

Title: Creating a Course Reserve textbook database management system for promoting SJSU Library's Course Reserves program

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Project Description

Internet technology has changed our daily lives dramatically, such as shopping, entertainment and business behavior. While the commercial world benefits tremendously from cutting-edge technology, some institutions have not yet adopted the newest trend. One example is public library systems.

As Master students at San Jose State University, our team members have all encountered inconvenience with purchasing course required textbooks. Textbooks can be very expensive, especially the newest editions. They can be heavy and thus hard to carry around all the time. They can depreciate quickly as newer editions come out. Purchasing a hundred-dollar textbook only for occasional use always makes students debate whether it is worth it or not.

Luckily, many universities in the United States provide course required textbooks rental at their school library. At the San Jose State University Library, a special collection of course required textbooks called Course Reserves are available for SJSU students. Instructors can make a request to the SJSU library to place a university-owned or personal item on the physical Course Reserves for student uses. Students can check out these materials with their student ID.

Library staffs are very passionate about this Course Reserves program because it provides convenience to the students, making their education more affordable. And many students benefit from this program.

But the Course Reserves program also has its limitations. With research and personal experiences, we identify the following issues with the Course Reserves program:

1. The program is highly under-promoted. Many students who needed the help do not know the existence of this program.

2. The program lacks a user-friendly interface to attract its target audience: college students, a large portion of which are undergraduates.

3. The number of textbooks for each course is not proportional with actual demand, causing waste of budget and longer wait time for popular textbooks.

4. The SJSU library website only supports textbook search based on course number and instructor's name. A general search with other information is not supported by the current system.

The goal of this project is to help the Course Reserves program to build a more attractive user interface that allows more search options and design a backend database that would support these search options as well as store more information on renting behaviors to enable further analysis and optimization.

Approach

Due to common practice of most library database systems, our team has decided to create a relational database. Our choice of RDBMS is MySQL due to our familiarity with the system and its compatibility with other programming languages.

Our project focuses on 3 target audiences: students who will be renting from the Course Reserves, librarians who performs daily managing of the textbooks and the database administrator. The project outcome should be as follows:

1. For the student side, our goal is to build a stable and user-friendly web interface, allowing them to search for course required textbooks by ISBN number, title, major, courses and instructors.
2. For the librarian side, we want to create a database with enough information for them to track usage of books and do analysis on the program. Ultimately, our goal is to optimize the Course Reserves program to reach maximum usage and minimum expense.
3. For the administrator, he or she would be given the authorization to both managing the librarians and making major changes to the database.

Implementation steps	
Activity	Limitation and Restrictions
Identify entities, relationships, connectivity and cardinality	
Establish the ER diagram	
Collect and prepare data	Due to university policy, the course reserves list provided by the SJSU library is historical data from the past academic year. We also needed to create some fictional data due to unavailability of the actual data.
Create schema in MySQL	
Import data	
Analyze and check completeness of the database through running a few query statements	
Create a web interface	

Other Restrictions and Limitations:

Because of data privacy, the Course Reserves list we used in this project is historical data from last year, courtesy of SJSU library. We will also need to produce artificial data of student records and renting history, for those data are not available.

Due to the choice of using a relational database, we will process check out and check in data through regular DML. This does not go against the convention of real-world practices, though

new ways of processing it as streaming data may be more efficient. But the choice of a relational database can serve our purpose well enough.

Because we've decided to use ISBN as the primary key to our main book table, this database can only store textbooks with an ISBN number. Other formats such as manuscripts and videos are not supported by our database.

Implementation Details:

1. We first established our business rules as follows:

1) Course Reserves are not restricted by majors. The Course Reserves program opens to both undergraduate and graduate students. Some undergraduate students do not have a declared major.

2) A course can have 0 course reserves, but a course reserve textbook must correspond to at least 1 course.

3) Different classes of the same course may require different textbooks based on instructor's preference.

4) Multiple classes can have the same textbook.

5) One class can have multiple textbooks.

6) One student can borrow multiple books.

7) The database supervisor will be supervising all librarian's uses on the database. He or she has root access to the database.

8) Librarians may add items to the database but cannot delete anything.

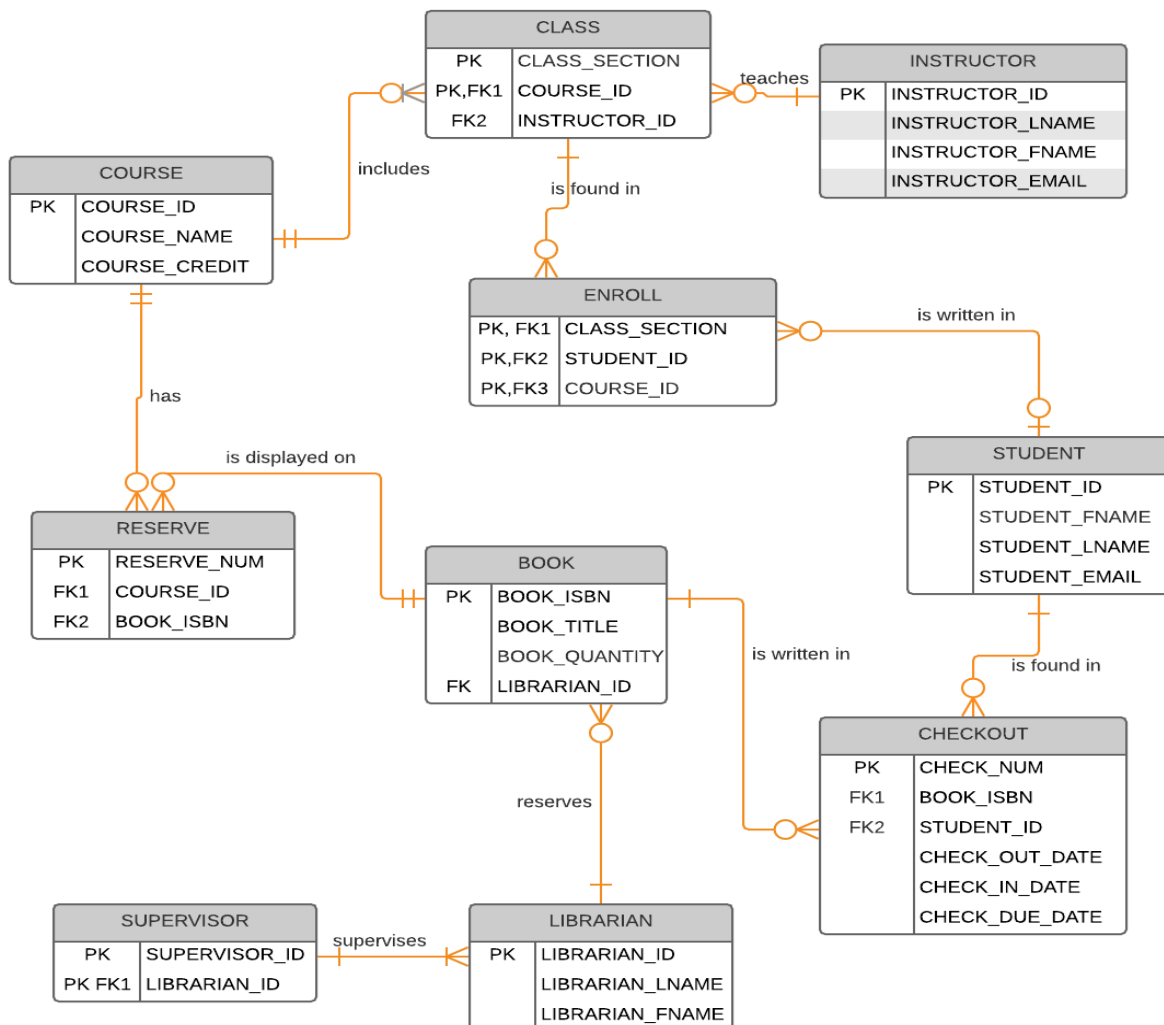
9) Only SJSU student with a valid student ID can check out materials from the Course Reserves Stack.

