

Implementation Data Models

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A Wee Bit O' History

There are four data models of note:

1. Hierarchical (early 1960s, IBM)
2. Network (early 1970s, CODASYL/DBTG)
3. Relational (early 1970s, Codd @ IBM)
4. Object (???)

Hierarchical Model: Background and Ideas

Background:

- John F. Kennedy, May 25, 1961: ‘... man on the moon ...’
- Rockwell needed to organize parts for the Apollo CM & SM
- IBM created IMS (Information Management System) in 1968
 - original name: ICS/DL/I; thankfully renamed in '69
 - both used and introduced the Hierarchical Model
 - still sold today!

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Hierarchical Model: Terminology

Sample Logical Schema:

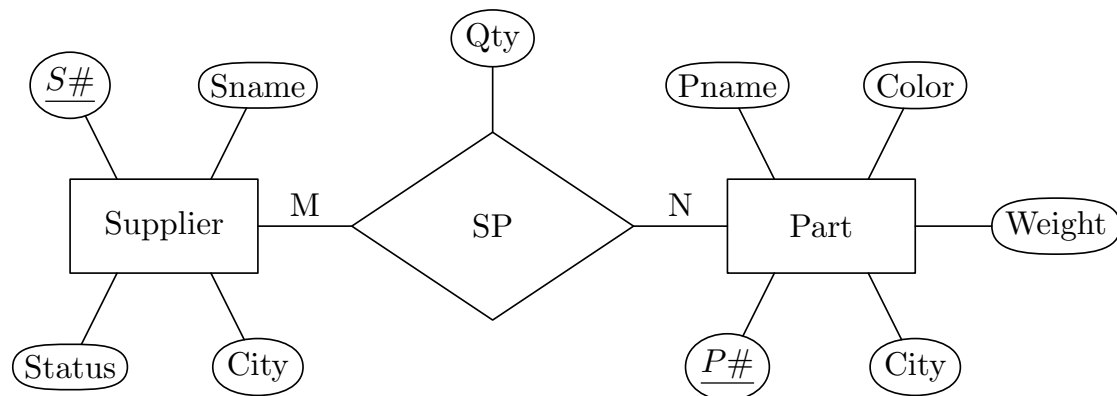
Terminology:

E-R Model	Hierarchical Model
Entity Set	≡
Entity	≡
Attributes	≡
Relationships	≡

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Hierarchical Model: Supplier–Part Schema

Consider this subset of Codd's SPJ schema:



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Hierarchical Model: M:N Relationships (1 / 3)

Still a Logical Schema, but augmented with fields:

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Hierarchical Model: M:N Relationships (2 / 3)

Physical Schema:

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Hierarchical Model: M:N Relationships (3 / 3)

The physical schema for Supplier–Part w/ sample data:

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Network Model: Background and Ideas

- Created in the early 1970s by CODASYL's
(Conference/Committee on Data Systems Languages)
DBTG (Database Task Group)
- Goal: A standard theory of DB systems.
Origin of the ideas of DML and DDL
- Became an ISO standard in 1987 (ISO 8907:1987)
(And was withdrawn in 1998!)
- Graph-based instead of tree-based

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Network Model: Terminology

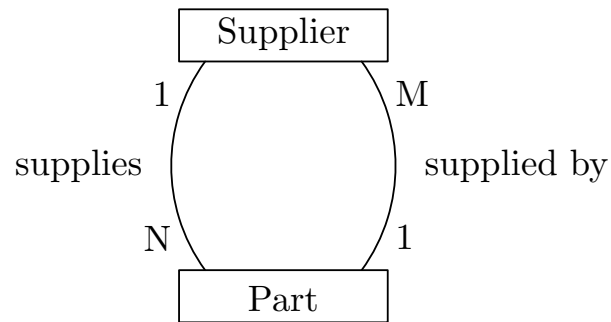
A Sample Logical Schema:

Terminology:

E-R Model	Network Model
Entity Set	≡
Entity	≡
Attributes	≡
Relationships	≡

Network Model: M:N Relationships (1 / 2)

Logical Schema (of the M:N Supplier - Part relationship):



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Network Model: M:N Relationships (2 / 2)

Physical Schema (and *just* a little messy ...):

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Relational Model: Background and Ideas

- Created by Edgar F. Codd. Famous paper:
“A relational model of data for large shared data banks,” 1970.
- Theoretical foundation: Set Theory
- Uses foreign keys instead of pointers
- No distinction between logical and physical schemas

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Relational Model: DMLs

Codd proposed two types of DMLs:

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Relational Model: Terminology (1 / 2)

Sample Supplier - Part Schema:

S	<u>S#</u>	Sname	Status	City
	S1	Acme	10	Omro
	S2	Fubar	10	Fisk
	S3	Snafu	20	Ring

P	<u>P#</u>	Pname	Color	Weight	City
	P1	Nut	Pink	0.2	Anton
	P2	Bolt	Blue	0.9	Borea

Terminology:

E-R Model

Relational Model

Entity Set ≡

Entity ≡

Attributes ≡

Relationships ≡

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Relational Model: Terminology (2 / 2)

Sample Department – Employee Schema:

DEPARTMENT	<u>DeptNum</u>	DeptName	ManagerID	ManagerStartDate
	1	Shipping	364	2001-04-01
	2	Payroll	NULL	NULL
	3	Billing	298	2000-11-17

EMPLOYEE	Surname	GivenName	<u>EmpNum</u>	DeptID	Salary
	Spade	Sam	786	1	48000
	Trune	Joe	410	2	49500
	Smith	Megan	364	1	75000
	Maher	Mary	298	3	72000

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Relational Model: Misc. Notes

- Order of tuples in a relation is logically irrelevant (Why?)
- Fields are single-valued by default (vs. set-valued)
- Relationships are supported by foreign keys

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Relational Model: 1:N Relationships

We've already seen how to do this! (Just two slides ago!)

DEPARTMENT	<u>DeptNum</u>	DeptName	ManagerID	ManagerStartDate
	1	Shipping	364	2001-04-01
	2	Payroll	NULL	NULL
	3	Billing	298	2000-11-17

EMPLOYEE	Surname	GivenName	<u>EmpNum</u>	DeptID	Salary
	Spade	Sam	786	1	48000
	Trune	Joe	410	2	49500
	Smith	Megan	364	1	75000
	Maher	Mary	298	3	72000

Relational Model: 1:1 Relationships

- Just a restriction of 1:N relationships:
 - We still store a FK in the 'many' relation
 - Must constrain the field's values to be unique; two options:

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Relational Model: M:N Relationships

S

<u>S#</u>	Sname	Status	City
S1	Acme	10	Omro
S2	Fubar	10	Fisk
S3	Snafu	20	Ring

P

<u>P#</u>	Pname	Color	Weight	City
P1	Nut	Pink	0.2	Anton
P2	Bolt	Blue	0.9	Borea

SP

<u>S#</u>	<u>P#</u>	Qty
S1	P1	50
S1	P2	150
S2	P2	25
S3	P1	300

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Object Model: Ideas

- OO programming languages have existed since Simula in 1967
- We'd like to be able to store objects in a DBMS
 - provides object persistence
 - can do it by mapping object instance fields to relational tuples, but that's clunky
- The Object Data Management Group (ODMG) defined an object-based DBMS standard
 - finished ODMG 3.0 in 2001 (and then disbanded!)

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Object Model: Object DBMS Types

Two major varieties:

1. Object Oriented DBMS (OODBMS)
 - Marriage of an OOPL and a DBMS
2. Object Relational DBMS (ORDBMS)
 - A relational DBMS with added objects