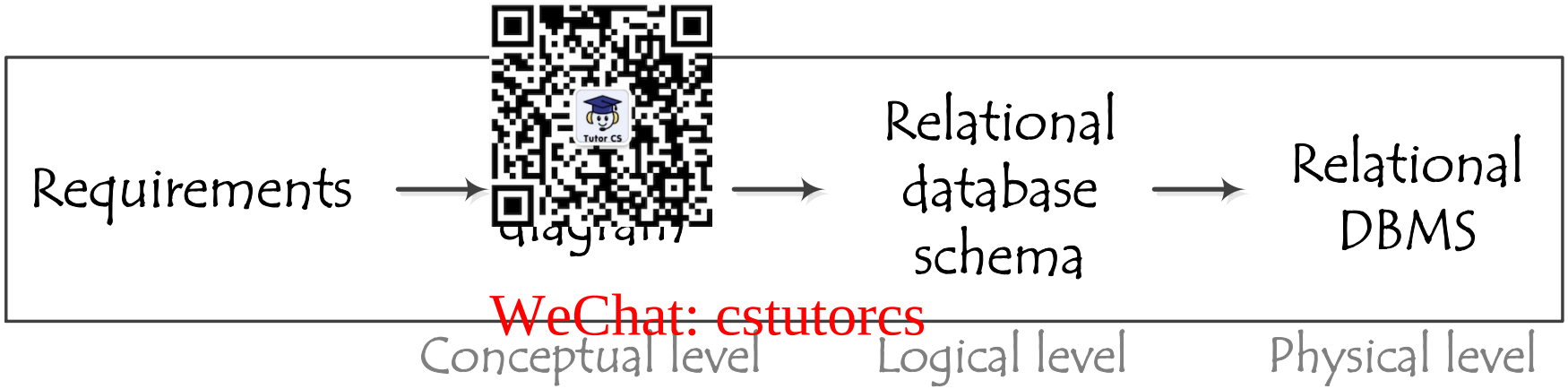
# Entity-Relationship Model – Part 4



## From ER to Relations

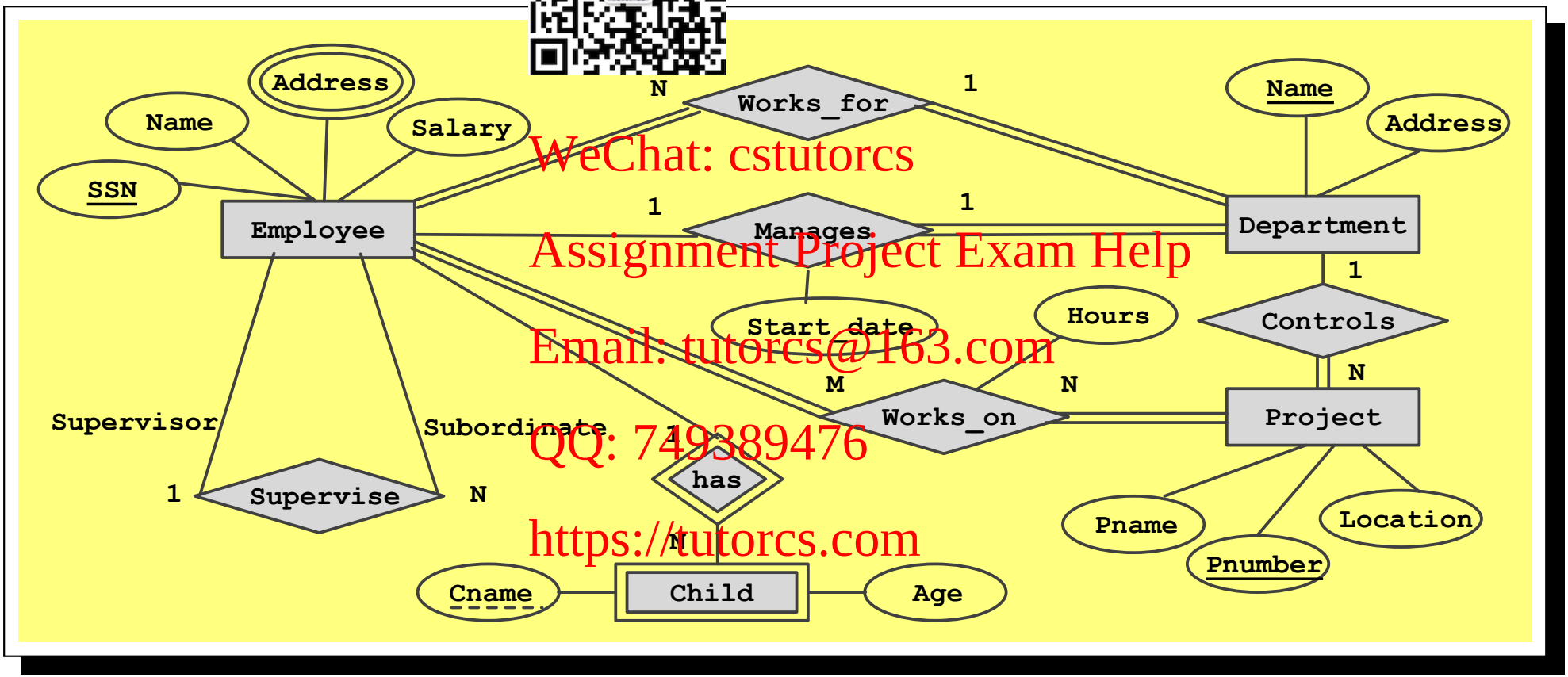
# Recap - Data Modeling






- ER design is **subjective**:
  - There are many ways to model a given scenario.
  - Analyzing alternative schemas is important.
- Constraints play an important role in designing a good database. But,
  - Not all constraints can be expressed in the ER model;
  - Not all constraints in the ER model can be translated.
- A good database design requires to further refining a relational database schema obtained through translating an ER diagram.

