

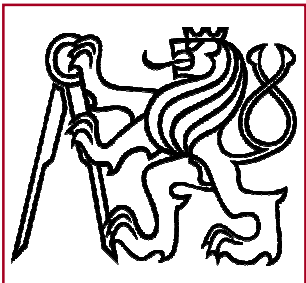
Y35PES

Programming for Embedded Systems

Ondřej Špinka, Pavel Němeček

spinkao@fel.cvut.cz nemecp1@fel.cvut.cz

<http://dce.felk.cvut.cz/pes>



Lectures Annotation

1. Familiarization with development kit and toolchain, Atmel AT91SAM7 PIO Controller. Building and running a simple project.
2. Main differences between C and Java from programmer's point of view. Phases of C program build. Introduction to C. Basic structure of a C program. Matrix keyboard.
3. Pointers and their correspondence with assembler code. Arrays and strings. Scope of a variable. Functions, function calls, function parameters.
4. Code decomposition, makefile. Advanced C programming techniques. Inline code. C code portability.
5. Microprocessor basics (how a CPU works, RISCxCISC, pipelining, etc.). Microprocessor x microcontroller x SOC (System-On-Chip).
6. Description of the ARM core and its philosophy. Example of ARM-based microcontroller. Basic hardware peripherals and their usage (TPU, UART, PWM, CAN, watchdog...).
7. ARM exceptions and interrupts handling, writing an interrupt handler
8. Atmel Advanced Interrupt Controller (AIC). Volatile-type variables, program safety. ARM assembler basics.
9. Introduction to embedded systems. ES properties and design phases. Electrical and mechanical requirements. Reliability, safety and testing. Real-time operations.
10. TBA
11. TBA
12. Reserve
13. Final test

Labs Annotation

1. Familiarization with development tool chain, building and running a simple program
2. I/O ports, matrix keyboard
3. Interrupts, Timers and PWM
4. A/D converter, I²C bus
5. Reserve, finalizing homework
6. Test (simple program)
7. Reserve
8. Individual lab work (semester project)
9. Individual lab work (semester project)
10. Individual lab work (semester project)
11. Individual lab work (semester project)
12. Individual lab work (semester project)
13. Semester work evaluation, finish

Knowledge and Skills Required

- Students attending this course should have basic programming skills and basic knowledge about processor functionality.
- Students are supposed to have passed following courses:
 - Y36PJV Programování v jazyce Java
 - Y36SAP Struktura a architektura počítačů

What will you learn

- Basic knowledge concerning Embedded Systems
- ARM architecture overview
- Basic C language programming skills
- Basic programming techniques for Embedded Systems
- Basic knowledge about software portability, effectiveness and safety

Requirements to Finish the Course

- A student must acquire at least half of the points from the labs and must complete his lab project to be allowed to the exam (maximum 80 points, 40 points are mandatory).
- At least half of the points must be achieved during the final test in order to pass. (maximum 60 points, 30 points are mandatory).

Course Classification:

- | | | | |
|-----------------------|----|------|----------------------------------|
| • 140 points | A* | :-O | (Outstanding – you're the King!) |
| • 130 – 139 points | A | :-D | (Excellent) |
| • 120 – 129 points | B | :-) | (Very Good) |
| • 105 – 119 points | C | :- | (Good) |
| • 90 – 104 points | D | :-\ | (Satisfactory) |
| • 70 – 89 points | E | :-(| (Sufficient) |
| • Less than 70 points | F | :-((| (Failed) |

Recommended Literature

- John Bayko - Great Microprocessors of the Past and Present (<http://jbayko.sasktelwebsite.net/cpu.html>)
- Arbitrary C language programming guide / tutorial
 - Pavel Herout – Programování v jazyce C – (book in Czech language, good C tutorial)
 - http://einstein.drexel.edu/courses/CompPhys/General/C_basics/ - short C language tutorial, in English)
 - <http://www.tuke.sk/podlubny/C/> (in Slovak, good C tutorial)
- ARM7TDMI Technical Reference Manual (pdf version available at the course website <http://dce.felk.cvut.cz/pes>)
- ARM Programming Techniques (pdf version available at the course website <http://dce.felk.cvut.cz/pes>)
- AT91SAM7X256 datasheet (available at the course website <http://dce.felk.cvut.cz/pes> or at the manufacturer's web <http://www.atmel.com>)