Chapter 15: Object-Oriented Database Development

Modern Database Management

6th Edition

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Object Definition Language (ODL)

- Corresponds to SQL's DDL (Data Definition Language)
- Specify the logical schema for an object-oriented database
- Based on the specifications of Object Database Management Group (ODMG)

Defining a Class

- **class** – keyword for defining classes
- **attribute** – keyword for attributes
- **operations** – return type, name, parameters in parentheses
- **relationship** – keyword for establishing relationship

Defining an Attribute

Value can be either:

- Object identifier OR Literal

Types of literals

- Atomic – a constant that cannot be decomposed into components
- Collection – multiple literals or object types
- Structure – a fixed number of named elements, each of which could be a literal or object type

Attribute ranges

- Allowable values for an attribute
- enum – for enumerating the allowable values

Kinds of Collections

Set – unordered collection without duplicates

Bag – unordered collection that may contain duplicates

List – ordered collection, all the same type

Array – dynamically sized ordered collection, locatable by position

Dictionary – unordered sequence of key-value pairs without duplicates

Defining Structures

Structure = user-defined type with components

struct keyword

Example:

```
struct Address {
    String street_address
    String city;
    String state;
    String zip;
};
```

Defining Operations

- Return type
- Name
- Parentheses following the name
- Arguments within the parentheses

Defining Relationships

Only unary and binary relationships allowed

Relationships are bi-directional

- implemented through use of **inverse** keyword

ODL relationships are specified:

- **relationship** indicates that class is on many-side
- **relationship set** indicates that class is on one-side and other class (many) instances unordered
- **relationship list** indicates that class is on one-side and other class (many) instances ordered

