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Internship Portfolio

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Internship Portfolio

by

Aparna Mantha

A Portfolio

Submitted to the Graduate Faculty of

St. Cloud State University

in Partial Fulfilment of the Requirements

for the Degree of

Master of Science

in Computer Science

May 2018

Portfolio Committee:
Al-Azzam Omar, Chairperson
Jie H. Meichsner
Tirthankar Ghosh

Executive Summary

My one-year internship program work was with Mayo Clinic, Rochester. I was involved in the software development as part of a work term, all of which will be outlined in this report. The report will cover some background information on the projects I was involved in, as well as details on how the projects were developed. The report also states how and what academic courses and projects helped me in overall internship experience so far.

At the beginning of the internship, I formulated serval learning goals, which I wanted to achieve:

- To understand the functioning and working conditions of the organization;
- To explore working in a professional environment;
- To explore the work environment for the possibility of a future career;
- To utilize my gained skills and knowledge;
- To find skills and knowledge I still need to work in a professional environment;
- To learn about software development life cycle;
- To learn about the development methodologies;
- To obtain fieldwork experience/collect data in an environment unknown for me;
- To obtain experience working in multicultural and diverse environment;
- To enhance my interpersonal and technical skills;
- To network with professionals in the industry.

There are five major projects that I had a significant role in. The first project was Space Tools, involved gaining a good understanding of a javascript framework called Angular. My task was to study its working, develop wireframes from the view point of developing an application using that technology. My task was to do the following:

- Understand working with Angular framework,
- Understand working with Git,
- Develop wireframes.

As this was my first project with Mayo Clinic, particularly at Development Shared Services (DSS) as a team project, I also had a large scope of understanding Agile Methodology - Scrum Process in particular.

The second project was BAMS which was a rewrite of existing application in Windows Presentation Framework(WPF) and .Net backend. In this project my tasks were

- Understand using WinForms and WPF,
- Develop pages using WPF- MVVM Framework.

The third project was DSA, where I acquired knowledge of working on Angular4 and frontend Unit testing in Karma using Mocha and Chai frameworks.

The fourth project is MML Notification and Delivery, which started with an analysis phase in which were asked to analyze the data flow and system integrations the current Mayo Access and Mayo Link (MML Internal Operations) are dependent upon. We are to provide a new functionality to Mayo Access users of Notification and Delivery of tests results.

The fifth project is “MML Database Analysis”. This project is in the analysis phase. We were given a task to analyze MML databases to write an API instead of frontend calls to the database.

I acquired many new technical skills throughout my work. I acquired new knowledge in Front-end development using various versions of Angular framework and Unit testing using Mocha and Chai framework in Karma. I also brushed my HTML/HTML5, CSS/CSS3, Javascript, Java, C# skills while working on various projects. Then I was introduced to the area

of research and analysis and how to approach it. Most importantly, the work included good fellowship, cooperative teamwork and accepting responsibilities.

Although I spent much time as a learning curve, I found that I was well trained in certain areas that helped me substantially in my projects. Many programming skills and Software Development Life Cycle understanding that I used in my internship, such as programming style and design, were the skills that I had acquired during my studies in Computer Science.

This report also includes advantages of using Angular framework over other Javascript frameworks. The report concludes with my overall impressions of my work experience as well as my opinion of the Industrial Internship Program in general.

Acknowledgements

I would like to express my sincere gratitude to my committee members for providing their invaluable guidance, encouragement, comments, suggestions and whole- hearted cooperation throughout the duration of my project.

I deeply express my sincere thanks to our Department Chair Dr. Ramnath Sarnath for his encouragement and allowing me to present my “Project/Internship Portfolio” at our department premises for the partial fulfilment of the requirements leading to the award of master’s degree. I take this opportunity to thank all my professors who have directly or indirectly helped me in my project.

I would like to express also my special thanks of gratitude to my family and relatives who have supported me morally and financially.

Last but not the least, I express my thanks to my friends for their cooperation and support.

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1. Introduction

1.1 Background

As background for this portfolio, I am a master's student at St. Cloud State University in the Computer Science and Information Technology Department. I have investigated work in various fields.

I have a bachelor's degree in Computer Science from RVR & JC College of Engineering. I was accepted at St. Cloud State University, in St. Cloud, Minnesota, and started fall 2015. Originally, I had hoped to study finance, but my love of computers won in the end. Within Computer Science, my primary interest for many years was Networking. However, after my bachelor's, I've been convinced otherwise – my primary interest, which I'm currently working on, is web development and java backend. I started investigating Big Data management. I currently have a GPA of 3.51 and expect to graduate this May.

The undergraduate courses that I have taken were: C programming, Data structures using C, Operating Systems, Database Management System, Computer Organization, Object Oriented Programming, Unix programming, Design Analysis of Algorithms, Computer Networks, Network Security, Software Engineering, Java programming, Complier Design, Artificial Intelligence, Computer Vision and Machine Learning. Taking these courses, increased my love towards Computer Science. The more I attended school, the more I wanted to learn. Once I completed my Bachelor's in Technology (BTech), I immediately enrolled in Master's program in Computer Science at St. Cloud State University.

The graduate courses that I have taken are: Formal Methods, Advanced Data Structures, Advanced Computer Architecture, Database Theory/Design, Advanced Concepts of Operating Systems, Security Policy/IT Risk Management, Computer Security, Advanced topics in

Computer Software Engineering and Parallel Computing. Having taken these courses, I always wanted to have a practical implementation of all the technical knowledge that I have pursed. As part of my master's course structure, there is a requirement to participate in Curricular Practical Training to graduate.

Combined with the course requirement and my zeal to work, I started my professional career as an IT-Intern at Mayo Clinic, Rochester, Minnesota in May 2017. This is where I have realized, Knowledge not only enhances my professional prowess, it also enhances my quality of life.

1.2 Motivations

There are many options on where to start our career. Initially, I thought starting my career with a full-time job would be a better start after my graduation. But, as of today we are witnessing an exponential increase of young people creating start-up companies while studying, others pursuing freelance work. But what about students doing internships while studying? This thought motivated me in understanding and developing interest in doing an internship during my Master's study.

Therefore, here are my few motivations of why I decided an internship would be a wonderful way to start for my career and become more competitive.

1. **Strengthen my CV:** It's natural and obvious that if we have more experience, we can build a better career portfolio. Yet, most students and graduates don't have prior work experience when they graduate. They limit themselves to having great grades, complete a degree and then go out to the market. I have few friends and cousins who come under this category. They suggested to me, there is nothing wrong with choosing this path, but the difference will come when we must perform and demonstrate that we understand the

business in a fast way, know how to work with a team and assume responsibilities. That's when I decided to have an internship experience might give me a story to tell beyond having spent my university life studying.

2. **Test-Drive my knowledge and Skills:** We must be passionate about our field of study. I thought, exploring an internship might give me grounded experience of what my studies might look like in a work environment.
3. **Find Role-Models:** There are plenty of leader's worldwide known role-models. But they are not the norm, rather than exception. Doing an internship can give me the opportunity to meet different managers/colleagues, with diverse leadership skills. This motivated me, thinking one of the biggest assets that I can have when I get out of college is how to adapt myself to my superiors and become an added value to their team.
4. **Might find my Future Employer:** As we all know, an internship program is something common in the industry, but SMEs are having more and more interns to increase their HR capacity and create some branding through such internships. Fall Internships, summer internships, spring internships, or quarterly internships, doing any internship program means that I have an ongoing pipeline of future employers and references.
5. **Networking:** Sometimes the difference between getting our dream job and not getting it is that one reference, one call that we missed to have in comparison to someone else. An internship, give us the opportunity to increase our network, expand our professional branding, and having probably one or two personal ambassadors that would be glad to help us when we need them.
6. **Experience of a Lifetime:** I know this might be doubtful, but many internships can give us the opportunity to work in areas that we won't work anytime in future, we might get

to know people that become lifetime friends, or we can realise how passionate we were about something we only get to know through our internship we had.

Internship opportunity provides the students a great chance to relate their theoretical knowledge with the competitive and tough real job market environment.

1.3 About the Company

Name of the Organization: Mayo Clinic

Location: Rochester, Minnesota

Mayo Clinic is a nonprofit organization committed to clinical practice, education and research, providing expert, whole-person care to everyone who needs healing. Its mission is to inspire hope and contribute to health and well-being by providing the best care to every patient through integrated clinical practice, education and research with a primary motto “The needs of the patient come first”.

Mayo Clinic is recognized for high-quality patient care more often than any other academic medical center in the nation. U.S. News & World Report ranked Mayo Clinic in Rochester, Minn. the best hospital in the nation in their 2017-2018 rankings. And for the first time, Mayo Clinic in Arizona is named to the Honor Roll, coming in at No. 20. Mayo Clinic has ranked at or near the top of "Honor Roll" hospitals through the history of U.S. News and World Report's best-hospital rankings.

