

Medical Informatics

Lecture 4: The Relational Model

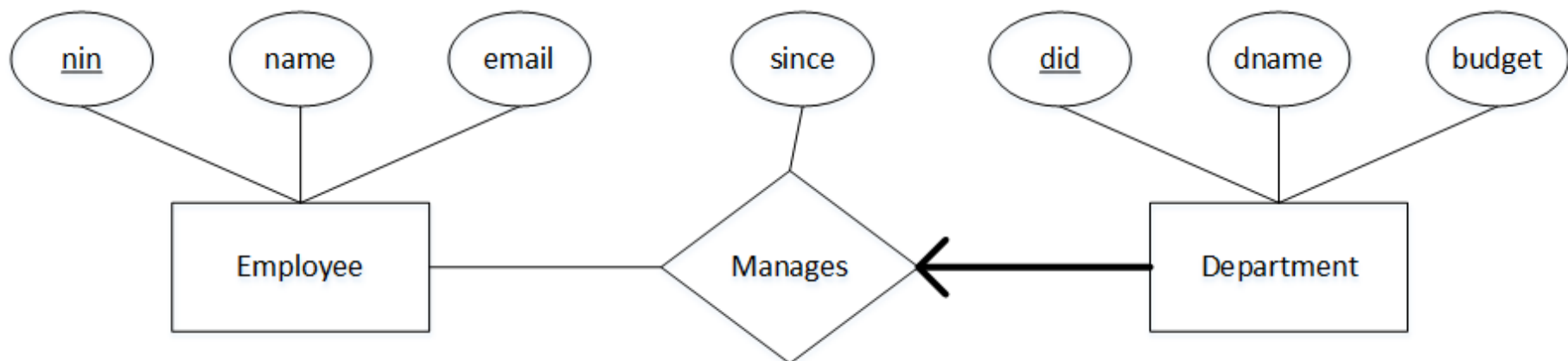
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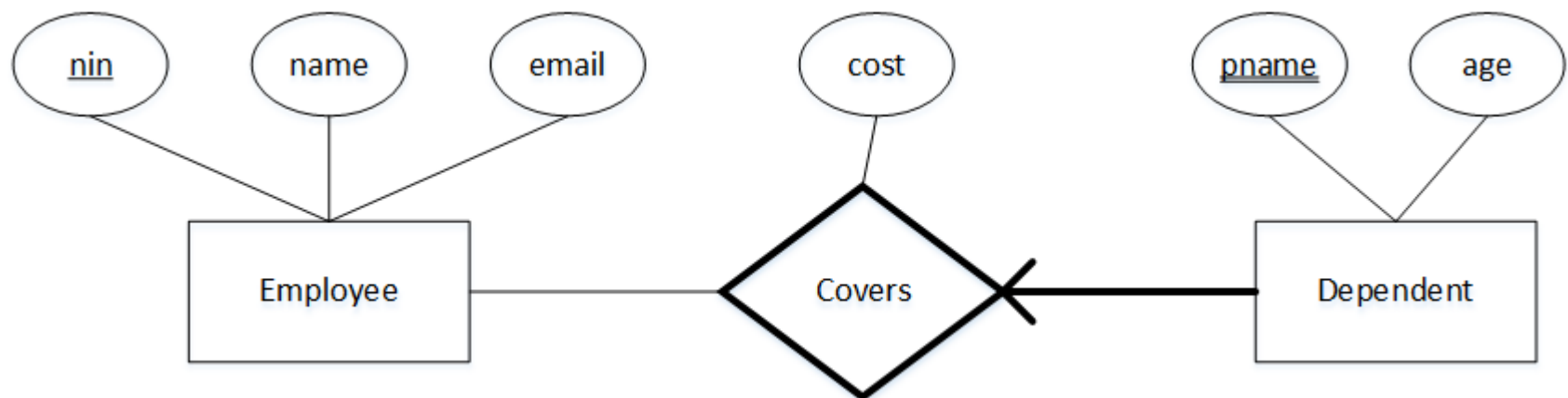
In the previous lecture

- Refining the ER model
- Constraints:
 - key constraints
 - participation constraints