2. We identified the entities needed in the database as the following table:

ENTITY	RELATIONSHIP	CONNECTIVITY	ENTITY
COURSE(0,1)	HAS	1:M	RESERVE(0,M)
BOOK(0,1)	IS DISPLAYED ON	1:M	RESERVE(0,M)
COURSE(1,1)	INCLUDES	1:M	CLASS(0,M)
INSTRUCTOR(1,M) (needs authorization)	TEACHES	1:M	CLASS(0,M)
CLASS (1,1)	IS FOUND IN	1:M	ENROLL(0,M)
STUDENT(0,1)	IS WRITTEN IN	1:M	ENROLL(0,M)

SUPERVISOR(1,1)	SUPERVISES	1:M	LIBRARIAN(0,M)
LIBRARIAN(1,1) (needs authorization)	RESERVES	1:M	BOOK(0,M)
BOOK(1,1)	IS WRITTEN IN	1:M	CHECKOUT(0,M)
STUDENT(1,1)	IS FOUND IN	1:M	CHECKOUT(0,M)
<p>NOTE1: RESERVE is the composite entity that implements the M:N relationship “COURSE reserves BOOK”</p> <p>NOTE2: ENROLL is the composite entity that implements the M:N relationship “STUDENT enrolls in CLASS”</p> <p>NOTE3: CHECKOUT is the composite entity that implements the M:N relationship “BOOK is checked by STUDENT”</p>			

3. Based on the business rules and entity table, we drew the following ER Diagram for our database. The database is in 3rd normal form.



4. Data Preparation:

Raw data file of the Course Reserves list was provided by the SJSU IT department. After communicating through several emails, they compiled the historical data from past academic year into an excel sheet. The raw Course Reserves list contains the course name, book title and ISBN numbers of the textbooks. There were three main problems that we recognized about this raw data file:

1. A lot of ISBN numbers were missing.
2. The raw data file contained multiple ISBN numbers for the same book. There were different versions of ISBN numbers such as the 10-digit ISBN10 number and the 13-digit ISBN13 number.
3. The raw data file contained course materials of various formats such as manuscripts in PDF format and DVDs.

Our solutions for cleaning up the raw course list file was:

1. We manually filled in all the missing ISBN13 numbers.
2. We decided to use ISBN13 as our primary key to the BOOK table, so we manually cleaned out all superfluous ISBNs and other book identification numbers.
3. We decided to only limit our database to textbooks with an ISBN number, so we cleared out materials of other formats.
4. We converted it into csv format.

For the course list, we manually copied course information from the SJSU course catalog webpage and pasted it into an excel sheet, then converted it into csv format.

We also generated some fictional data due to the unavailability of the actual data. The data files we generated were: student information, librarian information, instructor information, check-in and check-out history, enrollment information.

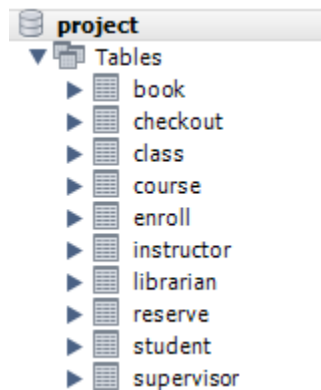
We used some built-in functions in Excel to generate random numbers of a specific format. For student ids , we first defined the function randbetween(000000000, 999999999) in the first cell and then dragged down to generate random 9-digit number combinations. Similar procedure was used to generate how many copies of textbook there were. We defined the range as 1 to 3 copies for each book.

For student and instructor names, we found the top 500 popular names online and randomly assigned them to the student's and instructor's first and last names. After that, we used the function concatenate() to generate their email addresses like that of the SJSU official email address.

5. Creating the database

We used MySQL workbench to create our database schema and built-in functions to import the data from csv file.

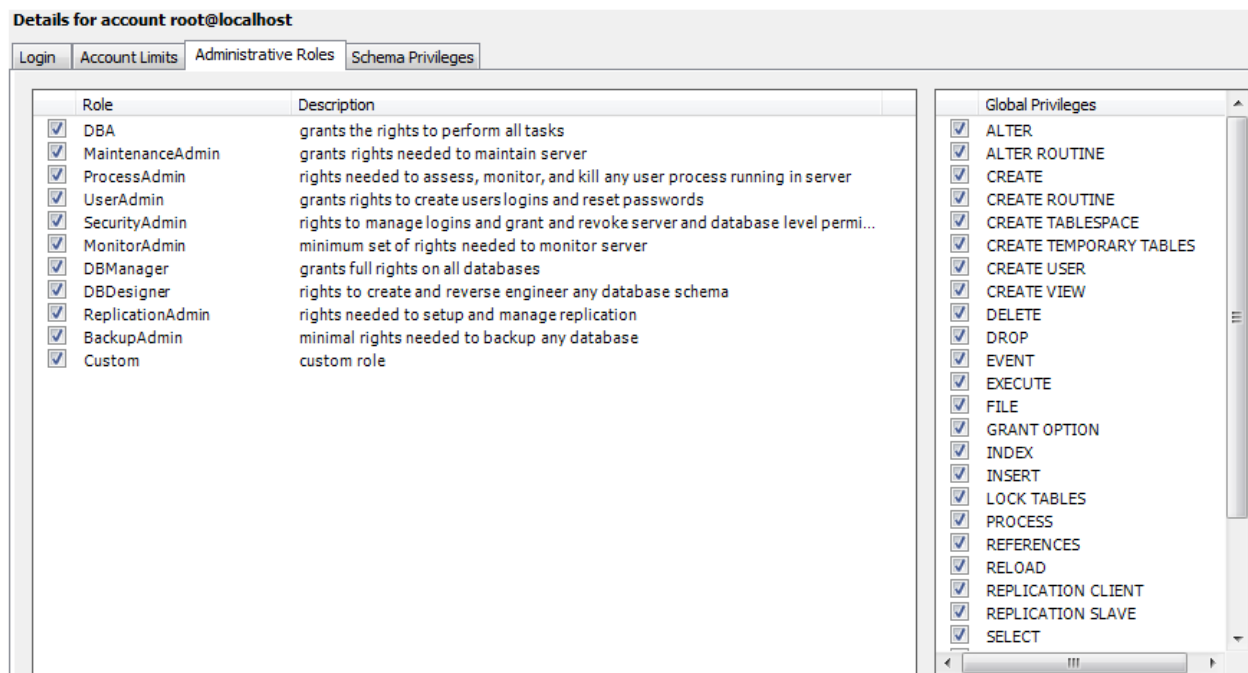
- List of Tables:



- User&Authorizations:

We defined three types of accesses: root access for the database supervisor who has administrative privilege to the database, he or she is allowed to perform all actions to the database; librarian access for the librarians who can add books to and backup the database; student access who can only run queries but cannot modify the database.

Root access authorizations:



Librarian access authorizations:

Details for account librarian@localhost

Login Account Limits Administrative Roles Schema Privileges

Role	Description
<input type="checkbox"/> DBA	grants the rights to perform all tasks
<input type="checkbox"/> MaintenanceAdmin	grants rights needed to maintain server
<input type="checkbox"/> ProcessAdmin	rights needed to assess, monitor, and kill any user process running in server
<input type="checkbox"/> UserAdmin	grants rights to create users logins and reset passwords
<input type="checkbox"/> SecurityAdmin	rights to manage logins and grant and revoke server and database level permi...
<input type="checkbox"/> MonitorAdmin	minimum set of rights needed to monitor server
<input type="checkbox"/> DBManager	grants full rights on all databases
<input type="checkbox"/> DBDesigner	rights to create and reverse engineer any database schema
<input type="checkbox"/> ReplicationAdmin	rights needed to setup and manage replication
<input checked="" type="checkbox"/> BackupAdmin	minimal rights needed to backup any database
<input checked="" type="checkbox"/> Custom	custom role

Global Privileges

- ☐ CREATE USER
- ☐ CREATE VIEW
- ☐ DELETE
- ☐ DROP
- ☒ EVENT
- ☐ EXECUTE
- ☐ FILE
- ☐ GRANT OPTION
- ☐ INDEX
- ☒ INSERT
- ☒ LOCK TABLES
- ☐ PROCESS
- ☐ REFERENCES
- ☐ RELOAD
- ☐ REPLICATION CLIENT
- ☐ REPLICATION SLAVE
- ☒ SELECT
- ☒ SHOW DATABASES
- ☐ SHOW VIEW
- ☐ SHUTDOWN
- ☐ SUPER
- ☐ TRIGGER
- ☐ UPDATE

Student access authorizations:

Details for account student@localhost

Login Account Limits Administrative Roles Schema Privileges

Role	Description
<input type="checkbox"/> DBA	grants the rights to perform all tasks
<input type="checkbox"/> MaintenanceAdmin	grants rights needed to maintain server
<input type="checkbox"/> ProcessAdmin	rights needed to assess, monitor, and kill any user process running in server
<input type="checkbox"/> UserAdmin	grants rights to create users logins and reset passwords
<input type="checkbox"/> SecurityAdmin	rights to manage logins and grant and revoke server and database level permi...
<input type="checkbox"/> MonitorAdmin	minimum set of rights needed to monitor server
<input type="checkbox"/> DBManager	grants full rights on all databases
<input type="checkbox"/> DBDesigner	rights to create and reverse engineer any database schema
<input type="checkbox"/> ReplicationAdmin	rights needed to setup and manage replication
<input type="checkbox"/> BackupAdmin	minimal rights needed to backup any database

Global Privileges

- ☐ ALTER
- ☐ ALTER ROUTINE
- ☐ CREATE
- ☐ CREATE ROUTINE
- ☐ CREATE TABLESPACE
- ☐ CREATE TEMPORARY TABLES
- ☐ CREATE USER
- ☐ CREATE VIEW
- ☐ DELETE
- ☐ DROP
- ☐ EVENT
- ☐ EXECUTE
- ☐ FILE
- ☐ GRANT OPTION
- ☐ INDEX
- ☐ INSERT
- ☐ LOCK TABLES
- ☐ PROCESS
- ☐ REFERENCES
- ☐ RELOAD
- ☐ REPLICATION CLIENT
- ☐ REPLICATION SLAVE
- ☐ SELECT

- Table contents:

BOOK: information on all books in the Course Reserves Program.

	book_isbn	book_title	book_quantity	librarian_id
▶	9780030206931	Pushing electrons : a guide for students of orga...	2	101
	9780030322846	The Dobe Ju/'hoansi /	3	102
	9780060182939	Paper daughter : a memoir /	2	102
	9780060194482	A people's history of the United States : 1492-p...	1	103
	9780060242534	Am I blue? : coming out from the silence /	3	103
	9780060747497	Rebirth of a nation : the making of modern Ame...	1	104
	9780060760908	One Crazy Summer	1	105
	9780060838652	A People's History of the United States	3	105
	9780060959449	Yell-oh girls! : emerging voices explore culture, i...	3	103
	9780061695131	Tell my horse /	1	104
	9780061857768	Wemberly Worried	1	101
	9780062641946	The One and Only Ivan	1	103
	9780070089853	Advanced strength and applied stress analysis /	1	102
	9780071280839	Life-Span Development 12e	3	103
	9780071362962	The robot builder's bonanza /	3	104
	9780071452816	Practical Electronics for Inventors 2e	1	103
	9780071467810	Resumes for Social Service Careers 3e	2	105
	9780071544825	Great Jobs for Sociology Majors 3e	1	104
	9780072356441	Principles of electrical engineering materials and...	1	105
	9780072424430	Modern compressible flow : with historical persp...	3	103
	9780072828801	Marketing Re	3	104

CHECKOUT: records borrowing history such as check-in and check-out records and due dates.

check_num	book_isbn	check_out_date	check_due_date	check_in_date	student_id
91001	9780060838652	2018-09-11	2018-09-18	2018-09-13	335493990
91002	9780520274358	2018-06-27	2018-07-04	2018-07-03	906554769
91003	9780134101972	2018-05-10	2018-05-17	2018-05-15	543667343
91004	9780321052964	2018-10-13	2018-10-20	2018-10-26	803147960
91005	9781476739410	2018-07-23	2018-07-30	2018-07-25	963450841
91006	9780134571706	2018-10-12	2018-10-19	2018-10-17	679482761
91007	9780205771295	2018-05-29	2018-06-05	2018-06-01	524004622
91008	9780072424430	2018-06-01	2018-06-08	2018-06-04	620029738
91009	9780275950712	2018-08-18	2018-08-25	2018-08-19	094399377
91010	9780807842218	2018-08-19	2018-08-26	2018-08-23	684551731
91011	9780807740422	2018-07-18	2018-07-25	2018-07-23	568092859
91012	9780385523462	2018-05-06	2018-05-13	2018-05-19	762471111
91013	9780072949582	2018-06-22	2018-06-29	2018-07-02	835555030
91014	9780393614183	2018-08-26	2018-09-02	2018-09-01	437537690
91015	9780393614190	2018-09-18	2018-09-25	2018-09-20	052196504
91016	9780393935523	2018-07-09	2018-07-16	2018-07-15	429064800
91017	9780393911916	2018-08-10	2018-08-17	2018-08-18	803826642
91018	9780393935523	2018-07-09	2018-07-16	2018-07-15	429064800