Mayo Clinic’s Rochester campus has more No. 1 rankings than any other hospital in the nation, with No. 1 rankings in six specialties:

- Diabetes & Endocrinology
- Gastroenterology & GI Surgery
- Geriatrics

- Gynecology
- Nephrology
- Neurology & Neurosurgery

In addition, the Rochester campus is ranked No. 2 in:

- Cardiology & Heart Surgery
- Orthopedics
- Pulmonology
- Urology

The Rochester campus ranks No. 3 in Cancer and No. 4 in Ear, Nose & Throat. All specialties at Mayo Clinic work together to provide whole-person care for each patient, every day.

1.4 About my Department: Development Shared Services (DSS)

DSS are a solution provider at Mayo clinic with domain knowledge of Mayo technologies, practices and procedures. It offers opportunity to work with a partner that can help IT teams realize the solutions they are being asked to deliver while at the same time:

- Promoting the use of Mayo standards tool and platforms
- Maximizing the use of software engineering best practices
- Not leaving partners behind and keeping them involved in the project.

The prime mission of the team is that “We aim to change lives through solution excellence”. Just like our customers, Development Shared Services’ goal is to bring Mayo Clinic consistent and continual value through the work we do. It is our passion to create software that is robust, maintainable, and delightful for our customers.

DSS offers a range of software services including:

- Software development

- Software Architecture
- User Centric Design
- Education

1.5 Development Methodology

We use Agile iterative development approach in which requirements and solutions evolve through collaboration of multi-skilled team members, combined with frequent, transparent progress documentation and analysis. This approach promotes near real time visibility and control of the project as the Client Product Owner and DSS team jointly define the contents of each two-week sprint. This makes it easy to get in touch at any time, while keeping a rigorous log of requirements and a firm grip on the final objective.

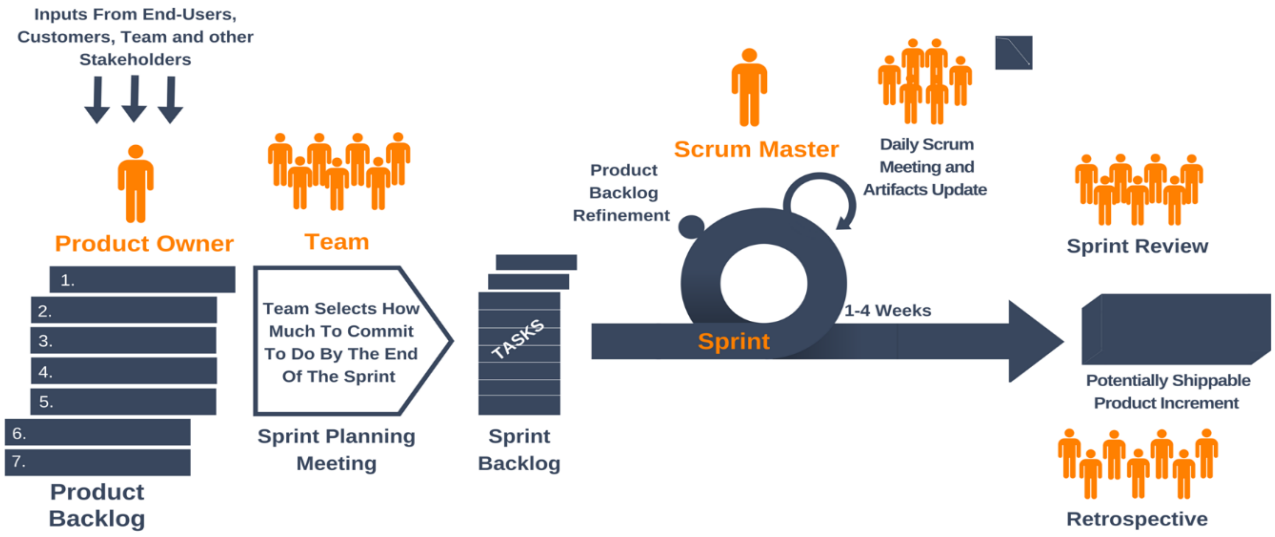

Figure 1: *Scrum Process Overview*

1.5.1 Roles

Product Owner: Sets Priorities, Manages Product Backlog

Scrum Master: Teach Scrum, Manages Process, Protect Team, Enforce Rules, Remove Blocks

Team: Develop Product, Organize work, Report Progress.

Stakeholders: Observe and advise.

1.5.2 Artifacts

Product Backlog: Consists list of requirements, owned by product owner, anyone on the team can add tasks to it, prioritized by the product owner, can be changed without affecting the active sprint.

Sprint Goal: It is a one sentence summary that is defined by the product owner and accepted by the team.

Sprint Backlog: It is a decomposed task list which, driven by a portion of product backlog, which is owned and modified by the team.

Block List: List of blocks and pending decisions, owned by scum master. Blocks stay on the list until they are resolved.

1.5.3 Scrum Ceremonies

Sprint Planning: Used to identify and commit user stories for the sprint

Agenda:

- Review user stories for their completeness (story points, description, acceptance criteria).
- Commit user stories for the current sprint.
- Capacity allocation and planning
- Break down user stories into tasks

- After the planning, the Scrum master is responsible to update the committed sprint story pints at program sprint metrics

Daily Scrum: Used to get team members updates on works towards the completion of a given sprint.

Agenda:

- What did I do yesterday to help the team meet our Sprint Goal?
- What will I do today to help the team meet our Sprint Goal?
- Do I see anything that prevents me or the team from meeting the Sprint Goal?

Sprint Retrospective: Used to Identify improvement opportunities for upcoming sprint.

Agenda:

- Discuss process improvements, successes and failures.
- Adjust processes
- Attended by team and product owner

Backlog Grooming: Used to refine and prioritize user stories not in the current sprint but for the next sprints.

Agenda:

- Review any emergent user stories
- Prioritize user stories
- Review user stories for their completeness.

Sprint Review: Used to review the work done during the sprint.

Agenda:

- It is an informal, informational discussion at the end of the sprint cycle.

- The team discusses and demonstrates the current version of the product, working functionality.
- The product is tested and documented according to project definition of “done”.

1.6 About my Team

Our team of the software development was a part of a hierarchy described by the following diagram:

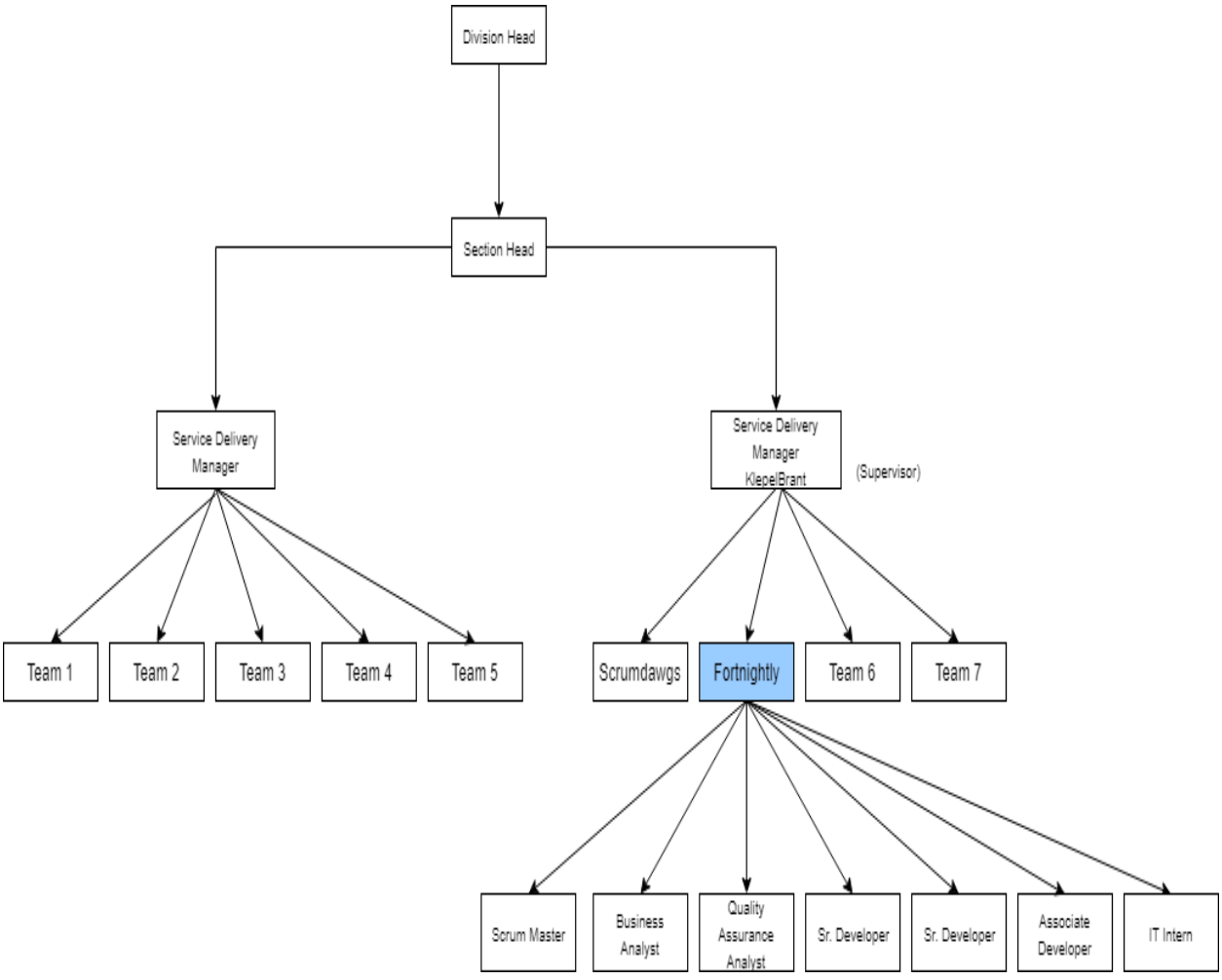

Figure 2: *Department Hierarchy*

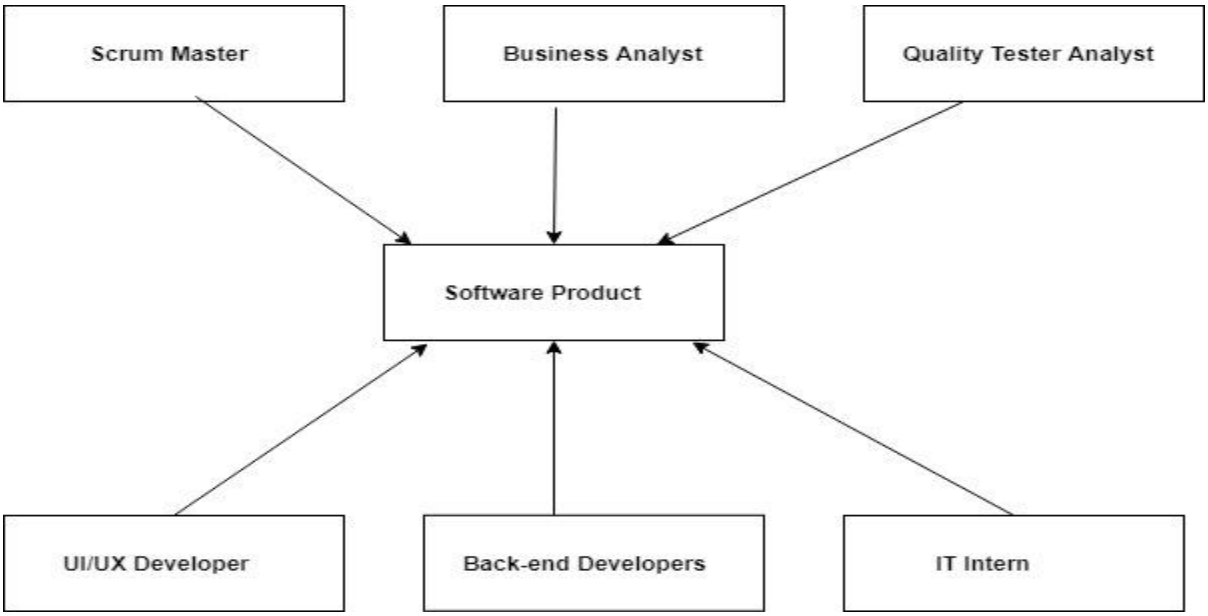

Figure 3: *My Team*

In the product development cycle, we as interns had to assume multiple roles of developing the product, analysis, debugging as well as GUI development.

2. Projects Overview

I worked on the following projects as part of my internship at Mayo Clinic:

2.1 Space Tools

Space Tool is a web application that provides users a way to request space on one of the RCF volumes, provides administrators a way to approve or decline the requests, creates approved requests, and then tracks space usage by each project.

Technologies Used:

Back-end: Java (Spring Framework)

Front End: Angular 2 (Javascript Framework)

Database: MySQL

2.2 BAMS

The BAMS (Bacterial Anti-Microbial Susceptibility) system is an in house (Mayo) developed application. It is tool for data collection and analysis, which is used to determine an organism identity and its susceptibility to various antibiotics. Initially the project was called as MIDAS (Mayo Id And Susceptibility), later named as BAMS. It is basically a rewrite of the already existing application with latest technologies.

Technologies Used:

Backend: .Net

Frontend: WPF (Windows Presentation Framework)

Database: SQL

2.3 DLMP -DSA:

DLMP is an in house (Mayo) developed application. The project is to develop a Donor Scheduling Application(DSA) for fresh donors for clinical studies. Primary functionality of this project is to automate the scheduling activities and keep the master calendar up to date. Scheduling activities include:

- Donor Recruitment
- Search capability of donors
- Definition of appointments and scheduling of appointments
- Create, print, distribute donor cards (resembling patient appointment for non-donors)
- Generate payment list

Currently all the data is maintained using excel sheets and we are to provide them a user interactive application.

Technologies Used:

Frontend: Angular 4

Backend: Java (Spring, Hibernate frameworks)

Database: SQL Server

2.4 MML Notification & Delivery

Mayo Medical Laboratories (MML) N&D is an in-house project. Notification and delivery is a combination of two related projects. For delivery, the ability to include PDFs of lab test results in Rich Text Format (RTF) is a critical differentiator for MML. Furthermore, we've committed to the practice that we would be able to push this content, which is often narrative/visual, into an Epic EMR. The notification project involves sending email or text notices to clients regarding a change in their test status or the availability of results.

2.5 MML Database Analysis

Mayo Medical Laboratories (MML) is a department of Mayo Clinic which performs laboratory testing. MML has various departments and each accompanied by a database which is in wither MSSQL or MySQL. MML database analysis is a project in which we were tasked to find out the dataflow, data manipulations, and who and how the data is being used. The applications using this data are written on Ruby on Rails and PHP. We need to develop a restful-API, so the applications use the API to utilize data rather than making a call to the database.

2.6 Academic Projects

Below are the major projects that have helped me through my internship. These projects not only provided me with the knowledge, but also helped me in understanding Software Development Life Cycle (SDLC) stages, Agile Methodology, working with Databases etc.,

Database Projects – Databases (CSCI 511)

This includes two projects which deals with Analyzing ER Diagrams, Converting ER diagram into a set of schemas, Creating Database tables using SQL and Writing SQL queries. These projects are part of my Database Theory/ Design (CSCI 511) coursework under Dr. Donald Hamnes. The objectives of these projects were to use SQL to create number of relational tables, insert entries into the tables and perform a series of queries on the resulting relational tables and writing stored procedures and triggers.

Working on Database Projects helped me in understanding how to model ER diagrams, analyze them and convert the ER diagram into set of database schema's. Taking this course also helped in writing SQL queries, stored procedures and triggers.

Online Airline Reservation System – (CSCI 575)

This project involves all the steps needed in application development (Software Analysis), which includes Problem Definition, Motivation of the work, Project Blast-off, Design Plan, Functional Requirements and Design Models.

This was my final project for the course Advanced Topics in Computer Science Software Engineering (CSCI – 575) under Dr. Omar, Al-Azzam. This was a group project with a team of 3 in which we are asked to identify any existing problem, apply software analysis techniques and develop a working prototype in our preferred computer language. The deliverables being

1. Software Requirement Specification (SRS) document;
2. Any design decisions and models;
3. Working prototype of the product.

We came up with an SRS document that included

a) Problem Definition
b) Project Blast-off – Purpose of the project, context diagram.
c) Project Scope – Identify Stakeholders, Constraints, Assumptions and Facts, Potential Risks, Cost Estimation, Decision go/no go.
d) Business Use cases (BUCs) – System Use Case Diagram
e) Techniques used to investigate the work – Brainstorming and Focus Groups, Surveys, Analysis of Work Databases, Trade-off between Data Collection Methods, Questionnaires.
f) Scenarios – Both Business Use Case scenarios (BUC's) and Product Use Case scenarios (PUC's)

g) Techniques used to understand the real problem – Problem Analysis and Business Modelling

h) Techniques used to start the solution – Trawling Requirements, Apprenticing, Family Therapy, Interviewing.

i) Functional Requirements – Description, Rationale and Fit Criterion.

j) Non-Functional Requirements – Usability and Humanity Requirements, Performance Requirements, Security Requirements, Look and Feel Requirements, Operational and Environmental Requirements, Support Requirements, Cultural and Political Requirements.

k) Quality Gateway

l) Techniques we used to check requirement completeness – Acceptance and Satisfaction, Development Cost and Schedule, Development, Verification,

m) Models used throughout the work – Context Models, Data Models, Event Models, State Models, Use Case Models and Brown Cow Model.

Cyber Security Attacks – (CSCI 615)

This paper discusses few of the recent cyber-attacks and the techniques, tools used to resolve the attack. I worked on this paper as part of my Computer Security (CSCI 615) under Dr. Jayantha Herath.

In a world driven by social networks, cloud computing, online transactions and automated processes, the growth of technology is tremendous. But with the technological evolution comes the progress in cyber-crime, which leads to new attack types, techniques and tools which allow attackers to penetrate more complex or well-controlled environments. This leads to increased damage and even the attack untraceable. A Cyber-attack is any type of

offensive maneuver employed by individuals or whole organizations that targets computer information systems, infrastructures, computer networks, and/or personal computer devices by various means of malicious acts usually originating from an anonymous source that either steals, alters, or destroys a specified target by hacking into a susceptible system.

