Cloud Application Development Project Manual

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Contents

Preface

This is a placeholder for the preface.

Chapter 0

Introduction

0.1 Overview

The MSSS Cloud Application Development project consists of a project summarized in table 1 and detailed in this manual. This consists of four phases: inception, data component, logic component, and interface component. The two purposes of the projects are to (1) give students the opportunity to reflect on what they are learning and apply the material to a “real world” project, and (2) allow them to construct a portfolio that they can use for the purpose of gaining employment as an application developer.

0.2 Inception

The first two weeks of the MSSA program will consist of the selection of the project. Students are not expected to have the technical skills necessary to begin the project, but are expected to have a layman’s grasp of software applications and an interest in some knowledge domain that they can leverage throughout their course.

0.2.1 Preliminary research

Students will begin thinking about the kind of project they would want to showcase for their project. They should list the specific functionalities of their chosen kind of project, and so some preliminary investigation toward implementing the project. All projects should include a data component, a logical component, and an interface component. The deliverable should be a five paragraph document listing several specific projects they would be interested in doing, and a short description of the characteristics of each project. See chapter 1 for for more information.

0.2.2 Project exploration

Students will select one project from their list to focus on for their project They should make a formal investigation of the requirements of the project. If possible, they should identify similar applications that have been written. There are two deliverables, a written paper‘and an oral presentation (with an optional slide deck). The project proposal should contain a sufficient description of the project that would allow construction of the project to begin, including a discussion of the supporting database, the program code, and the user interface.

Chapter	Phase	Topic	Deliverables
Ch. 1	Inception	Project exploration	5 paragraph writeup
Ch. 2	Inception	Project selection	an oral and written presentation
Ch. 3	Data	Requirements	an Information Flow Diagram and requirements list
Ch. 4	Data	Database conceptual design	Entity Relationship Diagram
Ch. 5	Data	Logical design of database	logical database diagram
Ch. 6	Data	Physical design of database	physical database diagram
Ch. 7	Data	Implementation	SQL source listing
Ch. 8	Data	Presentation	an oral and written presentation
Ch. 9	Logic	Requirements	informal requirements list
Ch. 10	Logic	Analysis	Software Requirements Specification
Ch. 11	Logic	Design	UML diagrams
Ch. 12	Logic	Implementation	C# source listing
Ch. 13	Logic	Testing	C# source listing
Ch. 14	Interface	Wireframe	Image file and/or source listing
Ch. 15	Interface	User Interface	Source listing
Ch. 16	Final	Project Presentation	oral and written presentation

Table 1: Project schedule

0.3 Data

This phase concentrates on using persistent data using a relational database (SQL Server). The outcome of this phase will be a fully functional database.

0.3.1 Requirements

Every database stores data according to some requirements. In this step, students will collect as many of their data requirements as possible. The deliverable is a simple list of data requirements in a plain text or Markdown file. The requirements should be as complete and as detailed as possible.

0.3.2 Conceptual design

Students will discover the nature of conceptual database design. The deliverable will be an entity-relationship diagram (ERD) showing the conceptual design of their project database.

0.3.3 Logical design

Students will discover the nature of logical database design. The deliverable will be an database diagram showing the logical design of their project database.

0.3.4 Physical design

Students will discover the nature of physical database design. The deliverable will be an database diagram showing the physical design of their project database.

0.3.5 Implementation

Students will write a SQL source listing implementing their database. The deliverable will be the SQL source listing.

0.3.6 Presentation

Presentation: students will prepare a slide presentation and make an oral presentation of the database to the class. Deliverables include the slide presentation and (optionally) a video of their oral presentation.

0.4 Logic

The logic component includes the business rules for the application. This should be accessible from a console interface. It should be a fully functional version of their implemented project.

0.4.1 Requirements

Students will create a list of application requirements. These generally consist of the *functional* requirements of their project. This list should be as exhaustiive and complete as possible. The requirements list provides the foundation of the application, in the sense that you cannot build an appication if you do know know what kid of appication you are buildin.

0.4.2 Analysis

Students will create a software requirements specification (SRS) of the *functional* requirements of their project. (The project does not include *non-functional* requirements.) The deliverable will be the project SRS.

0.4.3 Design

Students will create appropriate design artifacts. These will include a class diagram, a component diagram, a system sequence diagram, and other documents as necessary (e.g., data flow diagrams, state models, etc.) The deliverable will be a collection of design diagrams.

0.4.4 Implementation

Students will implement the logic component of their project. The deliverable will be the source code listings of their implementation. These will not include auxilliary files, such as container folders, configuration files, etc.

0.4.5 Testing

Students will write automated tests for their application using both white box and black box techniques. All test code should be automated. The deliverable will be the source listiong for the test suite.

0.5 Interface

This phase concentrates on a graphical user interface. Students will use either UWP or ASP as they choose.

0.5.1 Prototype

A prototype, in this case, is a semi-functional layout that can give a high-fidelity preview of the actual app or website user interface (front-end) functionality. While prototype might not have full functionality, it generally gives customers and/or end-users an ability to click around the elements of the interface and simulate the way the app will actually work. Deliverable will be a source listing.

0.5.2 Implementation

Students will implement the user interface of their project. The deliverable will be the source code listings of their implementation. These will not include auxilliary files, such as container folders, configuration files, etc.

0.5.3 Final project presentation

Presentation: students will prepare a slide presentation and make an oral presentation of the user interface to the class. Deliverables include the slide presentation and a video of their oral presentation.

0.6 Wrap Up

The instructor's obligation throughout the project is to provide guidance for each phase. For example, during the Data phase, he should discuss the database design process including normal forms and integrity constraints. During the Logic phase, he should discuss iterative, incremental processes and UML. During the Interface, he should discuss principles of user interface design.

Instructors should use the project as an opportunity to add value to the curriculum by exposing the students to topics not expressly included in the curriculum, such as version control, software engineering, software quality control (testing), security, design patterns, and so on. This should be at the instructor's discretion.

The project is a *supplement* to the official curriculum. As such, it should enhance the student's experience, and not detract from it by overloading the student with an amount of work that is impossible to do. The emphasis is on understanding the topics presented and building a portfolio, not building a completely functional application.

Part I

Inception

Chapter 1

Project Inception

1.1 Preliminary research

Students will begin thinking about the kind of project they would want to showcase for their project. They should list the specific functionalities of their chosen kind of project, and some preliminary investigation toward implementing the project. All projects should include a data component and an interface component. The deliverable should be a two page document listing several specific projects they would be interested in doing, and a short description of the characteristics of each project.

You may choose your own project. Here is a list of sample projects for you to consider.

School system This may consist of a student module, an instructor module, a curriculum module, and provides for the assignment of instructors to classes, students to classes, course management, student management, an d instructor management. As example would be the CSU student information system.

Electronic learning system This may consist of a collection of courses. Each course may allow for tests, quizzes, exercises, research papers, discussions, etc. As example would be Cougarview.

An auction system. This my consist of a sellers module, a bidders module, a purchase module, and provide for different kinds of sales (i.e., open bidding, bidding with reserve, buy now, etc.). It would include user registrations and appropriate databases of auctions, transactions, etc. An example would be eBay.

Messaging system This would include user registrations, posting messages, sending messages, composing groups, and similar functionality. An example would be Twitter.

Encyclopedia This would include editor registrations, posting entries, editing entries, search functions, analytical functions, and similar functionality. An example would be Wikipedia.

Electronic voting system This would include voter registrations, candidate qualification, casting ballots with appropriate authentication, and calculation of results. An example would be the current voting system in Georgia.

Networking system This would include user registrations, posting employment data, school data, certification data, allow the posting of jobs, etc. An example would be LinkedIn.

Online store This would implement the display of merchandise, a shopping cart, a payment module, and inventory control mechanism, etc. An example would be Amazon.

Database GUI This would implement a graphical front end to a database. Modules would (1) create or drop databases, (2) create, drop, and alter tables, (3) insert, update, or delete data, and (4) run simple queries. An example would be TOAD.

Organization system This might include member registration, a member directory, an event calender, a newsletter, a photo album, a FAQ, or other functions suitable for organizations. Examples would include a social organization, a service organization, a band or orchestra, a church, an athletic team, etc.

Automated teller machine This might include customer authentication, checking account status, acceptance of deposits, and dispensing cash.

A strategy game At a minimum, this would consist of a user interface, a data source, and a logic engine implementing the game rules.

1.2 Deliverable

Your deliverable will be a five paragraph (or more) paper of three or four proposed projects. Your description of each proposed project should contain enough information so that readers can understand the nature of the project. You may also give examples of similar, existing implementations.

The format of the paper will eventually use *Markdown*. For now, please write your paper either in Markdown or in plain ASCII text with no formatting, perhaps using Microsoft Notepad or a similar application. In general, your papers should consist of a short introduction, a short conclusion, and a body containing the substance of your discussion. For this paper, structure it like this:

1. A first paragraph or two introducing yourself and stating your personal objectives for your project.
2. A paragraph or two describing your first reviewed project, and how that project will help you accomplish your personal objectives.
3. A paragraph or two describing your second reviewed project, and how that project will help you accomplish your personal objectives.
4. A paragraph or two describing your third reviewed project, and how that project will help you accomplish your personal objectives.
5. A final paragraph or two reflecting on how you will achieve your personal objectives by building the project.

Your paper should have a title, author, and date. The subdivisions of your paper should have appropriate section and subsection headings.

1.3 Version Control

The topic for this week will be version using the Git Version Control System. The following will be covered.

- The rationale for version control in software development
- Installation of the Git SCM software
- The command `git config` for the user name, user email, and core editor
- The command `git init`
- The command `git add` with the appropriate arguments
- The command `git status`
- The command `git commit` with the appropriate arguments
- The command `git log`

1.4 Markdown

Markdown is a very simple, human readable, formatting system. A Markdown document is a simple text document, with no binary codes or special formatting instructions. It contains only printable characters, such as alphabetical characters, punctuation, and digits. The file extension is `.md`. This is half of all the Markdown you will need to know. You can pick up the other half just as easily.