CLASS: class sections of each course.

course_id	class_section	instructor_id
DSIT 5	1	100
EDSE 224	1	100
EE 128	1	100
ENVS 185	1	100
PSYC 102	2	100
BUS4 118H	1	101
BUS5 40	1	101
HIST 210C	1	101
MATH 265	1	101
POLS 170V	1	102
SCWK 111	1	102
BUS 282B	1	103
CA 172	1	103
SOCI 160	1	103
HPRF 100W	1	104
OCTH 212	1	104
GEOL 6	1	105
ANTH 11	1	107
ARTH 182A	1	107
FS 11	1	107
AAS 33A	2	107

COURSE: courses in a semester

course_id	course_name	course_credit
AAS 33A	Asian American Studies 33A	3
AE 264	Aerospace Engineering 264	5
AFAM 110	African American Studies 110	4
AMS 169	American Studies 169	3
AMS 1A	American Studies 1A	5
AMS 1B	American Studies 1B	5
ANTH 107	Anthropology 107	4
ANTH 11	Anthropology 11	3
ANTH 115	Anthropology 115	3
ANTH 12	Anthropology 12	4
ANTH 130	Anthropology 130	3
ANTH 131	Anthropology 131	4
ANTH 140	Anthropology 140	3
ANTH 175	Anthropology 175	3
ANTH 230	Anthropology 230	3
ANTH 25	Anthropology 25	4
Anthropo...	Anthropology 140	4
Anthropo...	Anthropology 140	5
Anthropo...	Anthropology 195	5
Anthropo...	Anthropology 193	5
ART 100W	Art 100W	3
ARTH 110	Art History 110	3

ENROLL: enroll table to store which student is enrolled in which class. Allows textbook search based on courses that the student takes.

course_num	class_section	student_id
HIST 177	1	003040211
ARTH 183B	1	007600332
LING 129	1	007600332
CHEM 132	1	010499474
OCTH 246	1	010499474
BOT 165	1	033438480
MATH 285	1	033438480
ANTH 230	1	043344439
JPN 25B	1	043344439
ARTH 193A-2	1	048339590
MAS 135	1	048339590
ANTH 131	1	052196504
JOUR 61	1	052196504
DSIT 109	1	053219245
PSYC 121B	1	053219245
ARTH 182A	1	061987846
LING 112	1	061987846
CMPF 255	1	062299076

INSTRUCTOR: instructor information. Allows textbook search based on instructor names.

instructor_id	instructor_lname	instructor_fname	instructor_email
100	james	abourezk	abourezk.james@sjsu.edu
101	creighton	abrams	abrams.creighton@sjsu.edu
102	jane	ace	ace.jane@sjsu.edu
103	john	acton	acton.john@sjsu.edu
104	abigail	adams	adams.abigail@sjsu.edu
105	douglas	adams	adams.douglas@sjsu.edu
106	henry	adams	adams.henry@sjsu.edu
107	john	adams	adams.john@sjsu.edu
108	john	adams	adams.john@sjsu.edu
109	samuel	adams	adams.samuel@sjsu.edu
110	scott	adams	adams.scott@sjsu.edu
111	jane	addams	addams.jane@sjsu.edu
112	joseph	addison	addison.joseph@sjsu.edu
113	alfred	adler	adler.alfred@sjsu.edu
114	theodor	adorno	adorno.theodor@sjsu.edu
115	ben	affleck	affleck.ben@sjsu.edu
116	keiko	agena	agena.keiko@sjsu.edu
117	spiro	agnew	agnew.spiro@sjsu.edu
118	koy	ah	ah.koy@sjsu.edu
119	eden	ahbez	ahbez.eden@sjsu.edu
120	bertie	ahern	ahern.bertie@sjsu.edu
121	clay	aiken	aiken.clay@sjsu.edu
122	conrad	aiken	aiken.conrad@sjsu.edu
123	peter	akinola	akinola.peter@sjsu.edu
124	muqtada	al-sadr	al-sadr.muqtada@sjsu.edu

LIBRARIAN: librarians who manages the Course Reserves stack.

librarian_id	librarian_fname	librarian_lname
101	garrison	william
102	kennedy	john
103	snow	carrie
104	stewart	jon
105	thompson	hunter

RESERVE: table that stores which textbooks are reserved for which course.

reserve_num	course_id	book_isbn
RE1	AAS 33A	9780060838652
RE2	AAS 33A	9780520274358
RE3	AAS 33A	9780134101972
RE4	AAS 33A	9780321052964
RE5	AAS 33A	9781476739410
RE6	AAS 33A	9780134571706
RE7	AAS 33A	9780205771295
RE8	AE 264	9780072424430
RE10	AFAM 110	9780807842218
RE11	AFAM 110	9780807740422
RE9	AFAM 110	9780275950712
RE12	AMS 169	9780385523462
RE13	AMS 1A	9780072949582
RE14	AMS 1A	9780393614183
RE15	AMS 1A	9780393614190
RE16	AMS 1A	9780393935523
RE17	AMS 1A	9780393911916
RE18	AMS 1A	9780393920291
RE19	AMS 1A	9780205962051
RE20	AMS 1A	9780760700761
RE21	AMS 1A	9781133310242
RE22	AMS 1A	9781133310259
RE23	AMS 1A	9781133310266
RE24	AMS 1A	9780393264524
RE25	AMS 1A	9780393264531
RE26	AMS 1A	9780393918861
RE27	AMS 1A	9780393918878
RE28	AMS 1B	9780393614183
RE29	AMS 1B	9780393614190
RE30	AMS 1B	9780393935523
RE31	AMS 1B	9780393911916

STUDENT: records of all students on campus.

