FINAL PROJECT INSTRUCTION

Fall 2014 INFO 5100 / CSYE 6200

General Information

The objective of the final project is for you to explore the design and implementation of software systems for complex problems. You will practice our building block techniques to program complex software. You will be playing multiple roles in this project to build good understanding of the development and management of information systems. The roles include: functional architect (analyst) who develops understanding on the problem and designs use-cases; user process designer who develops the object model and user-interaction protocols; software programmer who implement the system using Java programming language; innovator who finds creative things that no one else thought that before; and presenter who communicates his/her idea to the audience clearly and completely. You will also need to decide on the most important aspects that you think are critical for the success of the effort. You need to target high impact and low cost effort so you can finish a good chunk of the project on time.

You will find a couple of problem statements in the later section. You will need to select one from them and implement an application that solves that problem. And the final project has to be done individually, plagiarism (use other people's code or other project sources) is not allowed and will not be tolerated.

In the end, you need to present your project to the graders. Graders will evaluate the completeness, correctness, and creativity of your project and reach a final decision based on the grading guidelines.

Here are some important dates for the final project:

Date	Activity	Deliverable
October 24th, 2014	Final Project Announcement	N/A
November 14th, 2014	Status Check I	Proposal, Research Notes
November 21st, 2014	Status Check II	Object Model Draft
December 7th, 2014 11:59pm	Submission Deadline	Complete Project, Presentation Slide
December 8th – 12th, 2014	Presentation	

Here are the topics you can choose from:

1. Global Surveillance and Forensic System for Protecting Pharmaceutical Distribution Supply Chain
2. National Vaccine Distribution System
3. An Healthcare Internet: Exploring the Construction of Use-Inspired Communication Eco-System for Patient-Centered Care
4. Auction-Based Internet Advertising Platform
5. Medical Device Inventory Management for a Medical Establishment Network of Service Providers

Global Surveillance and Forensic System for Protecting Pharmaceutical Distribution Supply Chain

Overview

Drug medications are products that are in high demand world-wide. Such products move through a complex pharmaceutical distribution supply chain that crosses national boundaries. This chain begins with bio-medical laboratories that create chemical compounds in the form of active and inactive ingredients, and, clinical trials, manufacturing, distribution, and all the way to patients, and finally may be back to hospitals and emergency rooms in case of adverse events.

The objective is to build a global communication network for protecting the drug distribution supply chain and investigating drug counterfeit crimes. The communication infrastructure will be designed as a social network of communicating private and public organizations as well as doctors, hospitals, and patients. The network will require the participation of pharmaceutical companies, law enforcement agencies, etc.

In this pharmaceutical supply chain so many things can go wrong that endanger the safety of patients with billions of dollars in cost. Your task is to study ways to build new kind of information systems that will protect the pharmaceutical distribution supply chain and allow law enforcement personnel to intervene when violations occur. The system will allow government pharmacy oversight agencies and law enforcement personnel in cooperation with trading partners (Supplier, Wholesale Distributor, Re-packager, and Dispenser, etc) to fight such crimes. You must emphasize the best practices promoted in the pending Senate Bill (see the attached file) as well as robust communication and data/knowledge sharing as a way to stop illegitimate drugs from infiltrating the pharmaceutical drug distribution supply chain.

Suggest Reading and Research Topic

1. Draft of Drug Distribution Security Bill.

Required Functionality

1. Must implement all use cases for the construction and subsequent operations of a pharmaceutical supply chain eco-system in compliance with the Senate Bill proposed best practices.
2. Enable a pharmacist to check if the medication is a suspect product. In the case of a product that has a missing link in its chain of trust, then allow the pharmacist to report that incident to a law enforcement unit. See the Senate Bill for the definition of a suspect product.
3. Enable a patient to report a suspect product due to an adverse event, suspect packaging, etc.
4. Must implement a complete workflow involving: at least one manufacturer, one distributor, one hospital, and multiple patients.
5. You need to capture or maintain a record of the movement of valid products through the supply chain capturing certified product ownership through the pharmaceutical supply chain. For each product, you must maintain a transaction history of transitions of ownership (a chain of trust).
6. Allow pharmaceutical manufacturers and distributors to fulfill drug medication orders. Orders can only be taken from trusted (licensed) partners.
7. Enable pharmaceutical companies to manage their drug catalogs and medication inventory, and maintain a history of suspect/illegitimate products. Allow pharmaceutical companies to run BI to establish patterns of counterfeiting incidents/crimes from anywhere in the world.