Common Cyber Threats

- Phishing and spear phishing
- Malicious code
- Weak and default passwords
- Unpatched or outdated software vulnerabilities
- Removable media

Recent Cyber Attacks

i) Health Insurer Anthem, Inc. – February 2015

ii) Ashley Madison Breach – July 2015

iii) J & B Group Crypto Locker Attack- August 2016

iv) Breach of the White House's unclassified network – October 2014

v) Experian credit breach – October 2015

SQL Injection Detection Tools

As SQL injection attacks exploit vulnerable Web application and database code, the only way to prevent them is to resolve code's vulnerabilities. Any place that code dynamically generates a SQL query using data from an external source should be closely checked.

A good Web vulnerability scanner will spot common technical vulnerabilities, such as:

- SQL injection flaws
- Cross-site scripting vulnerabilities

- Parameter tampering
- Hidden field manipulation
- Backdoors
- Debug options
- Buffer overflows

Prevention

There are many ways to prevent cyber-attacks, which include:

- Creating of an internal policy
- Learning from other's mistakes
- Keeping computers updated
- Using Cloud services
- Knowing what not to do
- Increasing employee awareness
- Creating strong passwords and change them frequently
- Hiring a security expert

I also had one training session at my work place to identify possible cyber-attacks that we can come across in general. Having this prior knowledge helped in understanding and identifying phishing mails.

3. Project I: Space Tools

Timeline – May to Mid-July

Team: Scrumdawgs

Team-size: 8

The purpose of this tool is to provide a single place to manage the allocation of file space for research projects on the RCF file system. At the lowest level this tool provides its users a way to request space and monitor the space they have been given. At the intermediate level it enables Approvers to grant or deny space requests and monitor people's usage of their allocated space. At the top level, it enables Approvers and RF staff to add new volumes and project types to the list of those that can be used, impose file space organization, and monitor available space, as well as find out which Space Tool users created projects that are using more spaces than the projects were allocated, or for longer than the projects were approved.

The Space Tool is a web application that displays all current file allocations on the volumes under its supervision, as well as all pending, rejected, or expired allocation requests.

Technologies Used:

Back-end: Java (Spring Framework)

Front End: Angular 2 (Javascript Framework)

Database: MySQL

3.1 System Architecture

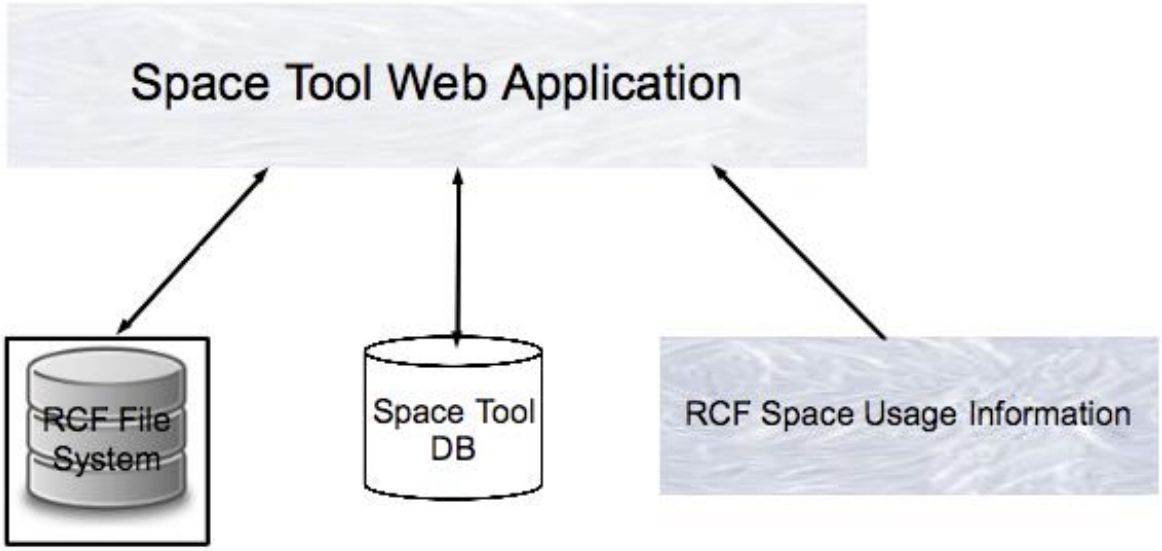

Figure 4: *Space Tools - System Architecture*

3.2 Use Case Scenarios

1. Viewing Projects
2. Creating or Editing a Project
3. Adding Volumes to the Space Tool
4. Assigning an Approver to a project type
5. Approve or Reject Request
6. Create or Edit or Delete a Report

3.3 User Authentication & Authorization

After user is authenticated, the user's information is obtained from the Space Tool DB and displayed accordingly.

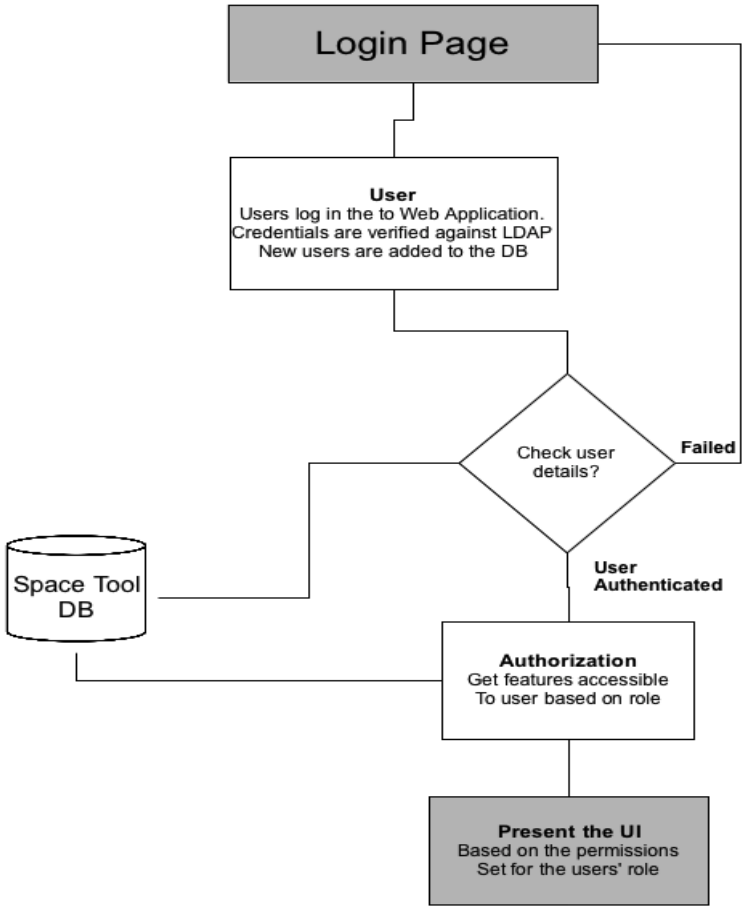

Figure 5: *Space Tools – User Authentication & Authorization Flow*

My role:

- Developed Wire frames for the application
- Worked on client-side validation using Angular 2 and created custom validators.
- Worked on Unit testing for the frontend using Mocha and Chai frameworks in Karma.

Space Tools being a small project in terms on budget and timeline, we had to deliver the product for phase two, which included feature enhancements and refinements.

4. Project II: BAMS

Timeline –Mid-July to Mid-October

Team: Scrumdawgs

Team-size: 8

MIDAS (Mayo ID and Susceptibility) system is an in house developed application which was later named as BAMS (Bacterial Anti-Microbial Susceptibility). It is a tool for data collection and analysis, which is used to determine an organism's identity and its susceptibility to various antibiotics. It is basically a rewrite of the already existing application with latest technologies.

Current Technologies:

Sybase Adaptive Server Enterprise

PowerBuilder 8.0

Technologies Used:

Backend: .Net

Frontend: WPF (Window Presentation Framework)

Database: SQL

The existing technologies are replaced due to various reasons:

- Difficult to enhance and maintain after 20 years,
- No easy retrieval of historical data- as data is stored in flat files,
- Wasn't meeting the labs current and expanding needs.

