

CSCI 5408



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Content

Introduction to Transactions

Real world problems



We have a problem scenario, but we do not have data

We have a problem scenario, and we have dataset

We have dataset and problem scenario is unknown

We have a problem scenario, and we cannot compromise the system's efficiency

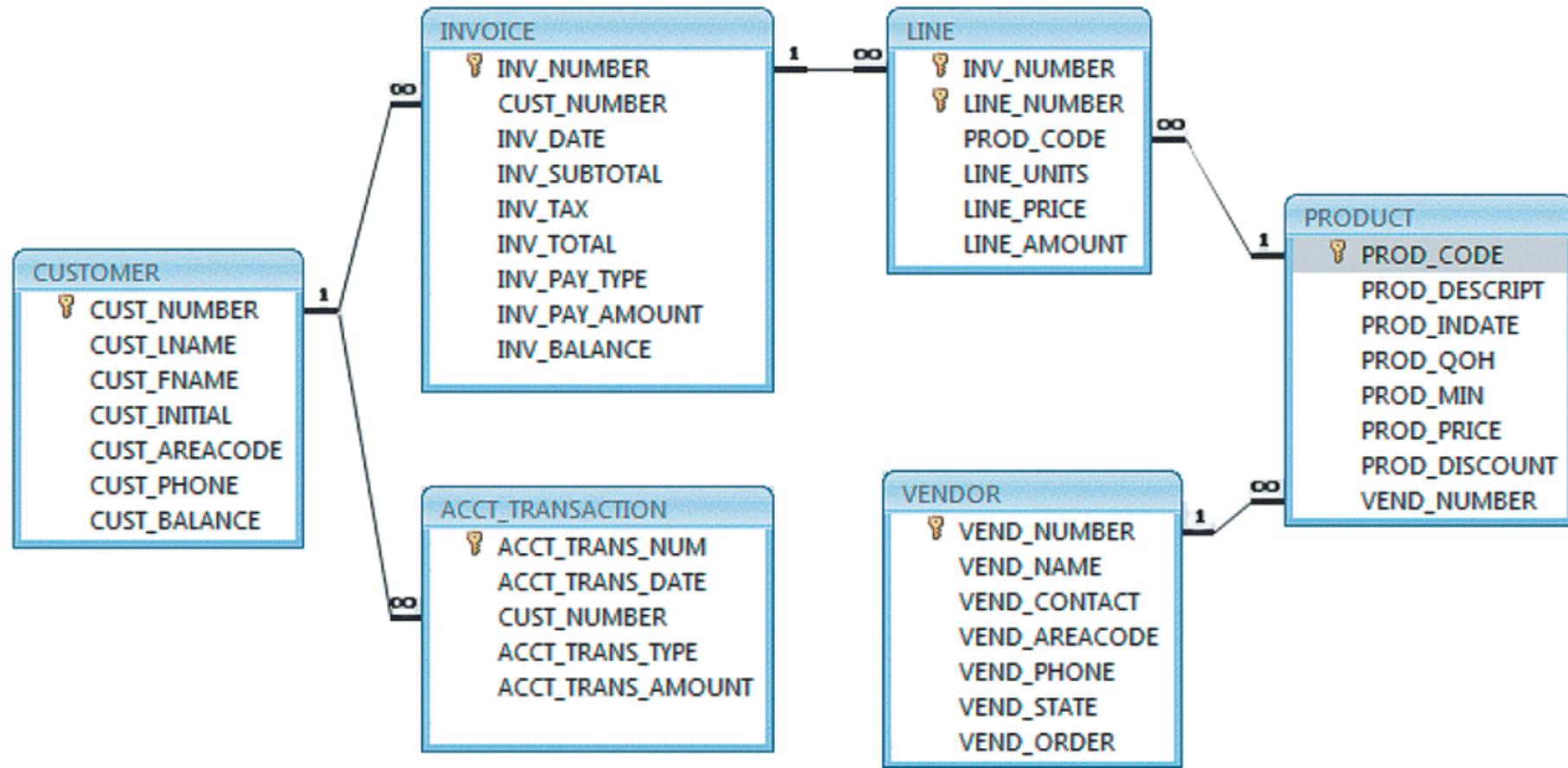
We have an initial problem scenario, which may update.
Flexibility is important.

