BZAN 6354

Lecture 4

February 12, 2024

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UNIVERSITY of HOUSTON
C. T. BAUER COLLEGE of BUSINESS
Department of Decision & Information Sciences

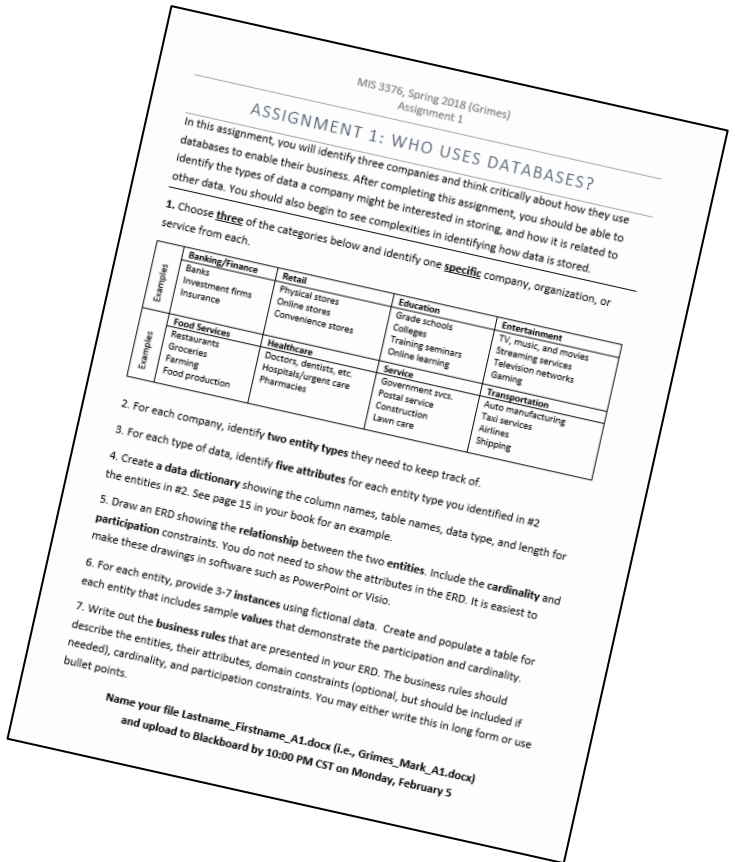
Agenda

- Administration
- Quick review
- Module 3.1 – Bearcat Incorporated Part 1
- Break
- Module 3.2 – Bearcat Incorporated Part 2

Administration: Assignment 1

- Due today at 6:00 PM

- Late submissions are deducted 10% per day for a maximum of five days



MIS 3376, Spring 2018 (Grimes)
Assignment 1

ASSIGNMENT 1: WHO USES DATABASES?

In this assignment, you will identify three companies and think critically about how they use databases to enable their business. After completing this assignment, you should be able to identify the types of data a company might be interested in storing, and how it is related to other data. You should also begin to see complexities in identifying how data is stored.

1. Choose **three** of the categories below and identify one **specific** company, organization, or service from each.

Examples	**Banking/Finance** Banks Investment firms Insurance	**Retail** Physical stores Online stores Convenience stores	**Education** Grade schools Colleges Training seminars Online learning	**Entertainment** TV, music, and movies Streaming services Television networks Gaming
Examples	**Food Services** Restaurants Groceries Farming Food production	**Healthcare** Doctors, dentists, etc. Hospitals/urgent care Pharmacies	**Service** Government svcs. Postal service Construction Lawn care	**Transportation** Auto manufacturing Taxi services Airlines Shipping

2. For each company, identify **two entity types** they need to keep track of.

3. For each type of data, identify **five attributes** for each entity type you identified in #2

4. Create **a data dictionary** showing the column names, table names, data type, and length for the entities in #2. See page 15 in your book for an example.

5. Draw an ERD showing the **relationship** between the two **entities**. Include the **cardinality** and **participation** constraints. You do not need to show the attributes in the ERD. It is easiest to make these drawings in software such as PowerPoint or Visio.

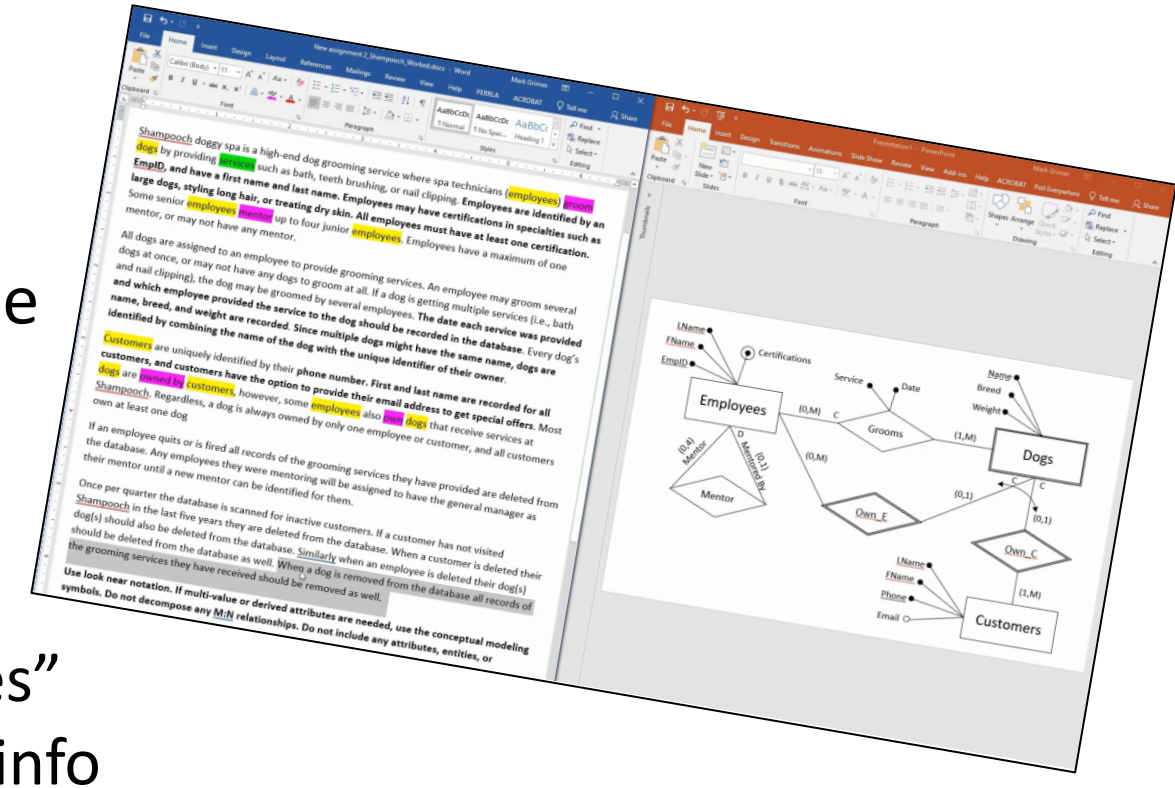
6. For each entity, provide 3-7 **instances** using fictional data. Create and populate a table for each entity that includes sample **values** that demonstrate the participation and cardinality.

7. Write out the **business rules** that are presented in your ERD. The business rules should describe the entities, their attributes, domain constraints (optional, but should be included if needed), cardinality, and participation constraints. You may either write this in long form or use bullet points.

Name your file Lastname_Firstname_A1.docx (i.e., Grimes_Mark_A1.docx) and upload to Blackboard by 10:00 PM CST on Monday, February 5

Administration: Assignment 2

- “Shampooch Doggy Spa”
- Similar to what we will do in class today
- There is a walk-through video linked in the assignment file
- Due in 2 weeks, February 26 at 6:00 PM
  - You’ll need our discussion of “weak entities” for part of the case, but you have enough info after today to do like 99% of the assignment

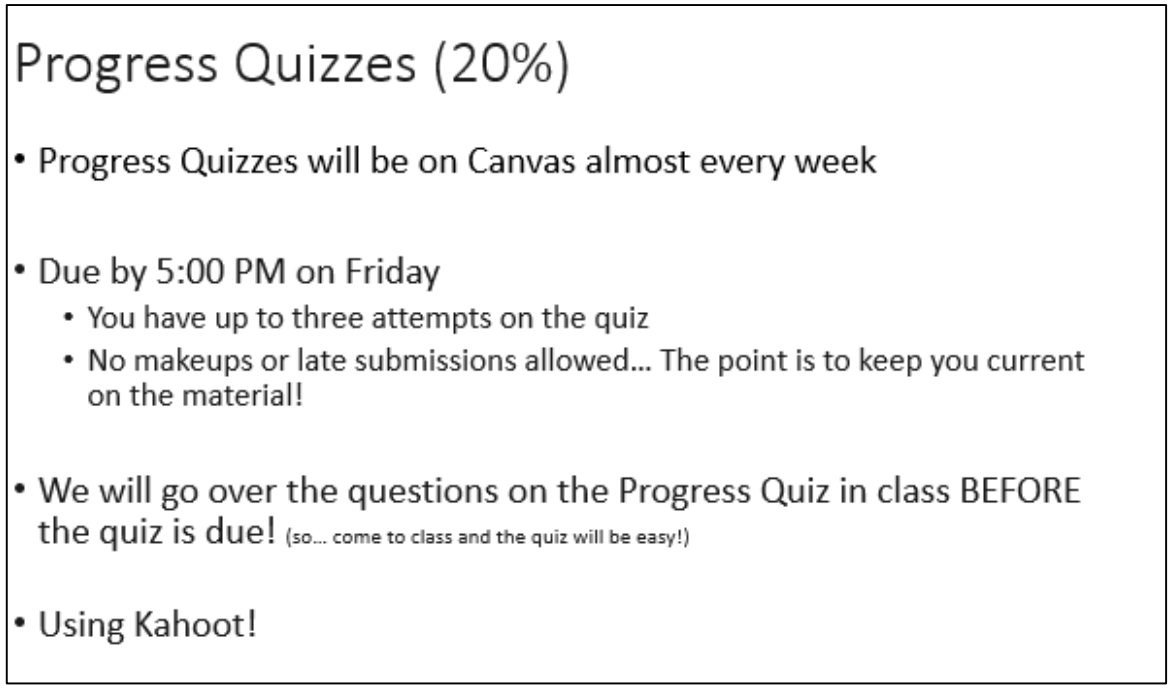


Administration: Progress Quizzes

- Due (almost) every Friday at 5:00 PM

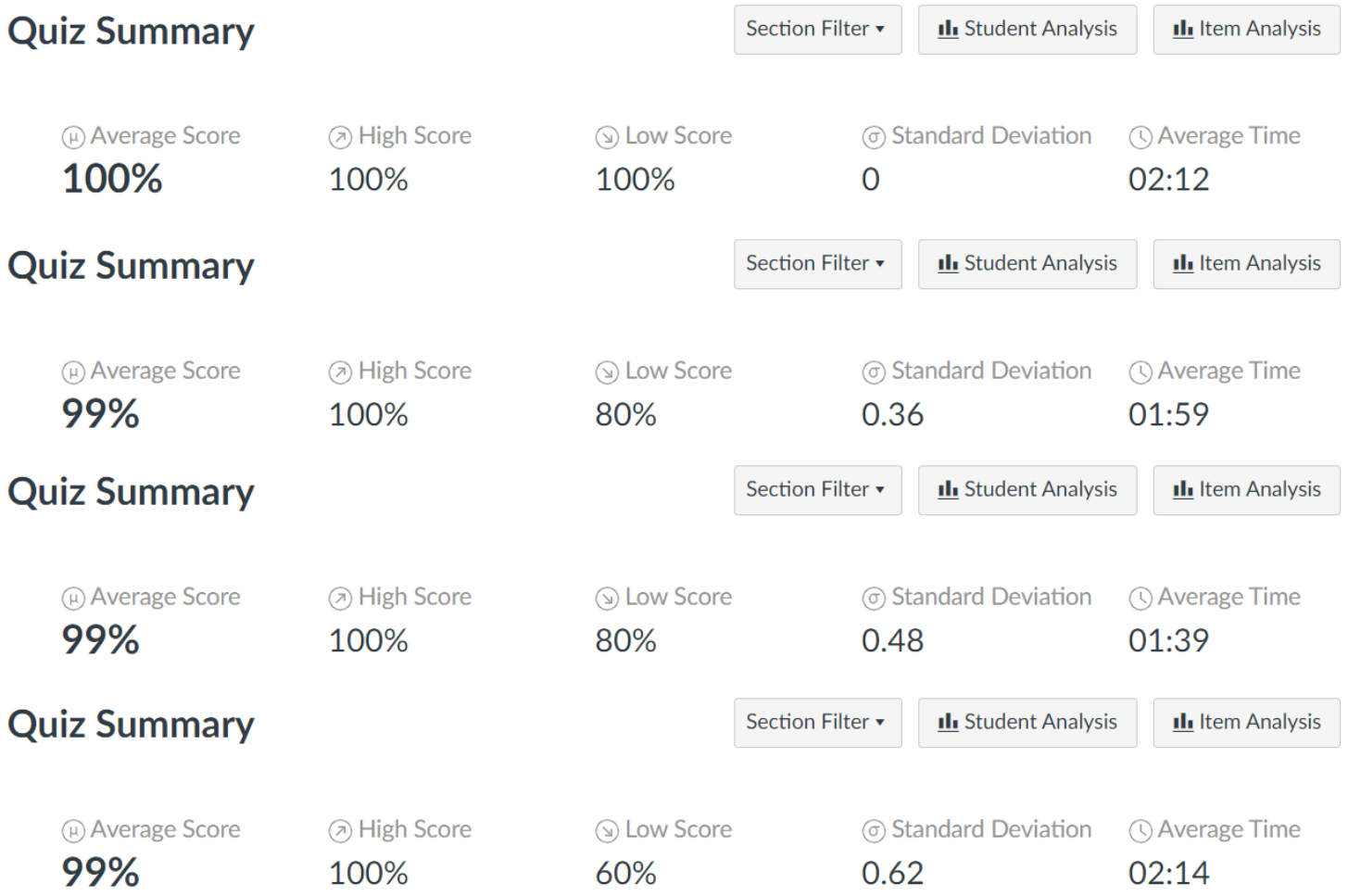
- The point is to keep you on track with the material – thus no late submissions
  - You have the entire week to complete
  - it takes on average about 2 minutes
  - I give you the answers in class
  - About 89% of students complete on time

- Asking to submit late runs the risk of costing “professionalism” points



Administration: Progress Quizzes

- For all the quizzes / sections so far – literally about 2 minutes….



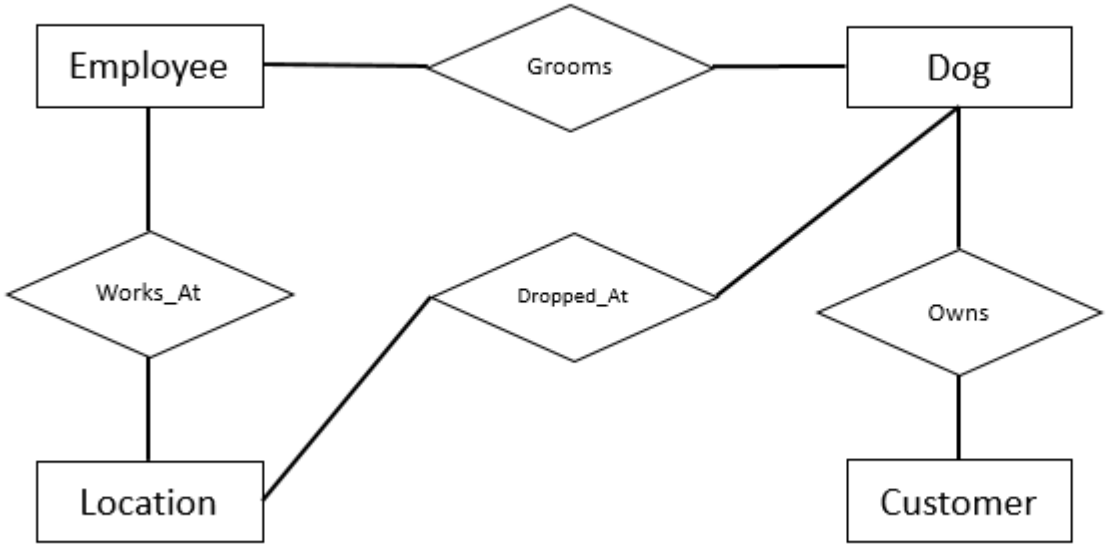
Review: The Purpose of ER models

- Communication/presentation device used by an analyst to interact with the **end-user community**

- A design tool at the highest level of abstraction to convey a **deeper level understanding to the database designer**

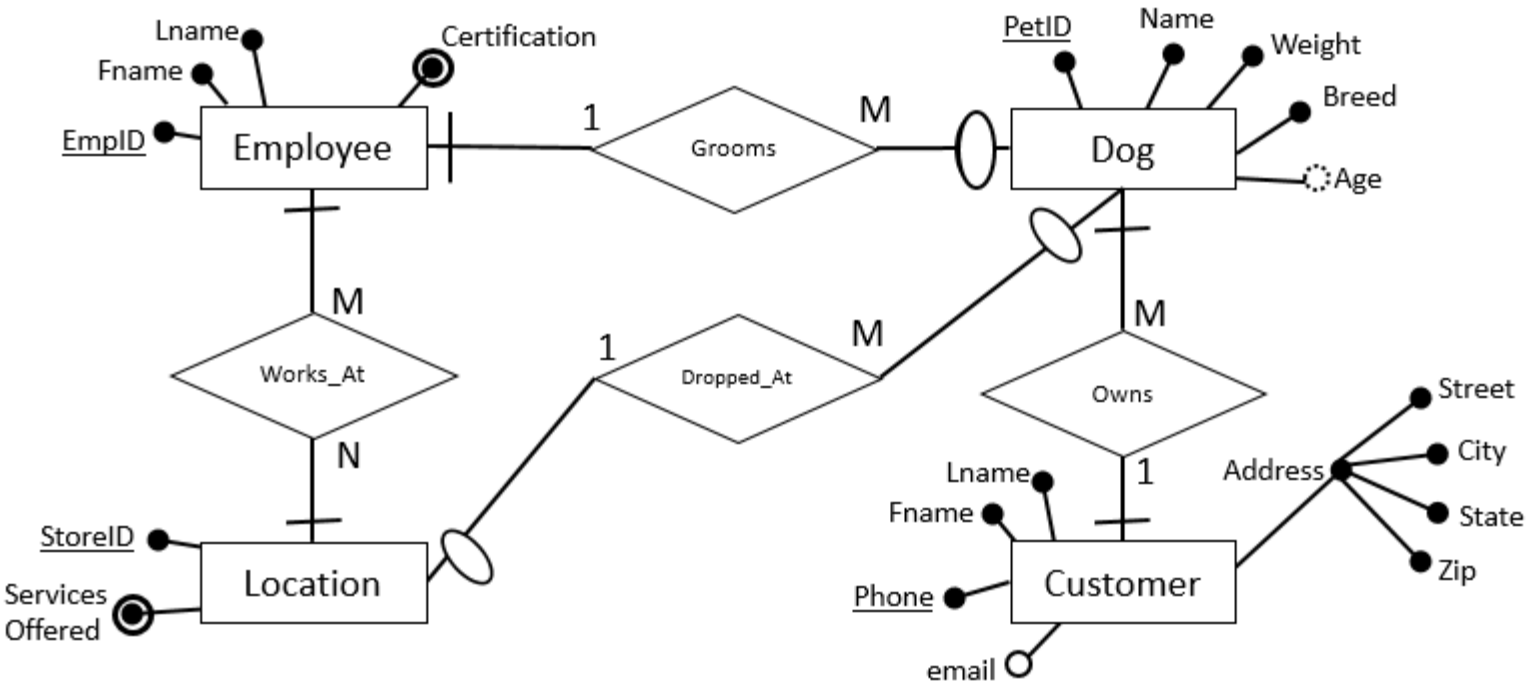
We are getting better at this

- Started simple and imprecise…



We are getting better at this

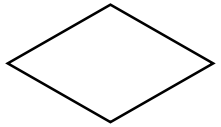
- Adding some precision
  - Participation constraints and Cardinality
  - Different types of attributes



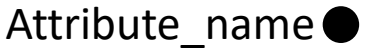
Review: Notations we have already seen

Entity

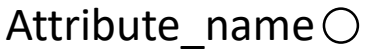
Relationship



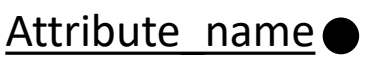
Mandatory Attribute



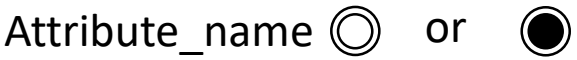
Optional Attribute



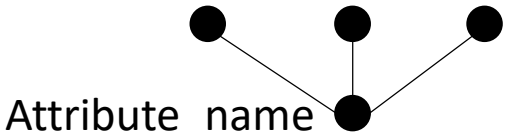
Primary Key



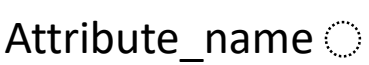
Multivalue Attribute



Composite Attribute

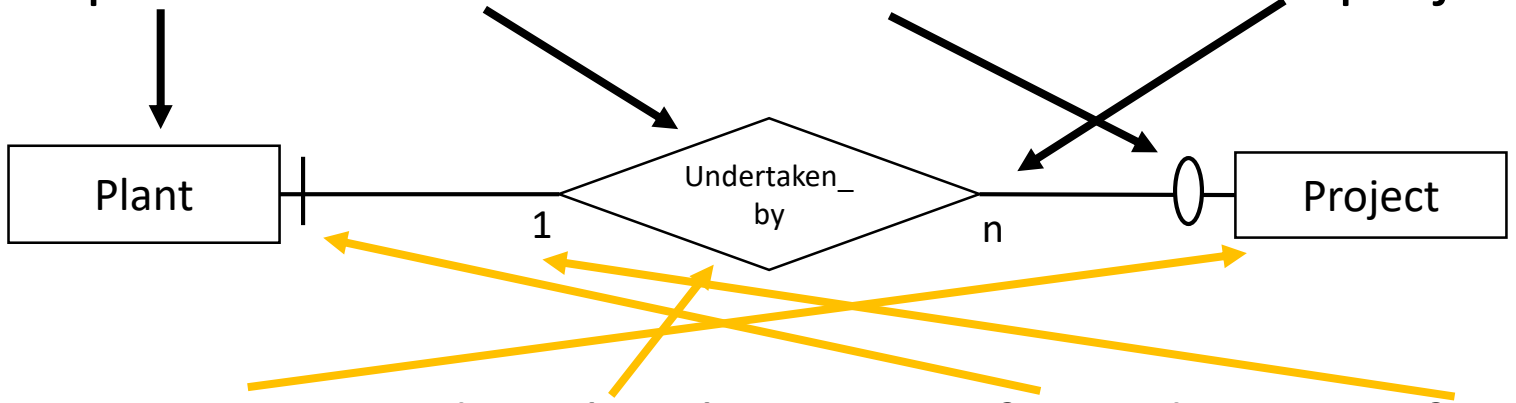


Derived Attribute



Review: Reading ER Diagrams

- The “Look across” method
  - A plant undertakes a min of zero and max of n projects



  - A project is undertaken by a min of 1 and a max of 1 plants

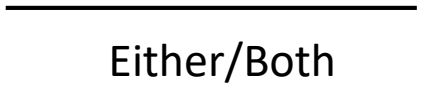
- We “look across” the relationship to determine participation and cardinality of an entity

New notations we will introduce today

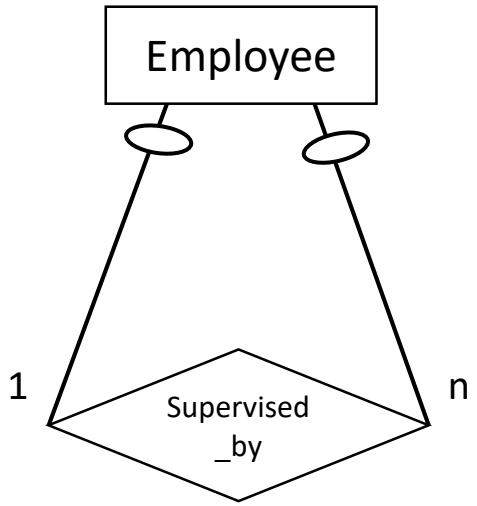
- Exclusive arc – one or the other, but not both

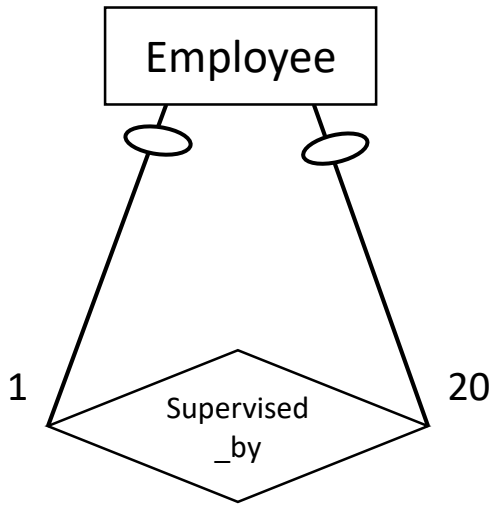
- Inclusive arc – must be both

- Either/Both arc – can be either or both



- Maximum Cardinality

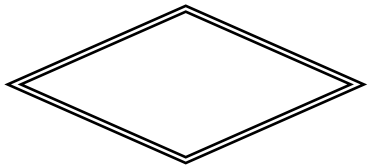




Notations we will introduce next week…

- We are not quite here yet, but these get mentioned as part of assignment 2

Weak Entity 

Identifying Relationship 

Partial Key 

Module 3.1
Bearcat Incorporated: Part 1

Bearcat Incorporated is a manufacturing company with several plants in the northeastern United States

The **bearcat**, also known as the binturong,
is a viverrid mammal from Southeast Asia (Wikipedia)

