Physical Database Design

Introduction:

The physical database design for our library DBMS directly follows the creation of the logical relational model. The physical database converts the logic relational model–with each entity and relationship defined with members–into the actual database schema. On top of this, we also filled the relations with simulated data.

Platform Decision:

We decided to use PostgreSQL for several reasons. First, it is a widely used relational database interface in industry, so it is a relevant tool to learn. Second, it's relatively lightweight, and it's documentation is thorough and helpful. Third, it provides good support for features like foreign keys and subqueries.

Physical Schema (DDL Statements)

```
-- Anna
CREATE TABLE AppUser(
    User_ID INT PRIMARY KEY,
    First_Name VARCHAR(255) NOT NULL,
    Last_Name VARCHAR(255) NOT NULL,
    Email VARCHAR(255) NOT NULL,
    Address_Number VARCHAR(255) NOT NULL,
    Phone_Number VARCHAR(255) NOT NULL
);

CREATE TABLE LibraryStaff (
    Staff_ID INT PRIMARY KEY,
    Salary INT NOT NULL,
    Position_Name VARCHAR(255) NOT NULL,
    Position_Type VARCHAR(255) NOT NULL,
    FOREIGN KEY (Staff_ID) REFERENCES AppUser(User_ID)
);


CREATE TABLE SystemAdministrator (
    Staff_ID INT PRIMARY KEY,
    Managees VARCHAR(255),
    FOREIGN KEY (Staff_ID) REFERENCES AppUser(User_ID)
);
```

```sql
--Library Member
CREATE TABLE LibraryMember (
    LibraryMember_ID INT PRIMARY KEY,
    Items_CheckedOut INT NOT NULL,
    Date_Joined DATE NOT NULL,
    Outstanding_Balance DECIMAL(5,2) DEFAULT 0.00 NOT NULL
CHECK(Outstanding_Balance >= 0),
    Sex CHAR(1) NOT NULL CHECK (Sex IN ('M','F','O')),
    DOB DATE NOT NULL,
    Status VARCHAR(20) NOT NULL,
    FOREIGN KEY(LibraryMember_ID) REFERENCES AppUser(User_ID)
);

-- Hart



--Publisher

CREATE TABLE Publisher(
    Publisher_ID INT PRIMARY KEY,
    Name VARCHAR(255) NOT NULL
);
--Author
CREATE TABLE Author(
    Author_ID INT PRIMARY KEY,
    Name VarCHAR(255) NOT NULL
);
--genre
CREATE TABLE Genre(
    Genre_ID INT PRIMARY KEY,
    Name VARCHAR(255) NOT NULL
);
-- Kaden
CREATE TABLE Item (
    Item_ID INT PRIMARY KEY,
    ISBN CHAR(13) NOT NULL,
    Title VARCHAR(255) NOT NULL,
    Publication_Year INT NOT NULL,
```

```sql
    Publisher_ID INT NOT NULL,
    Genre_ID INT NOT NULL,
    Quantity INT DEFAULT 0,
    Author_ID INT NOT NULL,
    FOREIGN KEY (Publisher_ID) REFERENCES Publisher(Publisher_ID),
    FOREIGN KEY (Genre_ID) REFERENCES Genre(Genre_ID),
    FOREIGN KEY (Author_ID) REFERENCES Author(Author_ID)
);

--Copy
CREATE TABLE Copy(
    Copy_ID INT PRIMARY KEY,
    Item_ID INT NOT NULL,
    Status VARCHAR(255) NOT NULL,
    FOREIGN KEY (Item_ID) REFERENCES Item(Item_ID)
);

CREATE TABLE Book (
        Item_ID INT PRIMARY KEY,
    Quantity_Available INT NOT NULL,
    FOREIGN KEY (Item_ID) REFERENCES Item(Item_ID)
);

CREATE TABLE DigitalMedia (
        Item_ID INT PRIMARY KEY,
        Medium VARCHAR(225) NOT NULL,
    Quantity_Available INT NOT NULL,
    FOREIGN KEY (Item_ID) REFERENCES Item(Item_ID)
);

-- Sriya

--Transactions NOTE: NEED Plural because else its a keyword
CREATE TABLE Transactions (
    Transaction_ID INT PRIMARY KEY,
    Copy_ID INT NOT NULL,
    User_ID INT NOT NULL,
    Date_CheckOut DATE NOT NULL,
    Due_Date DATE NOT NULL,
    Num_Renewals INT NOT NULL,
```

```sql
    Return_Date DATE,
    FOREIGN KEY (Copy_ID) REFERENCES Copy(Copy_ID),
    FOREIGN KEY (User_ID) REFERENCES AppUser(User_ID)
);

--Amount
CREATE TABLE Amount (
    Fine_ID INT PRIMARY KEY,
    User_ID INT NOT NULL,
    Item_ID INT NOT NULL,
    Amount DECIMAL(5,2) NOT NULL CHECK (Amount >= 0),
    Transaction_ID INT NOT NULL,
    FOREIGN KEY (User_ID) REFERENCES AppUser(User_ID),
    FOREIGN KEY (Item_ID) REFERENCES Item(Item_ID),
    FOREIGN KEY (Transaction_ID) REFERENCES Transactions(Transaction_ID)
);

-- Audrey
--Hold
CREATE TABLE Hold(
    Hold_ID INT PRIMARY KEY,
    User_ID INT NOT NULL,
    Copy_ID INT NOT NULL,
    Hold_Date DATE NOT NULL,
    Expiration_Date DATE NOT NULL,
    Status VARCHAR(255) NOT NULL,
    FOREIGN KEY (Copy_ID) REFERENCES Copy(Copy_ID),
    FOREIGN KEY(User_ID) REFERENCES LibraryMember(LibraryMember_ID)

);
```