What is Transaction?
How does it help?



Case Study (SaleCo)

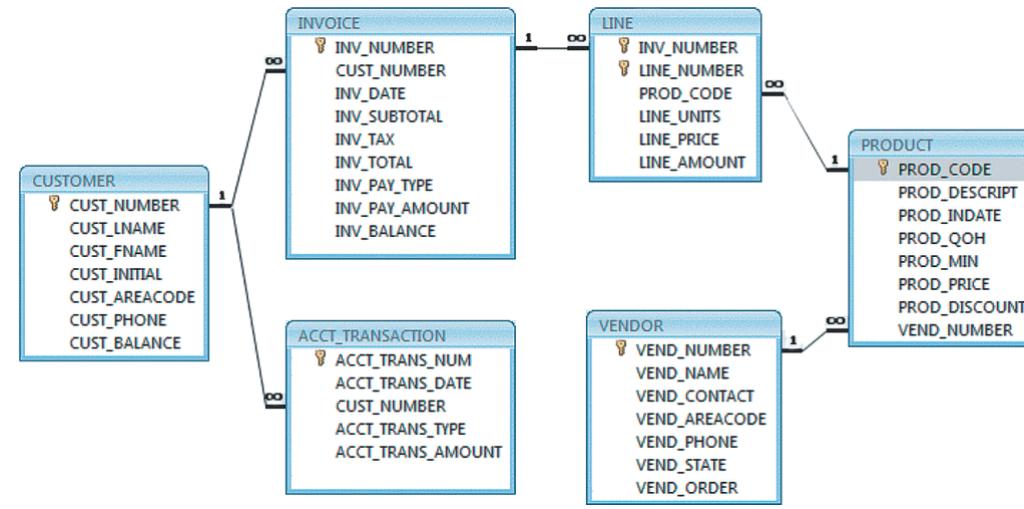
- You must write new customer invoice
- Reduce the quantity on hand in the product's inventory
- Update the account transactions
- Update the customer balance



What is a Transaction?

A logical unit of work that must be entirely completed or aborted

- Consists of:
 - SELECT statement
 - Series of related UPDATE statements
 - Series of INSERT statements
 - Combination of SELECT, UPDATE, and INSERT statements



SQL statements of the transaction

```
INSERT INTO INVOICE  
VALUES (1009, 10016, '18-Jan-2018', 256.99,  
20.56, 277.55, 'cred', 0.00, 277.55);
```

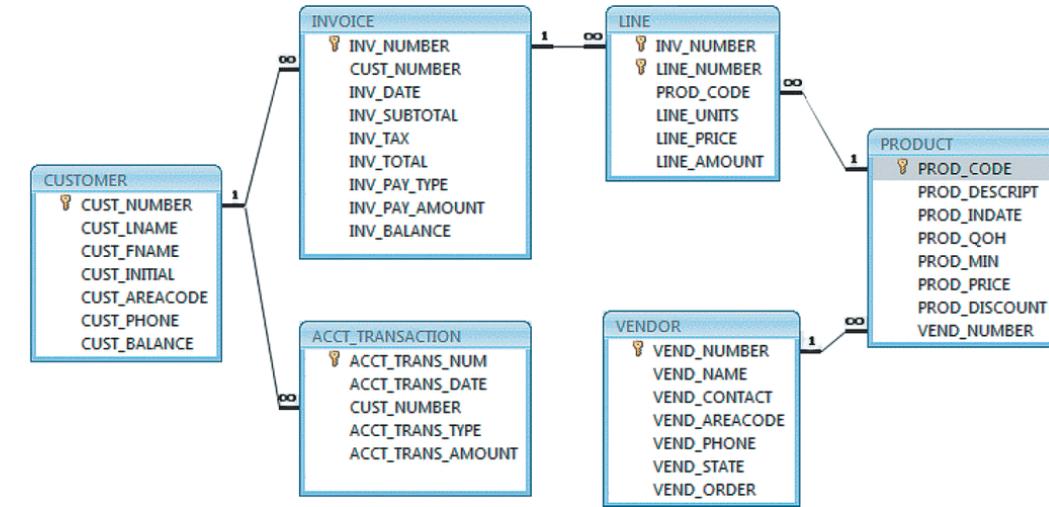
```
INSERT INTO LINE  
VALUES (1009, 1, '89-WRE-Q', 1, 256.99, 256.99);
```

```
UPDATE PRODUCT  
SET PROD_QOH = PROD_QOH - 1  
WHERE PROD_CODE = '89-WRE-Q';
```

```
UPDATE CUSTOMER  
SET CUST_BALANCE = CUST_BALANCE + 277.55  
WHERE CUST_NUMBER = 10016;
```

```
INSERT INTO ACCT_TRANSACTION  
VALUES (10007, '18-Jan-18', 10016, 'charge',  
277.55);
```

```
COMMIT;
```



