Problem Analysis & Modelling

Project Sprint 2

Team Name: THE FIBRILLIN GENiES

Team Members

Hemanth Sai Kumar Gaddam

Puja Mishra

Priyanka Reddy Kuta

Sanjana Rajan

Department of Informatics and Computing, Indiana University

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Professor Saptarshi Purkayastha

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Problem Analysis and Modelling

Introduction:

According to Visual Paradigm, the Unified Modeling Language (UML) is a comprehensive modeling language that provides a suite of diagrams for system and software developers to detail, visualize, and document software and non-software systems (Visual Paradigm, n.d.).

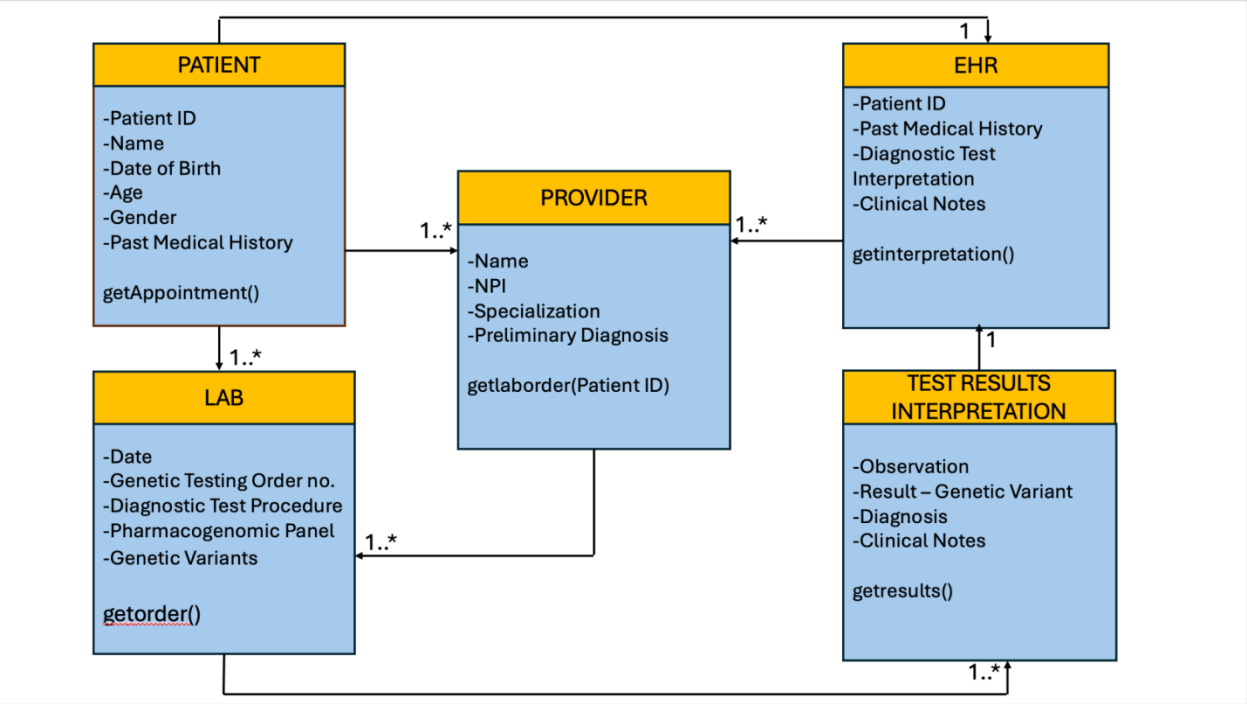
BPMN diagrams help visualize workflow, Athuraliya (2023) states that there are multiple processes involved in creating a BPMN diagram. These include determining the scope of the process, selecting suitable tool, and then diagramming the process using components such as activities, start events, gateways, and end events.

Use case description:

"A 34-year-old male patient with a history of rib cage defect (pectus excavatum), long fingers, flat feet, and "double-jointedness" seeks a diagnosis. The clinician orders genetic testing on multiple Fibrillin-1 (FBN1) gene variants (mutations). A genetic testing laboratory receives the order and performs detailed testing, which shows that the "FBN1 c.7039_7040del (p.Met2347fs)" variant is positive, with all other tested FBN1 variants negative. The result is sent back to the clinician, who makes a diagnosis".

