



System Architecture (block course) - SS13  
Exercise Sheet 10 (due: 11.09.13) - 13 points

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**Exercise 5:**

(4)

Prove the correctness of the Hardware MMU in user mode. I.e., prove that for MIPS+Interrupts configurations  $c$  and hardware configurations  $h$ , if  $h.mode[0] = 1$  and  $c \sim h$ , then:

(a) (2 points)

$$/h.E \rightarrow ma(h) = \begin{cases} ptea(c, c.pc) & h.phase = 0 \\ pma(c, c.pc) & h.phase = 1 \end{cases}$$

(b) (2 points)

$$h.E \wedge (sw(c) \vee lw(c)) \rightarrow ma(h) = \begin{cases} ptea(c, ea(c)) & h.phase = 0 \\ pma(c, ea(c)) & h.phase = 1 \end{cases}$$

You can assume the correctness of the old hardware design (without the MMU).

**Exercise 6:**

(1)

Give a formal definition of the page fault on a load or store instruction ( $pfls(c) \in \mathbb{B}$ ).