Figure 15-1 –UML class diagram for a university database

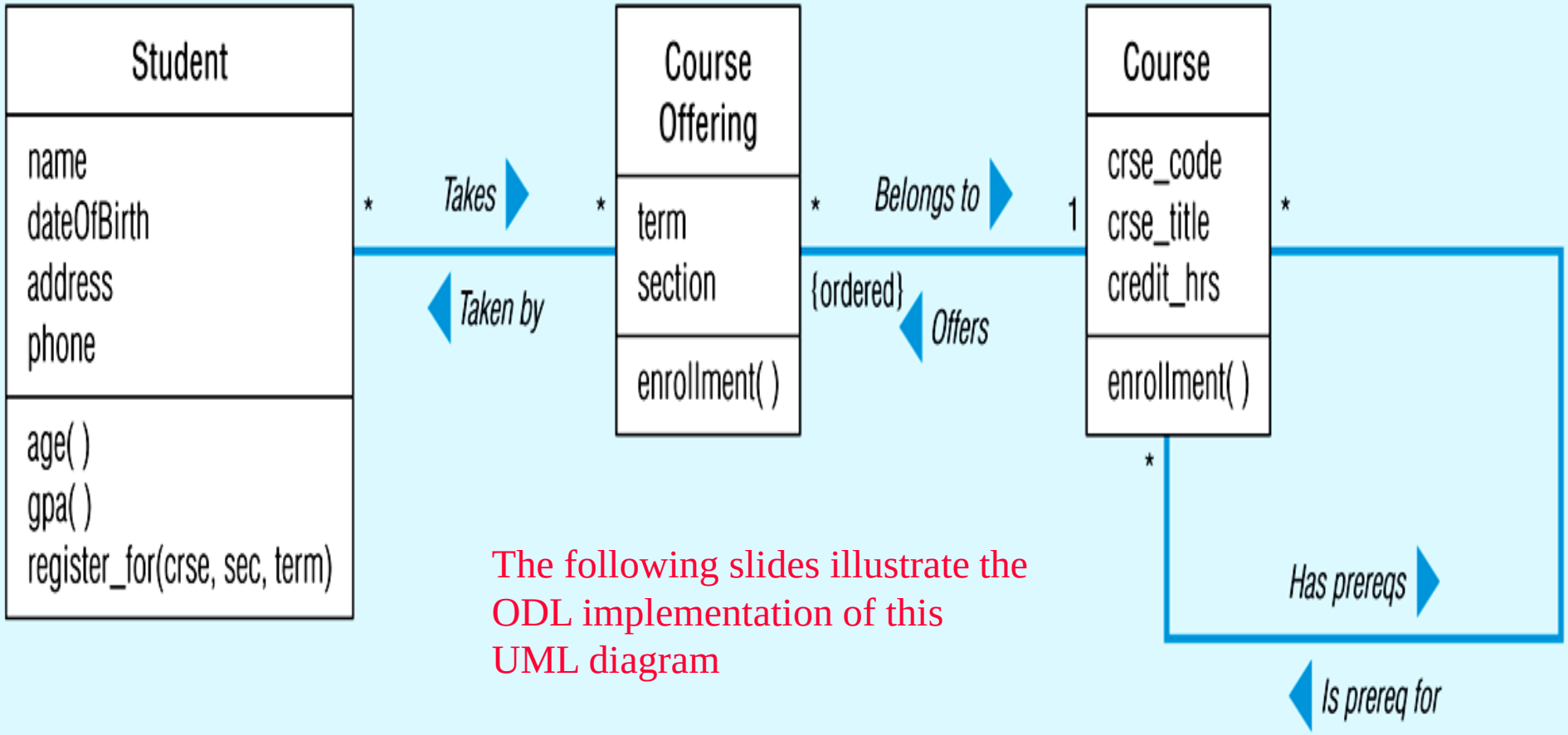

Figure 15-2 –ODL Schema for university database

```
class Student {
(     extent students)
      attribute string name;
      attribute Date dateOfBirth;
      attribute Address address;
      attribute Phone phone;
      relationship set (CourseOffering) takes inverse CourseOffering::taken_by;
      short age( );
      float gpa( );
      boolean register_for(string crse, short sec, string term);
};

class CourseOffering {
(     extent courseofferings)
      attribute string term;
      attribute enum section {1, 2, 3, 4, 5, 6, 7, 8};
      relationship set (Student) taken_by inverse Student::takes;
      relationship Course belongs_to inverse Course::offers;
      short enrollment( );
};

class Course {
(     extent courses)
      attribute string crse_code;
      attribute string crse_title;
      attribute short credit_hrs;
      relationship set (Course) has_prereqs inverse Course::is_prereq_for;
      relationship set (Course) is_prereq_for inverse Course::has_prereqs;
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};
```

class keyword begins the class definition.Class components enclosed between **{** and **}**

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};
```

attribute has a data type and a name

specify allowable values using **enum**

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};
```

extent = the set of all instances of the class

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      short enrollment( );
};
```

Operation definition: return type, name, and argument list. Arguments include data types and names

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      short enrollment( );
};
```

relationship sets indicate 1:N relationship to an *unordered* collection of instances of the other class

