Welcome to SENG 321
Requirements Engineering
Let's make this an engaging course

Professor Hausi A. Müller PhD PEng FCAE
Department of Computer Science
Faculty of Engineering
University of Victoria

http://www.engr.uvic.ca/~seng321/
https://courses1.csc.uvic.ca/courses/201/spring/seng/321

Course Objectives

1
- Appreciate the importance of requirements engineering
- Understand the complexity of software-intensive systems and inherent difficulties of requirements engineering

2
- Apply requirements elicitation, analysis, negotiation, modeling, validation including feasibility studies, risk management
- Apply iterative requirements engineering

3
- Apply group communication and teamwork techniques
- Apply techniques for client-supplier relationship management
- Become familiar with process and prototyping approaches

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Requirements Engineering

Given time and budget constraints, arrive at an agreement between client and supplier of what the customer or client requires and what the supplier or developer will deliver for a software-intensive system.
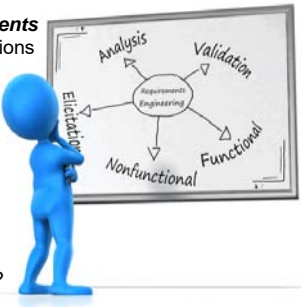
What is it?

Requirements Engineering

The process of establishing what the functions and services are the **client** or customer requires from the software system developed by the **supplier** including the constraints under which it operates and is developed.

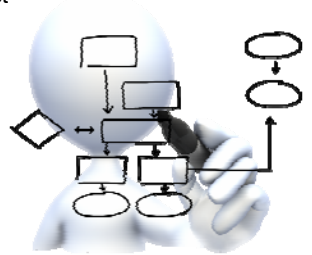## Functional and Non-functional Requirements

- **Functional requirements** describe system functions or services

- **Non-functional requirements** is a constraint on the system or on the development process

- What's the difference?

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What is a Requirement?

High-level abstract statement of a service or system constraint

Low-level detailed functional specification

Dual Purpose of Requirements

High level requirements to allow bidding for a contract
- therefore must be open to interpretation

Low level requirements to define the contract itself
- therefore must be defined in detail

Iterate

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Requirements Conundrum

Would you tell me please,
which way I ought to go from here?
That depends a good deal on
where you want to get to, said the cat.
I don't much care where, said Alice.
Then it doesn't matter which way you go,
said the cat.

Lewis Carroll, Alice in Wonderland

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Requirements Definition and Specification

Requirements definition
- A high level statement in natural language with diagrams describing the services the system provides including its operational constraints. *Written for customers.*

Requirements specification
- A structured document detailing system services. *Written as a contract between client and supplier.*

Software specification
- Detailed description as a basis for a design and implementation. *Written for developers.*

Requirement Definition

A thing that is needed or wanted
- Choose the type of window that suits your requirements best

A thing that is compulsory; a necessary condition
- Applicants must satisfy the normal entry requirements

Webster
- Something that is needed or must be done
- Something that is necessary for something else to happen

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IEEE Standard Glossary of Software Engineering Technology: Requirements

- A condition or capability needed by a user to solve a problem or achieve an objective.

- A condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed document.

- A documented representation of a condition or capability

Reading Assignment
ieeexplore.ieee.org/xpl/articleDetails.jsp?&arnumber=159342

Requirements Engineering Process

Feasibility study
- Find out if the current user will be satisfied given the available technology and budget; prototype
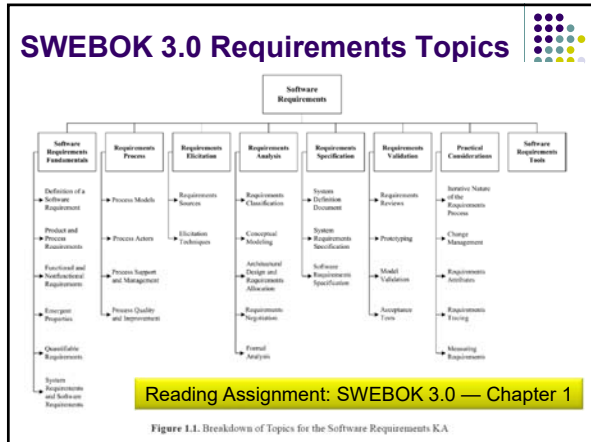
Requirements analysis
- Find out what stakeholders require from the desired system