8. A licensing and verification unit at the federal level to license manufacturers and a licensing unit at the state level to enable licensing of wholesale distributors. There are many kinds of licensing categories that you should pursue (block prescription sales, verses patient specific needs, etc).
9. Product owners must provide request services to inquiring government oversight and law enforcement units for suspect product transaction history information.
10. Wholesale distributors must provide alert mechanisms which will allow for the immediate notification of suspect drug products to buyers (other distributors, dispensers, etc).
11. The focus is on the ordering and distribution and not the manufacturing and production of drugs.

Grading Levels

The grading levels are described incrementally. Therefore, in order to get certain grade level, you not only need to implement the functions described at level, but also all the functions from the lower levels.

1. Base Level [C+ to B-)
    a. Able to build an eco-system between multiple enterprises joined together as trading partners.
    b. Manage drug inventory at the manufacturer, distributor, and hospital.
    c. Initiate and fulfill inventory orders between the manufacturer and distributor.
    d. Must provide proper logging or overview of what have been going on with the whole system.
    e. Database support (db4 database).
2. Feature Level [B- to A-)
    a. Implement all the requirements in the feature list described above.
    b. Good use of colors, layouts, proportionality, symmetry, etc.
3. Creativity Level [A- to A)
    You decide what is interesting here. The following are example options that you can consider, and you are more than welcome to come up with your own creative ideas
    a. Full forensics system of global scale (multi-national) showing how the pharmaceutical distribution supply chain best practices (from the Senate Bill) can be used to build a full-fledged forensic system. Show how multiple countries can work together to fight counterfeit crimes.
    b. Use the order life cycle approach to capture transactions and transaction histories. This will include packaging of orders, shipping, delivery, invoicing, and payments.
    c. Find innovative ways of determining suspect and illegitimate products. What sort of gaps in the "trust chain" that will help determine suspect products?
    d. Extensive use of Alerts.

National Vaccine Distribution System

Overview

Vaccine distribution management and responsibility needs have grown in recent years. Currently, vaccine management generally consists of a mess of isolated computer applications and paper-based systems that are managed by the CDC and state-level vaccination programs. The way vaccine distributed, and inventoried are complicated and costly. Little information is known about the state of vaccine supply and demand. This leads to inefficiencies and safety problems at the provider level (hospitals and clinics).

Your task to build a vaccine inventory management and distribution system that will operate at the national, state and local levels. The objective is to use application engineering technology to improve the efficiency, accountability, and the ability to respond to safety problems and public health crisis.

The first part of the project is to research this problem in detail and come up with business architecture that will define the scope of your solution. You then need to follow that with a software implementation of your solution in Java. The solution must address vaccine financial management, vaccine distribution, provider ordering (hospital and clinics), inventory management, and the operation of the national vaccine stockpile.

Key Entities

1. Center for Disease Control (CDC): Receive vaccine order from individual state Public Health Department (PHD) for vaccine. Orders are approved by CDC according to state allocation and passed on to national distributor for shipping directly to hospitals, pharmacies, clinics, etc (referred to as sites).
   The CSC keeps track of available inventory on a daily basis and uses a formula to determine how to allocate vaccines supply to sites. The formula is based on the population size of each state. A site can only order from the allocated quantity for that state. If the limit is reached for that state then the order is delayed or rejected.
2. Distributor: A single national distributor responsible for shipping to registered clinics and hospitals. Satellite clinics receive their supply from their affiliated hospitals. The distributor interacts with vaccine manufactures and ship through their distribution centers which are located in different regions of the country. Distributor bills providers.
3. Department of Public Health: Receives orders from registered sites. It is responsible for reviewing and approving site requests for vaccine. Approved requests are forwarded to the CDC for approval and shipping. The state keeps track of registered sites. Only registered site can order vaccine.
4. Provider: Prepares and submits orders to the PHD for approval. The distributor will ship directly to the site. Maintains vaccine inventory for its satellite clinics. Provider billed by the distributor. Providers schedule their orders: monthly or biweekly depending on their anticipated demand forecast.
5. Clinic: Maintains vaccine inventory
6. Other Entities: Any additional entities such as central pharmacies (such as regional CVS units responsible for pharmacies in their region).