- Headings
- Paragraphs
- Itemized lists
- Enumerated lists
- Rules

Chapter 2

Project Selection

2.1 Project selection

Students will select one project from their list to focus on for their project They should make a formal investigation of the requirements of the project. If possible, they should identify similar applications that have been written. The deliverable is a six to eight paragraph project proposal. The project proposal should contain a sufficient description of the project that would allow construction of the project to begin.

2.2 Deliverable

You have two deliverabes for this step, an oral presentation and a written paper. Your oral persentation should be no longer than five minutes, and should cover the same topics as the written paper. It should be short and succienct, but it should cover all topics adequately. You may use a slide presentation if desired.

Your written deliverable will be a six to eight paragraph discussion of your proposed project. Your proposal should begin with a short introduction and conclude with a short conclusion. It should include discussions of the purpose of the software, an overall description of the high-level functional requirements of the software (that is, what the software will actually do), a survey of the relevant literature available that will assist you in completing your project, a short discussion of similar software, and a brief discussion of your project plan. Your writeup is not limited to two pages, and can include other sections that you feel will help the reader in understanding your proposal.

The format of the paper will eventually use *Markdown.* For now, please write your paper either in Markdown or in plain ASCII text with no formatting, perhaps using Microsoft Notepad or a similar application. In general, your papers should consist of a short introduction, a short conclusion, and a body containing the substance of your discussion. For this paper, structure it like this:

1. A first paragraph or two briefly introducing yourself and stating how your chosen project will accomplish your personal objectives.

2. A paragraph or two describing the data phase of your project. This should include a general description of the kinds of information your database will contain.

3. A paragraph or two describing the programming phase of your project. This should include a general description of the processing necessary to accomplish your objectives.

4. A paragraph or two describing the interface your project will present to the users. Focus on the functionality, not things such as layout, color, font, and so on.

5. A final paragraph or two reflecting on how you will actually go about building your project. This does not need to be in detail, but a general plan of actiob.

2.3 Distributed Version Control

The topic for this week will be version control using the Github Distributed remote repository. The following will be covered.

- The rationale for distributed version control in software development
- Signing up for a Github account
- Creating your first remote repository
- The command `git remote add` with the appropriate arguments
- The command `git remote -v`
- The command `git push` with the appropriate arguments
- a `.gitignore` file
- a `README.md` file

2.4 Markdown

Markdown is a very simple, human readable, formatting system. A Markdown document is a simple text document, with no binary codes or special formatting instructions. It contains only printable characters, such as alphabetical characters, punctuation, and digits. The file extension is `.md`. This is half of all the Markdown you will need to know. You can pick up the other half just as easily.

- Emphasis
- Hyperlinks
- Images
- HTML elements
- Source listings

Part II

Data

Chapter 3

Requirements

3.1 Introduction to database requirements

The purpose of a database generally is to store data. Databases can be of various kinds, such as a filing cabinet, a list written on a sheet of paper, a wall of sticky notes, and so on. In this project, we will use a relational database, also know as a SQL database. A relational database is a mathmatical model of the world, and as such it is extremely limited. However it has great power, stemming from rigorous mathmatics, and is enormously popular in the business world.

A *database requirements document* usually is an extensive document covering a multitude of topics. You can search the internet for examples, and see a number of different templates. We will not be doing this. The purpose of the requirements stage in this project is merely to collect a more or less complete list of the data your project will need to function.

How do you accomplish this task? For an existing project, the developer will review all the paper the organization collects and see what information those documents contain. For people, information might include the name, address, ID number, telephone number, username, password, etc. For products, information might include the product name, the model number, the serial number of individual items, the supplier, the expiration date, etc. For military units, imformation might include the unit designation, the parent unit, subordinate units, tables of organization and equipment, etc.

One good way to do this is to go through your project in your mind, exercising all the functionality you can think of, and write down every single piece of information you will need to exercise than functionality. If your application is a messaging app, you will need the name and IP address of the sender, the name and IP address of the reciever, the data and text of the message, etc. For an auction app, you will need the name and contact information of the seller, the name and contact information of all bidders, the description of the item, and a way to keep track of the bids. *Use your imagination!!!* This document will be absolutely essential in order to complete the next step, the conceptual design.

3.2 Deliverable

Your deliverable can be as simple as a list, composed of sublists divided appropriately, written in Markdown, and posted to your Github account. If you have the time and energy, you can make it as complete as you would like, following the template of your choice. The ultimate grading criterion will be the completeness of your list, not the formality.

3.3 Software Life Cycle

A brief introduction to the software life cycle:

- Inception
- Elaboration

- Construction
- Transition
- Maintenance
- End of life

3.4 Software Development Cycle

A brief introduction to software development workflows:

- Requirements
- Analysis
- Design
- Implementation
- Testing

3.5 Software Process Models

A brief introduction to software process models:

- Incremental development
- Iterative development
- Spiral models
- Waterfall
- Rational Unified Process
- Agile processes

Chapter 4

Conceptual Design - Analysis

4.1 Database Conceptual Design

Typically, a database project consists of five or six phases: requirements engineering, conceptual design (analysis), logical design, physical design, implementation, and testing. For the CAD project, we will only cover requirements, conceptual design, logical design, physical design, and implementation. We will not cover requirements engineering generally nor testing. We do not cover the requirements engineerinng phase because, presumably, since you are your own client/customer, you will already know your requirements. We do cover testing, but not in the database phase of the project. During the later phases of the project, you will be able to test your database design and revise it as necessary.

Generally, the conceptual design phase of a database project requires developers to break down the problem domain into relevant objects, called entities, and identify the relationship between objects. For example, a school might have courses, teachers, and students: teachers *teach* courses, students *enroll in* courses, and teachers *grade* students. The entities are TEACHER, STUDENT, and COURSE. The relationships are TEACH, ENROLL IN, and GRADE.

For this week's assignment, you will prepare a conceptual design of your project database and create an *entity-relationship diagram*. This process requires you to identify the entities that your project deals with and the relationship between the entities. This process also requires you to identify important attributes of your entities, and (if necessary) of your relationships. Examples of important attributes for STUDENT would be ID and NAME, and for COURSE would be CRN and TITLE.

We will also discuss the Dia Diagram Editor, `https://sourceforge.net/projects/dia-installer/`.

4.2 Deliverable

Your deliverable is an Entity Relationship Diagram (ERD). Your ERD is an image, and you should prepare it in some graphical format. The preferred format is PDF, but other image formats are acceptable, such as SVG, JPEG, GIF, PNG, EPS, etc.

4.3 Entities, Relationships, and Attributes

The following topics will be discussed:

- What is *conceptual database design*
- What is an *entity*
- What is a *weak entity*
- What is an *entity attribute*
- What is a *relationship*

- What is a *relationship type*
- What is a *relationship degree*
- What is a *relationship attribute*
- What is a *candidate key*
- What is a *super key*

Chapter 5

Logical Design

5.1 Database Logical Design

Typically, a database project consists of five or six phases: requirements engineering, conceptual design (analysis), logical design, physical design, implementation, and testing. For the CAD project, we will only cover requirements, conceptual design, logical design, physical design, and implementation. We will not cover requirements engineering nor testing. We do not cover the requirements phase because, presumably, since you are your own client/customer, you will already know your requirements. We do cover testing, but not in the database phase of the project. During the later phases of the project, you will be able to test your database design and revise it as necessary.

Generally, the logical design phase of a database project requires developers to decompose the entities identified by the conceptual design and create a logical schema. This means that the entities become tables (relations), and the attributes are expanded and identified as fields. During this process, the database is normalized and integirity constraints are realized. Logical design is much more of an art than a science, and is notoriously difficult.

For this week's assignment, you will prepare a logical design of your project database and create a *database diagram*. This process requires you to identify the relations (tables), that you normalize your database, and that you specify all fields (attributes) of your tables.

5.2 Deliverable

Your deliverable is an Database Diagram. Your database diagram is an image, and you should prepare it in some graphical format. The preferred format is PDF, but other image formats are acceptable, such as SVG, JPEG, GIF, PNG, EPS, etc.

5.3 Normalization and integrity constraints

The following topics will be discussed:

- What is *first normal form*
- What is *second normal form*
- What is *third normal form*
- What is *entity integrity*
- What is *domain integrity*
- What is *referential integrity*
- What is *logical (business) integrity*

5.4 Thought Exercise

You are given an assignment to build a database that models student enrollments in courses. In your conceptual design phase, you identify two entities, students and courses, and one relationship, `[Students] Enroll in [Courses]`. In your first attempt, you see immediately that your database is not in first normal form in that multiple students enroll in the same course and multiple students enroll in the same course. It's not in second normal form because student attributes do not depend on the course primary key, and course attributes depend do not on the student primary key. You see that it also (probably) is not in third normal form because some non-key attributes uniquely identify other non-key attributes.

Complete a logical design of this problem. We will discuss this in class. In my solution to this exercise, I designed five different tables. You may or may not have the same number of tables in your solution.

Chapter 6

Physical Design

6.1 Database Physical Design

Typically, a database project consists of five or six phases: requirements engineering, conceptual design (analysis), logical design, physical design, implementation, and testing. For the CAD project, we will only cover conceptual design, logical design, physical design, and implementation. We will not cover requirements engineering nor testing. We do not cover the requirements phase because, presumably, since you are your own client/customer, you will already know your requirements. We do cover testing, but not in the database phase of the project. During the later phases of the project, you will be able to test your database design and revise it as necessary.

Physical design targets a particular relational database management system, such as SQL Server or SQLite. Logical designs target an abstract database, but physical designs must be specific to the particular database system. All elements must be specified, such as the constraints we will discuss. You should be able to hand your physical design to a SQL programmer, and he should be able to write the implementation code without reference to anything other than your physical design.

