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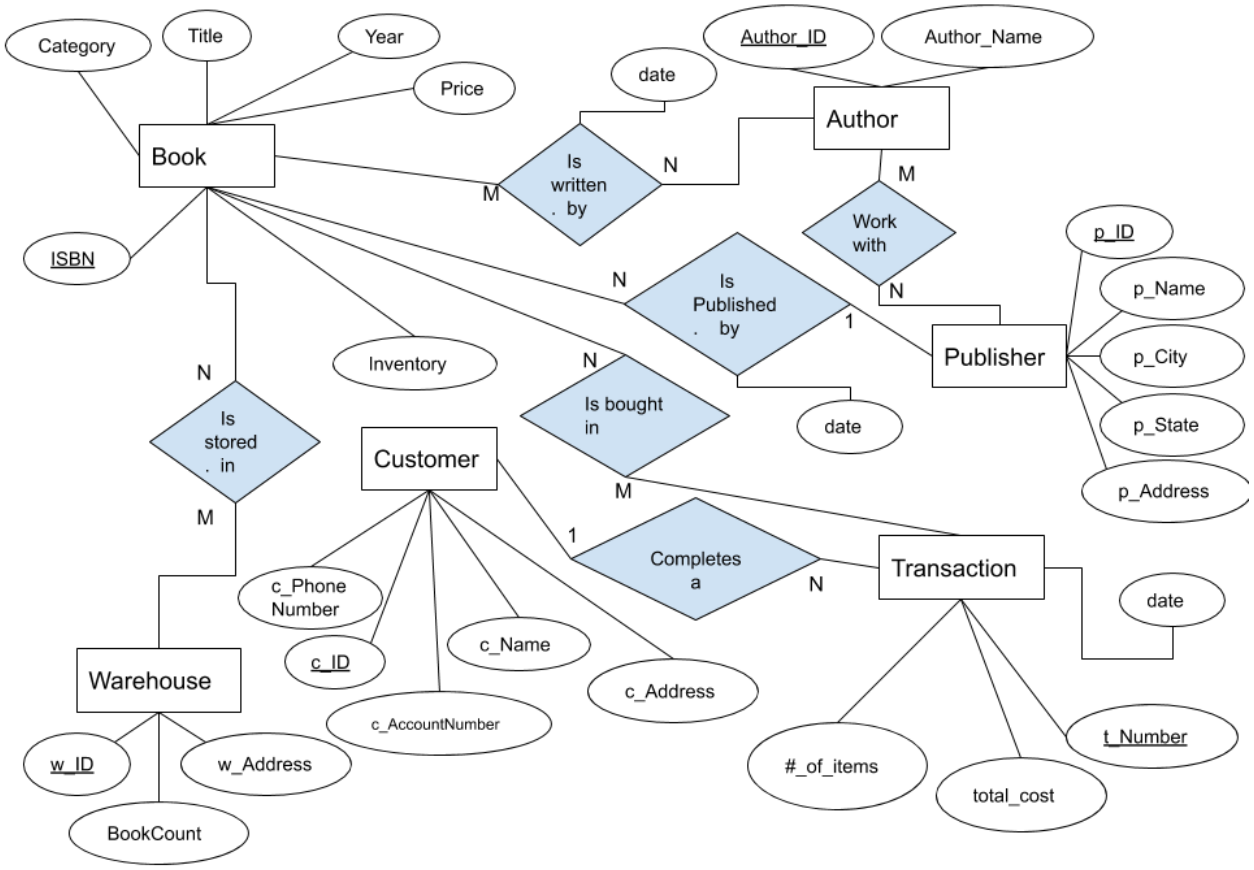
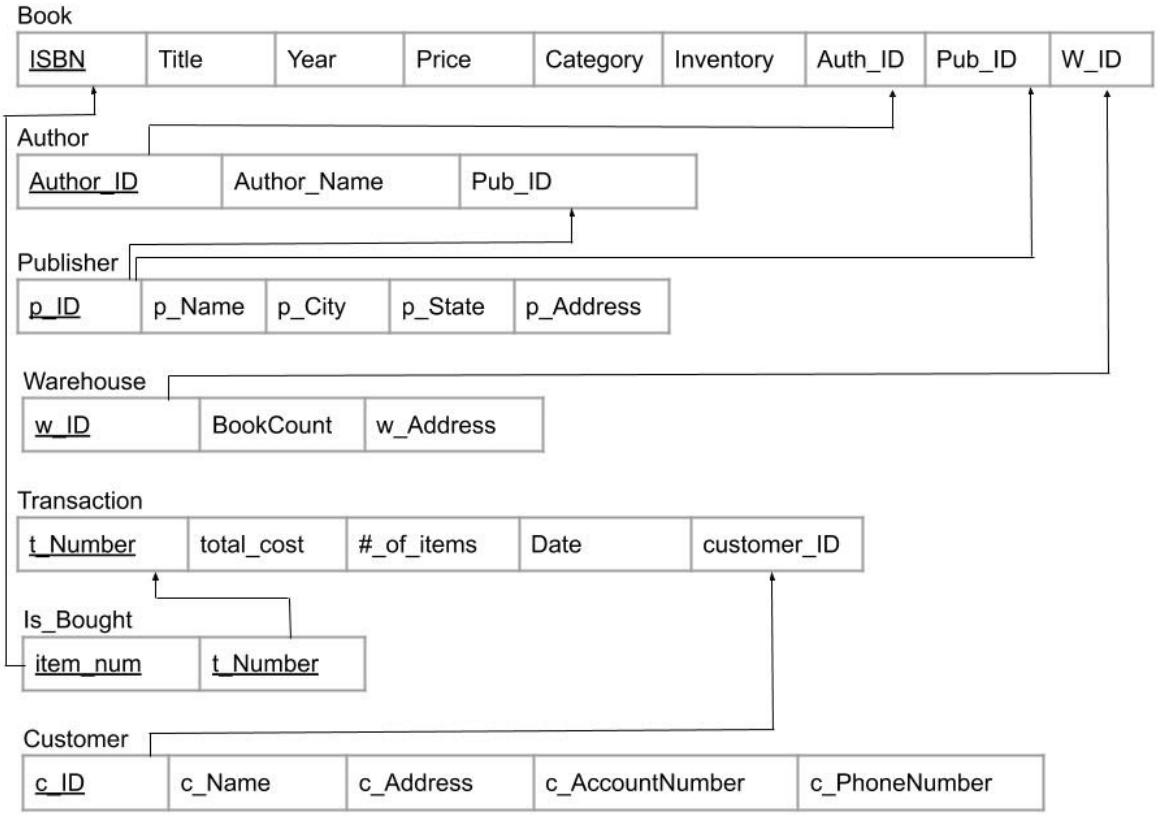
1. Provide a current version of your ER Model as per Project Checkpoint 01. If you were instructed to change the model for Project Checkpoint 01, make sure you use the revised version of your ER Model.