Values in table after executing SQL

Database name: Ch10_SaleCo

Table name: INVOICE

INV_NUMBER	CUST_NUMBER	INV_DATE	INV_SUBTOTAL	INV_TAX	INV_TOTAL	INV_PAY_TYPE	INV_PAY_AMOUNT	INV_BALANCE
1001	10014	16-Jan-18	54.92	4.39	59.31	cc	59.31	0.00
1002	10011	16-Jan-18	9.98	0.80	10.78	cash	10.78	0.00
1003	10012	16-Jan-18	270.70	21.66	292.36	cc	292.36	0.00
1004	10011	17-Jan-18	34.67	2.79	37.66	cc	37.66	0.00
1005	10018	17-Jan-18	70.44	5.64	76.08	cc	76.08	0.00
1006	10014	17-Jan-18	397.83	31.83	429.66	cred	100.00	329.66
1007	10015	17-Jan-18	34.97	2.80	37.77	chk	37.77	0.00
1008	10011	17-Jan-18	1033.08	82.65	1115.73	cred	500.00	615.73
1009	10016	18-Jan-18	256.99	20.56	277.55	cred	0.00	277.55

Table name: PRODUCT

PROD_CODE	PROD_DESCRPT	PROD_INDATE	PROD_QOH	PROD_MIN	PROD_PRICE	PROD_DISCOUNT	VEND_NUMBER
11QER/31	Power painter, 15 psi., 3-nozzle	03-Nov-17	8	5	109.99	0.00	25595
13-Q2/P2	7.25-in. pwr. saw blade	13-Dec-17	32	15	14.99	0.05	21344
14-Q1/L3	9.00-in. pwr. saw blade	13-Nov-17	18	12	17.49	0.00	21344
1546-QQ2	Hrd. cloth, 1/4-in., 2x50	15-Jan-18	15	8	39.95	0.00	23119
1558-QW1	Hrd. cloth, 1/2-in., 3x50	15-Jan-18	23	5	43.99	0.00	23119
2232-QTY	B&D Jigsaw, 12-in. blade	30-Dec-17	6	5	109.92	0.05	24288
2232-QME	B&D Jigsaw, 8-in. blade	24-Dec-17	6	5	99.87	0.05	24288
2238-QPD	B&D cordless drill, 1/2-in.	20-Jan-18	12	6	39.95	0.05	25595
23109-HB	Claw hammer	20-Jan-18	23	10	9.95	0.10	21225
23114-AA	Sledge hammer, 12 lb.	02-Jan-18	8	6	14.40	0.05	
54778-2T	Rat-tail file, 18-in. fine	15-Dec-17	43	20	4.99	0.00	21344
89-WRE-Q	Hicut chain saw, 16 in.	07-Jan-18	11	5	256.99	0.05	24288
PVC23DRT	PVC pipe, 3.5-in., 8-ft	06-Jan-18	188	75	5.87	0.00	
SM-18277	1.25-in. metal screw, 25	01-Mar-18	172	75	6.99	0.00	21225
SW-23116	2.5-in. wd. screw, 50	24-Feb-18	237	100	8.45	0.00	21231
WR3/IT3	Steel matting, 4'x8x1/8", .5" mesh	17-Jan-18	18	5	119.95	0.10	25595