# An ER Diagram - The Company Database



# ER-to-Relations Algorithm

- 7-step algorithm to c asic ER model into relations, and more steps for the EER m

Step 1: Mapping of Regular Entity Types

Step 2: Mapping of Weak Entity Types

Step 3: Mapping of Binary 1:1 Relationship Types

- Foreign key approach
- Merged relation approach
- Cross-reference approach

Step 4: Mapping of Binary 1:N Relationship Types

Step 5: Mapping of Binary M:N Relationship Types

Step 6: Mapping of Multi-valued Attributes

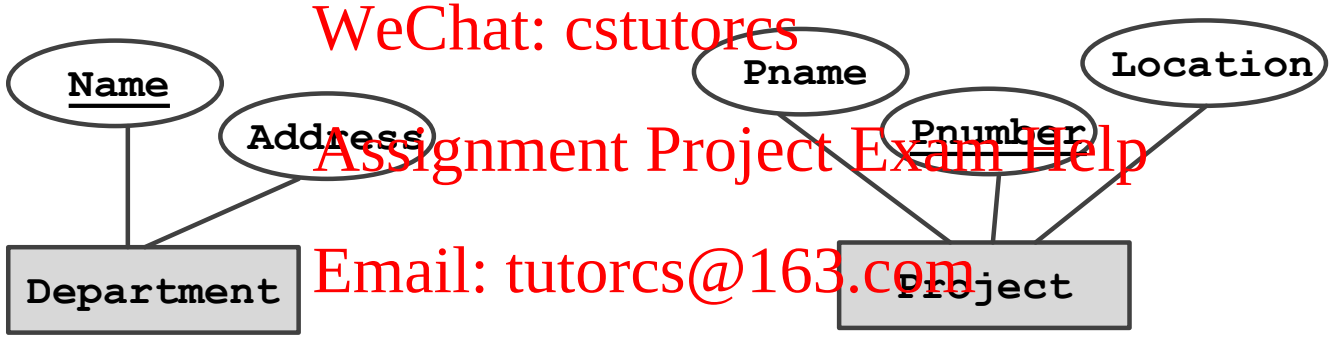
Step 7: Mapping of N-ary Relationship Types

