Data Bases II
Exercises

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Abstract

The course aims to prepare software designers on the effective development of database applications.

First, the course presents the fundamental features of current database architectures, with a specific emphasis on the concept of transaction and its realization in centralized and distributed systems.

Then, the course illustrates the main directions in the evolution of database systems, presenting approaches that go beyond the relational model, like active databases, object systems and XML data management solutions.

Contents

Chapter 1

Exerise session I

Exercise 1

Can the following schedules produce anomalies? c_i and a_i indicate the transactional decision (commit/abort).

1. $r_1(x)w_1(x)r_2(x)w_2(y)\ a_1\ c_2$
2. $r_1(x)w_1(x)r_2(y)w_2(y)\ a_1\ c_2$
3. $r_1(x)r_2(x)r_2(y)w_2(y)r_1(z)\ a_1\ c_2$
4. $r_1(x)r_2(x)w_2(x)w_1(x)\ c_1\ c_2$
5. $r_1(x)r_2(x)w_2(x)r_1(y)\ c_1\ c_2$
6. $r_1(x)w_1(x)r_2(x)w_2(x)\ c_1\ c_2$

Answer of exercise 1

1. We have a serial execution, but with the abort of the first transaction. Since the second transaction reads the modified value of x before the abort, we have a dirty read.
2. We have a serial execution and the two transactions require different resources, so there are no anomalies.
3. There are no anomalies because the last operation of the first transaction works on a different resource.
4. Both transactions first reads in sequence the resource x and then updates it without considering the updated value, so we have a lost update.

5. There are no anomalies because the last operation of the first transaction works on a different resource.

6. We have a serial execution, so the schedule is correct.

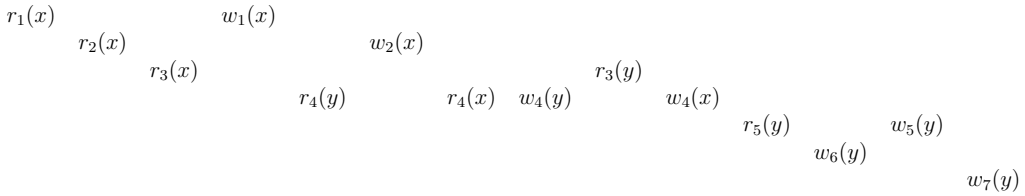
Exercise 2

The following schedule may produce 2 anomalies: a lost update and a phantom update. Identify them.

$$r_1(x)r_2(x)r_3(x)w_1(x)r_4(y)w_2(x)r_4(x)w_4(y)r_3(y)w_4(x)r_5(y)w_6(y)w_5(y)w_7(y)$$

Answer of exercise 2

We can write the schedule in the following way:



And we can see that there is a lost update with transactions T_1 and T_2 and a phantom update with T_3 and T_4.

Exercise 3

Classify the following schedule:

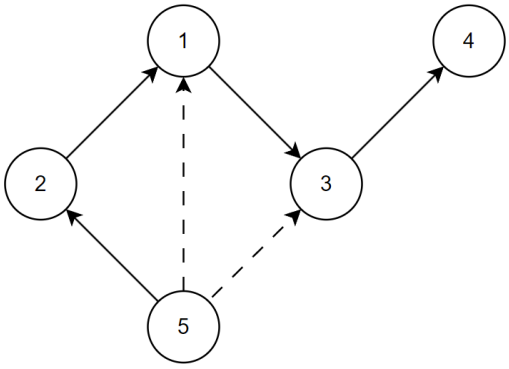
$$r_1(x)r_2(y)w_3(y)r_5(x)w_5(u)w_3(s)w_2(u)w_3(x)w_1(u)r_4(y)w_5(z)r_5(z)$$

Answer of exercise 3

Since CSR contains VSR we check with the conflict graph. To do so we first divide the schedule based on the resources:

- $x : r_1\ r_5\ w_3$
- $y : r_2\ w_3\ r_4$
- $z : w_5\ r_5$
- $s : w_3$
- $u : w_5\ w_2\ w_1$

The nodes are $\{1, 2, 3, 4, 5\}$ and the arcs are found with the write-write or write-read relations found in the previous groups. So we have the following graph:



Some arcs can be omitted if the nodes are connected in another way (in this case we can remove arcs $\{\{5, 1\}, \{5, 3\}\}$).

There are no cycles: the schedule is CSR (and also VSR).

