Exercise 6

Matthias Gollwitzer, Jan Schalkamp

June 8, 2013

1 EXERCISE 1

With BFS result in following ordering of nodes: $R_0 < R_1 < R_3 < R_2 < R_4$. Figure 1.1 shows the execution of the *EnumerateCsg(G)* algorithm, and table 1.1 shows the *EnumerateCmp(G,S1)* algorithm. The stars in table 1.1 denote the execution of *EnumerateCsgRec()*. Empty rows depict multiple outputs for the step above them. (See the next pages)

S	X	N	emit
$\{R_4\}$	$\{R_0..R_4\}$	$\emptyset$	$\{R_4\}$
$\{R_2\}$	$\{R_0, R_1, R_2, R_3\}$	$\emptyset$	$\{R_2\}$
$\{R_3\}$	$\{R_0, R_1, R_3\}$	$\{R_2\}$	$\{R_3\}$
			$\{R_2, R_3\}$
$\{R_2, R_3\}$	$\{R_0, R_1, R_2, R_3\}$	$\emptyset$	-
$\{R_1\}$	$\{R_0, R_1\}$	$\{R_2, R_4\}$	$\{R_1\}$
			$\{R_1, R_2\}$
			$\{R_1, R_4\}$
			$\{R_1, R_2, R_4\}$
$\{R_1, R_2\}$	$\{R_0, R_1, R_2, R_4\}$	$\{R_3\}$	$\{R_1, R_2, R_3\}$
$\{R_1, R_2, R_3\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-
$\{R_1, R_4\}$	$\{R_0, R_1, R_2, R_4\}$	$\emptyset$	-
$\{R_1, R_2, R_4\}$	$\{R_0, R_1, R_2, R_4\}$	$\{R_3\}$	$\{R_1, R_2, R_3, R_4\}$
$\{R_1, R_2, R_3, R_4\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-
$\{R_0\}$	$\{R_0\}$	$\{R_1, R_3\}$	$\{R_0\}$
			$\{R_0, R_1\}$
			$\{R_0, R_3\}$
			$\{R_0, R_1, R_3\}$
$\{R_0, R_1\}$	$\{R_0, R_1, R_3\}$	$\{R_2, R_4\}$	$\{R_0, R_1, R_2\}$
			$\{R_0, R_1, R_4\}$
			$\{R_0, R_1, R_2, R_4\}$
$\{R_0, R_1, R_2\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-
$\{R_0, R_1, R_4\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-
$\{R_0, R_1, R_2, R_4\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-
$\{R_0, R_3\}$	$\{R_0, R_1, R_3\}$	$\{R_2\}$	$\{R_0, R_2, R_3\}$
$\{R_0, R_2, R_3\}$	$\{R_0, R_1, R_2, R_3\}$	$\emptyset$	-
$\{R_0, R_1, R_3\}$	$\{R_0, R_1, R_3\}$	$\{R_4\}$	$\{R_0, R_1, R_3, R_4\}$
$\{R_0, R_1, R_3, R_4\}$	$\{R_0, R_1, R_3, R_4\}$	$\{R_2\}$	$\{R_0, R_1, R_2, R_3, R_4\}$
$\{R_0, R_1, R_2, R_3, R_4\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-