How this will work

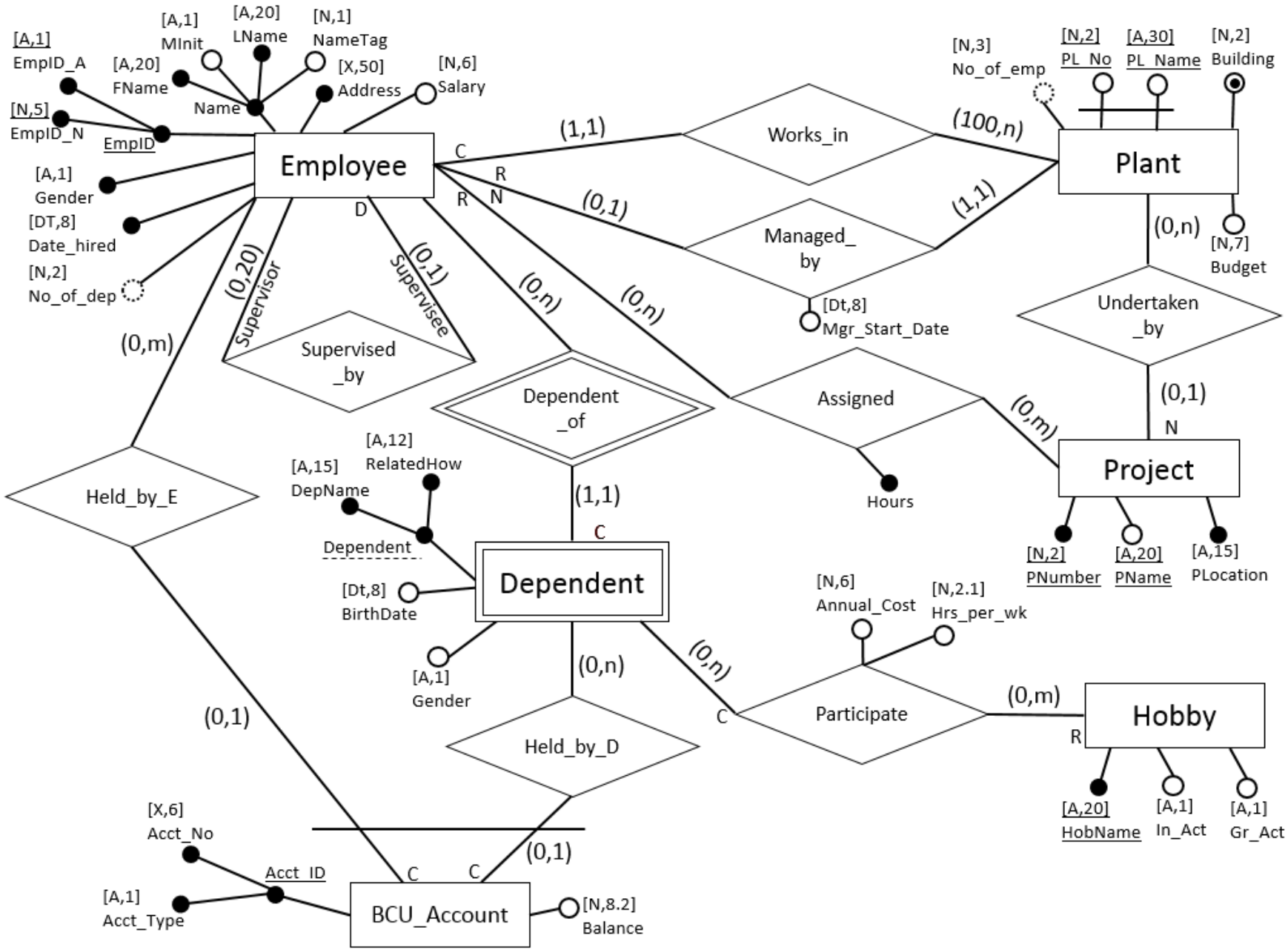
- Brief discussion of the Bearcat case
  - Story to read about the company
- Organize yourselves into groups of 3-4
  - Not a long term commitment
- We will collaboratively work through creating an ERD to capture the business rules described in the case

The Bearcat story is a complex one

- Bearcat has plants that undertake projects
  - We did this one already

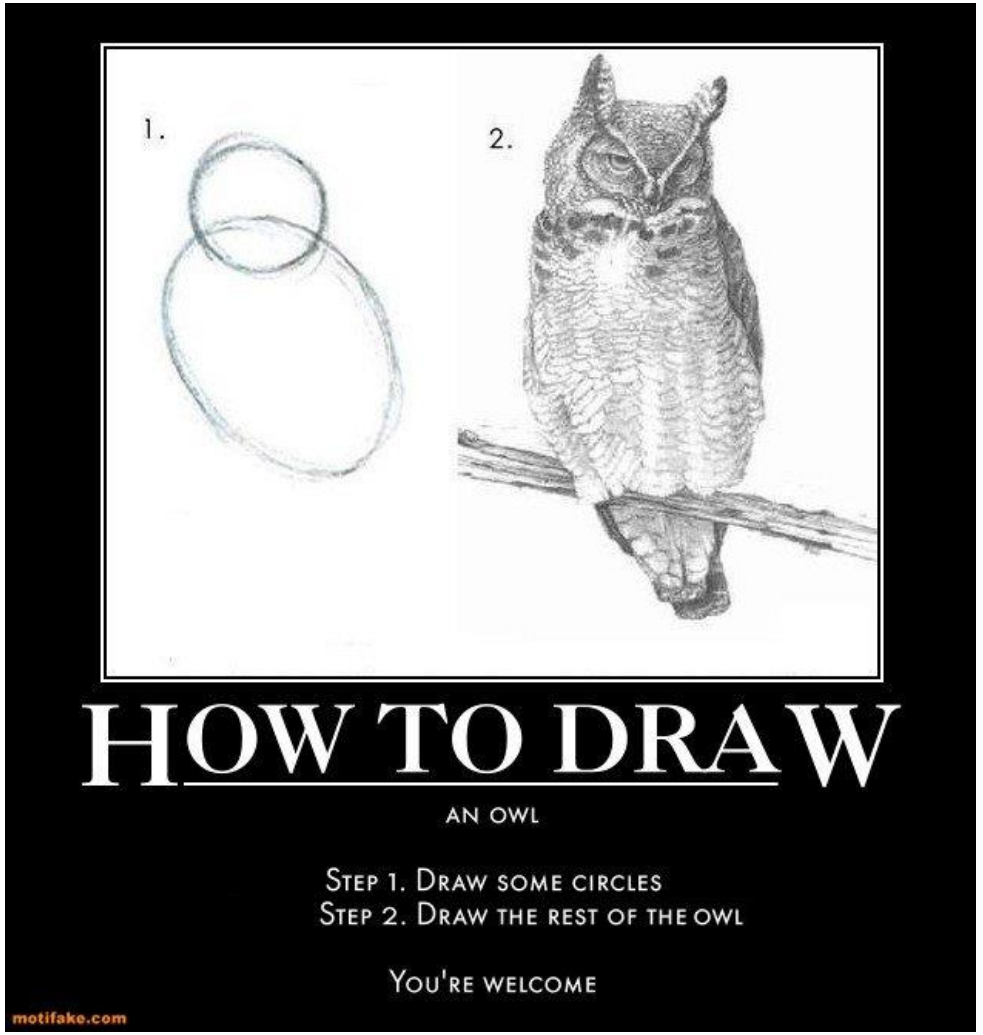
- Bearcat also has employees…
- …that may or may not be managers
- …and that may or may be / have supervisors
- …and that may or may not have dependents
- …and whose dependents may or may not have hobbies
- …and employees and their dependents may or may not participate in the company credit union, either with individual accounts, joint accounts, or both

By the end of class we'll get here



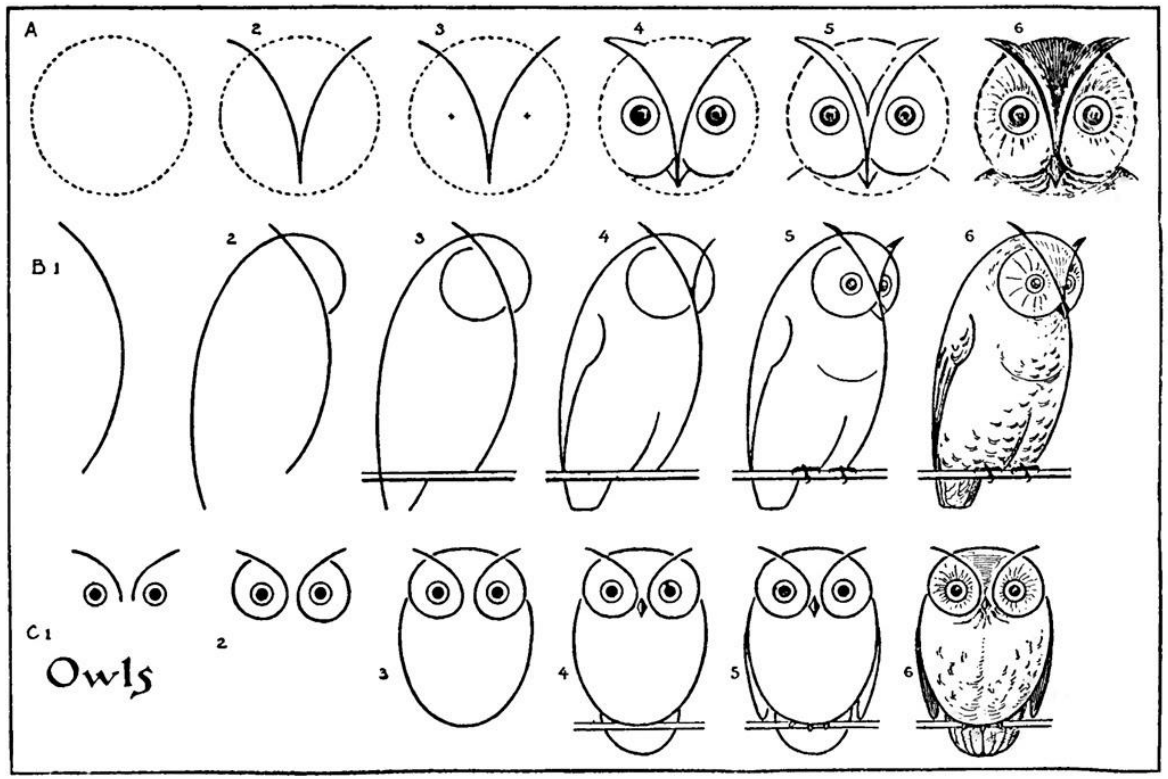
Decomposing business rules

- Too often we look at big jobs and think like this



Decomposing business rules

- However, if we take a complex problem and break it down into simple elements, it's really not that bad
  - Not just applicable to database (or IS in general) – works for anything



Identifying entities – two ways of thinking about this:

- **Synthesis approach** (bottom up)
  - List all discernible data elements in the narrative, treating the all as attributes
  - Group them together in a way that makes sense (to you)
  - Clusters of attributes are (or might be) entities

- **Analysis approach** (top down)
  - Nouns are modeled as entity types or as attributes
  - Identify relationships between the entities (typically verbs)

- For both approaches, be careful to only bring in elements that are in scope – not EVERYTHING belongs in your model

Let’s take 5 minutes to read (individually)

- Make a note of what entities, attributes, and relationships you see
- Don’t worry about being too precise right now – this is the first pass
- Remember: it’s an iterative process

(This is the same story that opens Chapter 3, on page 79-81 of the book)

What entities did you find?

Developing the Presentation Layer ER Model

- Divide story into meaningful “chunks” and identify relationship(s) among entity types – i.e., both cardinality constraint(s) and participation constraints.
- Go back and read the story (strike out story lines already captured if need be) and refine entity types and relationship types of the ER diagram based on additional facts discerned
- Gather business rules that can’t be captured in the ERD into a list of Semantic Integrity Constraints – a supplement to the ERD
- Repeat last two steps (as many times as necessary) until all aspects of the story (i.e., the business rules) have been accounted for in the ER model

Chunks

- There are several smaller stories we are telling
  - How plants and projects are related
  - How employees are related to plants and projects
  - How employees and supervisors are related
  - How employees and dependents are related
  - How employees and dependents are related to BCU
  - How dependents and hobbies are related

- In each story, we describe participation constraints, cardinality, attributes, deletion constraints, etc…

- Take it one step at a time

Story 1

Bearcat Incorporated is a manufacturing company with several plants in the northeastern United States.

These plants are responsible for leading different projects that the company might undertake, depending on a plant's function. A certain plant might even be associated with several projects, but a project is always under the control of just one plant. Some plants do not undertake any projects at all.

If a plant is closed down, the projects undertaken by that plant cannot be canceled. The project assignments from a closed plant must be temporarily removed in order to allow the project to be transferred to another plant.

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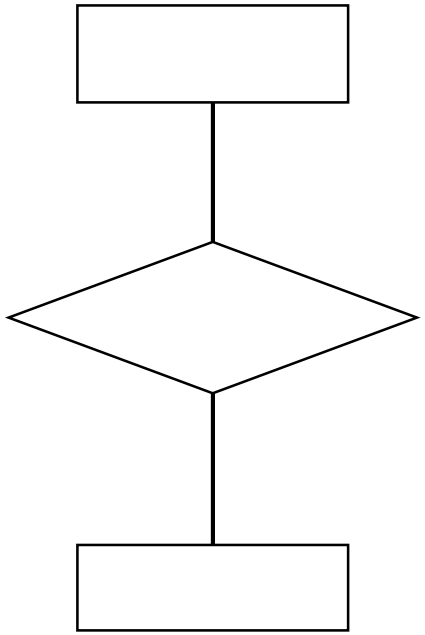

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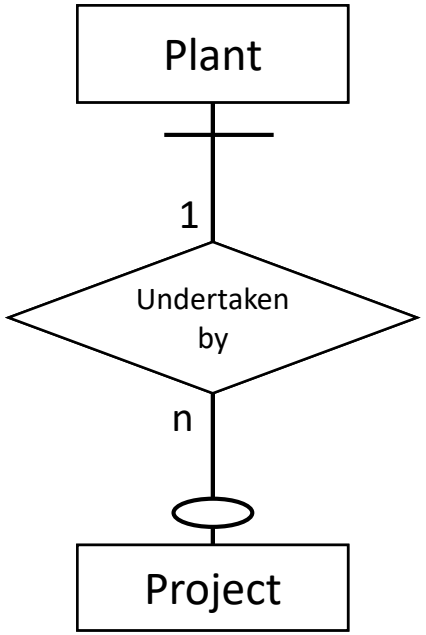

Story 2

Employees work in these plants, and each employee works in only one plant. A plant may employ many employees but must have at least 100 employees in order to exist.

A plant with employees cannot be closed down.

Every plant is managed by an employee who works in the same plant; but every employee is not a plant manager, nor can an employee manage more than one plant. Company policy dictates that every plant must have a manager.

Therefore, an employee currently managing a plant cannot be deleted from the database. If a plant is closed down, the employee no longer manages the plant but becomes an employee of another plant.

Some employees are assigned to work on projects and in some cases might even be assigned to work on several projects simultaneously. For a project to exist, it must have at least one employee assigned to it. A project might need several employees, depending on its size and scope.

As long as an employee is assigned to a project, his or her record cannot be removed from the database. However, once a project ends, the employee records are removed from the database and all assignments of employees to that project must be removed.

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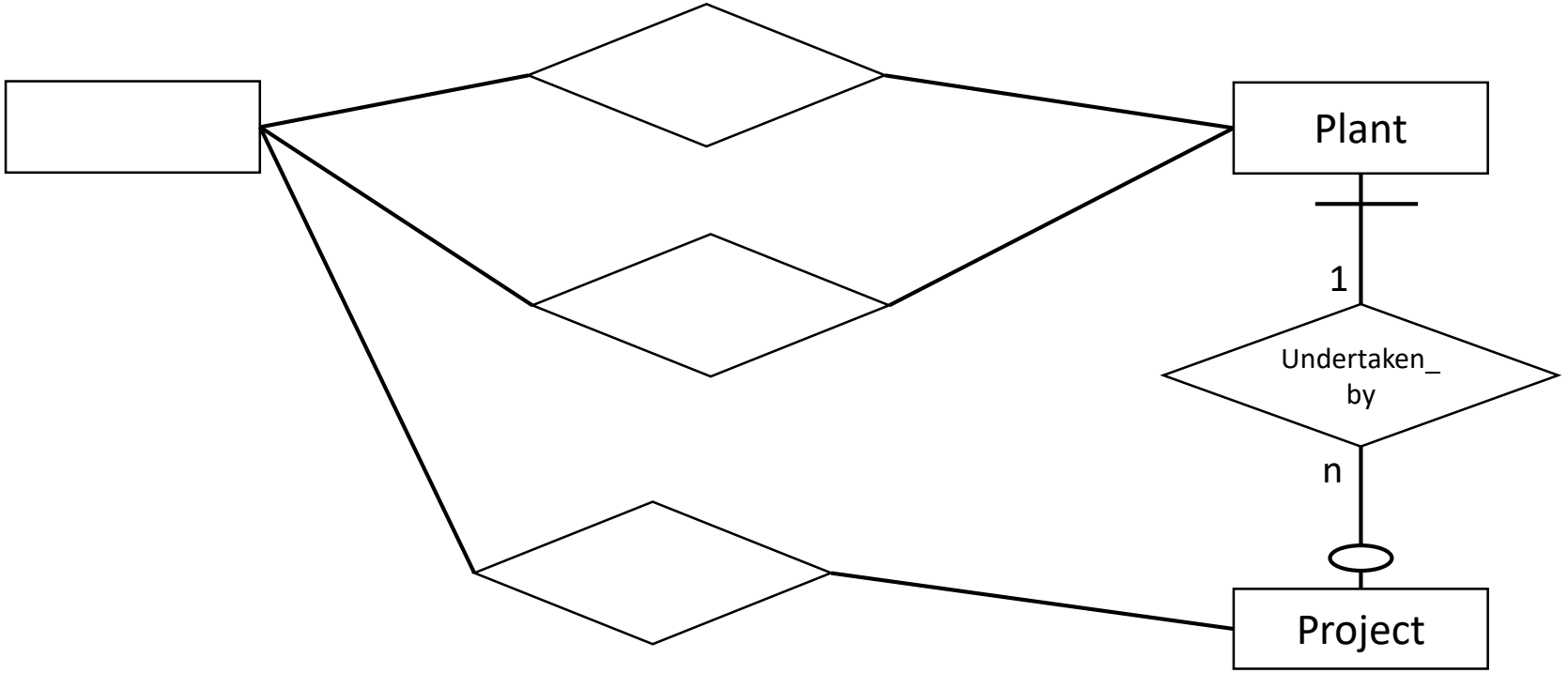

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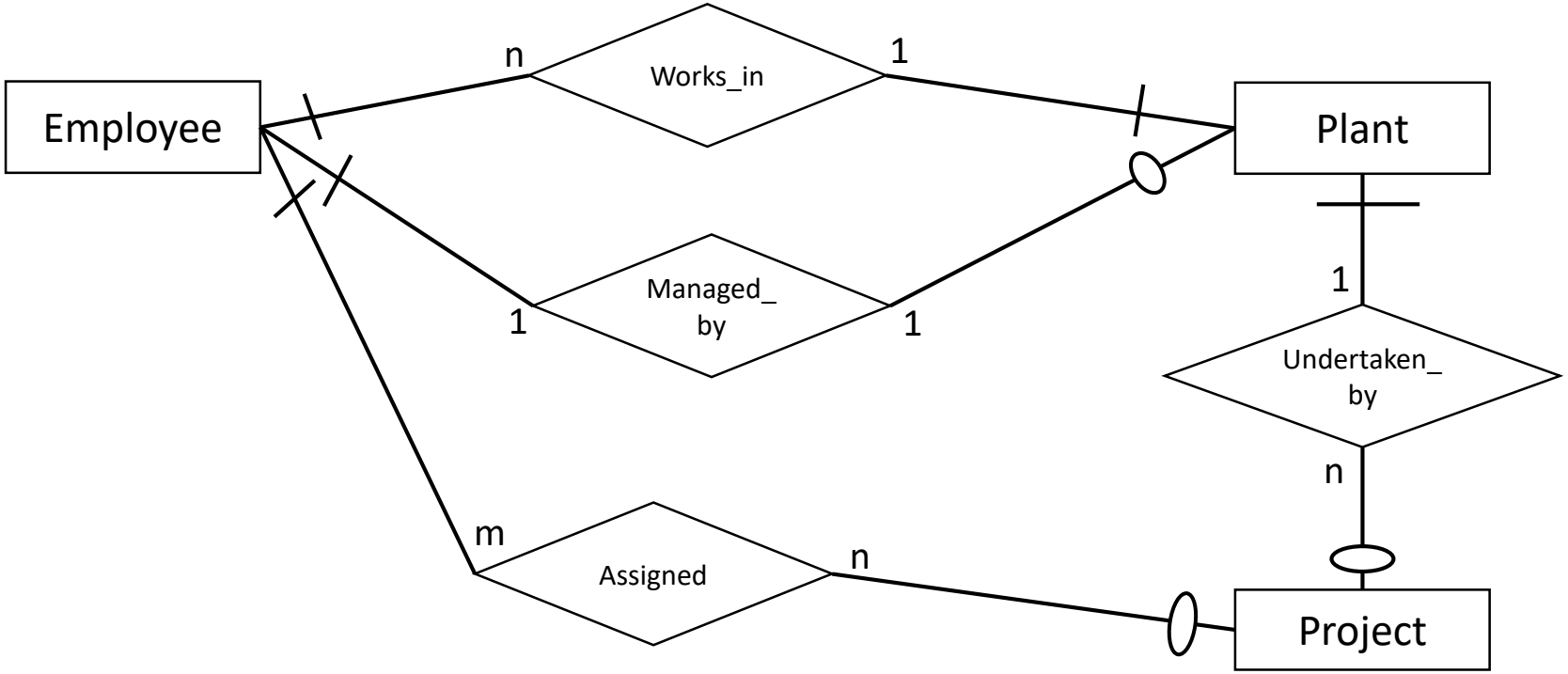

Story 3

Some employees also supervise other employees, but all employees need not be supervised; the employees that are supervised are supervised by just one employee. An employee may be a supervisor of several employees but no more than 20.

The Human Resources Department uses a designated default employee number to replace a supervisor who leaves the company. It is not possible for an employee to be his or her own supervisor.

Some employees also supervise other employees, but all employees need not be supervised; the employees that are supervised are supervised by just one employee. An employee may be a supervisor of several employees but no more than 20.

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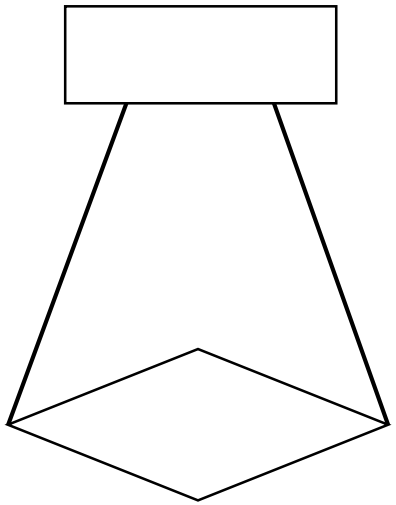

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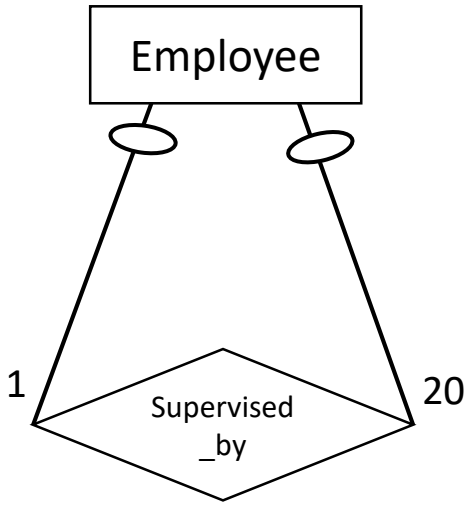
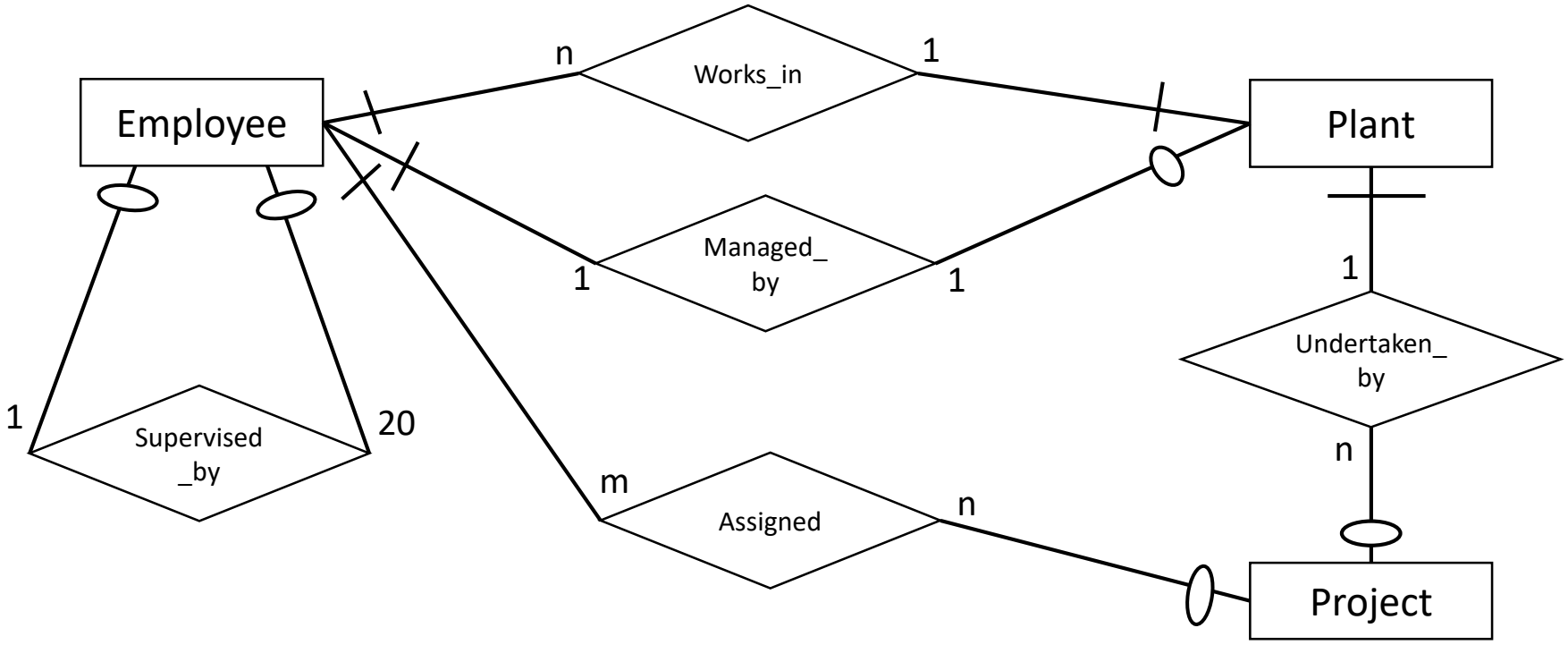


Putting it all together…



Story 4

Some employees may have several dependents. Bearcat Incorporated does not allow both husband and wife to be an employee of the company. Also, a dependent can only be a dependent of one employee at any time.

