Data Modeling and Databases I project.

Innopolis University (2019)

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Phase 1:

Notes on the System.

Our Hospital Management System (HMS) has 16 principal actors, whose interactions with each other, we believe, represent a reasonable model for how most of real hospitals operate. Each actor (with the exception of priest and cook, since in our model they are not full-time staff members of the hospital) has his/her own account in the HMS in order to handle permissions for accessing different data and specific interactions for a single actor.

One of the most significant interactions is an appointment, involving several actors at once, since doctors' consultation is the primary service that the hospital offers. Moreover, any other service (surgery, planned hospitalization, etc.) may be offered only after the consultation.

Another important functionality involves a scheduling system for hospital staff members and notification system for both staff and patients. We decided to include this into the system, because day-to-day communication between actors would be very chaotic and difficult to manage without such functionality.

In addition, every actor has specific interaction to manage his/her department or workplace with suitable permissions (for example, a pharmacist may access and modify records of available medicine, while a cook will not have such ability).

ID	01
Title	Appointment
Type	Functional
Description	The hospital system will have an appointments between the doctors and the patients
Priority	1
Risk	C
Comments	Not implementing this requirement will break the main functionality of the system. Appointments are one of the fundamental aspects of every hospital.

ID	02
Title	Booking Appointments by Patient
Type	Functional
Description	A patient can book an appointment with a doctor using his/her

	account or a terminal in the Hospital.
Priority	1
Risk	C
Comments	Not implementing this requirement will break the main functionality of the system. The hospital is useless if you cannot book an appointment with a doctor.

ID	02
Title	Booking Appointments by Receptionist
Type	Functional
Description	Booking can also be done by a receptionist in case that the patient can't do it him/herself and can be done also by a nurse.
Priority	1
Risk	C
Comments	Not implementing this requirement will break the main functionality of the system. The hospital is useless if you cannot book an appointment with a doctor.

ID	03
Title	Booking Appointments Only in Working Hours
Type	Non-functional
Description	Patients can only book appointments for the time when the doctor is available.

Priority	1
Risk	C
Comments	Not implementing this requirement will break the main functionality of the system. If you will be able to book appointments in non-working hours, it will crash the whole functionality.

ID	04
Title	No Overlap or Clashing of Appointments and Staff Meetings.
Type	Non-functional
Description	Two patients can't have an appointment with the same doctor at the same time. Also, the staff meeting time should not clash with the time of some of the doctors' appointments.
Priority	1
Risk	C
Comments	Not implementing this requirement will break the main functionality of the system. This is very important to have not overlapping events in our timetable.

ID	05
Title	Appointments’ Management
Type	Functional

Description	Doctors can ask for a day off or reschedule their appointment in case of emergency. The head doctor has to approve it via Email.
Priority	2
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds. Such kinds of requirements are very important for normal hospital to exist but not to our system.

ID	06
Title	Decline an Appointment
Type	Functional
Description	A patient can decline an appointment but not later than 2 days before.
Priority	1
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	07
Title	View Appointments by the Patient
Type	Functional
Description	A patient can view his appointment and can see the free slots to reserve another appointment.

Priority	1
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	08
Title	View Appointments by the Doctor
Type	Functional
Description	The doctor can see the appointment that is assigned to him/her.
Priority	1
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	09
Title	View Appointments by the Nurse
Type	Functional
Description	The nurse can see the appointment that is assigned to him/her with the corresponding doctor.
Priority	1
Risk	L

Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	10
Title	Emergency Appointments
Type	Functional
Description	Each doctor has special time during the day for emergency appointments.
Priority	1
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	11
Title	Appointment Privacy
Type	Non-Functional
Description	Patients can not see who booked the time slot. He/She can only see if it's taken.
Priority	3
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	12
Title	Free Operations
Type	Non-functional

Description	In case of an emergency or an extreme situation, surgery can be done for free. Also appointments in "Emergency hours" are free.
Priority	3
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	13
Title	Surgeries
Type	Functional
Description	Patients cannot simply book a time for surgery. Only Doctors can do it in case it is needed.
Priority	1
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	14
Title	Schedule
Type	Functional
Description	Doctors and nurses have a schedule that is made by Head Doctor and Head Nurse respectively. Doctors' schedules contain appointments, surgeries, emergency appointments. Nurses' ones contain shifts.

Priority	1
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	15
Title	List of Employees
Type	Functional
Description	There is a list of all accounts of the staff members which can be modified by HR. Also, it has information about their contracts (e.g. salary, date of the employment and etc.)
Priority	1
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality. It will be extremely difficult to manage the employees, but the rest of the system will work pretty well.