inverse establishes the bidirectionality of the relationship

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      attribute short credit_hrs;
      relationship set (Course) has_prereqs inverse Course::is_prereq_for;
      relationship set (Course) is_prereq_for inverse Course::has_prereqs;
      relationship list (CourseOffering) offers inverse CourseOffering::belongs_to;
      short enrollment( );
};
```

relationship indicates N:1 relationship to an instance of the other class

Figure 15-3 – UML class diagram for an employee project database

(a) Many-to-many relationship with an association class

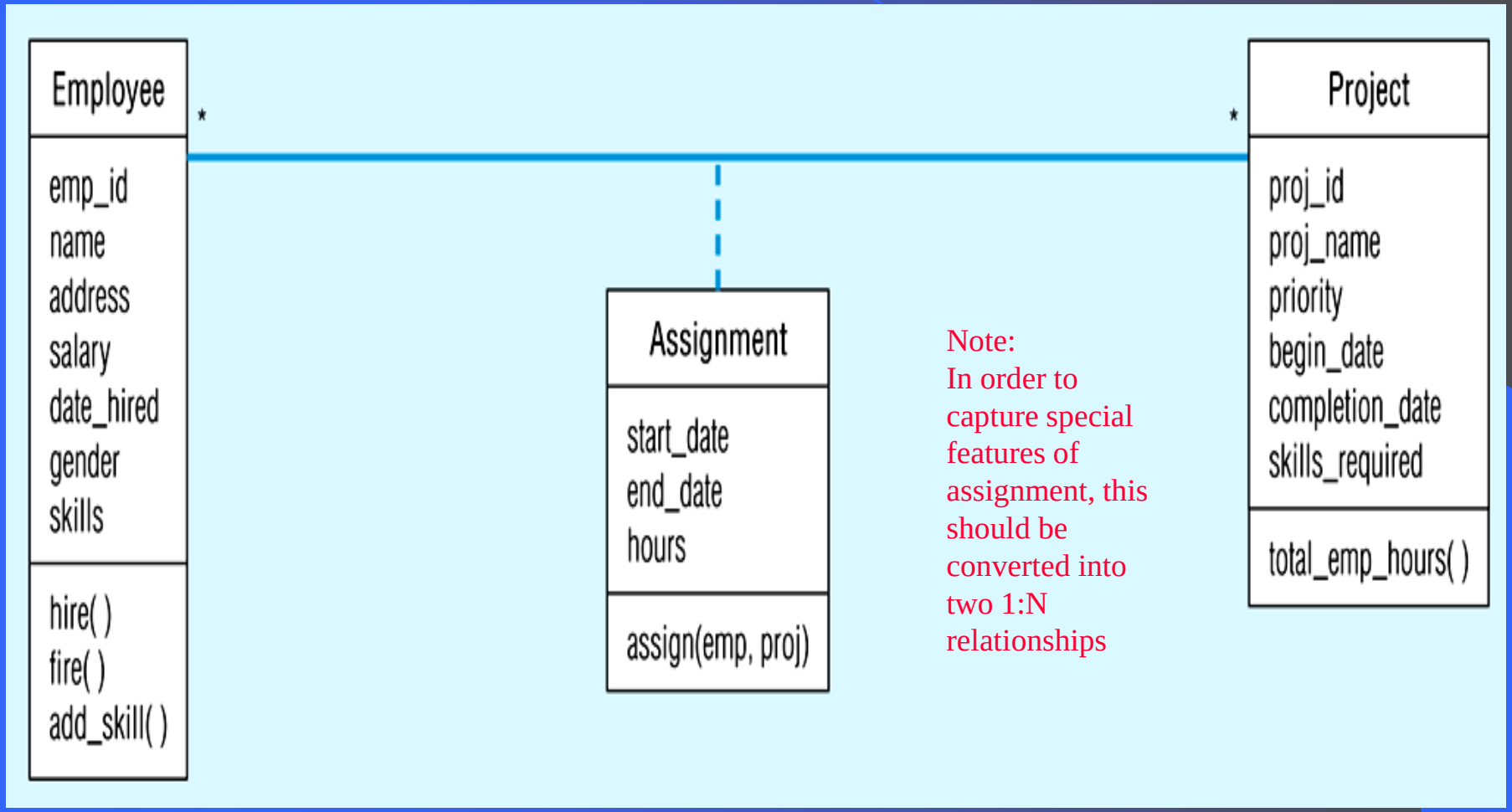
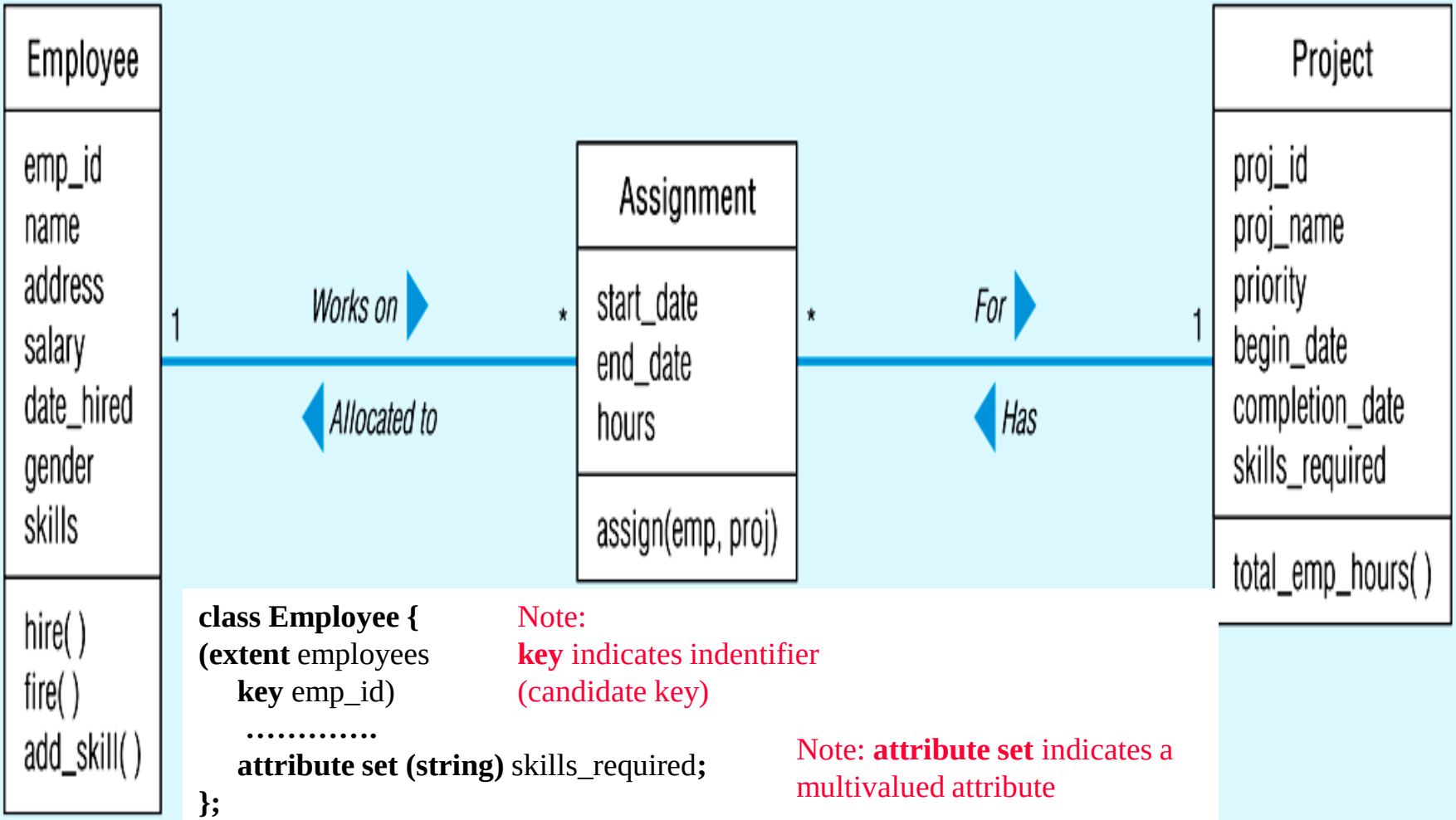


Figure 15-3 – UML class diagram for an employee project database

(b) Many-to many relationship broken into two one-to-many relationships

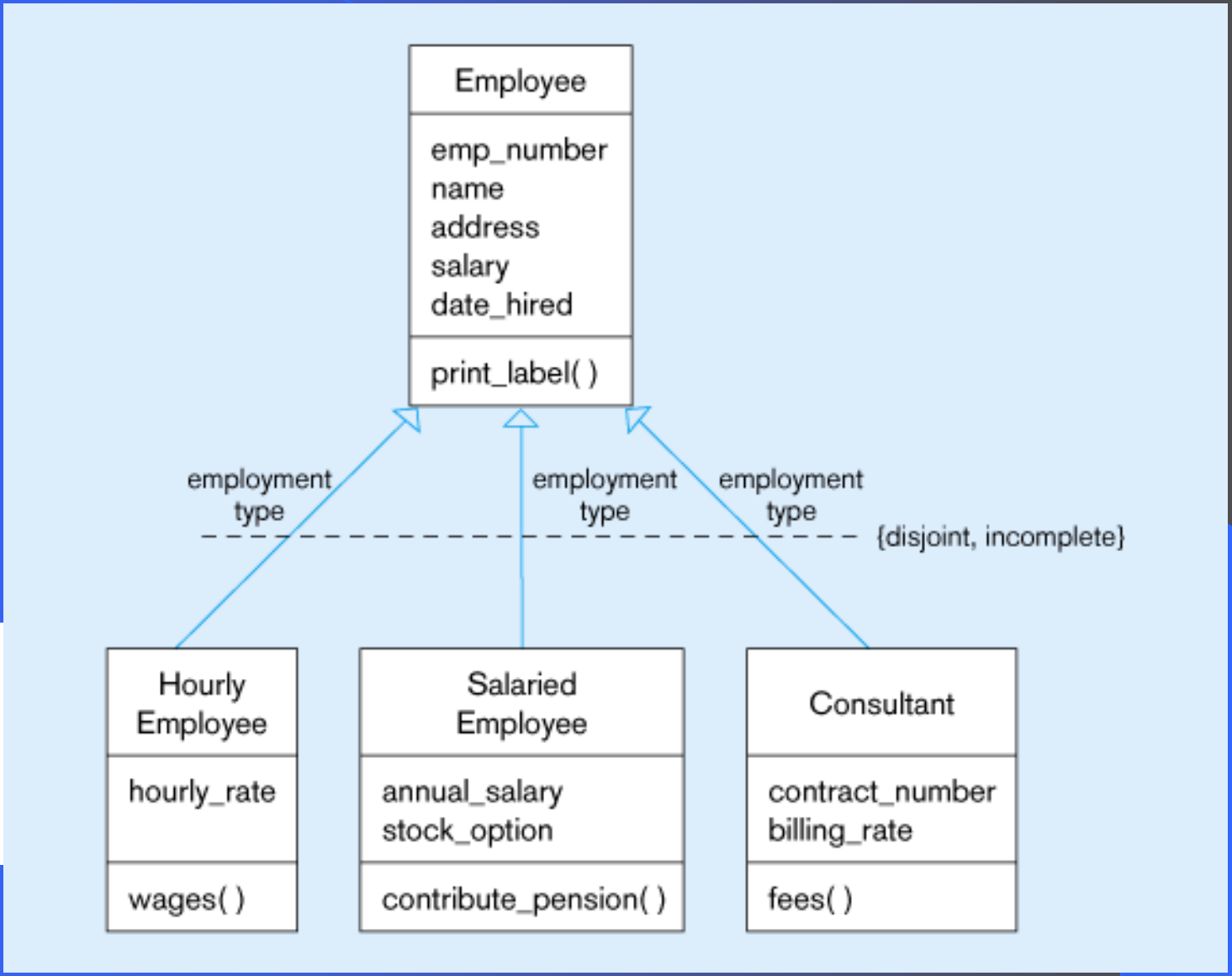



