University of the Saarland
Department 6.2 - Informatik
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Computer Architecture II - SS 04

(due: 12.10.2004)

Exercise 1: (Table Size vs. Number of Iterations) **(9 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 bit of precision (i.e. $\delta_i < 2^{-p-1}$) is then bounded by

$$i = \begin{cases} 1 & \text{if } p = 24 \wedge \gamma = 16 \\ 2 & \text{if } p = 24 \wedge \gamma = 8 \vee p = 53 \wedge \gamma = 16 \\ 3 & \text{if } p = 24 \wedge \gamma = 5 \vee p = 53 \wedge \gamma = 8 \\ 4 & \text{if } p = 53 \wedge \gamma = 5 \end{cases}$$

Show for each case, that the number of iterations suffices to achieve the desired precision.

Exercise 2: (Comparing absolute values) **(5 points)**

For testing $|a| < |b|$ it suffices to test $\langle e_a f_a \rangle < \langle e_b f_b \rangle$ In the lecture we already showed this for normal numbers a,b. Prove the remaining cases.

Exercise 3: (FMA precision) **(20 points)**

In the lecture we already showed that the *FMA* needs a precision of 4p+2 bits for computing normal numbers.

a.) How many bits do we need for denormal numbers in case we have a non-trapped execution, i.e. no exponent wrapping?

b.) How many bits do we need for a fully *IEEE* compliant computation?