COMP 3311
DATABASE MANAGEMENT SYSTEMS

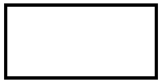
TUTORIAL 1
ENTITY-RELATIONSHIP (E-R) MODEL AND DATA BASE DESIGN

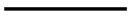
REVIEW: E-R MODEL & DATABASE DESIGN

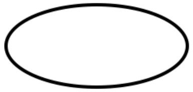
- Generally, we construct an E-R diagram, by identifying:
  - Entity types ⟹ what should be entities?
    - Strong or weak?
    - Attributes
      - Can they be inherited (generalization or specialization)?
  - Relationship types ⟹ how should entities be related?
    - Participation constraints
      - Total participation or partial participation?
    - Cardinality constraints
      - One to one, one to many or many to many?
    - Any attributes?
    - Need to label roles?

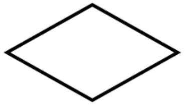
- E-R Diagram Notation
  - Many different notations; no standard E-R notation!

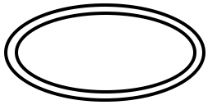
REVIEW: E-R DIAGRAM LECTURE NOTATION

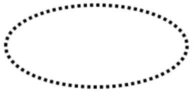

entity

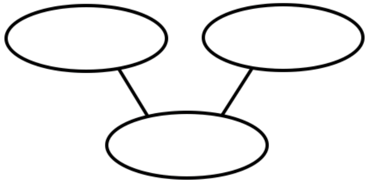

link

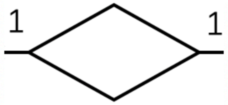

attribute


relationship

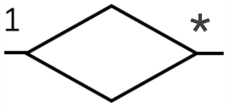

multivalued attribute


derived attribute

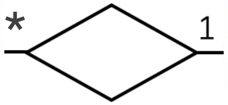

composite attributes



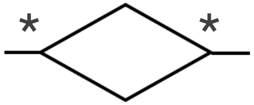
one-to-one relationship



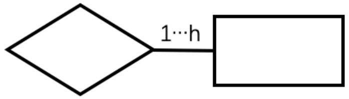
one-to-many relationship



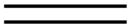
many-to-one relationship

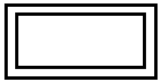


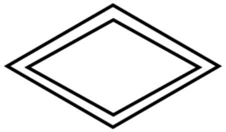
many-to-many relationship

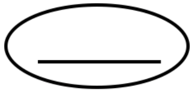


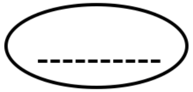
Cardinality limits


total participation

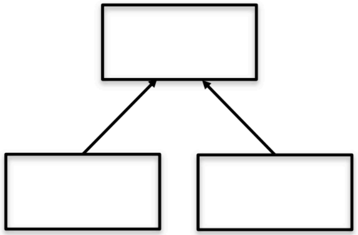

weak entity


weak relationship

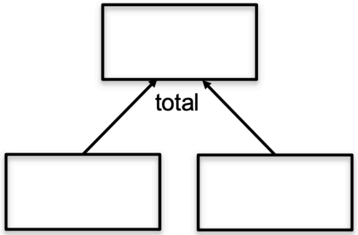

key attribute / single valued attribute


discriminator (partial key) attribute

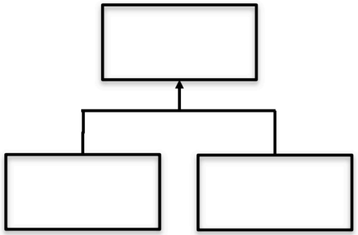
REVIEW: E-R DIAGRAM LECTURE NOTATION（cont.）



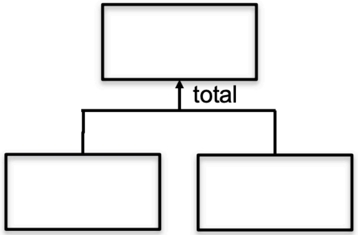
overlapping generalization



total overlapping generalization

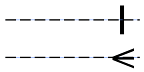
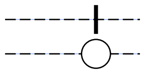
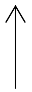


disjoint generalization



total disjoint generalization

REVIEW: E-R DIAGRAM ALTERNATIVE NOTATION

Entity	entity type
Relationship	relationship type
attribute	single-valued attribute
{attribute}	multivalued attribute
attribute ()	derived attribute
	cardinality constraint (one or many)
	participation constraint (total or partial)
Weak entity	weak entity type
Relationship	identifying relationship for weak entity type
	generalization

EXERCISE 1: BANK APPLICATION

We want to record account and loan information for a bank’s customers.