4.1 System Architecture

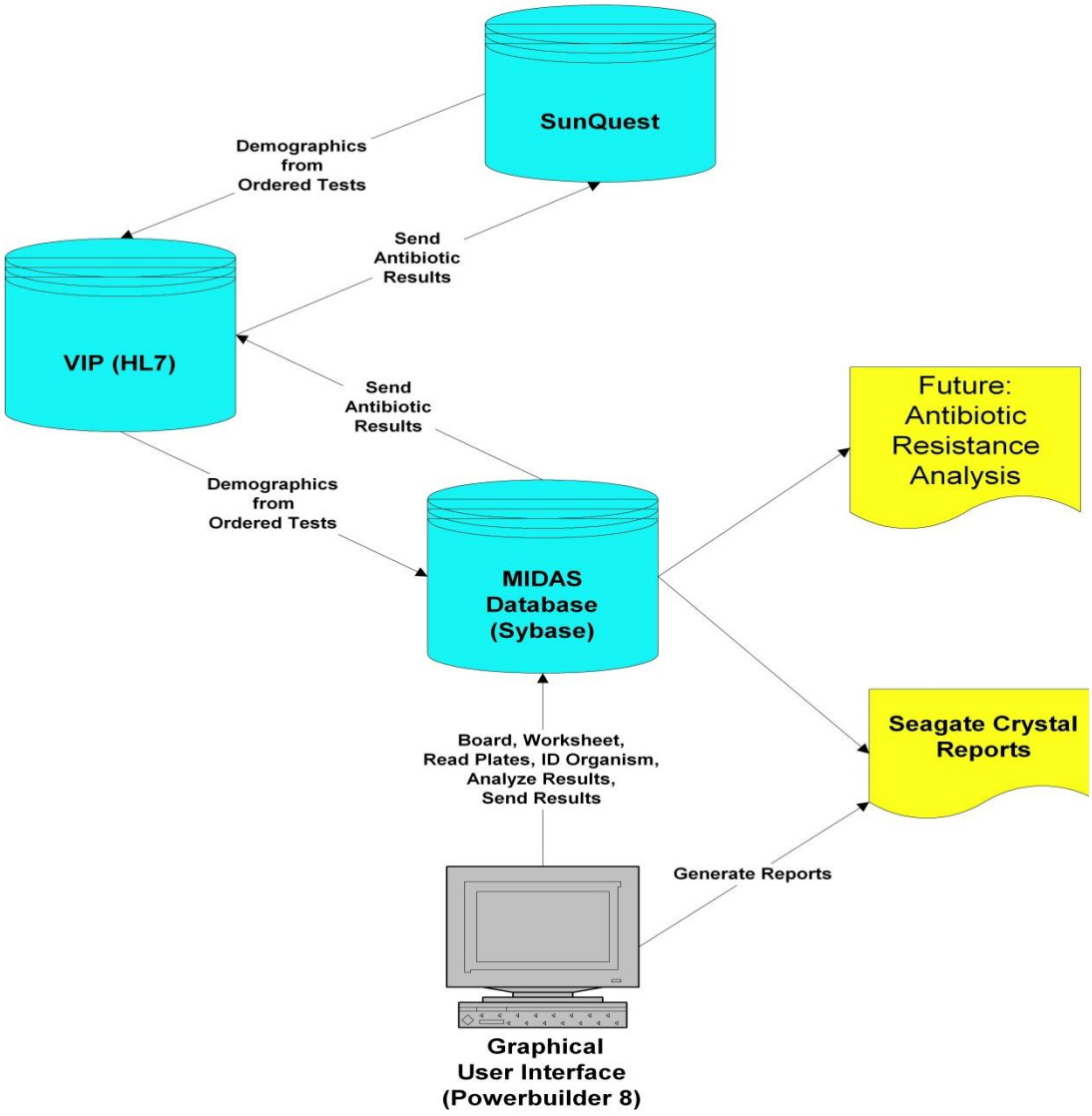

Figure 6: *BAMS – System Architecture*

4.2 Work Flow

1. Backend Setup
2. Authentication
3. User Role Maintenance
4. Maintenance

5. Board Setup/Modify
6. Worksheet Setup/Modify
7. Read Plates
8. Antibiotic (AST) Results
9. Get Patient Demographics
10. SoftMIC to MIDAS Interface for Orders
11. MIDAS to SoftMIC Interface for Results Reporting

My roles:

- Designed UI screens and implemented application logic using WPF and ASP.NET.
- Extensively worked on Data Binding, Commands (Routed Commands), Delegate Commands, Styles, Data Templates in XAML.
- Created custom controls for textbox, combo-box, checkbox etc.
- Worked on User Interface using WPF MVVM (Model View- View Model) pattern.
- Implemented LINQ to SQL to connect to SQL Server database and implemented LINQ to Object for retrieving, manipulating and querying data.

5. Project III: DLMP -DSA

Timeline –Mid-October to December

Team: Fortnightly

Team-size: 6

DLMP is an in house (Mayo) developed application. The project is to develop a Donor Scheduling Application(DSA) for fresh donors for clinical studies. Primary functionality of this project is to automate the scheduling activities and keep the master calendar up to date.

Scheduling activities include:

- Donor Recruitment
- Search capability of donors
- Definition of appointments and scheduling of appointments
- Create, print, distribute donor cards (resembling patient appointment for non-donors)
- Generate payment list

Currently they maintain all this data using excel sheets and we need to provide them a user interactive application.

Technologies Used:

Frontend: Angular 4

Backend: Java (Spring, Hibernate frameworks)

Database: Microsoft SQL Server

5.1 System Architecture

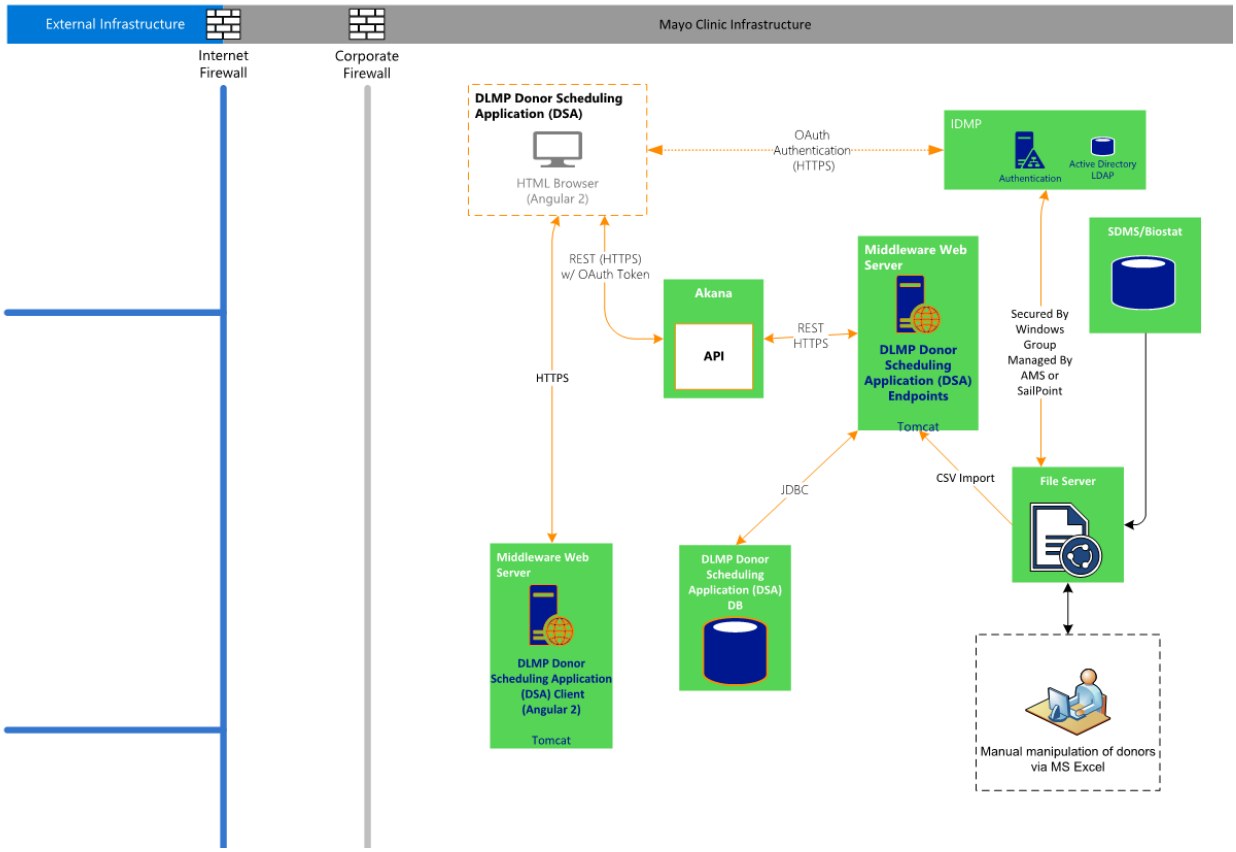

Figure 7: *DLMP – DSA – System Architecture*

5.2 Features

1. Login and Logout
2. System Administration
3. Master Calendar
4. Donor Management
5. Scheduling Appointments
6. Study Tracking

My roles:

- Involved in designing the user experience interface UI/UX strategy, UI requirements, converting findings into UI designs.
- Leveraged MVC design pattern to organize Angular4 controllers, Custom directives, factories and views.
- Used Angular4 as framework to create a Single Page Application (SPA) which can bind data to specific views.
- Used Jasmine/Karma for unit testing.
- Developed web pages using HTML/HTMl5, CSS/CSS3 and JavaScript.
- Debugging using firebug and web developer tools on Chrome, Firefox and Internet Explorer.
- Prototyped several versions of possible UI approach to provide choices to the business.