Table name: CUSTOMER

CUST_NUM	CUST_LNAME	CUST_FNAME	CUST_INITIAL	CUST_AREACODE	CUST_PHONE	CUST_BALANCE
10010	Ramas	Alfred	A	615	844-2873	0.00
10011	Dunne	Leona	K	713	894-1238	615.73
10012	Smith	Kathy	W	615	894-2285	0.00
10013	Diowski	Paul	F	615	894-2160	0.00
10014	Orlando	Myron		615	222-1672	0.00
10015	D.Brian	Amy	B	713	442-3381	0.00
10016	Brown	James	G	615	297-1228	277.55
10017	Williams	George		615	290-2556	0.00
10018	Farris	Anne	G	713	382-7185	0.00
10019	Smith	Olette	K	615	297-3009	0.00

Table name: ACCT_TRANSACTION

ACCT_TRANS_NUM	ACCT_TRANS_DATE	CUST_NUMBER	ACCT_TRANS_TYPE	ACCT_TRANS_AMOUNT
10003	17-Jan-18	10014	charge	329.66
10004	17-Jan-18	10011	charge	615.73
10006	29-Jan-18	10014	payment	329.66
10007	18-Jan-18	10016	charge	277.55

ACID Properties

Atomicity

All operations of a transaction must be completed; if not the transaction is aborted. The database state is left unchanged

Consistency

Permanence of database's consistent state. Database will be from one consistent state to another.

Isolation

Data used during transaction cannot be used by second transaction until the first is completed

Durability

Ensures that once transactions are committed they cannot be undone or lost

Transaction Properties (contd.)

Serializability:

Ensures that the schedule for the concurrent execution of several transactions should yield consistent results

Multiuser databases subject to multiple concurrent transactions

e.g. The transaction T_2 updates the database before the first transaction (T_1) is finished, the isolation property is violated and the database is no longer consistent.

The DBMS must manage the transactions by using **concurrency control** techniques to avoid undesirable situations.

Transaction Log

Keeps track of all transactions that update the database

DBMS uses the information stored in a log for a

- Recovery requirement triggered by a ROLLBACK statement
- Program's abnormal termination
- System failure

Transaction Log (Contd.)

The transaction log is a critical part of the database, and it is usually implemented as one or more files that are managed separately from the actual database files.

A TRANSACTION LOG									
TRL_ID	TRX_NUM	PREV PTR	NEXT PTR	OPERATION	TABLE	ROW ID	ATTRIBUTE	BEFORE VALUE	AFTER VALUE
341	101	Null	352	START	****Start Transaction				
352	101	341	363	UPDATE	PRODUCT	1558-QW1	PROD_QOH	25	23
363	101	352	365	UPDATE	CUSTOMER	10011	CUST_BALANCE	525.75	615.73
365	101	363	Null	COMMIT	**** End of Transaction				

 TRL_ID = Transaction log record ID
TRX_NUM = Transaction number
PTR = Pointer to a transaction log record ID
(Note: The transaction number is automatically assigned by the DBMS.)

Concurrency Control

Coordinating the simultaneous execution of transactions in a multiuser database system.

It ensures serializability of transactions in multiuser database system.

