

**PLACE YOUR ANSWER TO THIS QUESTION ON BLANK PAGE IN EXAM PROBLEMS**

2. ABC Manufacturing is constructing a database for keeping track of what maintenance parts and supplies are used by each of their machining stations. Parts (nuts, bolts, assemblies, etc.) and supplies (lubrication, hydraulic fluid, etc.) share some common attributes but differ on others. They need to store data about their machining stations (type of station, operators required, etc.), parts and supply lists, and line items for each station list, as well as information on the parts and supplies themselves. As some parts and supplies change over time for each station and it is important to know what list was in effect historically, a station may have many parts and supply lists. Every time an item on a station's list changes a new list is created by placing an entry into the parts and supply list table (e.g. date created, operator creating list, etc.) and placing line items in a separate table that store the specific parts and supplies for that part and supply list. The previous entries for the previous version of the list are retained. Therefore, stations can have one to many part and supply lists that contain one to many parts and supplies. Each part and supply item may be on zero to many part and supply lists.

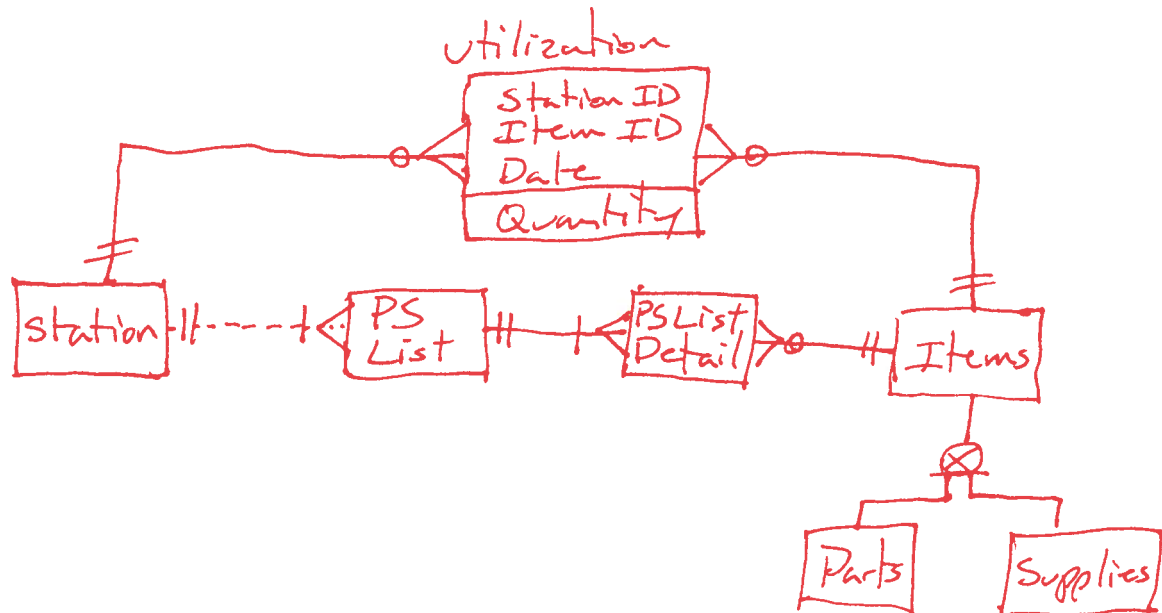
Finally, each machine station will consume various parts and supplies and there needs to be a way to store each time a station consumes a part or supply and the quantity that is consumed. So it needs to be able to store the station, the item consumed, the quantity consumed, and the date consumed.

Draw an E-R diagram to represent this database.

- If necessary, create an association pattern if a relationship needs additional attributes other than foreign keys. Show attributes for association patterns only.
- Show all minimum and maximum cardinalities.
- Do not show attributes for entities (other than association patterns). Some attributes are given as examples in the problem so that you understand what is being stored. Most of these do not need to be shown on diagram (association patterns, discussed above, are the exception).
- Do not use any three-way (ternary) relationships.
- Do not use any structures that imply multi-valued attributes would exist.
- List any non-obvious assumptions you made.

2. (18 points) See question on reference sheets.