Figure 1.1: Connected Subgraph Enumeration

S	X	N	emit
$\{R_4\}$	$\{R_0..R_4\}$	$\emptyset$	-
$\{R_2\}$	$\{R_0,R_1,R_2,R_3\}$	$\emptyset$	-
$\{R_3\}$	$\{R_0,R_1,R_3\}$	$\{R_2\}$	$\{R_2\}$
* $\{R_2\}$	$\{R_0,R_1,R_2,R_3\}$	$\emptyset$	-
$\{R_2,R_3\}$	$\{R_0,R_1,R_2,R_3\}$	$\emptyset$	-
$\{R_1\}$	$\{R_0,R_1\}$	$\{R_2,R_4\}$	$\{R_4\}$
			$\{R_2\}$
* $\{R_4\}$	$\{R_0,R_1,R_2,R_4\}$	$\emptyset$	-
* $\{R_2\}$	$\{R_0,R_1,R_2\}$	$\{R_3\}$	$\{R_2,R_3\}$
* $\{R_2,R_3\}$	$\{R_0,R_1,R_2,R_3\}$	$\emptyset$	-
$\{R_1,R_2,\}$	$\{R_0,R_1,R_2\}$	$\{R_3,R_4\}$	$\{R_4\}$
			$\{R_3\}$
* $\{R_4\}$	$\{R_0,R_1,R_2,R_3,R_4\}$	$\emptyset$	-
* $\{R_3\}$	$\{R_0,R_1,R_2,R_3\}$	$\emptyset$	-
$\{R_1,R_2,R_3\}$	$\{R_0,R_1,R_2,R_3\}$	$\{R_4\}$	$\{R_4\}$
* $\{R_4\}$	$\{R_0,R_1,R_2,R_3,R_4\}$	$\emptyset$	-
$\{R_1,R_4\}$	$\{R_0,R_1,R_4\}$	$\{R_2\}$	$\{R_2\}$
* $\{R_2\}$	$\{R_0,R_1,R_2\}$	$\{R_3\}$	$\{R_2,R_3\}$
* $\{R_2,R_3\}$	$\{R_0,R_1,R_2,R_3,R_4\}$	$\emptyset$	-
$\{R_1,R_2,R_4\}$	$\{R_0,R_1,R_2,R_4\}$	$\{R_3\}$	$\{R_1,R_2,R_3,R_4\}$
* $\{R_3\}$	$\{R_0,R_1,R_2,R_3,R_4\}$	$\emptyset$	-
$\{R_1,R_2,R_3,R_4\}$	$\{R_0,R_1,R_2,R_3,R_4\}$	$\emptyset$	-
$\{R_0\}$	$\{R_0\}$	$\{R_1,R_3\}$	$\{R_3\}$
			$\{R_1\}$
* $\{R_3\}$	$\{R_0,R_1,R_3\}$	$\{R_2\}$	$\{R_2,R_3\}$
* $\{R_2,R_3\}$	$\{R_0,R_1,R_2,R_3\}$	$\emptyset$	-
* $\{R_1\}$	$\{R_0,R_1\}$	$\{R_2,R_4\}$	$\{R_1,R_2\}$
			$\{R_1,R_4\}$
* $\{R_1,R_2\}$	$\{R_0,R_1,R_2,R_4\}$	$\{R_3\}$	$\{R_1,R_2,R_3\}$
* $\{R_1,R_2,R_3\}$	$\{R_0,R_1,R_2,R_3,R_4\}$	$\emptyset$	-
* $\{R_1,R_4\}$	$\{R_0,R_1,R_2,R_4\}$	$\emptyset$	-
$\{R_0,R_1\}$	$\{R_0,R_1\}$	$\{R_2,R_3,R_4\}$	$\{R_4\}$
			$\{R_2\}$
			$\{R_3\}$
* $\{R_4\}$	$\{R_0,R_1,R_2,R_3,R_4\}$	$\emptyset$	-
* $\{R_2\}$	$\{R_0,R_1,R_2,R_3\}$	$\emptyset$	-
* $\{R_3\}$	$\{R_0,R_1,R_3\}$	$\{R_2\}$	$\{R_2,R_3\}$
* $\{R_2,R_3\}$	$\{R_0,R_1,R_2,R_3\}$	$\emptyset$	-
$\{R_0,R_1,R_2\}$	$\{R_0,R_1,R_2\}$	$\{R_3,R_4\}$	$\{R_4\}$
			$\{R_3\}$
* $\{R_4\}$	$\{R_0,R_1,R_2,R_3,R_4\}$	$\emptyset$	-
* $\{R_3\}$	$\{R_0,R_1,R_2,R_3\}$	$\emptyset$	-
$\{R_0,R_1,R_4\}$	$\{R_0,R_1,R_4\}$	$\{R_2,R_3\}$	$\{R_2\}$
			$\{R_3\}$

* $\{R_2\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-
* $\{R_3\}$	$\{R_0, R_1, R_3, R_4\}$	$\{R_2\}$	$\{R_2, R_3\}$
* $\{R_2, R_3\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-
$\{R_0, R_1, R_2, R_4\}$	$\{R_0, R_1, R_2, R_4\}$	$\{R_3\}$	$\{R_3\}$
* $\{R_3\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-
$\{R_0, R_3\}$	$\{R_0, R_3\}$	$\{R_1, R_2\}$	$\{R_2\}$
			$\{R_1\}$
* $\{R_2\}$	$\{R_0, R_1, R_2, R_3\}$	$\emptyset$	-
* $\{R_1\}$	$\{R_0, R_1, R_3\}$	$\{R_2\}$	$\{R_1, R_2\}$
$\{R_0, R_2, R_3\}$	$\{R_0, R_2, R_3\}$	$\{R_1\}$	$\{R_1\}$
* $\{R_1\}$	$\{R_0, R_1, R_2, R_3\}$	$\{R_4\}$	$\{R_1, R_4\}$
* $\{R_1, R_4\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-
$\{R_0, R_1, R_3\}$	$\{R_0, R_1, R_3\}$	$\{R_2, R_4\}$	$\{R_4\}$
			$\{R_2\}$
* $\{R_4\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-
* $\{R_2\}$	$\{R_0, R_1, R_2, R_3\}$	$\emptyset$	-
$\{R_0, R_1, R_3, R_4\}$	$\{R_0, R_1, R_3\}$	$\{R_2\}$	$\{R_2\}$
* $\{R_2\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-
$\{R_0, R_1, R_2, R_3, R_4\}$	$\{R_0, R_1, R_2, R_3, R_4\}$	$\emptyset$	-