Requirements definition
- Define the requirements in a form understandable to the customer

Requirements specification
- Define the requirements in detail understandable to contractor negotiators and developers

SWEBOK 3.0 Requirements Topics

Figure 1.1. Breakdown of Topics for the Software Requirements KA

Reading Assignment: SWEBOK 3.0 — Chapter 1

Laws of Requirement Engineering

- The hardest single part of building a software system is deciding precisely what to build.
- No other part of the conceptual work is as difficult as establishing the detailed technical requirements, including all the interfaces to people, to machines, and other software systems.
- No other part of the work so cripples the resulting system, if done wrong.
- No other part is more difficult to rectify later.

Fred Brooks, No Silver Bullet
IEEE Computer, 1987

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People Depend on Software

Software is central to our lives
We interact daily with software
- **At home—computer games**
- **At the office—on-line services**
- **In the car—embedded control systems**

We expect software to be reliable, efficient and effective in safety-critical systems as well as desktop computers

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Course Scope

1. • Teach fundamental tools, and concepts of requirements engineering—requirement elicitation and management

2. • Discuss the role of requirement analysts and team members in gathering, understanding, and prioritizing requirements

3. • Hands-on approach
   • Practice the fundamentals of requirement engineering

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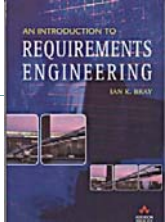---

Specific Learning Outcomes

1. • Learn how to discover, model, analyse, communicate requirements for software systems
   • Develop techniques for requirements elicitation, analysis and modelling
   • Understand techniques for formal specification, negotiation and decision making
   • Develop techniques for customer/client interaction in requirements engineering

2. • Experience how customers and clients interact in requirements engineering
   • Define, specify and negotiate requirements through prototype design and prototyping tools
   • Learn how to validates requirements through prototype design and class presentations
   • Learn how to design, evaluate, communicate software architecture meeting requirements

3. • Appreciate the economic implications of requirements engineering
   • Understand the impact of software quality on society
   • Appreciate the ethical challenges in requirements engineering
   • Appreciate the challenges with respect to equity and diversity in requirements engineering

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Text Books

Required Textbook

- Ian K. Bray: An Introduction to Requirements Engineering, Pearson (2002)

Recommended Textbook

- P. Bourque, R. Fairley: SWEBOK V3.0: Guide to the Software Engineering Body of Knowledge, IEEE Computer Society (2014)

http://www.engr.uvic.ca/~seng321/resources.html

Expectations

- Read assigned readings
- Attend lectures and participate in discussions
- Bring your ideas and concerns to class
- Work effectively in a group setting—group members will evaluate each other
- Learn how to use the techniques and understand your project *very well*
- Hand in your deliverables on time

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Evaluation

- Marks will be posted on the web by student id
  - If you do not want your marks to be posted, notify the instructor by e-mail before Jan 15, 2016

- Midterm exam will be on Tue, Feb 23, 2016
  - In-class, one hour, closed books, closed notes, no calculators, no gadgets

- Final exam will scheduled by UVic in April
  - Three hours, closed books, closed notes, no calculators, no gadgets

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Evaluation

- **3 Quizzes**   **6%**
- **Participation**   **5%**
- **Midterm exam**   **14%**
- **Group Project**   **40%**
- **Final exam**   **35%**

- Remarks
  - Midterm is in-class; final is scheduled by UVic
  - You *have* to pass the project and the final exams to pass the course

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What Is Course Participation?

