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ER→Relational Mapping

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❖ ER to Relational Mapping

Reminder: a useful strategy for database design:

- perform initial data modelling using ER
  (conceptual-level modelling)
- transform conceptual design into relational model
  (implementation-level modelling)

A formal mapping exists for ER model →Relational model.

This maps "structures"; but additional info is needed, e.g.

- concrete domains for attributes and other constraints

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❖ Relational Model vs ER Model

Correspondences between relational and ER data models:

- attribute(ER) ≅ attribute(Rel), entity(ER) ≅ tuple(Rel)
- entity set(ER) ≅ relation(Rel), relationship(ER) ≅ relation(Rel)

Differences between relational and ER models:

- Rel uses relations to model entities *and* relationships
- Rel has no composite or multi-valued attributes (only atomic)
- Rel has no object-oriented notions (e.g. subclasses, inheritance)

Note that ...

- not all aspects of ER cab be represented exactly in a relational schema
- some aspects of relational schemas (e.g. domains) do not appear in ER

❖ Mapping Strong Entities

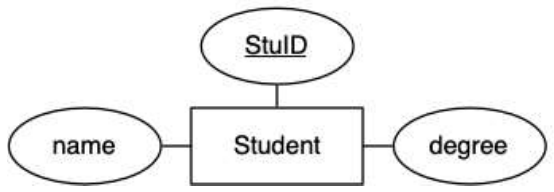
An entity set *E* with atomic attributes $a_1, a_2, ... a_n$

maps to

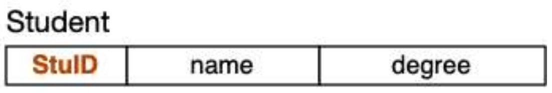
A relation *R* with attributes (columns) $a_1, a_2, ... a_n$

Example:

ER Model



Relational Version



Student

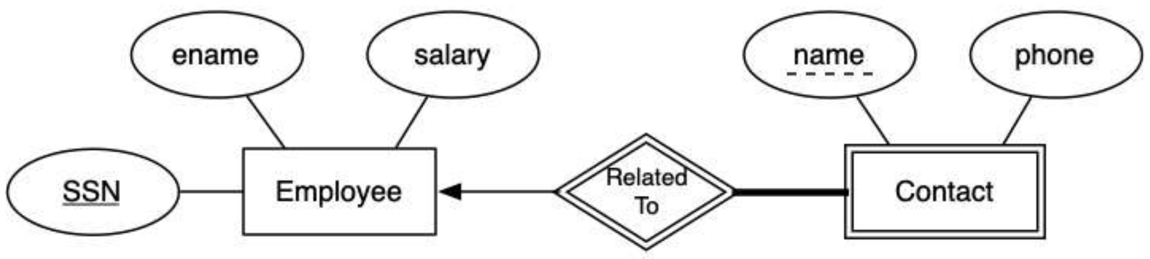
StuID	name	degree

Note: the key is preserved in the mapping.

❖ Mapping Weak Entities

Example:

ER Model

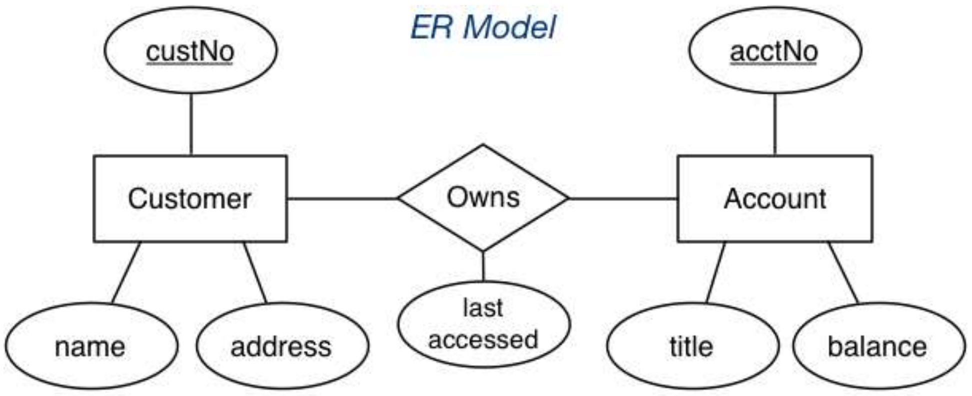


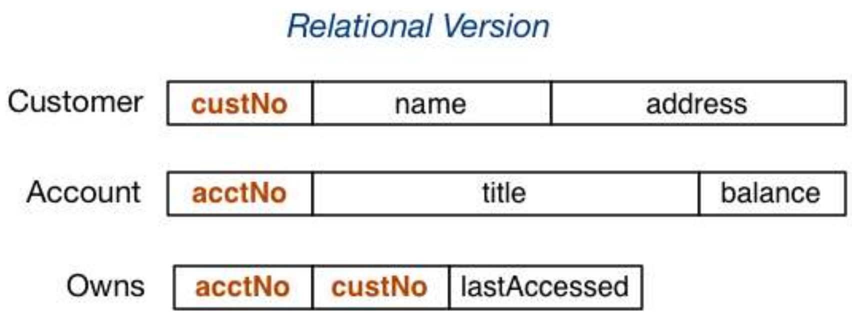
Relational Version

Employee	**SSN**	ename	salary
Contact	**SSN**	**name**	phone

❖ Mapping N:M Relationships

Example:





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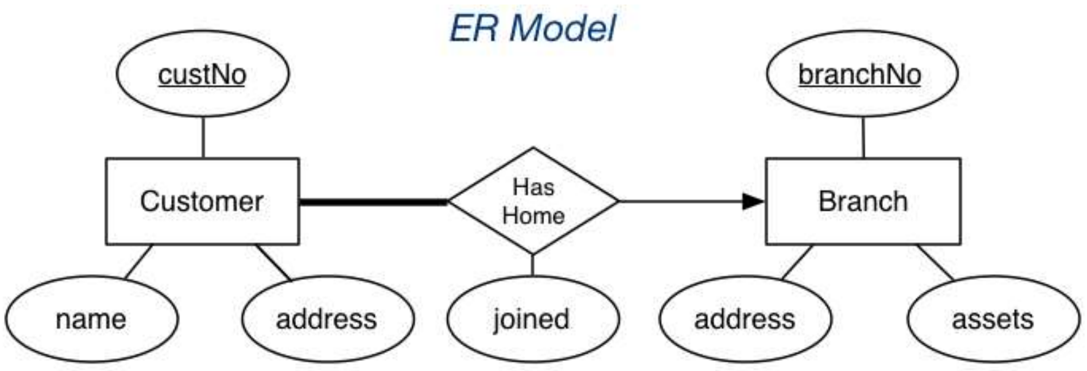
❖ Mapping 1:N Relationships

Example:



Relational Version

Customer

custNo	name	address	branchNo	joined

Branch

branchNo	address	assets

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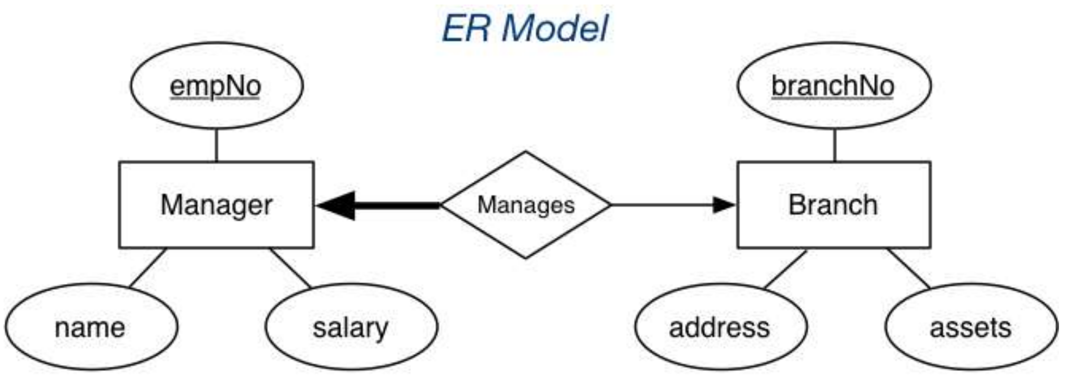
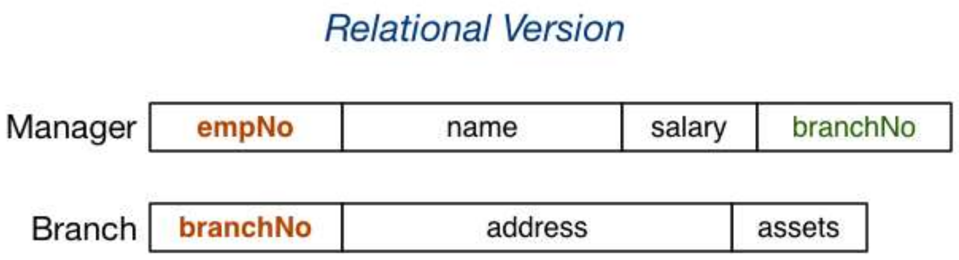
❖ Mapping 1:1 Relationships