For this week's assignment, you will prepare a physical design of your project database and create a *database diagram*. This process requires you to create tables, create columns, specify

6.2 Deliverable

Your deliverable is a Database Diagram. Your database diagram is an image, and you should prepare it in some graphical format. The preferred format is PDF, but other image formats are acceptable, such as SVG, JPEG, GIF, PNG, EPS, etc.

6.3 Database objects and constraints

The following topics will be discussed:

- What is are *column level constraints* and *table level constraints*
- What is a *primary key*
- What is a *foreigh key*
- What are *insert, delete, and update anomolies*
- What is a *nullability constraint*
- What is a *uniqueness constraint*
- What is a *datatype*

- What is an *index*
- What is an *enumeration*
- What is a *check constraint*

Chapter 7

Implementation

Database Implementation

Your assignment is to implement the database you designed in your last deliverable. You should create a new database, define your tables, and fully implement the tables. You should also insert a sufficient amount of data into your tables to allow for testing, and develop a sufficient number of queries to test your database.

Your deliverable is a SQL file containing your implementation code. You should also deliver a TXT file containing the results of the execution of your SQL file.

Chapter 8

Database Presentation

8.1 Database Presentation

For this week's assignment, you will prepare and deliver a short oral presentation and a written paper. In your presentation, you should (1) introduce yourself, (2) give a short summary of your project, (3) discuss the information architecture of your project, and (4) discuss the design and implementation of your database. You can use the deliverables from the last four weeks as building blocks for your presentation.

8.2 Deliverable

You have two deliverables, one written and one oral. You should first prepare your written presentation. The format of the paper will use *Markdown*. Your paper should have a title, author, and date. The subdivisions of your paper should have appropriate section and subsection headings.

The second deliverable is an oral presentation, This should be short, not more than five minutes. Optionally, you may make a video of your presentation using your compputer. If your laptop did not come with video software, VSDC is free and works well.

Upload your written presentation to Github. You may upload your video presentation to your project account in Linkedin or another appropriate platform.

8.3 Software Development Cycle

A brief review to software development workflows:

- Requirements
  - requirements engineering
  - collaboration with stakeholders
  - use cases (user stories)
- Analysis
  - functional requirements
  - non-functional requirements
  - Software Requirements Specification (SRS)
- Design
  - Unified Modeling Language (UML)
  - static design diagrams

  - dynamic design diagrams
- Implementation
- Testing

8.4 Object Oriented Development Principles

A brief review to software development principles for OOAD:

- Single responsibility principle (SRP): This principle states that software component (function, class or module) should focus on one unique tasks (have only one responsibility).
- Open/closed principle (OCP): This principle states that software entities should be designed with the application growth (new code) in mind (be open to extension), but the application growth should require the smaller amount of changes to the existing code as possible (be closed for modification).
- Liskov substitution principle (LSP): This principle states that we should be able to replace a class in a program with another class as long as both classes implement the same interface. After replacing the class no other changes should be required and the program should continue to work as it did originally.
- Interface segregation principle (ISP): This principle states that we should split interfaces which are very large (general-purpose interfaces) into smaller and more specific ones (many client-specific interfaces) so that clients will only have to know about the methods that are of interest to them.
- Dependency inversion principle (DIP): This principle states that entities should depend on abstractions (interfaces) as opposed to depend on concretion (classes).

Part III

Logic

Chapter 9

Requirements

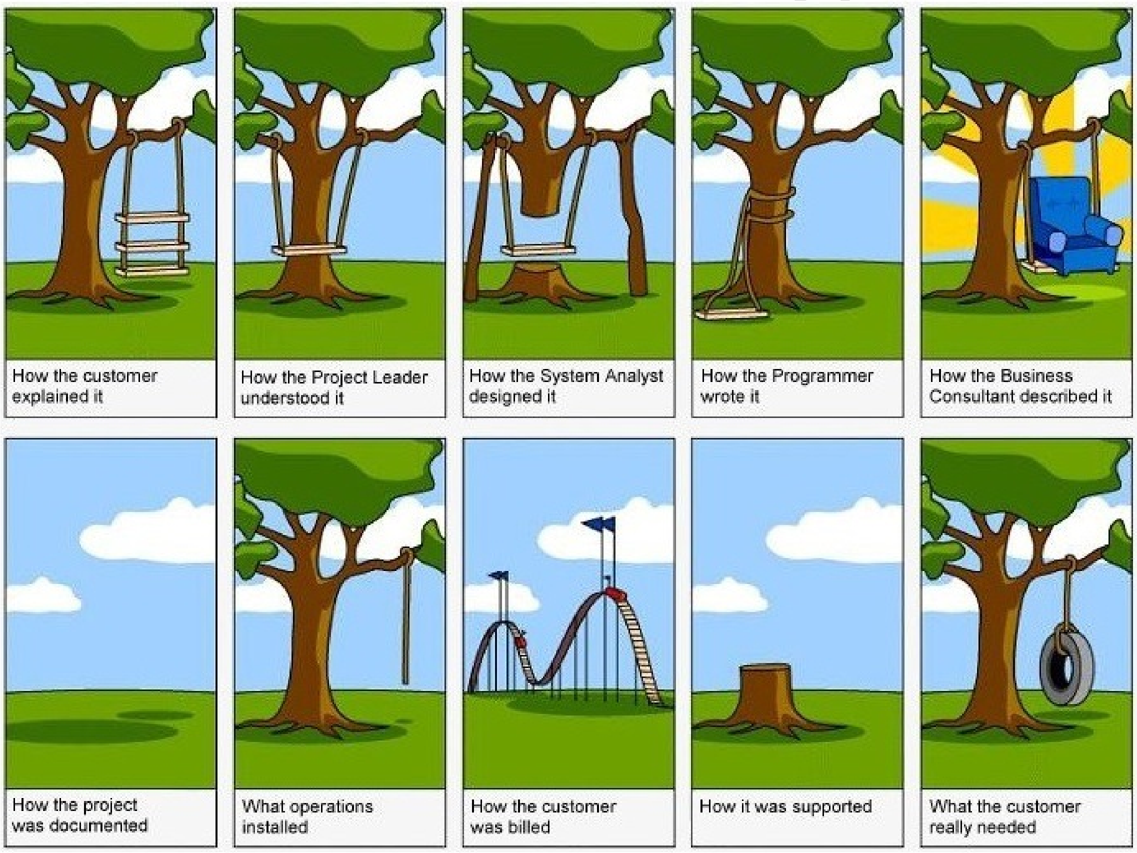

How the customer explained it
How the Project Leader understood it
How the System Analyst designed it
How the Programmer wrote it
How the Business Consultant described it
How the project was documented
What operations installed
How the customer was billed
How it was supported
What the customer really needed

Figure 9.1: Different views of requirements

With over 70% of project failures being attributed to requirements gathering, why are we still using the same techniques and expecting different results? Requirements need to be discovered before they can be gathered and this requires a robust approach to analyzing the business needs.[1]

[1] Stieglitz, C. (2012). Beginning at the endrequirements gathering lessons from a flowchart junkie. Paper presented at PMI Global Congress 2012North America, Vancouver, British Columbia, Canada. Newtown Square, PA: Project Management Institute.

9.1 Requirements Phase

The Cloud Application Development Project consists of four parts, an inception part, the database part, the prgram development (logic) part, and the interface part. All these parts can be considered integral to software development, but they are approached differently. Last week, we concluded the database portion of the project. This week, we begin five week looking specifically at programming development. We can call this *software emngineering* in a narrow sense.

The discipline of software engineering includes various workflows in building software applications. These workflows are the same as engineering workflows in other engineering disclipines, such as civil and automotive engineering. These workflows consists of the following:

- Requirements Gathering
- Requirements Analysis
- Program Design
- Program Implementation
- Application Testing

Software engineers use many different processes, among them waterfall, the Rational Unified Process, and various agile processes, including Scrum and Kanban. Different processes order and emphasize the workflows differently, but despite their differences, all processes use the same workflows. The process we will use in this project is a modified version of Extreme Programming (XP). If you are interested in XP, you can read about it offline.

9.2 Requirements Gathering

Requirements gathering is probably the most important activity to be performed in delivering an information solution. There is no one perfect means for identifying and gathering requirements. The most appropriate methods will vary from project to project. Some commonly used methods include:[2]

- Interviews
- Storyboarding
- Use cases
- Questionaires
- Brainstorming
- Prototyping

Use cases can be especially valuable since they provide specific scenarios of how the solution is intended to be used and by whom. These use cases can then provide a direct basis for testing the delivered solution. Following are some things to keep in mind when gathering requirements:

- Identify and involve a representative set of stakeholders (don't lose sight of all of the players)
- Seek breadth before depth (get the big picture before deep diving)
- Iterate and clarify (as more requirements surface they will evolve)
- Prioritize (separate the must-haves from the nice-to-haves)
- Use the stakeholder's terminology (you're doing an information solution not a technical solution)

[2] https://its.unl.edu/bestpractices/requirements-gathering

- Employ KISS (keep it simple but be thorough)
- Realize that you will never get a complete set of requirements up-front; some won't surface until the stakeholders have pieces of the solution that they can see and touch (be careful of scope creep)
- Remember goals and objectives are not requirements (they are just as important though)
- Requirements and constraints should drive the solution not the other way around

9.3 What is Requirements Elicitation?

Requirements elicitation (also known as Requirements Gathering or Capture) is the process of generating a list of requirements (functional, system, technical, etc.) from the various stakeholders (customers, users, vendors, IT staff, etc.) that will be used as the basis for the formal Requirements Definition.

The process is not as straightforward as just asking the stakeholders what they want they system to do, as in many cases, they are not aware of all the possibilities that exist, and may be limited by their immersion in the current state. For example asking people in the 19th Century for their requirements for a self-propelled vehicle, would have just resulted in the specification for a faster horse-drawn carriage rather than an automobile. Beware the old adage, "it's everything I asked for, but not what I need"![3]

9.3.1 What Techniques Can Be Used?

Interviews - These are an invaluable tool at the beginning of the process for getting background information on the business problems and understanding a current-world perspective of what the system being proposed needs to do. You need to make sure that your interviews cover a diverse cross-section of different stakeholders, so that the requirements are not skewed towards one particular function or area.

