Phase 4 By Ethan Seem Yaseen Hassan Alan Nguyen

A. Problem Description: Replicate the provided medical database project description.

There is a PERSON table. They have a personID, date of birth, gender, and their name (first, middle, last). The personID must be in the format P-XXX where X is a number from 0-9.

There are also 3 tables that are the PERSON_EMAIL_ADDRESS, PERSON_PHONE_NUMBER, and PERSON_LOCATION. They tie email addresses, phone numbers, and state/street/city/zip together via personID.

There is a HEALTHCARE_PROFESSIONAL table. Any PERSON can be a Healthcare professional as long as they are over 18 years old, have non-negative years of experience and working hours. They have an employeeID, specialization, department, and a hire date as well. The employeeID must be in the form EMP-XXX where X is a number from 0-9. Each HEALTHCARE_PROFESSIONAL is tied to a unique personID as well.

There are tables for 4 types of specialization: DOCTOR, NURSE, TECHNICIAN, and ADMINISTRATIVE STAFF. They each have special IDs that have the prefixes DO ,NU ,TEC , and AD, followed by 3 numbers from 0-9. They are also tied to an employee ID, however ADMINISTRATIVE STAFF must be tied to a Doctor ID instead.

There is a PATIENT table. It has PatientID, EmployeeID, PersonID, and Enrollment_date. The PatientID must be in the format PT-XXXXX where X is a number from 0-9. Each patient is tied to their respective PersonID, as well as an employeeID if they have one.

There is a PHARMACY table that contains PharmacyID, Name, Location, and ContactInformation. The PharmacyID must be in the format PH-XXX where X is a number from 0-9.

There is a BILL table that contains BillingID, BillDate, ItemizedCosts, TotalCost, PaymentMethod, and PatientID. The BillingID must be in the format B-XXX where X is a number from 0-9. It also must be tied to a patient via their patient ID.

There is an APPOINTMENT table that contains AppointmentID, AppointmentDate, Purpose, AppointmentTime, PatientID, and EmployeeID. The AppointmentID must be in the format A-XXX where X is a number from 0-9. It also must be tied to a patient (who is visiting) and a healthcare professional (who is conducting the appointment) via their

respective IDs.

There is a MEDICAL_RECORD table that contains RecordID, PatientID, Healthcare_ProfessionalID, Diagnosis, Treatment_History, Allergies, and LabResults. The RecordID must be in the format R-XXXXX where X is a number from 0-9. It must also be tied to a patient and healthcare professional via their respective IDs.

There is a TREATMENT table that contains TreatmentID, StartDate, EndDate, Description, Outcome, PatientID, PharmacyID, and Healthcare_ProfessionalID. The last 3 have to be tied to their respective tables' IDs. The TreatmentID must be in the format T-XXX where X is a number from 0-9.

Finally, there is an INSURANCE table that has an InsuranceID, CompanyName, and BillAmount.

B. Project Questions: Address and answer the three project questions listed above.

How crucial is the ability to model superclass/subclass relationships in a medical database environment, particularly for entities like Healthcare Professionals and Patients?

Modeling superclass/subclass relationships improves data organization, integrity, and access control in medical database environments. By categorizing entities like Healthcare Professionals and Patients hierarchically, data management can be streamlined, and data consistency rules can be enforced. Additionally, evolving healthcare roles and responsibilities can be accommodated by enabling targeted queries, optimizing database performance, and facilitating scalability. Thus, superclass/subclass modeling ensures effective medical data management through a secure and flexible framework.

Identify 5 additional business rules that the MedConnect database should accommodate. How would these rules impact your Extended Entity-Relationship (EER) model?

Patient-Healthcare Professional Association

 A patient can be associated with multiple healthcare professionals for various treatments and consultations, but each healthcare professional should be assigned to at least one patient. This rule impacts the EER model by introducing a many-to-many relationship between the Patient and the Healthcare Professional entities, requiring an association table to manage these relationships.

