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22C:169
Computer Security

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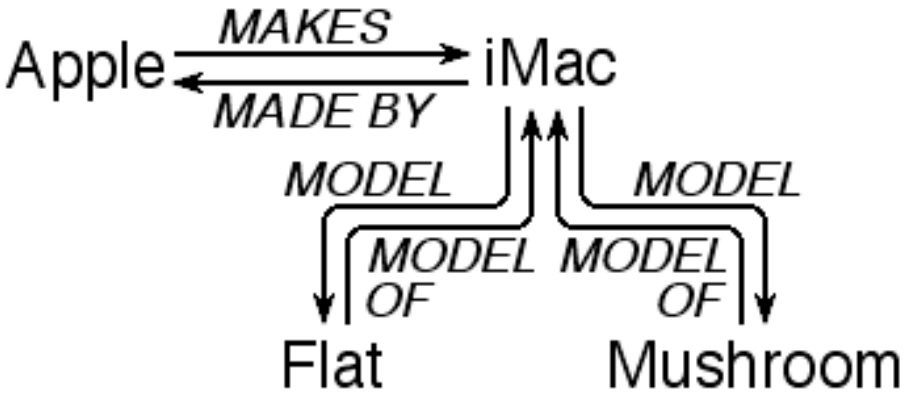
Database Security

What is a database

A table giving related attributes

Manuf	Model	Color	Price
Apple	iMac	White	$1.4K
Dell	Dim.8400	Black	$829

Entities and their Relationships



The Relational Model

Equivalent to entity-relationship model!

Multiple tables,

- *one for each relationship*
- *list all participating entities*
- *give the entity to which they are related*
- *n-way relationships lead to n+1 columns*

What is a database schema?

For a simple table

The labels on the columns

For relational model

What tables are present

For an entity relationship model

For each class of entities,

What relationships should be recorded

Type information can be included
(pick your type model!)

Database Issues

Integrity

- Does the database stay self consistant?
- Are constraints on data met?

Update and Access Control

- Who may add data?
- Who may examine data?

BIG PROBLEM: In general, each relationship between pairs of entities may have different access constraints!

Fault Tolerance

No matter what happens

We typically want to avoid data loss

Must address:

Failure of media

Failure of computer during update

Failure of security (vandalism)

User error (including Administrator error)

Backups and transaction logs address this complex issue

Availability

No matter what happens

We typically want instant access to data

Must address

- Failure of media
- Failure of computer systems
- Attacks on computer systems
- User error ...

Redundant storage and access paths address this difficult issue

Two Phase Update

Problem: Must either

Debit and Credit or make no change

May not

Debit one account or
Credit another account
Without doing the other

Cannot, therefore, write this code:

```
account1 = account1 + 1;
account2 = account2 - 1;
```

Implementing 2-phase update

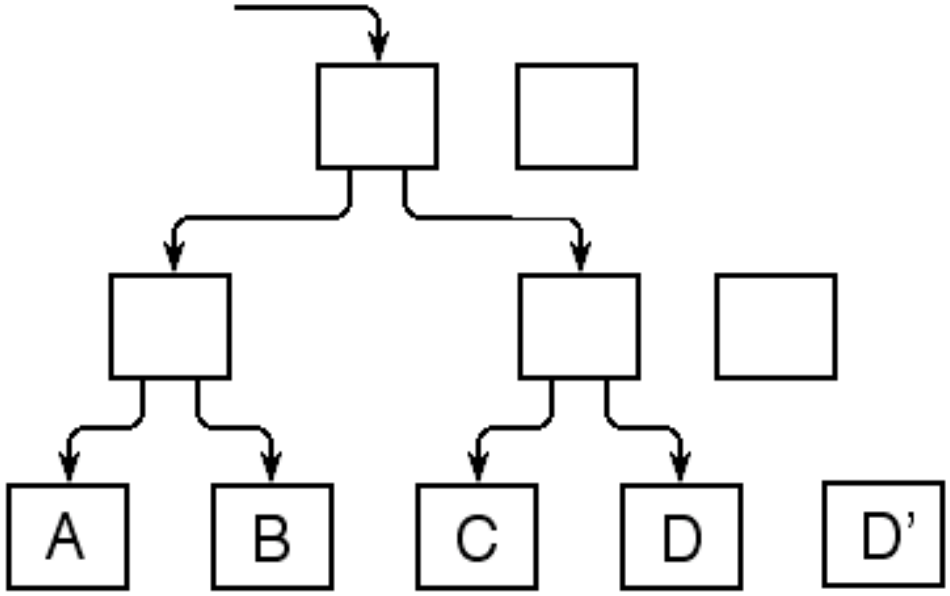
Step 1

Record updates in new memory
(old memory not changed)

Step 2

Commit change
(typically by changing pointer to data)

2-Phase Update



How do you update a pointer on disk?

Problem

Writing a disk block is not atomic

So a failure during write produces

Corrupt data

Solution: Atomic update algorithm

2 or more copies of data

Each with checksum (or signature)

Always write in specific order

Read until good copy found

Atomic Update Algorithm

```
store(x)
   x1 = <x,signature(x)>
   x2 = <x,signature(x)>

read
   if x1.sig = signature(x1.data)
      return x1.data
   if x2.sig = signature(x2.data)
      return x2.data
   return failure!!!
```