Bearcat Incorporated offers credit union facilities as a service to its employees and to their dependents. An employee is not required to become a member of Bearcat Credit Union (BCU). However, most employees and some of their dependents have accounts with BCU. Some BCU accounts are individual accounts, and others are joint accounts held by an employee and his or her dependent(s). Every BCU account must belong to at least one employee or a dependent. Each joint account must involve no more than one employee and no more than one of his or her dependents. If an employee leaves the company, all dependents and BCU accounts of that employee must be removed. In addition, as long as a dependent has a BCU account, deletion of the dependent is not permitted.

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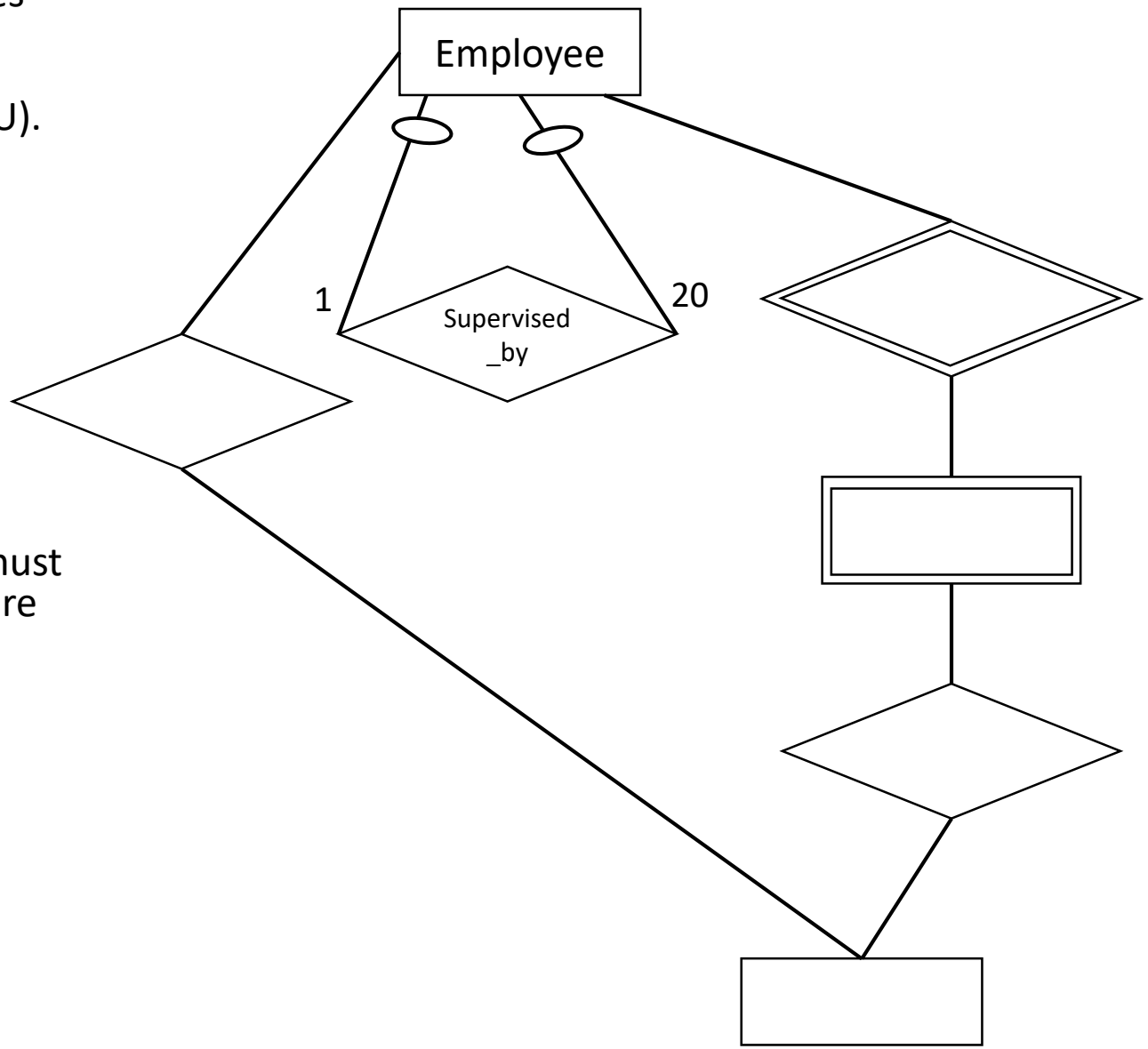

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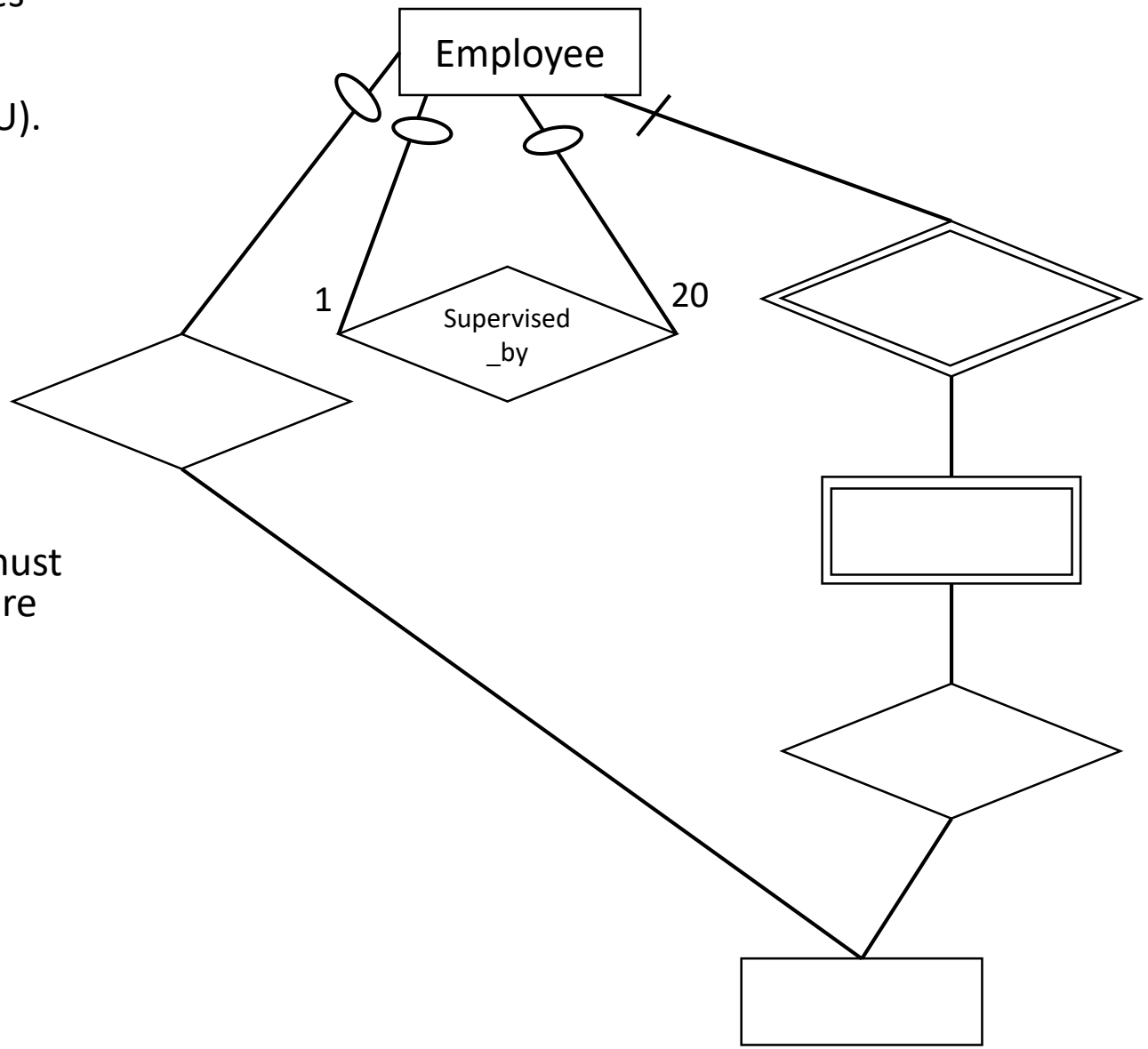

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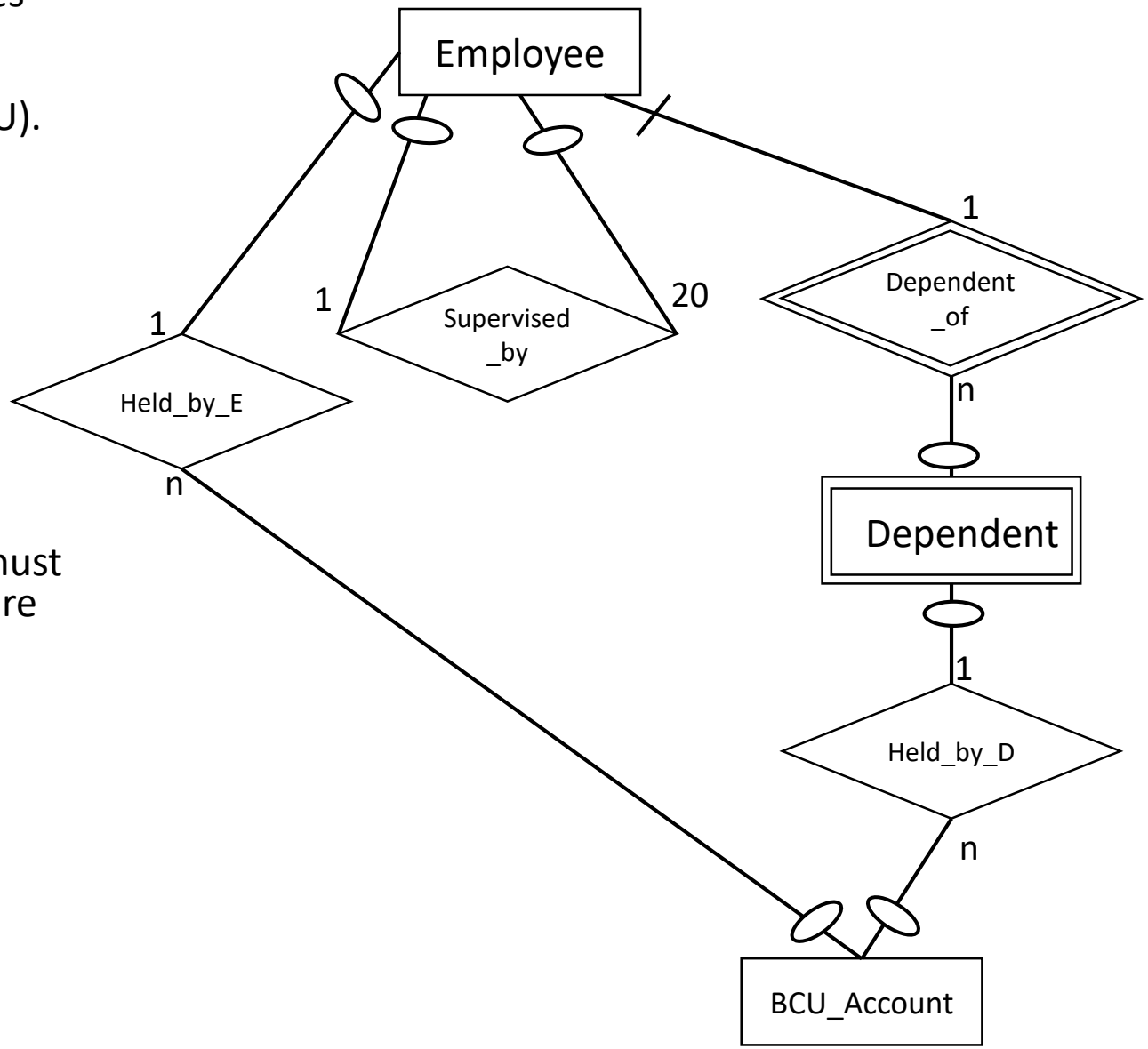
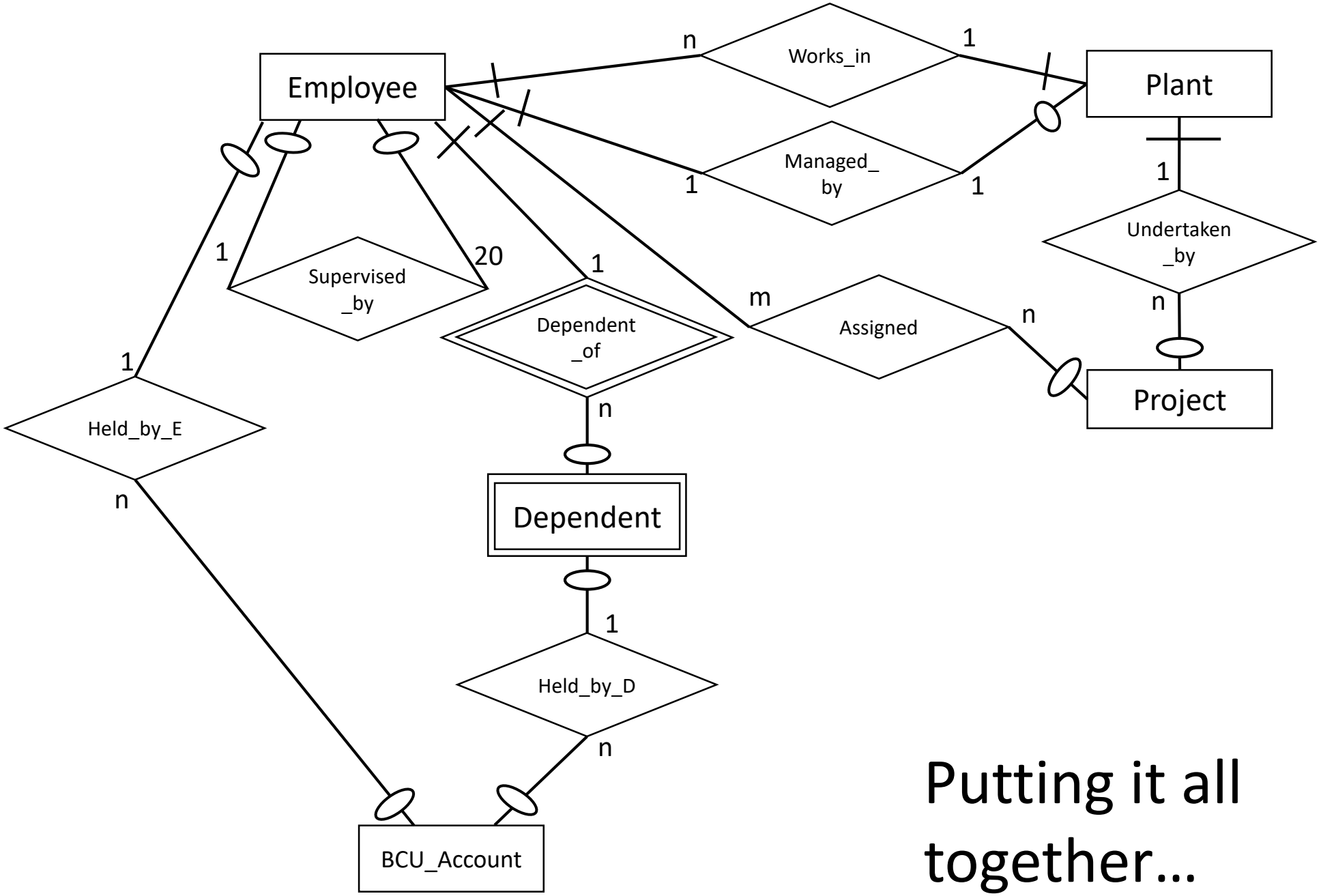




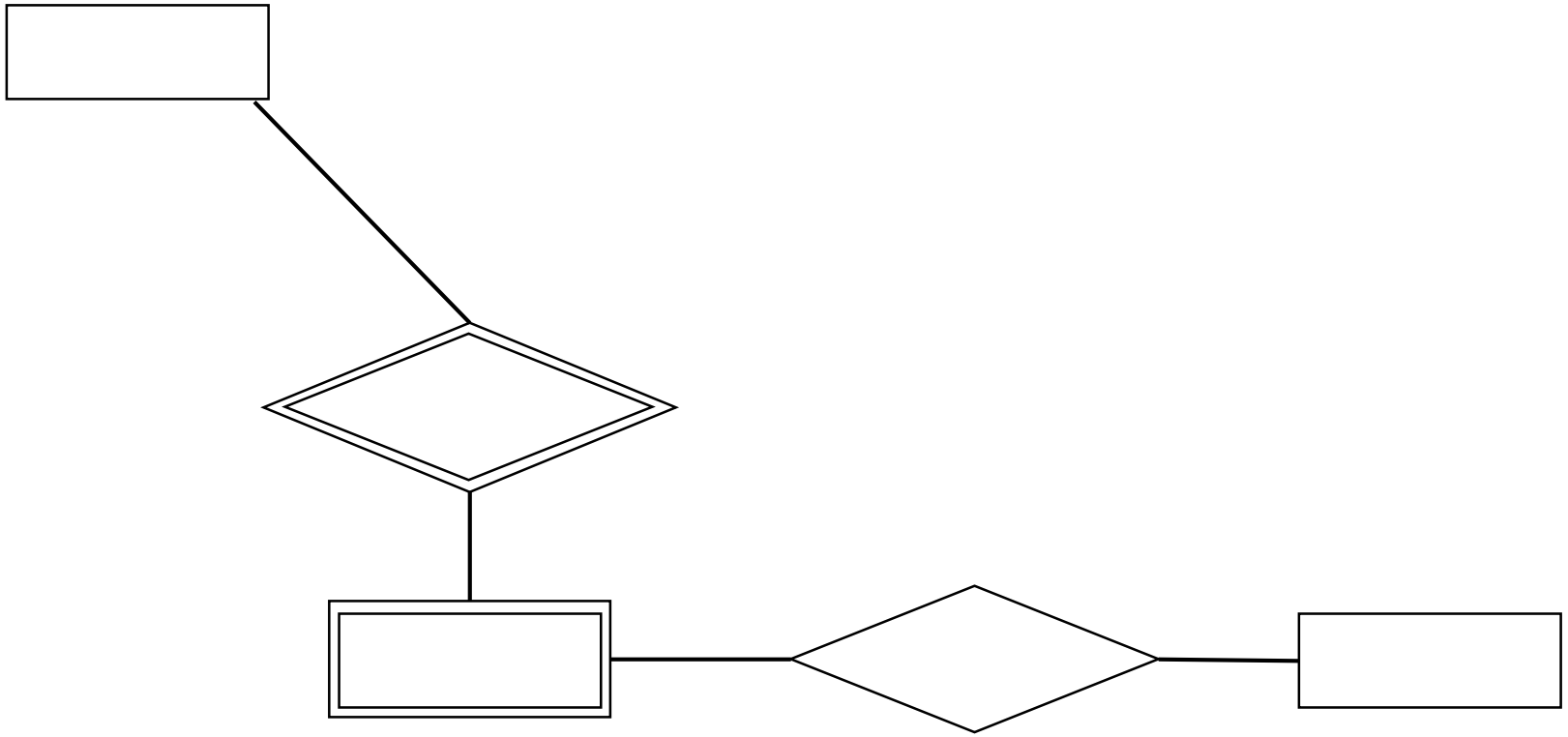
Putting it all together…

Story 5

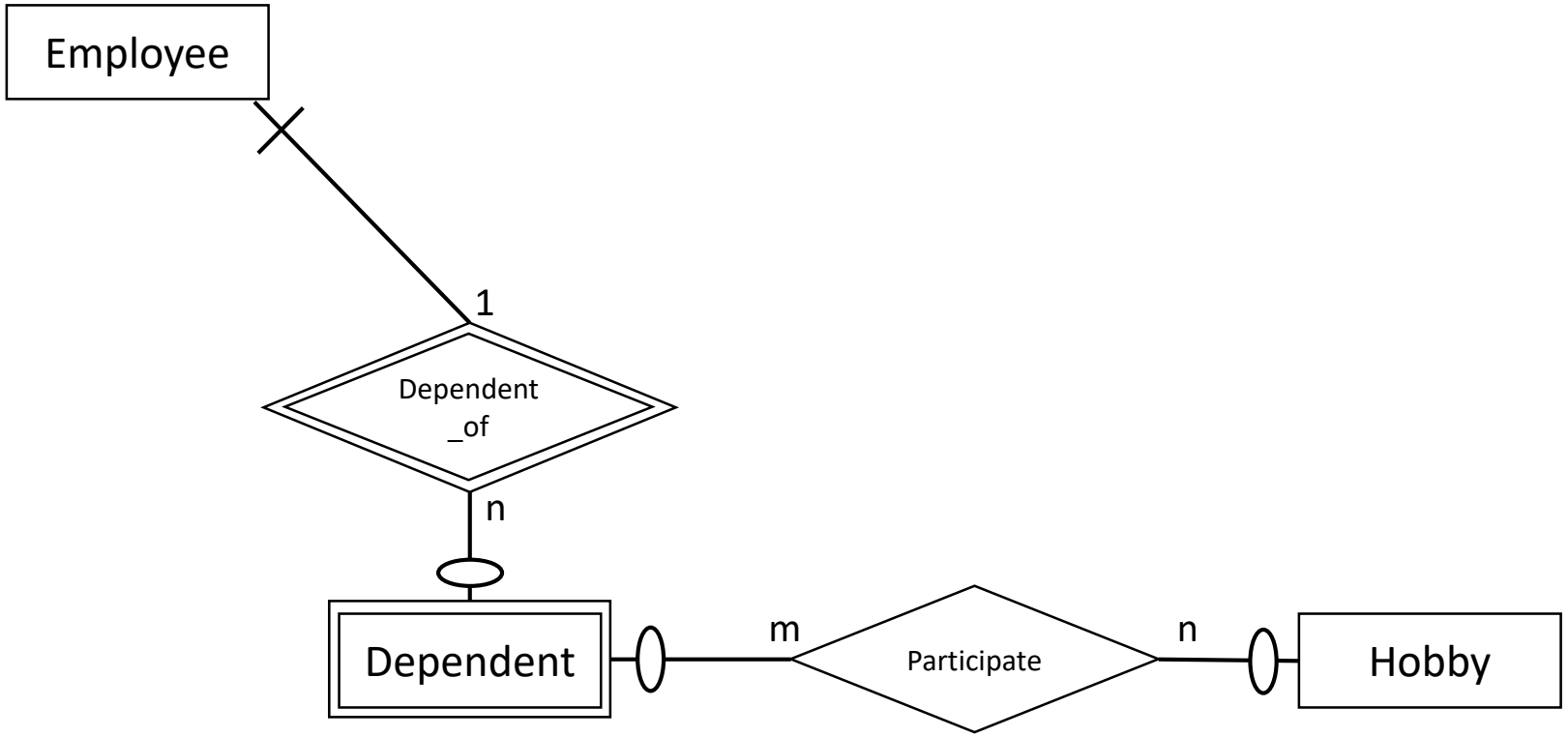
To nurture the hobbies of employees' dependents, Bearcat Incorporated sponsors recreational opportunities. Dependents need not have a hobby, but some dependents may have several hobbies. Because some hobbies are not as popular as others, every hobby need not have participants.

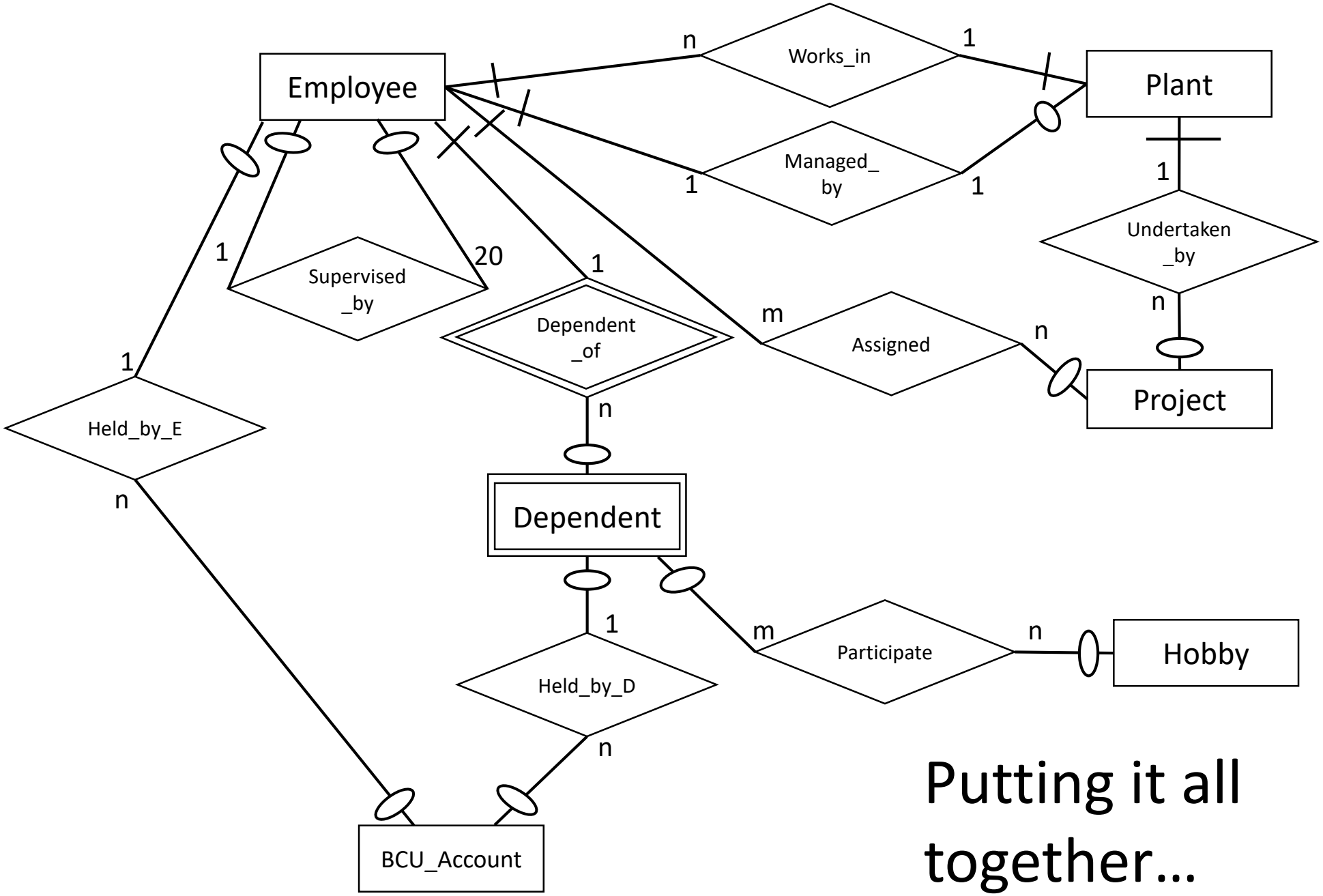
If a dependent is no longer in the database, no records of that dependent's participation in hobbies should exist in the database. Finally, as long as at least one dependent participates in a hobby, that hobby should continue to exist.