Allergy Constraint Enforcement

 The database should enforce allergy constraints, allowing only values from a predefined list of common allergens. This rule affects the Medical Records entity by adding a constraint on the Allergies attribute, ensuring that only valid allergens are recorded.

Appointment Overlap Prevention

Appointments for a healthcare professional should not overlap. The
database must check for time conflicts when scheduling appointments to
ensure that a healthcare professional is available during the specified time
slot. This rule influences the Appointments entity by introducing time
constraints and validation checks during appointment scheduling.

Minimum Age for Treatment

- Patients must be at least 18 years old to receive certain treatments. This rule impacts the Treatment entity by adding an age verification check before allowing treatment records to be created for a patient.

Payment Plan Options

 The billing system should support multiple payment methods and installment plans for patients. This rule affects the Billing entity by adding attributes to capture payment method details (Cash, Credit, Insurance) and installment plan information, allowing for flexible patient billing options.

These five additional business rules impact the EER model by introducing new relationships, constraints, attributes, and validation checks to ensure data accuracy and integrity while adhering to business policies and regulations. Through these additional business rules, the model becomes more comprehensive and realistic to fit real-world scenarios, making the database more functional.

Argue the case for using a Relational DBMS such as Oracle for the MedConnect project. (Detailed explanation with design justifications to be provided in the final report). Utilizing Oracle as the Relational Database Management System for the MedConnect project ensures data integrity and consistency, scalability, and security. Oracle ensures data integrity via constraints, triggers, and foreign key relationships, which are essential for managing accurate healthcare data and vital for patient safety and regulatory adherence. Scalability features such as partitioning, clustering, and parallel processing ensure efficient management of

large healthcare data volumes as the database expands. Security measures like role-based access control, encryption, and auditing protect patient information to maintain data confidentiality and integrity. Furthermore, Oracle's SQL capabilities and advanced analytical tools facilitate comprehensive data analysis, reporting, and business intelligence. Finally, Oracle offers high availability features, disaster recovery solutions, and industry compliance, making it a safe choice for MedConnect to ensure continuous service delivery, minimize downtime, and mitigate data loss or system failure risk.

Design Justifications:

- Entity-Relationship Model: Oracle supports implementing complex entity-relationship models, accommodating entities like Patients, Healthcare Professionals, Medical Records, etc., along with their relationships, attributes, and constraints.
- Normalization: Oracle's support for normalization ensures efficient data storage, reduces redundancy and enhances data integrity within the database schema.
- Indexing and Query Optimization: Oracle's indexing capabilities and query optimization techniques ensure fast and efficient data retrieval, crucial for MedConnect's real-time healthcare services and reporting needs.
- Stored Procedures and Triggers: Oracle allows the implementation of stored procedures and triggers for automating tasks, enforcing business rules, and improving database performance.
- Backup and Recovery: Oracle's robust backup and recovery solutions, including RMAN (Recovery Manager), Data Guard, and Flashback technologies, provide MedConnect with reliable data protection and disaster recovery capabilities.

D.Relational Schema after Normalization: Present all tables in 3NF with primary and foreign keys indicated.

PERSON(PERSON_ID (Primary Key), DATE_OF_BIRTH, GENDER, FIRST_NAME, LAST_NAME, MIDDLE_NAME)

PERSON_EMAIL_ADDRESS(PERSON_ID(foreign/primary key from PERSON), EMAIL_ADDRESS (primary key))

PERSON_PHONE_NUMBER(PERSON_ID(foreign/primary key from PERSON), PHONE_NUMBER (primary key))

PERSON_LOCATION(PERSON_ID(foreign/primary key from PERSON), STATE, STREET, CITY, ZIP)

HEALTHCARE_PROFESSIONAL(EMPLOYEE_ID (primary key), PERSON_ID (foreign/primary key from PERSON), SPECIALIZATION, DEPARTMENT, HIRE_DATE, YEARS OF EXPERIENCE, WORKING HOURS, ENROLLMENT DATE)

DOCTOR(DOCTOR_ID (primary key), EMPLOYEE_ID (foreign key from HEALTHCARE PROFESSIONAL))

