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

Computer Architecture II - SS 04

(due: 14.09.2004)

For the admission to the exam you will need at least 50 % of the combined points of all excercises. You are allowed to solve the exercise sheets in groups of arbitrary size. But everybody who has his name on the solution must be able to present it in the tutorials. Everybody must present the solution of at least two excercises.
The first three weeks we will only have one exercise per week, the discussions are Thursdays. The last three weeks we will have exercises every Tuesday and Thursday

The discussion of this exercise will be on Thursday 16.09.04 14-16 in Room R013

Exercise 1: (Two's Complement Fractions) **(2 points)**

Let $\left[a[n-1:0].f[1:p]\right] = -a[n-1] * 2^{n-1} + \langle a[n-2:0].f[1:p-1]\rangle$.

Let $x = \left[a[s-1:0].f[1:u]\right]$ and $y = \left[b[t-1:0].g[1:v]\right]$ be 2's complement fractions with $s > t$ and $u < v$.
Prove:

- $x + y = (\left[af0^{v-u}\right] + \left[b_{t-1}^{s-t} b[t-1:0]g\right]) * 2^{-v}$

Exercise 2: (Computation Rules) **(2 + 2 + 2 + 2 + 2 + 2 points)**

In the lecture we introduced some computation rules for α equivalence and α representatives. Prove the correctness of the following lemmas:

Let $x =_\alpha x'$. Then it holds:

1. $-x =_\alpha -x'$
2. $[-x]_\alpha = -[x]_\alpha$
3. $2x =_{\alpha-1} 2x'$
4. $2^e * x =_{\alpha-e} 2^e * x'$
5. Let y be a multiple of $2^{-\alpha}$. Then it holds: $x + y =_\alpha x' + y$
6. Let $\beta < \alpha$ then $x =_\beta x'$

Exercise 3: (Rounding Theory) **(2 + 2 + 2 points)**

Prove:

If $\hat{\eta}(x) = (s, e, f)$, then:

1. $\hat{r}(x) = \hat{r}([x]_{p-e})$
2. $\hat{\eta}([x]_{p-e}) = (s, e, [f]_p)$
3. $x =_{p-e} x' \Rightarrow \hat{r}(x) = \hat{r}(x')$

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Exercise 4: (Sticky Bit Computation) **(4 points)**

Let $f = f[-u : 0].f[1 : v]$ be a binary fraction.
Let

$$g = f[-u : 0].f[1 : p]$$

and let

$$s = \bigvee_{i=p+1}^{v} f[i]$$

be the sticky bit of f for position p.
Show:

$$[\langle f \rangle]_p = \langle gs \rangle$$