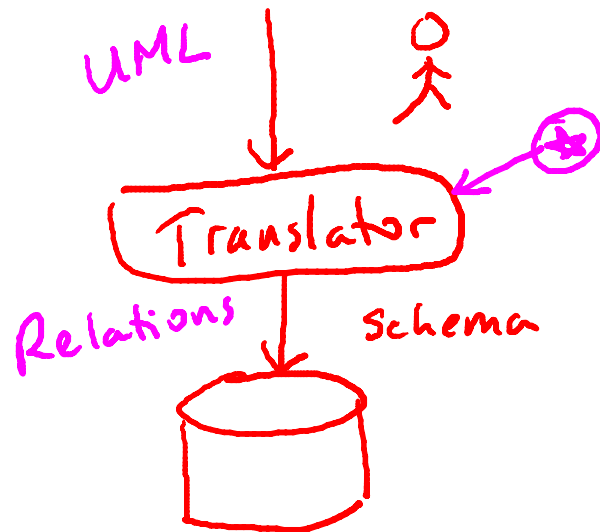# UML

UML to Relations

Jennifer Widom

High-Level Database Design Model

- User-friendly (graphical) specification language
- Translated into model of DBMS

Jennifer Widom

Unified Modeling Language (UML)
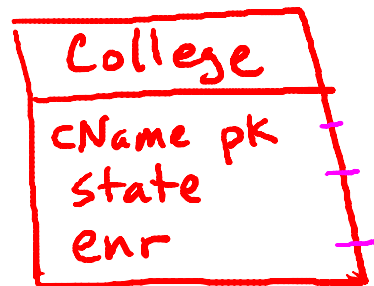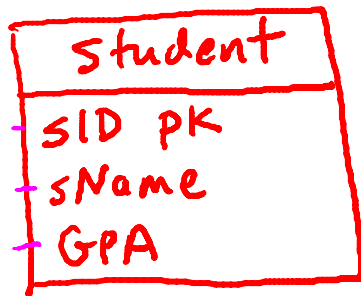
Data modeling subset

- 5 concepts
  - (1) Classes
  - (2) Associations
  - (3) Association Classes
  - (4) Subclasses
  - (5) Composition & Aggregation

- Designs can be translated to relations automatically

  Provided every "regular" class has a key

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UML to Relations: **Classes**

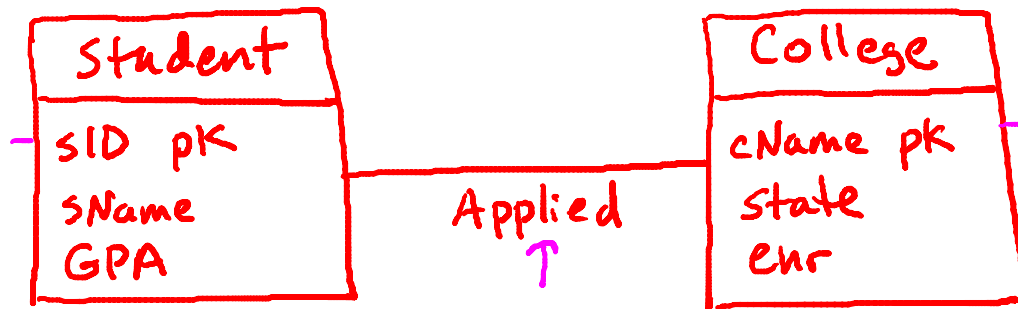Every class becomes a relation; pk $\rightarrow$ primary key

Student (<u>SID</u>, sName, GPA)

College (<u>cName</u>, state, enr)

UML Data Modeling: 5 concepts

(1) Classes ✓

(2) Associations

(3) Association Classes

(4) Subclasses

(5) Composition & Aggregation

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UML to Relations: **Associations**