Step 8: Mapping of Superclass/Subclass

# Step 1: Regular Entity types

- For each regular enti**create a relation schema** with the attributes of *E* (ignore multi-va**tes** until Step 6), where
  - **PK:** the key att







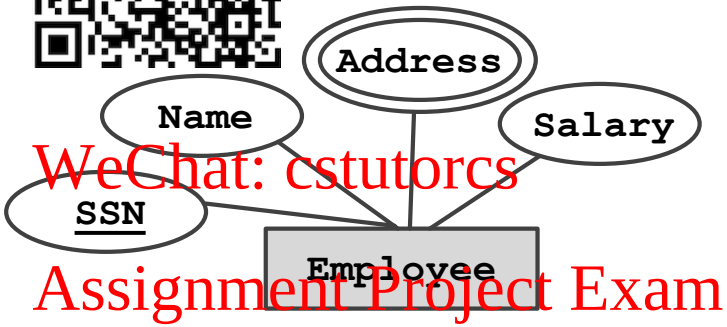

- DEPARTMENT(Name, Address) with PK: {Name}
  PROJECT(Pnumber, Pname, Location) with PK: {Pnumber}



- **Note:** These are not necessarily the final relation schemas of DEPARTMENT and PROJECT.

# Step 1: Regular Entity types

- How can we translate the regular entity type EMPLOYEE?



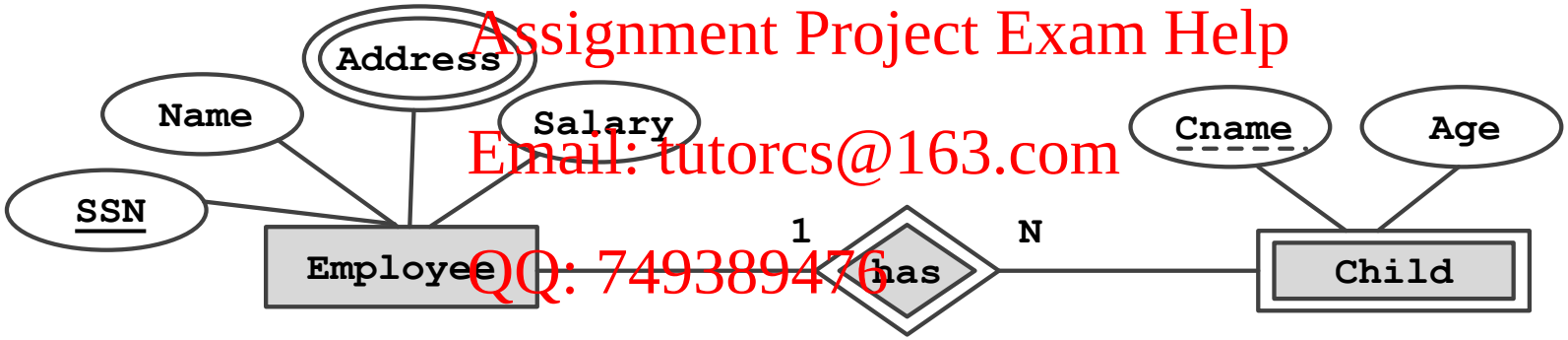



- EMPLOYEE(SSN, Name, Salary) with PK: {SSN}
- **Note:**
  - This is not the final relation schema of EMPLOYEE (will be further extended later on).
  - Multi-valued attributes are ignored until Step 6.

