Hospital Information System

I have read and understood the course academic integrity policy in the syllabus of the class.

1. Team details

Name - Shruti Gupta
Ubname - sgupta55
Ubmail - sgupta55@buffalo.edu

Name - Pavana Lakshmi Venugopal
Ubname - pavanala
Ubmail - pavanala@buffalo.edu

Name - Rounak Biswas
Ubname - rounakbi
Ubmail - rounakbi@buffalo.edu

2. Problem Statement

For the hospital to handle patient information, medical records, supplies, and other routine data, a database management system must be effective and dependable. The manual nature of the present system makes it prone to mistakes, which causes delays in patient treatment, poor departmental collaboration, and inefficient use of resources. The administration of the hospital requires a system that can handle procedures, safely keep data, give users access to information in real-time, and produce reports for analysis and decision-making. The system should also be simple to use and adaptable to the unique requirements and processes of the facility. The hospital is looking for a solution that will increase efficiency all around, better patient treatment, and streamline processes.

3. Target Users

In a hospital setting, there may be several users who would need to access and use the hospital management database system. These users can include:

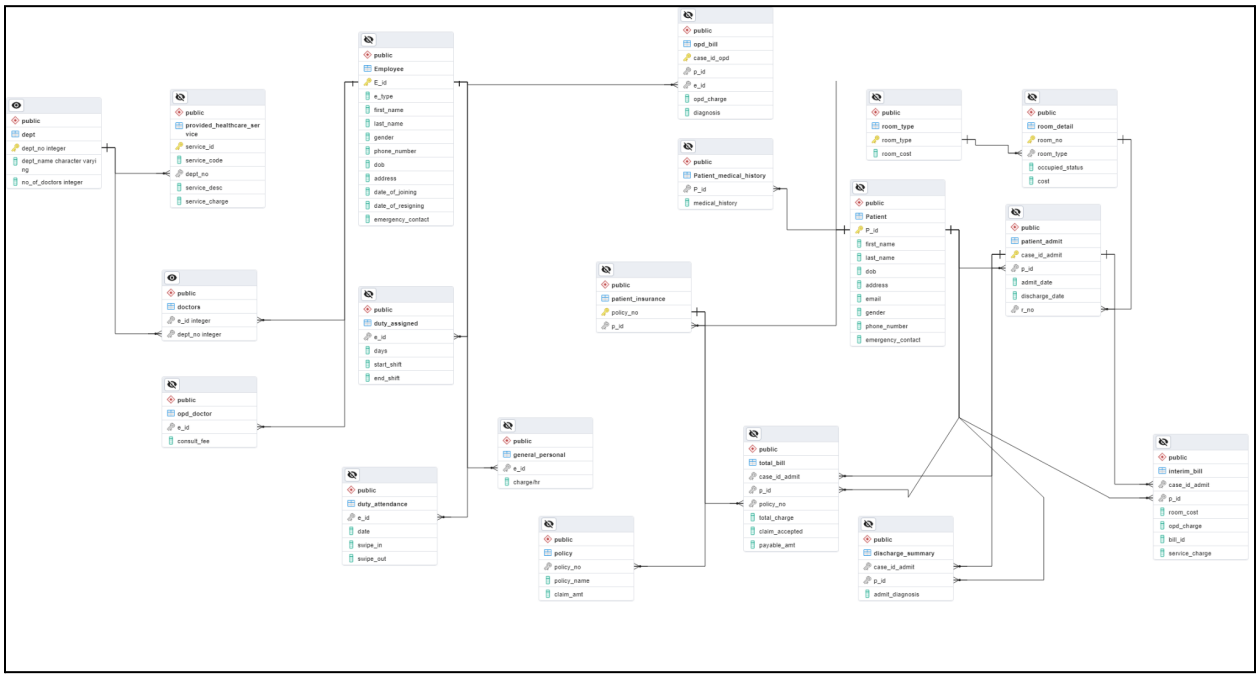
- Doctors, nurses, and other healthcare workers who require access to patient information, medical documents, and therapy plans. In order to make educated choices about a patient's treatment, a doctor could, for instance, use the database to examine the patient's medical history and other details.