Relation with key from each side

Student
SID pk
SName
GPA

College
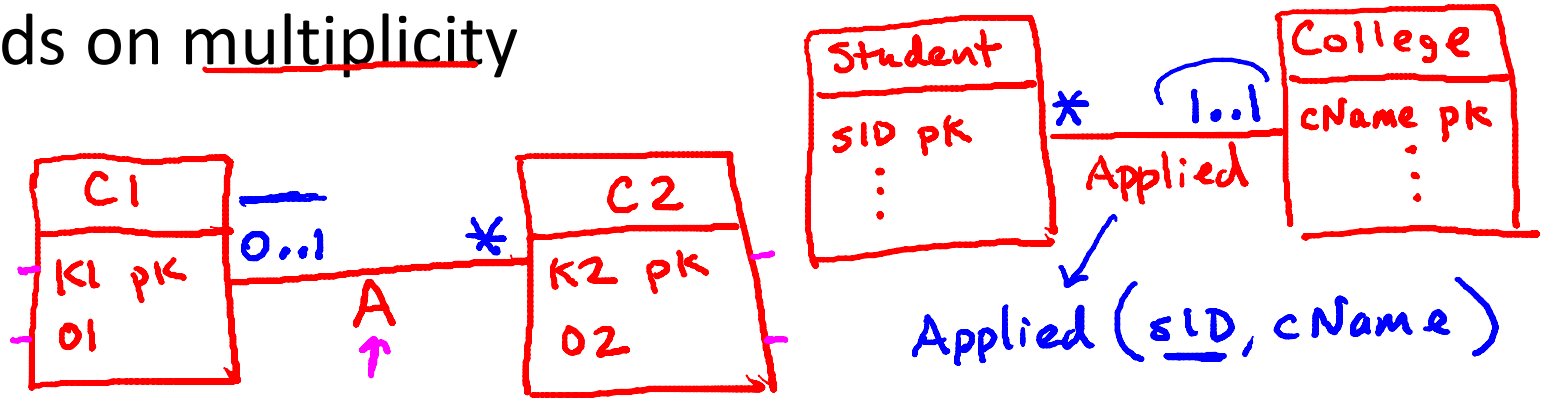cName pk
state
enr

Applied

- Student (...)
- College (...)
Applied (sID, cName)

Keys for Association Relations

Depends on <u>multiplicity</u>

C1

K1 pk
O1

0..1

A

*

C2

K2 pk
O2

Student

sID pk
⋮

*

1..1

Applied

College

cName pk
⋮

C1(<u>K1</u>, O1)

C2(<u>K2</u>, O2)

A(K1, <u>K2</u>) ← *

Applied(<u>sID</u>, cName)

Association Relation Always Needed?

Depends on multiplicity
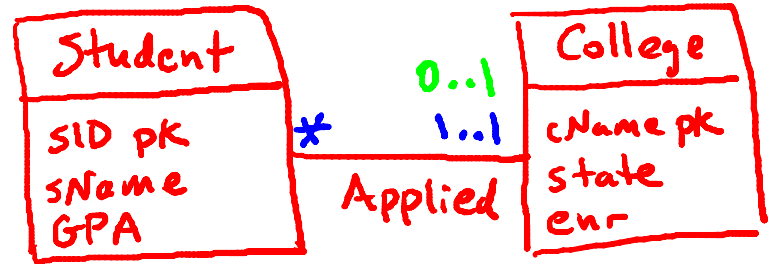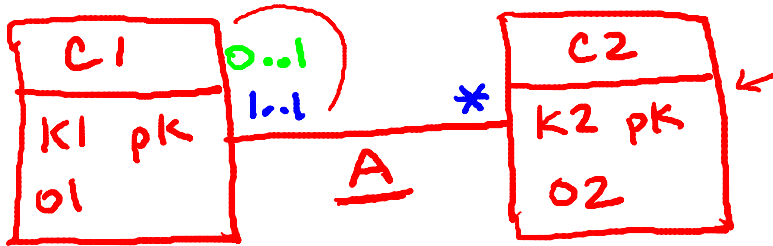
C1 (<u>K1</u>, O1)
C2 (<u>K2</u>, O2)   C2(<u>K2</u>, O2, K1)
A (K1, K2)   ↑
                                      Null

Student (<u>sID</u>, sName, GPA, cName)
College (<u>cName</u>, state, enr)   ↑
                                       Null
Applied (sID, cName)
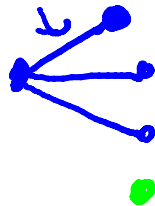
Jennifer Widom
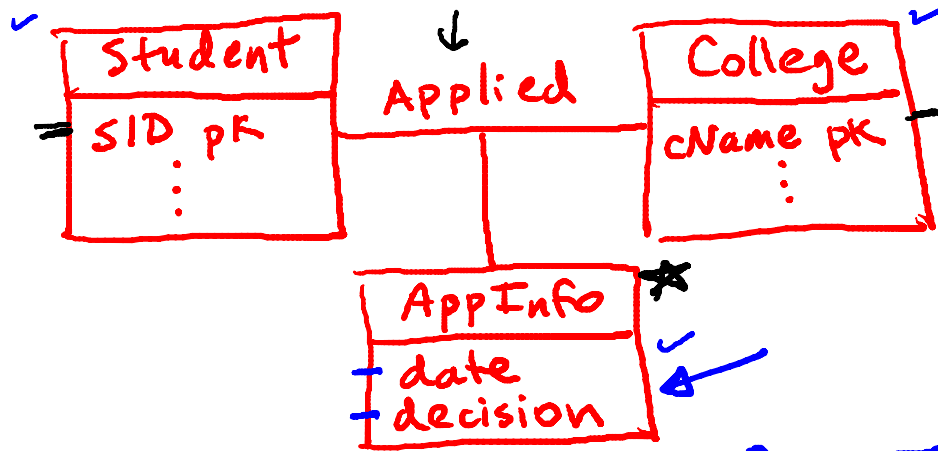
UML Data Modeling: 5 concepts

✓ (1) Classes

✓ (2) Associations

(3) Association Classes

(4) Subclasses

(5) Composition & Aggregation

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UML to Relations: **Association Classes**

Add attributes to relation for association

Require a Key for every "regular" class.