NURSE(NURSE_ID (primary key), EMPLOYEE_ID (foreign key from HEALTHCARE PROFESSIONAL))

TECHNICIAN(TECHNICIAN_ID (primary key), EMPLOYEE_ID (foreign key from HEALTHCARE_PROFESSIONAL))

TREATMENT(TREATMENT_ID (primary key), END_DATE, START_DATE, OUTCOME, DESCRIPTION, PRESCRIPTION_RECORDS, HEALTHCARE_PROFESSIONAL_ID(foreign key from HEALTHCARE_PROFESSIONAL), PHARMACY_ID(foreign key from PHARMACY), PATIENT_ID(foreign key from PATIENT))

BILL(BILLING_ID(primary key), DATE, ITEMIZED_COSTS, TOTAL_COST, PAYMENT METHOD, PATIENT ID(foreign key from PATIENT))

PATIENT(PATIENT_ID(primary key), PERSON_ID(foreign key from PERSON), EMPLOYEE ID (foreign key from HEALTHCARE PROFESSIONAL))

PHARMACY(PHARMACY ID(primary key), NAME, LOCATION, PHONE NUMBER)

MEDICAL_RECORD(RECORD_ID(primary key), DIAGNOSIS,
TREATMENT_HISTORY, ALLERGIES, CURRENT_MEDICATIONS, LAB_RESULTS,
HEALTHCARE_PROFESSIONAL_ID(foreign key from
HEALTHCARE_PROFESSIONAL), PATIENT_ID(foreign key from PATIENT))

APPOINTMENT(APPOINTMENT_ID(primary key), TIME, PURPOSE, DATE, HEALTHCARE_PROFESSIONAL_ID(foreign key from HEALTHCARE_PROFESSIONAL), PATIENT_ID(foreign key from PATIENT))

ADMINISTRATIVE_STAFF(ADMIN_ID(primary key), DOCTOR_ID(foreign key from DOCTOR))

INSURANCE(INSURANCE_ID(primary key), COMPANY_NAME, BILL_AMOUNT)

In table form:

PERSON_ID DA	ATE_OF_Birth	GENDER FIRST_NAM	ME MIDDLE_NAM	LAST_NAME				
REATMENT					T			
TREATMENT_ID	END_DATE	START_DATE	OUTCOME	DESCRIPTION	PRESCRIPTION_RECORDS	HEALTHCARE_PROFESSIONAL_ID	PHARMACY_ID	PATIENT_ID
LL								
BILLING_ID	DATE	ITEMIZED_COSTS T	OTAL_COST PAY	MENT_METHOD PATIE	NT_ID			
HARMACY								
HARMACY_ID	NAME	LOCATION PHONE	NUMBER					
EDICAL_RECOR	RD							
RECORD_ID [DIAGNOSIS	TREATMENT_HISTORY	ALLERGIES	CURRENT_MEDICATIO	NS LAB_RESULTS HEALT	THCARE_PROFESSIONAL_ID PATIEN	T_ID	
PPOINTMENT								
	MENT_ID	TIME	PURPOSE	DATE HE	ALTHCARE_PROFESSIONAL_ID	PATIENT_ID		

EMPLOYEE_ID	DEPARTMENT	SPECIALIZATION	YEARS_OF_EXPERIENCE	WORKING_HOURS	PERSON_ID	ENROLLMENT_DATE
ECHNICIAN						
EMPLOYEE_ID	TECHNICIAN_ID					
III DOE						
EMPLOYEE_ID	NURS	SE_ID				
DOCTOR						
EMPLOYEE_ID	DOCT	OR_ID				
erson Email_Address						
PERSON_ID	EMAIL_ADDRE	ss				
Person Phone_Number						
PERSON_ID	PHONE_NUMB	ER				
PERSON_LOCATION	ON					
PERSON_ID		STATE	STREET	CITY		ZIP
INSURANCE						
INDUITAINGE						