To nurture the hobbies of employees' dependents, Bearcat Incorporated sponsors recreational opportunities. Dependents need not have a hobby, but some dependents may have several hobbies. Because some hobbies are not as popular as others, every hobby need not have participants.



To nurture the hobbies of employees' dependents, Bearcat Incorporated sponsors recreational opportunities. Dependents need not have a hobby, but some dependents may have several hobbies. Because some hobbies are not as popular as others, every hobby need not have participants.





Putting it all together…

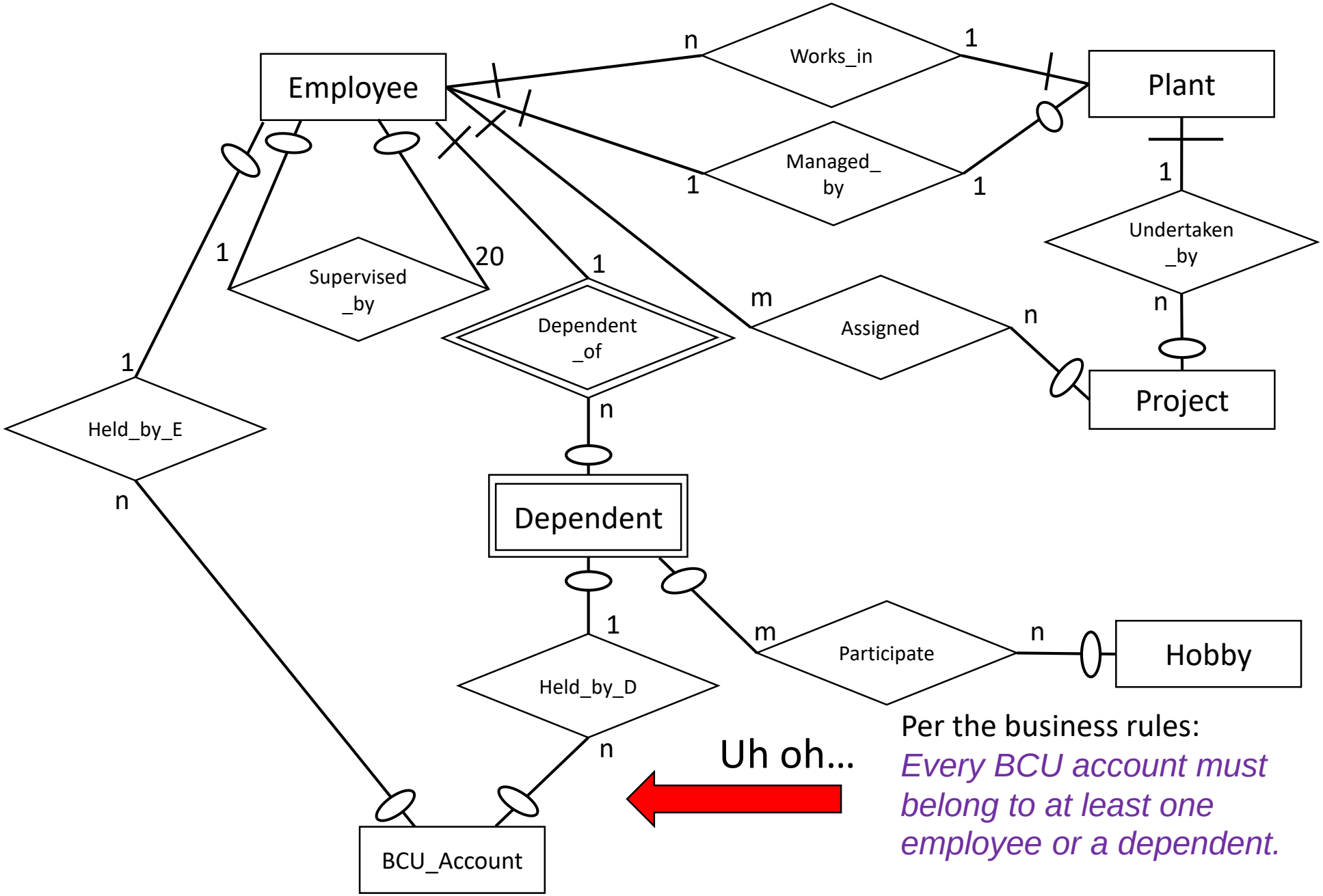
Re-examine the business rule from story 4

Some employees may have several dependents. Bearcat Incorporated does not allow both husband and wife to be an employee of the company. Also, a dependent can only be a dependent of one employee at any time.

Bearcat Incorporated offers credit union facilities as a service to its employees and to their dependents. An employee is not required to become a member of Bearcat Credit Union (BCU). However, most employees and some of their dependents have accounts with BCU.

Some BCU accounts are individual accounts, and others are joint accounts held by an employee and his or her dependent(s). Every BCU account must belong to at least one employee or a dependent. Each joint account must involve no more than one employee and no more than one of his or her dependents.

If an employee leaves the company, all dependents and BCU accounts of that employee must be removed. In addition, as long as a dependent has a BCU account, deletion of the dependent is not permitted.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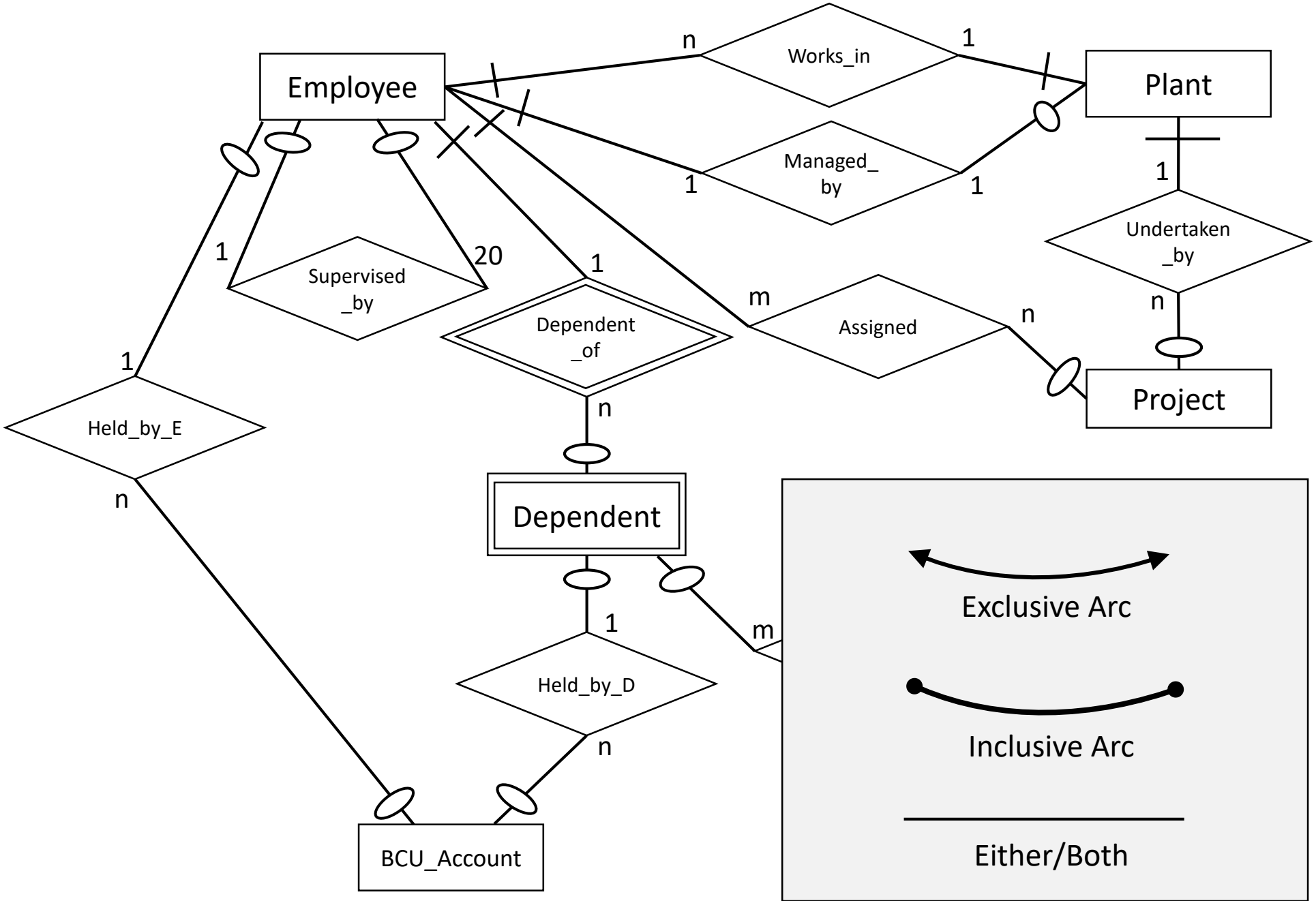
BCU_Account
Uh oh...
Per the business rules:
Every BCU account must
belong to at least one
employee or a dependent.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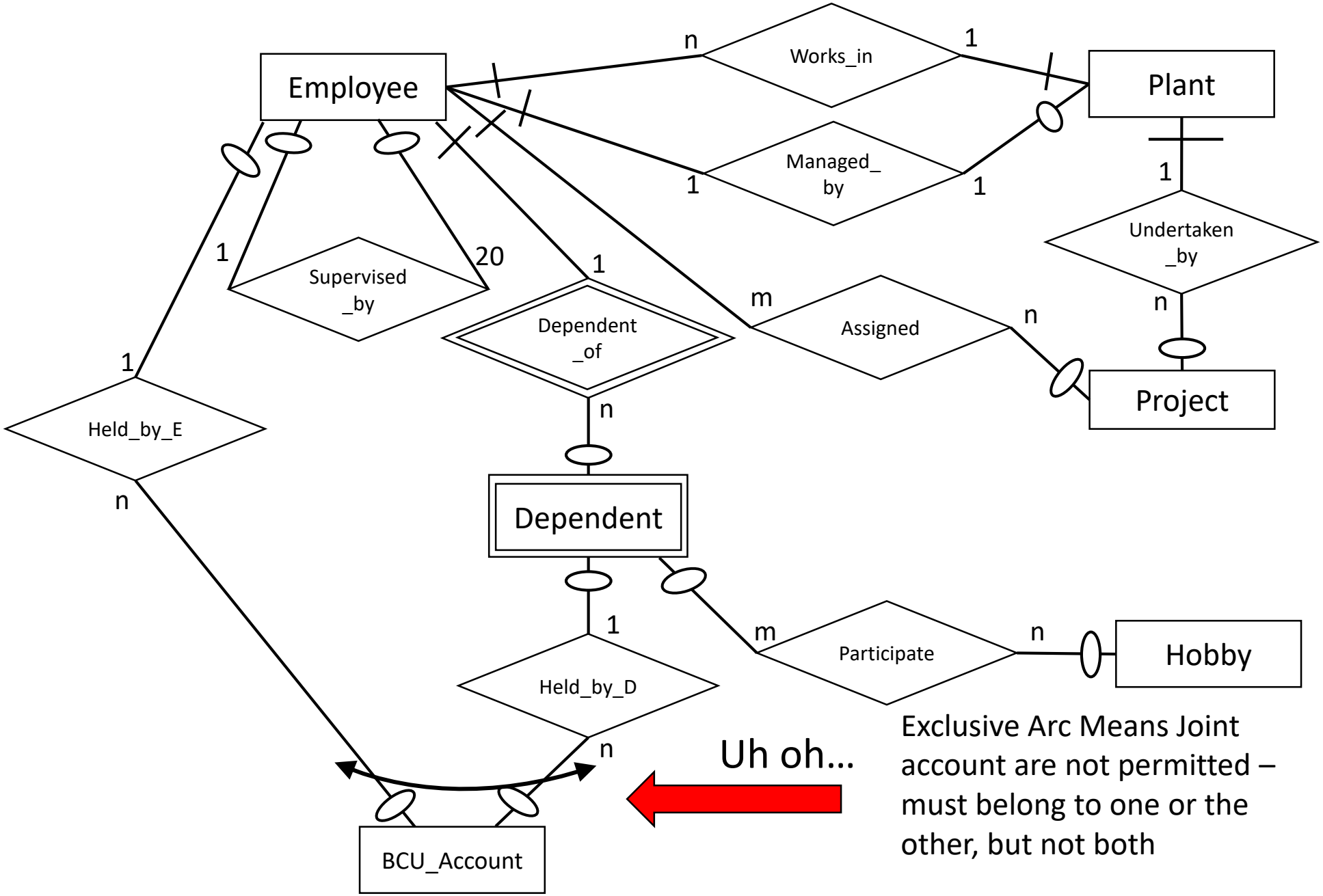
Exclusive Arc
Inclusive Arc
Either/Both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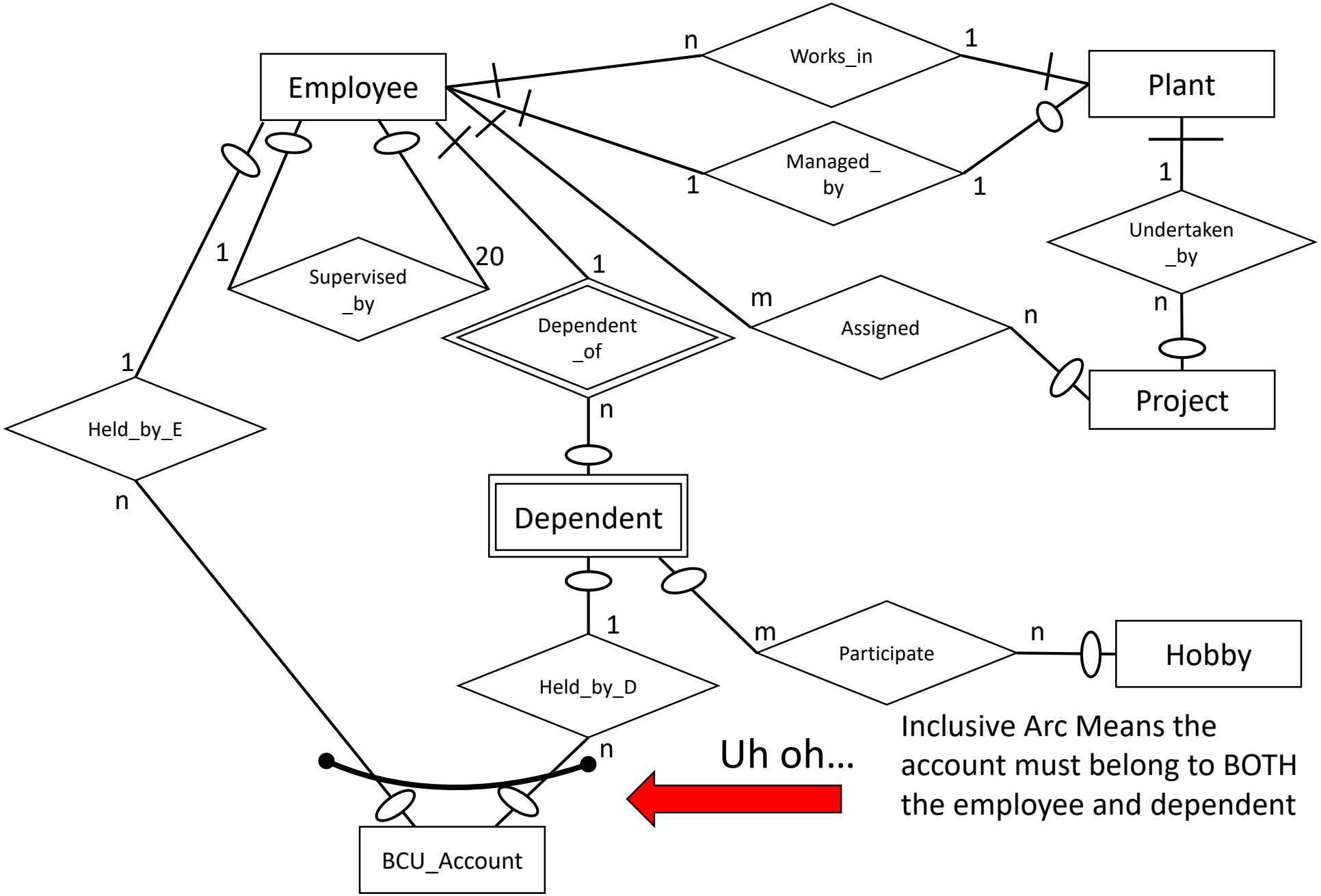
BCU_Account
Uh oh…
Exclusive Arc Means Joint account are not permitted – must belong to one or the other, but not both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Participate
Hobby
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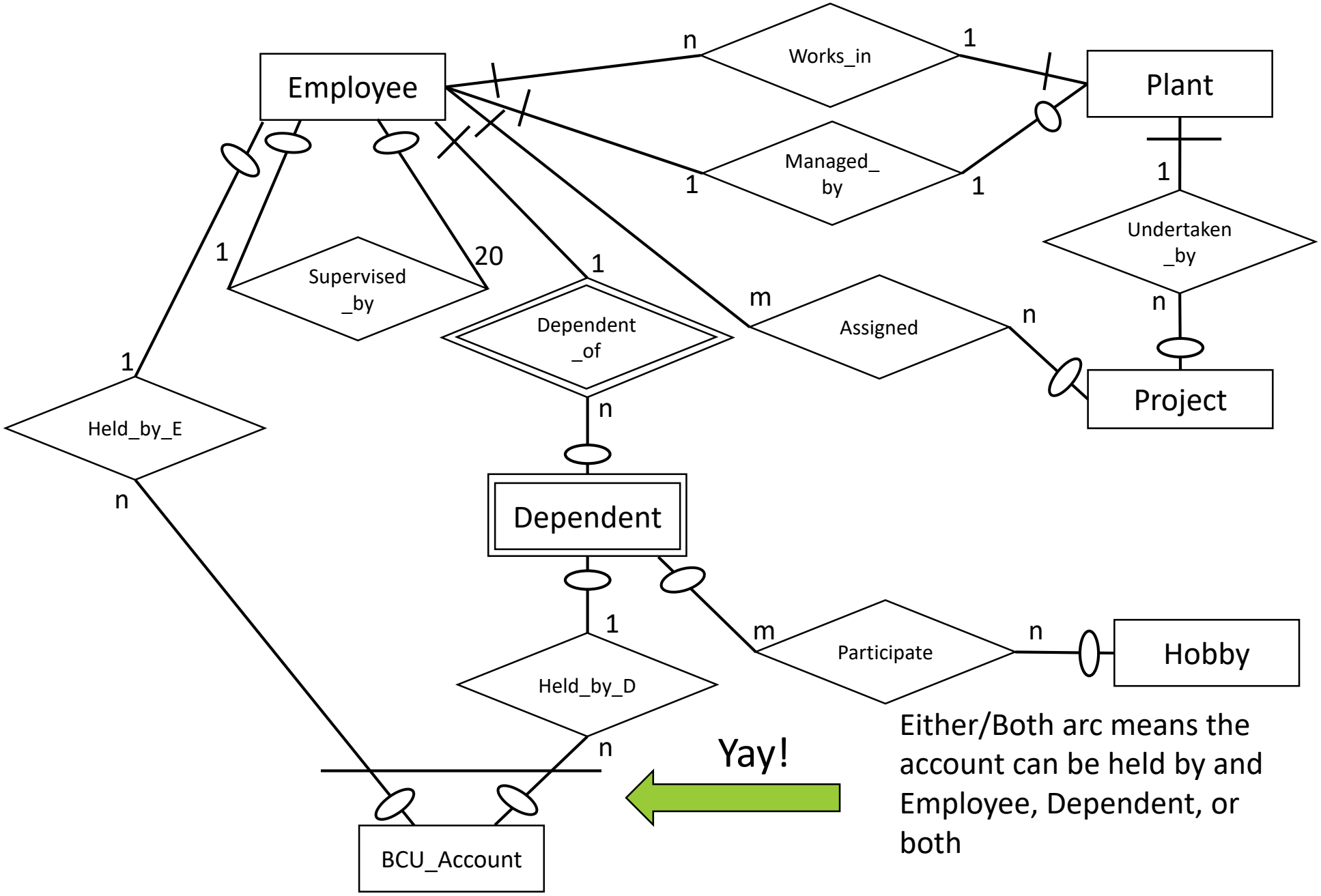
Uh oh...
Inclusive Arc Means the account must belong to BOTH the employee and dependent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Held_by_D
n
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Participate
n
Hobby
Yay!
BCU_Account
Either/Both arc means the account can be held by and Employee, Dependent, or both

Break

- After break we will continue to build on and refine this model

- We have not yet modeled
  - Attributes
  - Deletion rules
  - Other integrity constraints

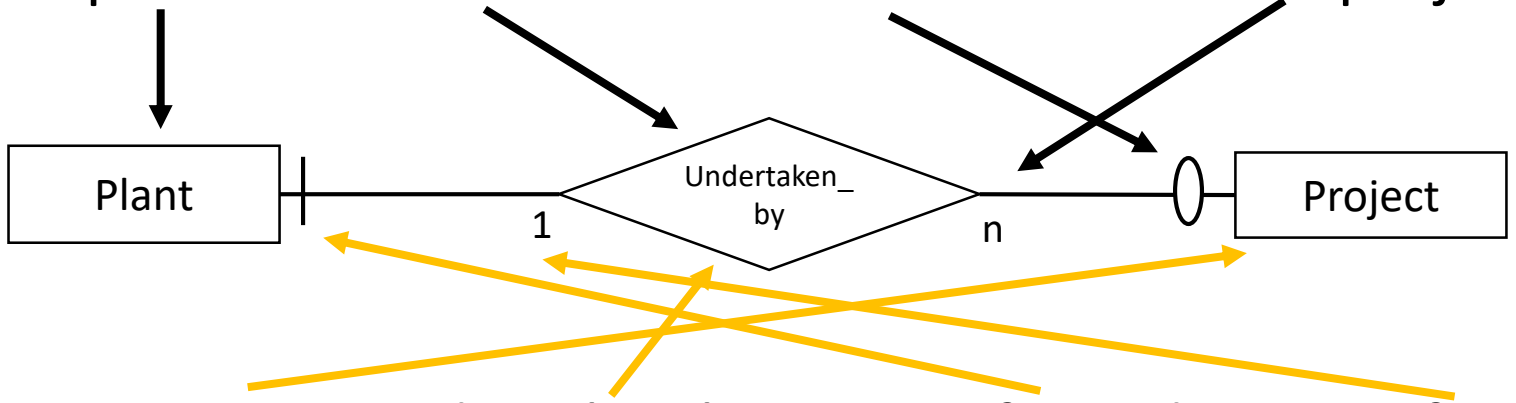
Module 3.2
Bearcat Incorporated: Part 2

Bearcat Incorporated is a manufacturing company with several plants in the northeastern United States

The **bearcat**, also known as the binturong,
is a viverrid mammal from Southeast Asia (Wikipedia)

A new way of reading ER Diagrams

- The “Look across” method (what we’ve been doing)
  - A plant undertakes a min of zero and max of n projects

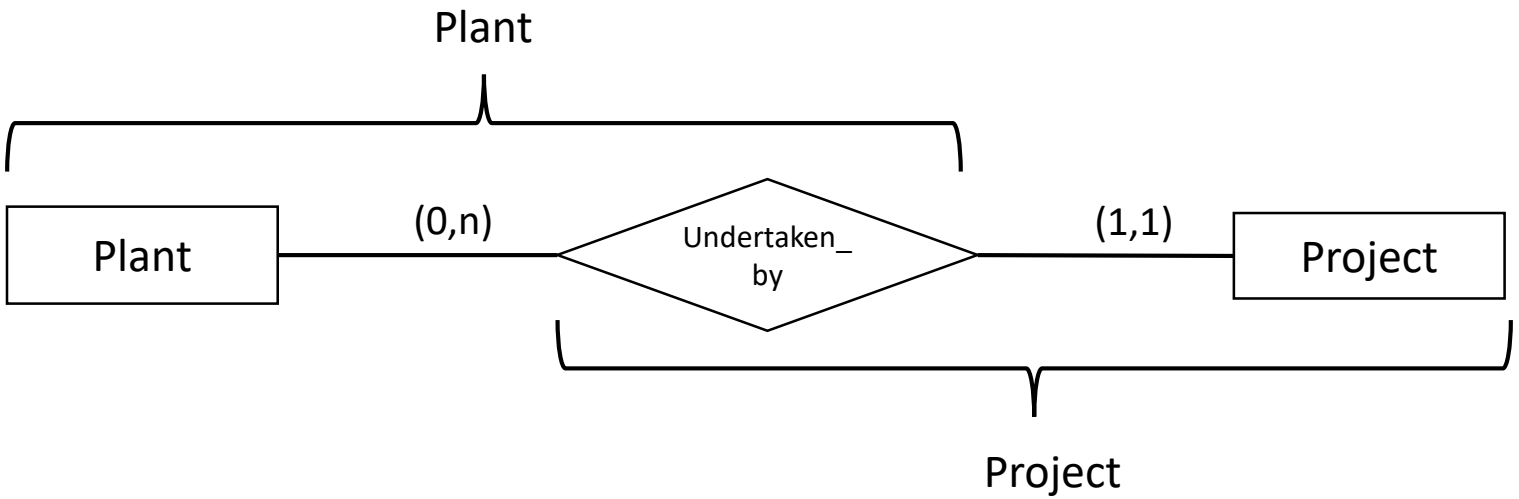


  - A project is undertaken by a min of 1 and a max of 1 plants

- We “look across” the relationship to determine participation and cardinality of an entity

