1. Show that the optimal order of applying a set of joins \( S = \{\sigma_1, \ldots, \sigma_2\} \) can be found by sorting the elements of \( S \) according to a ranking function. Note that \( |S| \) can be larger than 2! (4)

2. Give an example where GreedyHeuristic-1 does not produce the optimal solution, but IKKBZ does. (2)

3. Extend the program from the previous exercise to create joins if possible (HashJoin in tinydb). Measure the difference for the query

```
select *
from lineitem l, order o
where l.l_orderkey = o.o_orderkey
```

Note: This uses the TPC-D data set available from the exercise web page. (4)