E. Dependency Diagram: Provide a dependency diagram for each table from Phase III-b.

-PERSON (PERSON FID) RATE OF BIRTH GENDER FIRST MAME, MIDDLE NAMES
F= 2 ERERSON-IPS-> 2 DATE OF BYRTH GERMATER FIRST, HAME, MIDDLE-NAME,
READON-DE TOATE OF BIRTH GET DE DIFTIBLE NAME MIDDLE HAME STATE STORES
FOCATAISTE
IMF (Eliminate any multinula) (un-posite attribute) and (coupe a seperate table for It) X
PERSON PERSONED ONTE-OF-BLATH GENDER FIRST-NAME IMMODIE-MAME LAST-NAME FOLL FOLL
PERSON-LOCATION [PERSON-ED STATE STREET CITY ZIP) FOR
2NF & Fliminute Partial Pepensiners)
3 NF. (Acoure Translitue Dependencies)
L. Same as above

- TECH NICTAN CEECHNICEANTON TEMPLOYEE - DOSHEALTH	HCARE_PERSON-FO)
F = ZERECHNECEAN-ERESEMPLOTEE-FOSHEALTHCARE ZEMPLOTEE-IPS-> 2 HEALTHCARE-PERSON-FOSS	E-18140N-509
(7M1) MAZIMAN ===	
TECHNICIAN - TO EMPLOYEE - TO HEALTHCARE PERSON - FD	
TECHNICIAN IDEMPLOYEE-TO MENTINATE PORTION DEPONDENT OF	n frm luzs
TECHNICIAN-DDJEMPLOYEE-LDJ FOR ID A	me.
HEALTH (ARE-PROFESSIONAL	Caroll Mariano
EMPLOTEE TO DEPARTMENT SPECIALIZATION TEARS-OF EXPERTE	SHOE TRIEFFING THE T
PERSON-TO IENROLLMENT-DATES	
3N= (Remore Translate Dependencia)	
\ x =	
I Same as the one above	
- NURSE (NURSE _ CO) EMPLOYEE EN) HEALTHCARE_	BEUZON-tD)
F= & {NUASE-TOS-ZEMPLOYEE-TO, HEALTH(AME.	LPERDW-FRY
NURSE CINF)	
MURSE_ ID EMPLOYEE ID HEALTHWARE - PLEADW-ED)	
FOI L	
F02	

MURSE (2MF) Elimikale Partial Papandary in Primar mg
TNUNSIZ-TO EMPLOYEE - TO
HEATTH CARE-PROPESSIONAL TEMPLOYEE-EDIPERARMENT SPECIALIZATION YEARS-OF EXPERIENCE MORILING-HOW)
(PERDONED) ENRULHMENT-PATE)
3 NF (Lemor on Trustim Dependencia)
some as abore
TO CONTROL TO FINAL OUTE TO HEALTH (ARE PERSON-TO)
- OOCTOR (DOCTOR_FD) FMPLOYEE ID) HEALTHCARE PERSON-FD) F= 2 2 DOCTOR_TDS - 2 EMPLOYEE ID) HEALTHCARE PERSON-FD) ZEMPLOYEE - IDS - 2 HEALTHCARE PERSON-FD) G OOCTOR (INF)
DOCTOR-ED EMPLOYIEE ED HE ALTHCARE - PERSON-ED FOR
OOCTOR (ZNF) Eliminate Partial Depending in Primy
DOGOL-TO EMPLOYEE-TO)
tol