Place E-R Diagram on this page:



Line Item Structures (8pts)

Supertype/Subtype Structures (5pts)

Association Entity Structure (5pts)

## 2. (18 points) – PLACE ANSWER ON DESIGNATED EXAM PAGE –

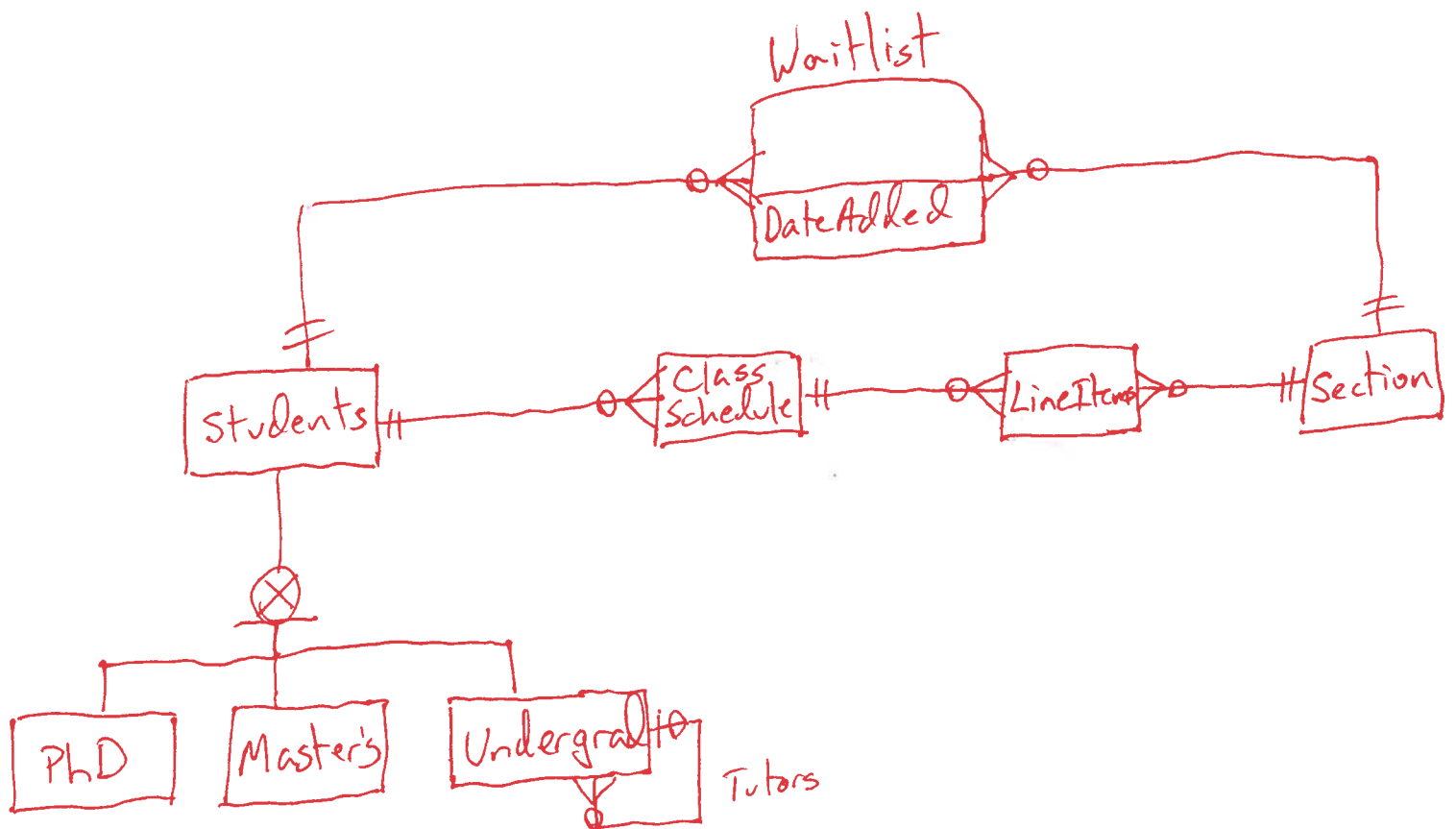
Draw an E-R diagram to represent this database.