Database Table Contents

transaction_id	copy_id	user_id	date_checkout	due_date	num_renewals	return_date
1000	1013	20	2025-04-11	2025-05-03	1	
1001	530	1	2025-04-11	2025-05-05	2	2025-05-05
1002	1139	3	2025-04-01	2025-05-09	0	
1003	1475	30	2025-04-14	2025-05-08	2	2025-05-12
1004	976	52	2025-04-21	2025-05-12	1	
1005	36	54	2025-04-03	2025-05-05	0	
1006	499	33	2025-04-10	2025-05-11	2	
1007	1134	65	2025-04-17	2025-05-06	1	2025-05-09
1008	678	38	2025-04-12	2025-05-12	1	
1009	515	37	2025-04-08	2025-05-02	2	
1010	245	48	2025-04-18	2025-05-13	2	
1011	444	8	2025-04-16	2025-05-05	2	
1012	1075	24	2025-04-20	2025-05-05	0	2025-05-05
1013	466	3	2025-04-12	2025-05-03	1	
1014	1094	5	2025-04-05	2025-05-05	0	2025-05-09
1015	599	56	2025-04-05	2025-05-11	1	
1016	26	48	2025-04-19	2025-05-05	1	
1017	698	47	2025-04-06	2025-05-01	1	2025-05-08
1018	234	19	2025-04-03	2025-05-07	1	
1019	1290	9	2025-04-22	2025-05-01	0	
1020	1153	36	2025-04-10	2025-05-02	0	
1021	853	58	2025-04-20	2025-05-10	2	
1022	1071	20	2025-04-13	2025-05-08	1	
1023	1206	23	2025-04-14	2025-05-05	2	2025-05-10
1024	204	45	2025-04-07	2025-05-11	0	
1025	167	48	2025-04-06	2025-05-04	0	
1026	321	7	2025-04-01	2025-05-07	1	2025-05-08
1027	597	15	2025-04-02	2025-05-04	1	2025-05-12
1028	930	57	2025-04-03	2025-05-11	0	2025-05-13
1029	1281	7	2025-04-19	2025-05-11	0	
1030	1116	12	2025-04-08	2025-05-11	0	2025-05-14