- Students should be prepared to **speak up** in class and in their group

- Class participation does <u>not</u> just mean signing in—attendance will be taken regularly

- Note that 5% class participation corresponds to a full letter grade

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SENG 321 Calendar

First day of classes	Tue, Jan 5
Labs begin	Tue, Jan 12
Reading break	Feb 8-12
Midterm	Fri, Feb 23
Easter break	Mar 25-28
Project presentations	Mar 29-31
Last day of classes	Fri, Mar 31

Detailed course calendar: deliverables deadlines
http://www.engr.uvic.ca/~seng321/calendar.html

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Students must participate in all project presentations in class & labs
No show results in a 25% reduction in the mark for that presentation

Project Deadlines and Marks

1.	Call for Project Proposals		**6 Jan (Class)**
2.	Request for Proposal (RFP)		**8 Jan**
3.	Project selection		**12 Jan (Lab)**
4.	Team selection		**14 Jan (Lab)**
5.	Informal Requirements Definition (S0)	5%	**21 Jan (Lab)**
6.	Project website up and running (S0)	5%	**21 Jan (Lab)**
7.	Customer Feedback on S0 (C0)	5%	**26 Jan (Lab)**
8.	Formal Requirements Spec (S1)	10%	**16 Feb (Lab)**
9.	Customer Feedback on S1 (C1)	5%	**18 Feb (Lab)**
10.	Detailed Requirements Spec (S2a)	10%	**1 Mar (Lab)**
11.	Prototype demo (S2b)	5%	**3 Mar (Lab)**
12.	Customer Feedback on S2a-b (C2)	5%	**8 Mar (Lab)**
13.	Final Requirements Spec (S3a)	15%	**15 Mar (Lab)**
14.	User Manual (S3b)	10%	**22 Mar (Lab)**
15.	Customer Feedback on S3a-b (C3)	5%	**24 Mar (Lab)**
16.	Demo Final Project (S4)	10%	**29,31 Mar (Lab)**
17.	Customer Feedback on S4 (C4)	5%	**29,31 Mar (Lab)**
18.	Instructor and TA Evaluations (S5)	5%	**1 Apr**

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Lectures
Labs

Hausi Müller PhD PEng FCAE

- E-mail: hausi@cs.uvic.ca
- Phone: 250-472-5719
- Office: ECS 614
- Office: TWF 3:30–4:30 pm

Lecture Sections A01 and A02
- TWF 3:30 – 4:30 MAC ELL167

Lab Sections B01, B02, B03
- Instructors: Müller, Angara, Jain
- Start Jan 11
- TR 4:30-5:50
  ELL167/ELW B220/B215

Markers
- Angara, Jain

You MUST attend all scheduled lectures and labs
- Early in the term, extra lectures will be given in lab slots to ramp up the projects
- Later in the term, you will have more time for meetings and discussions related to your project in the lab

Course web pages
- http://www.engr.uvic.ca/~seng321/
- https://courses1.csc.uvic.ca/courses/2016/spring/seng/321

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Questions?

- Organization of the course?
- Evaluation scheme?

- Study course web site carefully
- Visit course web site regularly

- Other questions?!?

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Keep In Mind …

Ask Questions Any Time

Let's make this a truly engaging course!

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Team Project
Overview

- Each team of four will act as
  - a *customer* (client), who will have a project
  - a *developer* (supplier), who will work with a customer to specify a project
- Deliverables
  - Informal requirements definition (S0)
  - Formal requirements specification (S1)
  - Detailed requirements specification (S2a)
  - Prototype demo (S2b)
  - Final requirements specification (S3a)
  - User manual (S3b)
  - Final project demo (S4)

Substantial enough for a team of four

Doable in one term

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Team Project
Member Roles and Needs