- If necessary, create an association pattern if a relationship needs additional attributes other than foreign keys. Show attributes for association patterns only.
- Show all minimum and maximum cardinalities.
- Do not show attributes for entities (other than association patterns). Some attributes are given as examples in the problem so that you understand what is being stored. Most of these do not need to be shown on diagram (association patterns, discussed above, are the exception).
- Do not use any three-way (ternary) relationships.
- Do not use any structures that imply multi-valued attributes would exist.
- List any non-obvious assumptions you made.
- *ID-Dependent vs non-ID-Dependent relationships do not have to be distinguished for this diagram (will not be a grading point).*

A database needs to be developed for a small university to keep track of student course schedules, waitlists for sections, basic student data, and tutoring relationships between undergraduate students. Each student has basic data stored about them (name, address, phone, etc.). Additionally, each of the three academic levels (PhD, Masters, Undergraduate) has some specialized data being stored about those students. For instance, PhD students have the name of their dissertation advisor, Master's students have their GMAT score and undergraduate GPA, undergraduate students have their ACT or SAT scores and high school GPA. Students may only enroll in one academic level. There is a tutoring program, arranged by the school, only for the undergraduate students. Here, one undergraduate may tutor zero to many other undergraduates and each undergraduate may be tutored by zero to one other undergraduates. The system needs to store these relationships.

Each student (regardless of academic level) has zero to many class schedules (each schedule belongs to one and only one student). Each class schedule has zero to many line items. Basic information (times, instructor, credit hours, etc.) on class sections is stored and each section may have zero to many class schedule line items. Each line item is related to one and only one section.

There is a waitlist for class sections (separate from class schedules). Each student may have zero to many sections on their waitlist and each section may have zero to many students on their waitlist. In addition to storing which sections which students are waiting for, the date the student was added to the waitlist for that section must be stored to prioritize the waitlist.



18 Points Total

- 7 Line Item Structure
- 4 SuperType/Subtype Structure
- 3 Recursive Undergrad Tutoring Relationship
- 4 Waitlist Association Pattern

5. (time management: allow approx 25 minutes) ABC Entertainment Inc. wants to design a database for its new cable television service. ABC has 10 premium channels and 60 basic channels. They use a different price structure than most similar companies where each customer can select individual basic channels for \$0.95 each/month. Premium channels (HBO, Showtime, etc.) carry various monthly fees. The date that the service was started and stopped needs to be stored for each subscribed channel so that partial month charges may be calculated. In addition, they offer pay-per-view as a separate service. The attributes stored for premium and basic channels are the same except that only premium channels need to have a fee stored for each channel and only basic channels need to have a Boolean attribute stating whether the channel is local or not. The attributes stored for pay-per-view services is *not* similar to the data stored for basic and premium channels.

ABC needs the database to be able to answer the following:

- What channels are subscribed to by what customers?
- When (the date) was each channel activated and deactivated for each customer over time?
- What pay-per-view services has a customer received (includes past history – not just current)?
- What is the monthly invoice for each customer, including line items for each basic channel, any premium channels, and any pay-per-view (includes past history – not just current)?
- What customers have referred what other customers?\*

\*As a startup company ABC will give customers discounts when they refer another customer to ABC. So one customer can refer many others, but each customer can only be referred by one other customer. The referrals should be available in the database but the discounts are manually adjusted and are not represented in the database structure.

