Advanced Topics in Databases
Exercise 5

1. [Group 5] Why is the scalability of Single-Core CPUs limited? What are problems with respect to Multi-Core CPUs? What benefit can a heterogeneous system provide? What is the main challenge for a heterogeneous system, and how can this challenge be circumvented?

2. [Group 6] In the lecture, five different processing devices were introduced. Discuss the usability of the device for the following database (sub)tasks?
   - Selections
   - Compression
   - Hashing
   - Sorting
   - Grouping
   - Aggregation
   - Insert/Update/Delete

3. [Group 7] State and explain the hazards discussed in lecture. What is forwarding (sometimes also called bypassing) and what hazard can be mitigated with it?

4. [Group 7] What hazards can be found in the following assembler code snippets? To execute the code snippets in a RISC architecture without reordering, how much pipeline stalls would have to be included? What are possible points where a reordering makes sense?

   a) 
   ADDI F2, F0, #5
   ADD F1, F0, F0
   ADDI F4, F1, #5

   b) 
   L1: SUBI F3, F3, #1
   ADDI F2, F2, #2
   ADDI F1, F1, #1
   BNE F2, F1, L1

   c) 
   DADDU F2, F3, F4
   BEQZ F2, L1
   LW  F1, 0(F2)
   L1:

   d) 
   DADDU R1, R2, R3
   BEQZ R4, L1
   DSUBU R1, R5, R6
   L1:
   OR  R7, R1, R8

5. [Group 8] Loop unrolling can be used to reduce data hazards in tight loops. Considering the database tasks of Task 2, where could those tight loops occur?

6. [Group 9] Considering the code snippet Task 4 b, what is the optimal unrolling depth to avoid the data hazards? (A reordering should be included in your consideration.)

Good Luck!