:

```
 publisher_id |                name
--------------+-----------------------------------
            1 | Smith, Jacobs and Jimenez
            2 | Hernandez Group
            3 | Smith, Banks and Little
            4 | Brooks, Welch and Miller
            5 | Melton, Medina and Williams
            6 | Fernandez-Jennings
            7 | Galvan-Macdonald
            8 | Hubbard Ltd
            9 | Carroll, Perez and Lang
           10 | Snyder-Reed
           11 | Odonnell-Jensen
           12 | Russell, Bishop and Moore
           13 | Lucero-Grant
           14 | Hill-Franco
           15 | Curtis Ltd
           16 | Martin, Lopez and Yu
           17 | Navarro-Yates
           18 | Stewart and Sons
           19 | Floyd, Mccarthy and Smith
           20 | Taylor Inc
           21 | Bell-Owen
           22 | Garner, Giles and Chambers
           23 | Hall Inc
           24 | Marshall-Bowman
           25 | Delacruz and Sons
           26 | Gomez-Navarro
           27 | Murray LLC
           28 | Mcdonald, Davenport and Nguyen
           29 | Levine-Fletcher
           30 | Wright-Shaw
           31 | Rose Ltd
.
```

```
mydb=# select * from librarystaff;
 staff_id | salary | position_name | position_type
----------+--------+---------------+---------------
       39 |  44730 | Librarian     | Full-Time
       67 |  39440 | Technician    | Part-Time
       34 |  48364 | Archivist     | Full-Time
(3 rows)
```

librarymember_id	items_checkedout	date_joined	outstanding_balance	sex	dob	status
21	1	2021-07-30	0.00	M	1988-05-31	Active
61	1	2025-02-25	0.00	M	1988-08-09	Active
65	1	2021-07-18	0.00	M	1949-05-26	Active
41	0	2022-07-01	0.00	O	1985-06-26	Active
48	8	2024-03-05	0.00	O	1941-01-15	Active
16	3	2020-04-17	0.00	M	1967-02-23	Active
47	0	2023-04-20	0.00	M	1942-06-17	Active
8	5	2020-09-26	0.00	O	1979-01-30	Active
58	6	2021-08-08	0.00	M	1977-01-07	Active
24	5	2020-05-03	2.85	F	1965-02-13	Active
49	0	2024-07-25	0.00	F	1962-03-21	Active
7	5	2022-03-28	0.00	O	2013-05-24	Active
38	3	2025-02-22	19.41	M	1971-07-06	Suspended
17	6	2024-07-11	0.00	F	1947-05-19	Active
66	4	2020-06-25	0.00	F	2003-11-13	Active
44	0	2024-07-24	0.00	F	1959-12-23	Active
2	0	2020-10-07	0.00	M	1951-02-01	Active
33	6	2020-08-16	0.00	O	1988-05-16	Active
6	3	2021-05-10	0.00	M	1979-06-26	Active
36	0	2025-03-16	0.00	O	1985-03-24	Active
3	4	2023-06-16	0.00	F	1969-10-18	Active
12	6	2022-12-21	0.00	O	1960-10-18	Active
1	1	2022-09-13	0.00	M	1945-03-01	Active
31	4	2024-09-01	0.00	F	2001-04-01	Active
27	2	2024-06-15	0.00	F	1988-03-18	Active
28	0	2024-05-26	0.00	F	1997-08-14	Active
5	5	2022-01-15	0.00	M	1958-07-25	Active
52	4	2022-02-23	28.07	M	1951-09-08	Suspended
23	0	2025-03-16	0.00	O	1942-11-12	Active
20	4	2024-03-07	0.00	F	1989-09-13	Active
40	2	2021-10-11	0.00	O	1941-12-09	Active

:

publication_year	publisher_id	genre_id	quantity	author_id
2022	49	4	4	299
2011	58	6	2	99
1996	20	1	3	46
2005	60	4	1	141
1998	57	6	4	64
2017	63	10	5	38
2002	53	2	1	13
1998	14	10	4	90
2013	69	3	1	209
2013	47	3	5	180
2012	3	3	2	82
1997	7	9	4	213
2018	55	7	5	292
2018	16	2	5	225
2024	10	4	5	128
2022	62	1	4	186
2017	17	10	4	303
2014	65	4	3	50
2022	2	10	2	242
2010	4	2	3	82
2013	50	7	4	31
2010	1	8	5	95
2011	47	6	1	309
2019	67	10	3	17
2021	51	2	5	301
2019	41	10	1	155
2021	10	6	3	301
1999	62	5	2	337
2017	19	6	3	16
2013	21	9	3	6
2017	33	3	5	14