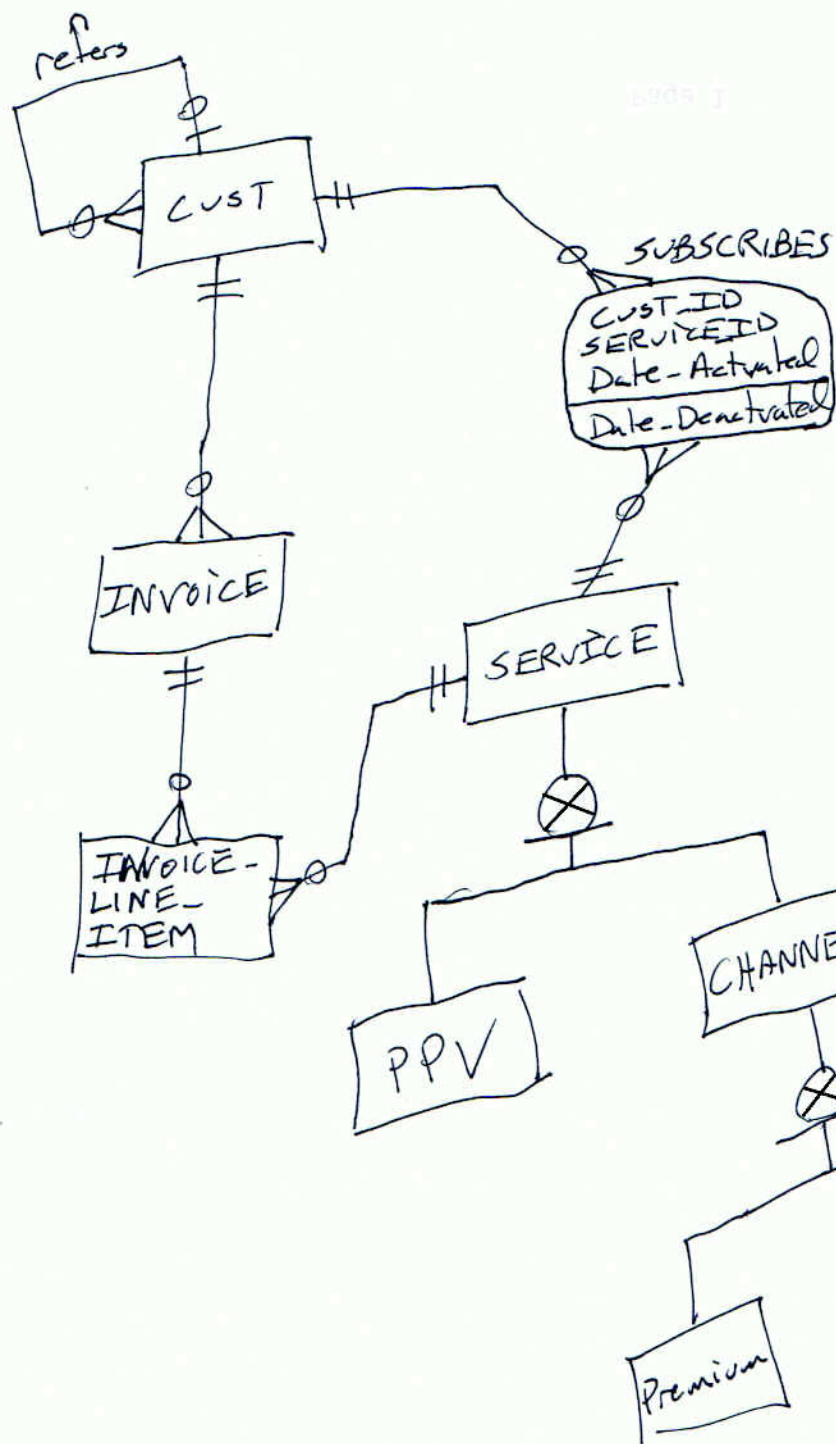
Draw an E-R diagram to represent this database.

- ~~Show the extra attributes for relationships (only) that require extra attributes besides the foreign keys.~~\*
- Show all minimum and maximum cardinalities.
- Do not show attributes for entities.
- Do not use any three-way relationships.
- Do not use any multi-valued attributes.

Place E-R Diagram on the following page.

*\*new language:  
if necessary, create  
an association entity  
if relationship needs  
add. formal attributes other  
than foreign keys. Show  
attributes for association  
entities only.*





**Note** this entity began as a relationship (M-N). It needed date-activated and date-deactivated to fulfill requirements. ∴ attributes are shown and it is an association entity. (this explanation would not be required in a student answer)

This is one of a few possible (full credit) solutions. The main variation is that the SERVICE Supertype is not mandatory; PPV and Channels may be treated as completely separate. Channels must be supertype for subtypes Premium and Basic ~~and~~ because of the very specific language in the problem (underlined). I do think this is the 'best' solution.

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2. Golden Flashes Credit Union (GFCU) needs a database to keep track of records for online banking as well as loan balance and status for customer loans. Each customer has zero to many statement periods and each statement period would have one to many statement transactions (line items). Each statement transaction is associated with one transaction item. Transaction items fall into two types: credits and debits. These transactions types share some common attributes but also have attributes that are only stored for one type but not the other.

Additionally, as part of the same database, GFCU wants to have basic information regarding a customer's loans. Customers can have zero to many loans and each loan may be associated with one to many customers (co-signatories). The system needs to store the current loan balance for that customer as well as the loan status (current, late, default, paid-in-full) for that customer. The balance and status of multiple signatory loans may differ between signatories so this information must be associated with the specific customer and the specific loan rather than just being associated with the loan by itself.