2. Map your ER model to a relational schema. Indicate all primary and foreign keys.



3. Given your relational schema, provide the relational algebra to perform the following queries. If your schema cannot provide answers to these queries, revise your ER Model and your relational schema to contain the appropriate information for these queries:

a. Find the titles of all books by Pratchett that cost less than $10

$$\pi_{\text{Title}}(\sigma_{\text{Price} < 10}(\sigma_{\text{Author\_Name} = \text{'Pratchett'}}(\text{Author} \bowtie_{\text{Author\_ID=Auth\_ID}} \text{Book})))$$

b. Give all the titles and their dates of purchase made by a single customer (you choose how to designate the customer: *Name of customer is David*)

$$\pi_{\text{Title,Date}}(\sigma_{\text{c\_Name} = \text{'David'}}(\text{Customer} \bowtie_{\text{c\_ID=customer\_ID}} \text{Transaction}))$$

c. Find the titles and ISBNs for all books with less than 5 copies in stock

$$\pi_{\text{Title,ISBN}}(\sigma_{\text{Inventory} < 5}(\text{Books}))$$

d. Give all the customers who purchased a book by Pratchett and the titles of Pratchett books they purchased

Pratchett_Transactions <- $\pi_{\text{Title,t\_Number, customer\_ID}}(\sigma_{\text{Author\_Name='Pratchett'}}(\text{Book} \bowtie_{\text{ISBN=item\_num}}(\text{Is\_Bought} \bowtie_{\text{t\_Number=t\_Number}} \text{Transaction})))$

$\pi_{\text{Title,c\_Name}}(\sigma_{\text{c\_Name='David'}}(\text{Customer} \bowtie_{\text{c\_ID=customer\_ID}} \text{Pratchett\_Transactions}))$

e. Find the total number of books purchased by a single customer (you choose how to designate the customer)

$$\pi_{\text{c\_Name}}(\mathcal{F}_{\text{SUM \#\_of\_items}}(\sigma_{\text{c\_Name = 'David'}}(\text{Customer} \bowtie_{\text{c\_ID=customer\_ID}} \text{Transaction})))$$

f. Find the customer who has purchased the most books and the total number of books they have purchased

$$\pi_{\text{c\_Name}}(\mathcal{F}_{\text{MAX \#\_of\_items}}(_{\text{c\_Name}}\mathcal{F}_{\text{SUM \#\_of\_items}}(\text{Customer} \bowtie_{\text{c\_ID=customer\_ID}} \text{Transaction})))$$

4. Come up with three additional interesting queries that your database can provide. Give what the queries are supposed to retrieve in plain English and then as relational algebra. Your queries should include joins and at least one should include an aggregate function. At least one of your queries should use “extra” entities you added to your model in Checkpoint 01.

a) Find the title of all books written by Hemmingway with category ‘Short Story’

$$\pi_{\text{Title}}(\sigma_{\text{Category = ‘Short Story’}}(\sigma_{\text{Author\_Name = ‘Hemmingway’}}(\text{Author} \bowtie_{\text{Author\_ID=Auth\_ID}} \text{Book})))$$

b) Find the number of books titled ‘1984’ in the warehouse with address ‘14 Main St.’

$$\sigma_{\text{w\_Address = ‘14 Main St.’}}(\sigma_{\text{Title = ‘1984’}}(\text{Book} \bowtie_{\text{Pub\_ID=p\_ID}} \text{Publisher}))$$

c) Find the name and state of each publisher of the book “1984”

$$\pi_{\text{p\_Name,p\_State}}(\sigma_{\text{Title = ‘1984’}}(\text{Book} \bowtie_{\text{W\_ID=w\_ID}} \text{Publisher}))$$