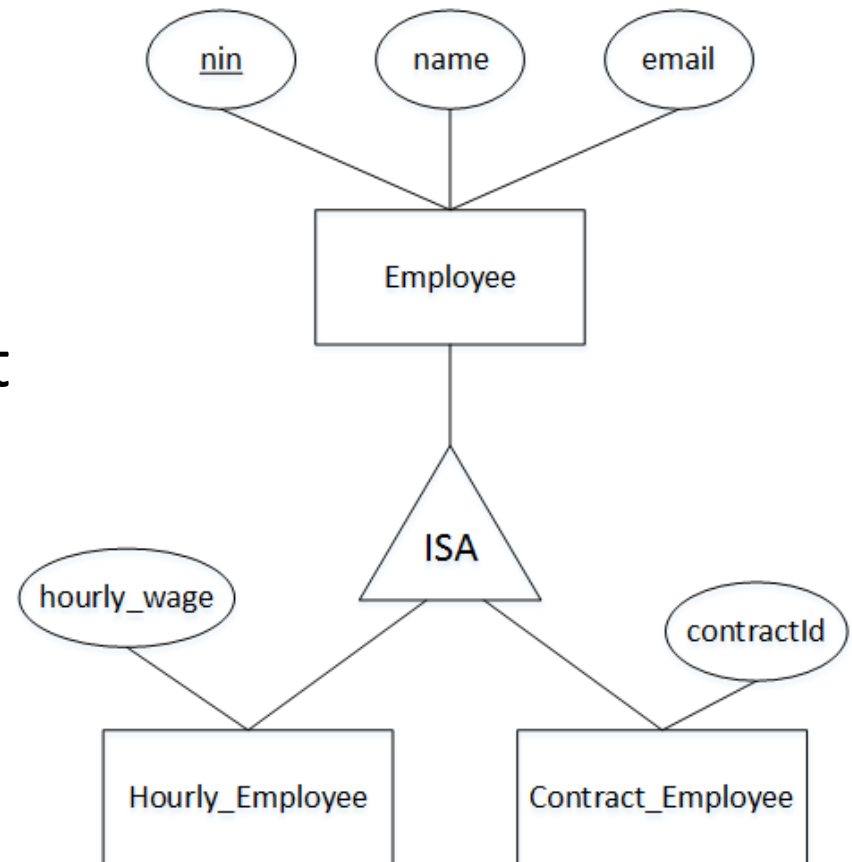
In the previous lecture

- Refining the ER model
- Constraints:
 - key constraints
 - participation constraints
- Weak entity sets



In the previous lecture

- Refining the ER model
- Constraints:
 - key constraints
 - participation constraint
- Weak entity sets
- Entity hierarchies



In this lecture

- Introduction to the relational model
- Creating tables with DDL
- Specifying integrity constraints

Introduction to the relational model

- Database: a collection of relations
- A relation consists of:
 - **Relation schema**: describes the format of a table, consisting of:
 - Relation's name
 - Name of each field (column)
 - Domain of each field
 - **Relation instance**: the content of a table
 - A set of tuples (records)

Introduction to the relational model

The diagram illustrates a relational table with four columns: **mn**, **name**, **email**, and **age**. The table contains five rows of data. Annotations include: a red arrow labeled *schema* pointing to the column headers; yellow arrows labeled *fields* pointing to each of the four columns; and a purple bracket labeled *tuples* encompassing the five rows of data.

mn	name	email	age
s0785212	Andrew	andrew@maths	19
s1253477	Jenny	jenny@inf	23
s1456381	Rhona	rhona@inf	18
s1489673	Stuart	stuart@law	34
s1473612	Alan	alan@law	20

- **Arity** (also called degree): number of fields
- **Cardinality**: number of rows