ID	16
Title	Patients' Accounts
Type	Functional
Description	Each patient has an account that will contain all his medical history in the hospital. Also, it will contain his own Notice Board, list of

	appointments,... etc.
Priority	1
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system. It is very important to distinguish between patients on the software level.

ID	17
Title	Creation of Patients' Accounts
Type	Functional
Description	Each patient should be able to create his/her account using the online portal or the terminal at the hospital.
Priority	1
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	18
Title	Creation of Patients' Accounts by the Receptionist
Type	Functional
Description	The receptionist can also make the patient's account instead of him/her when he/she comes to the hospital.
Priority	1

Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	19
Title	Privacy of The Patients' Accounts
Type	Non-Functional
Description	Each patient can only access his\her account by his\her username and password
Priority	1
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds. The privacy is crucial but not for the software, it can work pretty well without it.

ID	20
Title	Staff Account
Type	Functional
Description	Each one from the staff has an account that enables him to access certain data in the database the schedule, notice board, ...etc. The types of accounts that exist in the database: 1- Cleaning team, 2- IT team, 3- Maintenance team, 4- Nurse & Doctor account & Lab Technicians, 5-Security worker, 6-HR, 7-Head Doctor, 8-Receptionist, 9-Head nurse.
Priority	1
Risk	C
Comments	Not implementing this requirement will break the main functionality of the system. The whole system won't function withot staff account.

ID	21
Title	Cleaning Team Account

Type	Functional
Description	Members of the cleaning team can log in to their accounts.
Priority	2
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	22
Title	IT-team Account
Type	Functional
Description	Members of the IT-team can log in to their accounts.
Priority	2
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	23
Title	IT-team’s Access
Type	Functional
Description	Members of the IT-team have access to the list of IT complaints.
Priority	2

Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	24
Title	Maintenance Team Account
Type	Functional
Description	Members of the maintenance team can log in to their accounts.
Priority	2
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	25
Title	Maintenance Team’s Access
Type	Functional
Description	Members of the Maintenance team have access to the list of equipment complaints.
Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	26
Title	Cleaning Team’s Access
Type	Functional
Description	Member of the cleaning team have access to the cleaning schedule and the storage of the equipment

Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	27
Title	Nurses' Account
Type	Functional
Description	Nurses can log in to their accounts.
Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	28
Title	Nurses' Access
Type	Functional
Description	Nurses have access to patients' medical histories through their accounts.
Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	29
Title	Doctors' Access
Type	Functional
Description	Doctors have access to patients' medical histories through their accounts.

Priority	2
Risk	C
Comments	Not implementing this requirement will break the main functionality of the system.

ID	30
Title	Lab Technicians' Access
Type	Functional
Description	Lab technicians have access to patients' medical histories through their accounts.
Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	31
Title	Security Workers' Access
Type	Functional
Description	Security workers have access to CCTV cameras' records.
Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	32
Title	HR's Access
Type	Functional
Description	HR has access to the list of employees.

Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	33
Title	Head Doctor’s Access
Type	Functional
Description	Head Doctor has the ultimate access to everything in the system.
Priority	1
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	34
Title	Head Nurse’s Access
Type	Functional
Description	Head Nurse has access to the schedule of Nurses’ shifts
Priority	1
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	35
Title	Doctors’ Account
Type	Functional
Description	Doctors can log in to their accounts.
Priority	1

Risk	C
Comments	Not implementing this requirement will break the main functionality of the system.

ID	36
Title	Lab Technicians' Account
Type	Functional
Description	Lab Technicians can log in to their accounts.
Priority	2
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	37
Title	Security workers' Account
Type	Functional
Description	Security workers can log in to their accounts.
Priority	2
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	38
Title	HR's Account
Type	Functional
Description	HR can log in to his/her account.

Priority	2
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	39
Title	Head Doctor’s Account
Type	Functional
Description	Head Doctor can log in to his/her account.
Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	40
Title	Head Nurse’s Account
Type	Functional
Description	Head Nurse can log in to his/her account.
Priority	2
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	41
Title	Receptionists’ Account
Type	Functional
Description	Receptionists can log in to their accounts.

Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	42
Title	Schedule of Meetings
Type	Functional
Description	The head doctor is setting a weekly meeting with the staff. A notification about the meeting is being sent by email to the Internal Hospital mail system.
Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system. You cannot have a meeting without meeting's scheduling.