Example:




Relational Version

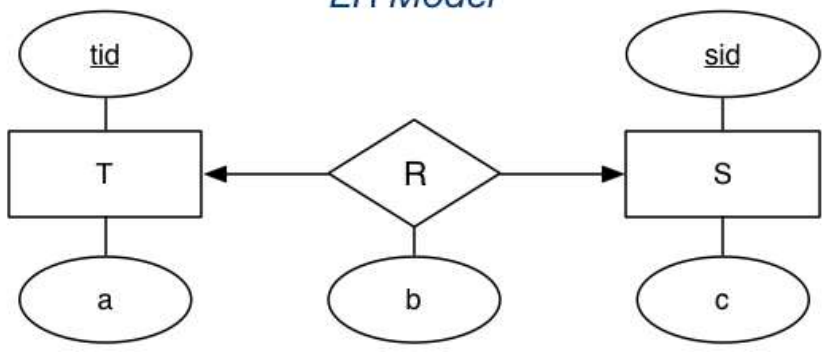
Manager	empNo	name	salary	branchNo

Branch	branchNo	address	assets

❖ Mapping 1:1 Relationships (cont)

If there is no reason to favour one side of the relationship ...

ER Model



Relational Version #1

T	**tid**	a	sid	b
S	**sid**	c		

Relational Version #2

T	**tid**	a		
S	**sid**	c	tid	b

❖ Mapping n-way Relationships

Relationship mappings above assume binary relationship.

If multiple entities are involved:

- *n:m* generalises naturally to *n:m:p:q*
  - include foreign key for each participating entity
  - include any other attributes of the relationship
- other multiplicities (e.g. *1:n:m*) ...
  - need to be mapped the same as *n:m:p:q*
  - so not quite an accurate mapping of the ER

Some people advocate converting n-way relationships into:

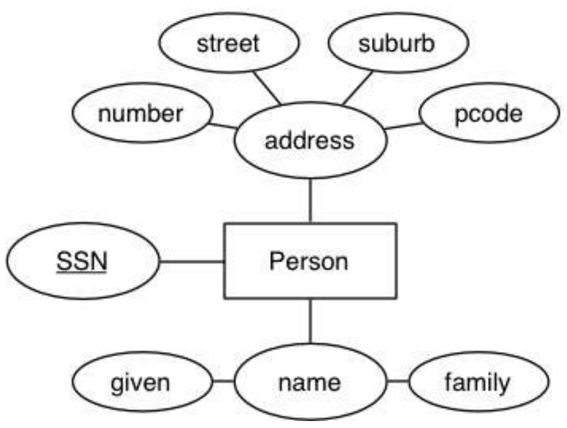
- a new entity, and a set of *n* binary relationships

❖ Mapping Composite Attributes

Composite attributes are mapped by concatenation or flattening.

