

## Case Study – EMR (Electronic Medical Records)

### Solution Document

Electronic Medical Records (EMR) are widely used by hospitals for storing and tracking patient information. Although the name uses the term “record”, the information captured is quite extensive and gets seamlessly used with information management systems for hospitals. Patients need to register at specific hospital before they can avail the services of the hospital. Once a patient has a registration at a hospital, the patient can visit the hospital to avail the services. A typical visit to the hospital can be either consultation or a diagnostic test. If a visit requires both consultation followed by a diagnostic test, it is treated as a separate visit (in other words, a visit cannot be counted towards both a consultation and a diagnostic test). The hospital charges the patient for each visit. Each consultation allows a patient to consult one doctor with prior appointment. As part of the consultation, the doctor may give a prescription to the patient, which may include one or more medications.

(Note: All the following classes must appear in your UML class diagram)

S. No.	Class Name	Class Description
1.	Patient	A person visiting the hospital
2.	Registration	Permits the patient to avail the services of a hospital
3.	Visit	A specific visit by the patient to the hospital
4.	Consultation	One of the types of visits. The name of the department being visited is captured.
5.	DiagnosticTest	One of the types of visits. The name of the tests are captured
6.	Doctor	The doctor being consulted
7.	Appointment	The appointment scheduled for a specific consultation between a doctor and a patient.
8.	Prescription	Provided by the doctor to a patient after the consultation
9.	Medication	Medicine prescribed in a prescription.

## Sample Data

(Note: All underlined data must appear somewhere in your database in some column)

Mr. Jalubu Zhukham is suffering from chronic cold and has been advised to consult a chest specialist. The patient goes to the hospital and registers himself on 1<sup>st</sup> April, 2013. He gets himself an appointment for the same day to meet the chest specialist Ms. Khemmu. The doctor asks the patient to undergo a diagnostic test named Choma Pariksha. After reviewing the results of the test, the doctor prescribes 1 teaspoon of honey and steam inhalation. Mr. Jalubu Zhukham walks away home happily until he realizes it was April Fools day! 😊

## Answer the following

A) (20 marks) Draw the complete object-oriented schema for given problem statement using the UML class diagram notation.

Note:

*All the classes mentioned above must (mandatory) appear in the final UML schema. You may add additional association classes where needed. Add natural attributes to classes based on the given description for the classes and the sample data.*

B) (20 marks) Map the UML schema to a relational schema. The relational schema should strictly follow the mapping rules discussed in the class. After doing OR mapping, every table in the relational schema should be shown in the following example format:

Table name = EMPLOYEE

Name of column	Data type	Constraints (PK, FK, Surrogate, UNIQUE, NOT NULL, etc.)
EMP_ID	Number	PK, Surrogate
Emp_Name	String	NOT NULL
Dept_ID	Number	FK references Department.Dept_ID, NOT NULL

Note:

- *Every table should contain only those columns that are either present in the UML schema or is introduced for the purpose of OR mapping. Do NOT introduce new attributes in the relational schema without a proper reason!*

C) (20 marks) Convert the sample narrative data given in "**Sample Data**" into actual table data as per the relational schema designed in (B) above. For every table, show the sample data in simple tabular form as shown in the following example:

Employee

Employee_Id	Name	Age	Dept_Id
394873	John Doe	34	D01
353636	Jane Doe	35	D01

Note:

*Every piece of information specified (underlined) in the "**Sample Data**" section must collectively find a place in the relational database you have designed.*

## Grading Guidelines

1. UML class diagram grading will be done on a negative marking scheme starting from 20 marks. The given class diagram solution will be considered as the “correct” solution for the grading. A penalty of 1 mark will be imposed for each of the following:

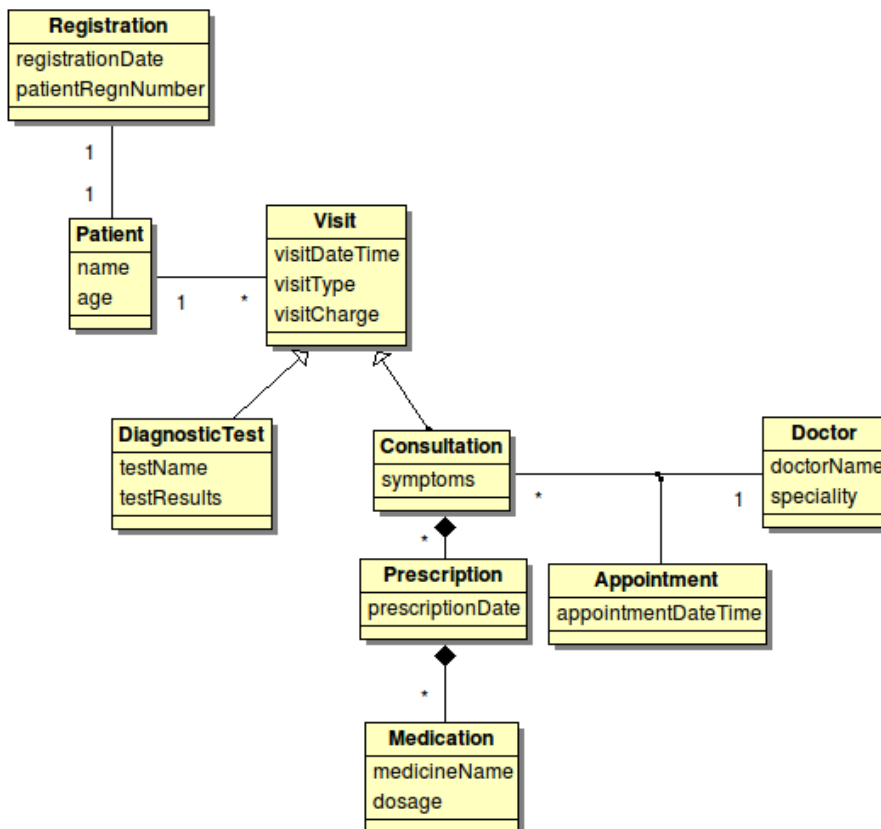
- Missing classes
- Missing associations
- Missing aggregations (showing it as association is okay)
- Missing composition (showing it as aggregation or association is okay)
- Missing inheritance (okay to show as partitioning or non-partitioning)
- Missing or incorrect cardinality
- Showing non-natural attributes not allowed (e.g., surrogate key should not be shown)

2. Relational schema grading will be done on a negative marking scheme starting from 20 marks. The given relational schema solution will NOT be used as the “correct” solution. Instead, your own UML schema will be considered as the “correct” input. Based on this input, all OR rules must be applied correctly. A penalty of 1 mark will be imposed for each of the following:

- Missing tables (with reference to YOUR UML schema)
- Missing PK, FK and NOT NULL constraints
- Missing surrogate key for PK in each table
- (Semantic constraints are optional)

3. Sample data grading will be done on a negative marking scheme starting from 20 marks. For every piece of missing data, a penalty of 2 marks will be imposed. The tables used for sample data must be same as YOUR relational schema.

## UML Class Diagram from EMR Case Study



## B) Relational Tables

### 1. Registration

- registrationID (PK)
- patientRegistrationNumber (UNIQUE NOT NULL)
- registrationDate
- patientID (FK REFERS Patient.patientID NOT NULL)

### 2. Patient

- patientID (PK)
- name
- age

### 3. Visit

- visitID (PK)
- visitDateTime
- visitType
- visitCharge
- patientID (FK REFERS Patient.patientID NOT NULL)

### 4. DiagnosticTest

- diagnosticTestID (PK, FK REFERS Visit.visitID)
- testName
- testResults

### 5. Consultation

- consultationID (PK, FK REFERS Visit.visitID)
- symptoms
- doctorID (FK REFERS Doctor.doctorID)

### 6. Doctor

- doctorID (PK)
- doctorName
- speciality

### 7. Appointment

- appointmentID (PK)
- appointmentDateTime
- consultationID (FK REFERS Consultation.consultationID)

### 8. Prescription

- prescriptionID (PK)
- prescriptionDate
- consultationID (FK REFERS Consultation.consultationID on DELETE CASCADE)

### 9. Medication

- medicationID (PK)
- medicineName
- dosage
- prescriptionID (FK REFERS Consultation.consultationID on DELETE CASCADE)

## Sample data

### Registration

registrationID	patientRegistrationNumber	registrationDate	patientID
r01	BLR-001	1 Apr 2013	p01

### Patient

patientID	name	age
p01	Jalubu Zhukham	25

### Visit

visitID	visitDateTime	visitType	visitCharge
v01	1 Apr 2013	Consultation	100
v02	1 Apr 2013	DTest	250

### DiagnosticTest

diagnosticTestID	testName	testResults
v02	Choma Pariksha	All is well

### Consultation

consultationID	symptoms	doctorID
c01	chronic cold	d01

### Doctor

doctorID	doctorName	speciality
d01	Ms. Khemmu	chest specialist

### Appointment

appointmentID	appointmentDateTime	consultationID
a01	1-4-13 10:00	c01

### Prescription

prescriptionID	prescriptionDate	consultationID
p01	1 Apr 2013	c01

### Medication

medicationID	medicineName	dosage	prescriptionID
m01	honey	1 tsp	p01
m02	steam inhalation	3 times	p01