Advanced Topics in Databases
Exercise 4

1. Future database systems need to use different processors. In the lecture, different processors were presented. How would the processors be used in the following scenarios, explain why:
   - Disk-based database
   - Main-Memory database
   - OLTP with small data footprint
   - OLAP with small data footprint
   - OLTP with medium data footprint
   - OLAP with medium data footprint
   - OLAP with large data footprint

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

4. 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?

```
ADDI F2, F0, #5
ADD F1, F0, F0
ADDI F4, F1, #5
L1: SUBI F3, F3, #1
ADDI F0, F0, #2
ADDI F1, F1, #1
BNE F2, F1, L1
DADDU F2, F3, F4
BEQZ F2, L1
DSUBU R1, R5, R6
DADDU R1, R2, R3
BEQZ R4, L1
L1: OR R7, R1, R8
LW F1, 0(F2)
```
5. 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. Considering the code snippet in Task 4 in the upper right corner, what is the optimal unrolling depth to avoid the data hazards? (A reordering should be included in your consideration.)

Good Luck!