T1
Read (account) = \$100

Read (account) = \$200
Write (account) = \$150

T2
Read (account) = \$100
Write (account) = \$200
commit

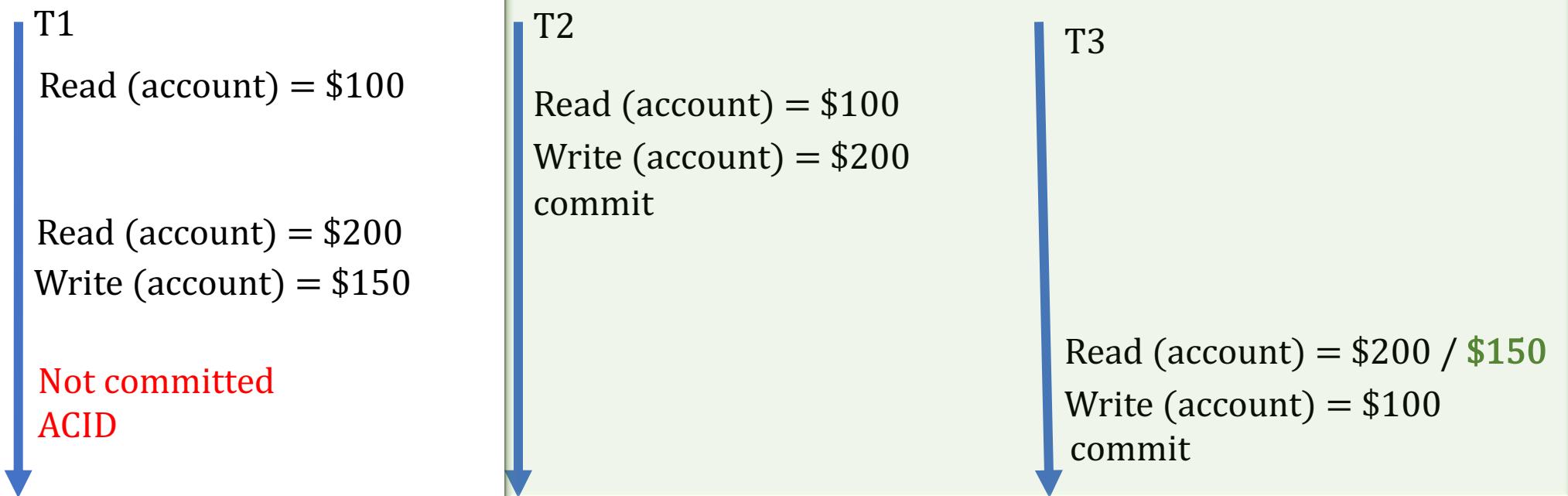
T3

Read (account) = \$150
Write (account) = \$100
commit

Concurrency Control

Coordinating the simultaneous execution of transactions in a multiuser database system.

It ensures serializability of transactions in multiuser database system.



Why Concurrency Control?

