ICS 321 Fall 2011
The Database Language SQL (iv)

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Insertion

**INSERT INTO** R(A1, A2, ...)
**VALUES** (v1, v2, ...);

**INSERT INTO** Studio(name)
**SELECT DISTINCT** studioname
**FROM** Movies
**WHERE** studioname **NOT IN**
(**SELECT** name
**FROM** Studio);

- If inserting results from a query, query must be evaluated prior to actual insertion
Deletion

Deletion specified using a where clause.

To delete a specific tuple, you need to use the primary key or candidate keys.

DELETE FROM R
WHERE <condition>;

DELETE FROM StarsIn
WHERE movieTitle = 'The Maltese Falcon' AND MovieYear = 1942 AND starName='Sydney Greenstreet';
Updates

UPDATE R
SET <new value assignments>
WHERE <condition>;

UPDATE MovieExec
SET name='Pres. ' || name
WHERE cert# IN (  
    SELECT presC#  
    FROM Studio );

• Tuples to be updated are specified using a where clause.

• To update a specific tuple, you need to use the primary key or candidate keys.
Airline Reservation Example

Flights ( fltNo , fltDate , seatNo , seatStatus )

To view available seats:

```
SELECT seatNo
FROM Flights
WHERE fltNo = 123 AND fltDate = DATE '2008-12-25'
    AND seatStatus = ' available ' ;
```

To reserve a particular seat:

```
UPDATE Flights
SET seatStatus = 'occupied'
WHERE fltNo = 123 AND fltDate = DATE '2008-12-25'
    AND seatNo = '22A';
```
Transactions

• A transaction is the DBMS’s abstract view of a user program: a sequence of reads and writes.
  – Eg. User 1 views available seats and reserves seat 22A.

• A DBMS supports multiple users, ie, multiple transactions may be running concurrently.
  – Eg. User 2 views available seats and reserves seat 22A.
  – Eg. User 3 views available seats and reserves seat 23D.
Concurrent Execution

- DBMS tries to execute transactions concurrently – why?

<table>
<thead>
<tr>
<th>Schedule 1</th>
<th>Schedule 2</th>
<th>Schedule 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1</td>
<td>U2</td>
<td>U1</td>
</tr>
<tr>
<td>Finds 22A empty</td>
<td>Finds 22A empty</td>
<td>Finds 22A empty</td>
</tr>
<tr>
<td>Reserves 22A</td>
<td>Reserves 22A</td>
<td>Reserves 22A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U1</td>
<td>U2</td>
<td>U1</td>
</tr>
<tr>
<td>Finds 22A taken</td>
<td>Does not reserve 22A</td>
<td>Finds 22A taken</td>
</tr>
<tr>
<td>Does not reserve 22A</td>
<td></td>
<td>Does not reserve 22A</td>
</tr>
</tbody>
</table>
ACID Properties

4 important properties of transactions

• **Atomicity**: all or nothing
  – Users regard execution of a transaction as atomic
  – No worries about incomplete transactions

• **Consistency**: a transaction must leave the database in a good state
  – Semantics of consistency is application dependent
  – The user assumes responsibility

• **Isolation**: a transaction is isolated from the effects of other concurrent transaction

• **Durability**: Effects of completed transactions persists even if system crashes before all changes are written out to disk
Atomicity

• A transaction might *commit* after completing all its actions, or it could *abort* (or be aborted by the DBMS) after executing some actions.

• A very important property guaranteed by the DBMS for all transactions is that they are *atomic*. That is, a user can think of a Xact as always executing all its actions in one step, or not executing any actions at all.

  – DBMS *logs* all actions so that it can *undo* the actions of aborted transactions.
Example (Atomicity)

- The first transaction is transferring $100 from B’s account to A’s account.
- The second is crediting both accounts with a 6% interest payment.
- There is no guarantee that T1 will execute before T2 or vice-versa, if both are submitted together. However, the net effect must be equivalent to these two transactions running serially in some order.

\[
\begin{align*}
T1: & \quad \text{BEGIN} \\
& \quad A = A + 100 \\
& \quad B = B - 100 \\
& \quad \text{END} \\
T2: & \quad \text{BEGIN} \\
& \quad A = 1.06 \times A \\
& \quad B = 1.06 \times B \\
& \quad \text{END}
\end{align*}
\]
Database View of Transactions

T1: BEGIN
A=A+100
B=B-100
END

T1: BEGIN
Read A from disk
A=A+100
Write A to disk

Read B from disk
B=B-100
Write B to disk
END

T1: BEGIN
R(A)
W(A)
R(B)
W(B)
END
Serial Executions

<table>
<thead>
<tr>
<th>T1</th>
<th>T2</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>A=A+100</td>
<td>A=1.06*A</td>
<td>A = 100, B = 200</td>
</tr>
<tr>
<td>B=B-100</td>
<td>B=1.06*B</td>
<td>A = 200, B = 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A = 200, B = 106</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A = 212, B = 100</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
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<td>B=1.06*B</td>
<td>A = 106, B = 200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A = 106, B = 212</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A = 206, B = 212</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A = 206, B = 112</td>
</tr>
</tbody>
</table>
### Example (Serializability)

<table>
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<th>Equivalent Results</th>
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<td>B = 1.06 * B</td>
<td>A = 200, B = 200</td>
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<td></td>
<td>A = 212, B = 200</td>
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The operations are equivalent.

A = 100, B = 200
A = 200, B = 200
A = 212, B = 200
A = 212, B = 106
Scheduling Transactions

- **Serial schedule**: Schedule that does not interleave the actions of different transactions.

- **Equivalent schedules**: For any database state, the effect (on the set of objects in the database) of executing the first schedule is identical to the effect of executing the second schedule.

- **Serializable schedule**: A schedule that is equivalent to some serial execution of the transactions.

(Note: If each transaction preserves consistency, every serializable schedule preserves consistency.)