- Hospital managers and support employees who handle patient's information, invoicing, view insurance details, see room availabilities and OPD doctor schedule and other administrative duties using the database. For instance, a member of the administrative team might use the database to create invoices for services performed, verify insurance coverage, and various admittance semantics.
- Patients: Patients can access their medical information, view their invoice, opt availability, insurance details, and doctor availabilities using the database. For instance, a patient might use the database to communicate with their doctor.

As for managing the database, this is typically done by a group of IT experts who are also in charge of making sure the system is secure, dependable, and fast. This can involve activities like designing, setting up, configuring, maintaining, and fixing databases. In some circumstances, hospital employees with IT knowledge may also help with database management.

Imagine a big hospital system with numerous locations and individual databases in the actual world. Healthcare workers, support staff, and patients would all have access to and use the databases to access and handle patient data as necessary. The databases would be administered and maintained by the hospital's IT department.

4. ER Diagram



5. Relational Schemas

We have generated our dummy data from https://www.mockaroo.com/

5.1 Relation: Patient

Relation Schema: Patient(P_id, First_name, Last_name, DOB, Address, email, gender, Phone number, Emergency contact)
Primary key: P_id

Attribute	Description	Domain	Constraints
P_id	Id which distinguishes each patient	Integer	Not null, Primary Key
First_name	First Name of the patient	Varchar	Not null
Last_name	Last Name of the patient	Varchar	Not null
DOB	Date of Birth of the Patient	Date	Not null
Address	Address of the Patient	Varchar	Not null
Email	Email address of the Patient	Varchar	Not null
Gender	Gender of the Patient	enum	Not null
Phone number	Phone number of the Patient	Integer	Not null
Emergency Contact	Emergency Contact of the Patient	Integer	Not null

P_id	first_name	last_name	DOB	Address	email
1	Willamina	Synke	6/26/1956	29122 Eggendart Park	wsynke0@eventbrite.com
2	Shurlocke	Tedman	5/22/2015	5 Red Cloud Park	stedman1@smh.com.au
3	Tracee	Kleimt	8/16/1984	02263 Canary Park	tkleimt2@cnn.com
4	Lorinda	Jenicek	5/9/1963	3200 Spenser Pass	ljenicek3@squarespace.com
5	Drona	Baiden	2/9/2004	53 Cordelia Lane	dbaiden4@youku.com

gender	Phone_Number	Emergency_contact
Female	270-318-4157	119-442-4713
Male	649-173-7797	131-934-8871
Female	884-983-3482	391-730-9961
Female	916-859-0263	607-721-5360
Female	318-815-5229	114-316-2227

5.2 Relation: Patient_med_history
Relation Schema: Patient_med_history(P_id, Med_history)
Primary key: P_id
Foreign key: P_id from Patient relation

Attribute	Description	Domain	Constraints
P_id	Id which distinguishes each patient	Integer	Not null, Primary Key
Med_History	States the medical history or symptoms of the patient	Varchar	Not null

Service_id	Service_Code	Dept_no.	Service_desc	Service_Charge
1	0D120Z4	8	Bypass Middle Esophagus to Cutaneous, Open Approach	$131730.05
2	05134AY	6	Bypass R Innom Vein to Up Vein w Autol Art, Perc Endo	$198487.43
3	047M3ZZ	7	Dilation of Right Popliteal Artery, Percutaneous Approach	$414692.34
4	DB20HZZ	9	Stereotactic Particulate Radiosurgery of Trachea	$801502.39
5	0SJL0ZZ	3	Inspection of Left Metatarsal-Tarsal Joint, Open Approach	$664566.39

5.3 Relation: Employee

Relation Schema: Employee(E_id, First_name, Last_name, DOB, Address, email, gender, JoinDate, ResignDate, Phone number, Emergency contact)

Primary key: E_id

Attribute	Description	Domain	Constraints
E_id	Id which distinguishes each Employee	Integer	Not null, Primary Key
First_name	First Name of the Employee	Varchar	Not null
Last_name	Last Name of the Employee	Varchar	Not null
DOB	Date of Birth of the Employee	Date	Not null
Address	Address of the Employee	Varchar	Not null
Email	Email address of the Employee	Varchar	Not null
Gender	Gender of the Employee	enum	Not null
JoiningDate	Date of joining of the employee	Date	Not Null
Resigndate	Date of resigning of the employee	Date	Can be null
Phone number	Phone number of the Employee	Integer	Not null
Emergency Contact	Emergency Contact of the Employee	Integer	Not null