Determining keys "Folding"
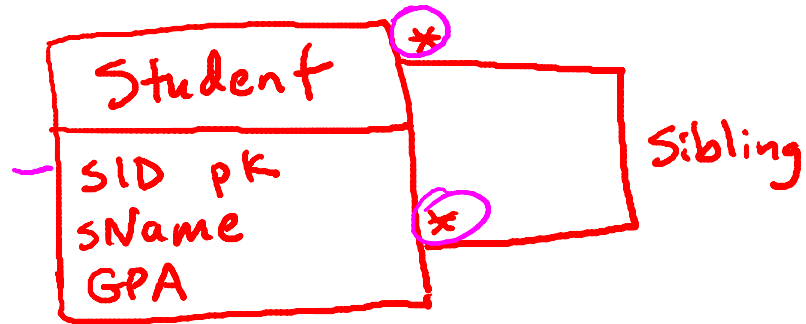
Student($\underline{sID}$, ...)

College($\underline{cName}$, ...)

Applied(sID, $cName$, date, decision)

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Self-Associations

Student (<u>SID</u> , sName, GPA)

Sibling (<u>SID1</u> , <u>SID2</u>) ←

Self-Associations
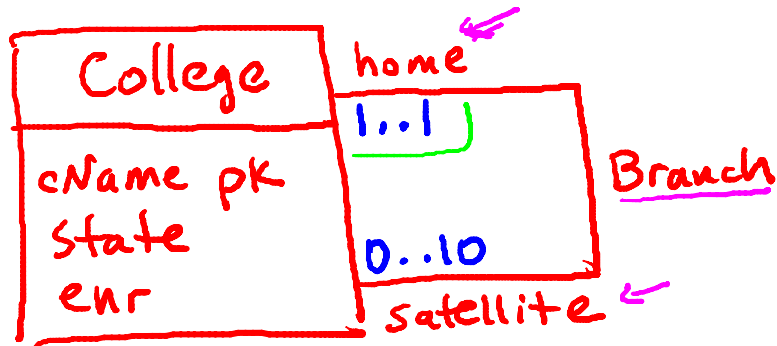
College (<u>cName</u>, state, enr)
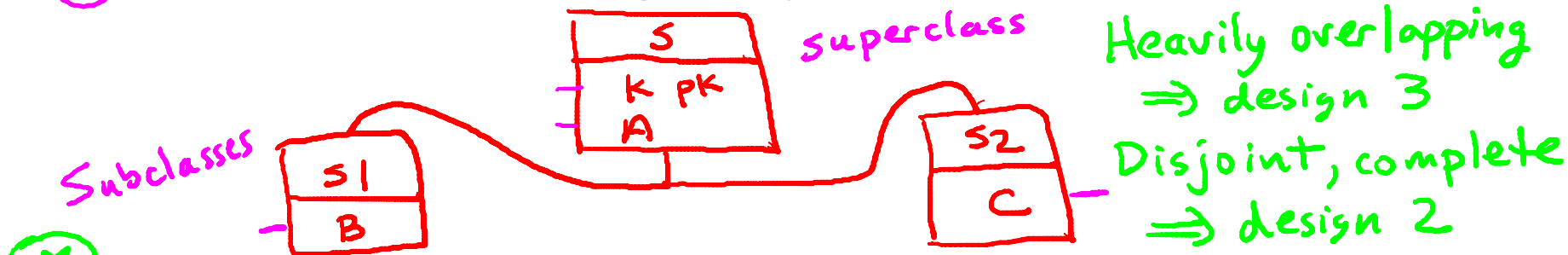
Branch (home, <u>satellite</u>)

(cName's)