student_id	student_fname	student_lname	student_email
003040211	foley	mick	foley.mick@sjsu.edu
007600332	ebadi	shirin	ebadi.shirin@sjsu.edu
010499474	khushchev	nikita	khushchev.nikita@sjsu.edu
033438480	harper	stephen	harper.stephen@sjsu.edu
043344439	dali	salvador	dali.salvador@sjsu.edu
048339590	farmer	frances	farmer.frances@sjsu.edu
052196504	canseco	josé	canseco.josé@sjsu.edu
053219245	manchester	william	manchester.william@sjsu.edu
061987846	early	jubal	early.jubal@sjsu.edu
062299076	king	martin	king.martin@sjsu.edu
062504889	kilmister	lemmy	kilmister.lemmy@sjsu.edu
064125376	barker	dive	barker.dive@sjsu.edu
065823029	galtieri	leopoldo	galtieri.leopoldo@sjsu.edu
066045388	kilmer	joyce	kilmer.joyce@sjsu.edu
070233705	galloway	george	galloway.george@sjsu.edu
071001735	jillette	penn	jillette.penn@sjsu.edu
075045794	john	paul	john.paul@sjsu.edu

SUPERVISOR: the 1 supervisor who manages all librarians.

supervisor_id	librarian_id
1	101
1	102
1	103
1	104
1	105

6. Queries

Our database should allow students to search for a specific book with various information and allow librarians to perform daily operations and information checking. We've written down a few queries that support typical functions of this system. The query statements, their functions and screenshots of their results are listed below:

Functions for the student's side:

1. Search for course reserve textbooks with course id containing "ANTH", such as "ANTH 107".

```
SELECT COURSE.COURSE_ID, COURSE_NAME, COURSE_CREDIT,  
INSTRUCTOR_FNAME, INSTRUCTOR_LNAME, BOOK.BOOK_ISBN, BOOK_TITLE,  
BOOK_QUANTITY  
FROM COURSE  
JOIN RESERVE ON COURSE.COURSE_ID=RESERVE.COURSE_ID  
JOIN BOOK ON RESERVE.BOOK_ISBN=BOOK.BOOK_ISBN
```

```

JOIN CLASS ON CLASS.COURSE_ID=COURSE.COURSE_ID
JOIN INSTRUCTOR ON CLASS.INSTRUCTOR_ID=INSTRUCTOR.INSTRUCTOR_ID
WHERE COURSE.COURSE_ID LIKE "%ANTH%";

```

course_id	course_name	course_credit	instructor_fname	instructor_lname	book_isbn	book_title	book_quantity
ANTH 107	Anthropology 107	4	alcott	louisa	9780199738144	Nutritional Anthropology 2e	3
ANTH 107	Anthropology 107	4	addison	joseph	9780199738144	Nutritional Anthropology 2e	3
ANTH 107	Anthropology 107	4	rothbard	murray	9780199738144	Nutritional Anthropology 2e	3
ANTH 11	Anthropology 11	3	adams	john	9781285738505	Classic Readings in Cultural Anthropology	1
ANTH 11	Anthropology 11	3	adams	john	9780321047069	Conformity and conflict : readings in cultural ant...	1
ANTH 11	Anthropology 11	3	adams	john	9781324000778	Cultural Anthropology	2
ANTH 11	Anthropology 11	3	adams	john	9780495467380	Cultural Anthropology (Custom Ed.)	3
ANTH 11	Anthropology 11	3	adams	john	9780072876086	Culture sketches : case studies in anthropology /	3
ANTH 11	Anthropology 11	3	adams	john	9780534066987	Ethnic Identity in China	3
ANTH 11	Anthropology 11	3	adams	john	9780385014854	Guests of the Sheik	2
ANTH 11	Anthropology 11	3	adams	john	9780073531045	Mirror for humanity : a concise introduction to c...	1
ANTH 11	Anthropology 11	3	adams	john	9780534613082	New capitalists : law, politics, and identity surro...	3
ANTH 11	Anthropology 11	3	adams	john	9780030322846	The Dobe Ju/hoansi /	3
ANTH 11	Anthropology 11	3	adams	john	9780536745545	Emerging Global Cultures 2e	3
ANTH 11	Anthropology 11	3	adams	john	9780134014012	Exploring Biological Anthropology: The Essential...	2
ANTH 11	Anthropology 11	3	adams	john	9781516519071	The Human Organism 2e	2
ANTH 130	Anthropology 130	3	gangchuan	cao	9780804754910	Busier than ever! : why American families can't ...	2
ANTH 130	Anthropology 130	3	gangchuan	cao	9780520269453	Deen China	3

2. Search for course reserve textbooks with course name containing “American”, such as “American History”.

```

SELECT COURSE.COURSE_ID, COURSE_NAME, COURSE_CREDIT,
INSTRUCTOR_FNAME, INSTRUCTOR_LNAME, BOOK.BOOK_ISBN, BOOK_TITLE,
BOOK_QUANTITY
FROM COURSE
JOIN RESERVE ON COURSE.COURSE_ID=RESERVE.COURSE_ID
JOIN BOOK ON RESERVE.BOOK_ISBN=BOOK.BOOK_ISBN
JOIN CLASS ON CLASS.COURSE_ID=COURSE.COURSE_ID
JOIN INSTRUCTOR ON CLASS.INSTRUCTOR_ID=INSTRUCTOR.INSTRUCTOR_ID
WHERE COURSE.COURSE_NAME LIKE "%American%";

```

course_id	course_name	course_credit	instructor_fname	instructor_lname	book_isbn	book_title	book_quantity
AAS 33A	Asian American Studies 33A	3	mann	horace	9780060838652	A People's History of the United States	3
AAS 33A	Asian American Studies 33A	3	mann	horace	9780520274358	American History Unbound: Asians and Pacific I...	1
AAS 33A	Asian American Studies 33A	3	mann	horace	9780134101972	Created Equal 5e	3
AAS 33A	Asian American Studies 33A	3	mann	horace	9780321052964	Created Equal: A social and political history of t...	1
AAS 33A	Asian American Studies 33A	3	mann	horace	9781476739410	The Making of Asian America: A History	1
AAS 33A	Asian American Studies 33A	3	mann	horace	9780134571706	The Struggle for Democracy	1
AAS 33A	Asian American Studies 33A	3	mann	horace	9780205771295	The Struggle for Democracy 10e	1
AAS 33A	Asian American Studies 33A	3	adams	john	9780060838652	A People's History of the United States	3
AAS 33A	Asian American Studies 33A	3	adams	john	9780520274358	American History Unbound: Asians and Pacific I...	1
AAS 33A	Asian American Studies 33A	3	adams	john	9780134101972	Created Equal 5e	3
AAS 33A	Asian American Studies 33A	3	adams	john	9780321052964	Created Equal: A social and political history of t...	1
AAS 33A	Asian American Studies 33A	3	adams	john	9781476739410	The Making of Asian America: A History	1
AAS 33A	Asian American Studies 33A	3	adams	john	9780134571706	The Struggle for Democracy	1
AAS 33A	Asian American Studies 33A	3	adams	john	9780205771295	The Struggle for Democracy 10e	1
AFAM 110	African American Studies 110	4	hart	lorenz	9780807842218	The Education of Blacks in the South, 1860-1935	3
AFAM 110	African American Studies 110	4	hart	lorenz	9780807740422	The White Architects of Black Education: Ideolo...	2
AFAM 110	African American Studies 110	4	hart	lorenz	9780275950712	Historical perspectives on the education of blac...	3
AMS 169	American Studies 169	3	baker	russell	9780385523462	Borat	3