HEALTHCARE_PROFESSIONAL
(EMPLOYEE - DO DEPARTMENT SPECIALIZATION) YEARS-OF-EXPERTENCE WORLING-HOLD
REPSON-TO/ENROLLMENT-DATE
J-5F02
3MFCRemore transitive Dependences).
In (same as above)
-TREATMENT (TREAMENT_DO) END-DATE START DATE OUT (OME) DESCRIPTION PRESCRIPTION PROFESSIONAL-FO) PHARMACY IN PROFESSIONAL-FO) PATTENT PERSON-FA) PATTENT DO EMPLOYEE PERSON-TO PATTENT PERSON-FA)
F= STREATMENT_IDS JEND_DATEJSTANTODATE, OUT COME, DESCRIPTION, PRESCRIPTION - RECORD, HEALTHCARE - PROFESSIONAL JED, PHARMAY-FO PATTENT IDS, ZHEALTHCARE - PROFESSIONAL - LOSS-3/ZEMPLOYER-PERSONATOR ZPATIENT-EDS->/ PATTENT-PERSON-EDY
TREATMENT (See Mindel) of The Millians (Mindel Mindel)
TREATMENTITOTE NO DATE START DATE OF COME OESCRIPTION PRESCRIPTION RECORDS
THEALTHCARE PROPEDITIONAL TO PHARMALY-TO PATIENT TO EMPLOYEE PAINTENT FOR FOR FOR FOR PORTIONAL TO PHARMALY-TO PATIENT TO EMPLOYEE PAINTENT PORTIONAL TO PROPERTIONAL TO
3W (Charles of Long Control
A

INF(Ellminute our multilling) composite curtification on repeating columns on create a seperate tusk for it

(plumps) a) Creste or seperate passe for "
TREATMENT FNO-DATE START DATE OUTCOME DESCRIPTION PRESCRIPTION-REW
TREATMENT TO FEND WAL ED PATIENT FD
2 NF (Eliminate Partial Octanioner)
3 NF (Acmine Transitive Dependences)
Jame as the are above
- APPOINTMENT (APPOINTMENT - LO) TIME, PURPOSE, DATE, HEALTH (ARE -PROFESSION - FD) PATIENT PERSON - FD)
F= 2 APPOINTMENT_IRY > 2TIME PORPOSE DATE HEALTHARE PROFEDIUMAL FOR
SOUTHENT-167 SEVELLENT-6EUM-207
APPOINTMENT
[APPOINTMENT DO] TIME POLPOSE O ATE HEALTHCARE PROFESSIONAL - FP PATTEM - DO
TEMPLOYEE-PERSON-ED PATIENT PERSON-ED FOR
F03

INF (Ellminute on maltinule) Composite attillutoja) repeatry column on create a separate traste for it)

APPOINTMENT
APPOINTMENT-ID TIME PURPOSE DATE HEALTH CARE - PROFESSIONAL-ED PATIENCE
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2NFCEllminate Partial Pependono7)
+ Some as the one above
3 NF (Elimhate Trunsitine Oceanions)
A same as the one above
- MEPICAL RECORD (RECORD-ED, DIAGNOSIS) TREATMENT HISTORY, ALL ERGIE CURRENT-MEDICATIONS) LAB-RESOLD, HEALTH (MRE-PROFESSMAL-E) PATIENT-FD) EMPLOYEE-PERSON-FD, PATERNT-PERSON-FD)
F= 2 2RECORD-IPS >2 DIAGNOSISTREATMENT_HISTORY/ALLERGIES (URRENT- MEDICATIONS) LAB-RESULTS JH FALTHCARE - PROFESSIONAL-ED) PATIENT IDS, THE ALTHCARE PROFESSIONAL-ED) 2 EMPLOYEE - PERSOW-DRY 2 PATIENT-IPS > 2 PATIENT - PERSOW-IDS
MEDICAL-REWRO
RECORDED DIAGNOS TREATMENT HISTORY ALLERGIES WROTENT MEDICATIONS LABREDULT
[HEALTH (ARE PROFESSIONAL IP) PATIENTID FMPLOTER PERSON PATIENT PERSON - TO

INFCEllminate con multimo conposite attribution RPRATE COLUMN ON CORATE OF SERVICE TUSIE FOR IT)

WEDECUT- VECOUD RECOLD-ED TO LAGNOSIS TREATMENT HISTORY ALLERGIES CORPENT MEDICATION LAGRENME HEALTHCARE-PROFESSIONAL-FO PATTENT-IDT 2NF (Remore Partial Dependency on Primary 1147) Some as the one above

> 3NF (Eliminate Transitive Dependence) Same is the one above