Exercise Sheet 1
(5 Points)

Lab exercises for the period from Wednesday, 18th October 2017

Hints: Please read the tutorial carefully and follow the instructions. If you have any questions, please contact your tutor.

Information about the lab computers

- In order to efficiently provide software required for various courses, the lab computers are equipped with several virtual machines. For the embedded systems lab exercises, we mostly use the Windows based VM CPSF (otherwise this will be indicated on the particular exercise sheet).
- Instead of the displayed Control + Alt + Del, press Control (right) + Del to log on.
- The provided account will be used for all virtual machines.
- The exercise sheets as well as required files can be found on the lab server under the path \pdc\cpsf\.
- The lab computers can access the university’s network only. To browse the web, configure the Firefox settings as follows: Under Advanced → Network → Connections → Settings choose “Manual proxy configuration” and enter proxy.cs.tu-dortmund.de with port 3128 as “HTTP Proxy”. Furthermore, check the box “Use this proxy server for all protocols”.

1.1 Statechart Tutorial (5 Points)

1. Copy the zip file tut_tpl.zip under "\pdc\cpsf\" to the desktop and extract it.
2. Change to the subdirectory vs and start visualSTATE.vnw.
3. Choose Modeling in the program window (Figure 1) or press F7.

Figure 1: Hauptbildschirm
4. Now you can draw a diagram making use of the StateChart elements like states or transitions on the left side. To position these elements, please click on the respective element and place it in the window using the left mouse button. To switch back to the pointer mode, press the right mouse button (cf. Figure 2).

Figure 2: visualState Designer

Figure 3: A simple StateChart example

5. Place the states and transitions as evident in Figure 3. Please note that it is necessary to define a start state.

6. To create a transition, double click on ?/. Thereupon, a dialogue window opens (cf. Figure 4), where several properties can be modified. Double click on Key0Press to activate the transition at a push of the first button.

Figure 4: Transition dialogue window

Figure 5: Create a new variable

7. To add a second action to the transition, click on Action Expression and subsequently on writeLine(0(VS_INT number):VS_VOID within the dialogue window. By this means, you assigned the transition writeLine0, which displays a number in the first row of the LCD.

8. Then, a new variable shall be created. For this purpose, click on the New symbol in the Rule list (cf. Figure 5 while Action Expression is still selected.

9. Select the list entry Internal Variable in the right column and click on the New symbol. As a consequence, a new dialogue window appears where you can specify the variable’s properties (cf. Figure 6).

10. Enter zahl as the variable’s name and press OK.

11. To assign a meaning to the formula you defined under Action Expression, mark X=?, click on the text box in the left column and enter: zahl = 1.

12. Finally, the number should be displayed on the LCD. To make this possible, double click on writeLine(0?), choose zahl as a parameter in the dialogue popping up and close the dialogue window by clicking on OK. Hence, when the transition fires, the function writeLine(zahl) is called and therefore the respective number is displayed on the LCD.

13. Please complete the diagram as shown in Figure 7.

14. Save the file and close the current program window.
15. In the main application, click on Validation or, alternatively, press F8, to open the StateChart simulation mode (cf. Figure 8).

16. In the column Event you can find a list of you StateChart’s events. By clicking on one of these events, it will be executed. The current states are highlighted in the column System, whereas the actions are listed in the last column.

17. If your system satisfies all requirements, close the validation window.

18. To automatically generate code from your StateChart, click on Code Generation in the main window (cf. Figure 1) or press F9. In the output window at the bottom of the screen, you can verify if your project has been translated properly.

19. If this is the case, start the program IAR Embedded Workbench, which can be found via the system search (click on the windows button and type the program name).

20. Choose open existing workspace and change to the project folder. In the subfolder ew a project compiler is provided.

21. Click on Project → Make or press F7 to compile the project.
22. Start the program *Flash Magic* that can be found via the system search.

23. Configure the properties according to Figure 9, whereat the user interface can differ depending on the version. LPC2103 may be found unter “ARM7”. Important settings: Board LPC2103, COM Port 1, Interface NXP ICP Bridge, Oscillator 16MHz.

![Flash Magic](image)

**Figure 9: Flash Magic**

24. Choose *compiler.hex* in the folder *Projekt/ew/Debug/Exe* as hex file. As soon as you click on *start*, your program will be transferred to the µController (cf. Figure 10).