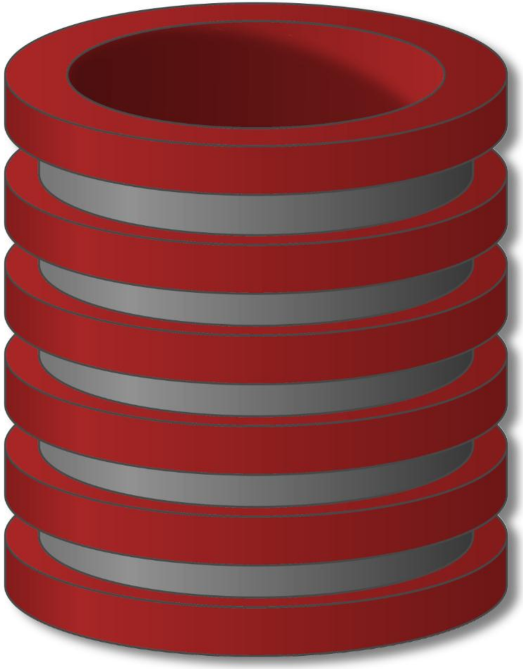

# Relational Design Theory

## Shortcomings of BCNF/4NF

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Shortcomings of BCNF/4NF

## Boyce-Codd Normal Form

Relation R with FDs is in BCNF if:

For each $\underline{A \rightarrow B}$, $\underline{A}$ is a key

## Fourth Normal Form

Relation R with MVDs is in 4NF if:

For each nontrivial $\underline{A \twoheadrightarrow B}$, $\underline{A}$ is a key

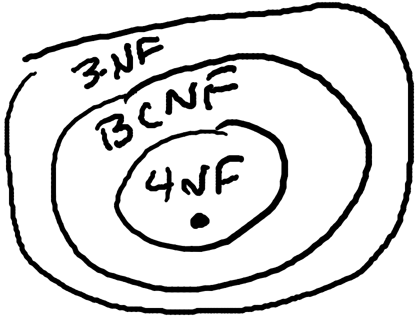
## Shortcomings of BCNF/4NF

# Example: College application info.

`Apply(SSN, cName, date, major)`

*Can apply to each college once for one major* ✓

*Colleges have non-overlapping application dates* ✓



FDs: SSN, cName → date, major    date → cName

Keys: SSN, cName

BCNF: No.    A1 (date, cName)    ?

A2 (SSN, date, major)

Good design? Not necessarily. 3rd Normal Form

# Example #2

**Student(SSN, HSname, GPA, priority)**

*Multiple HS okay, priority determined from GPA*

FDs: SSN → GPA $\boxed{\text{GPA} \to \text{priority}}$ SSN → priority ←

SSN → GPA, priority

Keys: SSN, HSname

BCNF: No. → S1(SSN, GPA, priority)

~~S2(SSN, HSname, GPA)~~ ←

~~S3(SSN, GPA)~~

→ S4(SSN, HSname)

Good design?

Not necessarily.

Shortcomings of BCNF/4NF

## Boyce-Codd Normal Form

Relation R with FDs is in BCNF if:

For each A → B, A is a key

## Fourth Normal Form

Relation R with MVDs is in 4NF if:

For each nontrivial A ↠ B, A is a key

After decomposition, no guarantee dependencies can be checked on decomposed relations

# Shortcomings of BCNF/4NF

## Example #3

**Scores(SSN, sName, SAT, ACT)** *

"Denormalized" relation

*Multiple SATs and ACTs allowed*

*All queries return name + composite score for SSN*

FDs + keys: SSN → sName. No Key.

MVDs: SSN, sName →→ SAT * "rest" (ACT)

4NF: No. ~~S1(SSN, sName, SAT)~~ ←

~~S2(SSN, sName, ACT)~~ ← 4NF

S3(SSN, sName) S5(SSN, ACT)

S4(SSN, SAT)

# Shortcomings of BCNF/4NF

## Example #4

```
College(cName, state)
CollegeSize(cName, enrollment)
CollegeScores(cName, avgSAT)
CollegeGrades(cName, avgGPA)
      …
```

"Too decomposed"

BCNF/4NF? Yes.

Good Design? Not necessarily.

Shortcomings of BCNF/4NF

# Designing a database schema

- Usually many designs possible
- Some are (much) better than others!
- How do we choose?

❖ Very nice theory for relational database design

- Normal forms – “good” relations
- Design by decomposition
- Usually intuitive and works well
- Some shortcomings
  - Dependency enforcement ✓
  - Query workload ✓
  - Over-decomposition ✓

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