Example:

ER Model



Relational Version #1

Person

SSN	name	address

Relational Version #2

Person

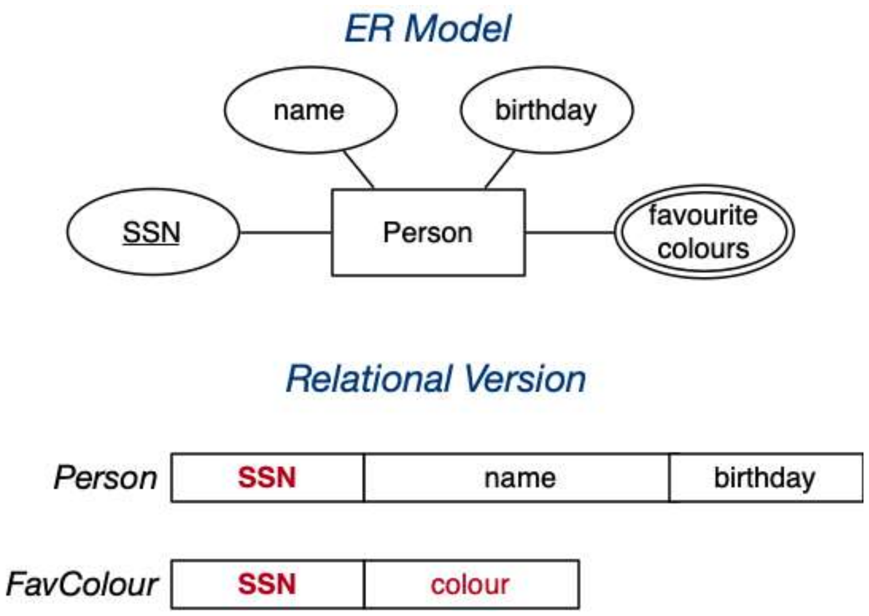
SSN	given	family	.....

.....	number	street	suburb	pcode

❖ Mapping Multi-valued Attributes (MVAs)

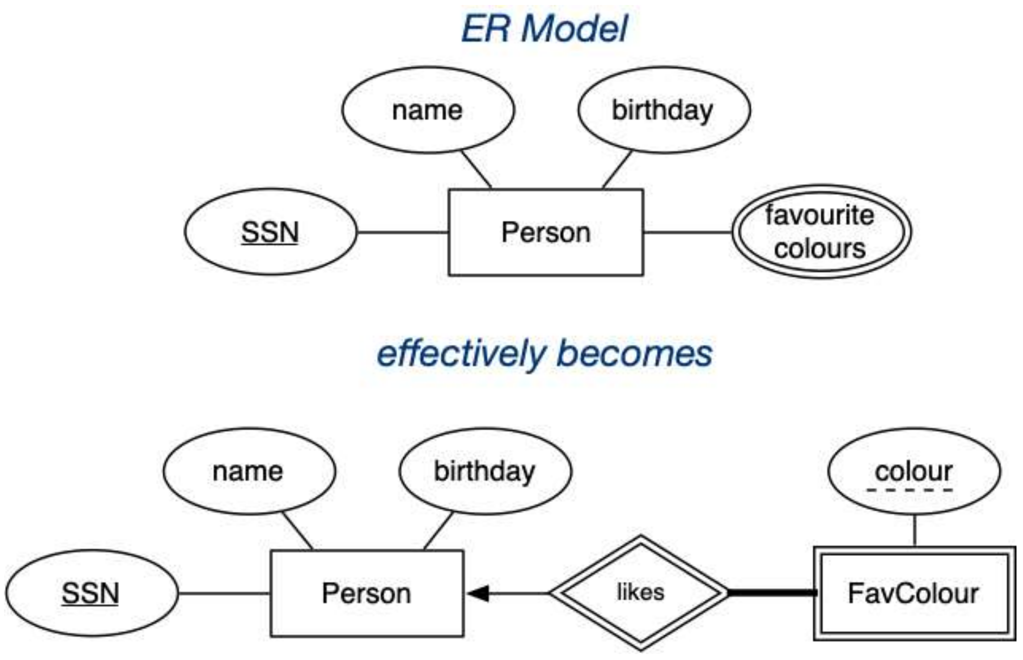
MVAs are mapped by a new table linking values to their entity.

