Chair of applied computer science III
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Query Optimization — Exercise sheet 1

## Exercise 1

You are given the following relations:

```
published(game, publisher)
designed(game, designer)
reviewed(game, reviewer)
```

Use relational algebra to construct a plan for each of the following queries. In addition, find a tree representation for each plan.

### Exercise 1 a)

Find all designers of the game "Sokoban".

### Exercise 1 b)

Find all publishers of all games designed by "Imabayashi".

### Exercise 1 c)

Find all reviewers who have reviewed at least one game that has not yet been published.

## Exercise 2

How does `Select Distinct` simplify the produced results?

## Exercise 3

Consider the relational algebra expression

$$R \bowtie S \bowtie T.$$

Since $\bowtie$ is commutative and associative, there are 12 equivalent ways to compute the result of the above expression:

$$(R \bowtie (S \bowtie T))$$

$$((R \bowtie S) \bowtie T)$$

$$(R \bowtie (T \bowtie S))$$

$$((R \bowtie T) \bowtie S)$$
$$(S \bowtie (R \bowtie T))$$
$$((S \bowtie R) \bowtie T)$$
$$(S \bowtie (T \bowtie R))$$
$$((S \bowtie T) \bowtie R)$$
$$(T \bowtie (R \bowtie S))$$
$$((T \bowtie R) \bowtie S)$$
$$(T \bowtie (S \bowtie R))$$
$$((T \bowtie S) \bowtie R)$$

We will soon see that, despite all expressions have the same result, their cost of computing differs greatly.

Implement a program that prints all possible ways to join $n$ relations.