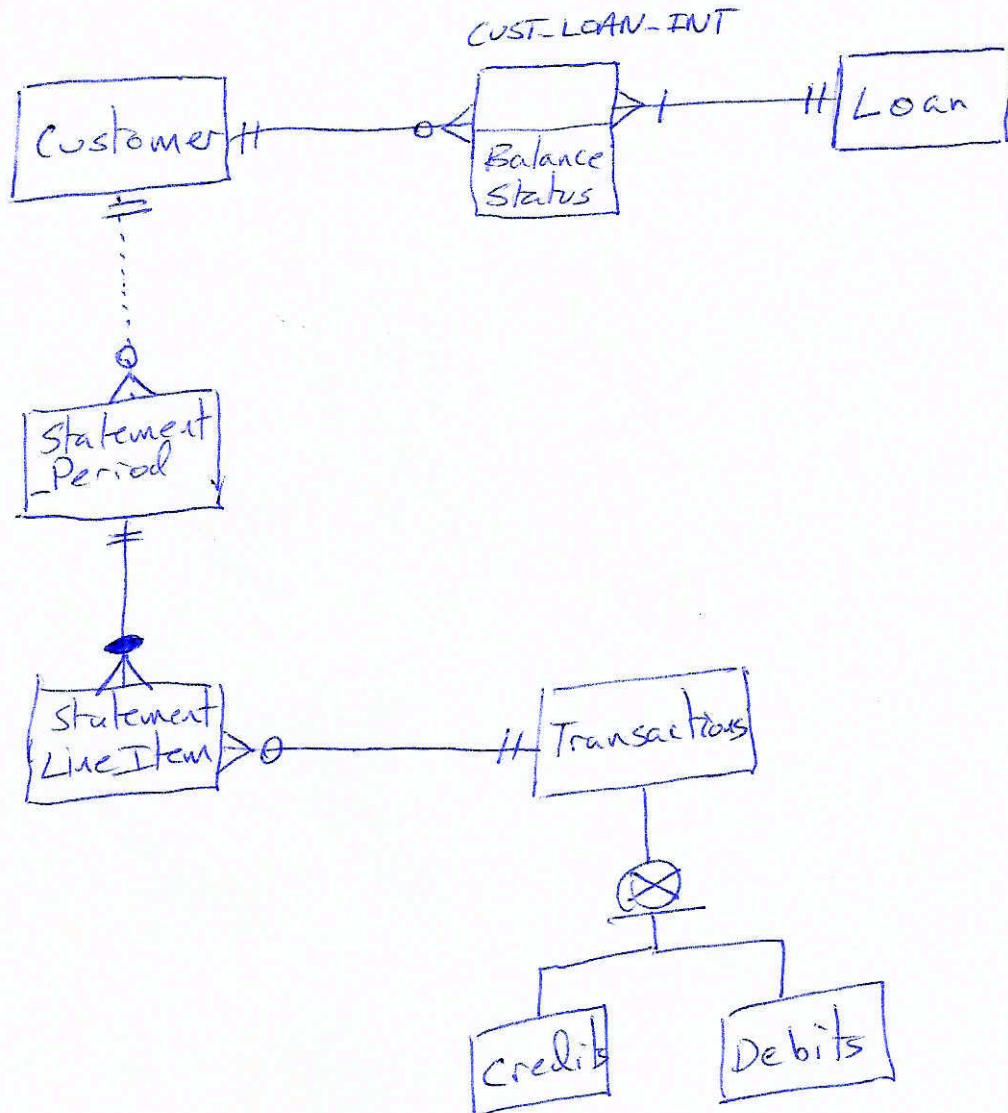
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- List any non-obvious assumptions you made.

**You may separate this page from the exam. Please place your name on every separate page and all pages must be turned in.**

2. (18 points) See question on reference sheets.

Place E-R Diagram on this page:





2. ABC Manufacturing needs a database to keep track of its payroll. Each employee can have multiple paychecks but have no paychecks when hired and added to the database. Each paycheck includes multiple line items. Each line item will be either a pay entry (base salary, overtime, etc.) or a deduction (various taxes, FICA, Medicare, retirement, etc.). Each item type, pay or deduction, has some common attributes with each other and some attributes that apply only to pay items or deduction items but not both. Pay and deductions are standardized to specific pay grades and deduction levels stored in the PayItems and DeductionItems tables. The system must also be able to store the items (pay and deduction) that apply to a particular employee along with the date it was activated and deactivated. Each item may apply to multiple employees and each employee will have multiple items. Additionally, employees' relationships to each other (spouse, children, etc.) must be stored for computing deductions. Employees may be related to multiple other employees in both directions (for instance, they may be the child of more than one employee and an employee may have multiple children that are employees). They need to be able to retrieve the employee ID of an employee, the employee ID of the employee they are related to, the type of relationship (spouse, child, sibling, domestic partner, etc.), the start and end date of the relationship (some relationship types may not be permanent, for instance, spouse).