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item_id	isbn	title	publication_year	publisher_id	genre_id	quantity	author_id
1	4025297006533	Long send because	2022	49	4	4	299
2	2853730176460	Stop guess tell	2011	58	6	2	99
3	8910220898062	Recently happy model	1996	20	1	3	46
4	9840641496748	Sign discuss sure pull	2005	60	4	1	141
5	2027430454654	South send education last her	1998	57	6	4	64
6	3005274726482	Sister write though lawyer past	2017	63	10	5	38
7	0958308880613	Speech travel themselves heart surface	2002	53	2	1	13
8	7424731664481	Ready its offer	1998	14	10	4	90
9	2952838485169	Score me well	2013	69	3	1	209
10	0854892420255	Natural behavior note really	2013	47	3	5	180
11	8287134718255	Stage record wide soon truth	2012	3	3	2	82
12	8515982584251	What at news	1997	7	9	4	213
13	8826431836480	Reach fund too	2018	55	7	5	292
14	5971216557934	Whole drive medical	2018	16	2	5	225
15	7537187677433	Country state PM back	2024	10	4	5	

:

```
mydb=# select * from hold;
 hold_id | user_id | copy_id | hold_date  | expiration_date |  status
---------+---------+---------+------------+-----------------+-----------
       1 |       4 |     137 | 2025-04-15 | 2025-04-29      | Fulfilled
       2 |      47 |      20 | 2025-04-02 | 2025-04-16      | Active
       3 |      31 |     349 | 2025-03-29 | 2025-04-12      | Fulfilled
       4 |       1 |     339 | 2025-04-11 | 2025-04-25      | Active
       5 |       5 |     296 | 2025-03-28 | 2025-04-11      | Active
       6 |      53 |     688 | 2025-03-20 | 2025-04-03      | Fulfilled
       7 |      48 |     339 | 2025-03-24 | 2025-04-07      | Active
       8 |      61 |     382 | 2025-03-26 | 2025-04-09      | Active
       9 |       3 |     497 | 2025-04-08 | 2025-04-22      | Fulfilled
      10 |      16 |     423 | 2025-04-04 | 2025-04-18      | Active
      11 |       4 |     223 | 2025-03-22 | 2025-04-05      | Fulfilled
      12 |       1 |    1377 | 2025-03-18 | 2025-04-01      | Fulfilled
      13 |      56 |     559 | 2025-04-13 | 2025-04-27      | Active
      14 |      63 |     598 | 2025-04-08 | 2025-04-22      | Active
      15 |      21 |     615 | 2025-04-03 | 2025-04-17      | Active
      16 |      66 |     541 | 2025-04-12 | 2025-04-26      | Fulfilled
      17 |      66 |    1181 | 2025-04-05 | 2025-04-19      | Active
      18 |       3 |    1386 | 2025-03-21 | 2025-04-04      | Active
      19 |      61 |     539 | 2025-04-09 | 2025-04-23      | Fulfilled
      20 |      31 |     136 | 2025-04-08 | 2025-04-22      | Active
      21 |      53 |    1108 | 2025-04-02 | 2025-04-16      | Fulfilled
      22 |      14 |    1396 | 2025-04-07 | 2025-04-21      | Active
      23 |      36 |    1419 | 2025-04-12 | 2025-04-26      | Active
      24 |      63 |     188 | 2025-03-27 | 2025-04-10      | Fulfilled
      25 |       3 |    1483 | 2025-04-09 | 2025-04-23      | Active
      26 |      32 |     702 | 2025-04-12 | 2025-04-26      | Fulfilled
      27 |      63 |    1010 | 2025-03-25 | 2025-04-08      | Fulfilled
      28 |      61 |      54 | 2025-04-03 | 2025-04-17      | Fulfilled
      29 |      13 |    1450 | 2025-04-08 | 2025-04-22      | Fulfilled
```

```
mydb=# select * from genre;
 genre_id |      name
----------+-----------------
        1 | Science Fiction
        2 | Fantasy
        3 | Mystery
        4 | Thriller
        5 | Romance
        6 | Non-Fiction
        7 | Historical
        8 | Young Adult
        9 | Biography
       10 | Horror
(10 rows)
```

```
 item_id |   medium   | quantity_available
---------+------------+--------------------
     401 | Blu-ray    |                  0
     402 | DVD        |                  3
     403 | DVD        |                  2
     404 | CD-ROM     |                  1
     405 | CD-ROM     |                  2
     406 | Audiobook  |                  3
     407 | Blu-ray    |                  5
     408 | Blu-ray    |                  2