Problem Analysis and Modelling

UML Class : Provider Centered Relationship Model



Footnotes: The UML diagram reflects the workflow of a genetic testing process involving a patient, provider, lab, test results interpretation, and EHR. It describes each entity's properties as well as the operations that can be performed, demonstrating the variety of interactions.

a.) Patient to Provider: The multiplicity is shown as "1..*" - a single provider can engage with one or more patients, but each patient only interacts with one provider at a time.

b.) Provider to Lab: The multiplicity is shown as "1..*" - a many-to-many relationship in which a single provider can request lab tests from one or more labs, and a single lab can accept test orders from one or more providers.

c.) Patient to Lab: The multiplicity is shown as "1..*" - a single patient may have several lab tests, and each lab can do tests on one or more patients.

d.) Lab to Test Results Interpretation: The multiplicity is shown as "1..*" - while each lab can generate several interpretations of test data, each interpretation is unique to that lab.

e.) Test Results Interpretation to EHR: The multiplicity is shown as “1” - each test result interpretation is associated with a single EHR, and each EHR has its own unique test result interpretation.

f.) EHR to Patient: The multiplicity is shown as "1" - a one-to-one relationship in which each patient is assigned a single EHR, and each EHR relates to only one patient.

Interoperability:

Standard terminologies such as LOINC for lab tests, SNOMED CT for clinical terminology, and ICD for diagnoses allow consistent data interpretation and interchange across Patient, Provider, Lab, EHR, and Test Results Interpretation..

a.) Semantic interoperability: This is achieved by standardizing data fields (such as Patient ID, Genetic Variants, and Observations), allowing different systems to understand and interpret data in the same way. For example, the EHR system must understand the Test Results Interpretation in order to be useful.

b.) Syntactic Interoperability: This is most certainly existent, but not explicitly demonstrated, and would entail the usage of standardized communication protocols and data formats to ensure data exchange between systems.

c.) Organizational interoperability: This UML diagram is evidenced by the defined roles and systematic data exchange among entities—Patient, Provider, Lab, EHR, and Test Results Interpretation—facilitating cohesive patient care.

d.) Process/Workflow Interoperability: The diagram implies a series of actions (like getAppointment(), getDiagnosis(), getTest(), getClinicalAnalysis(), and getSample()) that are part of a workflow, enabling different entities to work together seamlessly in a healthcare process.

BPMN Model Diagram:

Definition:

In the given use case, the clinician needs to gather information about the patient's history, family history and perform a physical examination, and perform tests to make a diagnosis which forms the steps of the workflow. The depicted model is divided into 3 parts which play a critical role in patient care.

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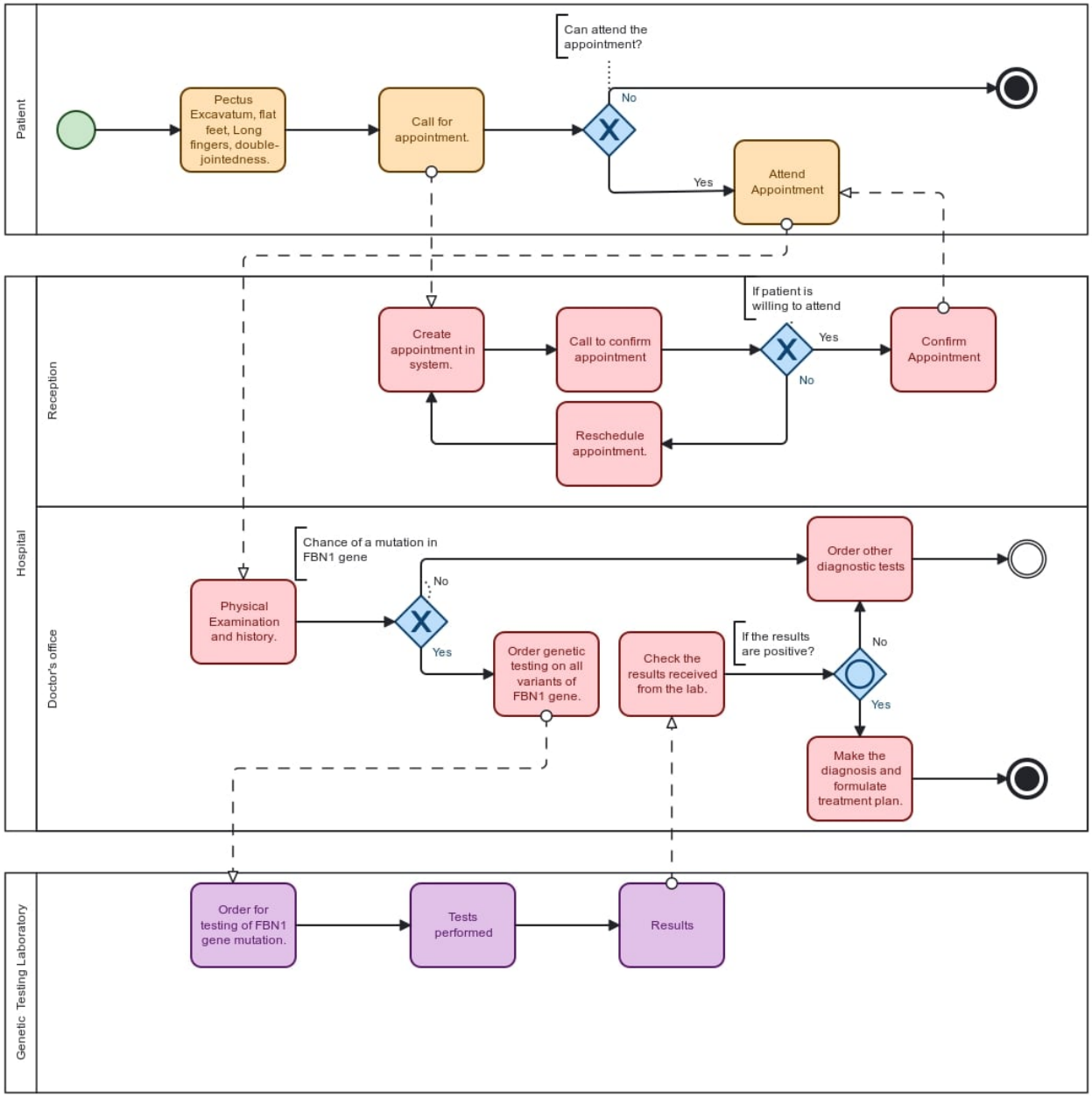