- Team roles
  - Client or customer
  - Supplier or developer
- Supplier roles
  - Project manager
  - Writing S0, S1, S2, S3, S4, manual
  - Presenting & customer relations S0, S1, S2, S3, S4
  - Website initial set up, regular updates
  - Developing prototypes
- Supplier roles
  - Providing feedback and supplier relations

Teams of four must be well organized and orchestrated

Time management is critical

Deadlines are firm

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Team Project
Selected Member Roles

Determine who best fits these roles—can change as the term progresses

1. Project lead—leadership, management, communications & negotiation skills
2. Documentation writer—writing, presentation, marketing & sales skills
3. Webmaster—website development, web tool & presentation skills
4. Toolsmith—tool experience & programming skills
5. Design expert—UML diagramming & object-oriented design skills
6. Interface expert—user interface programming & presentation skills
7. Analyst—analysis, verification, traceability, testing & reviewing skills

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Next Week

Tuesday
- Project selection
- 80 proposals
- 2 mins elevator speech per student
- Select 19-20 projects
- Lecture and lab
- ELL 167

Thursday
- Team selection
- 80 students
- Select 19-20 well balanced teams of 4 students
- Lab ELL 167

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Request for Proposal (RFP)

- Submit three documents
  - Your RFP — use 2016 SENG 321 RFP template
  - Your 1-page PDF slide for 2-mins elevator speech
  - Your 1-page résumé documenting your experience

- This assignment counts as class participation

- Due date Fri, Jan 8 — 1:00 pm
- Submit to submit@rigiresearch.com

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Deliverable 1a
RFP Template

Deliverable 1a
Statement of Work Template

I. **Scope of Work:** Describe the work to be done to detail. Specify the hardware and software involved and the exact nature of the work.

II. **Location of Work:** Describe where the work must be performed. Specify the location of hardware and software and where the people must perform the work

III. **Period of Performance:** Specify when the work is expected to start and end, working hours, number of hours that can be billed per week, where the work must be performed, and related schedule information.

IV. **Deliverables Schedule:** List specific deliverables, describe them in detail, and specify when they are due.

V. **Applicable Standards:** Specify any company or industry-specific standards that are relevant to performing the work.

VI. **Acceptance Criteria:** Describe how the buyer organization will determine if the work is acceptable.

VII. **Special Requirements:** Specify any special requirements such as hardware or software certifications, minimum degree or experience level of personnel, travel requirements, and so on.

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Deliverable 1a
Many Web Resources on RFPs

- How to respond to an RFP
  http://www.slideshare.net/MarianneKolodiy/how-torespondtorfp

- How to write an RFP for web content management
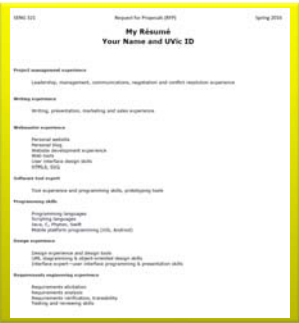 http://www.slideshare.net/Percussion/how-to-write-a-request-for-proposal-rfp-for-web-content-management

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Deliverable 1b
1-page PDF Project Summary

- 1-page PowerPoint slide to sell your project to the entire class
- On Tuesday
  - 2 mins elevator speech per student
  - Select 20 projects from 80 submissions by voting for projects

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Deliverable 1c
Your Résumé for Team Building

The resume is required for balanced group assignments

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Project Ideas

- Smart system
  - Context-aware
  - Self-adaptive
  - Mobile

- Example past projects
  - Web based sprinkler system
  - Food management system
  - Parking meter system
  - Travel management system
  - Inventory control system
  - Auction system
  - Smart home
  - Wardrobe advisor
  - Bus tracking system

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Web-Based Sprinkler System
Brief Problem Description

- Smart Sprinkler Co. is one of the largest companies in manufacturing sprinkler system in the world. We provide a complete line of commercial, industrial, institutional, residential lawn and garden sprinkler systems. Our product includes a full inventory of plastic pipes, wide selection of valves, tank flanges, basket strainers, combination nipples, and cam lever coupling.
- The objective of our company is to provide our costumer with best quality and newest technology sprinkler system. Currently our company provides a sprinkler system that allows the user to set up a timer and release water at a certain time period. This approach operates independently of actual weather status resulting poor water saving.
- In order to be more conservative with water, we need to install a control system that will automatically control sprinkler system. The control system must control the amount of water flow thought the sprinkler system based on the weather website. Also the control system needs to provide access for user to control the sprinkler system though the Internet.