Questionnaires - One of the challenges with interviews is that you will only get the information that the person is consciously aware of. Sometimes there are latent requirements and features that are better obtained through questionnaires. By using carefully chosen, probing questions (based on the information captured in prior interviews), you can drill-down on specific areas that the stakeholders don't know are important, but can be critical to the eventual design of the system.

User Observation - One of the best ways to determine the features of a system, that does not result in "paving the cowpath" (i.e. building a slightly improved version of the current state) is to observe users actually performing their daily tasks, and ideally recording the actions and activities that take place. By understanding the holistic context of how they perform the tasks, you can write requirements that will reinvent the processes rather than just automating them, and will ensure that usability is paramount.

Workshops - Once you have the broad set of potential requirements defined, you will need to reconcile divergent opinions and contrasting views to ensure that the system will meet the needs of all users and not just the most vocal group. Workshops are a crucial tool that can be used to validate the initial requirements, generate additional detail, gain consensus and capture the constraining assumptions.

Brainstorming - This is a powerful activity, which can be performed either in the context of a workshow or on its own. By considering different parts of the system and considering "what-if" scenarios, or "blue-sky" ideas, you can break out of the context of the current-state and consider visionary ideas for the future. Tools such as whiteboards or mind-mapping software can be very helpful in this phase.

Role Playing - In situations where the requirements depend heavily on different types of user, formal role-playing (where different people take on the roles of different users in the system/process) can be a good way of understanding how the different parts of the system need to work to support the integrated processes (e.g in an ERP system).

[3] https://www.inflectra.com/ideas/topic/requirements-gathering.aspx

Use Cases and Scenarios - Once you have the high-level functional requirements defined, it is useful to develop different use-cases and scenarios that can be used to validate the functionality in different situations, and to discover any special exception or boundary cases that need to be considered.

Prototyping - There is truth to the saying "I don't know what I want, but I know that I don't want that!". Often stakeholders won't have a clear idea about what the requirements are, but if you put together several different prototypes of what the future could be, they will know which parts they like. You can then synthesize the different favored parts of the prototypes to reverse-engineer the requirements.

9.3.2 How Should the Information Be Captured?

There are many different ways to capture the information, from a simple Word document, spreadsheet or presentation to sophisticated modelling diagrams. We recommend that the initial high-level brainstorming and requirements discovery be done on a whiteboard to foster collaboration. Once the initial ideas have crystallized, we recommend using a formal Requirements Management System to record the information from the whiteboard and drill-down the functional requirements in smaller focus-groups to arrive at the use-cases and system requirements.

9.3.3 What Pitfalls Exists?

The biggest risk is that by asking existing users or stakeholders to help define the requirements, you will get a requirements specification that is unduly influenced by the current ways of doing business. Therefore we recommend that you ensure that sufficient third-party research into industry-wide trends and usability research (e.g. observation) is done to ensure that the requirements take into account future opportunities as well as current problems.

9.4 Deliverable

You deliverable is an informal list of *functional* requirements of your application, that is, what your application‘should do. Previously, you made a requirements list for your database, which consisted of items of data that your application should keep track of. You could think of these items of data as nouns. Now, you will make a list of the functions your application will perform. You can think of these as verbs.

Formality isn't important. We will formalize this list next week in the analysis step. Completeness is important. The most important thing is to identify as many functions as possible that your application will need to do its job. Create the list using markdown, and post it to your project Github account.

Chapter 10

Analysis

10.1 Requirements Analysis

The discipline of software engineering includes various workflows in building software applications. These workflows are the same as engineering workflows in other engineering disclipines, such as civil and automotive engineering. These workflows consists of the following:

- Requirements Gathering
- Requirements Analysis
- Program Design
- Program Implementation
- Application Testing

Software engineers use many different processes, among them waterfall, the Rational Unified Process, and various agile processes, including Scrum and Kanban. Different processes order and emphasize the workflows differently, but despite their differences, all processes use the same workflows. Ideally, in this course we would use an iterative, incremental process, but unfortunately, 18 weeks is too short to do that. The process we will use in this project is a waterfall process. That is, we start ot the "top" of the waterfall with requirements , and "fall" down through analysis, design, implementation, and testing.

In the last step, we looked at the *requirements* workflow. In gathering requirements, developers try to understand the tasks that the application is to model. Developers engage in many different kinds of activities, such as reviewing paper files and other business documents, interviews with employees and other stakeholders, observation, and so on. The object of the requirements phase is to discover what it is that the software should actually do. The requirements workflow is incredibly important. After all, how can you build an application if you do not know what it will do? In fact, the largest number of software defects are failures in requirements. We build error-prone software because we fail to understand what it's supposed to do.

In ths step, we will do the *analysis* workflow. The object of analysis is to develop a *software requirements specification* (SRS) from the requirements. A SRS is a formal written document that derives directly from the requirements and addressed to software designers. Generally, requirements can be seen as *functional* and *non-functional* requirements. Functional requirements consist of discrete objectives stating exactly what the software will do. Non-functional requirements consist of other requirements, such as machine capability, availability and uptime, GUI requirements, and other requirements that are necessary for the software to perform but do not describe the functions that the software should perform. In this project, we will only consider fumctional requirements.

We will base our discussion on IEEE Std 830-1998, *IEEE Recommended Practice for Software Requirements Specifications*, June 25, 1998. This document has been superseded, but purchase is required for the current version. You can find copies of Std 830-1998 freely available. From the introduction of Std 830-1998:

> *This recommended practice describes recommended approaches for the specification of software requirements. It is based on a model in which the result of the software requirements specification process is an unambiguous and complete specification document. It should help*
>
> 1. *Software customers to accurately describe what they wish to obtain;*
> 2. *Software suppliers to understand exactly what the customer wants;*
> 3. *Individuals to accomplish the following goals:*
>   - *(a) Develop a standard software requirements specification (SRS) outline for their own organizations;*
>   - *(b) Define the format and content of their specific software requirements specifications;*
>   - *(c) Develop additional local supporting items such as an SRS quality checklist, or an SRS writer's handbook.*

We will focus our study on sections 4.3, *Characteristics of a good SRS*, and 5.3, *Specific requirements (Section 3 of the SRS)*. Section 4.3 sets forth the charictics of a good SRS. An SRS should be

a) Correct;

b) Unambiguous;

c) Complete;

d) Consistent;

e) Ranked for importance and/or stability;

f) Verifiable;

g) Modifiable;

h) Traceable.

Section 5.3 sets forth the specific requirements of an SRS, covering:

a) Specific requirements should be stated in conformance with all the characteristics described in 4.3.

b) Specific requirements should be cross-referenced to earlier documents that relate.

c) All requirements should be uniquely identifiable.

d) Careful attention should be given to organizing the requirements to maximize readability

Specific requirements include external interfaces, functions, performance requirements, logical database requirements, design constraints, standards compliance, software system attributes, reliability, availability, security, maintainability, portability, organization, modes, user classes, objects, features, stimuli, response, and hierarchy. For this class, we will focus primarily on functions, user classes, and objects.

10.2 Deliverable

You deliverable is a formal SRS, written using Markdown formatting. You should upload your SRS to your project account in Github.

Chapter 11

Design

11.1 Program Design

The discipline of software engineering includes various workflows in building software applications. These workflows are the same as engineering workflows in other engineering disclipines, such as civil and automotive engineering. These workflows consists of the following:

- Requirements Gathering
- Requirements Analysis
- Program Design
- Program Implementation
- Application Testing

For this deliverable, we will focus on software design. The design of software is *by far* the most difficult phase of software development. It's equal parts both science and art. This can be seen in the development of various programming paradigms since the advent of stored program computers. Programming paradigms include procedural (imperative) programming, functional programming, object oriented programming, event driven programming, declarative programming, and many others. In this class, we will focus only on object oriented programming.

The object of software design is to develop a series of design documents, software design descriptions (Software Design Descriptions) from the software requirements specification (SRS). Design documents can take various forms — for our purposes we will use graphics as design documents. We will will focus on the Unified Modeling Language (UML) documents, with one exception. We will base our discussion on IEEE Std 1016-2009, *IEEE Standard for Information Technology — Systems Design — Software Design Descriptions*, July 20, 2009. This document has been superseded, but purchase is required for the current version. You can find copies of Std 1016-2009 freely available. From the introduction:

> *SDDs play a pivotal role in the development and maintenance of software systems. During its lifetime, an SDD is used by acquirers, project managers, quality assurance staff, configuration managers, software designers, programmers, testers, and maintainers. Each of these stakeholders has unique needs, both in terms of required design information and optimal organization of that information. Hence, a design description contains the design information needed by those stakeholders. . . . The standard specifies that an SDD be organized into a number of design views. Each view addresses a specific set of design concerns of the stakeholders. Each design view is prescribed by a design viewpoint. A viewpoint identifies the design concerns to be focused upon within its view and selects the design languages used to record that design view. The standard establishes a common set of viewpoints for design views, as a starting point for the preparation of an SDD, and a generic capability for defining new design viewpoints thereby expanding the expressiveness of an SDD for its stakeholders.*

We will focus our study on section 5, *Design Viewpoints.*

1. Introduction
2. Context viewpoint
3. Composition viewpoint
4. Logical viewpoint
5. Dependency viewpoint
6. Information viewpoint
7. Patterns use viewpoint
8. Interface viewpoint
9. Structure viewpoint
10. Interaction viewpoint
11. State dynamics viewpoint
12. Algorithm viewpoint
13. Resource viewpoint

11.2 Project design

In this project, we have several predetermined design constraints. The most important is that of *object oriented anaysis and design.* We are using a object-oriented language, C#, and this fact alone dictates that we use object-oriented techniques and principles in building the application. Almost as important is that of the *model-view-controller* design pattern. The use of design patterns is essential for object oriented technology.[1]

In your design, you will have three kinds of classes: Model classes, which represent the data used by ytour application, View classes, which represent user iteraction, and Controller classes, which represent the program logic and business rules. To simplify building the project, we will start by building a very simple console application. As we progress, you will use ASP.NET to build an application with a graphical usr interface. For an example of a simple console application implementing MVC, please see appendix B.

