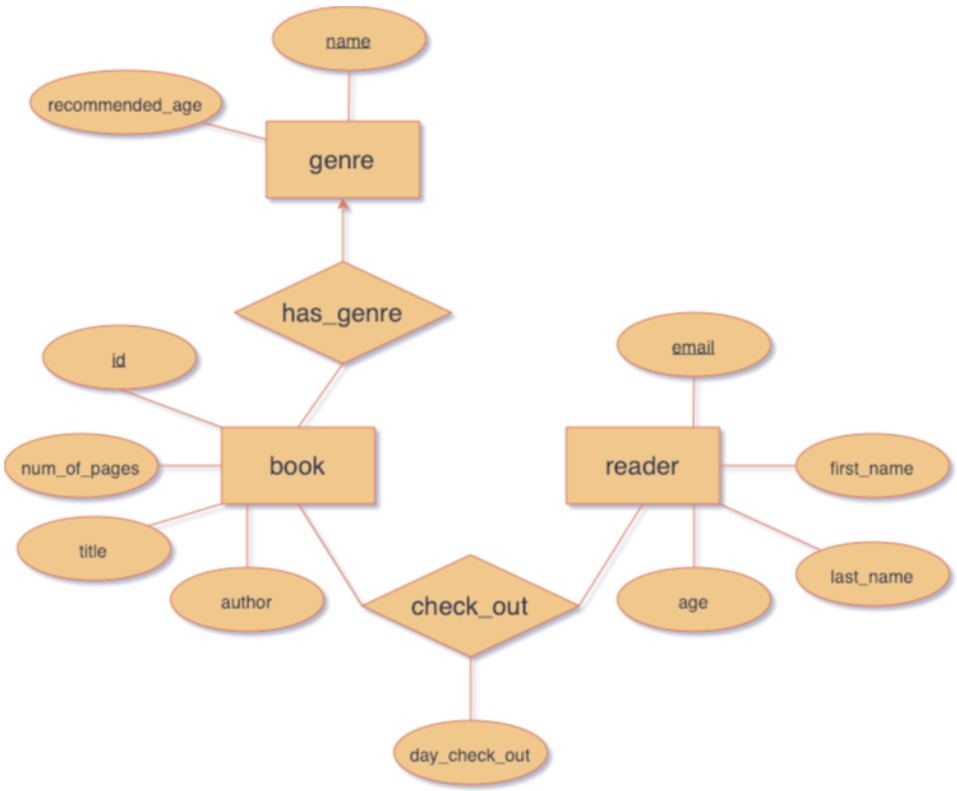
CSE 344 Section 4 Worksheet

Entity Relationships

Odegaard Library is in need of a new database, and they have asked you to help design it. Here are some of the requirements for what information needs to be stored in this database:

- Each book has a unique ID, a title, an author, a genre (0 or 1), and a number of pages
- Readers who visit the library have a unique email address, a first name, a last name, and an age
- Readers can "check out" multiple books from the library at a time, and one book can be checked out multiple times. We should keep track of the day that each book was checked out
- To make it easier to recommend books to readers, we should assign a recommended age for each genre

1. Design an ER diagram for the new library database.



See further explanation in the slides

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2. Convert the ER diagram to a series of CREATE TABLE statements. Include primary key and foreign key statements.

```
CREATE TABLE Genres (
  name VARCHAR(20) PRIMARY KEY,
  recommended_age INT
);

CREATE TABLE Books (
  id INT PRIMARY KEY,
  title VARCHAR(100),
  author VARCHAR(50),
  genre VARCHAR(20) REFERENCES Genres,
  num_pages INT
);

CREATE TABLE Readers (
  email VARCHAR(50) PRIMARY KEY,
  first_name VARCHAR(20),
  last_name VARCHAR(20),
  age INT
);

CREATE TABLE Checkouts (
  day_check_out VARCHAR(10),
  book_id INT REFERENCES Books,
  reader_email VARCHAR(50) REFERENCES Readers,
  PRIMARY KEY (book_id, reader_email)
);
```

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Functional Dependencies

id	name	tier	fee	pct_discount
101	Ava	Platinum	50	20
102	Ben	Gold	40	15
103	Chloe	Silver	30	15
104	Chloe	Bronze	25	7.5
105	Daniel	Gold	40	15
106	Daniel	Gold	40	15

3. Using the relation above, identify all the functional dependencies.

If an FD X → Y exists, then given a value for X, you should know the value of Y (i.e., for each unique value of X, there cannot be multiple values for Y).

id → name, tier, fee, pct_discount
tier → fee, pct_discount
fee → tier, pct_discount

4. Using the FDs you found, determine the closure of id, name, tier, fee, and pct_discount

id^+ = {id, name, tier, fee, pct_discount}
$name^+$ = {name}
$tier^+$ = {tier, fee, pct_discount}
fee^+ = {tier, fee, pct_discount}
pct_discount+ = {pct_discount}

Notice that id is not only a superkey, but also a (minimal) key.

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BCNF

5. Given R(A, B, C, D, E, F) and FDs: B → A, E → B, D → C, A → C

Decompose R into BCNF. In each step, explain which functional dependency/dependencies you used to decompose and explain why further decomposition is needed. Your answer should consist of a list of table names and attributes. Make sure you indicate the keys for each relation.

NOTE: Depending on the order in which you decompose, you might end up with a different set of normalized relations at the end. There are multiple valid solutions.

1. Use B → A, A → C
Decompose R into R1(B, A, C) and R2(B, D, E, F)

R1 violates A → C, so we need to further decompose R1
R2 violates E → B, so we need to further decompose R2

2. Use A → C
Decompose R1 into R11(A, C) and R12(A, B)

3. Use E → B
Decompose R2 into R21(E, B) and R22(E, D, F)

Final Decompositions: R11(A, B), R12(A, C), R21(E, B), R22(E, D, F)