Required Functionality

1. Configuration management that define users, geographies, players (enterprises) and including hospitals and their associated satellite clinics.
2. Provider contract management where providers agree to certain delivery schedule.
3. Inventory management and as it related to pharmaceutical companies.
4. Distribution centers manage the flow of vaccines from inventory centers to providers.
5. Providers requesting vaccines for their hospital and clinic operations.
6. Clinics that supplied by parent hospitals.
7. Address how the flow of funds and payments go through the system.
8. Vaccine adverse event management

Key Issues

1. Vaccine Safety: The CDC is interested in learning as quickly as possible if a particular batch of vaccine is spoiled or making people sick. The problem could occur because of problems in manufacturing a particular set. The CDC wants to send a recall by tracing back the factory where that batch was made, manufacture date, etc. Your system must allow for the easy access to that kind of information. In order words, linkage between the factory and the inventory as the vaccine moves through the supply chain.
2. Inventory that get wasted and the reasons for the waste.
3. Other possible issues that stop vaccines from being distributed and used properly and efficiently.

Grading Levels

The grading levels are described incrementally. Therefore, in order to get certain grade level, you not only need to implement the functions described at level, but also all the functions from the lower levels.

1. Base Level [C+ to B-] – Cover the life-cycle of vaccine and inventory management
   a. Eco-system configuration
   b. At least 4 roles: CDC, distributor, provider, and manufacture. Manufacturer has a contract with CDC to supply vaccine. Shipments are delivered to Distributor. Distributor is a single enterprise but inventory are maintained at multiple warehouses distributed in a number of regions.
   c. Inventory management of vaccine.
   d. Orders submitted by providers and approved by State DOPH. Shipping orders to providers are generated by distributors. Orders generated by providers are approved by the State and submitted to distributors. Automatically generated orders are possible as well.
   e. Must provide overview of distributed vaccines. For example, total number of doses that are available in the inventory throughout the eco-system (or at the each state).
   f. Database support (db4 database).
2. Feature Level [B- to A-] – Cover the billing and payment processing
   a. Financial management of state and federally funded vaccines. The distributor charges the CDC and the state for their vaccine orders.
   b. Patient vaccination is charged to the proper account. This will require including the patient and provider sites. Patient insurance information must be modeled and captured. Patients with no health insurance are paid by the CDC or the state. Patients who are

under-insured are covered by the CDC for the difference. Patient with private coverage are charged to their insurance.

    c. Must include cases for billing and payment processing.

3. Creative Level [A- to A)

You are responsible to determine what is innovative here. You must show advanced capabilities beyond the ones sited above in relation to safety, effective, and efficient.

An Healthcare Internet: Exploring the Construction of Use-Inspired Communication Eco-System for Patient-Centered Care

Overview

The project focus will be on the construction and operations of an Internet for Healthcare. The system will serve as communication system for clinical and administrative operations. The network nodes will be hospitals, clinics, doctors, nurses, administrators, pharmacies, pharmaceutical companies, and most importantly the patient. Such connectivity opens possibility for many useful uses that are critical to the safety and well-being of patients, effectiveness in delivering quality care, and efficiencies to ensure that the healthcare services are affordable. There are many uses for such system:

1. Drug safety management. Allow pharmaceutical companies to communicate drug safety issues to doctors, and patients. Also, allows patients and doctors to communicate their experiences with the use of drugs back to drug manufacturers. In the event of patterns that indicate serious drug interactions, the pharmaceutical companies will learn quickly about such dangers. They will be able to quickly communicate their decisions, for example, a callback of products, back to pharmacies, doctors, and patients. This must be done at regional, national, or global scale. See the REM guideline coming out the FDA.

