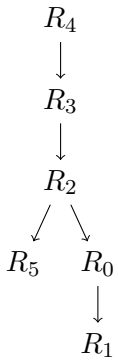
9 Exercise Sheet 9

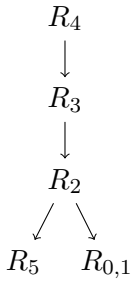
9.1 Exercise 1

9.1.1 linearize the search space

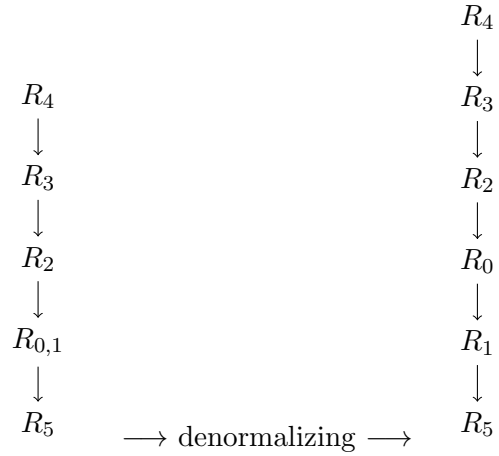


Relation	n	s	C	T	rank
R_3	40	0.3	12	12	$\frac{11}{12} = 0.9167$
R_2	50	0.2	10	10	$\frac{9}{10} = 0.9$
R_5	55	0.2	11	11	$\frac{10}{11} = 0.9091$
R_0	20	0.2	4	4	$\frac{3}{4} = 0.75$
R_1	10	0.1	1	1	0

merge R_0 and R_1



Relation	n	s	C	T	rank
R_3	40	0.3	12	12	$\frac{11}{12} = 0.9167$
R_2	50	0.2	10	10	$\frac{9}{10} = 0.9$
R_5	55	0.2	11	11	$\frac{10}{11} = 0.9091$
$R_{0,1}$			8	4	$\frac{3}{8} = 0.375$
R_0	20	0.2	4	4	$\frac{3}{4} = 0.75$
R_1	10	0.1	1	1	0



9.1.2 perform linearized DP

$R_4 \quad R_3 \quad R_2 \quad R_0 \quad R_1 \quad R_5$

Two Relations:

$(R_4 \bowtie R_3) \quad R_2 \quad R_0 \quad R_1 \quad R_5 \qquad \{R_3, R_4\} \quad C_{out} = 600$
$R_4 \quad (R_3 \quad R_2) \quad R_0 \quad R_1 \quad R_5 \qquad \{R_2, R_3\} \quad C_{out} = 400$
$R_4 \quad R_3 \quad (R_2 \quad R_0) \quad R_1 \quad R_5 \qquad \{R_0, R_2\} \quad C_{out} = 200$
$R_4 \quad R_3 \quad R_2 \quad (R_0 \quad R_1) \quad R_5 \qquad \{R_0, R_1\} \quad C_{out} = 20$
$R_4 \quad R_3 \quad R_2 \quad R_0 \quad (R_1 \quad R_5) \qquad \{R_1, R_5\} \quad \lightning$

Three Relations:

$(R_4 \bowtie (R_3 \bowtie R_2)) \quad R_0 \quad R_1 \quad R_5 \qquad \{R_2, R_3, R_4\} \quad C_{out} = 6400$
~~$((R_4 \bowtie R_3) \bowtie R_2) \quad R_0 \quad R_1 \quad R_5 \qquad \{R_2, R_3, R_4\} \quad C_{out} = 6600$~~
$R_4 \quad (R_3 \bowtie (R_2 \bowtie R_0)) \quad R_1 \quad R_5 \qquad \{R_0, R_2, R_3\} \quad C_{out} = 1800$
~~$R_4 \quad ((R_3 \bowtie R_2) \bowtie R_0) \quad R_1 \quad R_5 \qquad \{R_0, R_2, R_3\} \quad C_{out} = 2000$~~
$R_4 \quad R_3 \quad (R_2 \bowtie (R_0 \bowtie R_1)) \quad R_5 \qquad \{R_0, R_1, R_2\} \quad C_{out} = 220$
~~$R_4 \quad R_3 \quad ((R_2 \bowtie R_0) \bowtie R_1) \quad R_5 \qquad \{R_0, R_1, R_2\} \quad C_{out} = 400$~~
$R_4 \quad R_3 \quad R_2 \quad (R_0 \bowtie (R_1 \bowtie R_5)) \qquad \{R_0, R_1, R_5\} \quad \lightning$
$R_4 \quad R_3 \quad R_2 \quad ((R_0 \bowtie R_1) \bowtie R_5) \qquad \{R_0, R_1, R_5\} \quad \lightning$

Four Relations:

$(R_4 \bowtie (R_3 \bowtie (R_2 \bowtie R_0))) \quad R_1 \quad R_5 \qquad \{R_0, R_2, R_3, R_4\} \quad C_{out} = 24400$
~~$(R_4 \bowtie R_3) \bowtie (R_2 \bowtie R_0) \quad R_1 \quad R_5 \qquad \{R_0, R_2, R_3, R_4\} \quad C_{out} = 24800$~~
~~$((R_4 \bowtie (R_3 \bowtie R_2)) \bowtie R_0) \quad R_1 \quad R_5 \qquad \{R_0, R_2, R_3, R_4\} \quad C_{out} = 30400$~~
$R_4 \quad (R_3 \bowtie (R_2 \bowtie (R_0 \bowtie R_1)) \quad R_5 \qquad \{R_0, R_1, R_2, R_3\} \quad C_{out} = 1820$
~~$R_4 \quad (R_3 \bowtie R_2) \bowtie (R_0 \bowtie R_1) \quad R_5 \qquad \{R_0, R_1, R_2, R_3\} \quad C_{out} = 2020$~~
~~$R_4 \quad ((R_3 \bowtie (R_2 \bowtie R_0)) \bowtie R_1) \quad R_5 \qquad \{R_0, R_1, R_2, R_3\} \quad C_{out} = 3400$~~
$R_4 \quad R_3 \quad ((R_2 \bowtie (R_0 \bowtie R_1)) \bowtie R_5) \qquad \{R_0, R_1, R_2, R_5\} \quad C_{out} = 2420$

Five Relations:

$(R_4 \bowtie (R_3 \bowtie (R_2 \bowtie (R_0 \bowtie R_1)))) \quad R_5 \qquad \{R_0, R_1, R_2, R_3, R_4\} \quad C_{out} = 24000 + 1820 = 25820$
~~$((R_4 \bowtie R_3) \bowtie (R_2 \bowtie (R_0 \bowtie R_1))) \quad R_5 \qquad \{R_0, R_1, R_2, R_3, R_4\} \quad C_{out} = 24000 + 220 + 600 = 24820$~~

~~$((R_4 \bowtie (R_3 \bowtie R_2)) \bowtie (R_0 \bowtie R_1))$ R_5 $\{R_0, R_1, R_2, R_3, R_4\}$ $C_{out} = 24000 + 6400 + 20 = 30420$~~
~~$((R_4 \bowtie (R_3 \bowtie (R_2 \bowtie R_0))) \bowtie R_1)$ R_5 $\{R_0, R_1, R_2, R_3, R_4\}$ $C_{out} = 24000 + 24400 = 48400$~~
~~R_4 $(R_3 \bowtie ((R_2 \bowtie (R_0 \bowtie R_1)) \bowtie R_5))$ $\{R_0, R_1, R_2, R_3, R_5\}$ $C_{out} = 17600 + 2420 = 20020$~~
R_4 $((R_3 \bowtie (R_2 \bowtie (R_0 \bowtie R_1))) \bowtie R_5)$ $\{R_0, R_1, R_2, R_3, R_5\}$ $C_{out} = 17600 + 1820 = 19420$
Six Relations:
~~$(R_4 \bowtie ((R_3 \bowtie (R_2 \bowtie (R_0 \bowtie R_1))) \bowtie R_5))$ $\{R_0, R_1, R_2, R_3, R_5\}$ $C_{out} = 264000 + 19420 = 283420$~~
$((R_4 \bowtie R_3) \bowtie ((R_2 \bowtie (R_0 \bowtie R_1)) \bowtie R_5))$ $\{R_0, R_1, R_2, R_3, R_5\}$ $C_{out} = 264000 + 600 + 2420 = 267020$
~~$((R_4 \bowtie (R_3 \bowtie (R_2 \bowtie (R_0 \bowtie R_1))) \bowtie R_5)$ $\{R_0, R_1, R_2, R_3, R_5\}$ $C_{out} = 264000 + 25820 = 289820$~~

9.1.3 perform a full DP

Size = 2:
$\{R_0, R_1\}$
$(R_0 \bowtie R_1)$ $C_{out} = 20$

$\{R_0, R_2\}$
$(R_0 \bowtie R_2)$ $C_{out} = 200$

$\{R_2, R_3\}$
$(R_2 \bowtie R_3)$ $C_{out} = 400$

$\{R_2, R_5\}$
$(R_2 \bowtie R_5)$ $C_{out} = 550$

$\{R_3, R_4\}$
$(R_3 \bowtie R_4)$ $C_{out} = 600$

Size = 3:
$\{R_0, R_1, R_2\}$
$(\{R_0, R_1\} \bowtie R_2)$ $C_{out} = 220$
~~$(\{R_0, R_2\} \bowtie R_1)$ $C_{out} = 400$~~

$\{R_0, R_2, R_5\}$
$(\{R_0, R_2\} \bowtie R_5)$ $C_{out} = 2'400$
~~$(\{R_2, R_5\} \bowtie R_0)$ $C_{out} = 2'600$~~

$\{R_0, R_2, R_3\}$
$(\{R_0, R_2\} \bowtie R_3)$ $C_{out} = 1'800$
~~$(\{R_2, R_3\} \bowtie R_0)$ $C_{out} = 2'000$~~

$\{R_2, R_3, R_5\}$
$(\{R_2, R_3\} \bowtie R_5)$ $C_{out} = 4'800$
~~$(\{R_2, R_5\} \bowtie R_3)$ $C_{out} = 4'950$~~