11.3 Discussion Topics

Theoretically, one team composes the SRS and hands it off to the design team. The design team (in theory) works *only* from the SRS and creates a series of design documents. The design team hands the design documents off to the implementation, which implements the software working *only* from the design documents. The design team thus has a double responsibility: it must decompose the software requirements into a set of drawings (and other documents) that completely express all the functional requirements, and it must prepare the SDD so that it may be implemented completely and unambiguously. Needless to say, this is a very difficult task.

We will discuss three of the most used programming paradigms in use today, procedural (imperative) programming, functional programming, and object oriented programming. We will look at the different ways they express delivering instructions to the computer, their advantages, and their differences.

We will discuss four kinds of UML diagrams: (1) class diagrams, (2) state diagrams, (3) system sequence diagrams, and (4) component diagrams. We will also discuss data flow diagrams (DFD), which are not part of UML.

[1] The "bible" of design patterns is *Design Patterns: Elements of Reusable Object-Oriented Software*, by Erich Gamma, Richard Helm, John Vlissides, Ralph Johnson. At some point in your career as a developer, you will read this book.

11.4 Deliverables

You deliverable is a set of images in PDF format, including a class diagram, a state diagram, and a component diagram.

Chapter 12

Implementation

12.1 Program Implementation

Working from your design, you will implement a significant subset of your project. Your implementation should focus primarily on the data component and the processing component. We will focus on user interfaces during the last phase of the project.

> In order to simplify the project, we will not address a graphical user interface in this phase. You application must be built as a **console** application. In the next phase, we will adapt your project to a graphical user interface using the MVC design pattern.

It is commonly said that a graphical user interface contributes 80 percent of the complexity to an application, but only 20 percent of the functionality. You will experience this as you begin to develop graphical applications. However, this course is not a user interface design course, but an application development course. As such, it's essential to focus obn functionality. Graphical user interfaces are important, but functionality is much more important.

12.2 Deliverables

Your assignment is to implement a subset of the requirements you have previously identified. You are not expected to implement the entire project. You deliverable is a set of C# class files.

Chapter 13

Testing

13.1 Testing

For this deliverable, we will focus on application testing. We will survey the following topics

1. unit tests
2. integration tests
3. regression tests
4. acceptance tests

Perhaps the key concept is this: *Testing is not complete until it is automated.* We will consider primarily usit tests, how you should conduct unit tests, and how you should automate unit tests.

13.2 Principles of testing

Discussion text to be added.

13.3 Test driven development

Discussion text to be added.

13.4 Deliverables

You deliverable is a set of C# class files implementing a serieso of automated tests.

Part IV

Graphical User Interface

Chapter 14

Interface Design

14.1 User Interface Design Process

The design process for user interfaces is somewhat similar to the design process for applications. In both cases, developers must identify requirements, define a requirements specification, design the interface, implement the interface, and test the interface. However, the work of a design engineer depends a great deal on graphical design skills, and most developers of user interfaces have much more in common with graphical artists than software developers. This week, we will consider the process of user interface design. Next week we will con sider the principles of interface design.

The user interface design process may be broken down into the following phases. As with software development processes, developers have different development models. However, all models include these phases:

- requirements engineering
- requirements analysis
- information architecture design
- construction of wireframes
- construction of prototypes
- implmentation
- testing

For this project, we will combine the wireframe, a prototype, and mockup steps. Next week, we will implement the user interface. Presumably, since this is your project, you have a pretty concrete idea about the requirements of the interface and the information architecture.

A *graphical user interface* denotes a human-computer interface (HCI), whereby humans give commands to computers by means of a point-and-click mechanism rather than by typing commands into a command prompt. The interface works by translating the actions of the human into commands that the application recognizes. This is an important point that cannot be missed: *a graphical interface is only another means of issueing commands to a computer.* As such, it cannot do more that the API of the software provides, and typically provides far less.

What is a wireframe? A wireframe is a model containing the essential elements of a system, with all external characteristics as to style and color removed. The wireframe represents the *functionality* of a system. For example, a wireframe of a new model of an automobile is just, literally, a "wire frame." We can see the engine compartment, the passenger compartment, the cargo compartment, the engine, transmission, and steering components, and the shape and size of the car. We can't see the exterior features, design elements, color, etc. In the same way, a wireframe of a user interface contains just the basics, with nothing to distract the developers. The function of the wireframe is simply to nail down the kinds of controls the interface contains. Many times, wireframes of user interfaces are realized by images: drawings, photographs, or other pictorial representations.

What is a prototype? A prototype can be though of as a wireframe with actions. The controls "work" in some sense. Users can type text into textboxes, select items from a drop down list, select files from a file explorer, push radio buttons, click submit buttons, etc. The purpose of a prototype is the exploration of the kinds of actions a user makes with the interface. Prototypes are usually realized by code that compiles and runs, but does not interact with any system. As example might be an HTML file that can be opened in a browser, that the user can explore, but that does not actually do anything.

What is a mockup? A mockup can be thought of as a prototype with style and design. What are the colors used? What fonts wil be used? What font sizes will the textual elements be? How will the interface be laid out? What are the accessibility issues? Mockups are generally realized by image files.

14.2 User Interface Design Activities

Users, UX and context

- identification of ways of the products application
- identification of the general target audiences (TA) attributes
- identification of usability goals of the TA
- identification of users roles vs. goals, ranking of goals importance for users
- identification of functionality options necessary for meeting TA goals and objectives; ranking of functionality attributes dependant on how well they help to reach goals
- comparative analysis of functionality and content vs. competitors products
- consideration of business and functionality-related limitations
- choice of the optimal products interfaces enabling to reach the key business goals of the project

The final document: usability analysis outlining potential user capabilities of the product vs. The initial business and functional requirements and limitations

Navigation and structure

- designing scenarios outlining the user-product interaction in order to reach the goals (applicable to the chosen interface options and user roles)
- ranking of scenarios by importance, relying on usage frequency and users roles
- development of the information architecture and structure and navigation interface design providing optimal functionality, content and user interaction scenarios

The final document: the UI-structure outlining the pattern of products interface and the path the user follows while browsing the website (in accordance with the user scenarios and roles)

Layout design

- layout design of the structures pages, which are to feature on a screen. Such design meets requirements towards navigation, functional, graphic and text elements of the screen forms of the pages. The requirements in question, in their turn, meet the standards of usability checklists

The final document: the UI-design featuring a catalogue of the key screen interface forms and requirements to location, priority, form and content of information, graphical and functional elements

Visual interface design

- designing of creative visual elements of the interface to meet the brand-book standards and the corporate identity. This includes: style, color, fonts, graphic solutions (read more...)
- design of association icons and graphic symbols
- general design of the key screen forms of the key screen forms of the compositional design

The final document: the GUI-design outlining visual standards of information, graphic and functional interface elements

Preparing of prototype

- creation of interactive model of the product enabling to make a full-scale investigation and evaluate the products usability, since the prototype fully imitates the future product (read more...)

The final document: the products prototype, which fully reflects features and usability of the future product (in terms of the user interface)

User testing

- recruitment of respondents
- the research set-up (defining of the research hypothesis, design of user scenarios etc.)
- conduction of testing and recording of the results
- the results analysis
- provision of report with recommendations on the way to eliminate weak points and problem zones

The final document: report on user testing

UI Specification

- preparation of the document User Interface Specification outlining standards of the structural, compositional and visual design of the product taking into account recommendations based on the usability testing results
- revision of the prototype relying on recommendations based on usability testing

The final document: Specification of the products UI

14.3 Deliverable – Prototype

You deliverable is a set of source files representing views of each functionality your application will provide to the user. These files may be C# files, `.cshtml` files, or plain HTML files.

Chapter 15

GUI Implementation

15.1 Implementation Introduction

You have built a data component to your project. You have build a component containing the business rules and logic of your project. You have designed a user interface for your project. At this stage, you should be ready to put everything together. If this were a "real world" project, this would represent the first iteration at the implementation phase — you would still have to test your application, and move to the second iteration. Lather. Rinse. Repeat.

The purpose of this project is to introduce you to the *how* a project is developed. You will almost never be involved in every part of the development of an application, except very small applications. But someone will be involved in every stage, whether designing the information architecture and building the database, designing and building the business logic, and designing and building the user interface.

Your implementation will not be complete. However, it should demonstrate what you have learned in this course, and should have introduced you to some of the important concepts of software development. Implement what you can, and if you have the interest and the time to continue to work on your project, it would be time well spent.

15.2 Deliverable – Implementation

You deliverable is a set of source files representing an implementation of your project, the interface, and *including the data and logic components.* These files must be C# files.

Part V

Final Presentation

Chapter 16

Final Presentation

16.1 Project Presentation

For this week's assignment, you will prepare and deliveer an oral presentation and a written presentation. In your presentation, you should (1) introduce yourself, (2) give a short summary of your project, (3) discuss the implementation of your project from a layered point of view, i.e., data, business rules, and user interface, (4) discuss the process you used in building your application, and (5) conclude your presentation in any manner you deem suitable. Remember, this presentation is the capstone of your project, and will be the presentation prospective employers will pay the most attention to. You should do your best to present yourself and your project in the most favorable light possible.