- For each customer we store an id, name, address, which is composed of street, city and state, and one or more phone numbers.
- For each account we store a unique account number and the balance.
- For a saving account we store the interest rate while for a checking account we store whether it has overdraft protection.
- An account can be held by several customers and a customer can hold several accounts.
- For each loan that a customer takes out we record a number and amount.
- A loan may require a guarantor, who must also be a bank customer.
- Each loan can have several payments for which we record a number, date and amount.
- A customer can either hold an account or take out a loan or both.

Construct an E-R diagram for the bank application.
Identify all keys of entities and constraints on relationships.

EXERCISE 1: BANK APPLICATION—ENTITIES

- For each customer we store an id, name, address, which is composed of street, city and state, and one or more phone numbers.
- For each account we store a unique account number and the balance.
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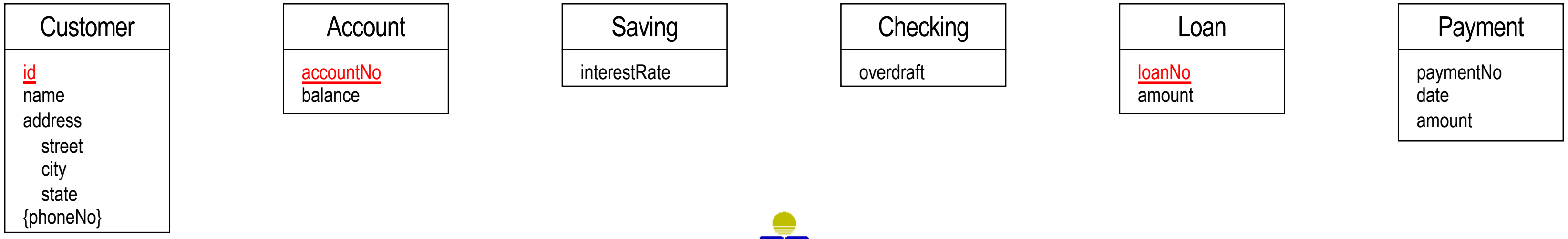
- Each loan can have several payments for which we record a number, date and amount.
- A customer can either hold an account or take out a loan or both.

Customer Account Saving Checking Loan Payment

EXERCISE 1: BANK APPLICATION— ATTRIBUTES AND KEYS OF ENTITIES

- For each customer we store an id, name, address, which is composed of street, city and state, and one or more phone numbers.
- For each account we store a unique account number and the balance.
- For a saving account we store the interest rate while for a checking account we store whether it has overdraft protection.
- An account can be held by several customers and a customer can hold several accounts.
- For each loan that a customer takes out we record a number and amount.
- A loan may require a guarantor, who is also a customer of the bank.
- Each loan can have several payments for which we record a number, date and amount.
- A customer can either hold an account or take out a loan or both.



Customer
id
name
address
street
city
state
{phoneNo}

Account
accountNo
balance

Saving
interestRate

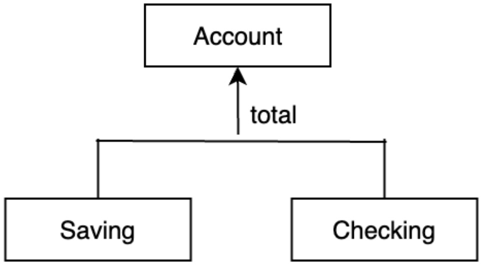
Checking
overdraft

Loan
loanNo
amount

Payment
paymentNo
date
amount

EXERCISE 1: BANK APPLICATION— ENTITY GENERALIZATION/SPECIALIZATION

- For each account we store a unique account number and the balance.
- For a saving account we store the interest rate while for a checking account we store whether it has overdraft protection.