3. Search for course reserve textbooks with instructor's last name containing "al", such as "Albert".

```
SELECT COURSE.COURSE_ID, COURSE_NAME, COURSE_CREDIT,
INSTRUCTOR_FNAME, INSTRUCTOR_LNAME, BOOK.BOOK_ISBN, BOOK_TITLE,
BOOK_QUANTITY
FROM COURSE
JOIN RESERVE ON COURSE.COURSE_ID=RESERVE.COURSE_ID
JOIN BOOK ON RESERVE.BOOK_ISBN=BOOK.BOOK_ISBN
JOIN CLASS ON CLASS.COURSE_ID=COURSE.COURSE_ID
JOIN INSTRUCTOR ON CLASS.INSTRUCTOR_ID=INSTRUCTOR.INSTRUCTOR_ID
WHERE INSTRUCTOR_LNAME LIKE "%al%";
```

course_id	course_name	course_credit	instructor_fname	instructor_lname	book_isbn	book_title	book_quantity
CHEM 130A	Chemistry 130A	5	adler	alfred	9781429234146	Principles of Biochemistry 6e	3
OCTH 266	Occupational Therapy 266	3	adler	alfred	9780803646056	Functional performance in older adults /	2
PSYC 135	Psychology 135	4	adler	alfred	9780205521081	Cognitive Psychology 8e	1
ME 106	Mechanical Engineering 106	3	crowley	aleister	9780195307023	Applied Mechatronics	3
ME 106	Mechanical Engineering 106	3	crowley	aleister	9781401812065	Embedded C programming and the Atmel AVR /	1
ME 106	Mechanical Engineering 106	3	crowley	aleister	9780131433564	Introduction to Mechatronic Design	1
ME 106	Mechanical Engineering 106	3	crowley	aleister	9780073380230	Introduction to Mechatronics and Measurement ...	3
ME 106	Mechanical Engineering 106	3	crowley	aleister	9780582357051	Mechatronics : electronic control systems in mec...	3
ME 106	Mechanical Engineering 106	3	crowley	aleister	9781568810119	Mobile robots : inspiration to implementation /	1
ME 106	Mechanical Engineering 106	3	crowley	aleister	9780201331387	Patterns for time-triggered embedded systems ...	3
ME 106	Mechanical Engineering 106	3	crowley	aleister	9780071452816	Practical Electronics for Inventors 2e	1
ME 106	Mechanical Engineering 106	3	crowley	aleister	9780521370950	The art of electronics /	2
ME 106	Mechanical Engineering 106	3	crowley	aleister	9780071362962	The robot builder's bonanza /	3
MATH 12	Mathematics 12	4	einstein	albert	9780321448040	Mathematics for elementary school teachers /	3
DSIT 109	Interior Design 109	4	forbes	malcolm	9781568987903	Digital fabrications : architectural and material t...	1
BUS 187	Business 187	4	ford	gerald	9780078112775	International Business 10e	1
CHAD 15	Child and Adolescent Deve...	4	ford	gerald	9781259343001	Life-Span Development	2
CHAD 15	Child and Adolescent Deve...	4	ford	gerald	9780071280839	Life-Span Development 12e	3

4. Search for course reserve textbooks with book title containing "al", such as "cultural".

```
SELECT COURSE.COURSE_ID, COURSE_NAME, COURSE_CREDIT,
INSTRUCTOR_FNAME, INSTRUCTOR_LNAME, BOOK.BOOK_ISBN, BOOK_TITLE,
BOOK_QUANTITY
FROM COURSE
JOIN RESERVE ON COURSE.COURSE_ID=RESERVE.COURSE_ID
JOIN BOOK ON RESERVE.BOOK_ISBN=BOOK.BOOK_ISBN
JOIN CLASS ON CLASS.COURSE_ID=COURSE.COURSE_ID
JOIN INSTRUCTOR ON CLASS.INSTRUCTOR_ID=INSTRUCTOR.INSTRUCTOR_ID
WHERE BOOK_TITLE LIKE "%al%";
```

course_id	course_name	course_credit	instructor_fname	instructor_lname	book_isbn	book_title	book_quantity
AAS 33A	Asian American Studies 33A	3	mann	horace	9780134101972	Created Equal 5e	3
AAS 33A	Asian American Studies 33A	3	mann	horace	9780321052964	Created Equal: A social and political history of t...	1
AAS 33A	Asian American Studies 33A	3	adams	john	9780134101972	Created Equal 5e	3
AAS 33A	Asian American Studies 33A	3	adams	john	9780321052964	Created Equal: A social and political history of t...	1
AE 264	Aerospace Engineering 264	5	cross	david	9780072424430	Modern compressible flow : with historical persp...	3
AFAM 110	African American Studies 110	4	hart	lorenz	9780275950712	Historical perspectives on the education of blac...	3
AMS 1A	American Studies 1A	5	niven	larry	9780760700761	The Constitution of the United States of Americ...	3
ANTH 107	Anthropology 107	4	alcott	louisa	9780199738144	Nutritional Anthropology 2e	3
ANTH 107	Anthropology 107	4	addison	joseph	9780199738144	Nutritional Anthropology 2e	3
ANTH 107	Anthropology 107	4	rothbard	murray	9780199738144	Nutritional Anthropology 2e	3
ANTH 11	Anthropology 11	3	adams	john	9781285738505	Classic Readings in Cultural Anthropology	1
ANTH 11	Anthropology 11	3	adams	john	9780321047069	Conformity and conflict : readings in cultural ant...	1
ANTH 11	Anthropology 11	3	adams	john	9781324000778	Cultural Anthropology	2
ANTH 11	Anthropology 11	3	adams	john	9780495467380	Cultural Anthropology (Custom Ed.)	3
ANTH 11	Anthropology 11	3	adams	john	9780073531045	Mirror for humanity : a concise introduction to c...	1
ANTH 11	Anthropology 11	3	adams	john	9780534613082	New capitalists : law, politics, and identity surro...	3
ANTH 11	Anthropology 11	3	adams	john	9780536745545	Emerging Global Cultures 2e	3
ANTH 11	Anthropology 11	3	adams	john	9780134014012	Exploring Biological Anthropology: The Essential...	2

Functions for librarians:

5. Search for borrowing record by student id.

```

SELECT STUDENT.STUDENT_ID, STUDENT_FNAME, STUDENT_LNAME,
BOOK.BOOK_ISBN, BOOK_TITLE, CHECK_OUT_DATE, CHECK_IN_DATE,
CHECK_DUE_DATE
FROM STUDENT
JOIN CHECKOUT ON STUDENT.STUDENT_ID=CHECKOUT.STUDENT_ID
JOIN BOOK ON BOOK.BOOK_ISBN=CHECKOUT.BOOK_ISBN
WHERE STUDENT.STUDENT_ID="335493990";