E_id	first_name	last_name	email	gender	Phone Number	DOB	Address
1	Alexandra	Lammin	alammin0@mayoclinic.com	Female	493-514-9273	11/30/1952	8271 Merchant Parkway
2	Benoite	Lent	blent1@jigsy.com	Female	123-865-2718	11/1/1974	77 Sherman Terrace
3	Mitch	Yurasov	myurasov2@behance.net	Male	406-464-7116	5/23/1951	24217 Stuart Circle
4	Alessandra	Moulson	amoulson3@ucoz.com	Female	774-701-8488	7/1/1957	19 Debs Way
5	Barde	Red	bred4@miibeian.gov.cn	Male	341-381-6500	3/5/1955	208 Duke Court

Date of joining	Date of Resigning	Emergency contact
8/16/1983		121-229-1940
11/28/1979	Syntax error in formula 'date of joining < date of resigning'	104-642-5067
10/6/1976		227-644-0049
9/29/1992		222-993-9548
4/8/1979		495-931-2228

5.4 Relation: Department
Relation Schema: Department(Dept_no, Dept_name)
Primary key: Dept_no

Attribute	Description	Domain	Constraints
Dept_no	Id which distinguishes each department	Integer	Not null, Primary Key
Dept_name	Name of each department	Varchar	Not null

Department Number	Department Name
1	Outpatient department
2	Pharmacy Department
3	Radiology Department
4	Anesthetics
5	Cardiology

5.5 Relation: Doctor
Relation Schema: Doctor(E_id, Dept_no)
Primary key: E_id
Foreign key: E_id from Employee relation; Dept_no from Department relation

Attribute	Description	Domain	Constraints
E_id	Id which distinguishes each doctor	Integer	Not null, Primary Key, Foreign Key
Dept_no	Department number of the Doctor's department	Integer	Not null, Foreign Key

E_id	Department Number
581	2
273	9
930	6
472	10
858	8

5.6 Relation: OPD_Doctor
Relation Schema:OPD_ Doctor(E_id, Cons_fee)
Primary key: E_id
Foreign key: E_id from Doctor relation

Attribute	Description	Domain	Constraints
E_id	ID which distinguishes each OPD_doctor	Integer	Not null, Primary Key, Foreign Key
Cons_Fee	Consultation fee of the OPD doctor	Integer	Not null

E_id	Consult_fee
772	$927.06
427	$585.61
699	$522.63
129	$863.46
689	$817.51

5.7 Relation: OPD_Duty_Assigned
Relation Schema: OPD_Duty_Assigned(E_id, Days, Start_shift, End_shift)
Primary key: E_id
Foreign key: E_id from OPD_ Doctor relation

Attribute	Description	Domain	Constraints
E_id	Id which distinguishes each OPD_doctor	Integer	Not null, Primary Key, Foreign Key
Days	Days on which the duty is assigned to the employee	enum	Not null
Start_shift	Assigned Start time of the shift	Time	Not null
End_shift	Assigned end time of the shift	Time	Not null

E_id	Days	Start_Shift	End_Shift
979	5	2:14 PM	6:17 AM
478	7	2:49 AM	4:17 PM
48	7	11:29 PM	3:26 AM
852	6	12:06 AM	4:13 PM
169	6	6:11 AM	5:17 AM

5.8 Relation: OPD_Duty_Attendance
Relation Schema: OPD_Duty_Attendance(E_id, Dates, Swipe_in, Swipe_out)
Primary key: E_id
Foreign key: E_id from OPD_ Doctor relation

Attribute	Description	Domain	Constraints
E_id	Id which distinguishes each OPD_doctor	Integer	Not null, Primary Key, Foreign Key
Dates	Date on which the duty is attended to the employee	Date	Not null
Swipe_in	Attended Start time of the shift	Time	Not null
Swipe_out	Attended end time of the shift	Time	Not null

E_id	Date	Swipe_in	Swipe_out
958	6/8/1986	6:50 AM	4:54 PM
690	9/8/2006	5:47 PM	9:38 AM
448	4/7/1989	10:20 AM	1:03 PM
389	1/10/2004	9:32 AM	12:44 PM
307	6/7/2003	10:24 AM	5:37 PM

5.9 Relation: General_personnel
Relation Schema: General_personnel(E_id, Charge_ph)
Primary key: E_id
Foreign key: E_id from Employee relation