2. A complete patient profile. Such a network could be used to develop a more complete patient profiles. For example, a doctor might be able to pull all kinds of medications that were prescribed by any doctor anywhere in the US. A doctor might be able to issue an inquiry about a patient over the network and all hospitals that have information about that patient will respond with whatever clinical or administrative information they might have. If a patient is travelling and ends up in an emergency room somewhere, the system will allow the doctor to pull all diagnoses and treatments date about that patient. In the end, all these cases will lead to more effective clinical decisions.

Suggest Reading and Research Topic

1. Healthcare Information Exchanges.
2. Risk Evaluation and Mitigation Strategies
3. Continuity of Care Documents (CCD or CCR)

Grading Levels

The grading levels are described incrementally. Therefore, in order to get certain grade level, you not only need to implement the functions described at level, but also all the functions from the lower levels.

1. Base Level [C+ to B-)
   a. Drug companies, hospitals, doctors, and patient scenarios. Must demonstrate the ability to search and find patient demographic and clinical information from multiple regions of the country.
   b. Must provide proper logging or overview of what have been going on with the whole system.
   c. Database support (db4 database)
2. Feature Level [B- to A-)
   Adverse events and clearly must demonstrate key features of risk evaluation and mitigation.

3. Creative Level [A- to A)

   You decide what is interesting here. The following is an example option that you can consider, and you are more than welcome to come up with your own creative ideas

   a. How to create social networks of "patients like me" type applications. This will allow patients to share their experiences. For example, consider diabetic patients who are taking the same drug and experiencing similar risks and/or benefits.

Auction-Based Internet Advertising Platform

Overview

Online advertising, is a form of marketing and advertising which uses the Internet to deliver promotional marketing messages to consumers. It includes email marketing, search engine marketing, social media marketing, many types of display advertising, and mobile advertising. In this project, we will focus on one of the types, which is display advertising. Display advertising conveys its advertising message visually using text, logos, or other graphics. Display advertisers frequently target users with particular traits to increase the ads' effect (for example, cookies).

Online advertising usually follows an action model where advertising space on web-pages is offered to the highest bidder on the fly. The user profile determines the prices for the advertising space. The sharper the profile in terms of buying habits and likelihood to click on the advertisement, the higher the price offered for the ad space. The auction for the ad space happens dynamically at the moment of click and only then the ad is determined for the user. User behavior is accumulated over time to sharpen the effectiveness of the ad.

Suggest Reading and Research Topic

1. Startups in Greater Boston Area that are into the real-time bidding advertisement business.
2. Consumer/User behavior and bidding strategies.

Key Entities

1. Exchange: the central entity of the system, it is where the auction take place. Publisher will submit its available display space to the Exchange and Advertiser bid on the space through Exchange.
2. Publisher: the publisher owns certain online content, such as website, video streaming services, etc. It provides display spaces, such as empty space on webpage, 10 seconds frames before video streaming, etc., to potential display advertising materials. The publisher will be compensated based on certain compensation model (for example, cost by click).
3. Advertiser: the advertiser provides the advertisements to be displayed on the publisher's content. In order to get the advertisement displayed, the advertiser needs to bid through exchange, the highest bidder's ad will get displayed.
4. Consumer: consumer will browse web pages or streaming services on Publisher's website, he/she might attracted by the advertisement and click on it. Each consumer will have certain browsing behavior pattern. This pattern is important to Advertisers because this will help them to come up with a better bidding strategy.

Required Functionality

1. Ads are dynamically selected at the moment of click.
2. Auction like model where user profiles and habits are offered to potential advertisers.
3. The ad space is assigned to the highest bidder.
4. The system maintains a list of user potential to click on the ad and the probability that will lead to a purchase.
5. Market definition and classification of users based on certain characteristics.
6. The system is global in nature and geography aware.

7. Invoicing and payment are supported. Advertisers maintain financial accounts and Publishers are compensated accordingly.
8. The system includes companies who wish to advertise as well as advertising and marketing agencies.
9. Ad price is determined on a multitude of factors such as page hit rates, user profile, page ad space dimensions, among others.

Grading Levels

The grading levels are described incrementally. Therefore, in order to get certain grade level, you not only need to implement the functions described at level, but also all the functions from the lower levels.