UML Data Modeling: 5 concepts

- ✓ (1) Classes
- ✓ (2) Associations
- ✓ (3) Association Classes
- (4) Subclasses
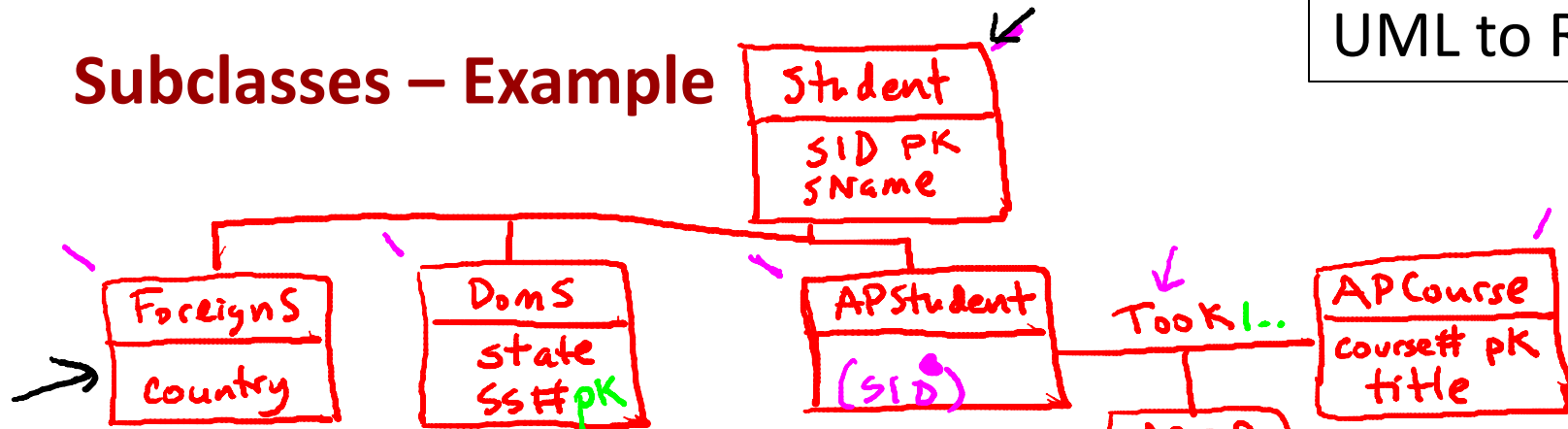- (5) Composition & Aggregation

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Subclasses

1) Subclass relations contain superclass key + specialized attrs. ←

2) Subclass relations contain all attributes

3) One relation containing all superclass + subclass attrs.

superclass

Heavily overlapping
$\Rightarrow$ design 3

Disjoint, complete
$\Rightarrow$ design 2

Subclasses

Best translation may depend on properties

(1) $S(\underline{K}, A)$ $S1(\underline{K}, B)$ $S2(\underline{K}, C)$

(2) ✗ $S(\underline{K}, A)$ $S1(\underline{K}, A, B)$ ← $S2(\underline{K}, A, C)$ ✓

(3) $S(\underline{K}, A, B, C)$ ←

Subclasses – Example

Student

SID PK
sName

ForeignS

country

DomS

state
SS# pK

APStudent

(SID)

Took 1...

APCourse

course# pK
title

APInfo

year
grade

Keys for
"regular"
classes

Student (SID, sName)

ForeignS (SID, country)

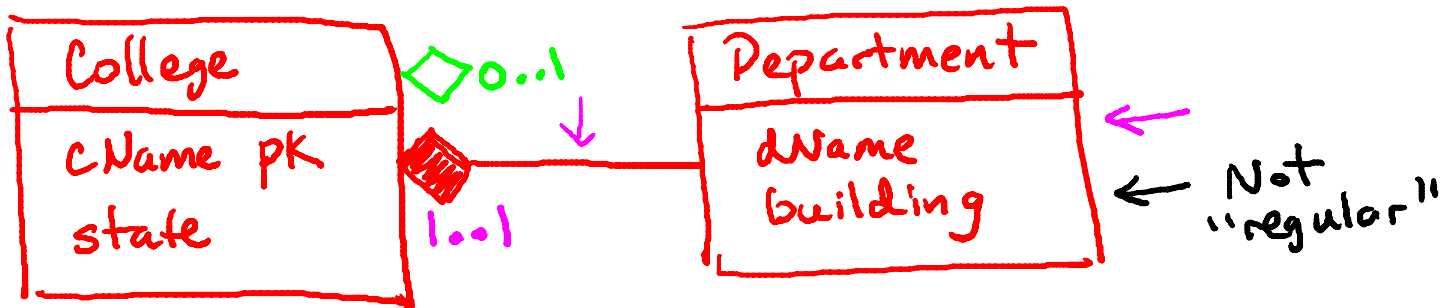DomS (SID, state, SS#)

APStudent (SID)

APCourse (course#, title)

Took (SID, course#, year, grade)

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UML Data Modeling: 5 concepts

  ✓(1) Classes

  ✓(2) Associations

  ✓(3) Association Classes

  ✓(4) Subclasses

  (5) Composition & Aggregation

Composition & Aggregation

College (<u>cName</u> , state)

Department (dName, building, c Name)

Null

UML: High-Level Database Design Model

- User-friendly graphical specification language
- Designs translated to relations automatically