Attribute	Description	Domain	Constraints
E_id	ID which distinguishes each general staff	Integer	Not null, Primary Key, Foreign Key
Charge_ph	Charge per hour for the employee	Integer	Not null

E_id	Charge/hr
448	$463.62
685	$183.85
391	$489.78
516	$309.28
149	$143.67

5.10 Relation: Provided_Healthcare_service
Relation Schema: Provided_Healthcare_service(Service_id, Service_code, Dept_no, Service_desc, Service_charge)
Primary key: Service_id
Foreign key: Dept_no from Department relation

Attribute	Description	Domain	Constraints
Service_id	ID which distinguishes each service	Integer	Not null, Primary Key
Service_code	Code of the Service	Enum	Not null
Dept_no	Department number, which provided the service	Integer	Not null, Foreign Key
Service_desc	Description of the service	Varchar	Not null
Service_charge	Charge of the service	Integer	Not null

Service_id	Service_Code	Dept_no.	Service_desc	Service_Charge
1	0D120Z4	8	Bypass Middle Esophagus to Cutaneous, Open Approach	$131730.05
2	05134AY	6	Bypass R Innom Vein to Up Vein w Autol Art, Perc Endo	$198487.43
3	047M3ZZ	7	Dilation of Right Popliteal Artery, Percutaneous Approach	$414692.34
4	DB20HZZ	9	Stereotactic Particulate Radiosurgery of Trachea	$801502.39
5	0SJL0ZZ	3	Inspection of Left Metatarsal-Tarsal Joint, Open Approach	$664566.39

5.11 Relation: Policy

Relation Schema: Policy(E_id, Cons_fee)
Primary key: Policy_no

Attribute	Description	Domain	Constraints
Policy_no	ID which distinguishes each Policy	Integer	Not null, Primary Key
Policy_name	Consultation fee of the OPD doctor	Varchar	Not null
Claim_amt	Claim amount of the policy allowed	Integer	Nullable

Policy_No	Policy_name	Claim_amt
0603-3162	Qualitest Pharmaceuticals	$7035.30
68001-117	BluePoint Laboratories	$5584.94
68180-402	LUPIN PHARMACEUTICALS INC	$7032.22
50730-7503	H and P Industries, Inc. dba Triad Group	$1161.69
54868-6293	Physicians Total Care, Inc.	$7165.79

5.12 Relation: Patient_insurance
Relation Schema: Patient_insurance(Policy_no, P_id)
Primary key: Policy_no
Foreign key: Policy_no from Policy relation; P_id from Patient relation

Attribute	Description	Domain	Constraints
Policy_no	ID which distinguishes each OPD_doctor	Integer	Not null, Primary Key, Foreign Key
P_id	Consultation fee of the OPD doctor	Integer	Not null, Foreign Key

Service_id	Service_Code	Dept_no.	Service_desc	Service_Charge
1	0D120Z4	8	Bypass Middle Esophagus to Cutaneous, Open Approach	$131730.05
2	05134AY	6	Bypass R Innom Vein to Up Vein w Autol Art, Perc Endo	$198487.43
3	047M3ZZ	7	Dilation of Right Popliteal Artery, Percutaneous Approach	$414692.34
4	DB20HZZ	9	Stereotactic Particulate Radiosurgery of Trachea	$801502.39
5	0SJL0ZZ	3	Inspection of Left Metatarsal-Tarsal Joint, Open Approach	$664566.39

5.13 Relation: OPD_bill
Relation Schema: OPD_bill(Case_id_opd, P_id, E_id, opd_charge, Diagnosis)
Primary key: Case_id_opd
Foreign key: P_id from patient relation; E_id from OPD_doctor relation

Attribute	Description	Domain	Constraints
Case_id_opd	Id which distinguishes each case in OPD	Integer	Not null, Primary Key
P_id	Id which identifies the Patient	Integer	Not null, Foreign Key
E_id	Id which identifies the OPD doctor	Integer	Not null, Foreign Key
opd_charge	Charges of the OPD	Integer	Not null
Diagnosis	Diagnosis provided by the OPD doctor	Varchar	Not null