Table 1.1: Enumerating Complementary Subgraphs

2 Exercise 2

Below $B()$ denotes the benefit function and all numbers i beside the Joins depict the relation R_i. Step 1 of the simplification shows that the relations R_2 and R_3 should be joined before joining them with R_0. Figure (2.1) shows the resulting query graph after this first step. The arrow determines the reading direction of the hyper edge. In this case: Join R_2 and R_3 before R_1.

Step 1:

$$B(0\bowtie 1, 0\bowtie 3) = \frac{C((0\bowtie 1)\bowtie 3)}{C((0\bowtie 3)\bowtie 1)} = \frac{20+2000}{1000+2000} = 0,673$$

$$B(1\bowtie 0, 1\bowtie 2) = \frac{C((1\bowtie 0)\bowtie 2)}{C((1\bowtie 2)\bowtie 0)} = \frac{20+100}{100+100} = 0,6$$

$$B(1\bowtie 0, 1\bowtie 4) = \frac{C((1\bowtie 0)\bowtie 4)}{C((1\bowtie 4)\bowtie 0)} = \frac{20+5000}{5000+5000} = 0,502$$

$$B(1\bowtie 2, 1\bowtie 4) = \frac{C((1\bowtie 2)\bowtie 4)}{C((1\bowtie 4)\bowtie 2)} = \frac{100+25000}{5000+25000} = 0,836$$

$$B(1\bowtie 2, 2\bowtie 3) = \frac{C((1\bowtie 2)\bowtie 3)}{C((2\bowtie 3)\bowtie 1)} = \frac{100+500}{250+500} = 0,8$$

$$B(0\bowtie 3, 3\bowtie 2) = \frac{C((0\bowtie 3)\bowtie 2)}{C((2\bowtie 3)\bowtie 0)} = \frac{1000+500}{250+500} = 2$$

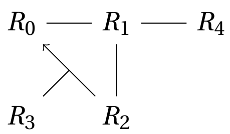

Figure 2.1: First step of simplification

For Step 2 we re-use the old calculations except those affected by the new hyper edge. The resulting graph is shown in Figure (3.3). The benefit of joining relations R_0 and R_1 before R_4 is this step's biggest benefit, wherefore a hyper edge between those relations is introduced.

Step 2:

$$B(0 \bowtie \{2,3\}, \{2,3\} \bowtie 1) = \frac{C((0 \bowtie \{2,3\}) \bowtie 1)}{C((1 \bowtie \{2,3\}) \bowtie 0)} = \frac{750+1000}{750+1000} = 1$$

$$B(0 \bowtie 1, 0 \bowtie \{2,3\}) = \frac{C((0 \bowtie 1) \bowtie \{2,3\})}{C((0 \bowtie \{2,3\}) \bowtie 1)} = \frac{20+1000}{750+1000} = 0,68$$

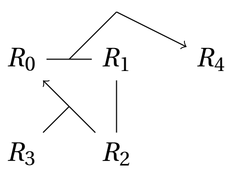

Figure 2.2: Second step of simplification

3 Exercise 3

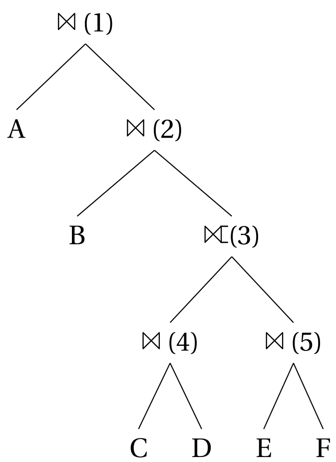

Figure 3.1: Given join tree

Join	SES	TES
1	{A,B}	{A,B,C,E,D}
2	{B,C}	{B,C,E,D}
3	{C,E}	{C,E,D}
4	{C,D}	{C,D}
5	{E,F}	{E,F}

Figure 3.2: Syntactic- and total eligibility set

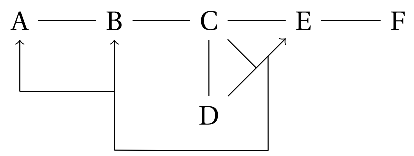

Figure 3.3: DPhyp graph