A new way of reading ER Diagrams

- The “Look near” method (an alternate approach)
  - A plant undertakes a min of zero and max of n projects

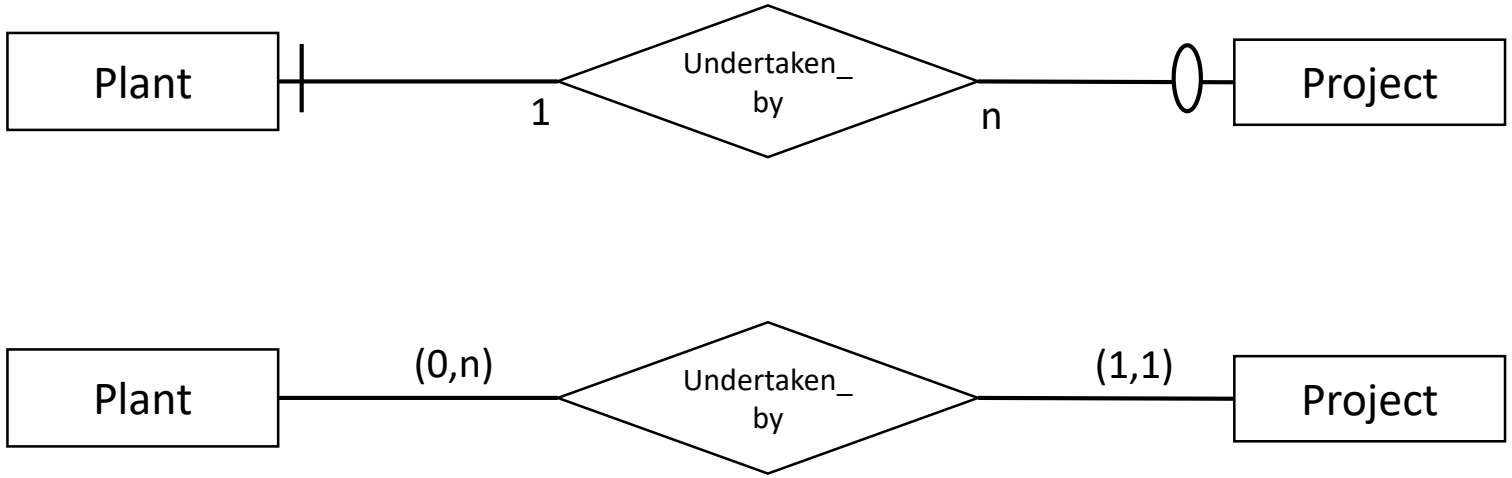


  - A project is undertaken by a min of 1 and a max of 1 plants

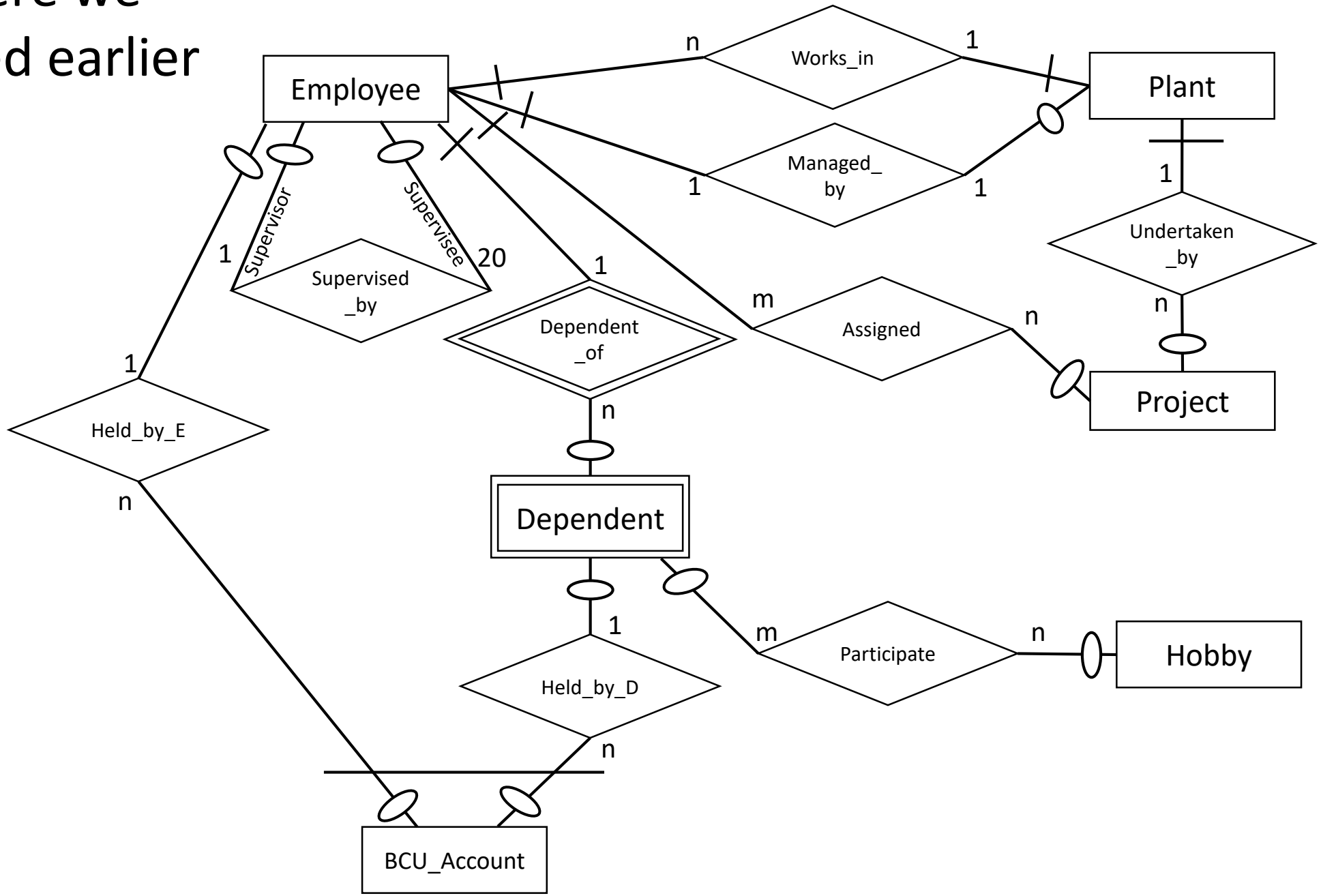
- We “Look near” the entity to determine its participation and cardinality

Reading ER Diagrams

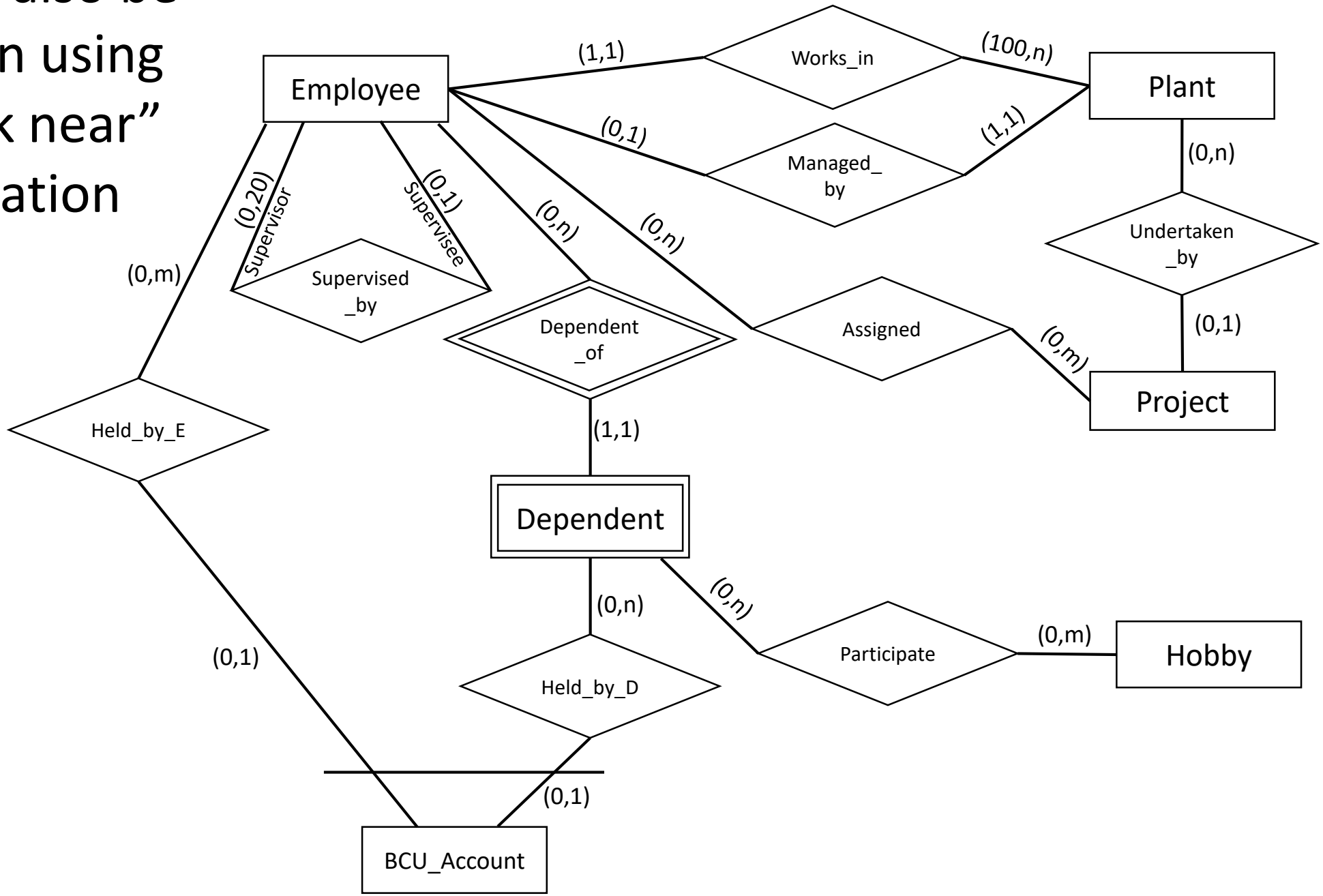
- These mean the same thing
- Use one or the other, but not both at the same time!



Where we stopped earlier

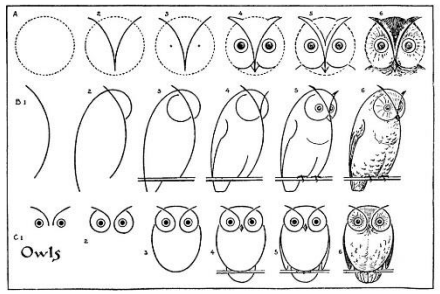


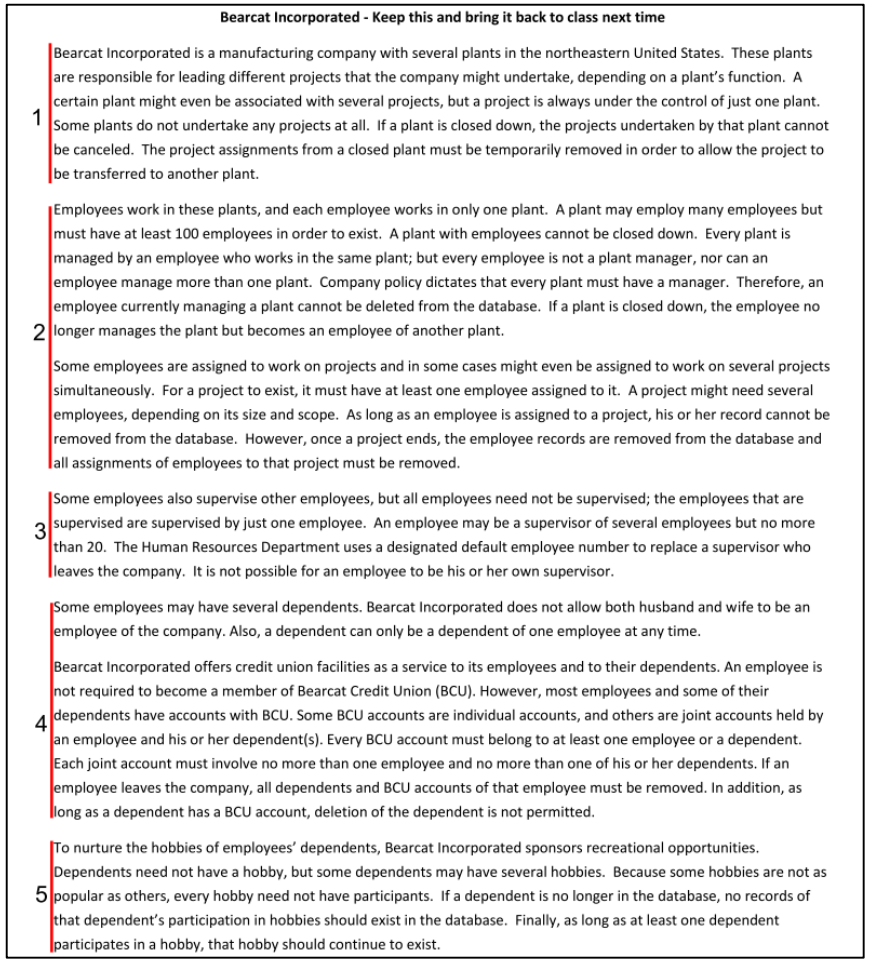
Could also be drawn using "Look near" notation



How did we get there?

- By **decomposing** the long complex story into smaller, more manageable chunks
  - Plants and Projects
  - Employees and Plants/Projects
  - Employees as Supervisors
  - Employees, Dependents, and BCU accounts
  - Dependents and Hobbies





Bearcat Incorporated - Keep this and bring it back to class next time

1 Bearcat Incorporated is a manufacturing company with several plants in the northeastern United States. These plants are responsible for leading different projects that the company might undertake, depending on a plant's function. A certain plant might even be associated with several projects, but a project is always under the control of just one plant. Some plants do not undertake any projects at all. If a plant is closed down, the projects undertaken by that plant cannot be canceled. The project assignments from a closed plant must be temporarily removed in order to allow the project to be transferred to another plant.

2 Employees work in these plants, and each employee works in only one plant. A plant may employ many employees but must have at least 100 employees in order to exist. A plant with employees cannot be closed down. Every plant is managed by an employee who works in the same plant; but every employee is not a plant manager, nor can an employee manage more than one plant. Company policy dictates that every plant must have a manager. Therefore, an employee currently managing a plant cannot be deleted from the database. If a plant is closed down, the employee no longer manages the plant but becomes an employee of another plant.

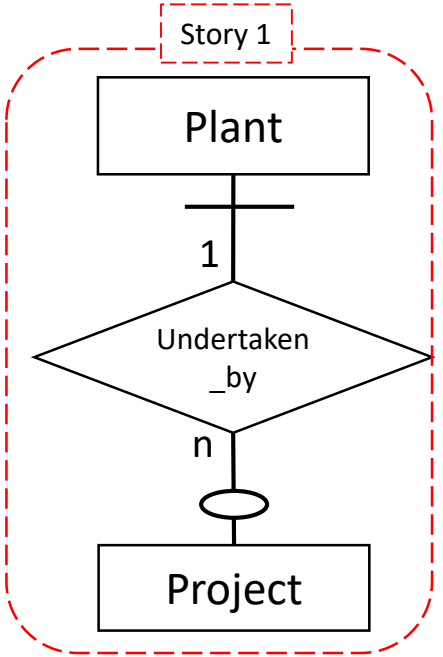
Some employees are assigned to work on projects and in some cases might even be assigned to work on several projects simultaneously. For a project to exist, it must have at least one employee assigned to it. A project might need several employees, depending on its size and scope. As long as an employee is assigned to a project, his or her record cannot be removed from the database. However, once a project ends, the employee records are removed from the database and all assignments of employees to that project must be removed.

3 Some employees also supervise other employees, but all employees need not be supervised; the employees that are supervised are supervised by just one employee. An employee may be a supervisor of several employees but no more than 20. The Human Resources Department uses a designated default employee number to replace a supervisor who leaves the company. It is not possible for an employee to be his or her own supervisor.

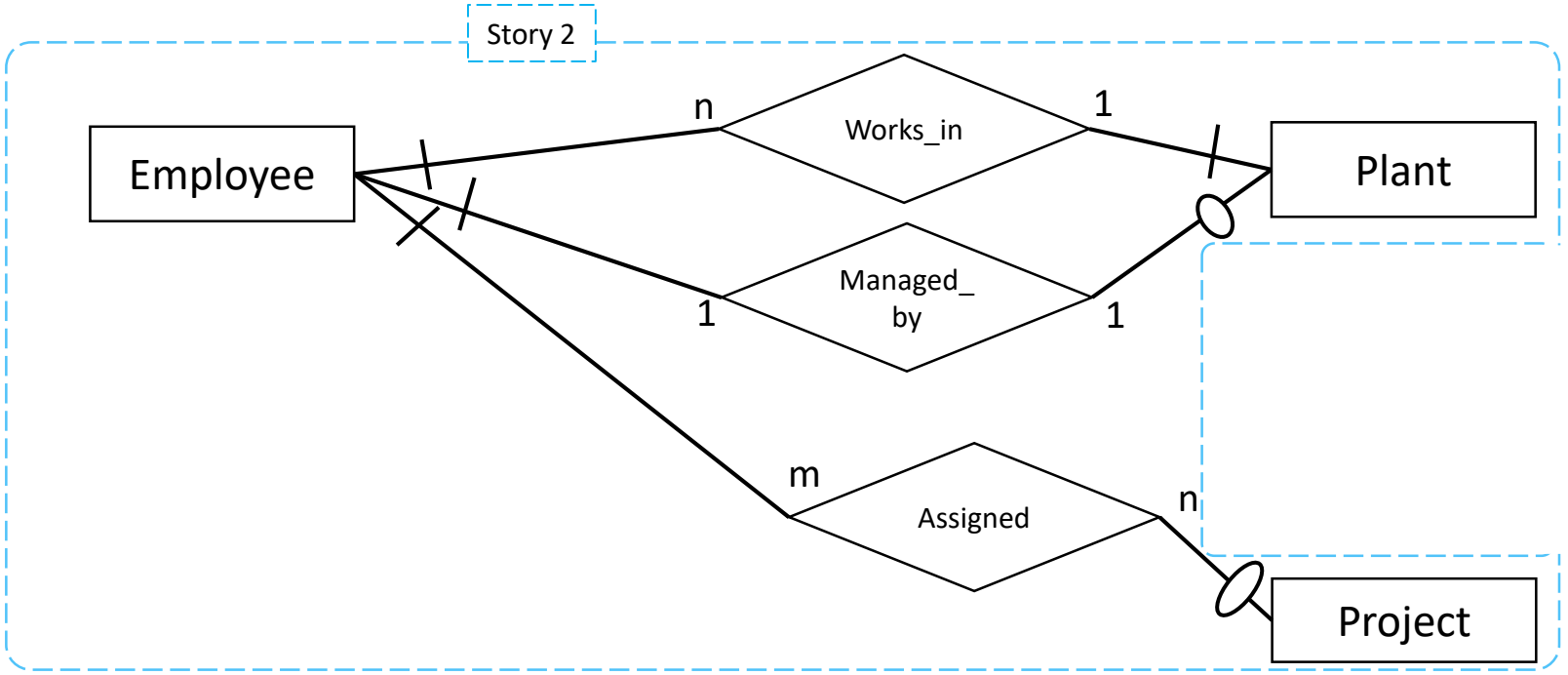
Some employees may have several dependents. Bearcat Incorporated does not allow both husband and wife to be an employee of the company. Also, a dependent can only be a dependent of one employee at any time.

4 Bearcat Incorporated offers credit union facilities as a service to its employees and to their dependents. An employee is not required to become a member of Bearcat Credit Union (BCU). However, most employees and some of their dependents have accounts with BCU. Some BCU accounts are individual accounts, and others are joint accounts held by an employee and his or her dependent(s). Every BCU account must belong to at least one employee or a dependent. Each joint account must involve no more than one employee and no more than one of his or her dependents. If an employee leaves the company, all dependents and BCU accounts of that employee must be removed. In addition, as long as a dependent has a BCU account, deletion of the dependent is not permitted.

5 To nurture the hobbies of employees' dependents, Bearcat Incorporated sponsors recreational opportunities. Dependents need not have a hobby, but some dependents may have several hobbies. Because some hobbies are not as popular as others, every hobby need not have participants. If a dependent is no longer in the database, no records of that dependent's participation in hobbies should exist in the database. Finally, as long as at least one dependent participates in a hobby, that hobby should continue to exist.



Putting it all together…



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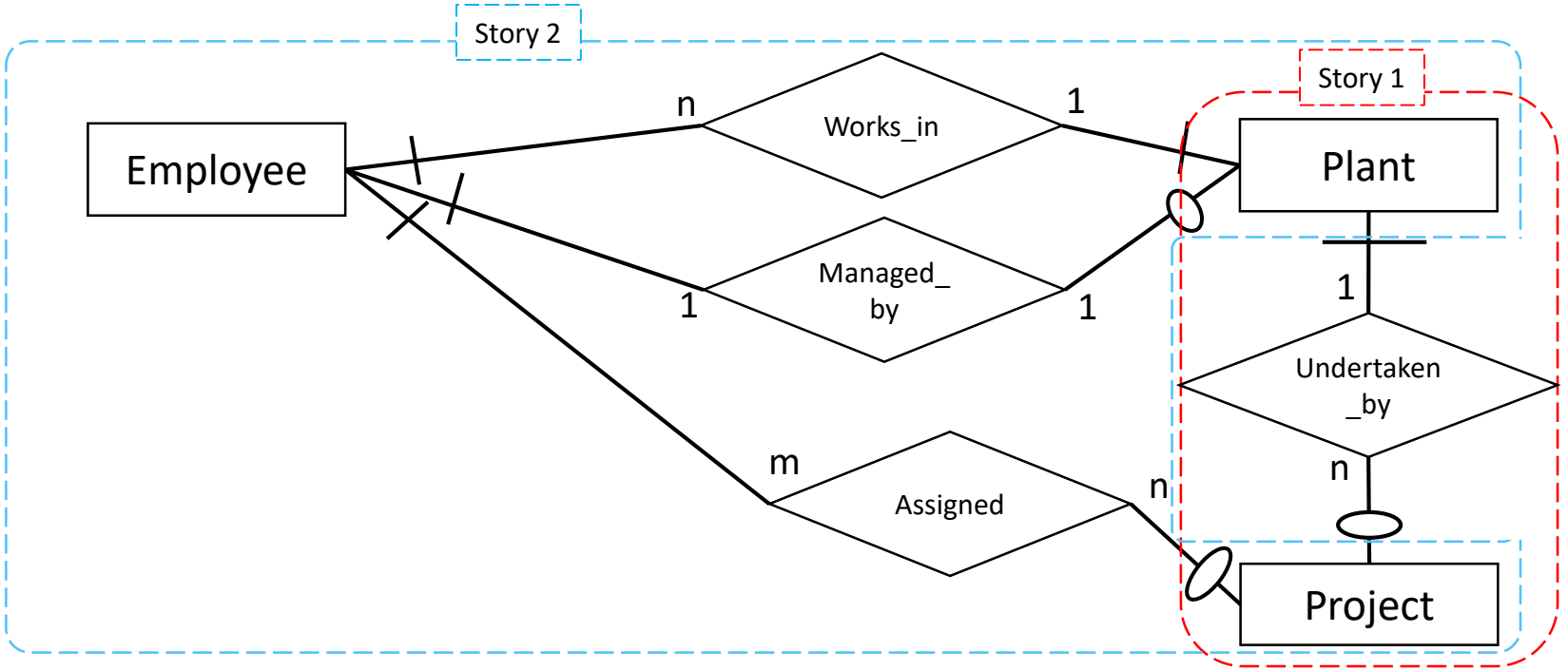

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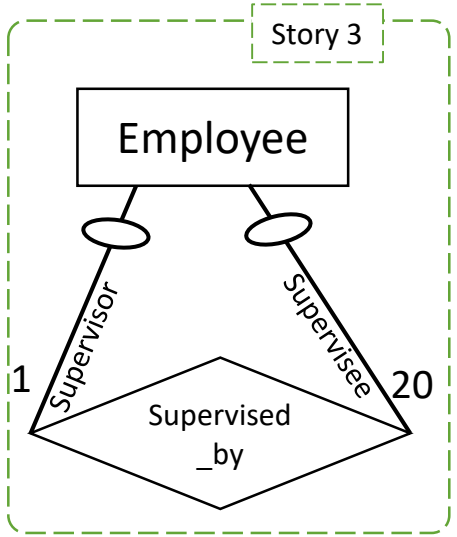

