INFOMOV 2017/2018 EXAM - November 7 – 17.00 - 19.00 – BEATRIX-7F

Answer these questions as elaborate as necessary. Don't be too elaborate; incorrect statements in your answer reduce your score. Negative scores for a (sub)question are not possible however.

1. The slides for lecture 8 state that "The memory hierarchy is explicit on the GPU". What does this mean? (15 pts)

2. Consider the following code snippet, which scales an 32-bit RGB color:

```
unsigned int ScaleColor( uint c, float x ) // x = 0..1
{  int red = (c >> 16) & 255, green = (c >> 8) & 255, blue = c & 255;
   red = red * x, green = green * x, blue = blue * x;
   return (red << 16) + (green << 8) + blue; }
```

   a) Describe the primary source of inefficiency in this code. (10 pts)
   b) Write down a more efficient version. Note: you will not be judged on precise syntax (within reason). (10 pts)

3. A processor is fitted with 512KB 8-way set associative L2 cache. The cache uses 32-byte cache lines. Calculate how many bits are stored for the tag. (15 pts)

4. A custom processor is to be designed specifically to run an algorithm that involves extensive data access to a 1024 x 1024 byte array. The algorithm accesses the array per row, as well as per column. The CPU designers have two options:
   1. Fit the CPU with an 16KB 4-way set associative cache;
   2. Fit the CPU with an 8KB 8-way set associative cache.
   Write down which option, in your opinion, is best. Motivate your answer. (15 pts)

5. Explain the following concepts in 30 words or less. (10 pts per concept)

   a) A prefetch thread
   b) A super-scalar pipeline
   c) Out-of-order execution

6. Some questions on vector processing. Use 30 words or less for each answer. (10 pts each)

   a) What is the difference between SIMD and SIMT?
   b) What is, in this context, a 'lane'?
   c) What is a 'horizontal operation'?

7. Explain how and under what conditions you could do an actual comparison of the quality of an eviction policy against Bélády's algorithm. (15 pts)

Good luck! ***max points: 140; grade: 1+pts*9/140***