6. Project IV: MML Notification & Delivery

Timeline – January to Mid-February

Team: Fortnightly

Team-size: 5

Mayo Medical Laboratories (MML) N&D is an in-house project. Notification and delivery is a combination of two related projects. For delivery, the ability to include PDFs of lab test results in Rich Text Format (RTF) is a critical differentiator for MML. Furthermore, we've committed to the practice that we would be able to push this content, which is often narrative/visual, into an Epic EMR. The notification project involves sending email or text notices to clients regarding a change in their test status or the availability of results.

Application Code Name: Pigeon

6.1 System Architecture

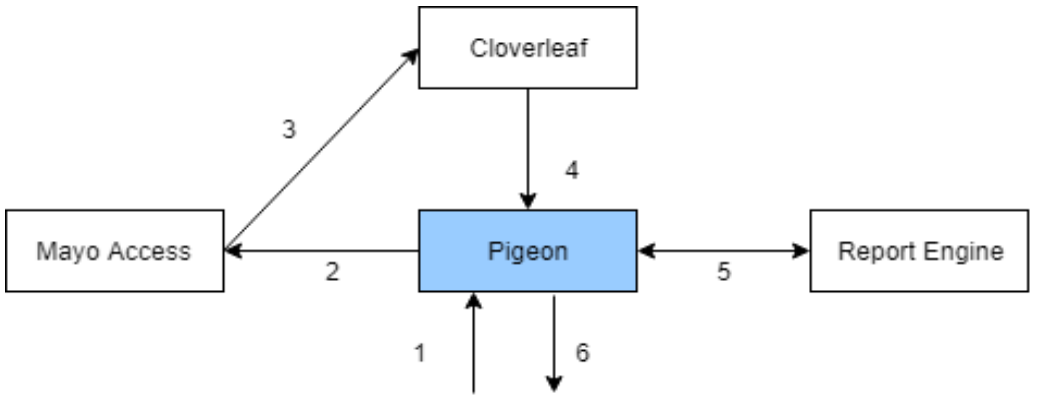

Figure 8: *MML Notification & Delivery – System Architecture*

6.2 System Interactions

The MML Applications that we need to connect to:

1) Mayo Access
2) Cloverleaf
3) Report Engine

Mayo Access should send feed to Cloverleaf for the clients that want Notification and Delivery (N & D), where the feed means list of HL7 result data.

Cloverleaf converts the feed to xml format, which then sends it to Pigeon.

Pigeon then parses the received xml data and maps to the appropriate client.

Once the Client is found, it processes the N & D rules.

If there is a rule match and report delivery is required, Pigeon talks to the Report Engine to get the appropriate report.

Changes that are required by the current system

1) MML needs to add code to send an extra feed of data results for the clients within pigeon.
2) Cloverleaf needs a way to talk to pigeon.

6.3 Entities in Pigeon

1. **Client -** Client is the Hospital/Clinic who is the user of Mayo Access Portal who wants N&D.
2. **Account –** Any user(s) within the client who accesses the Pigeon to create rules for N & D.
3. **Roles –** Role is the Authorization level given to each account. For example, the hierarchy below
    a. Client

i. Lab

1. Physician (Provider) – can create rules under their own account
2. Lab Staff employee
3. Physician office Provider Proxy
4. Hospital Provider Proxy

4. **Email –** List of the recipients for N & D.
5. **Certificates –** Certificate is required to receive delivery of report.
6. **Rule –** Condition(s) that must match for sending N & D.
7. **Orders notified –** History of notified/delivered orders that would be used for resending notification/delivery if of change in result.
8. **Email Client (Mayo SMTP) –** Mechanism for sending N & D via email

My roles:

- Analyzing the work flow and understanding the system interactions and integrations.
- Modeling ER Diagrams and database schema for the system.

Project Decision – No Go.

7. Project V – MML Database Analysis

Timeline – Mid-February to Present

Team: Fortnightly

Team-size: 5

Mayo Medical Laboratories (MML) is a department of Mayo Clinic which performs laboratory testing. MML has various departments and each accompanied by database which are in MSSQL and MySQL. MML database analysis is project in which we were tasked to find out the dataflow, data manipulations, and who and how the data is being used. The applications using this data are written on Ruby on Rails and PHP. We need to develop a restful-API, so the applications use the API to utilize data rather than making a call to the database.

Currently out of all the Databases present in Mayo Internal Network we are tasked to research on the LTC (Laboratory Test Catalog) Database schema. LTC is the repository for information about Mayo Clinic tests. Each test listing provides information such as clinical utility, interpretive information, reference values, methodology, specimen requirements, and laboratory contacts.

7.1 System Architecture

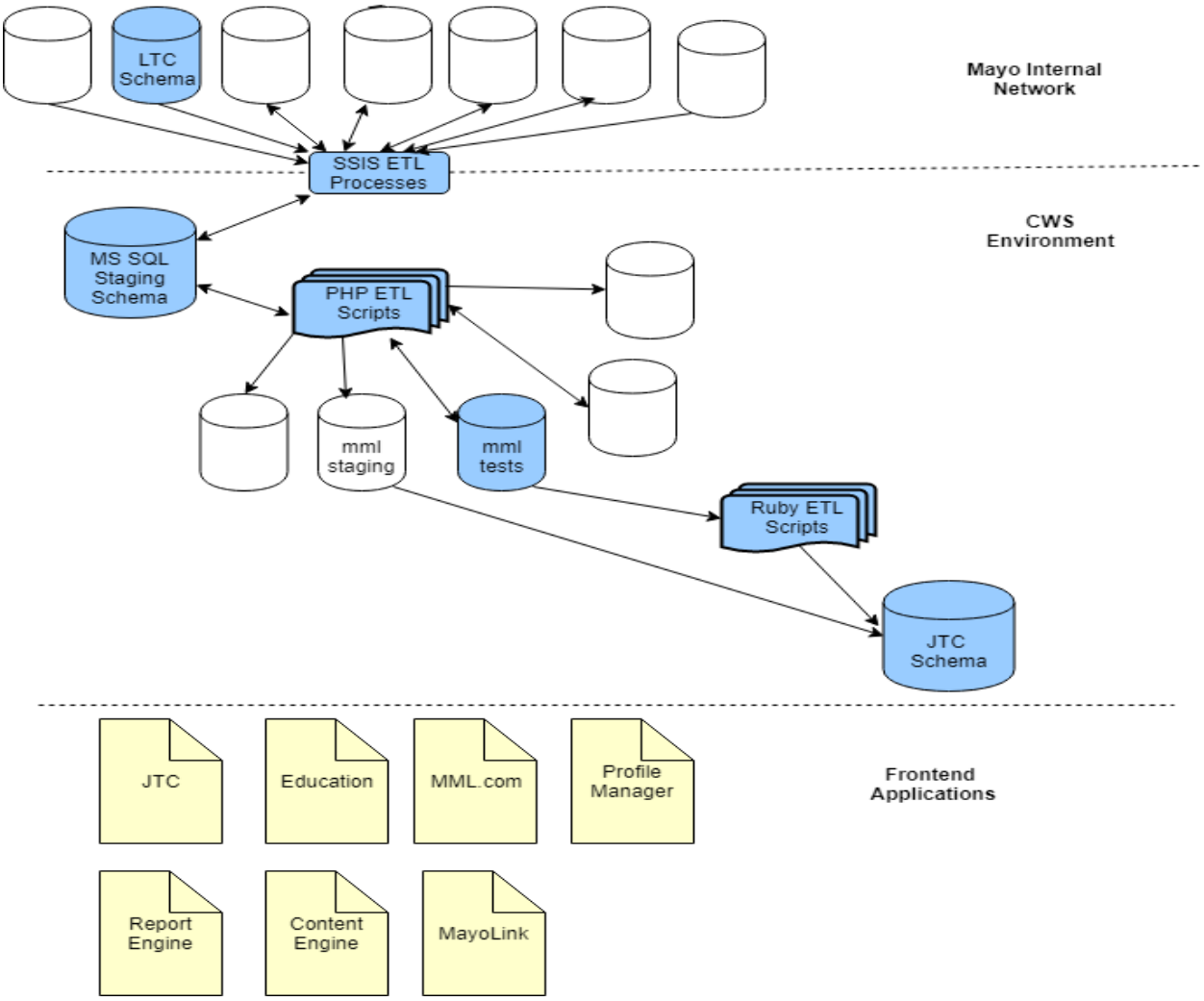

Figure 9: *MML Database Analysis – System Architecture*

My role:

- Analyzing the PHP and Ruby ETL script files to understand the dataflow.
- Document the database schema, tables.
- Analyze the data flow, data manipulations and which applications use the data.
- Analyze what API's are needed.

8. Top JavaScript Frameworks

Undoubtedly, JavaScript's (JS) popularity among the developer community has grown enormously over the years. The reason is its ability to allow developers to design and modify web pages in numerous ways and even add functionalities to web apps real-time. JavaScript is gathering attention not just for its simplicity and ease of use to what it brings to the table – Efficiency, Security, and Low-cost results.

At the same time, advancing technologies are pushing techies to add new skills to their repository for JS. Here we have listed top 3 best JavaScript frameworks that we must keep an eye on, in 2018 (Elliott, E. Dec 29, 2017):

8.1 Vue.js

- Introduced in 2014, Vue.js is an open-source progressive JS framework to build on the web.
- It offers two-way data binding (like Angular JS).
- A better choice for quick development of cross-platform solutions.
- It can power high-end single page applications (SPAs).
- It is a unique blend of React, Ember, and Angular.
- It is claimed to be faster and leaner as compared to React and Angular 2.0.