Footnotes:

1. **Patient's Home Segment:** The patient identifies potential symptoms of a genetic condition and contacts the clinician's office to schedule an appointment, initiating the process (start event with a thin circle). The patient's decision to attend the appointment is

an exclusive gateway (diamond shape), guiding the flow towards either attending the appointment or ending the process if unable to attend.

2. **Reception/Doctor's Office Segment:** The receptionist schedules the appointment within the EHR system (task). A follow-up task involves a call to confirm the appointment, which is a decision point (exclusive gateway) leading to either confirmation or rescheduling based on the patient's response.
3. **Doctor's Office Segment:** The doctor assesses the patient through a physical examination and history review. Based on the likelihood of an FBN1 gene mutation, another exclusive gateway determines whether to proceed with genetic testing. If testing is indicated, the process advances to order the test (task), and results are awaited from the laboratory (intermediate event).
4. **Genetic Testing Laboratory Segment:** Upon receiving the order for testing (message flow with dotted line), the laboratory performs the genetic tests (task). The results are then sent back to the clinician (message flow with dotted line), completing this segment of the process.
5. **Return to Doctor's Office Segment:** The clinician receives the test results, which trigger an intermediate event. An exclusive gateway then dictates the next steps based on the test outcomes—additional tests may be ordered, or a diagnosis and treatment plan are formulated, culminating in an end event.

Interoperability Notes:

- **Patient:** Demonstrates syntactic interoperability by using a standardized communication channel (phone or online system) to schedule an appointment with the clinician's office.

- **Reception/Doctor's Office:** Shows semantic interoperability to guarantee a consistent understanding of medical terminology and patient details during appointment scheduling and confirmation, vital for an efficient workflow in the EHR system.
- **Genetic Testing Laboratory:** Demonstrates syntactic interoperability by adhering to standardized procedures for test requests and results. Semantic interoperability is clear in ensuring the test findings are meaningful and accurate to the clinician.
- **Return to Doctor’s Office:** Highlights semantic interoperability ensuring the clinician comprehends lab results correctly for reliable diagnosis and treatment, aligned with the lab's conveyed findings.

References:

Athuraliya, A. (2023, December 12). *What is BPMN? The Easy Guide to Business Process Modeling Notation*. Creately. Retrieved from https://creately.com/guides/what-is-bpmn/

Visual Paradigm. (n.d.). *What is Unified Modeling Language (UML)?* Retrieved from https://www.visual-paradigm.com/guide/uml-unified-modeling-language/what-is-uml/