Case_id_opd	P_id	E_id	opd_charge	Diagnosis
90-219-4373	1	339	$9087.01	Dislocation of C3/C4 cervical vertebrae, subs encntr
64-238-2665	2	829	$2722.31	Laceration of blood vessel of left ring finger, init encntr
99-170-8198	3	879	$2678.39	Cereb infrc due to unsp occls or stenos of unsp cereb artery
57-980-0266	4	114	$552.04	Toxic effect of other ingested (parts of) plant(s), assault
86-191-4644	5	747	$8622.81	Pneumococcal arthritis, right shoulder

5.14 Relation: Patient_admit
Relation Schema: Patient_admit(Case_id_admit, P_id, admit_date, discharge_date, R_no)
Primary key: Case_id_opd
Foreign key: P_id from patient relation; r_no from room_details relation

Attribute	Description	Domain	Constraints
Case_id_admit	Id which distinguishes each case in OPD	Integer	Not null, Primary Key
P_id	Id which identifies the Patient being admitted	Integer	Not null, Foreign Key
admit_date	Date of admittance	date	Not null
discharge_date	Date of Discharge	date	Not null
Room_no	Room number the patient is admitted to	enum	Not null, Foreign Key

Case_id_admit	P_id	admit_date	discharge_date	R_no
76-709-8973	1	01/18/2016	09/07/2015	116
00-245-3524	2	01/17/2013	11/21/2022	30
51-652-3415	3	08/31/2002	08/11/2001	468
14-114-4826	4	09/14/2017	05/06/2009	471
44-336-0940	5	01/13/2021	10/26/2002	70

5.15 Relation: Total_bill
Relation Schema: Total_bill(Case_id_admit, P_id, Policy_No, total_charge, claim_accepted, payable_amt)
Primary key: Case_id_admit
Foreign key: Case_id_admit from Patient_admit relation; P_id from Patient relation; Policy_no from Policy relation

Attribute	Description	Domain	Constraints
Case_id_admit	Id which identifies case being admitted	Integer	Not null, Primary Key, Foreign Key
P_id	Id which identifies the Patient being admitted	Integer	Not null, Foreign Key
Policy_No	Policy number of the patient	Varchar	Not null, Foreign Key
total_charge	Total charge of the services	Integer	Not null
claim_accepted	Insurance Claim amount passing	Integer	Nullable
payable_amt	Final payable amount	Integer	Nullable

Case_id_admit	P_id	Policy_No	total_charge	claim_accepted	payable_amt
38-016-6161	1	24286-1562	$132.63	$7517.78	$1033.64
90-553-0491	2	58274-006	$7649.06	$7815.55	$7609.63
30-001-9006	3	50419-402	$7599.59	$7608.44	$7215.97
52-713-2707	4	13537-443	$5294.74	$3753.74	$8222.96
71-113-3632	5	0115-9544	$3105.78	$4712.18	$593.83

5.16 Relation: Discharge_summary
Relation Schema: Discharge_summary(Case_id_admit, P_id, admit_diagnosis)
Primary key: Case_id_admit
Foreign key: Case_id_admit from Patient_admit relation; P_id from Patient relation

Attribute	Description	Domain	Constraints
Case_id_admit	Id which identifies case being admitted	Integer	Not null, Primary Key, Foreign Key
P_id	Id which identifies the Patient being discharged	Integer	Not null, Foreign Key
admit_diagnosis	Diagnosis of the patient being discharged	Varchar	Not null

Case_id_admit	P_id	admit_diagnosis
57-517-6301	1	Strain intrns musc/fasc/tend r little finger at wrs/hnd lv
67-578-6869	2	Carrier of other streptococcus
73-096-8528	3	Person outside bus injured in clsn w rail trn/veh in traf
17-400-6117	4	Osteolysis, left hand
33-476-6078	5	Bitten by other mammals, sequela

5.17 Relation: Room_type
Relation Schema: Room_type(Room_type, Room_cost)
Primary key: Room_type

Attribute	Description	Domain	Constraints
Room_type	This identifies the type of room	Enum	Not null, Primary Key
Room_cost	the cost of the room relevant to the room type	Integer	Not null

Room_type	Room_cost
1	$200.00
2	$450.00
3	$700.00
4	$1,000.00
5	$1,500.00

5.18 Relation: Room_Detail
Relation Schema: Room_Detail(Room_no, Room_type, occupied_status)
Primary key: Room_no
Foreign key: Room_type from Room_type relation