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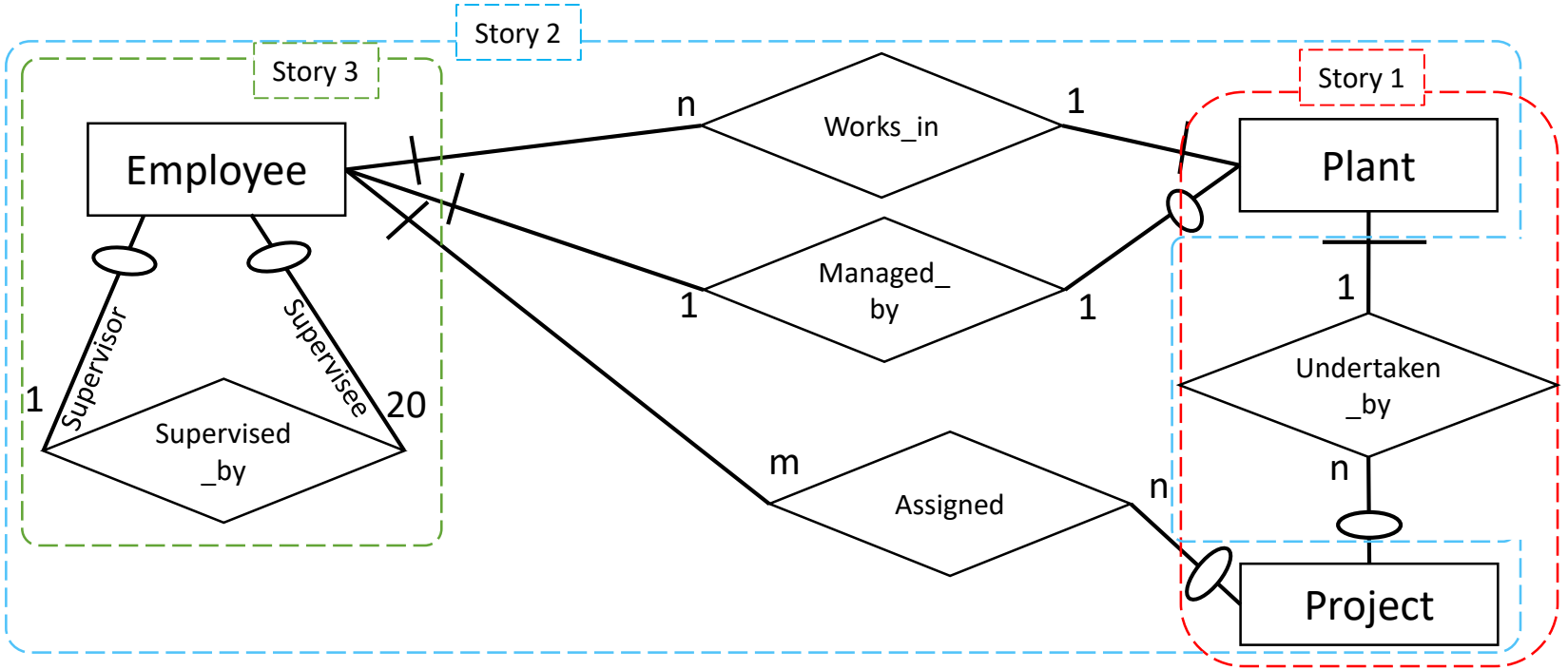

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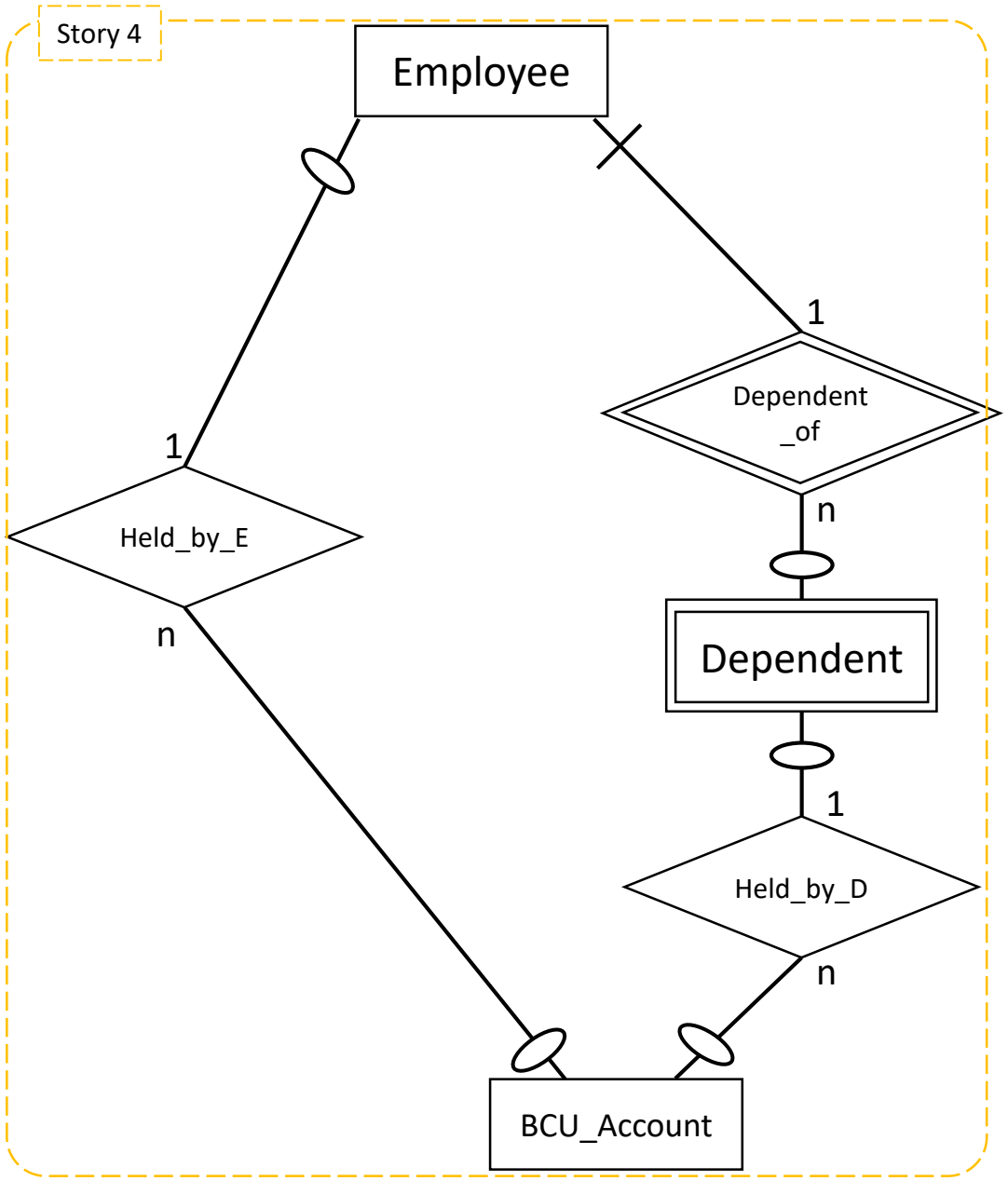
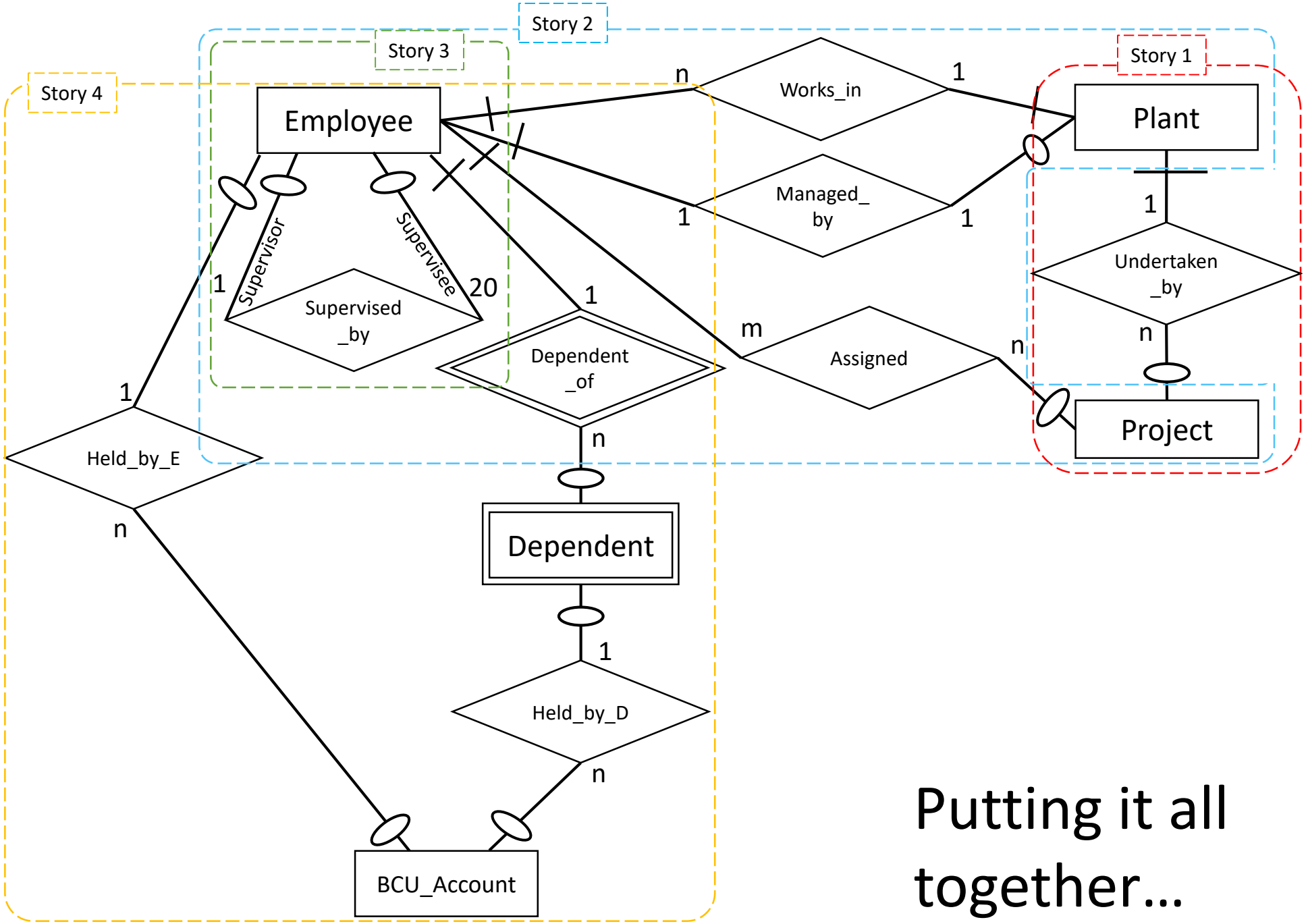
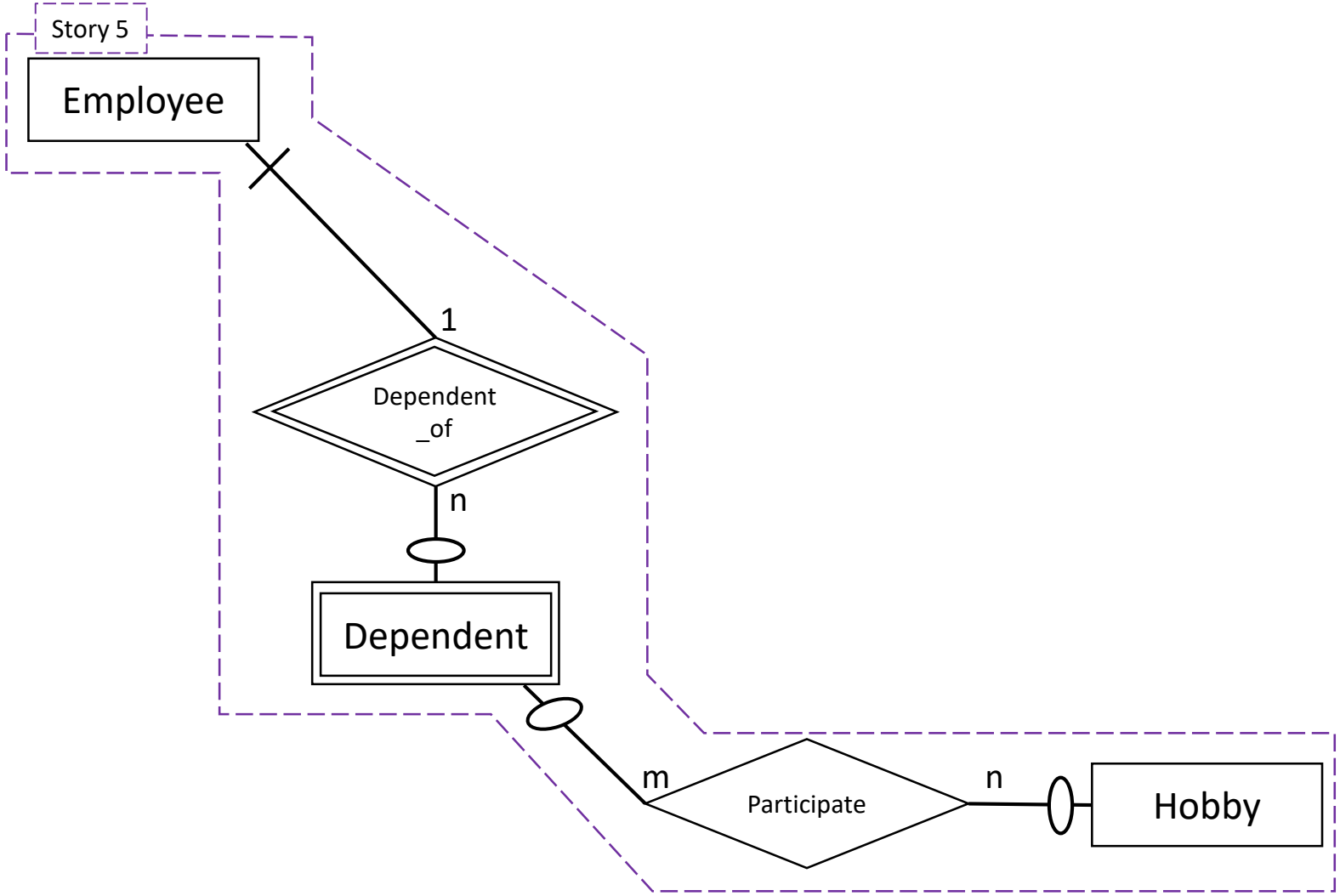


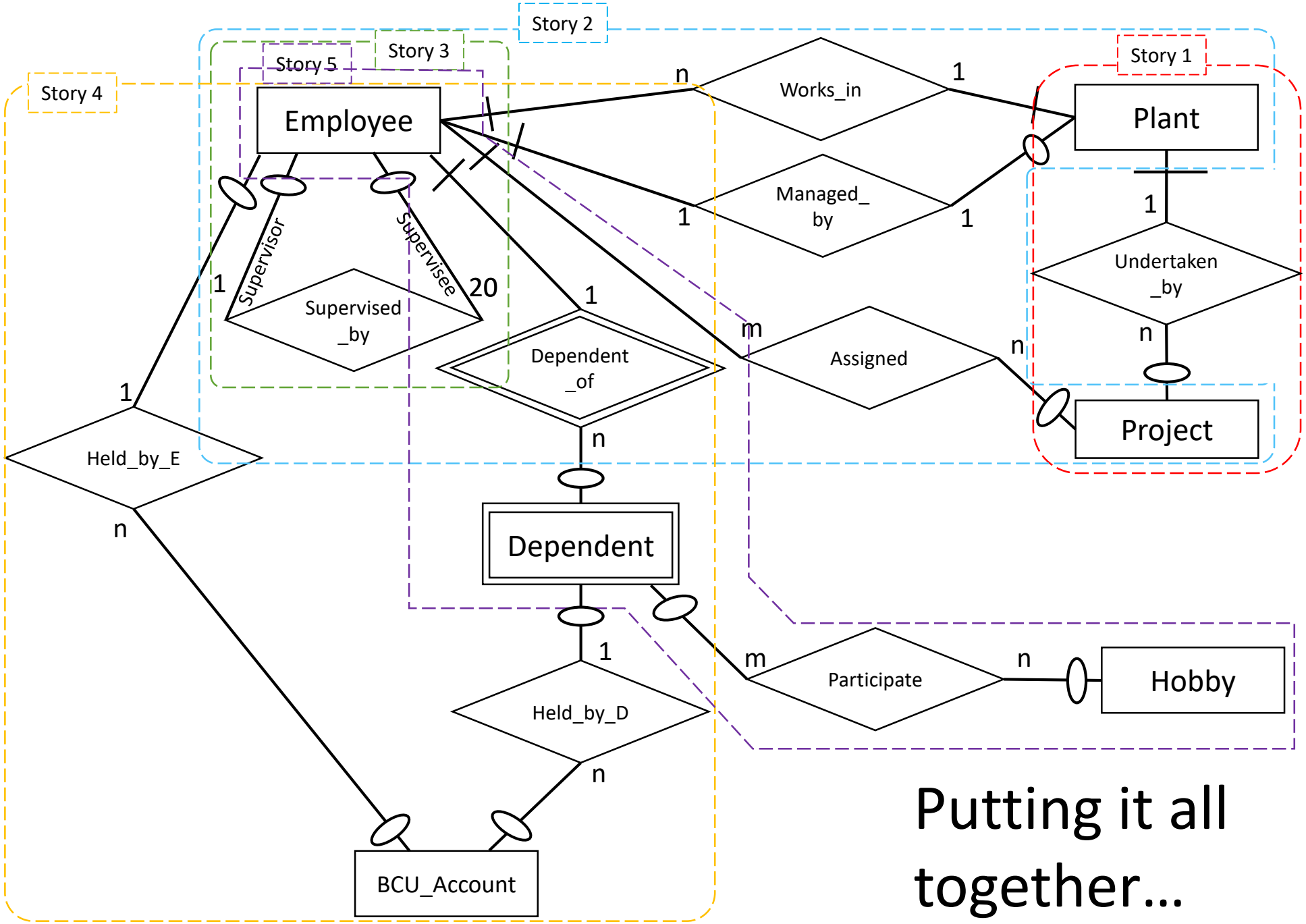
Putting it all together…



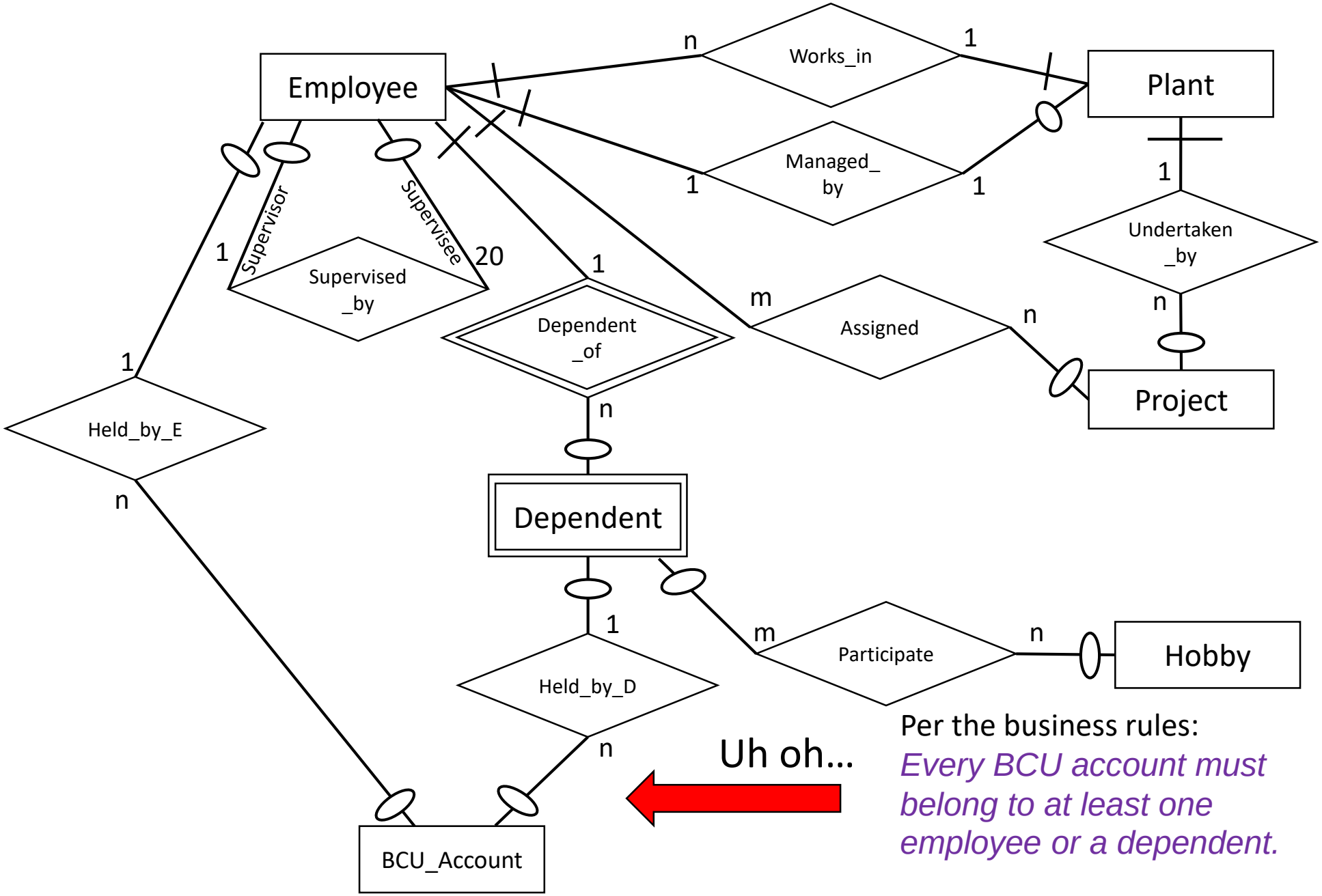
Putting it all together…



Putting it all together…



Putting it all together…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Participate
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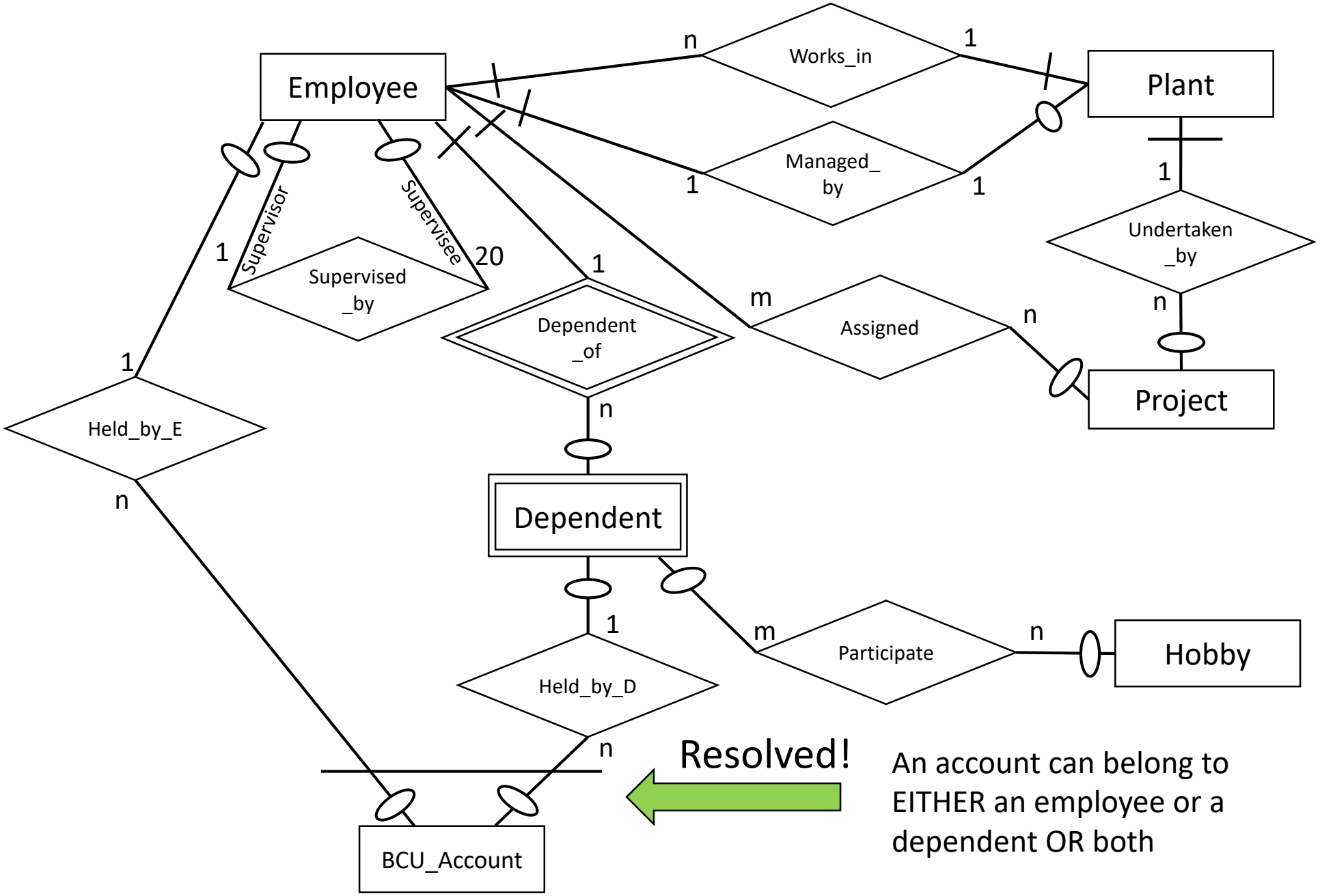
BCU_Account
Uh oh...
Per the business rules:
Every BCU account must belong to at least one employee or a dependent.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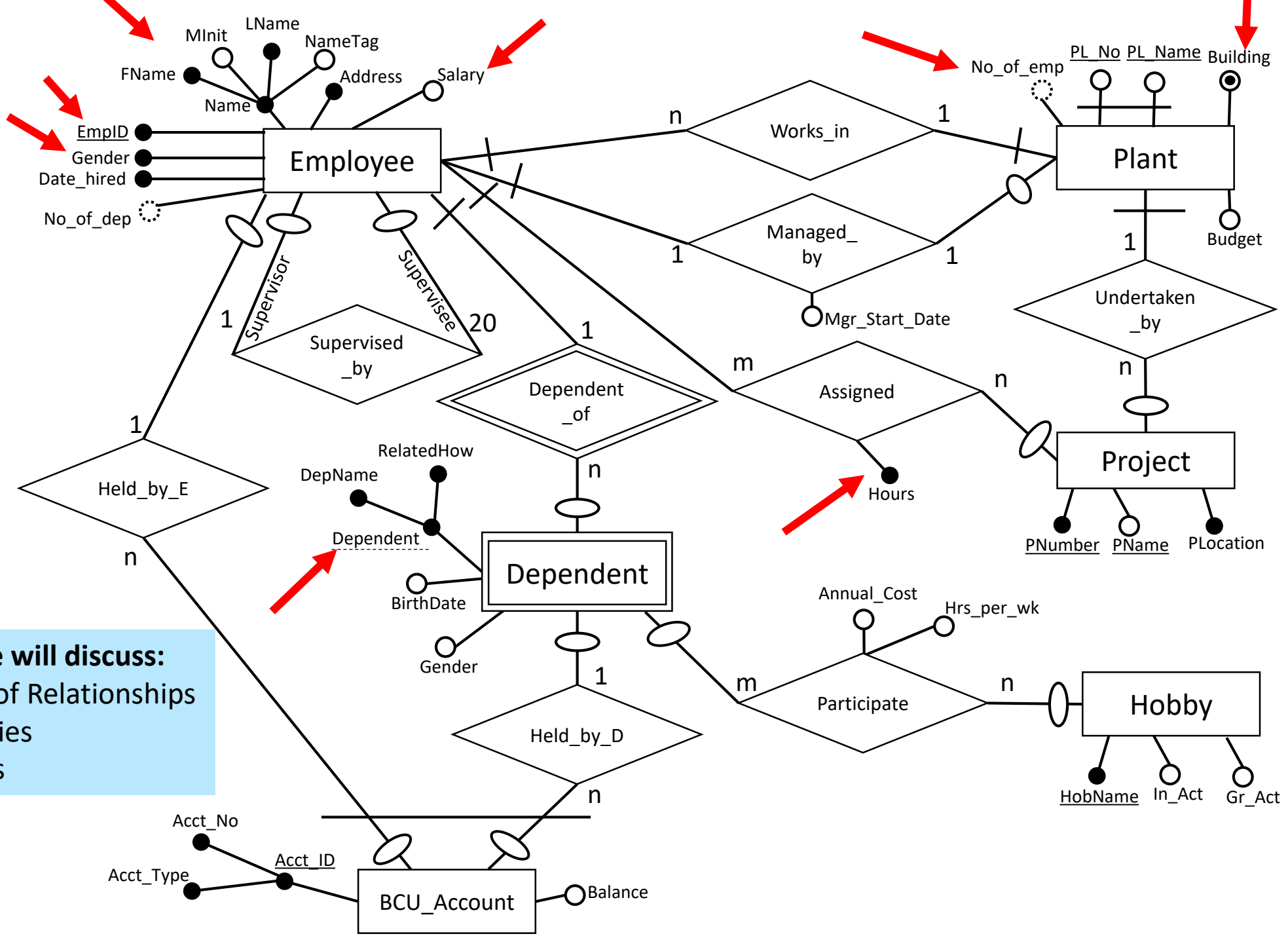
Participate
n
Hobby
Held_by_D
n
Resolved!
BCU_Account
An account can belong to
EITHER an employee or a
dependent OR both