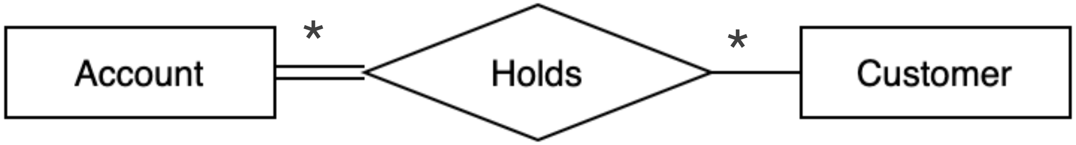
What should be the generalization? ⟹ Account superclass;
Saving, Checking subclasses

What should be the coverage constraint? ⟹ disjoint, total

Customer	Account	Saving	Checking	Loan	Payment

EXERCISE 1: BANK APPLICATION—RELATIONSHIPS

- An account can be held by several customers and a customer can hold several accounts.
- A customer can either hold an account or take out a loan or both.



What should be related? ⟹ Account related to Customer

What should be the cardinality constraints?

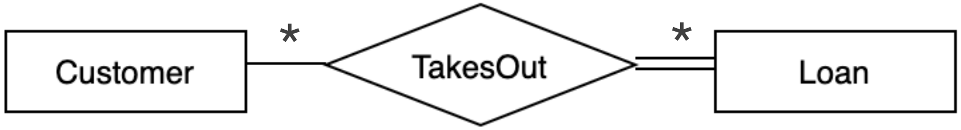
⟹ Account many (An account can be held by several customers.)
Customer many (A customer can hold several accounts.)

What should be the participation constraints?

⟹ Account total (Every account must be held by a customer—common sense.)
Customer partial (A customer may take out a loan only and hold no account.)

EXERCISE 1: BANK APPLICATION—RELATIONSHIPS

- For each loan that a customer takes out we record a number and amount.
- A customer can either hold an account or take out a loan or both.



What should be related? ⟹ Customer related to Loan

What should be the cardinality constraints?

⟹ Customer many (A customer could take out several loans—common sense.)
Loan unknown (Could be 1 or many—need to verify with client.)

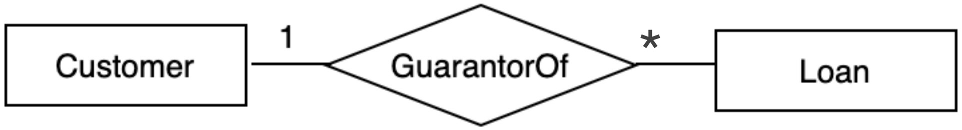
What should be the participation constraints?

⟹ Customer partial (A customer may hold an account only and have no loan.)
Loan total (Every loan must be taken out by a customer—common sense.)

Customer | Account | Saving | Checking | Loan | Payment

EXERCISE 1: BANK APPLICATION—RELATIONSHIPS

- A loan may require a guarantor, who must also be a bank customer.



What should be related? ⟹ Customer related to Loan

What should be the cardinality constraints?

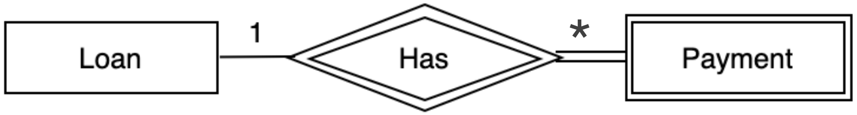
⟹ Customer many (A customer may be a guarantor for many loans—common sense.)
Loan 1 (A loan requires only one guarantor—implied by statement.)

What should be the participation constraints?

⟹ Customer partial (A customer may not be a guarantor of any loan.)
Loan partial (Not every loan requires a guarantor—implied by statement.)

EXERCISE 1: BANK APPLICATION—RELATIONSHIPS

- Each loan can have several payments for which we record a number, date and amount.



What should be related? ⟹ Loan related to Payment

What kind of entity is Payment? ⟹ Weak entity dependent on Loan.

Is there a discriminator for Payment? ⟹ Yes — paymentNo.

What should be the cardinality constraints?