# Step 2: Weak Entity Types

- For each weak entity type $E_w$, **create a relation schema** with the attributes of $E_w$ plus the PK of its identifying entity type, where
  - **PK:** the partial key attributes of $E_w$ plus the PK of its identifying entity type
  - **FK:** references the PK of its identifying entity type






- CHILD(SSN, Cname, Age) with
  PK: {SSN, Cname}
  FK: [SSN]⊆EMPLOYEE[SSN]

# Step 3: Binary 1:1 Relationship Types - (Foreign key approach)

- For a 1:1 relationshi[qr] one total participation, **extend the relation schema of** **de entity type** by the attributes of *R* and the PK of the partial-[qr] type, where
  - **PK:** still the PK of the total-side entity type
  - **FK:** references the PK of the partial-side entity type



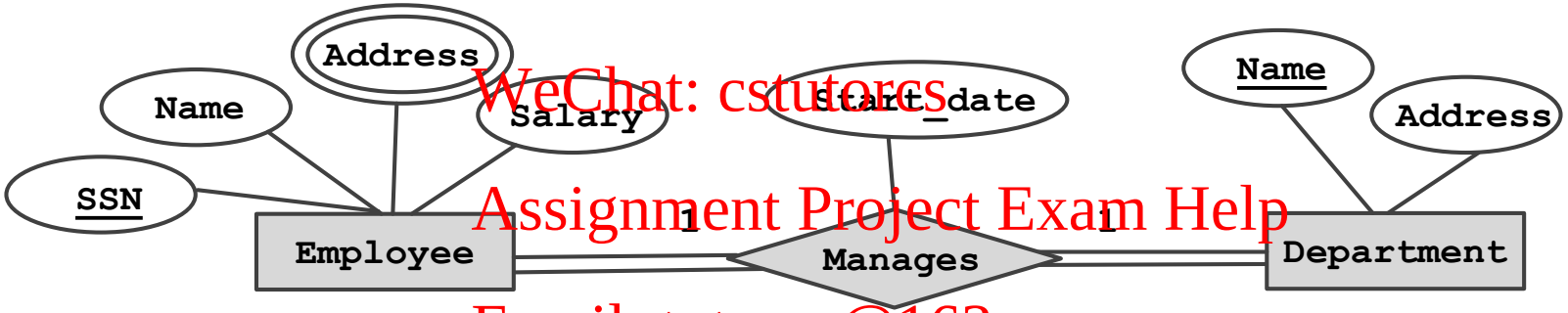

- DEPARTMENT(Name, Address, Mgr_SSN, Start_date) with

  PK: {Name}

  FK: [Mgr_SSN]⊆EMPLOYEE[SSN].

# Step 3: Binary 1:1 Relationship Types - (Merged relation approach)

- How can we translat ng kind of 1:1 relationship type?





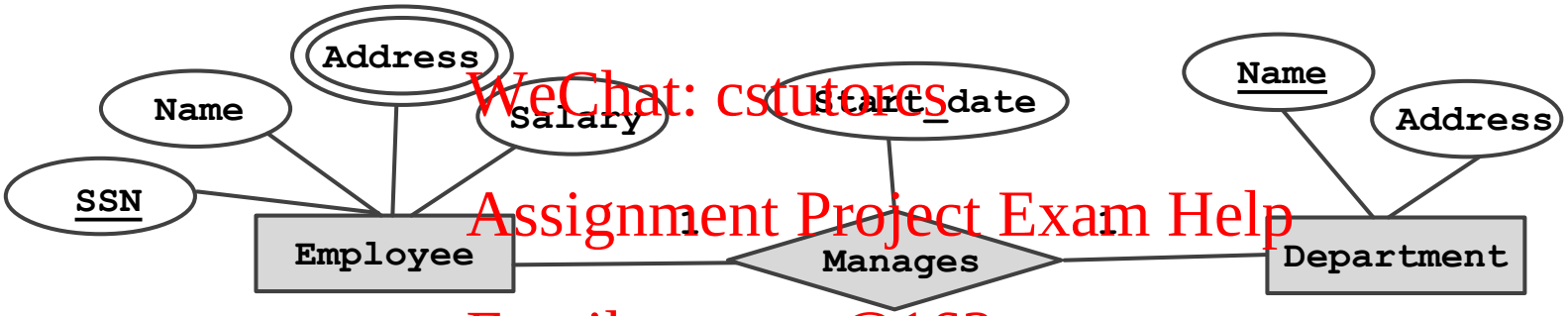

- If participation on both sides is total, we may **merge the relation schemas of both entity types and the attributes of the relationship type into a single relation**.

