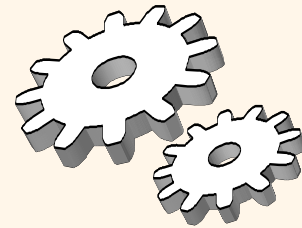
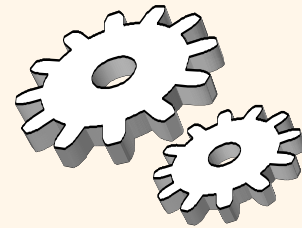


# *Transaction Management*



# *Motivation*

- ❖ What is a transaction and why we need them?
- ❖ Example: building a banking application
- ❖ Transfer \$20 from checking to saving account
- ❖ We can write an app with two SQL statements to do this
  - one statement subtracts \$20 from checking
  - another statement add \$20 to saving
- ❖ What if the app crashes in between two statements?
- ❖ We would have an “inconsistent” state



❖ Accounts(id, checking, saving)

❖ UPDATE Accounts

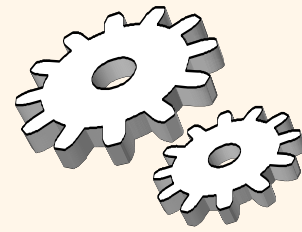
SET checking = checking - 20

WHERE id = 123

❖ UPDATE Accounts

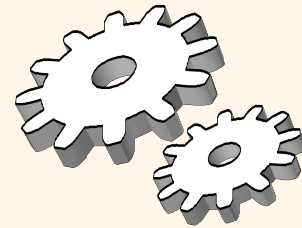
SET saving = saving + 20

Where id = 123



# *Inconsistency*

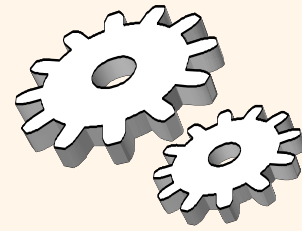
- ❖ When you write an application, you do have a notion of what it means for the app to be consistent, and when things may look inconsistent (“doesn’t make sense”)
  - “inconsistency” is subjective, depending on the business logic of the app
- ❖ Want to make sure app will never be in an inconsistent state
- ❖ Do this using the notion of transaction



# *Transaction*

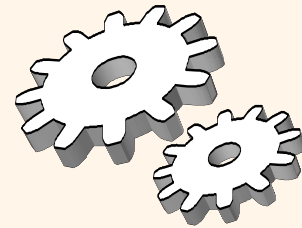
- ❖ A transaction is a sequence of SQL statements that you want to execute as a single “atomic” unit
  - either all statements in the transaction would be executed, or none would be executed
  - if the app is consistent before a transaction, we assume that it will also be consistent after the transaction
  - you don't want to execute a transaction half way; that can leave app in an inconsistent state
- ❖ When the app runs, transactions will be executed, one after another

# *What do we want the DB to do regarding transactions?*

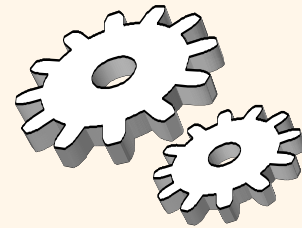


- ❖ ACID properties
- ❖ Atomic, consistent, isolation, durable
- ❖ Execute each transaction “atomically”
  - if a transaction crashes half way, then remove its effect
- ❖ Isolation: if two users run transactions concurrently, they should not interfere with each other
  - e.g., moving \$20 from checking to saving AND return the balance (the sum of checking + saving)

# *What do we want the DB to do regarding transactions?*

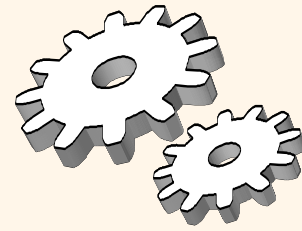


- ❖ Isolation: if two users run transactions concurrently, they should not interfere with each other
  - e.g., moving \$20 from checking to saving AND return the balance (the sum of checking + saving)
  - what do we want in this case? sequential execution of the two transactions
- ❖ Durable: if a transaction has been executed, its effect is persisted in the database
- ❖ What about “consistency”?



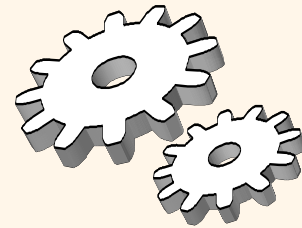
- ❖ Accounts(id, checking, saving)
- ❖ UPDATE Accounts  
SET checking = checking - 20  
WHERE id = 123
- ❖ UPDATE Accounts  
SET saving = saving + 20  
Where id = 123
- ❖ SELECT (checking + saving)  
FROM Accounts  
WHERE id = 123





# *How does the DB do this?*

❖ Using locks and crash recovery



# *Summary*

- ❖ Notion of transaction
- ❖ Each user app must be structured as executing transactions on a database
- ❖ Multiple users can execute multiple transactions concurrently
- ❖ We want ACID
- ❖ DB system ensures this using locks and crash recovery