

## Section 5: Relational Calculus, SQL and Datalog

In this section, we are going to solve a fun problem using relational calculus, SQL and datalog to reveal the power of the three languages.

### 1 N-length integer addition

Implement the addition of two  $N$ -length integers using relational calculus, SQL and Datalog.

**Define** A  $N$ -length integer is a integer with  $N$  maximum number of binary bits.

For example,  $A = 1110100$  and  $B = 10100101$  are both 8-length integers. The result of their addition is 11001 rather than 100011001 because the highest carry bit exceeds 8-bit length, so it's dropped.

For the problem. We are given three input tables (relations).  $\mathbf{A(x)}$ ,  $\mathbf{B(x)}$ , and  $\mathbf{T(x,y)}$ .

$A(x)$  is a table with a single integer column recording the 1-value bit positions of the first addition source number. For example, the number 1110100 corresponds to

A
2
4
5
6

$B(x)$  encodes the second addition source number. For example, 10100101 corresponds to

B
0
2
5
7

$T(x,y)$  records the larger-than total order of all the bit positions in an  $N$ -length integer. For example :

2-length x,y	3-length x,y	8-length x,y
1,0	2,1	7,6
	2,0	7,5
	1,0	...
		2,1
		2,0
		1,0

Note that  $A$ ,  $B$  and  $T$  are all duplicate free.

Write a relational calculus, SQL and a Datalog program to solve this problem. For the example  $A$ ,  $B$  and 8-bit  $T$ , the result is

x
0
3
4