- EMPLOYEE-DEP(SSN, Name, Salary, Start_date, Dname, Address) with PK: {SSN} or {Dname}

# Step 3: Binary 1:1 Relationship Types - (Cross-reference approach)



- How can we translat[illegible]ng kind of 1:1 relationship type?






- If both sides are partial, we may **create a relation schema** which cross-references the PKs of the relation schemas of the two entity types.
- MANAGES(SSN, Dname, Start_date) with

  PK: {SSN} or {Dname}

  FKs: [SSN]⊆EMPLOYEE[SSN] and [Dname]⊆DEPARTMENT[Name]

# Step 4: Binary 1:N Relationship Types

- For each 1:N relation[illegible] *R*, **extend the relation schema of the N-side entity type** b[illegible]utes of *R* and the PK of the 1-side entity type, where
  - **PK:** still the PK of the N-side entity type
  - **FK:** references the PK of the 1-side entity type



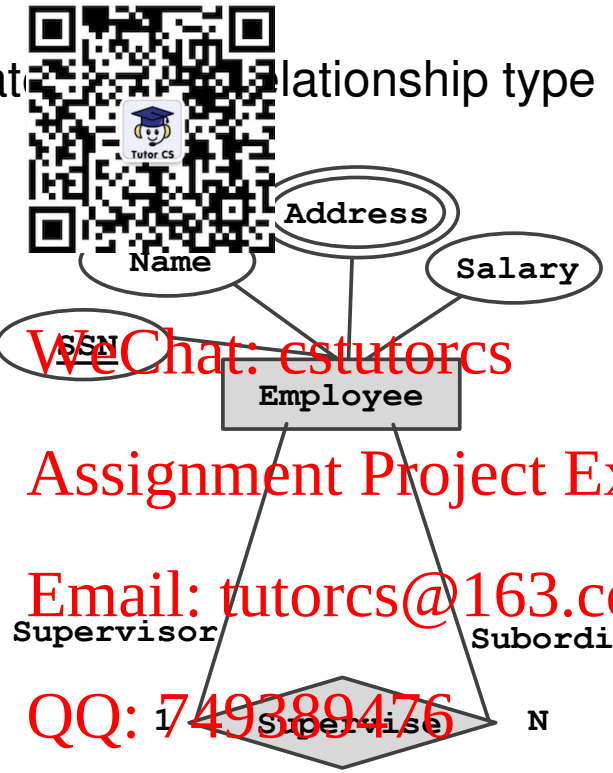

- EMPLOYEE(SSN, Name, Salary, Dname) with

  PK: {SSN}

  FK: [Dname]⊆DEPARTMENT[Name]

# Step 4: Binary 1:N Relationship Types

- How can we translate the binary 1:N relationship type SUPERVISE?