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Food Management System
Problem Description

- Despite rapid advances in technology in recent decades, today's refrigerators are not much more advanced than those made in the 1970s. With the current capability of computers and the Internet, there is great potential for a refrigerator system to be much more than a tool that keeps your food cold.
- This proposed project is the design of a "smart" refrigerator system that takes advantage of computer and Internet technologies. It will integrate a computer into a fridge system, serving as a database that maintains an inventory of the user's food stores. The system will also use the Internet to download recipes for the user, interface with online grocery shopping services, and serve as a remote control station for the fridge.
- The accepted proposal will be one that provides a feasible design that meets all the specified objectives, and fits within all the specified constraints.

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Parking Meter System
Brief Problem Description
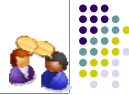
- As parking lots are reconstituted to additional buildings for university expansion, fewer parking spaces are available to members of the UVic community. To make finding a parking space on campus easier, we want a system that would advise the user of the closest parking space available; advice will be based on the current location of the user or the location of the entrance that the user will use to enter the campus.
- Campus w-parking should deliver a solution enabling drivers to get information on available parking spaces from anywhere; users will never again have to drive from parking lot to lot searching for an available parking space.

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Travel Management System
Brief Problem Description
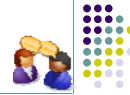
- Currently, determining the available transportation between different cities requires knowledge of the different modes of transportation and their website addresses in order to search for schedule and price information. This process is error-prone, and the traveler may not find the most efficient and inexpensive mode of transportation. If all modes of transportation were easily searchable on one website, the process of scheduling trips between cities would become much simpler. We plan to provide all these travel planning services on a new system called WEST (Web-enabled Scheduling of Travel) in order to increase our customers' level of satisfaction.
- We are looking for a web-based system, which will be accessible by customers and customer service representatives. It will provide different services to different user groups: for customers, it will provide a travel route planning, booking, and payment service; for employees, the system will provide a messaging service for notification about customers' requests for booking.
- Transportation data from the transportation companies is already available to us. The system will be able to access this data and determine possible travel solutions based on user requests. The travel routes will be shown visually on a map, and the users may change the time, date, and route on the map. The system will provide a booking service as well. The booking will be done online if the services are provided by the companies. Otherwise, the system will save the data and leave messages to our customer service representatives to make the booking for customers.

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Licenses Inventory System
Brief Project Description

- Wayne Enterprises is an extremely large sized business with many computers and a varying array of installed software. There is a need to inventory software licenses, keep track of the individual software applications installed on particular computers, and manage individual hardware profiles. The current system is inadequate and requires a vast improvement.

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Textbook Auction System
Brief Project Description
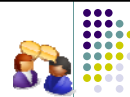
- The cost of textbooks is a significant drain on the limited funds of students. Campus books stores offer used books, but sell out quickly. Students can often sell books at campus book stores, but receive relatively little money. Students lack a centralized marketplace in which they can buy and sell used textbooks. With a larger pool of students, more books will be available at any time, increasing the chances that students will find what they need.
- An online auction and classifieds environment aimed entirely at textbook exchange amongst university students could significantly decrease the cost of books and increase the convenience of book transactions. As websites extend beyond the borders of the local campus, students can search through more used books than ever before; fewer books will go to waste, and students will save more money and time.