```

student_id	student_fname	student_lname	book_isbn	book_title	check_out_date	check_in_date	check_due_date
335493990	aaron	hank	9780060838652	A People's History of the United States	2018-09-11	2018-09-13	2018-09-18

6. Search for available books.

```

SELECT BOOK_ISBN,BOOK_TITLE,BOOK_QUANTITY
FROM BOOK
WHERE BOOK_QUANTITY>0

```

book_isbn	book_title	book_quantity
9780030206931	Pushing electrons : a guide for students of orga...	2
9780030322846	The Dobe Ju/'hoansi /	3
9780060182939	Paper daughter : a memoir /	2
9780060194482	A people's history of the United States : 1492-p...	1
9780060242534	Am I blue? : coming out from the silence /	3
9780060747497	Rebirth of a nation : the making of modern Ame...	1
9780060760908	One Crazy Summer	1
9780060838652	A People's History of the United States	3
9780060959449	Yell-oh girls! : emerging voices explore culture, i...	3
9780061695131	Tell my horse /	1
9780061857768	Wemberly Worried	1
9780062641946	The One and Only Ivan	1
9780070089853	Advanced strength and applied stress analysis /	1

7. Search for overdue books.

```
SELECT STUDENT.STUDENT_ID, STUDENT_FNAME, STUDENT_LNAME,
BOOK.BOOK_ISBN, BOOK_TITLE, CHECK_OUT_DATE, CHECK_IN_DATE,
CHECK_DUE_DATE
FROM STUDENT
JOIN CHECKOUT ON STUDENT.STUDENT_ID=CHECKOUT.STUDENT_ID
JOIN BOOK ON BOOK.BOOK_ISBN=CHECKOUT.BOOK_ISBN
WHERE CHECK_IN_DATE>CHECK_DUE_DATE OR (CHECK_IN_DATE IS NULL AND
CHECK_DUE_DATE<CURRENT_DATE());
```

student_id	student_fname	student_lname	book_isbn	book_title	check_out_date	check_in_date	check_due_date
033438480	harper	stephen	9781324000778	Cultural Anthropology	2018-07-31	2018-08-10	2018-08-07
741605658	harris	sam	9780495467380	Cultural Anthropology (Custom Ed.)	2018-08-07	2018-08-17	2018-08-14
633716084	hašek	jaroslav	9780030322846	The Dobe Ju/'hoansi /	2018-09-13	2018-09-23	2018-09-20
914374052	hathaway	anne	9780536745545	Emerging Global Cultures 2e	2018-05-27	2018-06-06	2018-06-03
914374052	hathaway	anne	9780520269453	Deep China	2018-07-20	2018-08-02	2018-07-27
085089735	jarry	alfred	9780813348612	Kinship and Gender: An Introduction 5e	2018-07-14	2018-07-24	2018-07-21
125967469	jay	glenn	9780520217546	Perfectly Japanese : making families in an era o...	2018-08-14	2018-08-27	2018-08-21
272760189	jelinek	fred	9780198740292	Witchcraft, oracles and magic among the Azande,	2018-10-18	2018-10-31	2018-10-25
071001735	jillette	penn	9780521815628	In search of respect : selling crack in El Barrio /	2018-08-28	2018-09-10	2018-09-04
484785070	joan	of	9780385019569	The Navaho /	2018-08-14	2018-08-22	2018-08-21
691609777	john	of	9780130195234	Human Development in Multicultural Contexts: ...	2018-06-08	2018-06-16	2018-06-15
366965808	khan	genghis	9780394556680	Other Americas /	2018-08-16	2018-08-26	2018-08-23
499756687	khayyam	omar	9780893816773	Electronic culture : technology and visual repres...	2018-05-08	2018-05-21	2018-05-15
405411138	khomeini	ruhollah	9780500203781	New media in art /	2018-04-24	2018-05-07	2018-05-01
010499474	khrushchev	nikita	9780520210134	Six years: the dematerialization of the art objec...	2018-07-31	2018-08-10	2018-08-07
312088128	king	coretta	9780870703744	The history of photography from 1839 to the pr...	2018-08-24	2018-09-01	2018-08-31
835740149	landers	ann	9780847808816	High tech architecture /	2018-11-01	NULL	2018-11-30

8. Find most popular textbooks so they may purchase more copies in the future.

```
SELECT CHECKOUT.BOOK_ISBN, BOOK.BOOK_TITLE,
COUNT(CHECKOUT.BOOK_ISBN) AS "TIMES"
FROM BOOK
JOIN CHECKOUT ON CHECKOUT.BOOK_ISBN=BOOK.BOOK_ISBN
GROUP BY CHECKOUT.BOOK_ISBN
ORDER BY TIMES DESC;
```

book_isbn	book_title	times
9780847808816	High tech architecture /	4
9781133310242	The Heath Anthology of American Literature Vol...	3
9781133310259	The Heath Anthology of American Literature Vol...	3
9781133310266	The Heath Anthology of American Literature Vol...	3
9780393264524	The Norton Anthology American Literature v1	2
9780393264531	The Norton Anthology American Literature v2	2
9780393614183	Give Me Liberty 5e v1	2
9780393614190	Give Me Liberty 5e v2	2
9780393911916	Give Me Liberty! An American History Volume 2,...	2
9780393918861	The Norton Anthology: American Literature Volu...	2
9780393918878	The Norton Anthology: American Literature Volu...	2
9780393920291	Give Me Liberty: An American History Volume 1 4e	2

7. Web interface design

For the web interface, we designed a dashboard for Librarians to better monitor the borrowing behavior and perform searches on the database. We used Apache server from XAMPP, PHP and bootstrap template with HTML, CSS and JavaScript.

We tried 2 search options: 1. search by partial title name; 2. a drop-down list of other information.

For the search by partial title name function, we used an html form and HTTP get method to store user input in a global value. Code snippets are shown below:

```
<form method="get">
  Search: <input type="text" name="search" ><br>
  <input type="submit" value="Submit">
</form>
```

```
<?php
if ($db->connect_error) {
    die("Connection failed: " . $db->connect_error);
}
if (isset($_GET['search'])) {
    $search = $_GET['search'];
} else {
    echo "Please submit a search.";
}
echo("$search");

$sql = "SELECT * FROM BOOK WHERE BOOK_TITLE LIKE '%" . "$search" . "%'";
```

But this search function was limited by the hardcoded table name, it can only search for results in the BOOK table. So, in further development we disabled this function and created a more dynamic search: we created a list of options for our users to select from. Each option corresponds to a specific query that will automatically create a view in our database.

