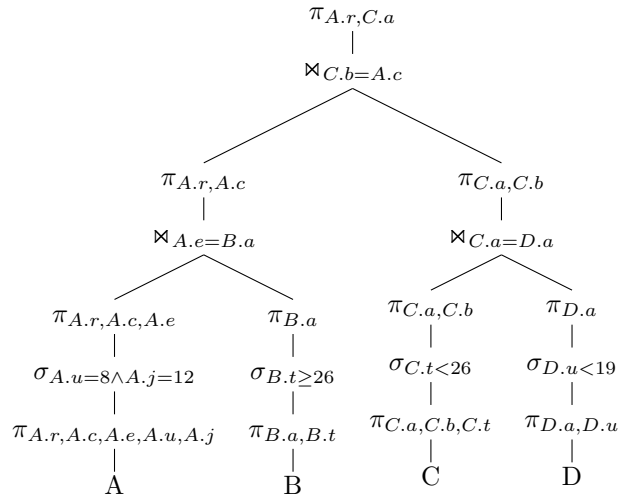# 1. From SQL to the Logical Plan

2. Heuristic Query Optimisation

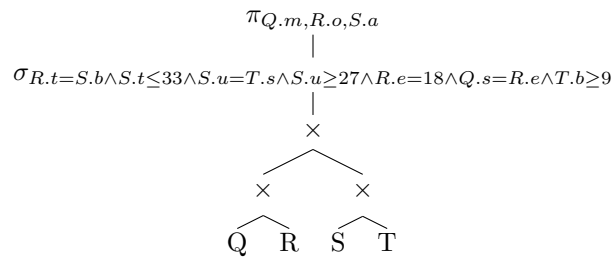## 2.1 (a)

Applying predicate and projection pushdown:

$$
\begin{array}{c}
\pi_{A.r,C.a} \\
| \\
\bowtie_{C.b=A.c}
\end{array}
$$

$$
\pi_{A.r,A.c} \qquad \pi_{C.a,C.b}
$$

$$
\bowtie_{A.e=B.a} \qquad \bowtie_{C.a=D.a}
$$

$$
\pi_{A.r,A.c,A.e} \qquad \pi_{B.a} \qquad \pi_{C.a,C.b} \qquad \pi_{D.a}
$$

$$
\sigma_{A.u=8 \wedge A.j=12} \qquad \sigma_{B.t \geq 26} \qquad \sigma_{C.t<26} \qquad \sigma_{D.u<19}
$$

$$
\pi_{A.r,A.c,A.e,A.u,A.j} \qquad \pi_{B.a,B.t} \qquad \pi_{C.a,C.b,C.t} \qquad \pi_{D.a,D.u}
$$

$$
A \qquad\qquad B \qquad\qquad C \qquad\qquad D
$$

2.2 (b)

2.2.1

$$
\pi_{Q.m,R.o,S.a}
$$

$$
\sigma_{R.t=S.b \wedge S.t \leq 33 \wedge S.u=T.s \wedge S.u \geq 27 \wedge R.e=18 \wedge Q.s=R.e \wedge T.b \geq 9}
$$

$$
\times
$$

$$
\times \qquad\qquad \times
$$

$$
Q \quad R \qquad S \quad T
$$

2.2.2

Applying predicate and projection pushdown:

$$\pi_{Q.m,R.o,S.a}$$
$$\bowtie_{R.t=S.b}$$

Left subtree:
$$\pi_{Q.m,R.o,R.t}$$
$$\bowtie_{Q.s=R.e}$$
$$\pi_{Q.m,Q.s} \qquad \sigma_{R.e=18}$$
$$Q \qquad \pi_{R.o,R.t,R.e}$$
$$R$$

Right subtree:
$$\pi_{S.a,S.b}$$
$$\bowtie_{S.u=T.s}$$
$$\sigma_{S.t \leq 33 \wedge S.u \geq 27} \qquad \sigma_{T.b \geq 9}$$
$$\pi_{S.a,S.b,S.t,S.u} \qquad \pi_{T.s,T.b}$$
$$S \qquad T$$
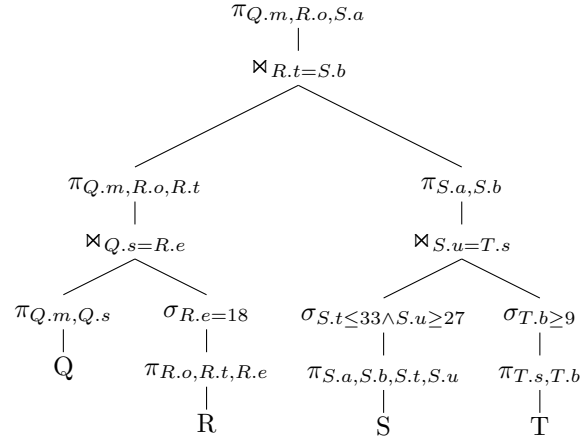
2.2.3

Since we defined predicates on attributes used in joins, we can also apply and push down those predicates on the key-attributes of the opposing relation.

$$\pi_{Q.m,R.o,S.a}$$
$$\bowtie_{R.t=S.b}$$

Left subtree:
$$\pi_{Q.m,R.o,R.t}$$
$$\bowtie_{Q.s=R.e}$$
$$\sigma_{Q.s=18} \qquad \sigma_{R.e=18}$$
$$\pi_{Q.m,Q.s} \qquad \pi_{R.o,R.t,R.e}$$
$$Q \qquad R$$

Right subtree:
$$\pi_{S.a,S.b}$$
$$\bowtie_{S.u=T.s}$$
$$\sigma_{S.t \leq 33 \wedge S.u \geq 27} \qquad \sigma_{T.b \geq 9 \wedge T.s \geq 27}$$
$$\pi_{S.a,S.b,S.t,S.u} \qquad \pi_{T.s,T.b}$$
$$S \qquad T$$