8.2 React

- It was designed by a developer's team from Facebook in 2013.
- It is a flexible, declarative, and an efficient JS library for building UI.
- Even Instagram uses the same UI which further backs the framework as "efficient" within a dynamic high-traffic application
- Though it has a high learning curve, a smooth data flow and simple display logic within make app development easily understandable.

8.3 Angular

Managed by a team of Google, the framework is built for speedy and agile work. Angular supports legacy browsers but low in performance and carry bugs while Angular is a rewritten version of AngularJS with tons of new features and improvements (Hfarazm ,2018).

- **Angular.js** – It is often referred to as an MVM (Model-View-Whatever) framework and a right fir for start-ups and mid-sized companies. Its benefits include smart-quick coding, two-way data binding (backend changes are reflected immediately on the UI), and easy testing.
- **Angular2** – It is available to developers with a long list of features that empower them to build anything and everything. Its benefits include improved dependency injection, active logging service, inter-component messages and more. Angular2 is suitable for large organizations strict programming environments who prefer high standards for code readability.
- **Angular4** - With this release, applications are made to consume less space (can reduce generated code for components by 60%) and work faster than ever before. Developers can apply codes in debug mode and creation mode too.
- **Angular5** – Angular5 was announced to the world on November 1,2017. The previous version was 4.4.0. Version5.0.0 of Angular, pentagonal-donut, is a major release containing new features and bugfixes. This release continues the focus on making Angular smaller, faster, and easier to use. Angular 6 beta version were released recently.

Taking a call on a right-fit JavaScript framework can be puzzling. However, it is not just limited to the number of features that frameworks can offer. Now that we know that Angular and React are not equal comparisons, we can investigate why we would choose one or both. Both can be complementary to each other (Willoughby, J. 2017). If we are choosing to build a web

application, it is important that we leverage new tooling, which can increase the quality of our brand interactions and decrease development time by leveraging existing libraries or frameworks. Angular is a great option for quickly improving our app's quality, an activity that Effective-UI specializes in. If our application has a lot of large data operations and dynamic content, React is an excellent addition to the stack.

9. Angular JS

Angular JS is a javascript-based structural open-source front-end web application framework mainly maintained by Google and by a community of individuals and corporations to address many of the challenges encountered in developing single-page applications. Its importance can be best understood by the front-end web developers who must rely most on JavaScript to create intuitive areas of a website that users see in their web browser.

Angular JS was mainly built –

- To provide a proper architecture to the application, throughout its life cycle, from UI designing to testing phase.
- To provide a modular architecture to the application, so that client end and server end of the application can be designed and developed parallelly.
- To enable the developers to design DOM (Document Object Model) independent application logic.

Since Angular's release in 2009, it has become widely adopted and supported. In the last five years, Angular JS has evolved tremendously. It has advanced from Angular JS version 1.0 to Angular version 5.0 and now Angular version 6.0 beta (Evan, Y. 2018). The AngularJS Development Company makes use of the features provided by the Angular 1.0 to 4.0 which brought major improvements of the development code size. It provides great impact on application performance and security. The migration has been quite smooth for the AngularJS developers.

9.1 Comparison of Angular Version 1.0 vs. Version 2.0

- **Architecture:** Angular 2.0 shows a substantial change in the structure as compared to version 1.0. The architecture of angular v1 based on MVC whereas the architecture of

Angular v2 is based on service/controller. There is very less possibility to upgrade the Angular v1 to v2, mainly developers must rewrite the entire application code.

- **Javascript and Typescript:** Angular v1.0 uses JavaScript to build the application while Angular 2.0 Typescript to write the application. Typescript is a superset of JavaScript which helps to build more robust and structured code. Dart can be used by developers along with TypeScript in version 2.0.
- **Mobile Support:** Angular 2.0 has made it possible to accomplish the native applications for a mobile platform like React Native. Angular 2.0 gives us the two layers: application layer and the rendering layer. As need, any view can be rendered in runtime for the required component.
- **Component-based UI:** The controller concept was present in Angular v1.0 is eliminated in Angular v2.0. Angular v2.0 has changed to component-based UI. This helps a developer to divide the applications in terms of components with desired features and enable to call required UI. These have helped to improve the flexibility and reusability as compare to Angular v1.0.
- **SEO Friendly:** With Angular v1.0 developing the search engine friendly Single Page Application was the major difficulty. But this bottleneck was eliminated in Angular v2.0. Angular JS development services build SEO friendly single page applications by rendering the HTML at the server side.

9.2 Features of Angular version 4.0

Apart from being a major release jump from version 2, Angular 4 also had many new features along with changes which were non-compatible with the previous versions. Few of these interesting new features were:

- **Architecture**: The upgrade of the version from 2.0 has reduced its bundled file size by 60%. The code generated is reduced and has accelerate the application development. Here the developed code can be used for prod mode and debug.
- **Router ParamMap:** Till Angular 2, key-value object structure was used to store route parameters, which make it accessible only via using standard JavaScript syntax (parameterObject[‘parameter-meter’]). From Angular 4, the parameters were made available in the form of a map & can be executed by simple method calls.
- **Dynamic components with NgComponentOutlet:** *ngComponentOutlet directive enables the web developers to develop dynamic components in a declarative way.
- **Typescript 2.1/2.2:** Angular 4 improved the type security of the applications and the speed at which the ngc-complier executes. This will help ensuring coding faults like defining a variable & telling TypeScript that “null” and “undefined” can be entered as the variable’s value.
- **Animation:** To ensure that the application package is not heavy due to additional coding, which is not required for specific application, Animations were put into a separate package of its own, which were earlier part of @angular/core module.
- **HTTP Request Simplified:** Adding parameters to the “HTTP” request, to perform a search operation has been simplified.
- **Service:** To perform the get or update operations, a new service was introduced, known as “Mega tags”.

9.3 Features of Angular version 5.0

On the other hand, when Angular 5 was released, it came with a whole bunch of additional and new features, service improvements and bug fixes. Some of these features were, a

pleasant surprise for our readers, so that they can easily understand the difference between the two versions.

- **Build Optimizer:** This is a tool which was included in the CLI to help the developers in creating a smaller bundle for the application. Apart from decreasing the user's bundle size, the feature also helps in increasing the boot speed of the application for the users.
- **Compiler Improvements:** To enhance faster rebuilds for production and AOT (Ahead of Time) builds, Angular5 supports incremental compilation.
- **New Router Life Cycle Events:** This new feature was added to enable the developers in tracking the cycle of the router, starting from running guards to the completion of activation.
- **HTTP Client:** This feature has been recommended for all the application as HTTPClient was highly appreciated. The framework developer is not suggesting anymore, to use the previous @angular/http library. Developers can update the HTTPClient in 3 easy steps;
    1. In each module, replace HTTPModule with Http Client Module from @angular/common/http;
    2. Inject the HTTPClient service;
    3. Remove any map(res=>res.json()) calls, which are no longer needed.

9.4 Features in Angular 6 beta

Version 6 continues an emphasis on being smaller, faster and easier to use. Planned features include:

- Version 4 of the Webpack module bundler for JavaScript, generating smaller modules through a technique known as scope hosting.
- A new method of connecting modules and services, in which services can be 'tree-shakable', meaning they can be left out of an application if not used.

- Support for the R*JS 6 library for JavaScript, reducing bundle sizes for common use cases.
- The Angular command-line interface, bringing commands such as ng-update, for updating dependencies and code. Another command in the CLI, ng-add, helps developers more quickly add application features, such as starting out with a Material Design application rather than with a blank application.
- Capabilities are included from the Angular elements project, which packages components as reusable Custom Elements in an Angular Application.
- The Tree component in Angular Material and the Component Dev Kit to help visual tree structures such as list of files.
- An optional, backward-compatible generic type to support typed nativeElement.

Several release candidates for Angular 6 are scheduled for March 2018, with production release now delayed until April, from the original March.

9.5 Importance of Angular JS

The huge uptake of AngularJS by developers globally is evidenced by the kind of sites that have been built by using this MVC. YouTube on PS3, Vevo, Localytics, Balance Projector, MSNBC, and Sky Store are some of the leading examples that have been doing well in the market (Hfarazm. 2018). In fact, observations show that AngularJS has done remarkably well in a very short time as compared to other such as KnockoutJS, Backbone, Ember or Single Page Applications.

At this outset, top 10 reasons that make the learning of AngularJS imperative are:

1. **MVC implementation made easy:** MVC (Model-View-Controller) implementation on most frameworks require the developer to split the app into MVC components and then write a

code to tie them up again. Whereas, AngularJS only asks to split the app and does the rest by itself. It manages all the components and keeps them connected.

