Exam, Introduction to Electronic System Design (DAT093)

Wednesday Dec 21, 2016

Time and place: Wednesday Dec 21, 14:00, M building

Examiner: Lars Svensson

Department: Computer Science and Engineering

Inquiries: Lars Svensson (ext. 1704); will visit the room at 15:00 and at 17:30

Solutions: To be posted on Dec 22, in PingPong

Results: To be posted on or before Jan 9, 2017, in LADOK

Grading review: Room and time to be posted in PingPong

Grade limits:

3: 24–39 points; 4: 40–49 points, 5: 50– points

Extra grade points earned during the lab course (the 2016 installment) will be added to the exam result before computing the final grade.

Allowable references and utilities: English dictionary; no other books or papers.

General: Submit your solutions, ***in English***, on the blank paper sheets provided. Write legibly; feel free to use figures to get your point across.

Please write on only one side of each sheet. Please do not combine solutions to several problems on the same sheet. Please order your sheets in sequence with the problems solved.

In some problems, it may be necessary to make assumptions. When you do, state your assumptions explicitly and motivate them. Reasoning and descriptions can give partial credit even if the end result is incorrect.

The maximum points for each problem is given in parenthesis after the problem text.

Be sure to write your identification code on each sheet!

Good luck!

Problems

1. (a) The abbreviation "PVT" is used to describe design margins. For each of the three letters, briefly describe why a design margin may be needed to guarantee that performance targets are met. (6p)

   (b) The "cost" of design margins is frequently an increased power dissipation. Explain why and/or how. (2p)

2. The driving trend of electronic system development over the past few decades is known as *Moore's Law*.

   (a) What is the common definition of the "law"? (2p)

   (b) Discuss how the "law" has enabled the design and manufacturing of increasingly able, high-performance systems. (2p)

   (c) The previous task focused on the *benefits* of the "law". Next, select and discuss *two challenges* that must be addressed in order to benefit from the progression of the "law". (4p)

3. (a) On the topic of microprocessor design, briefly describe the expected trends for clock frequency, number of cores per processor, and power budget per processor. (6p)

   (b) Power-directed microprocessor design will often result in other design choices than purely performance-directed design. Briefly discuss one aspect which is affected by the power perspective, and outline how the power-aware design might be different. (2p)

4. From the DAT093 labs, you are familiar with FPGA development boards and how to program/configure them. Most probably, you have also come across traditional microprocessor development boards. While very useful in teaching, the main purpose of development boards is to ease development of *products* based on the FPGA or microprocessor featured on the board.

   A new type of development board, the ZedBoard[1], has recently become available, featuring a Xilinx "Zync" chip which combines a software-programmable ARM processor with some configurable FPGA hardware.

   (a) Describe some possible benefits and drawbacks of basing a design around a Zync chip compared with using a pure FPGA solution. (3p)

   (b) Describe some possible benefits and drawbacks of basing a design around a Zync chip compared with using a pure software-on-microprocessor solution. (3p)

   (c) What might characterize a product where the Zync solution would be superior to either of these two alternatives? (2p)

5. (a) Surface mounting of components is the default method for new-system development. Outline surface-mounting benefits and drawbacks, and give some examples of when it would *not* be a good choice. (4p)

[1] `http://www.zedboard.org`

(b) A Multi-Chip Module (MCM) may be an alternative to a "conventional" packaging strategy for an electronic system. Outline some benefits and drawbacks that can be expected when going for an MCM solution. In what kind of systems may MCMs be attractive? (4p)

6. Emilia, a designer of embedded electronic systems, has just received an emergency call: a product built by her employer includes a power supply unit which has proved to be unreliable[2] at the power level at which it currently operates. All units fed by this supply must therefore reduce their power drain if at all possible.

   Emilia is assigned to review an FPGA design that includes a soft processor core implemented in VHDL. It is not possible to replace the FPGA part (that would require a new PCB) but she does have spare room both in the FPGA itself and in the processor program memory (which is external to the FPGA). Also, the supply voltage for the FPGA can be adjusted via software that runs on the processor.

   Suggest at least three possible approaches for Emilia, and discuss why they might help her reach her goal as quickly as possible! (8p)

THE END

[2]Only three fires, but one of them is already trending on Twitter