

## Slide Set 7: Normalization 3NF

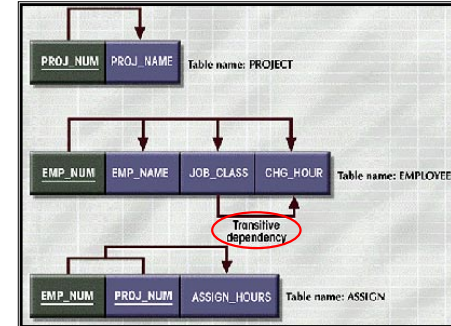
### *3NF = Third Normal Form*

- ❖ **Definition: Table format that:**
  - ◆ Is in 2NF and
  - ◆ No **Transitive Dependencies** exist
    - ◆ One or more attributes not functionally dependent on nonkey attributes.
- ❖ **Conversion to Third Normal Form**
  1. Be in 2NF
  2. Remove **Transitive Dependencies**.

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### *Identifying Transitive Dependencies*

- ❖ 2NF relation has no **partial dependencies**
  - ◆ No attribute dependent on a portion of primary key
- ❖ 3NF relation has no **transitive dependencies**
  - ◆ No non-key attribute determines another non-key attribute.



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### *Remove Transitive Dependencies*

- ❖ **Goal: No non-key attribute determines another non-key attribute.**
- ❖ **Method: Create additional table to remove the transitive functional dependence relationship.**

```
PROJECT (PROJ_NUM, PROJ_NAME)
EMPLOYEE (EMP_NUM, EMP_NAME, JOB_CLASS, CHG_HOUR)
ASSIGN (PROJ_NUM, EMP_NUM, HOURS)
```

```
PROJECT (PROJ_NUM, PROJ_NAME)
ASSIGN (PROJ_NUM, EMP_NUM, HOURS)
EMPLOYEE (EMP_NUM, EMP_NAME, JOB_CLASS)
JOB (JOB_CLASS, CHG_HOUR)
```

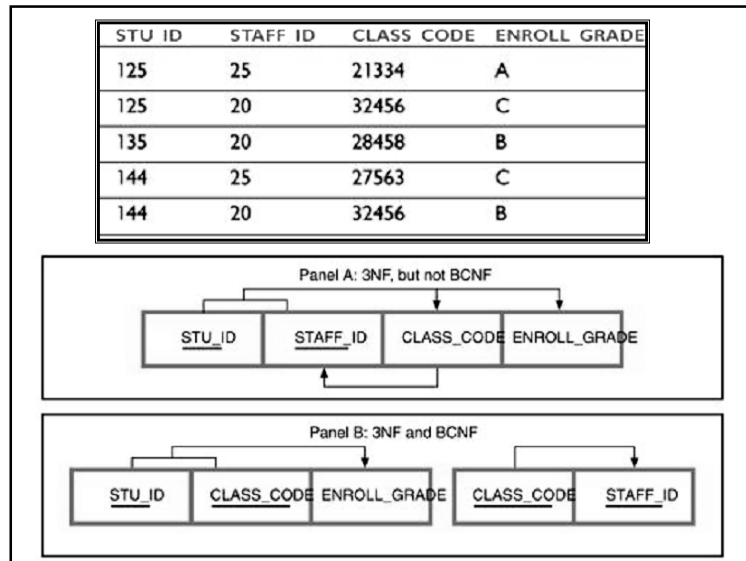
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### *Boyce-Codd Normal Form (BCNF)*

- ❖ A table is in **Boyce-Codd Normal Form (BCNF)** if every determinant in the table is a primary key.
  - ◆ A determinant is any attribute whose value determines other values with a row.
  - ◆ No non-key attribute can determine a key attribute.
- ❖ If a table contains only one primary key attribute, the 3NF and the BCNF are equivalent.
- ❖ BCNF is a special case of 3NF.

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## Slide Set 7: Normalization 3NF



## 4NF = Fourth Normal Form

- ❖ **Definition: Tabular format in which:**
  - ◆ It is in 3NF and
  - ◆ No multiple sets of multivalued dependencies
- ❖ **Conversion to Second Normal Form**
  1. Be in 3NF
  2. Remove multiple sets of multivalued dependencies.
- ❖ **Generally 3NF is enough normalization for business applications.**
  - ◆ 4NF not done.

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## Denormalization

- ❖ Normalization is only one of many database design goals.
- ❖ Normalized (decomposed) tables require additional processing, reducing system speed.
- ❖ Normalization purity is often difficult to sustain in the modern database environment.
  - ◆ The conflict between design efficiency
  - ◆ Information requirements
  - ◆ Processing speed
- ❖ Resolved through compromises that include **denormalization.**

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## Integrity constraints

- ❖ **Domain constraints**
  - ◆ Domain name, meaning, data type, size, allowable values/range
  - ◆ Part of “data dictionary”
- ❖ **Entity integrity**
  - ◆ Primary key: UNIQUE & valid, non-null
- ❖ **Referential integrity**
  - ◆ consistency in rows between relations
  - ◆ foreign key = primary key (or null)

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## Slide Set 7: Normalization 3NF

### Construction Company Example

- ❖ The company manages many projects.
- ❖ Each project requires services of many employees.
- ❖ An employee may be assigned to several different projects.
- ❖ Some employees are not assigned to a project and perform duties not specifically related to a project.
- ❖ Some employees are part of a labor pool, to be shared by all project teams.
- ❖ Each employee has a (single) primary job classification. This job classification determines the hourly billing rate.
- ❖ Many employees can have the same job classification.