     409 | Blu-ray    |                  1
     410 | Blu-ray    |                  3
     411 | DVD        |                  4
     412 | eBook      |                  4
     413 | CD-ROM     |                  4
     414 | CD-ROM     |                  3
     415 | CD-ROM     |                  1
     416 | Audiobook  |                  4
     417 | eBook      |                  5
     418 | DVD        |                  1
     419 | eBook      |                  2
     420 | eBook      |                  3
     421 | CD-ROM     |                  2
     422 | eBook      |                  3
     423 | DVD        |                  3
     424 | eBook      |                  1
     425 | Audiobook  |                  1
     426 | Blu-ray    |                  3
     427 | Audiobook  |                  2
     428 | Blu-ray    |                  5
     429 | Blu-ray    |                  2
     430 | DVD        |                  1
     431 | Blu-ray    |                  5
:
```

```
 copy_id | item_id |   status
---------+---------+------------
       1 |       1 | Available
       2 |       1 | Available
       3 |       1 | Available
       4 |       1 | Available
       5 |       2 | Available
       6 |       2 | Available
       7 |       3 | Available
       8 |       3 | Available
       9 |       3 | Available
      10 |       4 | Available
      11 |       5 | Available
      12 |       5 | Available
      13 |       5 | Available
      14 |       5 | Available
      15 |       6 | Available
      16 |       6 | CheckedOut
      17 |       6 | Available
      18 |       6 | Available
      19 |       6 | Available
      20 |       7 | CheckedOut
      21 |       8 | Available
      22 |       8 | Available
      23 |       8 | Available
      24 |       8 | Available
      25 |       9 | Available
      26 |      10 | Available
      27 |      10 | Available
      28 |      10 | Available
      29 |      10 | Available
      30 |      10 | Available
      31 |      11 | Available
:
```

```
 item_id | quantity_available
---------+--------------------
       1 |                   4
       2 |                   2
       3 |                   3
       4 |                   1
       5 |                   4
       6 |                   4
       7 |                   0
       8 |                   4
       9 |                   1
      10 |                   5
      11 |                   2
      12 |                   3
      13 |                   5
      14 |                   3
      15 |                   5
      16 |                   4
      17 |                   3
      18 |                   2
      19 |                   2
      20 |                   3
      21 |                   4
      22 |                   5
      23 |                   1
      24 |                   2
      25 |                   5
      26 |                   1
      27 |                   3
      28 |                   2
      29 |                   1
      30 |                   3
      31 |                   5
:
```

```
author_id |           name
----------+------------------------
        2 | Caitlin Huerta
        3 | Michael Mcgee
        5 | Jennifer Smith
        6 | Kanye West
        7 | Kenneth Daniels
        8 | Regina Martinez
        9 | Tracy Roberts
       10 | Cheryl Aguirre
       11 | Audrey Pan
       13 | Margaret Campbell
       14 | Kristina Wolf
       15 | Owen Rich
       16 | Jeremy White
       17 | Christopher Jones
       18 | Willie Alexander
       19 | Heather Bray
       21 | Tonya Hardy
       22 | Kyle Strong
       24 | Jesus Arias
       27 | James Terrys
       26 | John Clark
       28 | Jessica Keith
       29 | Thomas Hawkins
       30 | Mickey Mouse
       31 | Laura Schultz
       32 | Kitty Jenes
       33 | Cassandra Smith
       34 | Sue Dudley
       35 | Stuart Smith
       36 | Daniel Santana
       37 | Kathleen Smith
:
```