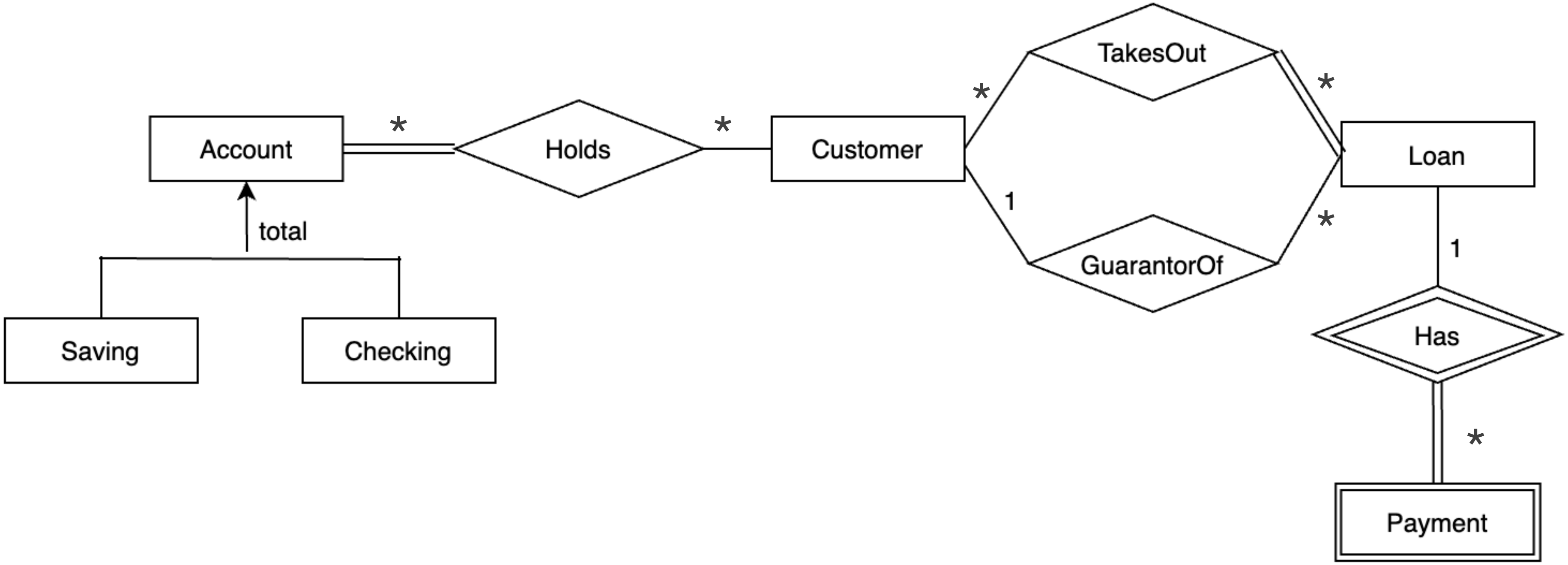
⟹ Loan many (Each loan can have several payments.)
Payment 1 (Every payment is for only one loan—common sense.)

What should be the participation constraints?

⟹ Loan partial (A loan may not have any payment yet—common sense.)
Payment total (Every payment must be for a loan—common sense.)

Customer | Account | Saving | Checking | Loan | Payment

EXERCISE 1: BANK APPLICATION—E-R DIAGRAM



Customer
id
name
address
  street
  city
  state
{phoneNo}

Account
accountNo
balance

Saving
interestRate

Checking
overdraft

Loan
loanNo
amount

Payment
paymentNo
date
amount

You must upload your completed exercise sheet to Canvas by **11 p.m. today.**

EXERCISE 2: FACTORY APPLICATION

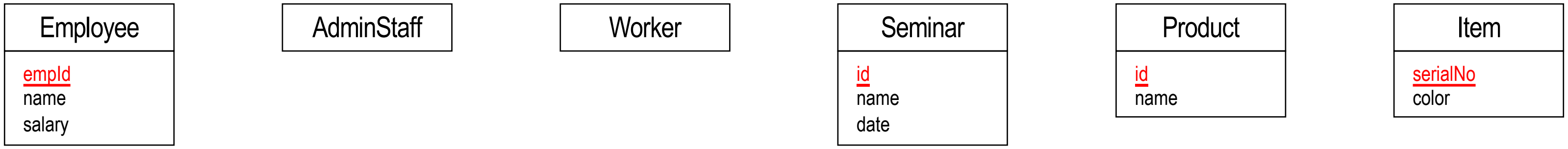
We want to record information about products that a factory manufactures.

- The factory has a number of employees. For each employee we store the employee id, name and salary.
- Each employee must be an admin staff or a worker, but not both.
- Admin staff must take seminars. For each seminar we store its id, name and date. For the admin staff, we store the grade received for each seminar taken.
- The factory manufactures a number of products and each product is identified by a product id and has a name.
- A worker is assigned to work on exactly one product; a product has multiple (one or more) workers assigned to it.
- A large number of items are manufactured for each product. Each item has a serial number and a color. Different items of the same product have different serial numbers. However, two items that belong to different products may have the same serial number.