Adding attributes

- I am confident that you all can identify attributes
  - We have discussed in class
  - We identified attributes of horses
  - We did it in homework one

Attributes →

Horses				
Name	Color	Spots	Gender	Weight
Amy	Yellow	Yes	F	920
Dave	Grey	No	M	1800
Ed	Yellow	No	M	1100
Sally	Black	No	F	1200
Sarah	Grey	No	F	1700
Tom	Red	Yes	M	1500
Jane	Red	No	F	1300



Next week we will discuss:

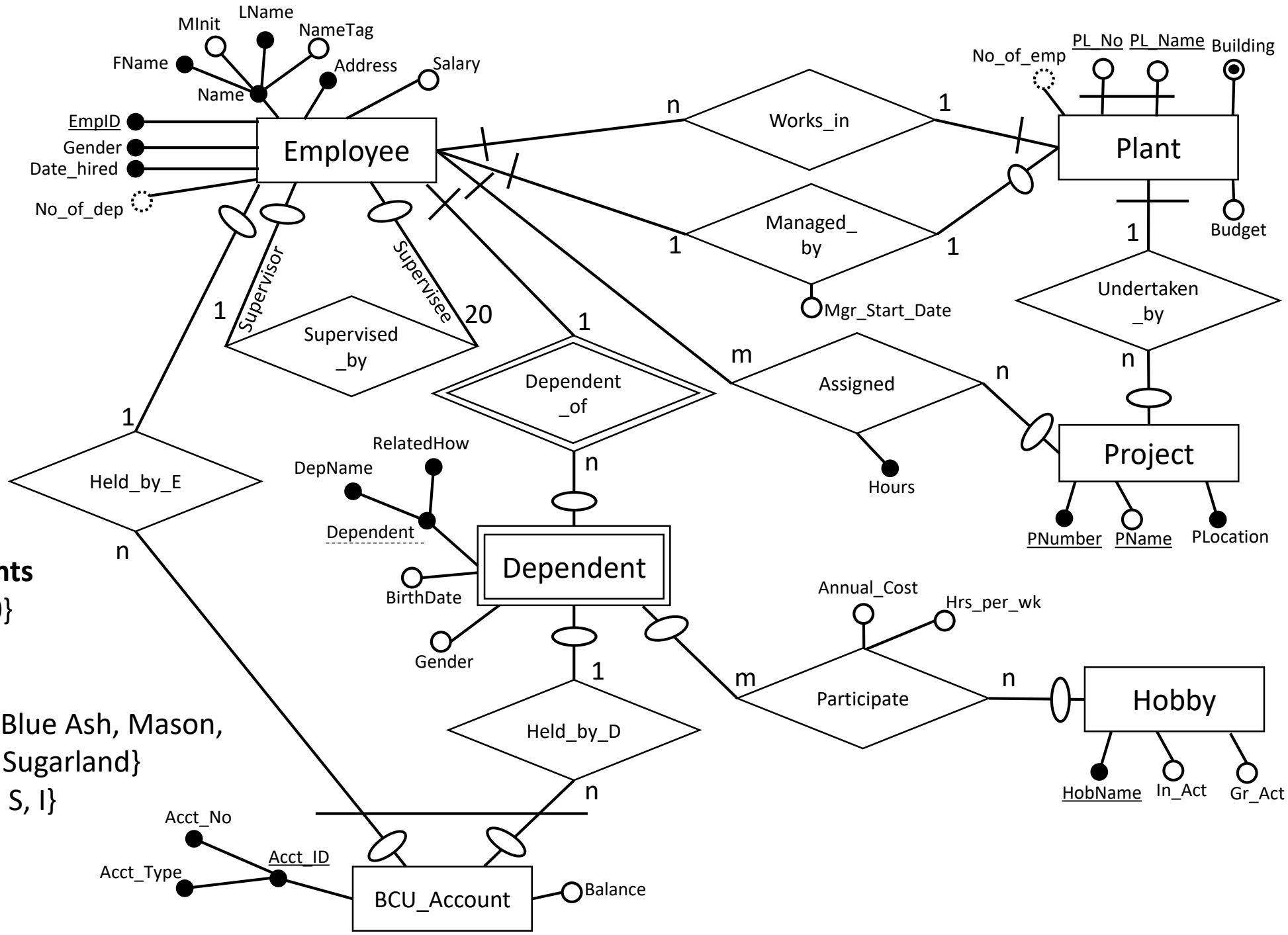
- Attributes of Relationships
- Weak Entities
- Partial Keys

This is “version zero”

- Keep iterating
  - Go back and read the story (strike out story lines already captured if need be) and refine entity types and relationship types of the ER diagram based on additional facts discerned
- Write down “Semantic Integrity Constraints”
  - Business rules that can’t be captured in the ERD – a supplement to the ERD
- Repeat last two steps (as many times as necessary) until all aspects of the story (i.e., the business rules) have been accounted for in the ER model

Semantic Integrity Constraints

- Attribute-Level Business Rules (Domain Constraints – back page of handout)
  - Each plant has a plant number that ranges from 10 to 20.
  - Gender is either male or female
  - Project numbers range from 1 to 40
  - Project locations are confined to the cities of Bellaire, Blue Ash, Mason, Stafford, & Sugarland
  - Account types are coded as checking (C), savings (S), or investment (I) accounts
  - A hobby can be either indoor (I) or outdoor (O) activity
  - A hobby can be a group (G) or individual (I) activity



Semantic Integrity Constraints

Plant.PL_No: Domain {10-20}
Employee.Gender: {M,F}
Project.PNumber: {1-40}
Project.PLocation: {Bellaire, Blue Ash, Mason, Stafford, Sugarland}
BCU_Account.Acct_type: {C, S, I}
Hobby.In_Act: {I, O}
Hobby.Gr_Act: {G, I}

Review: Deletion Rules

- Restrict: Do not allow coach (Parent) to be deleted
- Cascade: Delete all the players (Children) as well
- Set Null: Players (Children) exist, but without a coach (Parent)
- Set Default: A new “default” coach (Parent) is defined

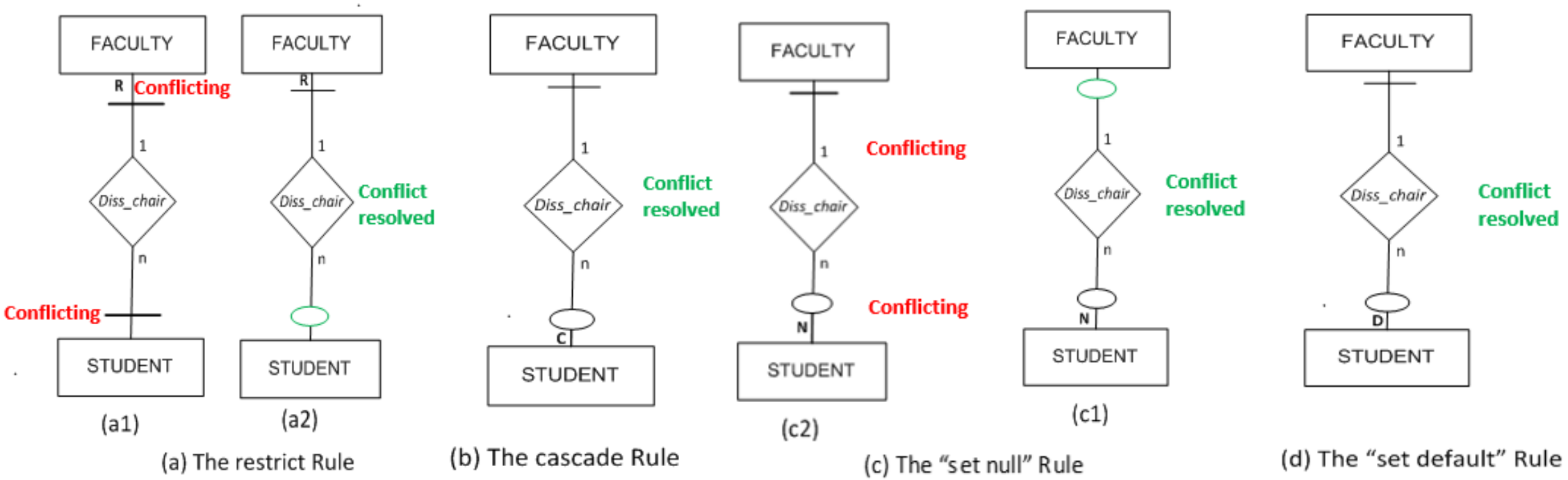
NO!

Don’t Leave me!

RESTRICTED!

Placement of deletion constraints

- As described previously, the restrict rule applies to the parent, while cascade, set null, and set default apply to the children.

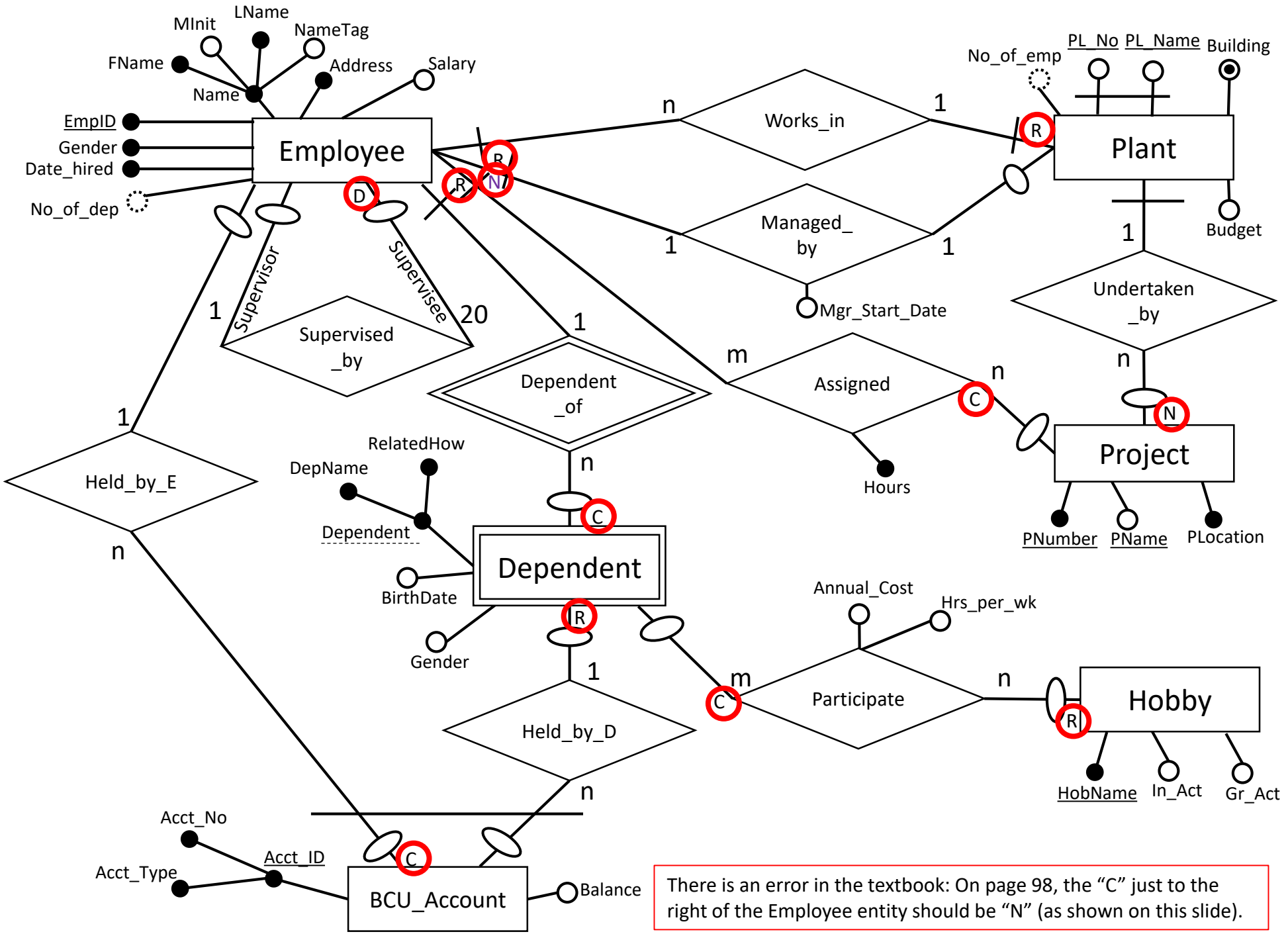


Adding deletion constraints

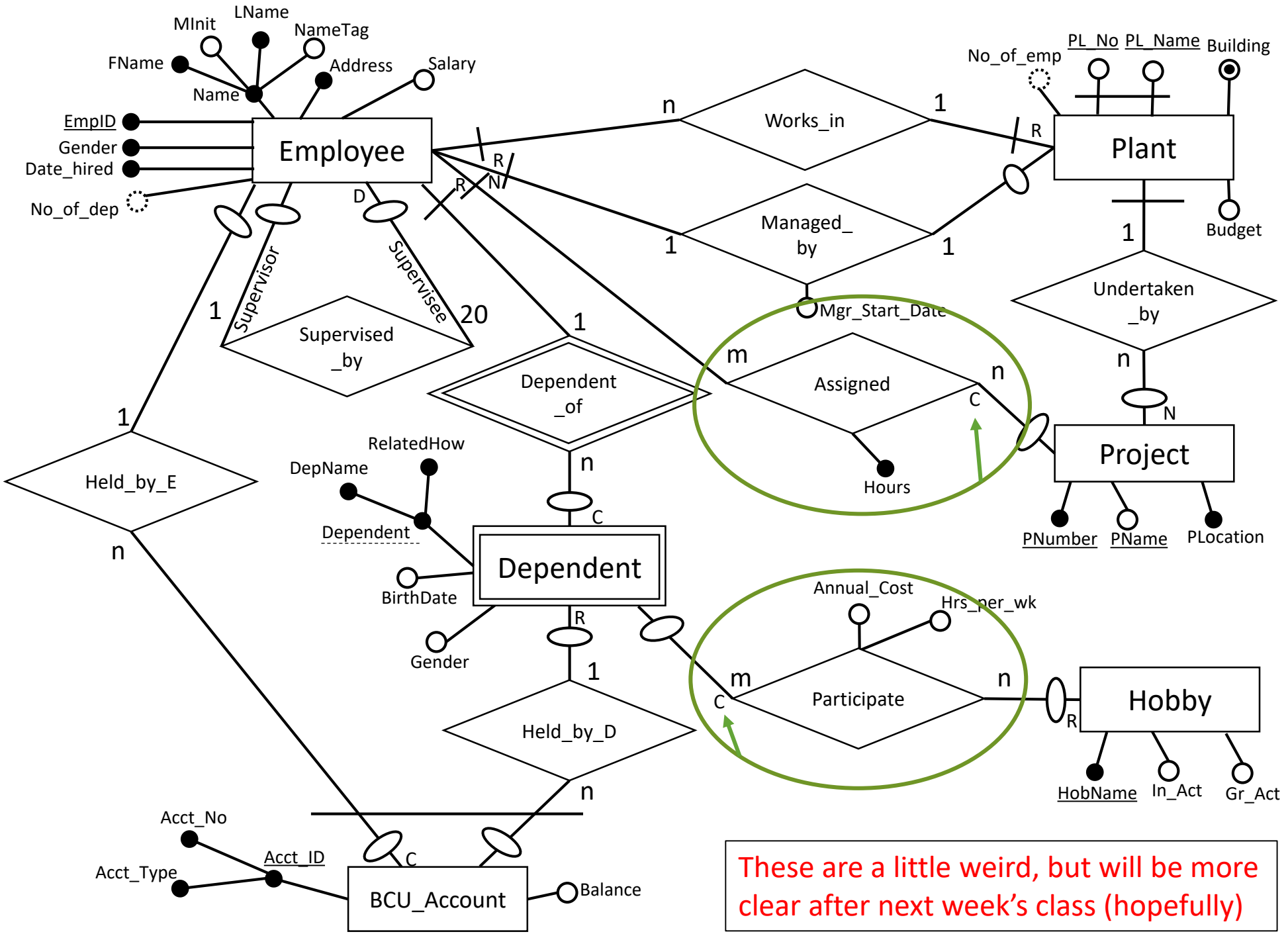
- Help me out using your handout

Business rules concerning deletion for Bearcat Incorporated

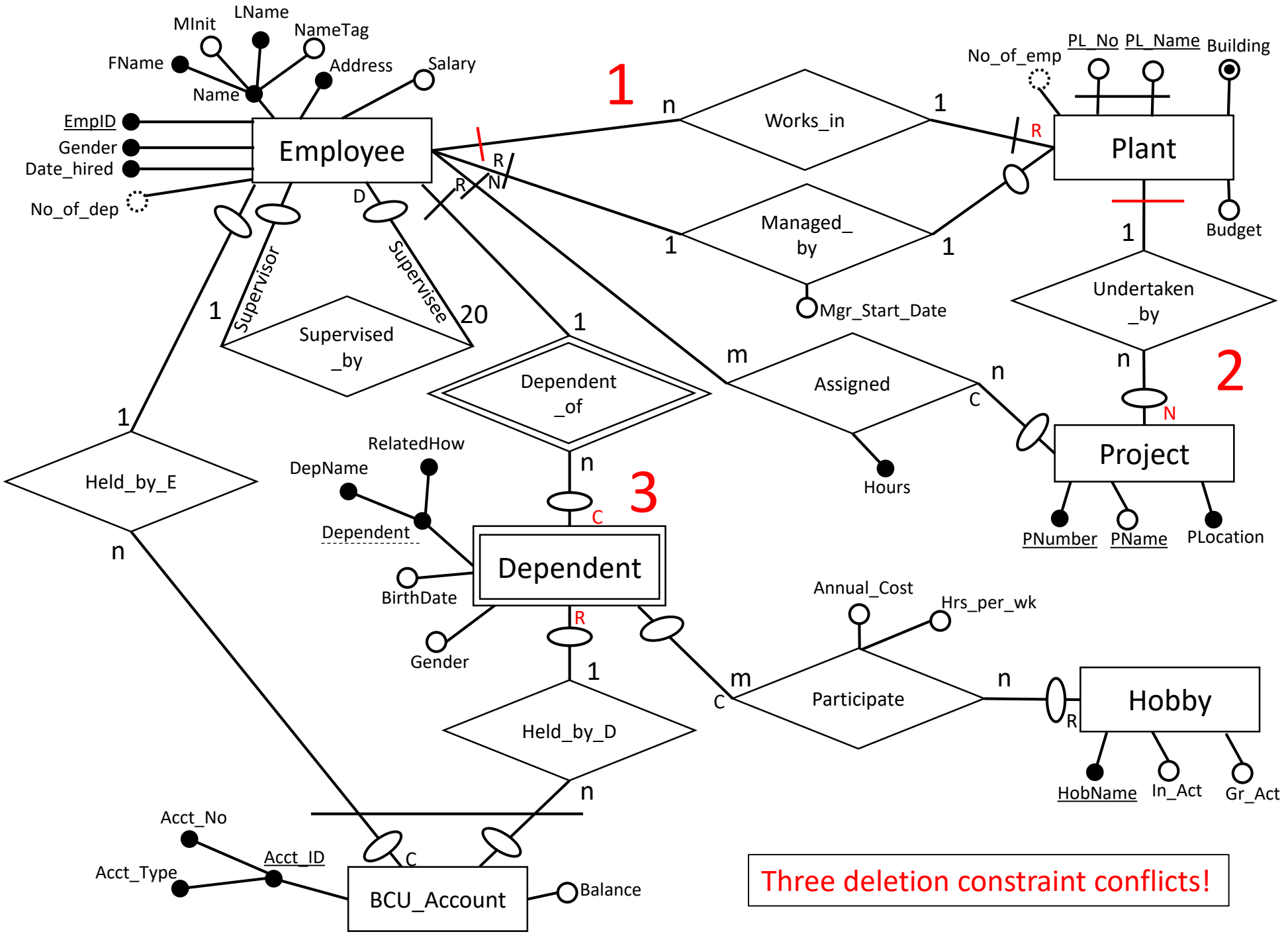
1. A plant with employees cannot be closed down.
2. If an employee is deleted, all BCU accounts of that particular employee must be deleted.
3. If a plant is closed down, the projects undertaken by that plant cannot be canceled. The project assignments from a closed plant must be temporarily removed in order to allow the project to be transferred to another plant.
4. The Human Resources Department uses a designated default employee number to replace a supervisor who leaves the company.
5. An employee currently managing a plant cannot be deleted from the database.
6. If a plant is closed down, the employee no longer manages the plant but becomes an employee of another plant.
7. If an employee leaves the company, all dependents and BCU accounts of the employee must be removed.
8. As long as a dependent has a BCU account, deletion of the dependent is prohibited.
9. As long as an employee is assigned to a project, his or her record cannot be removed from the database.
10. If a project is deleted, all assignments of employees to that project must be deleted.
11. If a dependent is deleted, all records of the participation of that dependent in hobbies must be deleted.
12. A hobby with at least one dependent participating in it cannot be deleted.



There is an error in the textbook: On page 98, the “C” just to the right of the Employee entity should be “N” (as shown on this slide).



