Practical Exercise – Mikrocomputertechnik
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Exercise Sheet 1 - Digital Outputs

The digital in- and output (I/O) ports are among the basic peripherals of a microcontroller. Depending on the device family, there are several universal I/O ports. In this case, a 'port' is the grouping of usually eight bi-directional I/O terminals, which are controlled by a register of the processor. The respective connections are referred to as 'pins'. As a microcontroller typically has significantly more peripheral functionality than pins, the funcational elements being provided by a single pin have to be chosen. The pin's routing is thereby determined by the configuration of a special register.

In exercise 1, we will take a closer look at the configuration of the registers controlling the digital I/O ports. First of all, a digital port must be initialized. For that purpose, the desired functionality of the port pins must be defined in the 'function select register' (PxSEL[1]). Next, the direction of the corresponding pins has to be selected, by granting either read access (input pin) or write access (output pin), by setting the 'direction register' (PxDIR[2]) accordingly. Once the direction is set, the status (High / Low) of each port pin can be changed by the 'output register' (PxOUT[3]).

> **Note:**
>
> *Unless noted otherwise, you should always merge all tasks of an exercise sheet into one piece of source code. The required tasks are intended to run together.*
>
> **Warning: Non-compliance to 'Note:' sections can lead to point deduction.**
> **Please keep that in mind for all exercise sheets!**

Task 1

a) Connect the red LED D6 (LED rt) to CON3:P1.4. Let the red LED D6 blink with a visible frequency of about $2\,\mathrm{Hz}$, the duty cycle[4] should be 50 %. (**3 pts.**)

b) Connect the blue LED D7 to CON3:P1.5. Let the blue LED D7 blink with half of the frequency of the red LED D6. Therefore, look for the required pin in the circuit diagram. (**2 pts.**)
   Then, add a comment section in your code describing the purpose of this pin. Which other device can be controlled by this pin and which condition has to be fulfilled for operating this additional device properly? (**1 pt.**)

c) Whenever a user input is received by the serial interace[5] on the microcontroller, i.e. when a message is sent from your computer to the microcontroller over HTerm[6], reply the current state (ON/OFF) of the blue LED D7 back to your computer. For this purpose, use the predefined functions from the EMP template, which can be found on the ILIAS web platform. (**3 pts.**)

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[1] see MSP430x2xx Family User Guide: Section 8.2.5, page 329 and Datasheet MSP430G2x53 page 42ff
[2] see MSP430x2xx Family User Guide: Section 8.2.3, page 329
[3] see MSP430x2xx Family User Guide: Section 8.2.2, page 328
[4] duty cycle D = time the signal is active T to the total period of the signal $\tau \Leftrightarrow D = \frac{T}{\tau}$
[5] All serial functions work on a serial console, which can not be accessed directly by Code Comp. Studio
[6] HTerm: http://www.der-hammer.info/terminal/

Task 2

Create a file `feedback.txt` with a brief feedback statement, which contains specific problems and issues you experienced while solving the exercise, additional requests, positive remarks and alike. Import this text file `feedback.txt` in your **C**ode **C**omposer **S**tudio (CCS) project, so that you can upload it together with your software deliverable. (**1 pt.**)

> ### *Note:*
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> 1. *Please **always** name both your project in CCS as well as the ZIP file you upload according to the following structure, replacing the expressions within the brackets:*
>
>   `Exercise_ [ExerciseNo]_ [YourLastName]`
>
>   *So, if you upload your solution for exercise 3 and your name is John Doe, then you have to upload the project Exercise_3_Doe within the ZIP folder Exercise_3_Doe.zip*
>
> 2. *Please **always** include your name in both your main.c (in a header comment) and your feedback.txt.*
>
> 3. *To export your project, please **always** use: File > Export. . . > General > Archive File, then select the required project and type the name of the ZIP file in the field 'To archive file:'.*