Construct an E-R diagram for the factory application.
Identify all keys of entities and constraints on relationships.

EXERCISE 2: FACTORY APPLICATION— ENTITIES AND ATTRIBUTES

- The factory has a number of employees. For each employee we store the employee id, name and salary.
- Each employee must be an admin staff or a worker, but not both.
- Admin staff must take seminars. For each seminar we store its id, name and date. For the admin staff, we store the grade received for each seminar taken.
- The factory manufactures a number of products and each product is identified by a product id and has a name.
- A worker is assigned to work on exactly one product; a product has multiple (one or more) workers assigned to it.
- A large number of items are manufactured for each product. Each item has a serial number and a color. Different items of the same product have different serial numbers. However, two items that belong to different products may have the same serial number.


Employee
empId
name
salary

AdminStaff

Worker

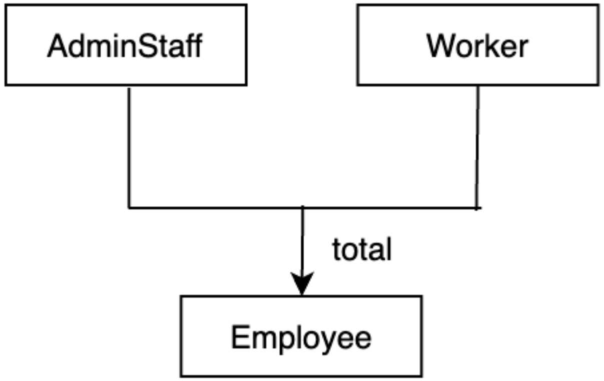
Seminar
id
name
date

Product
id
name

Item
serialNo
color

EXERCISE 2: FACTORY APPLICATION— RELATIONSHIPS

- The factory has a number of employees. For each employee we store the employee id, name and salary.
- Each employee must be an admin staff or a worker, but not both.

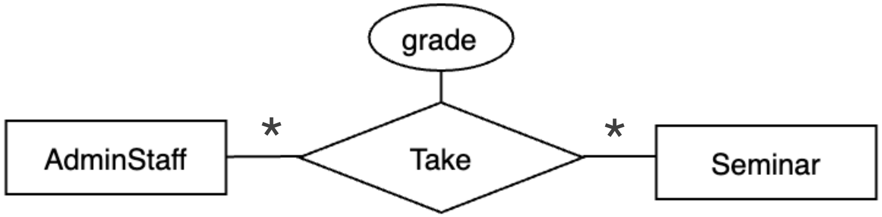


How to relate the enti

What should be the coverage constraint? ⟹ disjoint, total

EXERCISE 2: FACTORY APPLICATION—RELATIONSHIPS

- Admin staff must take seminars. For each seminar we store its id, name and date. For the admin staff, we store the grade received for each seminar taken.



What should be the cardinality constraints?

⟹ Seminar many (A seminar can be taken by many admin staff—common sense.)

AdminStaff many (An admin staff can take many seminars—common sense.)

What should be the participation constraints?

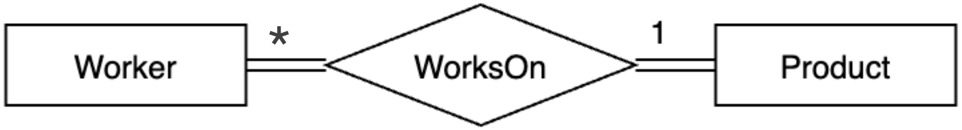
⟹ Seminar partial (A Seminar instance should be able to exist *before* any admin staff take it.)

AdminStaff partial (Although admin staff must take seminars, an AdminStaff instance should be able to exist *before* having taken any seminar.)

Anything else? ⟹ Add the attribute grade to the Takes relationship.

EXERCISE 2: FACTORY APPLICATION— RELATIONSHIPS

- The factory manufactures a number of products and each product is identified by a product id and has a name.
- A worker is assigned to work on exactly one product; a product has multiple (one or more) workers assigned to it.



What should be the participation constraint for Worker?