Introduction to the relational model

- Database: a set of tables with rows and columns, and links between them

Student

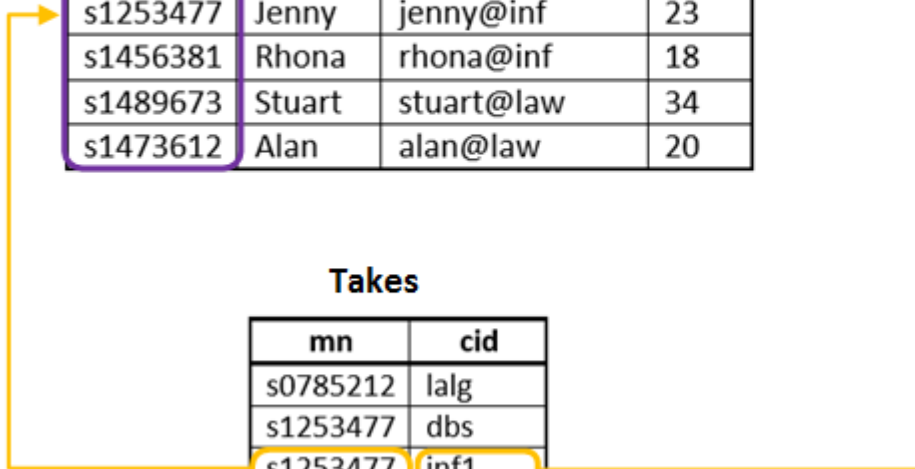
mn	name	email	age
s0785212	Andrew	andrew@maths	19
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s1473612	Alan	alan@law	20

Course

cid	title	credits
dbs	Database Systems	20
inf1	Informatics 1	10
sls	Scottish Legal System	10
lalg	Linear Algebra	10

Takes

mn	cid
s0785212	lalg
s1253477	dbs
s1253477	inf1
s1489673	sls



Creating relations with DDL

- Structured Query Language (SQL): standard language for creating, manipulating and querying data in relational database management systems
- Data Definition Language (DDL): subset of SQL that allows us to create, delete and modify tables
- **CREATE TABLE** declaration: define a new relation (called 'table' in SQL) with a particular schema

Creating relations with DDL

```
CREATE TABLE Student (  
  mn CHAR(8),  
  name VARCHAR(20),  
  email VARCHAR(25),  
  age INTEGER )
```

Student

mn	name	email	age
s0785212	Andrew	andrew@maths	19
s1253477	Jenny	jenny@inf	23
s1456381	Rhona	rhona@inf	18
s1489673	Stuart	stuart@law	34
s1473612	Alan	alan@law	20

- Domain constraint: for each row in this table, the values in each column must be drawn from the appropriate domain

Creating relations with DDL

- General form:

```
CREATE TABLE table-name (  
    <attribute declarations>  
    <integrity constraints>  
)
```

- Integrity constraints:
 - Key constraints
 - Foreign key constraints

Primary key constraints in DDL

```
CREATE TABLE Student (  
    mn CHAR(8),  
    name VARCHAR(20),  
    email VARCHAR(25),  
    age INTEGER,  
    PRIMARY KEY (mn)  
);
```

Student

mn	name	email	age
s0785212	Andrew	andrew@maths	19
s1253477	Jenny	jenny@inf	23
s1456381	Rhona	rhona@inf	18
s1489673	Stuart	stuart@law	34
s1473612	Alan	alan@law	20

- The **primary key** *uniquely identifies* a tuple.
- No two rows in the Student table have the same mn.

Foreign key constraints in DDL

- Foreign key constraints specify *links* between tables.

Student

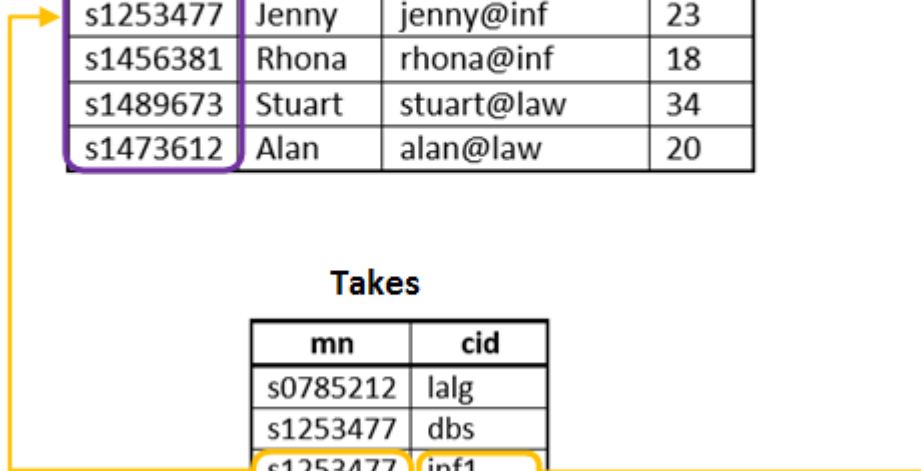
mn	name	email	age
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s1456381	Rhona	rhona@inf	18
s1489673	Stuart	stuart@law	34
s1473612	Alan	alan@law	20