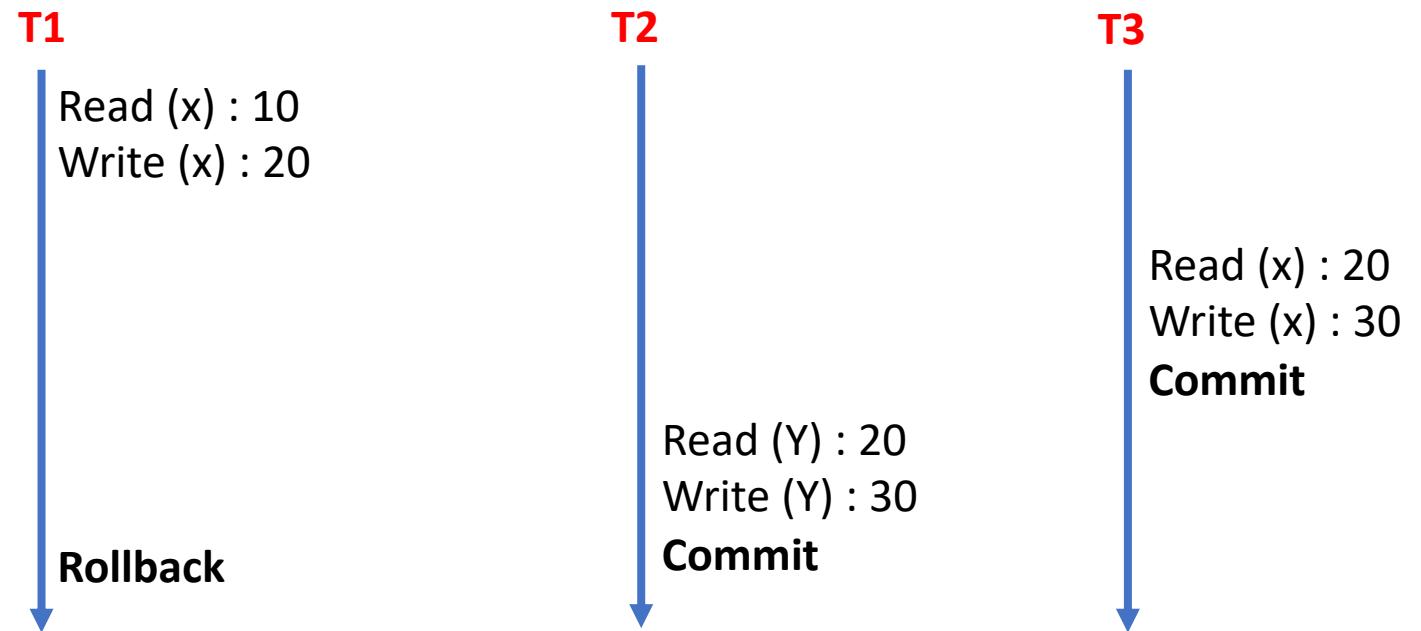
Simultaneous execution of transactions over a shared database can create several data integrity and consistency problems