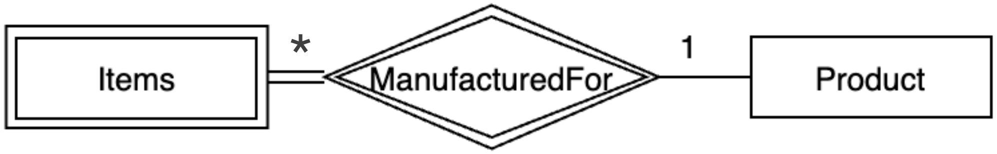
⟹ total (A worker is assigned to work on exactly one product.)

What should be the participation constraint for Product?

⟹ total (A product has multiple (one or more) workers assigned to it.)

EXERCISE 2: FACTORY APPLICATION—RELATIONSHIPS

- A large number of items are manufactured for each product. Each item has a serial number and a color. Different items of the same product have different serial numbers. However, two items that belong to different products may have the same serial number.



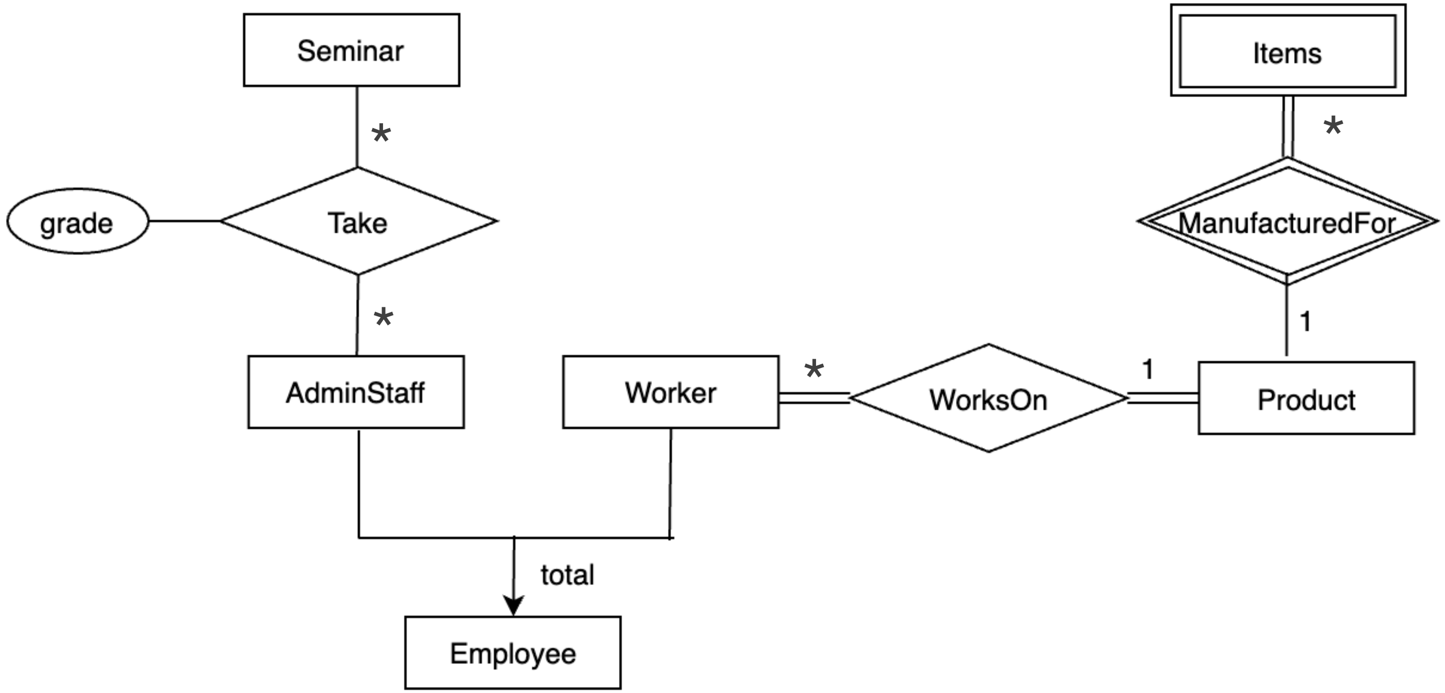
Is this representation correct?

Consider: two items that belong to different products may have the same serial number.

⟹ Item is a weak entity dependent on Product.

⟹ serialNo is a discriminator attribute.

EXERCISE 2: FACTORY APPLICATION— E-R DIAGRAM



Employee	AdminStaff	Worker	Seminar	Product	Item
empId name salary			id name date	id name	serialNo color