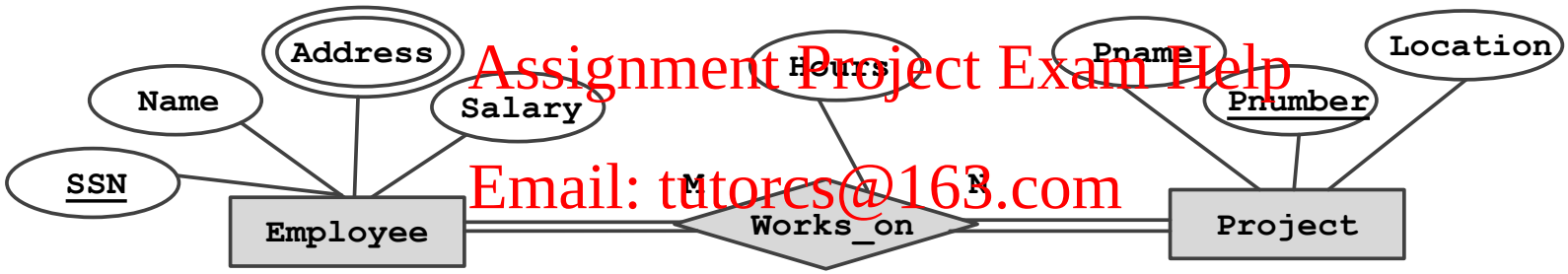



- EMPLOYEE(SSN, Name, Salary, Dname, Super_SSN) with
  PK: {SSN}
  FK: [Dname]⊆DEPARTMENT[Name] and [Super_SSN]⊆EMPLOYEE[SSN]

# Step 5: Binary M:N Relationship Types

- For each M:N relatio[illegible] *R*, **create a relation schema** with the attributes of *R* plus t[illegible]e participating entity types, where
  - **PK:** the combi[illegible] PKs of the participating entity types
  - **FKs:** references the PKs of the participating entity types






- WORKS_ON(SSN, Pnumber, Hours) with

  PK: {SSN, Pnumber}

  FKs: [SSN]⊆EMPLOYEE[SSN] and [Pnumber]⊆PROJECT[Pnumber]

# Step 6: Multi-valued Attributes

- For each multi-valued attribute $A$, **create a relation schema** with an attribute corresponding to $A$ + the PK of the entity/relationship type that has $A$ as an attribute
  - **PK:** the combination of $A$ and the PK of the entity/relationship type that has $A$
  - **FK:** references the PK of the entity/relationship type that has $A$



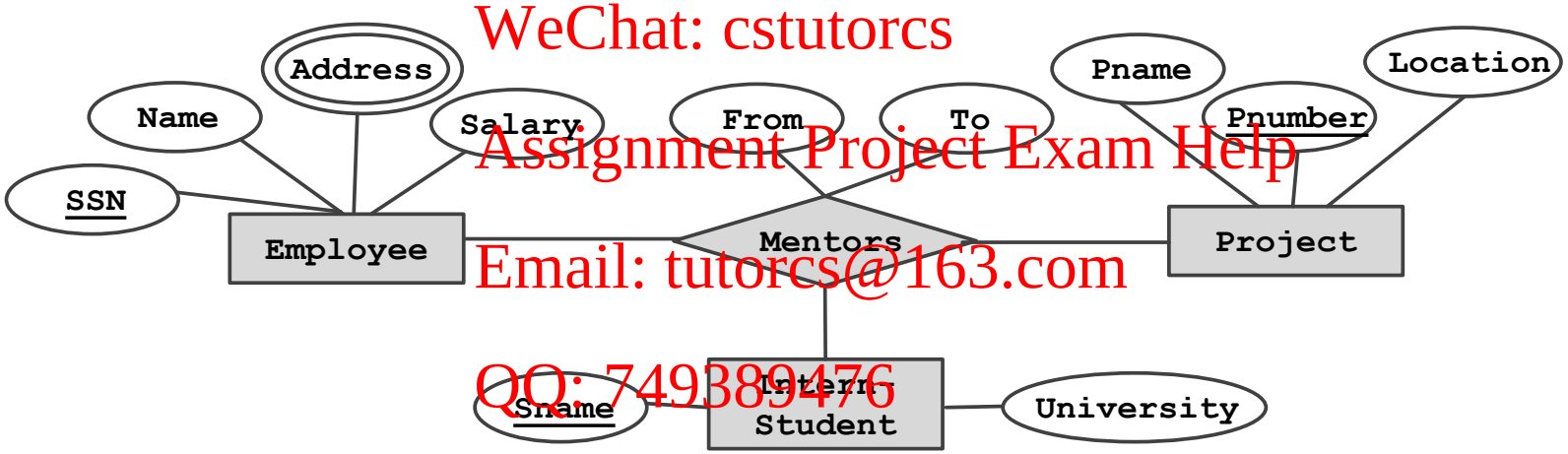

- EMPLOYEE_ADDRESS(SSN, Address) with

  PK: {SSN, Address}

  FK: [SSN]⊆EMPLOYEE[SSN]