16.2 Deliverable

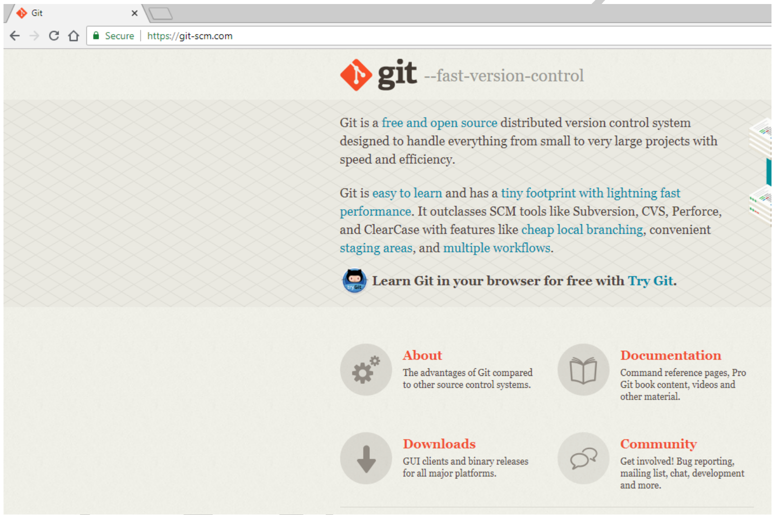
You have two deliverables, one written and one oral. You should first prepare your written presentation. The format of the paper will use *Markdown*. Your paper should have a title, author, and date. The subdivisions of your paper should have appropriate section and subsection headings. You should upload both your written presentation to your project account in Github.

The second deliverable is an oral presentation. This will be assessed as a major part of your fial project grade.

Appendix A

Installing git

This will contain instructions to install the git version control system.



Git is a free and open source distributed version control system designed to handle everything from small to very large projects with speed and efficiency.

Git is easy to learn and has a tiny footprint with lightning fast performance. It outclasses SCM tools like Subversion, CVS, Perforce, and ClearCase with features like cheap local branching, convenient staging areas, and multiple workflows.

Learn Git in your browser for free with Try Git.

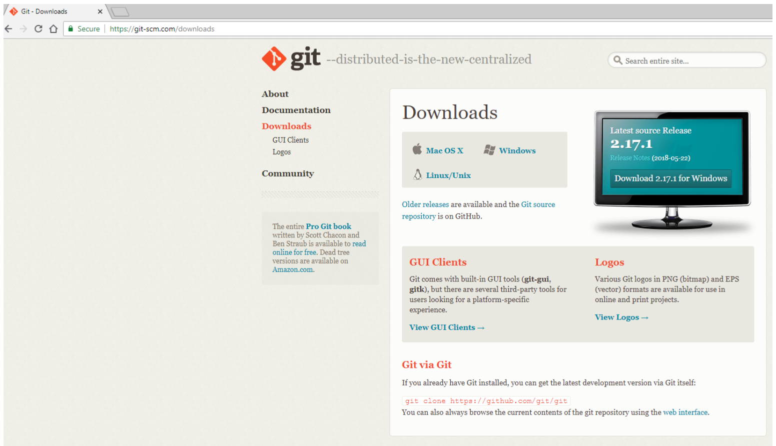
About
The advantages of Git compared to other source control systems.

Documentation
Command reference pages, Pro Git book content, videos and other material.

Downloads
GUI clients and binary releases for all major platforms.

Community
Get involved! Bug reporting, mailing list, chat, development and more.

Figure A.1:



The entire **Pro Git book** written by Scott Chacon and Ben Straub is available to read online for free. Dead tree versions are available on Amazon.com.

Downloads

Older releases are available and the Git source repository is on GitHub.

GUI Clients

Git comes with built-in GUI tools (**git-gui**, **gitk**), but there are several third-party tools for users looking for a platform-specific experience.

Logos

Various Git logos in PNG (bitmap) and EPS (vector) formats are available for use in online and print projects.

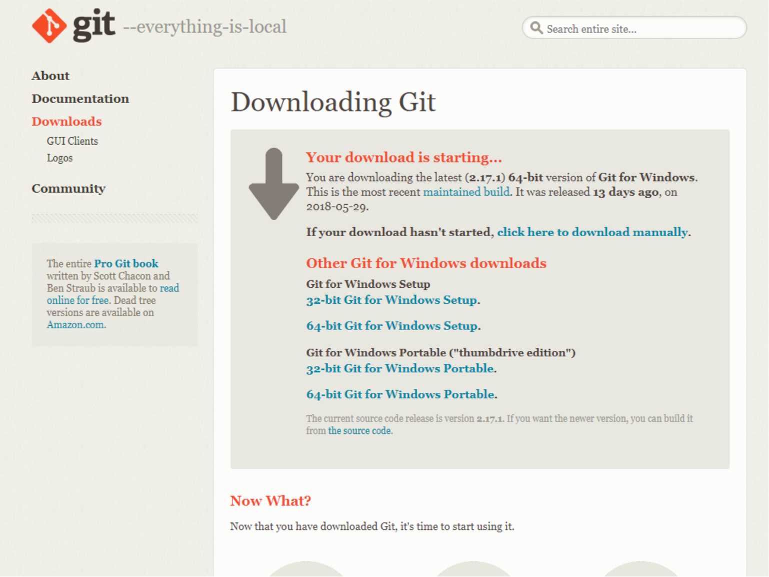
Git via Git

If you already have Git installed, you can get the latest development version via Git itself:

```
git clone https://github.com/git/git
```

You can also always browse the current contents of the git repository using the web interface.

Figure A.2:



The entire **Pro Git book** written by Scott Chacon and Ben Straub is available to read online for free. Dead tree versions are available on Amazon.com.

Downloading Git

Your download is starting...

You are downloading the latest (**2.17.1**) **64-bit** version of **Git for Windows**. This is the most recent maintained build. It was released **13 days ago**, on 2018-05-29.

If your download hasn't started, click here to download manually.

Other Git for Windows downloads

Git for Windows Setup
32-bit Git for Windows Setup.

64-bit Git for Windows Setup.

Git for Windows Portable ("thumbdrive edition")
32-bit Git for Windows Portable.

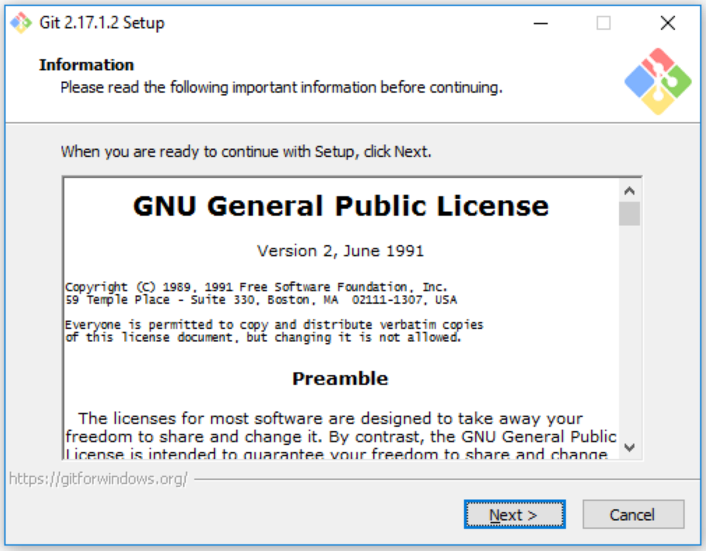
64-bit Git for Windows Portable.

The current source code release is version **2.17.1**. If you want the newer version, you can build it from the source code.

Now What?

Now that you have downloaded Git, it's time to start using it.

Figure A.3:



Information

Please read the following important information before continuing.

When you are ready to continue with Setup, click Next.

GNU General Public License

Version 2, June 1991

Copyright (C) 1989, 1991 Free Software Foundation, Inc.
59 Temple Place - Suite 330, Boston, MA 02111-1307, USA

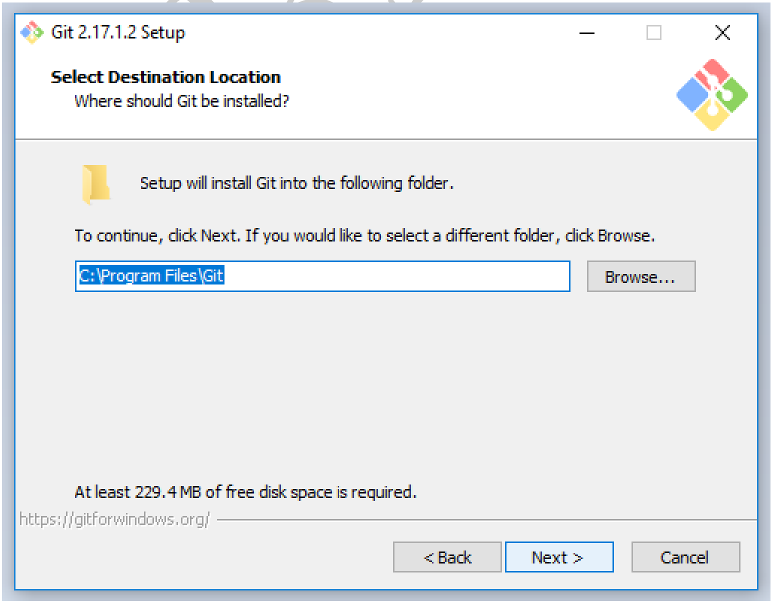
Everyone is permitted to copy and distribute verbatim copies
of this license document, but changing it is not allowed.

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change

https://gitforwindows.org/

Figure A.4:



Select Destination Location

Where should Git be installed?

Setup will install Git into the following folder.

