Saarland University
Department 6.2 - Computer Science
Prof. Dr. W. J. Paul
Dr. Mikhail Kovalev, Jonas Oberhauser

System Architecture (block course) - SS13
Exercise Sheet 4 (due: 21.08.13) - 13 points

Organizational notes:

- For feedback on the difficulty of the sheet, please write down the amount of time spent on the exercise sheet (in hours, excluding bonus exercises). This number is irrelevant for your admission but helps us adjust the amount of exercises on each sheet.

Name, matr. nr., time spent: _____

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Exercise 1: (4)

Recall correctness of the hardware during the execute cycle. Prove that for $c = c^i$, $h = h^{2i+1}$, if $c \sim h$ and $I(c) = h.I$, then:

(a) (1 point)
$$h^{2\cdot(i+1)}.pc = c^{i+1}.pc$$

(b) (3 points)
$$h^{2\cdot(i+1)}.gpr = c^{i+1}.gpr$$

Exercise 2: (3)

Recall the two alternative ways to compute the link address $linkad \in \mathbb{B}^{32}$: one using a 32-bit adder and the inputs pc and 4_{32} and one using a 30-bit incrementer with input $pc[31:2]$. Prove that both compute the same output.

Exercise 3: (2)

Recall that we used a 30-bit adder for adding $pc[31:2]$ and $imm_{15}^{14}imm$ to get $btarget$ in the case where $b = 1$, but a 32-bit adder in the case of computing the effective address ea from A and $sxtimm$. Explain in two sentences why a 32-bit adder is necessary in this case.

Exercise 4: (4)

Recall the definition of a/b as given in the lecture:

$$a/b = \max\{C \in \mathbb{N} : b \cdot C \leq a\}$$

(a) (1 point) Show that for all a, $a/0$ is not defined.
(b) (2 points) Show that small integer division does not work when $p[31] \neq 0$.
(c) (1 point) Prove that we can use small integer division to divide $|a|$ by $|b|$.