1. Base Level [C+ to B-)
   a. Eco-system configuration
   b. Has Publisher, Advertiser, Consumer and Exchange entities in your system. Able to complete some basic functionality such as of advertisement place bidding, consumer purchasing, etc.
   c. Must be able to support global activities.
   d. Must provide proper logging or overview of what have been going on with the whole system.
   e. Database support (db4 database).
2. Feature Level [B- to A-)
   a. Include billing, invoicing functionality for Publisher and Advertiser.
   b. Take consumer profile (such as browsing history, click history) into consideration during the bidding process.
3. Creative Level [A- to A)
   You decide what is interesting here. The following is an example option that you can consider, and you are more than welcome to come up with your own creative ideas
   a. In the real world advertisement bidding systems, the Advertisers don't actually sit together in a room and do an auction. Because, doing so is simply too slow comparing to the browsing rate of consumers. Instead, Advertisers come up with some predefined bidding model. For example, the Advertisers might decide that will always bid 10 cents for consumers who purchased certain product before. As you can see, the model is really important to Advertisers. How will you find a reasonable model that is effective and cost-efficient?

Medical Device Inventory Management for a Medical Establishment Network of Service Providers

Overview

Partner HealthCare System, Inc. (PHS) was founded in 1994 by Brigham and Women's Hospital and MGH. Partners is an integrated health care system that offers patients a continuum of coordinated high-quality care. Focused on patient care, teaching, and research. The system includes primary care and specialty physicians, community hospitals, the two founding academic medical centers, specialty facilities, community health centers, and other health related entities.

Medical devices and equipment represent tools that clinicians use to deliver patient care. Many medical devices are extremely complex and expensive to buy and expensive to maintain but they are crucial to patient safety. PHS is interested in an effective way of utilizing their expensive medical equipment. They want to share expensive equipment across its network of service providers (e.g., hospitals). Thus, eliminate the need to stock expensive equipment that won't be used often. In addition, good management of device utilization has impact on the clinical operations such as surgeries which have heavy dependence on the availability of medical devices. In other words, good management of device inventory means efficient utilization of the operating rooms as well as efficient use of clinician time and staff time.

Clearly the efficient management of medical devices has a fundamental impact on a medical establishment ability to operate efficiently, safely and effectively (i.e., eliminate an unnecessary work). Your project is to build an inventory system for managing medical devices for the Partners HealthCare network of service providers in Mass.

Required Functionality

1. Acquisition of new medical devices from a network of approved suppliers.
2. Inventory management, visibility, and share of device utilization across the network.
3. Warehouse management which keeps track of the movement of medical devices between operation rooms and storage space.
4. The dynamic configuration of the network of hospitals through easy to use interfaces.
5. Devices must be reserved way ahead of time. The system must allow for scheduling the use of the medical devices. Medical devices must be reserved for clinical operations (surgical procedures) and not operating rooms.
6. Operating rooms must be reserved for clinical operations. So operating must have schedules that allow for the scheduling of clinical procedures.
7. Operating procedures must have a care team to perform the prescribed operations. The network has a staff made up of persons. A care team has a leader and team members.

Grading Levels

The grading levels are described incrementally. Therefore, in order to get certain grade level, you not only need to implement the functions described at level, but also all the functions from the lower levels.

1. Base Level [C+ to B-)
   a. A detailed definition of medical devices (minimum 10 attributes)

      b. Multi-role support,

      c. One hospital (no sharing is required)

      d. Supplier management, order of equipment, and billing (accounting) and payment (treasury)

      e. Inventory management of equipment

      f. Device and room scheduling

      g. Report on usage of device inventory

      h. Database support (db4 database)

      i. Must use static methods, inheritance, and abstract classes or methods

      j. An example of a factory class pattern and a factory method pattern

      k. Must provide proper logging or overview of what have been going on with the whole system.

2. Feature Level [B- to A-)

      a. A network of hospitals

      b. Room and surgery scheduling

      c. Maintenance management and including keep track of the history of problems and fixes. A device must include a maintenance schedule (date last maintained, next maintenance date, etc.) Alerts should be issued, in the case where the device is not maintained as prescribed. Be careful of what attributes go on the device and those that must be part of the device inventory.

3. Creative Level [A- to A)

You decide what is interesting here. The following is an example option that you can consider, and you are more than welcome to come up with your own creative ideas

      a. Failure forecasting, usage trends, safety issues, etc.