ID	43
Title	List of IT Complaints
Type	Functional
Description	Each staff member can add items to the list of complaints in case something related to IT has to be fixed. IT crew should report about fixing via the Email system.
Priority	2
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	44
Title	List of Equipment Complaints

Type	Functional
Description	Each staff member can add items to the list of complaints in case something has been broken and has to be fixed. The maintenance crew should report about fixing via the Email system
Priority	2
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	45
Title	List of Patients' Complaints about the Hospital
Type	Functional
Description	Patients can add complaints to this list. The head doctor should reply to them.
Priority	2
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	46
Title	IT Complaints from Patients
Type	Functional
Description	Patients can complain about the work of the online portal which

	should be satisfied by the IT team.
Priority	3
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	47
Title	Notice Board
Type	Functional
Description	The hospital will have an electronic notice board that has important data such as the schedule of appointments and internal organizing schedule(doctors' shifts, nurses' shifts,....etc).
Priority	2
Risk	C
Comments	Not implementing this requirement will impact the main functionality of the system.

ID	48
Title	Notice Board Management
Type	Non-Functional
Description	Items in the notice board are modified and added automatically. E.g. if an appointment is scheduled, it is automatically added to the notice board and etc.
Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system. The notice board is useless if you cannot modify it.

ID	49
Title	Notice Board Accessibility

Type	Non-functional
Description	The users can see just part of the notice board e.g. the user can see the schedule of the appointments but he/she cannot see the schedule of the shift of the nurses or doctors.
Priority	3
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	50
Title	Notifications
Type	Functional
Description	The users of the system of the hospital including the staff and the patients are getting notifications from the system. For example a notification about the appointment for patient and notification about a general meeting for the staff, ...etc.
Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system. Notifications are very helpful in everyday life.

ID	51
Title	Medical History
Type	Functional

Description	Each patient has its own medical history. It consists of reports that include the dates of visits, the results, and the responsible staff.
Priority	1
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality. Some aspects of patient-doctor relationships will be broken if you do not implement this part.

ID	52
Title	Medical History Access and Modification
Type	Non-functional
Description	It can be accessed only by the doctor, Nurse, and Professor
Priority	1
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	53
Title	Internal Invoice Management
Type	Functional
Description	Each operation in the hospital has an invoice that states the amount of money that has been spent on this operation.The internal invoices are from the side of the hospital and the staff.
Priority	1
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	54

Title	External Invoice Management
Type	Functional
Description	Each operation in the hospital has an invoice that states the amount of money that has been spent on this operation. The external invoices are between the hospital and the patients to pay the money for the surgery for example.
Priority	1
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	55
Title	Medical Report Management
Type	Functional
Description	After every appointment and surgeries apart from the records in the patient's medical history doctors should write a report which is available to the patient and the doctor himself about everything that was done e.g. what pills were assigned, what treatment was done and etc. These reports should be sent to the patients in any way he/she wants e.g. email, SMS, post and etc.
Priority	1
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	56
Title	Regular Check-Ups of The Patients

Type	Functional
Description	Doctors who performed surgeries should visit their patients in their chambers. It is automatically added to their schedule.
Priority	2
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds. As always, it is very important for the hospital in real life, but not for the system.

ID	57
Title	Emailing System for the Staff for Internal Communications
Type	Functional
Description	The hospital has an internal email system that connects all the staff together to get internal notifications and messages.
Priority	2
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system. Many things in internal distribution of hospital's everyday life is based on the usage of the emailing system.

ID	58
Title	Emergency Internal Communication System
Type	Functional
Description	This system will be connected to special devices that the staff will carry a pager to get the emergency notifications of patients.

Priority	2
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	59
Title	User Interface & Online Accessibility for the System
Type	Functional
Description	The whole system of the hospital can be accessed from an online portal and an application on phones that connected to the database that can view the appointments, medical history, medical reports, ...etc.
Priority	2
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds. If the system cannot be adequately accessed, it still can work perfectly.

ID	60
Title	Responsive User Interface
Type	Non-functional
Description	The portal and the application that enable the users to see and access the data should be a friendly user interface and at the same time responsive.
Priority	2
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds. If the system cannot be adequately accessed, it still can work perfectly.

ID	61

Title	Monitoring of the Medicine Storage of the Pharmacy
Type	Functional
Description	The system will monitor the quantity and types of medicine in the pharmacy. Each transition of buying and selling for medicine in the system is stored in the history.
Priority	1
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system. The whole pharmacy system is dependent on the storage management.

ID	62
Title	View Pharmacy Storage.
Type	Non-functional
Description	Some types of staff can view pharmacy storage like doctors and nurses. The patients can access from the portal of the hospital to get the information about the available medicine in the pharmacy.
Priority	2
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	62
Title	Modification of the Pharmacy Storage
Type	Functional
Description	The pharmacist can change the quantity of available medicine.
Priority	1

Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system. The whole farmacy system is dependent on the storage management.