2. **Data models made easy with POJO:** Angular JS data models are plain old JavaScript objects (POJO) that cuts through the typical complexity of legacy data models. With this, developers can add or change properties directly any time. This keeps the code clean, simple and more intuitive. Named as scopes, Angular JS automatically views all properties on the scope, track changes and updates the view. Since scope doesn't have any data originally, they rely on controllers to feed data as required by the business.
3. **HTML driven declarative UI:** The intuitive and less convoluted nature of HTML used by Angular JS enables a user interface that is declarative. Compared to an interface written procedurally in JavaScript, HTML is less breakable to reorganize. The special features of HTML determine which controllers to use for each element that simplifies app development to a large extent.
4. **Parallel development made possible:** Apps that require several key operations, need a large team to be working on the same thing at the same time. With traditional JavaScript applications, developers usually step over each other. However, AngularJS can break the various actions for developers and enables them to test and code individually. This makes it an ideal and scalable deal for large projects and makes a developer's life a lot easier.
5. **Adds functionalities with directives:** AngularJS brings additional functionalities to HTML with directives that come in the form of custom HTML elements, attributes and class names that can be used as regular HTML elements. And by placing all DOM manipulation codes into directives, these can be separated from the MVC app, thereby allowing it to only update the view of the data. The resulting behavior of the app is managed by the directives

6. **Less to code, more to yield:** The various benefits of AngularJS imply the need for writing less code. The view being defined by HTML makes it more concise and eradicates the need to write the MVC pipeline. Similar data models, directives separate from the app, filters that can manipulate data on the view without changing controllers and such makes it for lesser code writing and more efficiently with AngularJS.
7. **Testing made easy, at a unit level:** Dependency Injection (DI) is what links Angular and manages the controller and scopes. Therefore, all data from controllers passes through the DI, and Angular's unit tests use this for unit testing. By injecting mock data in the controller, it measures the output and behavior at a granular level. AngularJS even has a mock HTTP provider for injecting fake server responses.
8. **Contextual and intuitive communication:** The PubSub system in AngularJS is contextual. By using a broadcast and emit system, it decouples communication from children and parent nodes. And AngularJS goes even a step further to make the system more intuitive between controllers through data binding. Scopes inherit properties of parent scopes. Which means, in AngularJS, when a child scope modifies any properties, all other scopes coming from the same parent will adapt the same modifications and Angular will update the view automatically.
9. **User interface design made easy:** Contrary to traditional process, the DOM manipulation code in AngularJS resides within the directives and not in the view. This makes it much easy for UI designers, as they don't have to look at DOM manipulations and jQuery calls and focus only on ways to enable business view. Web development thereby becomes more fun with this one functionality.

10. **More choice with Services:** By introducing Services, that provide an outward API and syncs to a server to maintain offline data store and expose methods to push and pull data, AngularJS creates an option for some heavy-duty development. Controllers are simple functions that only manage scopes; adding Services whereas creates the capability f resource sharing or multiple controllers. Services are individual objects and let the controllers remain lean and dedicated. However, if complexity is to be avoided, it is perfectly fine to do some light work inside the controller and leave the Services out.

10. Applications

Programming fascinated me in the aspect of all the programs and applications we can make with it. When I start using any application for first time, one of the striking features would be its look and feel. This inspired me to start working on the front-end applications all through my internship with a zeal of learning more about it. After researching different programming languages, I got really into HTML and CSS which I feel are the building blocks of any front-end application irrespective of the framework it is being development on.

In my 10 months of internship period, my focus was mostly on working on wireframes and angular framework for developing front-end parts of applications. Being motivated to progress my career as a frontend Software Developer (Web-Development), my focus was mostly on UI/UX development throughout my internship. I worked on various versions of AngularJS which is the trending Javascript framework these days, the latest version of AngularJS that is available is 5.2.9, while only beta version of Angular6 has been released. I would describe how to work with angular framework and provide the advantages of using this framework over other javascript frameworks.

A website wireframe, also known as a page schematic or scree blueprint, is a visual guide that represents the skeletal framework of a website. Wireframes are created for arranging elements to best accomplish a particular purpose. They make the design process iterative which is one of the key concepts of agile methodology. Instead of trying to combine the functionality/layout and creative/branding aspects of the website in one step, wireframes ensure that these elements are taken in one at a time. This allows clients (and other team members) to provide feedback earlier in the process.

10.1 Benefits of using Wireframes

1. Display site architecture visually.
2. Allow for clarification of the website features.
3. Push usability to the forefront.
4. Identify ease of updates
5. Help make the design process iterative.
6. Save time on the entire project.

In short, using wireframes helps in creating consistent UI designs which is one the key goal of any UI/UX developer. Consistency in UI design is concerned with making sure elements in a user interface are uniform. To develop consistency in UI design, we should aim to be consistent with device UI guideline and behaviors, other similar apps/sites, and with our own design.

10.2 Benefits of Consistency in UI Design:

1. Increased Usability
2. Eliminates Confusion.
3. Evoke an Emotional Response
4. Consistency in Practice

Mostly, I developed applications using Angular framework which is one of the most preferred framework for creating interactive components of a website. It was designed as a full-featured JavaScript framework to enhance simplicity and efficiency.

10.3 Benefits of using Angular Framework

1. **The app is easy to learn and get started:**

   Getting up and running with AngularJS is perhaps the simplest thing a developer can imagine. Simply include some attributes into the HTML, and we can complete the first app in a couple of minutes.

2. **Data Binding:**

   This is the coolest concept with two-way binding in AngularJS and we would like to introduce it as an eye candy feature.

3. **Security:**

   When we talk about enterprise development or transformation to a new leading technology framework, Security is the top most concern. And now more than ever enterprises are focusing more on data security, easy access to their channels, distributors and sales team. Certainly, they must look for a complete solution that can power enterprise processes and business.

4. **Affordability:**

   Because AngularJS is an open source framework, developers can come up with custom apps at lower costs.

5. **Declarative User Interface:**

   For defining app's UI AngularJS uses HTML, which is a declarative, intuitive and less convoluted language than defining an interface in Javascript.

6. **Integration:**

   It is easy to integrate third party features with AngularJS as Angular integration comes pre-built into frameworks such as Telerik's Kendo UI, Ionic, Famous.us, Wijmo and others.

7. **Less Coding:**

   Coders need to spend less time in coding process as AngularJS requires less coding.

8. **Testable:**

   The codes written in JavaScript are required to follow a series of tests. As we know that JavaScript is interpreted and dynamic and not complied.

11. Benefits of Internship

If we are starting out, one of the best and easiest ways to get a job is through an internship. I can say with personal experience, this is especially true if we are trying to get a job with a big technology company like Microsoft, Google, Facebook, or Apple. Many large technology companies only hire experienced software developers or interns.

Internships are a wonderful way to learn the ropes so even if we find ourselves filing or making coffee, if we're learning about the field, we must take the advantage of the opportunity. All that I have understood through my internship is "Asking questions is one key to learning in an internship and keeping ourselves flexible throughout the internship can open may doors." Having an internship can be something that transforms our life and gives us new perspective. Besides getting a foot in the door with a potential employer and looking for good on a resume, internships have other benefits.

1. **Learn more about myself**: "Knowing yourself is the beginning of all wisdoms." – Aristotle. The experience that I had throughout my internship helped me in shaping myself. My internship not only encouraged personal development, but also greater understanding of myself. Knowing myself is to know about my goals and how to best achieve them. Finding this level of clarity is difficult, but sometimes all it takes is trying something new, out of our comfort zone.
2. **Learn more about field or industry:** Along with job shadows and informational interviews, internships are of the best ways to truly learn about our field from real world perspective. While the classroom certainly teaches students import information, there's something different about implementing those teachings with a real client or customer. I was able spend time in patient area, server room etc., which was amazing for me. I was also able to see the

data that is going to be important to me in my career. I learned about things I'll never find in the classroom. Now I can focus on my studies and strive for the knowledge I'll need in tomorrow's workforce.

3. **Apply knowledge learned in the classroom:** Again, there's a significant difference between learning about the strategies and tactics and applying them. Interning for a renowned organization helped me in learning how my class knowledge applies to real situations and reinforce the concepts taught in classes.
4. **Develop and build upon skills**: Learning new skills in an internship can help us in future employment opportunities and might give us a leg on our competition in future application processes. Working as an intern has given me many opportunities to test and refine my skills. As a Software Developer intern, I had to create application logic from scratch, setting down its foundations through a mission and vision statement and creating core aspects of the program accompanied by the supporting details.
5. **Meet peers with similar interests:** Working as an Intern, has introduced me to other students and recent graduates in my field. I was inspired and motivated to work with them and share my thoughts and ideas in achieving the common goal.
6. **Learn about the world of work and exposure:** Although we've probably had a job before or during college, we probably don't know what the day-to-day experience of working in our field will be like until our first internship experience. Only after I chose to intern at Mayo, I have experienced first-hand what's it's like to work in an office at states. It also provided me with an opportunity to interact with supervisors and co-workers who are from various cultures and each having different thought processes in attaining a solution. I also had the chance of interacting and handling customers or clients.

7. An introduction to the field's culture and etiquettes at corporate level (Are clients addressed by their first name? Are jeans appropriate for Casual Friday?).
8. Gaining a "real world" perspective on an occupation. (How much overtime do employees really work? How much time is spent behind a desk versus in the field?)

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