$\{R_2, R_3, R_4\}$
$(\{R_2, R_3\} \bowtie R_4)$ $C_{out} = 6'400$
~~$(\{R_3, R_4\} \bowtie R_2)$ $C_{out} = 6'600$~~

Size = 4:
$\{R_0, R_1, R_2, R_5\}$
$(\{R_0, R_1, R_2\} \bowtie R_5)$ $C_{out} = 2'420$
~~$(\{R_0, R_2, R_5\} \bowtie R_1)$ $C_{out} = 4'600$~~
~~$(\{R_0, R_1\} \bowtie \{R_2, R_5\})$ $C_{out} = 2'770$~~

$\{R_0, R_1, R_2, R_3\}$
$(\{R_0, R_1, R_2\} \bowtie R_3)$ $C_{out} = 1'820$
~~$(\{R_0, R_2, R_3\} \bowtie R_1)$ $C_{out} = 3'400$~~
~~$(\{R_0, R_1\} \bowtie \{R_2, R_3\})$ $C_{out} = 2'020$~~

$\{R_0, R_2, R_3, R_5\}$
~~$(\{R_0, R_2, R_5\} \bowtie R_3)$ $C_{out} = 20'000$~~
$(\{R_0, R_2, R_3\} \bowtie R_5)$ $C_{out} = 19'400$
~~$(\{R_2, R_3, R_5\} \bowtie R_0)$ $C_{out} = 22'400$~~

$\{R_0, R_2, R_3, R_4\}$
~~$(\{R_0, R_2, R_3\} \bowtie R_4)$ $C_{out} = 25'800$~~
~~$(\{R_2, R_3, R_4\} \bowtie R_0)$ $C_{out} = 30'400$~~
$(\{R_0, R_2\} \bowtie \{R_3, R_4\})$ $C_{out} = 24'800$

$\{R_2, R_3, R_4, R_5\}$
~~$(\{R_2, R_3, R_4\} \bowtie R_5)$ $C_{out} = 72'400$~~
~~$(\{R_2, R_3, R_5\} \bowtie R_4)$ $C_{out} = 70'800$~~
$(\{R_2, R_5\} \bowtie \{R_3, R_4\})$ $C_{out} = 67'150$

Size = 5:
$\{R_0, R_1, R_2, R_3, R_4\}$
~~$(\{R_0, R_1, R_2, R_3\} \bowtie R_4)$ $C_{out} = 25'820$~~
~~$(\{R_0, R_2, R_3, R_4\} \bowtie R_1)$ $C_{out} = 48'800$~~
$(\{R_0, R_1, R_2\} \bowtie \{R_3, R_4\})$ $C_{out} = 24'820$
~~$(\{R_2, R_3, R_4\} \bowtie \{R_0, R_1\})$ $C_{out} = 30'420$~~

$\{R_0, R_1, R_2, R_3, R_5\}$
~~$(\{R_0, R_1, R_2, R_5\} \bowtie R_3)$ $C_{out} = 20'020$~~
$(\{R_0, R_1, R_2, R_3\} \bowtie R_5)$ $C_{out} = 19'420$
~~$(\{R_0, R_2, R_3, R_5\} \bowtie R_1)$ $C_{out} = 37'000$~~
~~$(\{R_2, R_3, R_5\} \bowtie \{R_0, R_1\})$ $C_{out} = 22'420$~~

$\{R_0, R_2, R_3, R_4, R_5\}$
- ~~$(\{R_0, R_2, R_3, R_5\} \bowtie R_4) \quad C_{out} = 45'800$~~
- ~~$(\{R_0, R_2, R_3, R_4\} \bowtie R_5) \quad C_{out} = 51'200$~~
- ~~$(\{R_2, R_3, R_4, R_5\} \bowtie R_0) \quad C_{out} = 93'550$~~
- $(\{R_0, R_2, R_5\} \bowtie \{R_3, R_4\}) \quad C_{out} = 29'400$

Size = 6:
$\{R_0, R_1, R_2, R_3, R_4, R_5\}$
- ~~$(\{R_0, R_1, R_2, R_3, R_4\} \bowtie R_5) \quad C_{out} = 288'820$~~
- ~~$(\{R_0, R_1, R_2, R_3, R_5\} \bowtie R_4) \quad C_{out} = 283'420$~~
- ~~$(\{R_0, R_2, R_3, R_4, R_5\} \bowtie R_1) \quad C_{out} = 293'400$~~
- ~~$(\{R_2, R_3, R_4, R_5\} \bowtie \{R_0, R_1\}) \quad C_{out} = 331'170$~~
- $(\{R_0, R_1, R_2, R_5\} \bowtie \{R_3, R_4\}) \quad C_{out} = 267'020$

Finally the best query is:
$(((R_0 \bowtie R_1) \bowtie R_2) \bowtie R_5) \bowtie (R_3 \bowtie R_4)$

9.1.4 compare

Both algorithms come up with an optimal solution. The cost is the same, the join tree is not.