Exercise 4

Classify the following schedule:

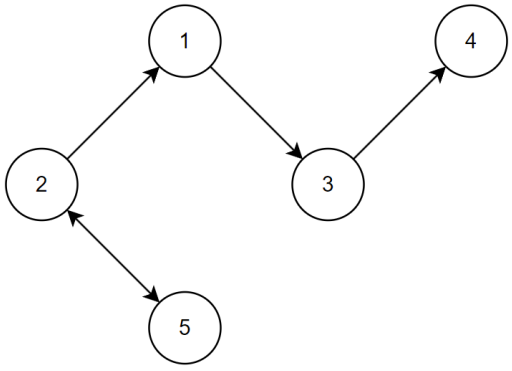
$$r_2(u)w_2(s)r_1(x)r_2(y)w_3(y)r_5(x)w_5(u)w_3(s)w_2(u)w_3(x)w_1(u)r_4(y)w_5(z)r_5(z)$$

Answer of exercise 4

Since CSR contains VSR we check with the conflict graph. To do so we first divide the schedule based on the resources:

- $x : r_1\ r_5\ w_3$
- $y : r_2\ w_3\ r_4$
- $z : w_5\ r_5$
- $s : w_2\ w_3$
- $u : r_2\ w_5\ w_2\ w_1$

The nodes are $\{1, 2, 3, 4, 5\}$ and the arcs are found with the write-write or write-read relations found in the previous groups. So we have the following graph:



It is possible to see that there is a cycle between two and five. The definition of VSR states that we need to have the same reads-from relations and final writes. So, we try to find a view-equivalent schedule that is also CSR. One possible solution is simply to swap the two writes on the resource u and that is sufficient to eliminate the cycle. So, the schedule:

$$r_2(u)w_2(s)r_1(x)r_2(y)w_3(y)r_5(x)w_5(u)w_2(u)w_3(s)w_3(x)w_1(u)r_4(y)w_5(z)r_5(z)$$

is CSR and also VSR.

Exercise 5

Classify the following schedule:

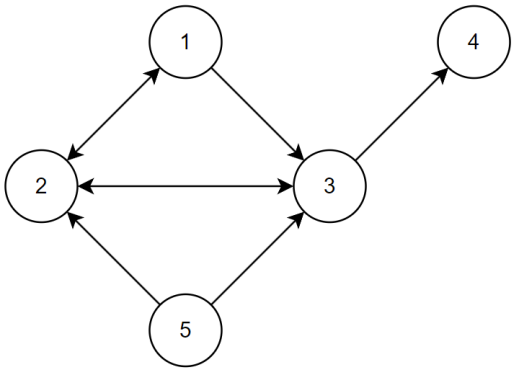
$$r_1(x)r_2(y)w_3(y)r_5(x)w_5(u)w_3(s)w_2(u)w_3(x)w_1(u)r_4(y)w_5(z)r_5(z)r_2(u)w_2(s)$$

Answer of exercise 5

Since CSR contains VSR we check with the conflict graph. To do so we first divide the schedule based on the resources:

- $x : r_1\ r_5\ w_3$
- $y : r_2\ w_3\ r_4$
- $z : w_5\ r_5$
- $s : w_3\ w_2$
- $u : w_5\ w_2\ w_1\ r_2$

The nodes are $\{1, 2, 3, 4, 5\}$ and the arcs are found with the write-write or write-read relations found in the previous groups. So we have the following graph:



In this case it is not possible to find a VSR schedule because it is impossible to do so without changing the final write on s.

Exercise 6

Classify the following schedule:

$$r_5(x)r_3(y)w_3(y)r_6(t)r_5(t)w_5(z)w_4(x)r_3(z)w_1(y)\dots$$

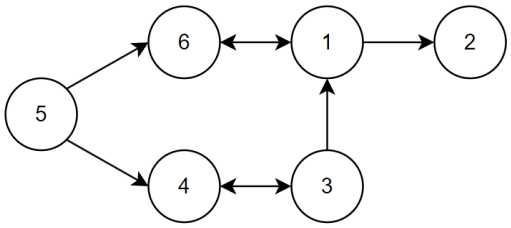
$$\dots r_6(y)w_6(t)w_4(z)w_1(t)w_3(x)w_1(x)r_1(z)w_2(t)w_2(z)$$

Answer of exercise 6

Since CSR contains VSR we check with the conflict graph. To do so we first divide the schedule based on the resources:

- $t:\ r_6\ r_5\ w_6\ w_1\ w_2$
- $x:\ r_5\ w_4\ w_3\ w_1$
- $y:\ r_3\ w_3\ w_1\ r_6$
- $z:\ w_5\ r_3\ w_4\ r_1\ w_2$

The nodes are $\{1, 2, 3, 4, 5, 6\}$ and the arcs are found with the write-write or write-read relations found in the previous groups. So we have the following graph:



We have two cycles. It is impossible to find a VSR schedule because only the conflict between four and three can be eliminated (the other one changes a read-write relation).