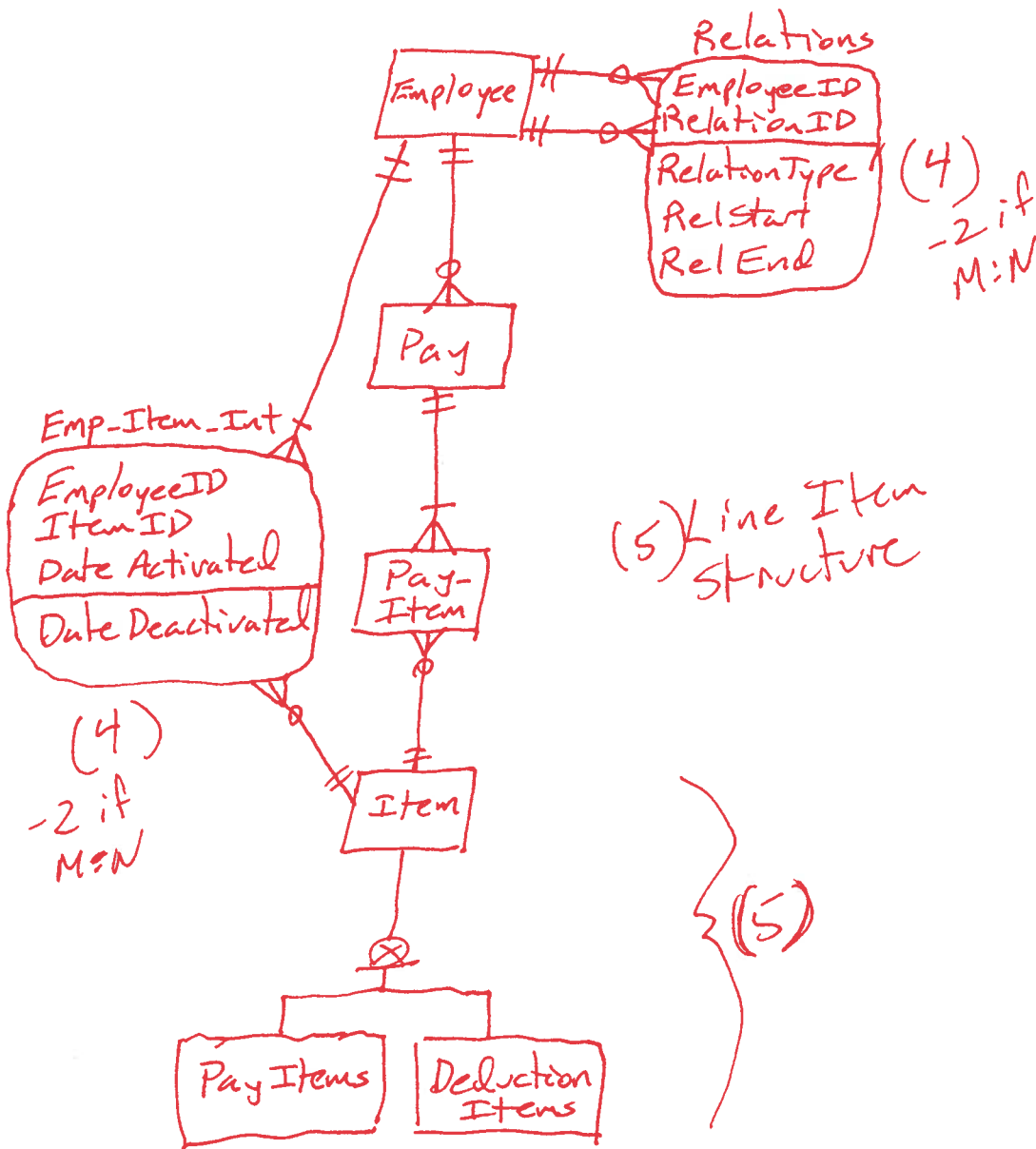
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Note: Identifying vs Non-identifying relationships were not a grading point on this so they are not distinguished between in this solution