# Step 7: N-ary Relationship Types

- For each N-ary relati… *R*, **create a relation schema** with the attributes of *R* plus t… participating entity types, where
  - **PK:** the combi… PKs of the participating entity types
  - **FKs:** references the PKs of the participating entity types



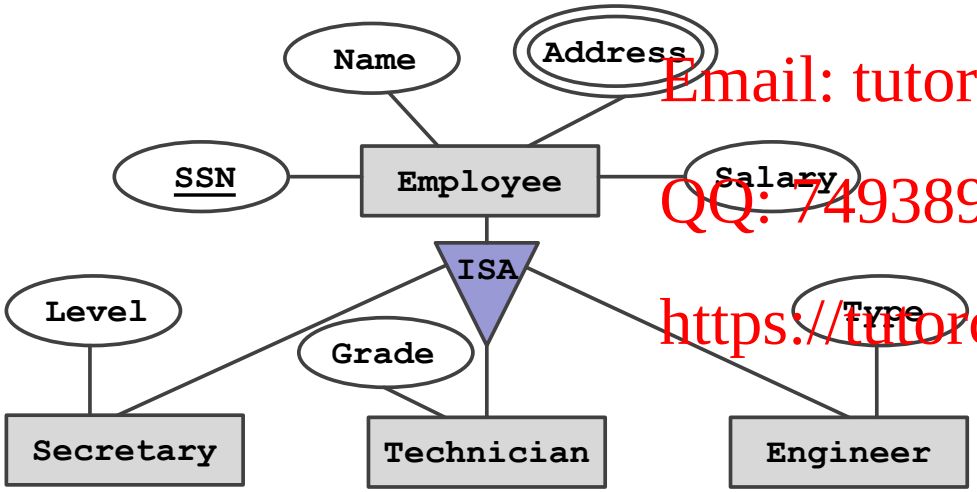



- MENTORS(SSN, Sname, Pnumber, From, To) with
  PK: {SSN, Sname, Pnumber}
  FK: [SSN]⊆EMPLOYEE[SSN], [Sname]⊆INTERN_STUDENT[Sname], and
  [Pnumber]⊆PROJECT[Pnumber]

# Step 8: Superclass and Subclass

- For each superclass, **elation schema** with its attributes.
- For each subclass, **c ation schema** with its attributes plus the key attributes of its superclass.
  - **PK:** the PK of the superclass
  - **FK:** references the PK of the superclass






- EMPLOYEE(...) (as done before)
- SECRETARY(SSN, Level), TECHNICIAN(SSN, Grade), ENGINEER(SSN, Type), which all have

  PK: {SSN}

  FK: [SSN]⊆EMPLOYEE[SSN]

# ER-to-Relations Algorithm (Recall)

- The algorithm to first[illegible] basic ER model into relations, and then convert superclass/s[illegible]m the EER model into relations.

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Step 6: Mapping of Multi-valued Attributes

Step 7: Mapping of N-ary Relationship Types

Step 8: Mapping of Superclass/Subclass

# A Relational Database Schema - The Company Database

- EMPLOYEE( SSN , N[illegible]y, Dname Super_SSN )
- WORKS_ON( SSN , [illegible], Hours)
- DEPARTMENT( Name, Address, Mgr_SSN , Start_date)
- PROJECT( Pnumber , Pname, Location, Dname )
- EMPLOYEE_ADDRESS( SSN , Address)
- CHILD( SSN , Cname, Age)