ID	63
Title	Getting the Medicine by the Staff.
Type	Functional
Description	Doctors and nurses can get the meds for patients in case they need it.
Priority	1
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	64
Title	Buying Medicine from the Pharmacy of the Hospital
Type	Functional
Description	Patients can buy medicine from the pharmacy.
Priority	3
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	65
Title	Request a Specific Type of Medicine to be Available in the Hospital's Pharmacy by the Doctors
Type	Functional
Description	The doctors can request new types of medicines from the system of

	the pharmacy through the portal.
Priority	2
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	66
Title	Request a Specific Type of Medicine to be Available in the Hospital's Pharmacy.
Type	Functional
Description	The nurses can request new types of medicines from the system of the pharmacy through the portal under the supervision of the doctors.
Priority	2
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	67
Title	Priest's Schedule
Type	Functional
Description	There is a schedule for the priest to come and visit some patients.
Priority	3

Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	68
Title	Patient's Family Book an Appointment with the Priest
Type	Functional
Description	The patient's family can booking an appointment with the priest and the appointment will be added to the schedule of the priest directly
Priority	3
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	69
Title	Payment
Type	Functional
Description	Amount of the paid money by the patient and how much else he/she should pay.
Priority	2
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	70
Title	Lawyer
Type	Functional

Description	In some cases, a lawyer can receive orders from the Head Doctor and deal with legal issues.
Priority	3
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

ID	71
Title	Monitoring of the Canteen Storage of the Pharmacy
Type	Functional
Description	The system will monitor the quantity and types of food in the canteen. Each transition of buying and selling for food in the system is stored in the history.
Priority	1
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system. The whole canteen system is dependent on the storage management.

ID	72
Title	View the Canteen Storage.
Type	Non-functional
Description	Some types of staff can view the canteen storage like the cooks.

Priority	2
Risk	L
Comments	Not implementing this requirement will impact the main functionality of the system. The whole canteen system is dependent on the storage management.

ID	73
Title	Modification of the Canteen Storage
Type	Functional
Description	Cook can change the quantity of the available storage of the supplies of the food.
Priority	1
Risk	H
Comments	Not implementing this requirement will impact the main functionality of the system. The whole canteen system is dependent on the storage management.

ID	74
Title	Buying Food from the Canteen of the Hospital
Type	Functional
Description	Patients can buy food from the hospital’s canteen.
Priority	3
Risk	L
Comments	Without this requirement system can be used without limitation, but with some workarounds.

ID	75
Title	Feeding of the Patients
Type	Functional

Description	Nurses can get food from the canteen to feed patients in the hospital.
Priority	1
Risk	M
Comments	Not implementing this requirement will impact some system features, but not the main functionality.

Use Case Diagram:

https://drive.google.com/file/d/1Xc5Uih4m8KuW8hnNYsV-DtHYnKpYoozs/view?usp=sharing

Phase 2:

The ERD elaborates on the previous phase by converting principal actors in the use-case diagrams into entities, as well as by adding key systems with which they interact. The largest entity is the User, which contains all people who can access the system (doctors, nurses, patients, etc.). In turn, User can be a Staff Member or a Patient. We represent this hierarchy by partial relationships between entity User and entities Staff Member and Patient, so that each table for the future conversion to database schema contains only relevant information for the specific entity. The idea is that more complicated queries will be accomplished by joining tables according to the IDs of the Users.

In addition to the User entities, we have other entities which help user effectively interact in a system (Schedule, Complaint, etc.).

We use Crow's Foot notation presented in lectures and tutorial for the ERD. The only discrepancy is that we represent key attributes of weak entities by italic bold font and underlining instead of dashed underline.

Link of ERD in draw.io: Phase2 DMD.drawio

Phase 3:

Link to the GitHub repo: https://github.com/GneyHabub/DMD-Project

1- Install postgres from that link and setup the environment or it depends on your machine, it is easier on linux OS.

1.1- and install faker library from here and psycopg2 from here.

1.2- Good links for configuration and running postgres:

- Link1
- Link2

2- Modify the password to "123456789" and the user "user".

3- You need to create a Database with the name "Hospital" in postgres using: `sudo -u postgres createdb Hospital`.

4- Run `sudo -u postgres psql -d Hospital` to run the database shell.

5- Type \c to connect to the database.

6- Run `generate.py` using `python3 generate.py` to generate fake data for testing.

7- Run `main.py` using `python3 main.py` to run the main program that is responsible for the queries.

8- To restore the schemas original files run `./restore_schemas.sh`