These are a little weird, but will be more clear after next week's class (hopefully)


MInit
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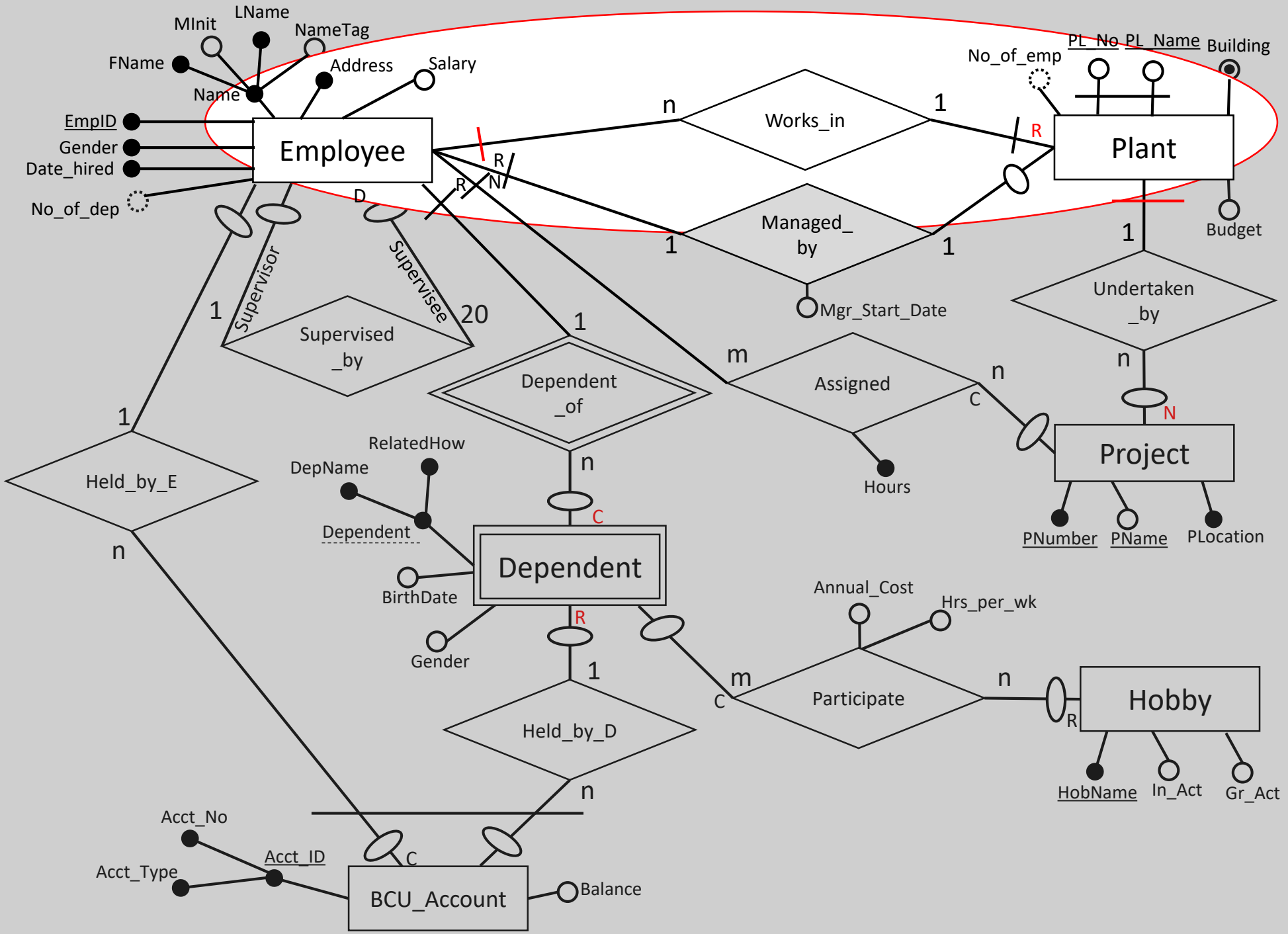
Three deletion constraint conflicts!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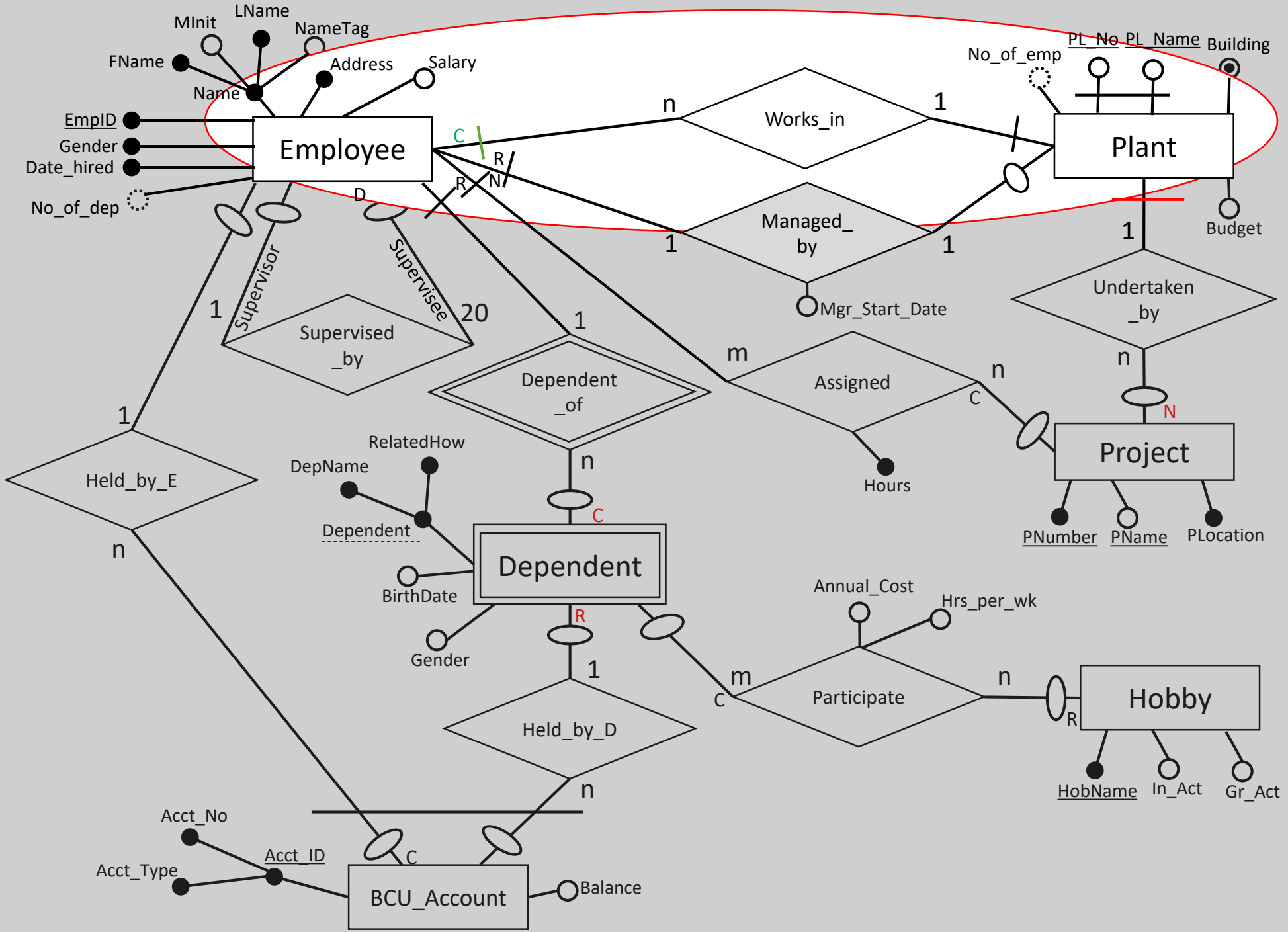
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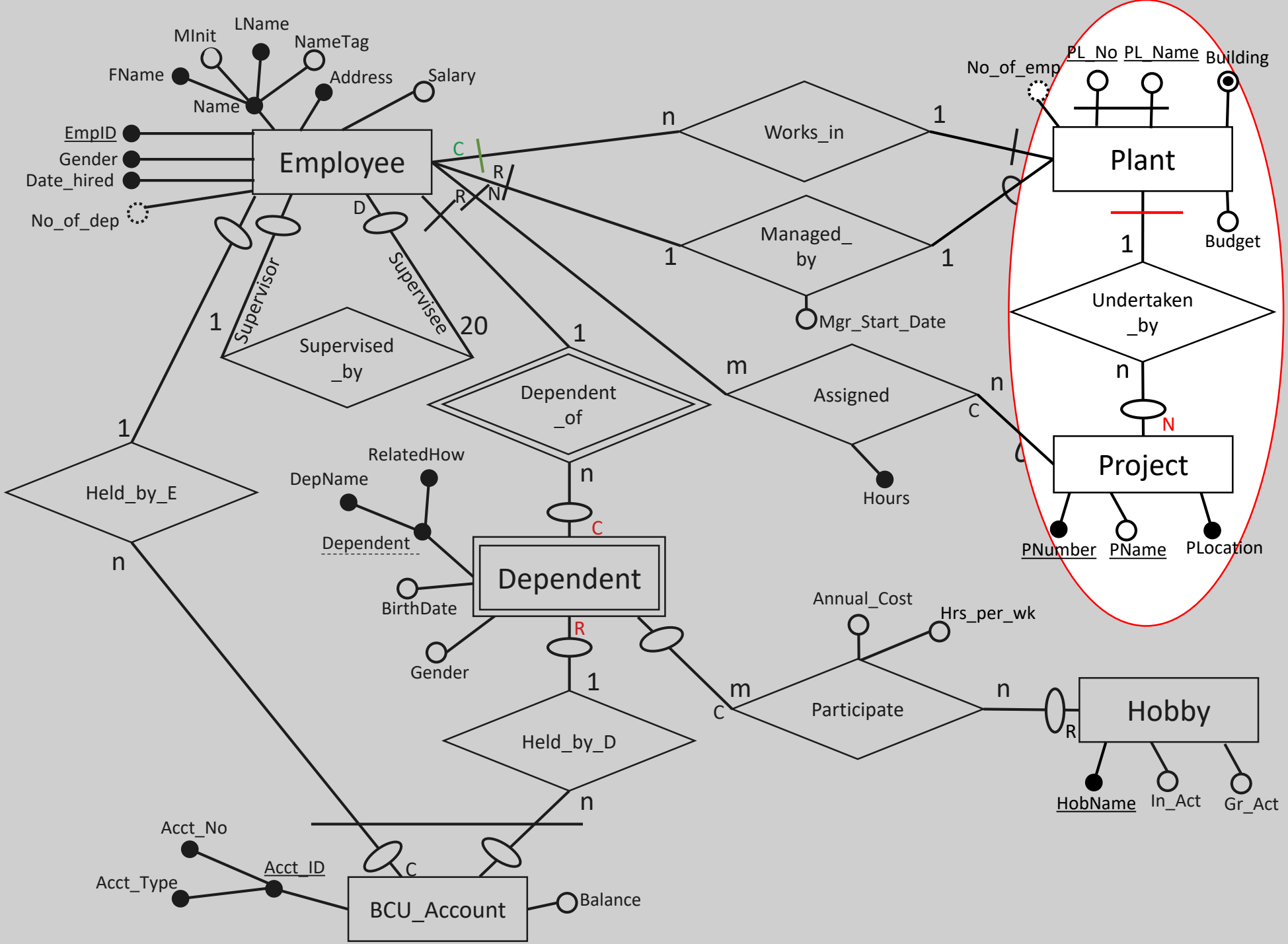
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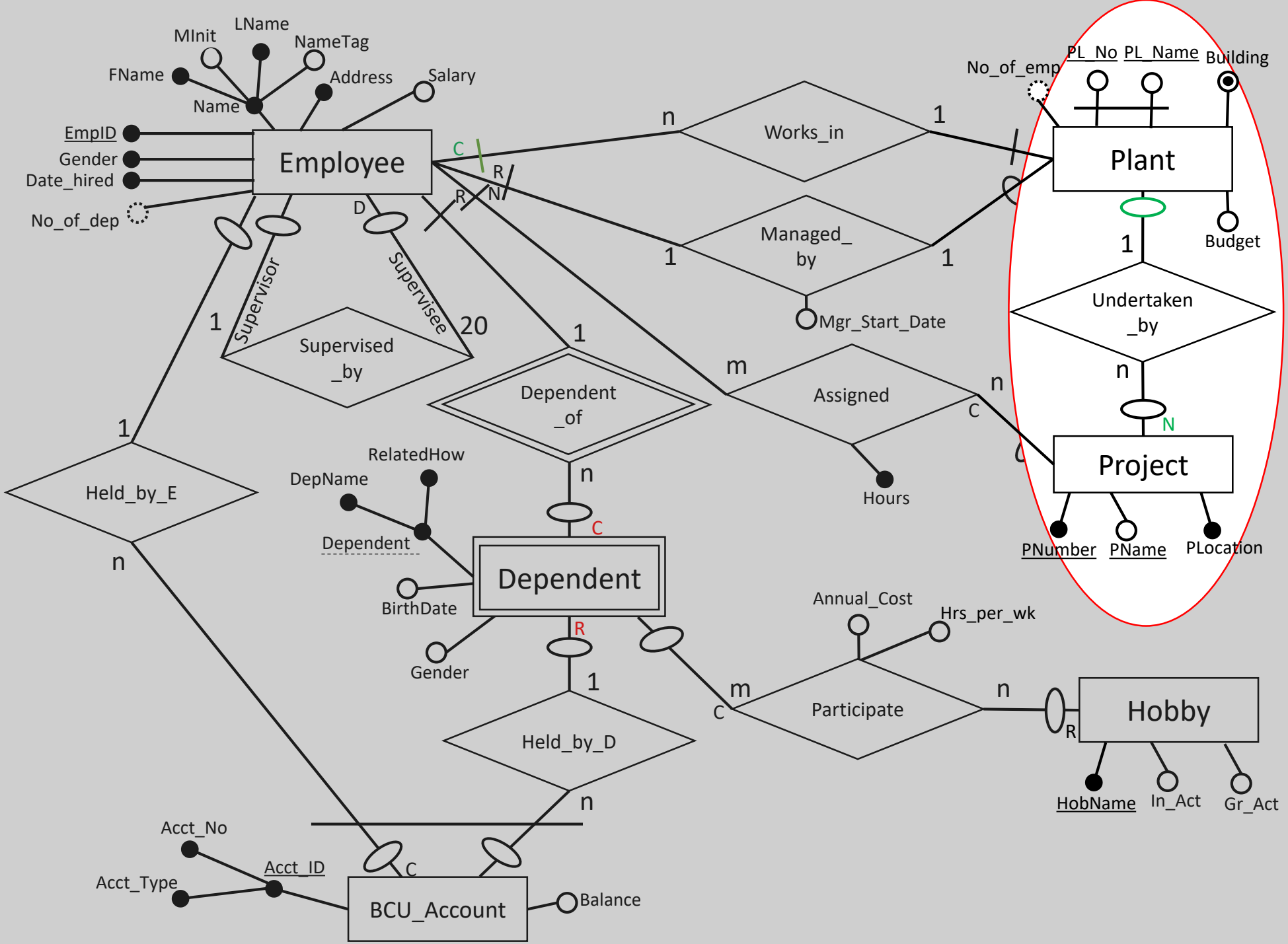
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Date_hired
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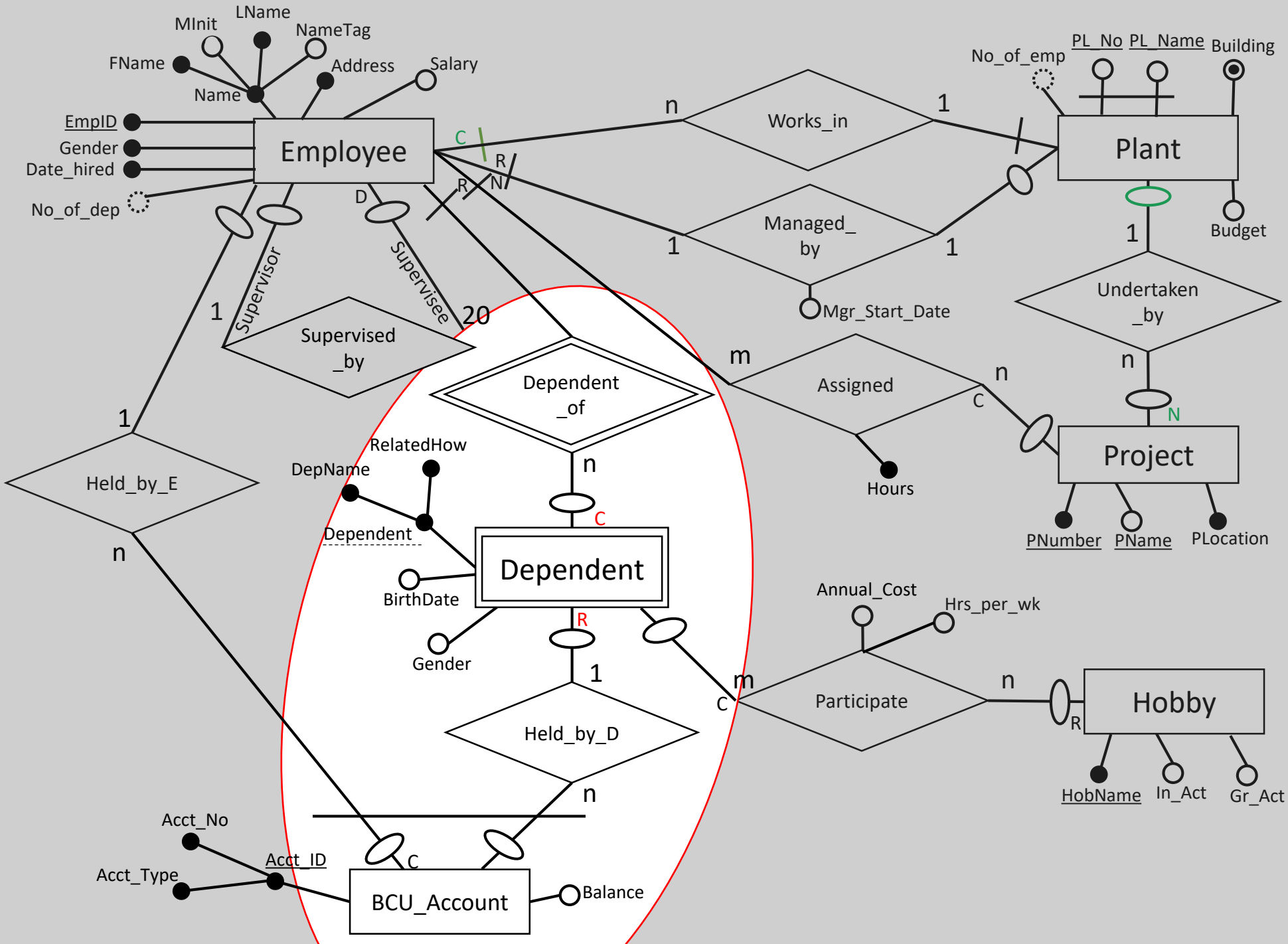
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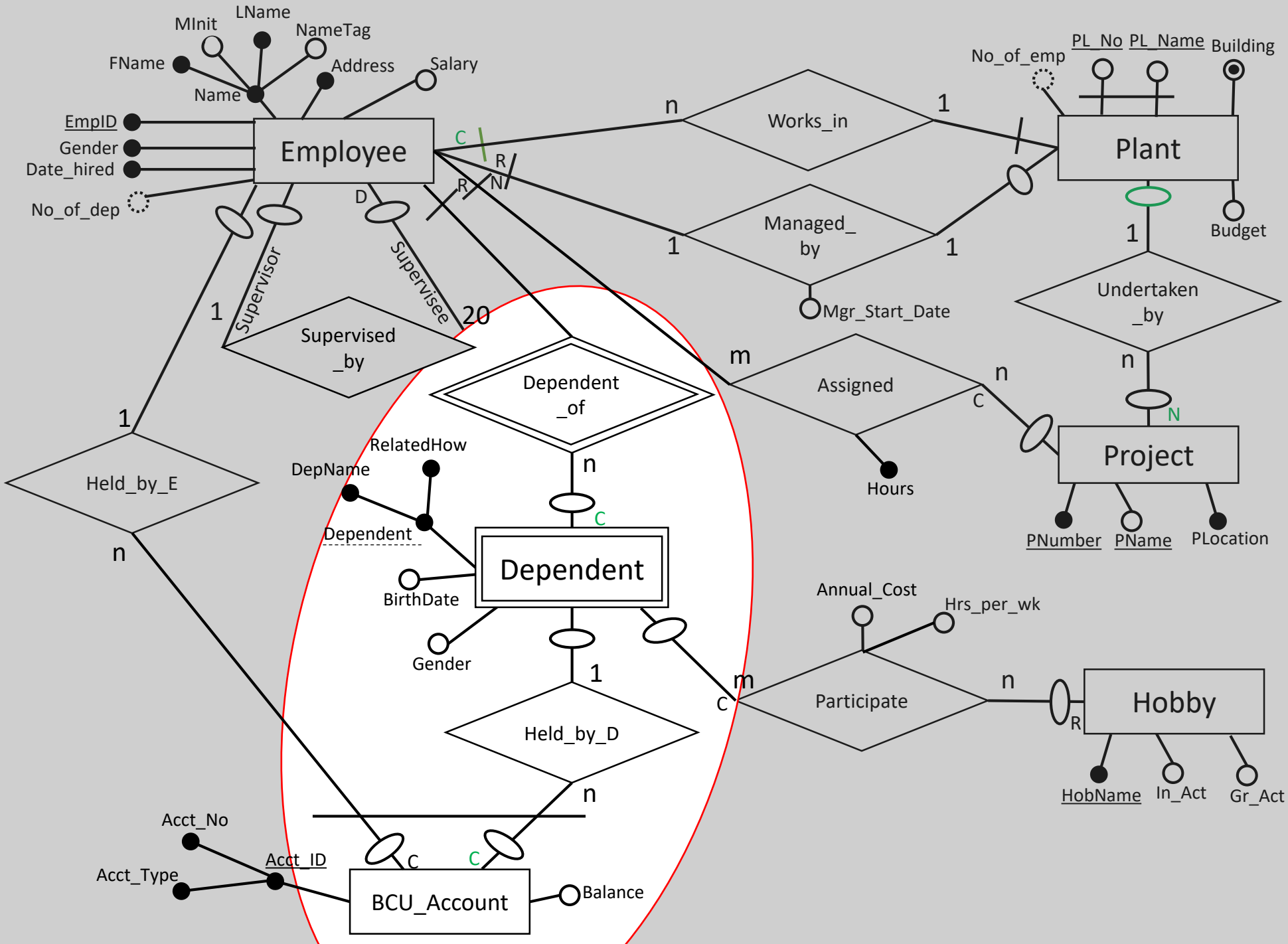
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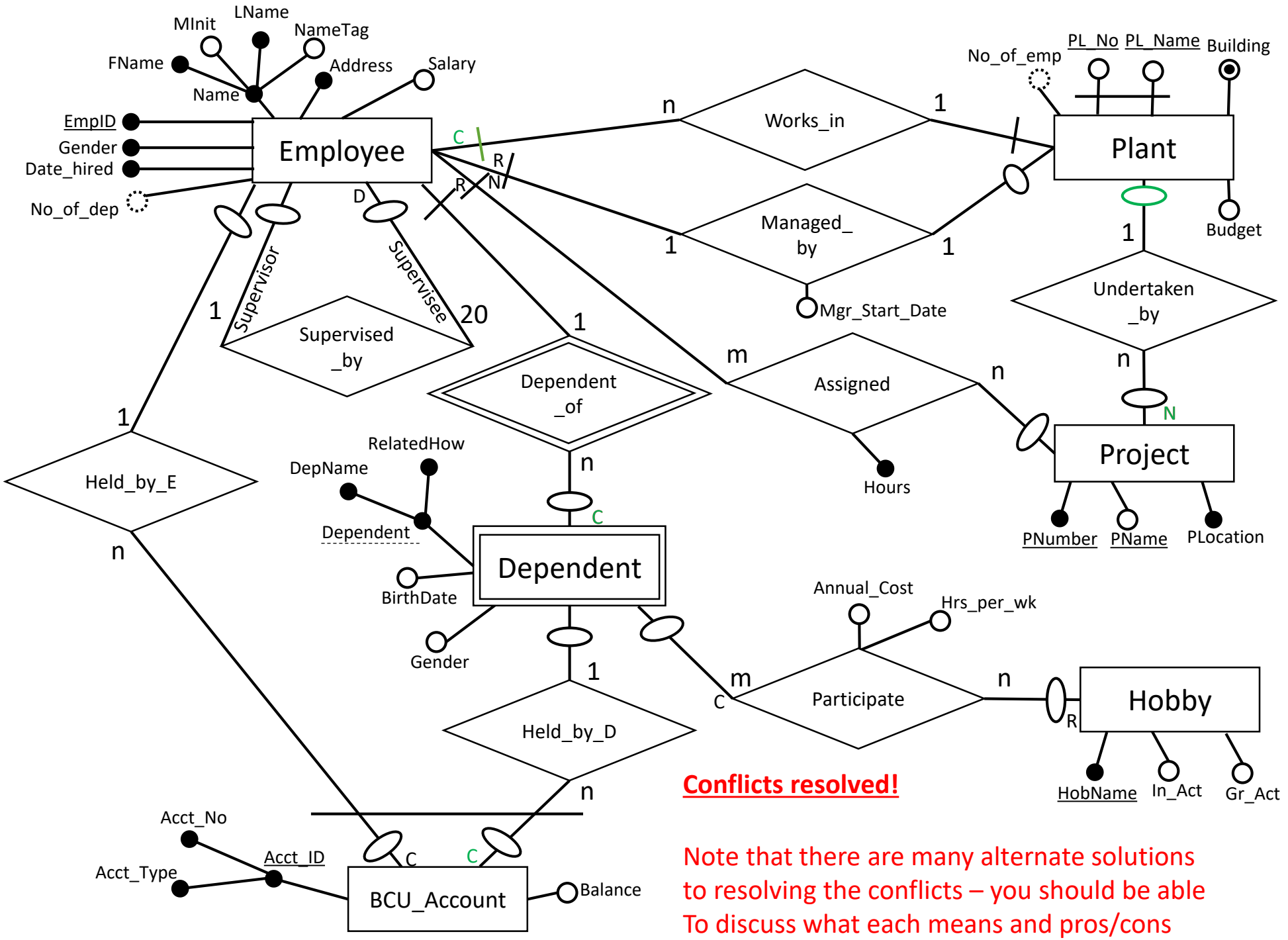

Conflicts resolved!

Note that there are many alternate solutions to resolving the conflicts – you should be able To discuss what each means and pros/cons

Deletion Rule Conflicts (Pages 100-101 in your book)

- A plant with employees cannot be closed down.
  - Note: restrict (R) on PLANT conflicts with the total participation of PLANT in Works_in
- If a plant is closed down, the projects undertaken by that plant cannot be canceled. The project assignments from a closed plant must be temporarily removed in order to allow the project to be transferred to another plant.
  - Note: Honoring this rule entails relaxation of the requirement (Section 3.1) that a project is always under control of a plant.
- If an employee leaves the company, all dependents and BCU accounts of the employee must be removed.
- As long as a dependent has a BCU account, deletion of the dependent is prohibited.
  - Note: Rule cannot be honored for dependents that have an account at BCU because Rule prohibits deletion of such dependents.

An increasingly precise ERD

- We are starting to get less user friendly, and more technical…
  - A necessary transition to get to logical data modeling
  - Appropriate for the business? Maybe – it depends.

- We started with a **Presentation Layer ERD**
  - Entities, and relationships at a high level of abstraction

- We are creating a **Design Specific ERD**
  - Defining attributes and datatypes
  - Defining min and max values

- And finally a **Decomposed Design Specific ERD**
  - Used to fix two issues that will blow your mind…

- Where you “change” from one type of ERD to another is “fluid”

Progress Quiz Time!

- The Progress Quiz is available in Canvas
  - You MUST complete the quiz on Canvas by 5:00 on Friday – This in-class activity does not count for points!
  - Each week we will discuss the questions, so for those of you that are in class and keeping up with things, you'll have an extra easy time with it!
- Go to http://kahoot.it and we'll get started momentarily!

Go forth and do great things!

- Next week we will discuss:
  - Implications of where attributes are placed
  - Weak Entities and Partial Keys
  - Modeling M:N relationships with **the gerund**
  - Modeling multi-value attributes
  - Data modeling errors
  - Introduction to Relational data modeling

BZAN 6354

Lecture 4

February 12, 2024

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Department of Decision & Information Sciences