>>

Transactions

/\ >>

❖ Transactions, Concurrency, Recovery

DBMSs maintain valuable information in an environment that is:

- shared - concurrent access by multiple users
- unstable - potential for hardware/software failure

Each user should see the system as:

- unshared - their work is not inadvertantly affected by others
- stable - the data survives in the face of system failures

Ultimate goal: data integrity is maintained at all times.

<< ^ >>

❖ Transactions, Concurrency, Recovery (cont)

Transaction processing

- techniques for managing "logical units of work" which may require multiple DB operations

Concurrency control

- techniques for ensuring that multiple concurrent transactions do not interfere with each other

Recovery mechanisms

- techniques to restore information to a consistent state, even after major hardware shutdowns/failures

COMP3311 only looks at the first of these

<< /\ >>

❖ Transactions

A transaction is

- an atomic "unit of work" in an application
- which may require multiple database changes

Transactions happen in a multi-user, unreliable environment.

To maintain integrity of data, transactions must be:

- Atomic - either fully completed or completely rolled-back
- Consistent - map DB between consistent states
- Isolated - transactions do not interfere with each other
- Durable - persistent, restorable after system failures

<< ^ >>

❖ Example Transaction

Bank funds transfer

- move *N* dollars from account *X* to account *Y*
- **`Accounts(id,name,balance,heldAt, ...)`**
- **`Branches(id,name,address,assets, ...)`**
- maintain **`Branches.assets`** as sum of balances via triggers
- transfer operation is implemented by a function which
  - has three parameters: amount, source acct, dest acct
  - checks validity of supplied accounts
  - checks sufficient available funds
  - returns a unique transaction ID on success

❖ Example Transaction (cont)

Example function to implement bank transfer ...

```
create or replace function
   transfer(N integer, Src text, Dest text)
   returns integer
declare
   sID integer; dID integer; avail integer;
begin
   select id,balance into sID,avail
   from   Accounts where name=Src;
   if (sID is null) then
      raise exception 'Invalid source account %',Src;
   end if;
   select id into dID
   from Accounts where name=Dest;
   if (dID is null) then
      raise exception 'Invalid dest account %',Dest;
   end if;
...
```

❖ Example Transaction (cont)

Example function to implement bank transfer (cont)...

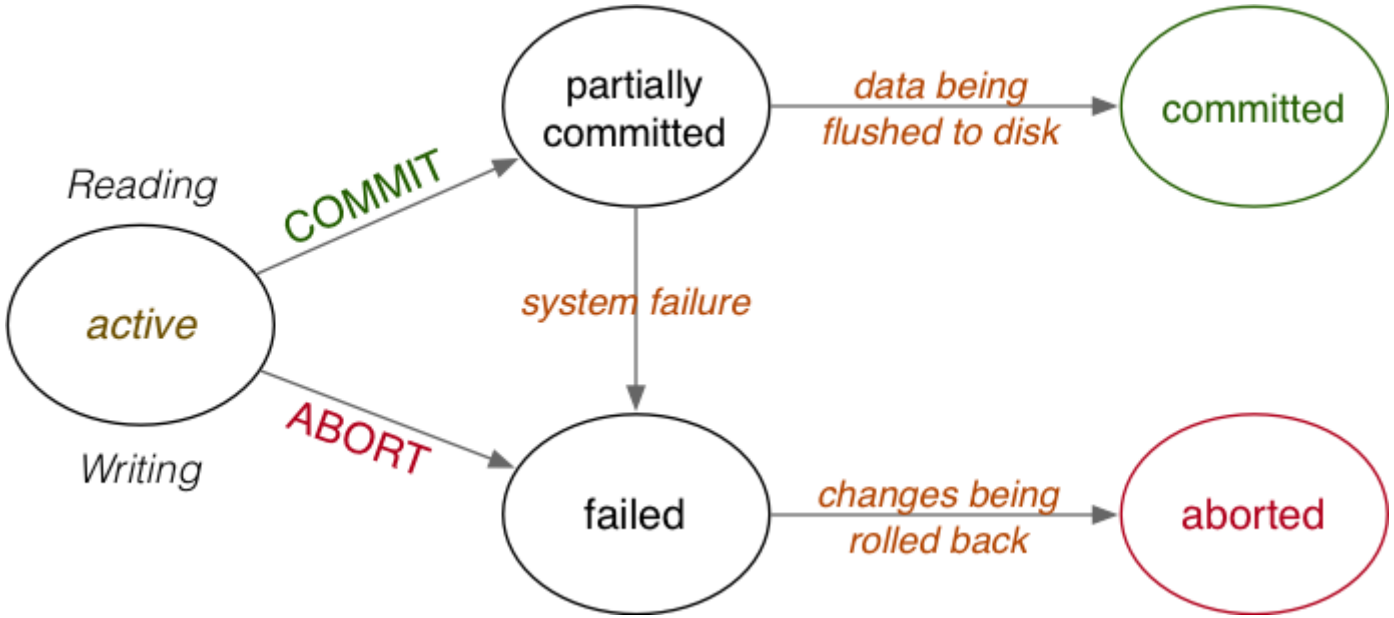
```
...
   if (avail < N) then
      raise exception 'Insufficient funds in %',Src;
   end if;
   -- total funds in system = NNNN
   update Accounts set balance = balance-N
   where  id = sID;
   -- funds temporarily "lost" from system
   update Accounts set balance = balance+N
   where  id = dID;
   -- funds restored to system; total funds = NNNN
   return nextval('tx_id_seq');
end;
```

<< ^ >>

❖ Transaction Concepts

A transaction must always terminate, either:

- successfully (**`COMMIT`**), with all changes preserved
- unsuccessfully (**`ABORT`**), with database unchanged

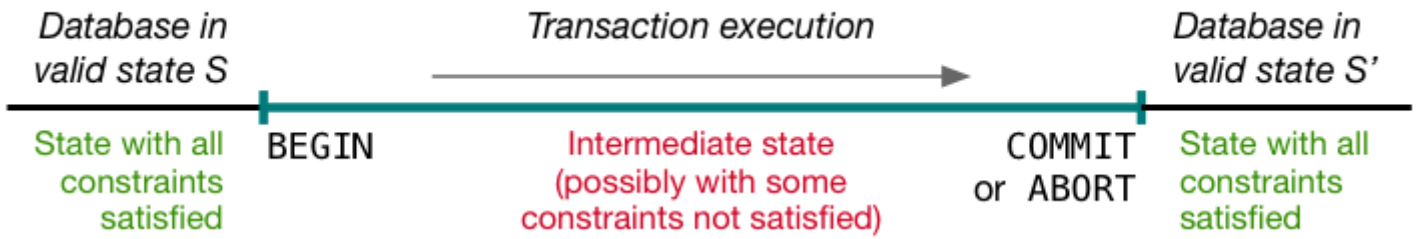


<< ^

❖ Transaction Consistency

Transactions typically have intermediate states that are invalid.

However, states before and after transaction must be valid.



Valid = consistent = satisfying all stated constraints on the data

Produced: 25 Mar 2021