Course

cid	title	credits
db	Database Systems	20
inf1	Informatics 1	10
sls	Scottish Legal System	10
lalg	Linear Algebra	10

Takes

mn	cid
s0785212	lalg
s1253477	db
s1253477	inf1
s1489673	sls



Foreign key constraints in DDL

- Foreign key constraints specify *links* between tables.

```
CREATE TABLE Takes (  
    mn CHAR(8),  
    cid CHAR(20),  
    mark INTEGER,  
    PRIMARY KEY (mn, cid),  
    FOREIGN KEY (mn) REFERENCES Student,  
    FOREIGN KEY (cid) REFERENCES Course  
)
```

- This specifies that mn will always take a value that appears in the Student table.

Foreign key constraints in DDL

- Foreign key constraints specify *links* between tables.

```
CREATE TABLE Takes (  
    mn CHAR(8),  
    cid CHAR(20),  
    mark INTEGER,  
    PRIMARY KEY (mn, cid),  
    FOREIGN KEY (mn) REFERENCES Student,  
    FOREIGN KEY (cid) REFERENCES Course  
)
```

- This specifies that cid will always take a value that appears in the Course table.

Foreign key constraints in DDL

```
CREATE TABLE Takes (  
    mn CHAR(8),  
    cid CHAR(20),  
    mark INTEGER,  
    PRIMARY KEY (mn, cid),  
    FOREIGN KEY (mn) REFERENCES Student,  
    FOREIGN KEY (cid) REFERENCES Course  
)
```

- The foreign key in a referencing relation must match the primary key of the reference relation.
- Same number of columns and same domains.

Foreign key constraints in DDL

- What should happen if a row in Student is deleted?
 - 1st approach: All rows in Takes that refer to it should be deleted.

```
CREATE TABLE Takes (  
    mn CHAR(8),  
    cid CHAR(20),  
    mark INTEGER,  
    PRIMARY KEY (mn, cid),  
    FOREIGN KEY (mn) REFERENCES Student  
        ON DELETE CASCADE,  
    FOREIGN KEY (cid) REFERENCES Course  
)
```

Foreign key constraints in DDL

- What should happen if a row in Student is deleted?
 - 2nd approach: For each row in Takes that refers to it, set its mn value to some pre-specified default value.

```
CREATE TABLE Takes (  
    mn CHAR(8) DEFAULT 's0000000',  
    cid CHAR(20),  
    mark INTEGER,  
    PRIMARY KEY (mn, cid),  
    FOREIGN KEY (mn) REFERENCES Student  
        ON DELETE SET DEFAULT,  
    FOREIGN KEY (cid) REFERENCES Course  
)
```

Foreign key constraints in DDL

- What should happen if a row in Student is deleted?
 - 3rd approach: For each row in Takes that refers to it, set its mn value to null.

```
CREATE TABLE Takes (  
    mn CHAR(8),  
    cid CHAR(20),  
    mark INTEGER,  
    PRIMARY KEY (mn, cid),  
    FOREIGN KEY (mn) REFERENCES Student  
        ON DELETE SET NULL,  
    FOREIGN KEY (cid) REFERENCES Course  
)
```

Conclusions

- The fundamental idea of the relational model is a relation.
- DDL allows us to specify:
 - the schema of our relations
 - primary and foreign keys
- In the next lecture we'll see how we can systematically translate an ER model into a relational one.
- Home exercise: How would you translate an entity set? And how a relationship set? Take a wild guess!

Acknowledgements

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