```
class Employee {
(extent employees
    key emp_id)
    ……
    attribute set (string) skills_required;
};
```

Note:
key indicates indentifier
(candidate key)

Note: **attribute set** indicates a multivalued attribute

Figure 15-4
UML class diagram showing employee generalization

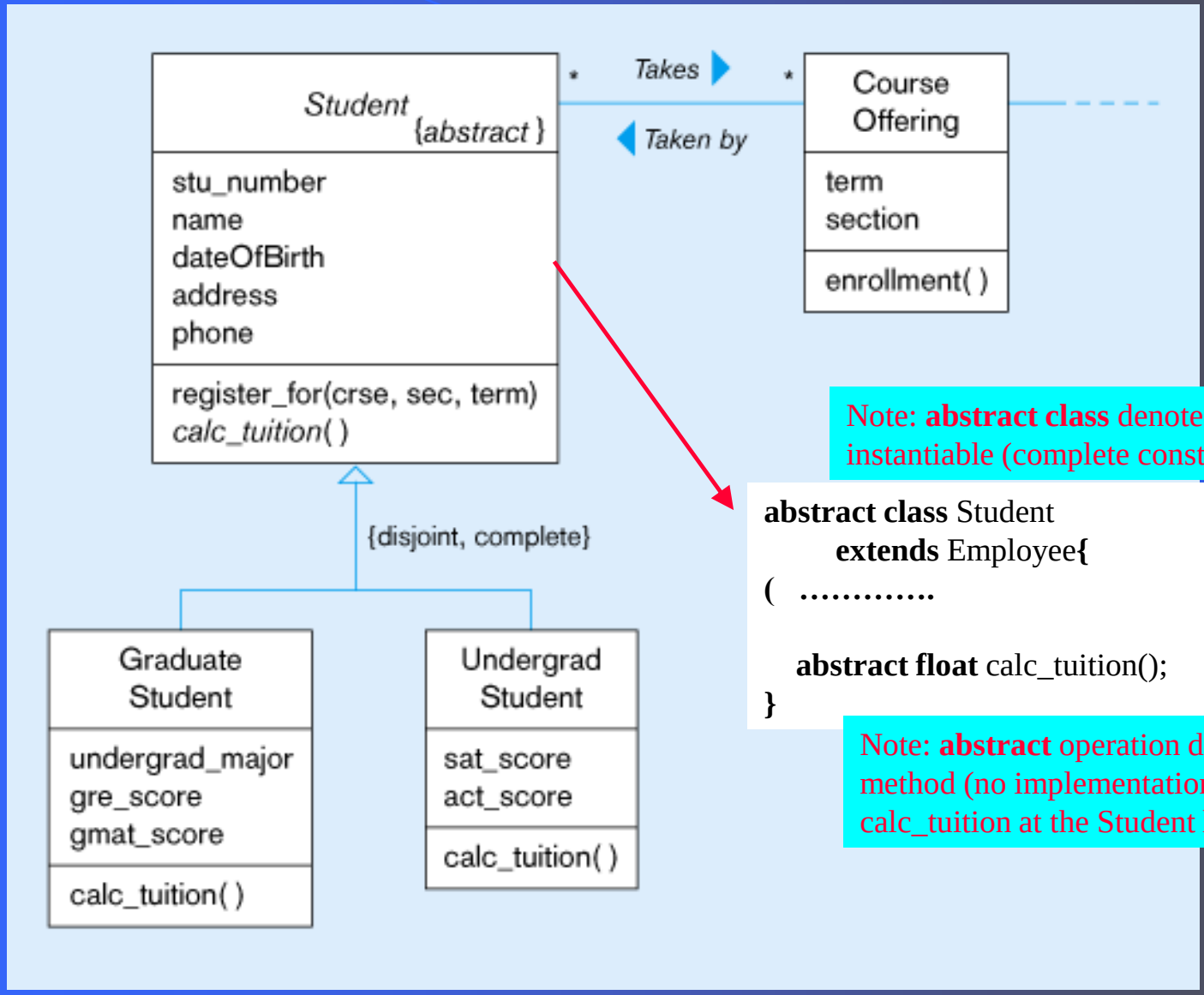



