

# Database Systems II – Exercise #5

## Sheet #5: Bit Manipulations, Row Store vs. Column Store

Daniel Flachs

Chair of Practical Computer Science III:  
Database Management Systems

27/03/2019



# Contents

- 1 Exercise Sheet #5
  - Task 1
  - Task 2

# Task 1

- a) Perform the following bit computations by hand.
- (i)  $0110 + 0010$
  - (ii)  $0011 * 0101$
  - (iii)  $1101 \gg 2$
- b) Explain the two's complement. What is the sum of a positive number and its two's complement?
- c) What does the following code do, given  $n$  is an integer?  
 $((n \& (n-1)) == 0)$
- d) Implement the `setBit` and the `hasZeroBit` member functions of the `Bitvector` class.

# std::bitset

- C++ offers a bit vector implementation: `std::bitset`
- Defined in header `bitset`
- Example: printing a bit pattern

```
1 uint32_t number = 13;
2 std::bitset<32> bits(number); // <32>: number of bits
3 std::cout << bits << std::endl; // prints 0..0 1101
```

# Task 2

Consider a database with the following schema.

- Customers: {[id:int, name:char(30), discount:double, country:int]}
- Countries: {[id:int, name:char(30), tax:double]}
- Products: {[id:int, name:char(30), price:double]}
- Orders: {[id:int, customer:int, product:int, quantity:int, date:int, totalPrice:double]}

# Task 2a

Represent the database relations in {row, column} store layout.

## Row store

```
1 struct country_t {
2     int _id;
3     char _name[30];
4     double _tax;
5 }
6 std::vector<country_t> countries;
```

## Column store

```
1 struct Countries {
2     std::vector<int> _ids;
3     std::vector<std::array<char, 30>> _names;
4     std::vector<double> _taxes;
5 }
```

# Task 2b

Implement a column store for the above schema in a class `CSDatabase`. You may use the `RSDatabase` as an orientation.

## Task 2c

Implement the following the SQL queries for both the row store and the column store. Variables preceded by an \$ represent parameters, i.e. only these parts of the query must be changeable, the rest can be hard-coded.

Hint: Implement each query as a member function of the RSDatabase and CSDatabase class.



# Task 2c

- ```
1 select totalPrice
  from orders
  order by totalPrice desc
  fetch first 10 rows only;
```
- ```
2 select date, sum(totalPrice)
  from orders
  where date >= $date
  group by date;
```
- ```
3 select c.id, c.name, count(o.id)
  from customers c, orders o
  where c.id = o.customer
  group by c.id, c.name;
```
- ```
4 update orders
  set totalPrice = $totalPrice
  where id = $orderId;
```