.3 User Classes and Characteristics

There is only one type of user that will use the system : a person from the IT department which wants to run a simulation of an HPC system.

2.4 Constraints

There is no apparent constraint, this software going to be used by only a few person inside an unique team.

2.5 Assumptions and Dependencies

One assumption about the product is that it will only be accessible for the moment by running a web app locally, and it needs to install some dependencies : Node and Angular CLI.
In a second time the web application should be put in production, on a real website.

3.   External Interface Requirements

3.1   User Interfaces

```
Please enter simulation parameters :                              HPC system parameters :

Simulation duration (in weeks): 1                                 Number of nodes : 128
                                                                  Number of cores by node : 16
Student parameters :                                              Total number of cores : 2048
                                                                  Number of cores dedicated to short jobs : 204
Number of students classes : 2                                    Number of cores dedicated to medium jobs : 614
                                                                  Number of cores dedicated to large jobs : 1024
  Number of students for class n° 1: 5
  Max ressources per class (core/hour) : 10000

  Number of students for class n° 2: 0
  Max ressources per class (core/hour) :

Researchers parameters :

Number of researchers groups : 1

  Number of researchers for group n° 1: 0
  Max ressources per group (core/hour) :

                              Start simulation
```

A first view presents all the input for the user. He can choose:
- the simulation duration
- the amount of classes of students which will be using the hpc during the simulation, and for each class the amount of students and the maximum ressources allowed per class
- the amount of groups of researchers
- the hardware architecture : number of nodes and number of cores by node

The button "Start simulation" launches the simulation and shows the second view.

Simulation webapp

Stop simulation

Simulation live data

Hours of simulation : 97 , Week 1,
Short jobs : 0 rejected, 1 queued, 2 running, 397 finished.
Medium jobs : 0 rejected, 84 queued, 5 running, 91 finished.
Large jobs : 2 rejected, 31 queued, 2 running, 15 finished.
Huge jobs : 11 rejected, 14 queued, 0 running, 0 finished.

Output

```
-------- SIMULATION RESULTS -------

Simulation duration : 2

Number of nodes : 128
Number of cores : 16
Total number of cores : 2048

Number of students classes : 2
Total number of students : 15

Number of researchers groups : 1
Total number of researchers : 4
```

A button "Stop simulation" stops the simulation. When the simulation is stopped all the results of the simulation are shown in the Output part. The part Simulation live data shows all the rejected, queued, running and finished jobs. User can also see the number of hours of simulation, if it is the weekend or not, and the number of week.

3.2   Hardware Interfaces

Since this product is only a simulation tool, there is no hardware interface.

3.3   Software Interfaces

Since this product is only a simulation tool, it does not interact with any other software component, database, operating system, tools, libraries, and integrated commercial components.

4.   System Features

This section includes the requirements that specify all the fundamental actions of the software system.

4.1   Run the webapp

ID: F1
TITLE: Run the web application
DESC: A user should be able to make the web application run locally to use it.
RAT: In order for a user to run the web application
DEP: None

4.2   Simulation duration

ID: F2
TITLE: Choose the duration of simulation
DESC: A user should be able to choose the duration of the simulation. The distribution of the job submissions decreases proportionally to this duration.
RAT: In order for a user to choose the duration of the simulation
DEP: F1

4.3   Simulated users

ID: F3
TITLE: Choose the amount of users
DESC: A user should be able to choose the amount of users inside the simulation. Users can be :
● students : they belong to classes, each class has (or not) an allocation of resources
● researchers : they belong to groups, each group has (or not) an allocation of resources
RAT: In order for a user to choose the amount of users
DEP: F1

4.4   Simulated HPC

ID: F4
TITLE: Choose the HPC system architecture
DESC: A user should be able to choose the simulated HPC system architecture. Users can choose :
● the number of nodes
● the number of cores by node
RAT: In order for a user to choose HPC system architecture
DEP: F1

4.5   Launch simulation

ID: F5

TITLE: Launch the simulation
DESC: A user should be able to launch the simulation
RAT: In order for a user to launch the simulation
DEP: F1

4.6 Stop simulation

ID: F6
TITLE: Stop the simulation
DESC: A user should be able to stop the simulation
RAT: In order for a user to stop the simulation
DEP: F5

4.7 Get results

ID: F7
TITLE: Get the output of the simulation
DESC: A user should be able to see the results of the simulation
RAT: In order for a user to get the results
DEP: none

4.8 See the simulation running

ID: F8
TITLE: See the simulation running
DESC: A user should be able to see the simulation running
RAT: In order for a user to see the simulation running
DEP: F5

5. Simulation Requirements

5.1 Queues Requirements

There is at least four differents job queues, each taking a certain subset of the total computing power.
- short : 2 nodes for no more than 1 hour, 10% subset
- medium : 10% of the maximum number of cores, 8h, 30% subset
- large : 50% of the maximum number of cores, 16h, 60% subset
- huge : running only during weekends, whole machine reserved

5.2 Simulated jobs Requirements

Each simulated user will request jobs. Each group has a budget of machine-hours, if the budget is completed, the jobs for this group will be rejected. The time between two successive job request is modeled by an exponential probability distribution.

5.3 Output Requirements

Output must show :
- number of jobs processed in each queue per week
- actual price of machine-hours consumed by users jobs
- resulting price paid by the users
- average wait time n each queue
- average turnaround time ratio
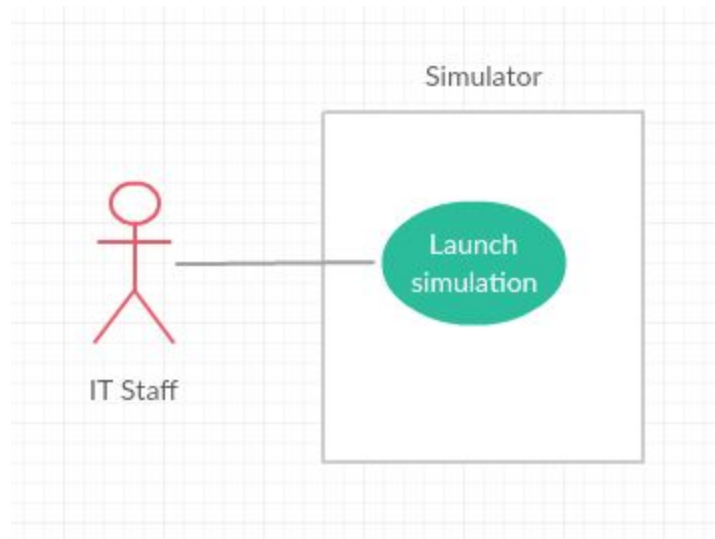
Appendix A: Analysis Models

Figure : Use case diagram n°1

Simulation sequence diagram