```
class Employee
      extends Employee{
(   ……..

  ……..
}
```

Note: **extends** denotes subclassing

Figure 15-5 –UML class diagram showing student generalization



Creating Object Instances

Specify a tag that will be the object identifier

- MBA699 course ();

Initializing attributes:

- Cheryl student (name: “Cheryl Davis”, dateOfBirth:4/5/77);

Initializing multivalued attributes:

- Dan employee (emp_id: 3678, name: “Dan Bellon”, skills {“Database design”, “OO Modeling”});

Establishing links for relationship

- Cheryl student (takes: {OOAD99F, Telecom99F, Java99F});

Querying Objects in the OODB

Object Query Language (OQL)

ODMG standard language

Similar to SQL-92

Some differences:

- Joins use class's relationship name:
  - Select x.enrollment from courseofferings x, ***x.belongs_to y*** where y.crse_course = "MBA 664" and x.section = 1;
- Using a set in a query
  - Select emp_id, name from employees where ***"Database Design" in skills***;

Current ODBMS Products

Rising popularity due to:

- CAD/CAM applications
- Geographic information systems
- Multimedia
- Web-based applications
- Increasingly complex data types

Applications of ODBMS

- Bill-of-material
- Telecommunications navigation
- Health care
- Engineering design
- Finance and trading

Table15-1 – ODBMS Products

Table 15-1 ODBMS Products

Company	*Product*	*Web Site*
Computer Associates	Jasmine	http://www.cai.com/products/jasmine.htm
Franz	AllegroSCL	http://www.franz.com
Gemstone Systems	GemStone	http://www.gemstone.com
neoLogic	neoAccess	http://neologic.com
Object Design	ObjectStore	http://www.odi.com
Objectivity	Objectivity/DB	http://www.objectivity.com
POET Software	POET Object Server	http://www.poet.com
Versant	Versant ODBMS	http://www.versant.com
Other Links Related to ODBMS Products		
Barry & Associates		http://www.odbmsfacts.com
Doug Barry's *The Object Database Handbook*		http://wiley.com
Object database newsgroup		news://comp.databases.object
Rick Cattell's *The Object Database Standard ODMG 3.0*		http://www.mkp.com
Object Database Management Group		http://www.odmg.org
Chaudhri and and Zicari's *Succeeding with Object Databases*		http://www.wiley.com/compbooks/chaudhri