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Bus-on-the-go
Brief Project Description

- A major problem that almost every commuter faces is trip planning on-the-go. That is, how does one get from point A to point B. Planning a trip from the comfort of your own home with access to resources like bus time-tables, maps, and computers is easy. But planning a spur-of-the moment trip with none of the above resources is a nightmare.
- Most people out on-the-go do not carry a computer, maps, or even a bus schedule with them. At the very least, they have a bus schedule, and even then it is really time consuming and cumbersome to refer to multiple bus routes and maps to plan your trip. In addition, bus schedules do not have information on the locations of restaurants, shops, and other commercial locations along your bus route.
- What commuters need is access to such information at their fingers tips, and what better way to provide them with this information than via a cell device; a device which most commuters carry.

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UVic Web System Integration
Brief Project Description

- The need for improvement in the client organization is that the current web registration and student information management systems are cumbersome and inefficient. They are all separate systems and we would like to have these four systems be consolidated into one encompassing system. This will improve the students' experience when using UVic web systems to register courses or administrate their account.

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Inventory Control System
Brief Project Description
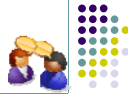
- HammerTime Contractors (HTC), Victoria B.C., is a large construction company operating across western Canada. HTC requests proposals for an inventory control system capable of tracking and identifying --in a court of law-- company tools across multiple construction sites.
- Recently HTC has expanded to include western Canada. Our current inventory control system (see 3.0) is incapable of handling the increased business; construction site managers are too busy looking for misplaced tools to finish contracts on schedule, employee safety is being compromised by misidentified damaged tools, and contract costs are rapidly increasing due to replacement of lost and stolen tools.
- Additionally, updating the current system's database is extremely time consuming. The head office inventory control manager often resorts to hand written notes regarding returned or assigned tools. Lost notes result in unreliable database entries, and lost time for our accounting department. To allow the continued success of HTC, a more efficient inventory control system is required.

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Smart Home System
Brief Project Description
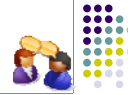
- Controls nearly every aspect of a modern home
- Its purpose is to supplement and enhance a homeowner's everyday life by automating tasks, remembering preferences and anticipating what the homeowner would like.
- Priorities of the system aside from its main function are providing some means of enhancing safety and security by helping to avoid dangerous situations and providing help when these situations are inevitable they do occur.
- The system provides an overall experience and easily accommodates many people living in a home.
- In the end, the system should blend into a homeowner's lifestyle and react naturally, not impeding but assisting and making life a little easier.

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Wardrobe Advisor
Brief Project Description
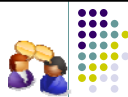
- Offers advice for day to day outfits according to your events and weather forecast; is customizable to fit the preferences and lifestyle of the user.
- The user interaction consist of a setup process; setting and defining user preferences; adding and removing wardrobe items; adding and modifying calendar events; and receive wardrobe recommendations based on the clothes available in the wardrobe, user preferences, scheduled events, and current weather conditions. The user will be able to select favourites and update whether the clothes are dirty.
- The user web interface will be graphical and allow the user to view the weather forecast, access their user preferences and view their wardrobe.

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Bus Tracking System
Brief Project Description

- As part of its mandate, BC Transit leads initiatives that try to encourage ridership by making it easier for people to use the transit system. One barrier that currently exists is the inability for the public to plan trips accurately using the bus schedule on the BC Transit website. Only static maps are available for each bus making it difficult to plan trips that involve a combination of different busses and walking on foot. Schedules on the static maps do not always reflect what is happening in reality. Sometimes busses are early and sometimes they are late. The public has no way of telling where the bus is currently or whether it is full or not. This lack of information can lead to frustration and ultimately lead to a decrease in ridership.
- The system is accessed by three entities: Public Users; VRTS Employees; and the bus interface. Public Users will be directed to a limited access web site while VRTS Employees will have access to an administrative web site. The bus interface communicates with the busses on each route to update the central server with the busses' information.

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Keep In Mind …

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