- Lost Update
- Uncommitted data
- Inconsistent retrievals

Read Problems

Dirty Read

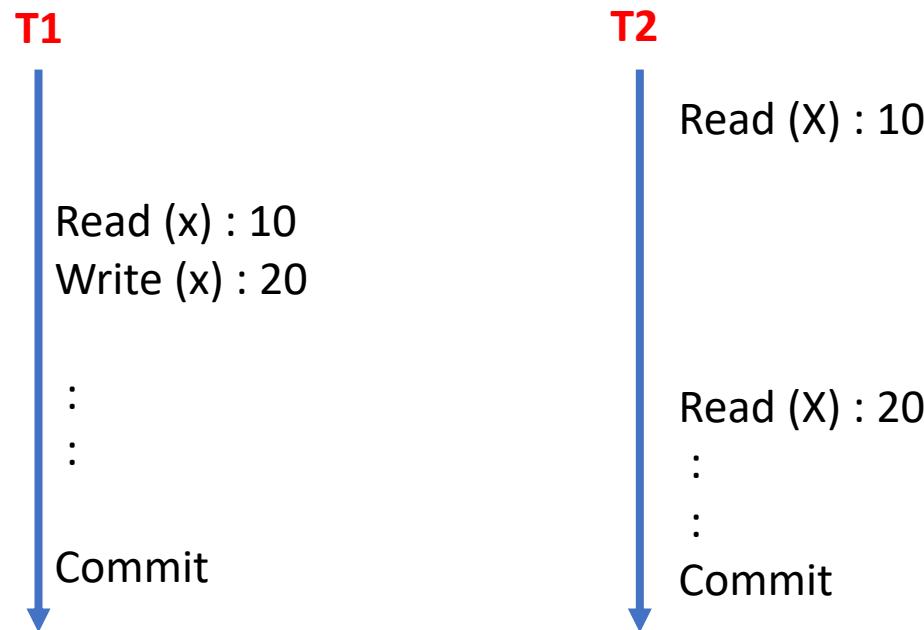
Transaction Management -- Read Problems



Read Problems

Unrepeatable Read

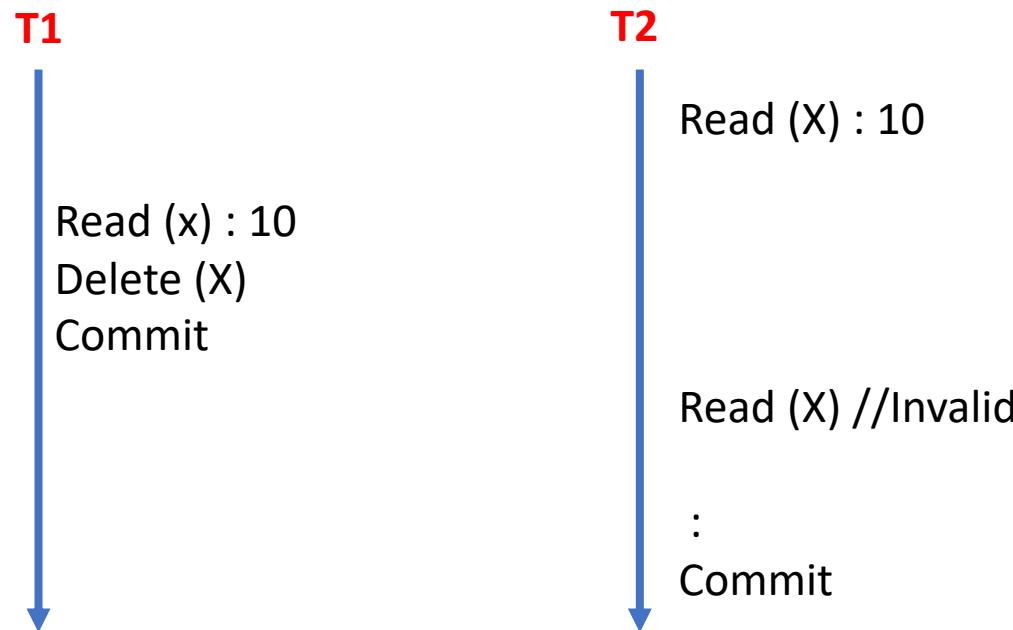
Transaction Management -- Read Problems



Read Problems

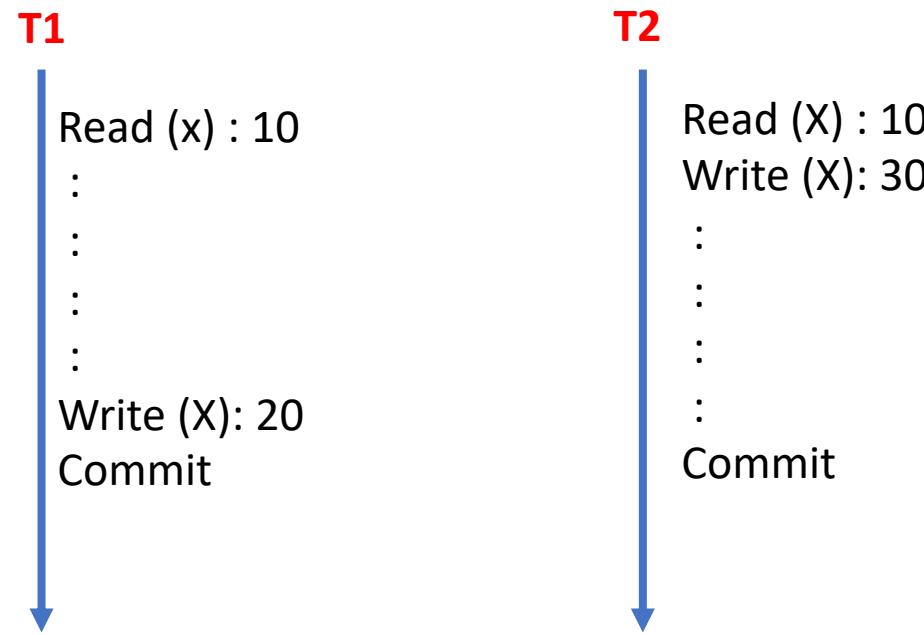
Phantom Read

Transaction Management -- Read Problems



Transaction Management -- Read Problems

Lost Update



End of Lecture Questions

1. Are there specific commands used for Transactions?
2. How to solve transaction read problems?
3. How to control concurrency in database transactions?