HOMEWORK 1
Informatics 2-Software Engineering 2014/15

Ajitha Rajan

16th September 2014

1 The problem

The problem you will work on is adopted from the automotive industry. It is a small system called the **Cruise Control System** that is responsible for automatically controlling the speed of the car. The system takes over the throttle of the car to maintain a steady speed as set by the driver and to accelerate the car upon the request of the driver.

1.1 Cruise Control System (CCS) Description

The cruise control function allows the driver of a car to maintain speed without pressing the accelerator pedal. The driver can switch on the cruise control by pressing the **Start cruising** button on the dashboard of the car. The cruise control will switch on only when the engine is running, the speed is at least 40 km/h, and the brake pedal is not depressed. When the cruise control is switched on, the CCS sets the desired speed to the currently measured speed and then attempts to maintain the measured speed within a margin of 1.5 km/h of the desired speed.

The **Start accelerating** button allows the driver to accelerate smoothly without pushing the accelerator pedal. When this button is pushed and the cruise control is on, the car will accelerate smoothly, at $2 metres/sec^2$, until the **Stop accelerating** button is pushed. When the cruise control is on, the driver can also accelerate by pushing the accelerator pedal. When the driver releases the accelerator pedal, speed returns to the speed set before the pedal was pushed or to the most recent speed achieved by pushing the Start accelerating button. Thus, if the maintained speed was 50 km/h before the accelerator was pressed, upon letting go of the accelerator, the cruise control system will bring the car back to 50 km/h.

If the driver presses the **Stop cruising** button, the cruise control switches off and closes the throttle smoothly. The Start accelerating button will have no effect until the cruise control is switched on again. If the driver pushes the brake pedal when the cruise control is on, then the cruise control will switch itself off immediately. The same happens when the engine switches off. In all these cases, the throttle should close itself completely immediately, rather than in a smooth manner by small steps.

If the driver pushes the **Resume** button when the cruise control is off, the engine is running, the brake pedal is released, and the speed is at least 40 km/h, the cruise control will then take the car back to the speed set before it was switched off. If no set speed is available from before it was swithced off, then the CCS should set the desired speed to the currently measured speed.

The CCS receives signals from the following sensors every second,

- A speed sensor that measures the actual speed of the car. Speed of the car can be between 0 and 250 km/h.
- A timer generates a pulse every second.
- A sensor connected to the brake pedal sends a signal to indicate if the pedal is pressed or released.
- A sensor connected to the accelerator pedal sends a signal to indicate if the pedal is pressed or released. If the accelerator pedal is pressed the sensor also gives the engine throttle set by the accelerator. For the sake of simplicity, let us assume that the engine throttle position can be set at any value between 0 to 5 Volts. When the current throttle position is more (or less) than the previous throttle position by the amount $diff$, the car will accelerate (or decelerate) smoothly at $(diff/5) * max\_accel$ metres/sec^2. Assume the max_accel for your car is 4 metres/sec^2. If the current throttle position is same as the previous position, then the car maintains the same speed and there is no acceleration (or decelaration).
- A sensor connected to the engine sends signals when the engine switches on and off.
- There are five buttons on the dashboard to operate the cruise control
  1. Start cruising
  2. Stop cruising
  3. Start accelerating
  4. Stop accelerating
  5. Resume

In addition the CCS is connected to an actuator

- One of the outputs from the CCS is a value for the engine throttle setting. An actuator connected to the throttle can put the throttle valve in any position indicated by a floating point value ranging from 0 (valve closed) to 5 (valve fully open). The driver can put the throttle in any of these positions too by using the accelerator pedal. If both the actuator and the pedal try to set the throttle in a certain position, the throttle will set itself to the largest of the two values. This property of the throttle can be assumed by the CCS. As mentioned earlier, the difference of the current and previous engine throttle position (between 0 to 5) is used to compute acceleration or deceleration (See formula provided in the sensor connected to the accelerator pedal).

2 Your task

Your task in this homework is to develop a requirements document for the CCS, a use case diagram with the actors and use cases and use use-cases to help you clarify how it is to be used. You may choose any organisation of your document, but always keep in mind that it must be readable, changeable, and capture all the essential information we have discussed in class. The customer wants the CCS to provide the following functions,

Start Cruising

Resume Speed

Stop Cruise Control

Store Cruising Speed

Accelerate

Stop Acceleration

A description of the functions is provided earlier in Section 1.1. There are some examples of use-case diagrams, scenarios, requirements in the slides and a requirements and use case template is available on the Schedule page along with the coursework handout. Finally, there are several checklists available that you can use to determine if your document is up to standards.

Helpful Hint. Do not invent many unneeded requirements. Focus on the core functionality of the CCS and do not add "things that would be nice to have." "Gold plating" the requirements by adding all kinds of nice, but unneeded, functionality will lead to an excessively large and complex document.

Do not try to capture all possible processing scenarios with your use-cases. As mentioned in class, focus on the main processing to clarify what required functions are needed. This is typically enough for the customer to understand the system and for you to understand the customer's needs.

3 Resources

Template to write use cases, a guide to specifying requirements and a checklist for the requirements document are all available on the class web page. Additionally, Tutorials in week 2 are designed to help you with this homework. You will be doing example use cases and requirements for other systems. The tutors and the TA will be able to help you with any questions or clarifications you may have about the CCS.

4 Use Case Diagram Tool

To draw the use case diagram, you will use the **Papyrus Tool**. You will first need to install Papyrus on **Eclipse 4.2 (Juno)**. Installation instructions will be shortly available on the News and Schedule web page.

5 Asking Questions

If you have questions about how the CCS works, please first check the Forum on the web (accessible from the class home page)—if the answer is not there, pose the question to the tutor in the Tutorial session in Week 2 or email your question to the TA or Lecturer or post the question for discussion on the class Forum.

6 Submission

For this homework, you are required to submit a document with the use case diagram (created with Papyrus in Eclipse 4.2-Juno), all the use cases and requirements for the CCS functions mentioned in Section 2. Make sure all use cases, requirements (including assumptions and constraints) are numbered. The use case diagram can be saved as an image file in Papyrus (right click on diagram > File > Save as Image File). Submit the requirements, use cases and use case diagram as one document (.pdf or .doc file). The document should include **a title page with names and UUNs of team members**. You should also submit **a text file named team.txt** with only the UUNs of the team members (one UUN on each line) as shown,
s1234567
s7891234

How to Submit. On the School of Informatics DiCE computer system, if your project is in a folder called *Application* (with the .pdf/.doc document and team.txt files) then you should submit it for Inf2C-SE homework1 using the command:

submit inf2c-se 1 Application

7 Due Date

Use case diagram, use cases, and requirements are due

Thursday, October 2nd at Noon.

This homework is worth 20% of the total coursework.