Advanced Topics in Databases
Exercise 5

1. 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

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

3. 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?

```assembly
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
    LW F1, 0(F2)
L1:
```

4. Loop unrolling can be used to reduce data hazards in tight loops. Considering the database tasks of Task 1, where could those tight loops occur?

5. Turn each of the loops in Figure 1 into branch-free loops.

6. Considering an unrolling of a selection that is using branching code. What does the optimal unrolling depth depend on in this case? What could be done to have a stable optimal unrolling depth?

Good Luck!
int count = 0;
for (int i = 0; i < array.size; ++i) {
    if (array[i] < 100)
        count++;
    else
        count--;
}

Abbildung 1: Loops for different countings.