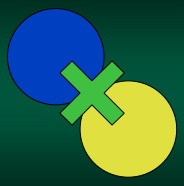
Relations in Computer Science

Part 2B

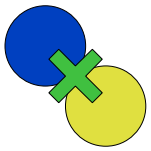


Cross Products & Databases

SQL is set notation

Products

- We are in the "Information Age" where knowledge is now computerized
- Information is stored in databases
- These systems are based on tuples and sets



Fields

- *Fields* contain the smallest unit of data
  - e.g. Number, Text
  - So, each can be seen as a tuple (it can be a set, but rarely so)
- Each field has a unique field name
  - Name
  - Age
  - etc....

Records

- A *record* is a set of data fields
  - represents a logical group of data
  - these include related numbers, text, images, etc...
- Examples
  - Course: department, number, section
  - Student: name, age, class
  - Computer: brand, speed, cost, etc...

Database Example

First	Last	Major	Greek
Peter	Griffen	Und	Tappa Kegga Bru
Joe	Gunchy	CSc	Cuppa Kappa Chino
Rick	Sanchez	Sci	elta Phart
Eric	Cartman	Bus	Eta Lotta Pi

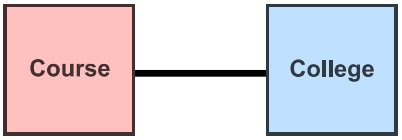
Record

Relationships & Cardinality

- Relationship
  - how tables are associated with each other
  - e.g. student records and class records
- Related tables are *joined* which performs a cross product on two tables
- Restrictions are used to eliminate unneeded records

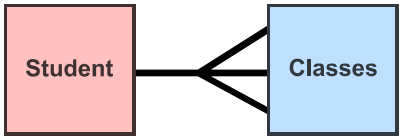
One-to-One Relationship

- One record is related to another single record
- e.g. Course and its Department



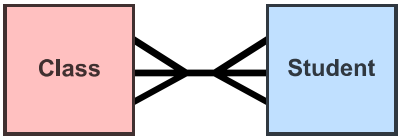
One-to-Many Relationship

- One record is related to many records
- e.g. Students and their classes



Many-to-Many Relationship

- One record is related to many records & vice-versa
- e.g. Class and students



Locating Specific Data

- A query language is used to:
  - Locate information
  - Sort records
  - Change data in records
- Examples:
  - SQL (Structured Query Language)
  - Natural language queries – not used that much

SQL Inner Join

```
SELECT Student.name,
       Course.grade
FROM Student
INNER JOIN Course
ON Student.sid = Course.sid
WHERE Course.department = "csc"
```

SQL Inner Set Notation (simplified)

$$\{ (s_{name}, c_{grade}) \mid s \in Student \text{ and } c \in Course \text{ and } s_{sid} = c_{sid} \text{ and } c_{department} = \text{"csc"} \}$$

Abstract Data Types

What *int* really means

Application of Sets

- An *abstract data type* is a set of values and operations (functions) on those values
- This is the basis for all objects, class, structures, etc….

Integer Example

- In the code below, *int* is an ADT found in most programming languages
- It declares a variable *n* of type *int*
- n represents a value from int's set of values

```
int n;
```


The Domain

- int is defined (normally) as 32-bit
- Set is { -2^{31}, …, $(2^{31} - 1)$ }
- So int $\subset$ Z

```
int n;
```


Operations

- ADT also defines that n can be manipulated by via functions +, -, ×, ÷
- Sometimes languages are different (division for example)

```
÷ : Z, Z → Z  in Java, C++, C#
÷ : Z, Z → R  in Visual Basic
```

Functions

Notation varies, but logic the same

Functions

- Many programming languages support customized functions
- The format often mirrors the discrete notation

C Family

- C programming language includes C++, Java, and C#
- Notation is very terse

```
name : int → int

int name(int n)
```


Visual Basic

- Visual Basic evolved from the original BASIC programming language
- Notation is far more verbose

```
name : Integer → Integer

Function name(n As Integer) As Integer
```


Pascal

- Pascal was very popular in the 1980's and 90's
- Created many concepts that were integrated into other languages

```
name : integer → integer

function name(n : integer) : integer
```


Swift

- Swift was created by Apple to replace older Objective-C
- Influenced by multiple languages

```
name : Int → Int

func name(n : Int) -> Int
```