University of the Saarland
Department 6.2 – Informatik
Prof. Dr. W.J. Paul

Computer Architecture II – WS 05/06

(due: Monday, 12.12.2005)

Exercise 1: (OVF1) **(10 points)**

Let:

$$f_r[-1:0] = 00 \Rightarrow e_r \le e_{max}$$

To be proven:

$$OVF1 \Leftrightarrow (e_r > e_{max}) \vee ((e_r = e_{max}) \wedge f_r[-1])$$

Exercise 2: (SELECT FD Circuit) **(5 + 10 points)**

Let:

$$\beta = f_a - E_b - 2^{-(p+1)} \cdot f_b$$

$$\langle 0.0^{24} f_{sb}[25.106] \rangle = \begin{cases} \langle 0.0^{24} 0^{29} D_b[0:52] \rangle & : db \\ \langle 0.0^{24} D_b[0:52] 0^{29} \rangle & : \neg db \end{cases}$$

$$= 2^{-(p+1)} \cdot f_b$$

The SELECT FD circuit given on page 386 in MP00 computes f_d as follows:

$$f_d = \begin{cases} E + 2^{-(p+2)} & : \text{ if } \beta < 0 \\ E + 2^{-(p+1)} & : \text{ if } \beta = 0 \\ E + 3 \cdot 2^{-(p+2)} & : \text{ if } \beta > 0 \end{cases}$$

1. Redo the construction of the SELECT FD circuit based on the shortened f_{sb} defined above.
2. Prove the correctness of you construction.

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Exercise 3: (Table Size vs. Number of Iterations) **(10 points)**

In the lecture we designed the multiply/divide unit from the book which performs a division based on the Newton-Raphson method. The iteration starts out with an initial approximation x_0 which is obtained from a $2^\gamma \times \gamma$ lookup table. The intermediate results are truncated after $\sigma = 57$ bits. The number i of iterations necessary to reach $p+2$ bits of precision (i.e. $\delta_i < 2^{-(p+2)}$) is then bounded by

$$i = \begin{cases} 1 \text{ if } (p=24) \wedge (\gamma=16) \\ 2 \text{ if } (p=24) \wedge (\gamma=8) \vee (p=53) \wedge (\gamma=16) \\ 3 \text{ if } (p=24) \wedge (\gamma=8) \vee (p=53) \wedge (\gamma=8) \end{cases}$$

To be proven: The number of iterations suffices to achieve the desired precision.