The list currently contains four options: 1. Check for all the textbooks in the database; 2. Check for currently available books; 3. Check for all borrowing history(for analysis purposes); 4. Check all student information in the system(for analysis purposes). But it is easy for us to expand the list in the future.

```
Choose the list you want:
<form action="" method="POST">
  <select name="mySelect">
    <option value="Books">Books</option>
    <option value="Availability">Currently Available</option>
    <option value="History">History</option>
    <option value="Student">Student</option>
  </select>
  <input type="submit" name="submit" value="Search" />
</form>
```

After getting the selected option from user, our code automatically finds the corresponding query and create a view of the information selected. The views were created in our MySQL database.

```
<?php
if(isset($_POST['mySelect'])){
    $selected_val = $_POST['mySelect'];
    if ($selected_val == "Books") {
        $sql = "select * from book ";
    } else if ($selected_val == "Availability") {
        //input query statement to display available books
        $sql="select * from book where book_quantity>0";
    } else if ($selected_val == "History") {
        //input query statement that displays borrowing history
        $sql="select student.student_id,student_fname,student_lname,book.book_isbn,
        book_title,check_out_date,check_in_date,check_due_date
        from student
        join checkout on student.student_id=checkout.student_id
        join book on book.book_isbn=checkout.book_isbn";
    } else {
        //query for student info
        $sql="select * from student";
    }
    $viewQuery = "CREATE VIEW myView" . $selected_val . " AS " . $sql;
    echo $viewQuery;
    $db->query($viewQuery);
} else {
    echo "no table selected";
}
?>
```

Our code automatically creates the webpage table according to the view we've created and stored in the database. This search function was more dynamic than the previous one because it allows us to display different tables and results from joined tables.

```
<?php
//grasp the column names from created view.
$columns = $db->query("SHOW COLUMNS FROM myView" . $selected_val);
if (mysqli_num_rows($columns) > 0) {
    echo "<thead><br> <tr>";
    $attri[] = array();
    //output each column name as table heads.
    while($row = mysqli_fetch_assoc($columns)) {
        echo "<th>".$row["Field"]."</th>";
        $attri[] = $row["Field"];
    }
    echo "</tr><br></thead>";
} else {
    echo "0 results";
}
?>
```

```
<?php
if ($db->connect_error) {
    die("Connection failed: " . $db->connect_error);
}
//run the selected query in our database and
//get the output.
$result = $db->query($sql);
//display each record on the webpage table
while($row = mysqli_fetch_assoc($result)) {
    echo "<tr>";
    for($i = 0; $i < count($attri) - 1; $i++) {
        $key = $attri[$i+1];
        echo "<td>" . $row["$key"] . "</td>";
    }
    echo "</tr>";
}
?>
```


And the display on the webpage looked like this, we've printed out the query statement for testing purposes:

1.Check for all the textbooks in the database:

Choose the list you want:

Books

CREATE VIEW myViewAvailability AS select * from book where book_quantity>0

 Data Table Example

Show entries Search:

book_isbn	book_title	book_quantity	librarian_id
9780030206931	Pushing electrons : a guide for students of organic chemistry /	2	101
9780030322846	The Dobe Ju/'hoansi /	3	102
9780060182939	Paper daughter : a memoir /	2	102
9780060194482	A people's history of the United States : 1492-present /	1	103
9780060242534	Am I blue? : coming out from the silence /	3	103
9780060747497	Rebirth of a nation : the making of modern America, 1877-1920 /	1	104
9780060760908	One Crazy Summer	1	105

2. Check for currently available books.

CREATE VIEW myViewAvailability AS select * from book where book_quantity>0

Data Table Example			
Show 10 entries		Search: <input type="text"/>	
book_isbn	book_title	book_quantity	librarian_id
9780030206931	Pushing electrons : a guide for students of organic chemistry /	2	101
9780030322846	The Dobe Ju/'hoansi /	3	102
9780060182939	Paper daughter : a memoir /	2	102
9780060194482	A people's history of the United States : 1492-present /	1	103
9780060242534	Am I blue? : coming out from the silence /	3	103
9780060747497	Rebirth of a nation : the making of modern America, 1877-1920 /	1	104
9780060760908	One Crazy Summer	1	105
9780060838652	A People's History of the United States	3	105

3. Check for all borrowing history(for analysis purposes).

CREATE VIEW myViewHistory AS select

student.student_id,student_fname,student_lname,book.book_isbn,book_title,check_out_date,check_in_date,check_due_date from student join checkout on student.student_id=checkout.student_id join book on book.book_isbn=checkout.book_isbn

Data Table Example							
Show 10 entries		Search: <input type="text"/>					
student_id	student_fname	student_lname	book_isbn	book_title	check_out_date	check_in_date	ch
010499474	khushchev	nikita	9780520210134	Six years: the dematerialization of the art object from 1966 to 1972; a cross-reference book of information on some esthetic boundaries ...	2018-07-31	2018-08-10	20
033438480	harper	stephen	9781324000778	Cultural Anthropology	2018-07-31	2018-08-10	20
043344439	dali	salvador	9780393920291	Give Me Liberty: An American	2018-07-24	2018-07-25	20

4. Check all student information in the system(for analysis purposes).

```
CREATE VIEW myViewStudent AS select * from student
```

Data Table Example			
Show 10 entries		Search:	
student_id	student_fname	student_lname	student_email
003040211	foley	mick	foley.mick@sjsu.edu
007600332	ebadi	shirin	ebadi.shirin@sjsu.edu
010499474	khrushchev	nikita	khrushchev.nikita@sjsu.edu
033438480	harper	stephen	harper.stephen@sjsu.edu
043344439	dali	salvador	dali.salvador@sjsu.edu
048339590	farmer	frances	farmer.frances@sjsu.edu
052196504	canseco	josé	canseco.josé@sjsu.edu
053219245	manchester	william	manchester.william@sjsu.edu

Conclusion

In this project, we've theorized, designed, and implemented a MySQL database and a webpage interface to increase the usability and program efficiency of SJSU library's Course Reserves program. By utilizing the skills learnt both in class and by ourselves, we've gained much hands-on experience and insight into web design, database design and management.

The goal of our project is to design a database that would facilitate and optimize the work of the SJSU Course Reserves program. This database should enable more search options and store more information on borrowing behaviors to enable further analysis and optimization.

The current Course Reserves search webpage only allows 2 search options: search by course name or instructor name. With our new design of user interface, it allows students to search for textbooks by partial course name, ISBN, partial title, course, class, instructor and availability. Our database also stores enough information for program managers to check textbook use frequency and borrowing behavior to optimize their operation. The information in our database will be enough for us to develop a machine learning model to optimize the Course Reserves program.

But our pursuit for better performance should not end here. In the future, we would like to expand our database to store different formats of materials using NoSQL database. We would also like to develop a recommendation system to provide research material recommendation based on borrowing history and an algorithm to produce most efficient purchase plan to both satisfy students' needs and cut down cost for the Course Reserve Program.

Our project focuses on bringing a little convenience to our community. It can be of instant help to the SJSU library and Course Reserves program if implemented properly. It would provide a clear statistical analysis and visualization on the usage of Course Reserves, providing a better purchase plan for SJSU library as well as further promoting this program to SJSU students.