```
• Physical Model (SQL)
                                                                             Relational Data Model
                                                                                                                4 main components of
                                                                            • Tables = Relations
                                                                                                                 the Relational Model
                                                                            Rows = n-tuples

    Relations

                                                                            • Columns = Attributes

    Attributes

    Tuples

                                                              Header e.g. Home_phone, Cell_phone

    Domains

                                                                           (role names)
                                                                   Domain (D) - set of possible
                                                                  values for an attribute A. This
                                                                     can include NULL values.
                                                                                                                                     Relation state
                                                        dom(Home_phone)
                                                                                                        3 parts of a domain
                                                                                                                                     R - relation name
                                       Logical Definition of a Domain

    Logical definition

                                                                                                                                     r - ordered set of tuples
                                       Usa_phone_numbers - set of ten-digit
                                                                                                       (name)
                                                                                                                                     r = \{t1, t2, ..., tm\}
                                       phone numbers valid in the United States.

    Data Type

                                                                                                                                     t = \{v1, v2, ..., vn\}

    Format

                                       Data Type (Format) - primative types (int, float, boolean,
                                      i.e. Usa_phone_numbers - charater string that looks like
                                       (ddd)-(ddd)-(dddd).
                                                                                                                      r(R) - subset of dom(A1) x dom(A2), ..., x dom(An)).
                                       Employee_ages = possible ages of employees between 15 and 80
                                       (exclusive).
                                       Data Type = integer
                                                                                                               cardinality of a domain D
                                       Format (implied by the data type) may specify ages have to be two
                                                                                                              denoted |D| - total number of
                                       digit integers*
                                                                                                            possible values (assume Domain
                                                                                                                       D is finite).
                                                                                                                 Departments = {"CSCI",
                                 Relations
                                                                                                                     "BUS", "JOUR"}
                                 Relation schema R(A1, A2, ..., An)
                                                                                                                    (cardinality = 3)
                                 R - relation name.
                                 A1, A2, ..., An - ordered list of attributes.
                                 Ai - ith attribute of a relation schema R(A1, A2, ...,
                                                                                                                               R = \{A1, A2, ..., An\}
                                 D - domain of Ai donoted (D(Ai))
                                                                                                            Total number of
                                                                                                         possible Tuples for a
                                 Degree (arity) of a relation - the number of
                                                                                                        given relation state r(R)
                                 attributes in the ordered list A1, A2, ..., An i.e. n.
Anatomy of a Relation
       schema.
                                                                                                     |dom(A1)| x |dom(A2)| x, ... |dom(An)|
                  Relation name
                      STUDENT(Name, Ssn, Home_phone, Address, Office_phone, Age, Gpa)
                                                                          What's the degree of the
                                          What's the first attribute
                                                                            STUDENT relation?
                                          of the relation schema?
                                                  Name*
                                                                                    7*
                       STUDENT(Name: string, Ssn: string, Home_phone: string, Address: string,
                                      Office_phone: string, Age: integer, Gpa: float)
          dom(Home_phone) =
          Usa_pnone_numbers.
         Logical definition
         data type
         format
  Relation state - set of
        n-tuples.
• r(R)
• r = <t1, t2, ..., tm>
• t? t = <v1, v2, ..., vn>
```

Where does v1 have to be?

• Has to be in the dom(A1)*

• Logical data requirements / functional requirements

• Implementation Model (Relational Data Model)

• Conceptual Model (ER Model)

5.1 Relational Model Concepts 153

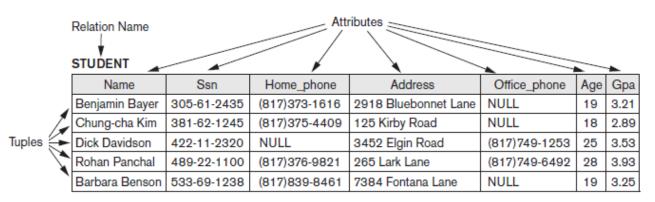


Figure 5.1
The attributes and tuples of a relation STUDENT.

Common terminology
• Intension - Relation schema R
• Extension - Relation state r(R)