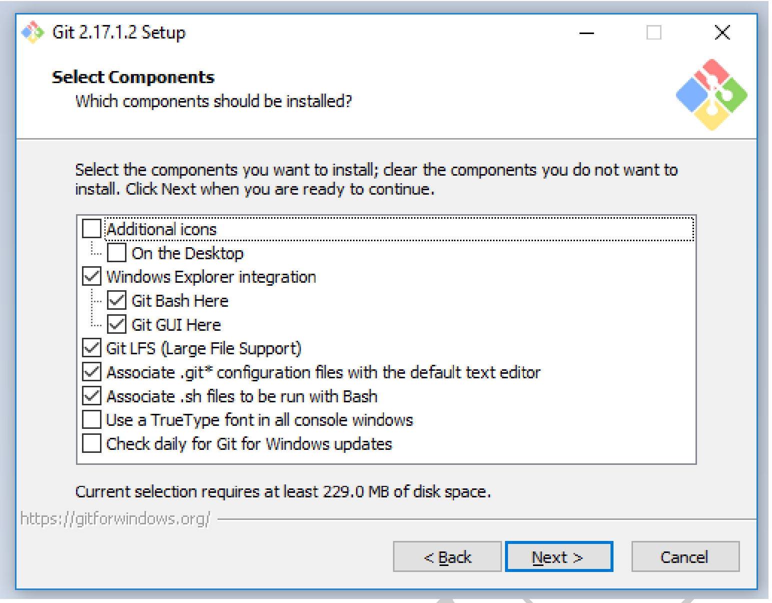
To continue, click Next. If you would like to select a different folder, click Browse.

C:\Program Files\Git

At least 229.4 MB of free disk space is required.

https://gitforwindows.org/

Figure A.5:



Select Components

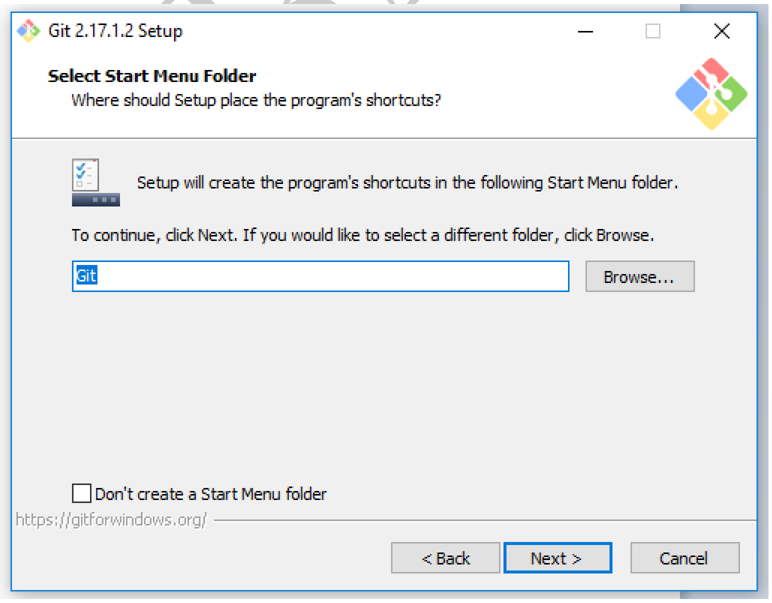
Which components should be installed?

Select the components you want to install; clear the components you do not want to install. Click Next when you are ready to continue.

- □ Additional icons
  - □ On the Desktop
- ☑ Windows Explorer integration
  - ☑ Git Bash Here
  - ☑ Git GUI Here
- ☑ Git LFS (Large File Support)
- ☑ Associate .git* configuration files with the default text editor
- ☑ Associate .sh files to be run with Bash
- □ Use a TrueType font in all console windows
- □ Check daily for Git for Windows updates

Current selection requires at least 229.0 MB of disk space.

Figure A.6:



Select Start Menu Folder

Where should Setup place the program's shortcuts?

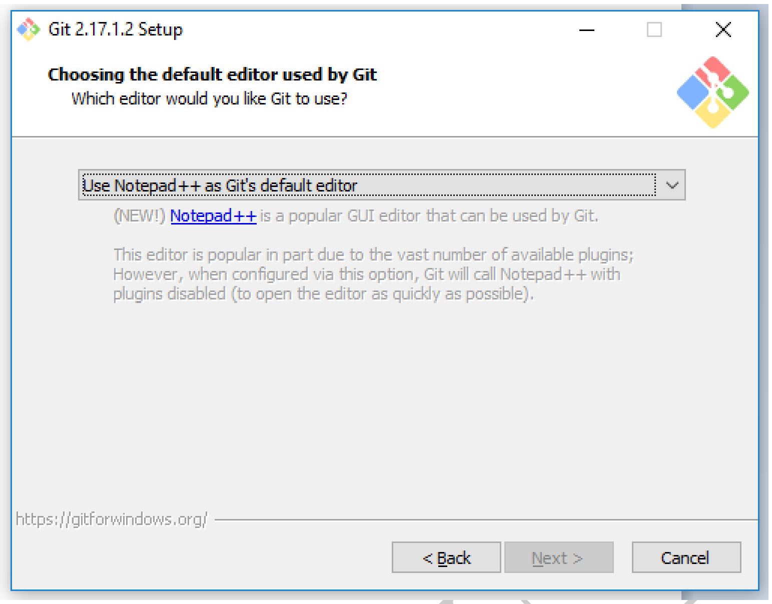
Setup will create the program's shortcuts in the following Start Menu folder.

To continue, click Next. If you would like to select a different folder, click Browse.

Git

□ Don't create a Start Menu folder

Figure A.7:



Git 2.17.1.2 Setup

Choosing the default editor used by Git

Which editor would you like Git to use?

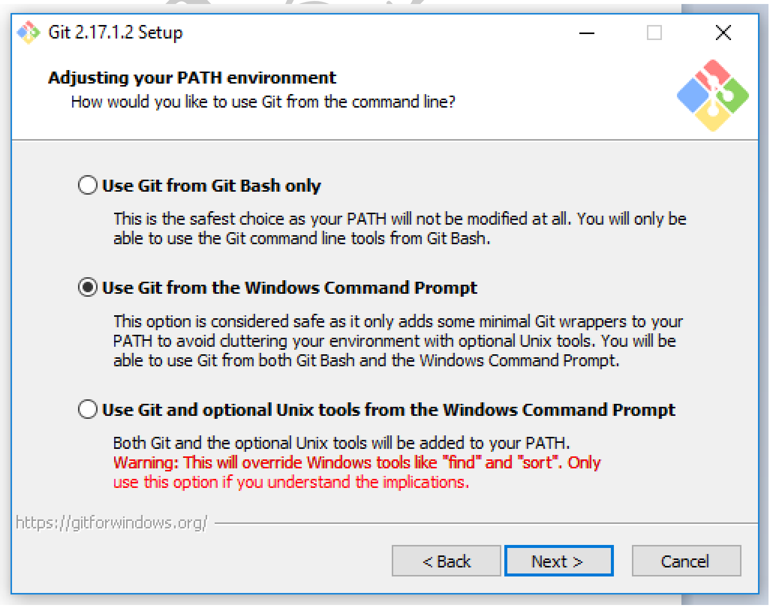
Use Notepad++ as Git's default editor

(NEW!) Notepad++ is a popular GUI editor that can be used by Git.

This editor is popular in part due to the vast number of available plugins; However, when configured via this option, Git will call Notepad++ with plugins disabled (to open the editor as quickly as possible).

https://gitforwindows.org/

Figure A.8:



Git 2.17.1.2 Setup

Adjusting your PATH environment

How would you like to use Git from the command line?

○ **Use Git from Git Bash only**

This is the safest choice as your PATH will not be modified at all. You will only be able to use the Git command line tools from Git Bash.

● **Use Git from the Windows Command Prompt**

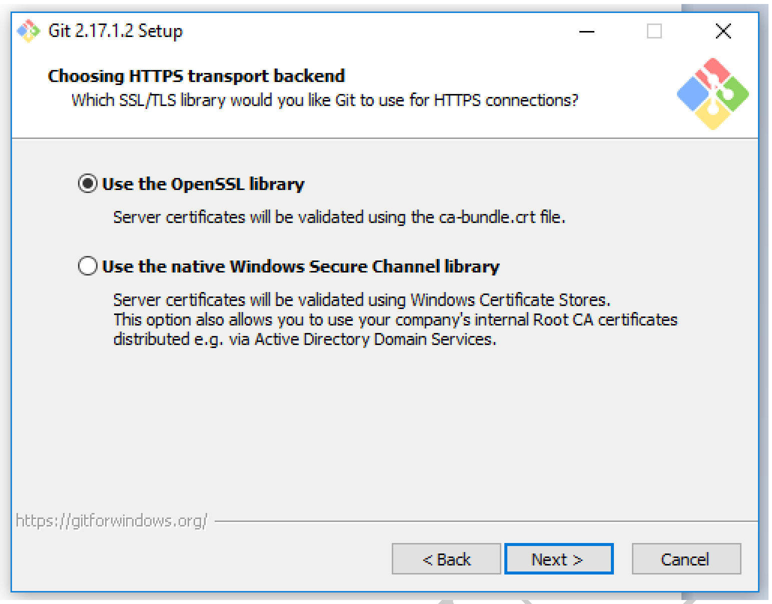
This option is considered safe as it only adds some minimal Git wrappers to your PATH to avoid cluttering your environment with optional Unix tools. You will be able to use Git from both Git Bash and the Windows Command Prompt.

○ **Use Git and optional Unix tools from the Windows Command Prompt**

Both Git and the optional Unix tools will be added to your PATH.
Warning: This will override Windows tools like "find" and "sort". Only use this option if you understand the implications.

https://gitforwindows.org/

Figure A.9:



Git 2.17.1.2 Setup

Choosing HTTPS transport backend

Which SSL/TLS library would you like Git to use for HTTPS connections?