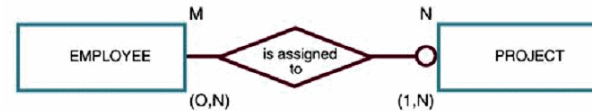
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### Normalization and Database Design

#### ❖ Two Initial Entities:

**PROJECT** (PROJ\_NUM, PROJ\_NAME)  
**EMPLOYEE** (EMP\_NUM, EMP\_LNAME,  
 EMP\_FNAME, EMP\_INITIAL, JOB\_DESCRIPTION,  
 JOB\_CHG\_HOUR)

#### ❖ What Normal form are these in?



Note: Some employees are not assigned to a project; thus, PROJECT is optional to EMPLOYEE.

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### Normalization and Database Design

#### ❖ PROJECT is in 3NF

**PROJECT** (PROJ\_NUM, PROJ\_NAME)

#### ❖ EMPLOYEE is in 2NF

**EMPLOYEE** (EMP\_NUM, EMP\_LNAME, EMP\_FNAME,  
 EMP\_INITIAL, JOB\_DESCRIPTION, JOB\_CHG\_HOUR)

#### ❖ To convert to 3NF remove transitive dependency by creating two entities

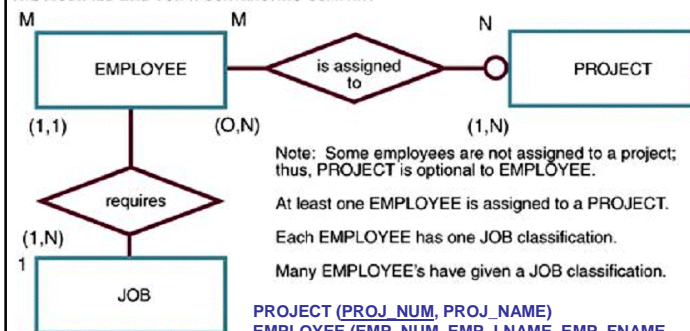
**EMPLOYEE** (EMP\_NUM, EMP\_LNAME, EMP\_FNAME,  
 EMP\_INITIAL, JOB\_CODE)

**JOB** (JOB\_CODE, JOB\_DESCRIPTION, JOB\_CHG\_HOUR)

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### Normalization and Database Design

#### THE MODIFIED ERD FOR A CONTRACTING COMPANY



Note: Some employees are not assigned to a project; thus, PROJECT is optional to EMPLOYEE.

At least one EMPLOYEE is assigned to a PROJECT.

Each EMPLOYEE has one JOB classification.

Many EMPLOYEE's have given a JOB classification.

**PROJECT** (PROJ\_NUM, PROJ\_NAME)  
**EMPLOYEE** (EMP\_NUM, EMP\_LNAME, EMP\_FNAME,  
 EMP\_INITIAL, JOB\_CODE)  
**JOB** (JOB\_CODE, JOB\_DESCRIPTION, JOB\_CHG\_HOUR)

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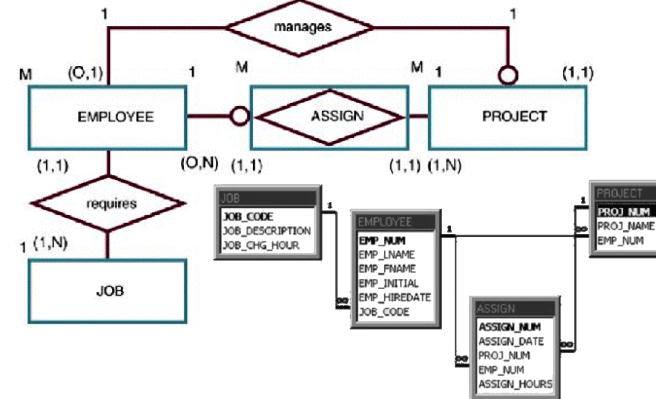
### Normalization and Database Design

- ❖ Eliminate M:N relation with ASSIGN composite entity
- ❖ Attribute ASSIGN\_HOUR is assigned to ASSIGN composite entity
- ❖ “Manages” relationship is created between EMPLOYEE and PROJECT entities.
  - PROJECT (PROJ\_NUM, PROJ\_NAME, EMP\_NUM)
  - EMPLOYEE (EMP\_NUM, EMP\_LNAME, EMP\_FNAME, EMP\_INITIAL, EMP\_HIREDATE, JOB\_CODE)
  - JOB (JOB\_CODE, JOB\_DESCRIPTION, JOB\_CHG\_HOUR)
  - ASSIGN (ASSIGN\_NUM, ASSIGN\_DATE, PROJ\_NUM, EMP\_NUM, ASSIGN\_HOURS)

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### Remove the M:N Relationship

- ❖ Create of the Composite Entity ASSIGN



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### In Class Problem:

- ❖ Review tabular presentation of information in the following slide
- ❖ List & discuss the kinds of anomalies present in each table (see textbook discussion & prior example)
- ❖ Create 1NF relation; write in shorthand notation; identify candidate keys
- ❖ Analyze functional dependencies
- ❖ Write final form of 2NF relation(s)
- ❖ What is required for 3NF?

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### In Class Problem:

PATIENT NO.	NAME	ADDRESS	DATE OF VISIT	DOCTOR	SYMPTOM
639147-0	Michael Smith	329 Fourth St.	3-24-94	Ryan	Fever
			7-6-94	Nelson	Sore throat
			8-16-94	Ryan	Cold
89043-0	Fred Jones	932 Third St.	2-20-94	Wood	Flu
			6-15-94	Nelson	Sore throat
			7-02-94	Ryan	Rash
90765-0	Sarah Smith	329 Fourth St.	3-24-94	Ryan	Fever
			10-28-94	Ryan	Bronchitis

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