Subject: **Database Management Systems** (**CO3021**)
Semester 1, 2018-2019

## Chapter 4: Introduction to Transaction Processing Concepts and Theory

**Question 4.1.** Differentiate multiuser systems from single-user systems. Give their examples.

**Question 4.2.** Describe different types of failures and give their examples.

**Question 4.3.** What is a transaction? Give 3 examples.

**Question 4.4.** Discuss the ACID properties of a transaction.

**Question 4.5.** What is a system log? What records are stored in the log? Write the content of the log for your transactions in Question 4.3.

**Question 4.6.** What is a commit point? Give an example.

**Question 4.7.** What is a schedule? Give an example.

**Question 4.8.** Given the following transactions:

$T_1$: $r_1(X)$; $r_1(Z)$; $w_1(X)$; $c_1$;

$T_2$: $r_2(Z)$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$; $c_2$;

$T_3$: $r_3(X)$; $r_3(Y)$; $w_3(Y)$; $c_3$;

What are valid schedules? Write their log contents.

$S_1$: $r_1(X)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $w_1(X)$; $w_3(Y)$; $c_1$; $c_3$;

$S_2$: $r_2(Z)$; $r_3(X)$; $r_2(Y)$; $r_3(Y)$; $w_2(Z)$; $w_3(Y)$; $w_2(Y)$; $a_3$; $c_2$;

$S_3$: $r_2(Z)$; $r_1(X)$; $r_1(Z)$; $w_2(Z)$; $w_1(X)$; $r_2(Y)$; $w_2(Y)$; $c_2$; $c_1$;

$S_4$: $r_1(X)$; $r_3(Y)$; $r_1(Z)$; $w_3(Y)$; $w_1(X)$; $c_1$; $r_3(X)$; $c_3$;

**Question 4.9.** What are recoverable schedules? What are cascadeless schedules? What are strict schedules?

**Question 4.10.** What is the recoverability characteristic of each following schedule?

$S_5$: $r_1(X)$; $r_2(Z)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $w_1(X)$; $c_1$; $w_3(Y)$; $c_3$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$; $c_2$;

$S_6$: $r_1(X)$; $r_2(Z)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $w_1(X)$; $w_3(Y)$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$; $c_1$; $c_2$; $c_3$;

$S_7$: $r_1(X)$; $r_2(Z)$; $r_3(X)$; $r_1(Z)$; $r_2(Y)$; $r_3(Y)$; $w_1(X)$; $c_1$; $w_2(Z)$; $w_3(Y)$; $w_2(Y)$; $c_3$; $c_2$;

$S_8$: $r_1(A)$; $r_2(B)$; $w_1(B)$; $c_1$; $w_2(C)$; $c_2$; $r_3(B)$; $r_3(C)$; $w_3(D)$; $c_3$;

$S_9$: $r_1(A)$; $w_1(B)$; $c_1$; $r_2(B)$; $w_2(C)$; $c_2$; $r_3(C)$; $w_3(D)$; $c_3$;

$S_{10}$: $r_2(A)$; $r_3(A)$; $r_1(A)$; $w_1(B)$; $c_1$; $r_2(B)$; $r_3(B)$; $w_2(C)$; $c_2$; $r_3(C)$; $c_3$;

$S_{11}$: $r_2(A)$; $r_3(A)$; $r_1(A)$; $w_1(B)$; $r_3(B)$; $w_2(C)$; $r_3(C)$; $a_1$; $a_2$; $a_3$;

**Question 4.11.** What are conflict-serializable schedules? Give an example.

**Question 4.12.** What is the conflict-serializable characteristic of each following schedule? Draw their precedence graphs. Determine their equivalent serial schedules.

$S_{12}$: $r_1(X)$; $r_3(X)$; $w_1(X)$; $r_2(X)$; $w_3(X)$;

$S_{13}$: $r_1(X)$; $r_3(X)$; $w_3(X)$; $w_1(X)$; $r_2(X)$;

$S_{14}$: $r_3(X)$; $r_2(X)$; $w_3(X)$; $r_1(X)$; $w_1(X)$;

$S_{15}$: $r_3(X)$; $r_2(X)$; $r_1(X)$; $w_3(X)$; $w_1(X)$;

$S_{16}$: $r_1(X)$; $r_2(Z)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $w_1(X)$; $w_3(Y)$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$;

$S_{17}$: $r_1(X)$; $r_2(Z)$; $r_3(X)$; $r_1(Z)$; $r_2(Y)$; $r_3(Y)$; $w_1(X)$; $w_2(Z)$; $w_3(Y)$; $w_2(Y)$;

$S_{18}$: $r_2(X)$; $r_1(X)$; $r_3(Y)$; $w_3(Y)$; $r_1(Y)$; $w_2(X)$; $w_1(X)$; $w_1(Y)$;

$S_{19}$: $r_1(Z)$; $r_1(X)$: $r_2(Y)$; $w_2(Y)$; $r_3(X)$; $r_2(Z)$; $w_1(Z)$; $w_1(X)$; $r_2(X)$; $w_3(X)$; $w_2(X)$;

$S_{20}$: $r_1(X)$; $w_1(X)$; $r_2(Y)$; $r_2(X)$; $w_2(Y)$; $r_1(Y)$; $w_2(X)$; $r_3(Y)$; $w_1(Y)$; $r_3(X)$; $w_3(X)$; $w_2(Y)$; $w_3(Y)$;

**Question 4.13**. Given two following transactions:

$T_4$: $r_4(A)$; $w_4(A)$; $r_4(B)$;$w_4(B)$;

$T_5$: $r_5(A)$; $w_5(A)$; $r_5(B)$;$w_5(B)$;

Prove that the schedule $S_{21}$ is conflict-serializable: $S_{21}$: $r_4(A)$; $w_4(A)$; $r_5(A)$; $w_5(A)$; $r_4(B)$;$w_4(B)$; $r_5(B)$;$w_5(B)$.

(Hint: reordering the nonconflicting operations in $S_{21}$ until we form the equivalent serial schedule)

**Question 4.14.** Consider the three transactions $T_6$, $T_7$, and $T_8$, and the schedules $S_{22}$ and $S_{23}$ given below. Draw the serializability graph for $S_{22}$ and $S_{23}$, and state whether each schedule is conflict-serializable or not. If a schedule is conflict-serializable, write down the equivalent serial schedule.

$T_6$: $r_6(B)$; $w_6(B)$;

$T_7$: $r_7(A)$; $w_7(A)$; $r_7(B)$; $w_7(B)$;

$T_8$: $r_8(A)$; $w_8(A)$;

$S_{22}$: $r_7(A)$; $r_6(B)$; $w_7(A)$; $r_8(A)$; $w_6(B)$; $w_8(A)$; $r_7(B)$; $w_7(B)$;

$S_{23}$: $r_7(A)$; $r_6(B)$; $w_7(A)$; $r_7(B)$; $r_8(A)$; $w_6(B)$; $w_8(A)$; $w_7(B)$;