Attribute	Description	Domain	Constraints
Room_no	Room number in the hospital	Integer	Not null, Primary Key
Room_type	Type of the room	Enum	Not null, Foreign key
Occupied_status	This tells whether the specified room type is occupied or not	Boolean	Not null

Room_no	Room_type	Occupied_status
360	3	false
497	3	true
352	4	true
46	4	true
295	3	false

5.19 Relation: Interim_bill
Relation Schema: Interim_bill(Bill_id, Room_cost, opd_charge, Service_charge, Case_id_admit, P_id)
Primary: Bill_id
Foreign key: Room_no from Room_Detail relation, P_id from Patient relation, Case_id_admit from Patient_admit relation, Case_id_opd from OPD_bill

Attribute	Description	Domain	Constraints
Bill_id	This id uniquely identifies the bill consisting of various charges	Integer	Not null, Primary Key
Case_id_admit	Id which identifies case being admitted	Integer	Not null, Foreign Key
P_id	Id which distinguishes each patient	Integer	Not null, Foreign Key
Room_no	Room no in which the patient was admitted	Integer	Not null
Room_cost	the cost of the room relevant to the room type	Integer	Not null
Case_id_opd	Id which distinguishes each case in OPD	Integer	Not null, Foreign Key
opd_charge	Charges of the OPD	Integer	Not null
Service_id	ID which distinguishes each service	Integer	Not null, Foreign Key
Service_charge	Charge of the service	Integer	Not null

Bill_Id	Case_ID_Admit	P_ID	Service_charge	OPD_charge	Room_cost
24	56-660-3519	1	$213843.17	$7156.94	$4278.06
44575	51-167-5325	2	$319465.57	$7527.87	$3826.94
7518	66-769-2094	3	$503984.19	$685.76	$6466.13
30	25-022-7555	4	$320812.03	$7075.41	$963.57
5554	81-732-0661	5	$730479.61	$3030.82	$9244.62

Relation between Tables

Table 1	Table 2	Relation Type	Explanation
Dept	doctors	one to one	One doctor can have one department
Dept	provided_healthcare_service	one to many	Each Department can have multiple healthcare services
Employee	doctors	one to one	one e_id can have one record in doctors table
Employee	opd_doctor	one to one	one e_id can have one record in opd_doctor table
Employee	duty_assigned	one to one	one e_id can have one record in duty_assigned table
Employee	duty_attendance	one to many	one e_id can have multiple records in duty_attendance table
Employee	general_personal	one to one	one e_id can have one record in general_personal table
Employee	opd_bill	one to many	one employee can be attending multipl patients that can lead to multiple bills in opd_bill
patient	discharge_summary	one to many	One patient can have many records in discharge summary
patient	patient_medical_summary	one to one	one patient can have one record in patient_medical_history table
patient	patient_insurance	one to one	one patient can have one insurance
patient	opd_bill	one to many	one patient can have multiple opd bills
patient	total_bill	one to one	one patient can have one record in total_bill table
patient	interim_bill	one to many	one patient can have multiple iterim bills
patient	patient_admit	one to many	one patient can have multiple records in patient_admit table
patient_insurance	total_bill	one to one	one patient's insurance can have one record in total_bill table
patient_insurance	policy	one to one	one patient's inurance can have one policy record
room_type	room_detail	one to one	one room type can have one room detail
room_detail	patient_admit	one to one	one room_no can be associated to one admitted patient
patient_admit	total_bill	one to one	one case_id_admit can have one record in total_bill table
patient_admit	discharge_summary	one to one	An admitted patient can have one record in discharge_summary table
patient_admit	interim_bill	one to many	One admitted aptient can have multiple interim bills

6. Milestone 2

1. Ensuring that the data is in Boyce-Codd Normal Form and figuring out all the functional dependencies.
2. Implementing various SQL queries and Query execution analysis
3. Working on the final demo video and the website.

7. References:

- **Generation of dummy data - https://www.mockaroo.com/**
- **Avi Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, Seventh Edition, McGraw-Hill, 2019.**
- **Ramakrishnan, R., & Gehrke, J. (2011). *Database Management Systems* (Third). McGraw-Hill.**
- **Garcia-Molina, H., Ullman, J. D., & Widom, J. (2014). *Database systems: The complete book* (Second). Pearson Education Limited.**