Example:



❖ Mapping Multi-valued Attributes (MVAs) (cont)

Analogy:



❖ Mapping Multi-valued Attributes (MVAs) (cont)

Example: the two entities

```
Person(12345, John, 12-feb-1990, [red, green, blue])
Person(54321, Jane, 25-dec-1990, [green, purple])
```

would be represented as

```
Person(12345, John, 12-feb-1990)
Person(54321, Jane, 25-dec-1990)
FavColour(12345, red)
FavColour(12345, green)
FavColour(12345, blue)
FavColour(54321, green)
FavColour(54321, purple)
```

❖ Mapping Subclasses

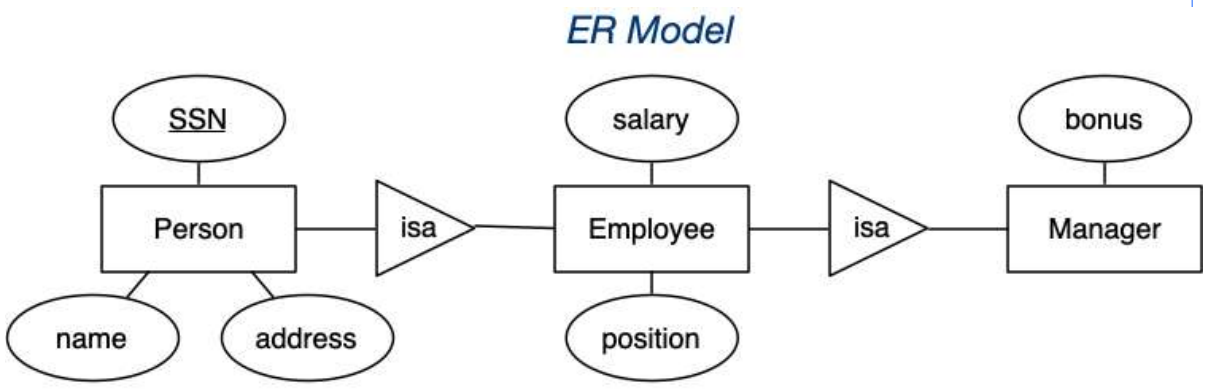
Three different approaches to mapping subclasses to tables:

- ER style
  - each entity becomes a separate table,
  - containing attributes of subclass + FK to superclass table
- object-oriented
  - each entity becomes a separate table,
  - inheriting all attributes from all superclasses
- single table with nulls
  - whole class hierarchy becomes one table,
  - containing all attributes of all subclasses (null, if unused)

Which mapping is best depends on how data is to be used.

❖ Mapping Subclasses (cont)

Example of ER-style mapping:

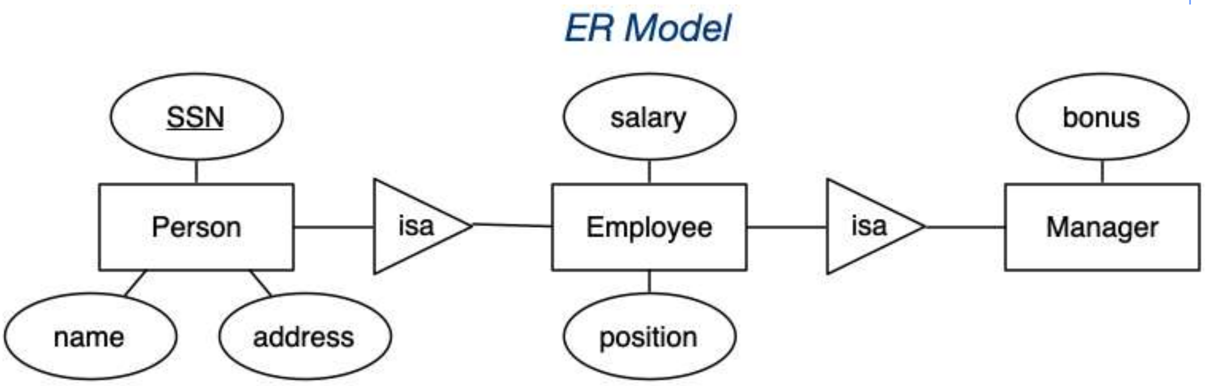


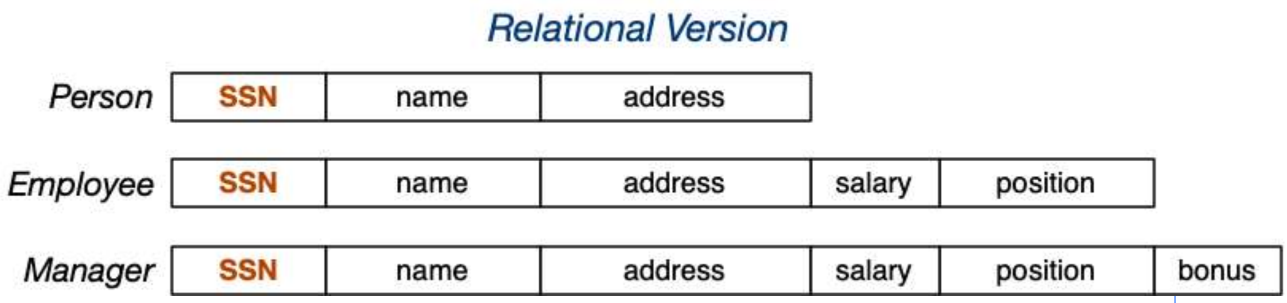
Relational Version

Person	SSN	name	address
Employee	SSN	salary	position
Manager	SSN	bonus	

❖ Mapping Subclasses (cont)

Example of object-oriented mapping:





Relational Version

Person	SSN	name	address			
Employee	SSN	name	address	salary	position	
Manager	SSN	name	address	salary	position	bonus

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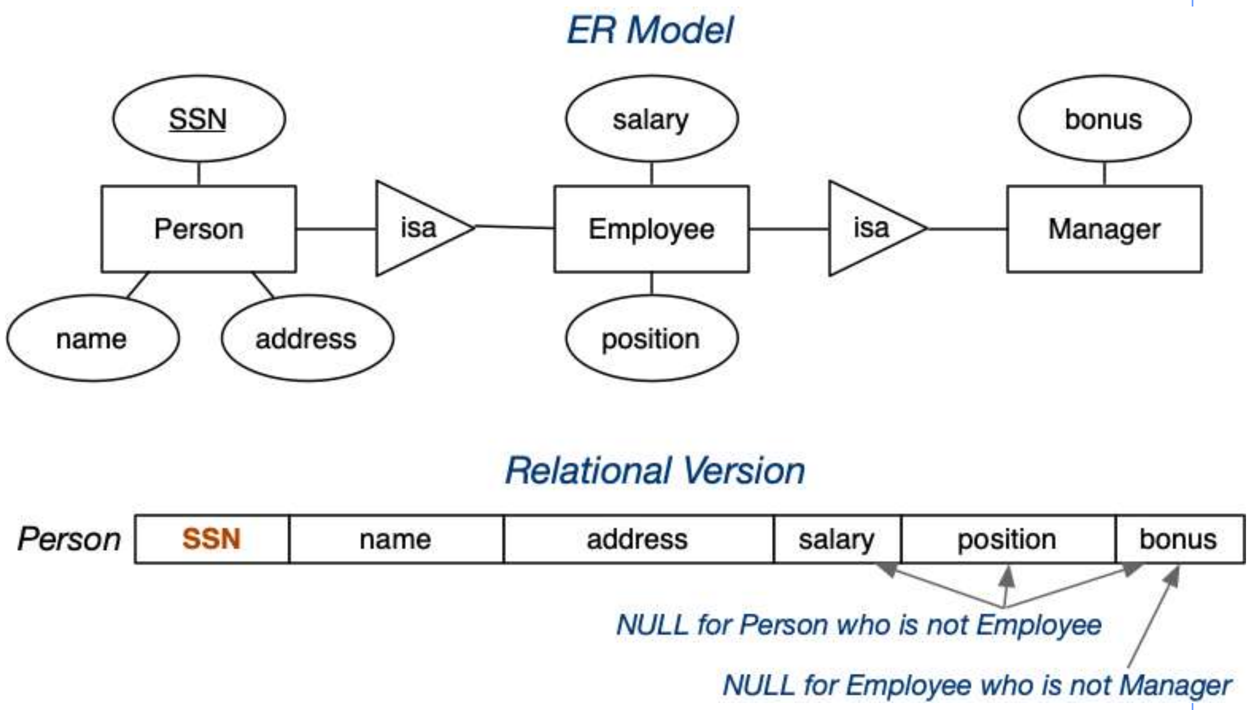
❖ Mapping Subclasses (cont)

Example of single-table-with-nulls mapping:



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