user_id	first_name	last_name	email	address_number	phone_number
1	Bryan	Johnson	anthony64@mcdowell.com	09428 Hernandez Locks Suite 380, East Barryshire, MS 80347	(001)073-0354
2	Vickie	Allison	tonya51@yahoo.com	1735 Jason Ports, Greenshire, DE 41204	(196)800-9762
3	Joshua	Williams	sharonperez@larson-hamilton.com	1008 Jennings Light Suite 703, New Elizabethhaven, WV 05988	(871)988-8590
4	Benjamin	Gallagher	johnsonbrandy@welch.com	PSC 7679, Box 9996, APO AE 59534	(001)188-9925
5	Robert	Jefferson	wallacedebra@yahoo.com	2899 Martin Street Apt. 876, Jacobfort, ME 07346	(131)263-6589
6	Anna	Howe	laurawilcox@hotmail.com	1673 Ashley Fall, North Taraland, MS 15318	(212)617-5770
7	Gabriel	Black	sean27@yahoo.com	2614 Ann Gateway Suite 485, East Allenville, IL 35120	(144)909-7517
8	Amber	Thomas	vcook@yahoo.com	90378 Roy Greens, Haroldberg, NY 34011	(001)192-9224
9	Beverly	Jones	joshuahart@gmail.com	221 Alyssa Rapid Apt. 302, South Travis, MI 72344	(194)708-3783
10	Jonathan	Thompson	donna98@dixon.com	48415 Jennifer Crossing, Port Kristineton, OR 09295	(794)195-2477
11	Joyce	Dickson	montgomeryanthony@frazier.com	8682 Jones Village Apt. 559, Port Lindsey, ID 01406	(439)072-1907
12	Joseph	King	darren83@rodriguez.org	5743 Mack Terrace Suite 891, South Ryanburgh, SC 59556	(798)995-6841
13	Douglas	Burns	jo60@alexander.org	78930 Sanchez Village, South Patriciaburgh, KS 37560	(641)905-9136
14	Derek	White	gbaker@davis.com	62075 Erik Glen, Kevinburgh, LA 40873	(245)841-8225
15	Scott	Martin	tiffany21@hotmail.com	861 Justin Heights Suite 264, Port Madisonberg, AL 10289	

```
mydb=# select * from amount;
 fine_id | user_id | item_id | amount | transaction_id
---------+---------+---------+--------+----------------
       1 |      24 |       7 |   2.85 |           1308
       2 |      38 |      11 |  19.41 |           1307
       3 |      52 |      46 |  28.07 |           1306
       4 |      37 |      22 |  25.07 |           1305
       5 |      15 |       6 |  39.31 |           1304
       6 |      29 |      40 |  33.94 |           1302
       7 |      32 |      25 |  10.14 |           1301
       8 |      57 |      32 |  20.92 |           1042
       9 |      51 |      43 |  13.21 |           1000
      10 |      11 |      14 |  36.57 |           1222
      11 |      56 |      46 |   1.55 |           1032
      12 |      15 |       3 |   1.72 |           1009
      13 |      37 |      45 |   3.54 |           1087
      14 |      60 |      38 |   2.66 |           1066
      15 |      35 |      21 |   3.64 |           1034
      16 |       3 |      16 |   0.97 |           1049
      17 |      29 |      10 |   1.05 |           1010
      18 |       2 |      19 |   3.70 |           1005
      19 |      14 |      34 |   0.83 |           1005
      20 |      36 |      49 |   0.60 |           1222
      21 |      66 |      21 |   0.98 |           1237
      22 |       9 |      11 |   2.07 |           1167
      23 |       4 |      15 |   1.89 |           1144
      24 |      45 |      38 |   3.98 |           1001
      25 |      24 |      17 |   0.73 |           1200
      26 |      17 |      19 |   0.54 |           1011
      27 |      21 |      21 |   1.84 |           1243
      28 |      32 |      19 |   1.90 |           1241
      29 |      10 |      38 |   2.36 |           1102
(29 rows)
```