● **Use the OpenSSL library**

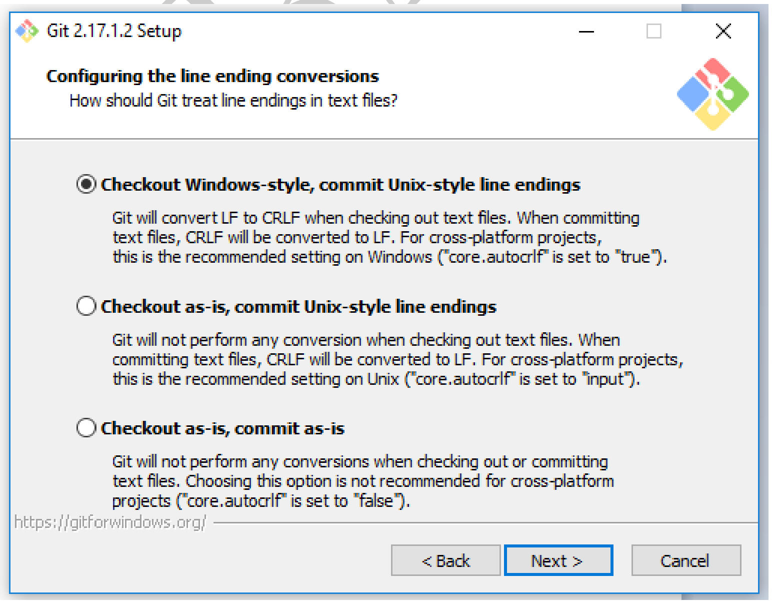
Server certificates will be validated using the ca-bundle.crt file.

○ **Use the native Windows Secure Channel library**

Server certificates will be validated using Windows Certificate Stores.
This option also allows you to use your company's internal Root CA certificates
distributed e.g. via Active Directory Domain Services.

https://gitforwindows.org/

Figure A.10:



Git 2.17.1.2 Setup

Configuring the line ending conversions

How should Git treat line endings in text files?

● **Checkout Windows-style, commit Unix-style line endings**

Git will convert LF to CRLF when checking out text files. When committing
text files, CRLF will be converted to LF. For cross-platform projects,
this is the recommended setting on Windows ("core.autocrlf" is set to "true").

○ **Checkout as-is, commit Unix-style line endings**

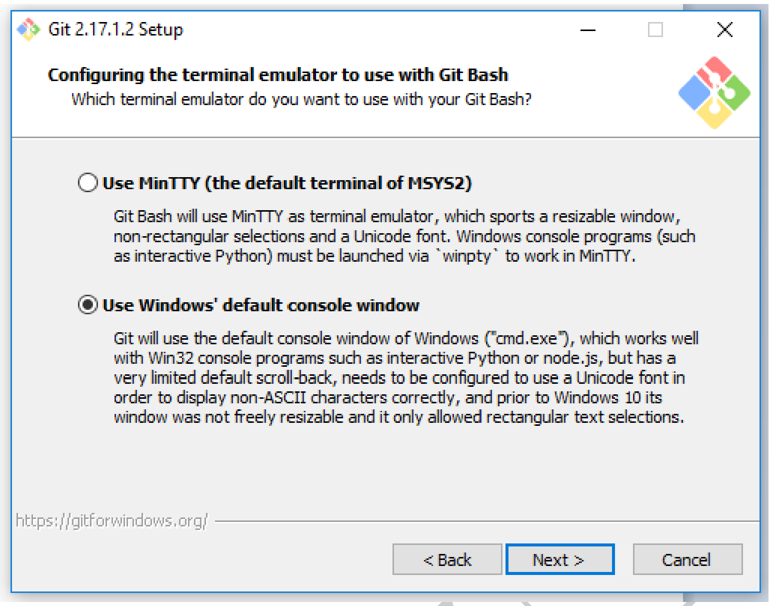
Git will not perform any conversion when checking out text files. When
committing text files, CRLF will be converted to LF. For cross-platform projects,
this is the recommended setting on Unix ("core.autocrlf" is set to "input").

○ **Checkout as-is, commit as-is**

Git will not perform any conversions when checking out or committing
text files. Choosing this option is not recommended for cross-platform
projects ("core.autocrlf" is set to "false").

https://gitforwindows.org/

Figure A.11:



Configuring the terminal emulator to use with Git Bash

Which terminal emulator do you want to use with your Git Bash?

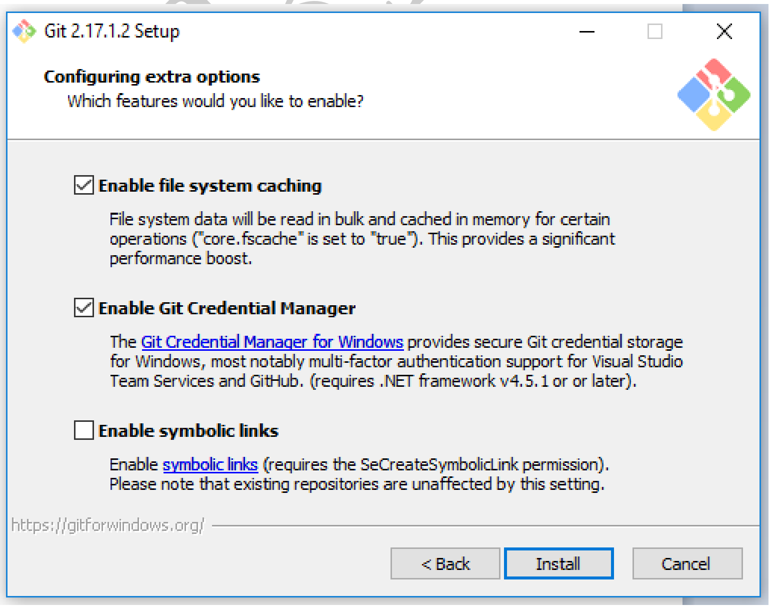
○ **Use MinTTY (the default terminal of MSYS2)**

Git Bash will use MinTTY as terminal emulator, which sports a resizable window, non-rectangular selections and a Unicode font. Windows console programs (such as interactive Python) must be launched via `winpty` to work in MinTTY.

● **Use Windows' default console window**

Git will use the default console window of Windows ("cmd.exe"), which works well with Win32 console programs such as interactive Python or node.js, but has a very limited default scroll-back, needs to be configured to use a Unicode font in order to display non-ASCII characters correctly, and prior to Windows 10 its window was not freely resizable and it only allowed rectangular text selections.

Figure A.12:



Configuring extra options

Which features would you like to enable?

☑ **Enable file system caching**

File system data will be read in bulk and cached in memory for certain operations ("core.fscache" is set to "true"). This provides a significant performance boost.

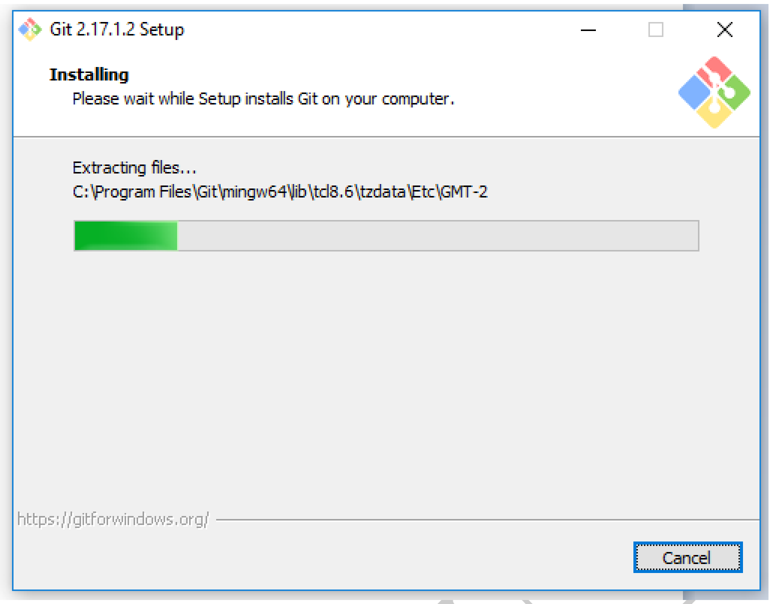
☑ **Enable Git Credential Manager**

The Git Credential Manager for Windows provides secure Git credential storage for Windows, most notably multi-factor authentication support for Visual Studio Team Services and GitHub. (requires .NET framework v4.5.1 or or later).

☐ **Enable symbolic links**

Enable symbolic links (requires the SeCreateSymbolicLink permission). Please note that existing repositories are unaffected by this setting.

Figure A.13:



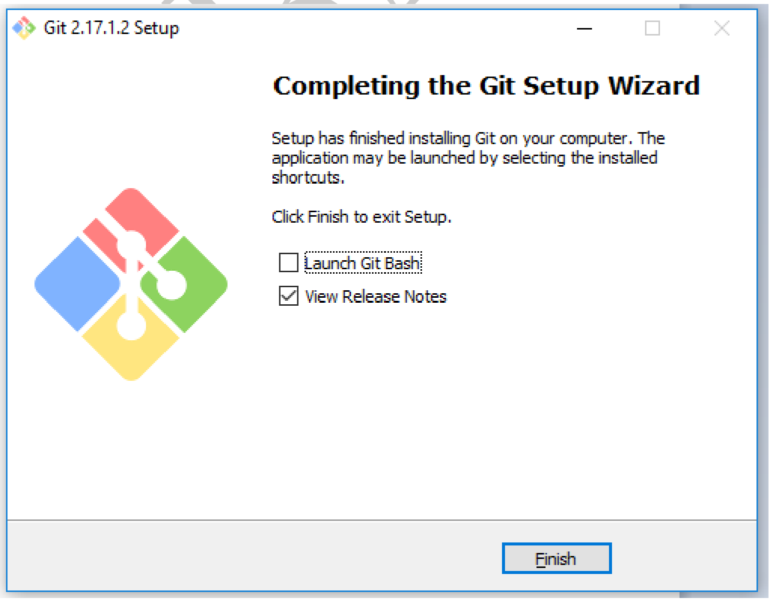
Git 2.17.1.2 Setup

Installing

Please wait while Setup installs Git on your computer.

Extracting files...
C:\Program Files\Git\mingw64\lib\tcl8.6\tzdata\Etc\GMT-2

Figure A.14:



Git 2.17.1.2 Setup

Completing the Git Setup Wizard

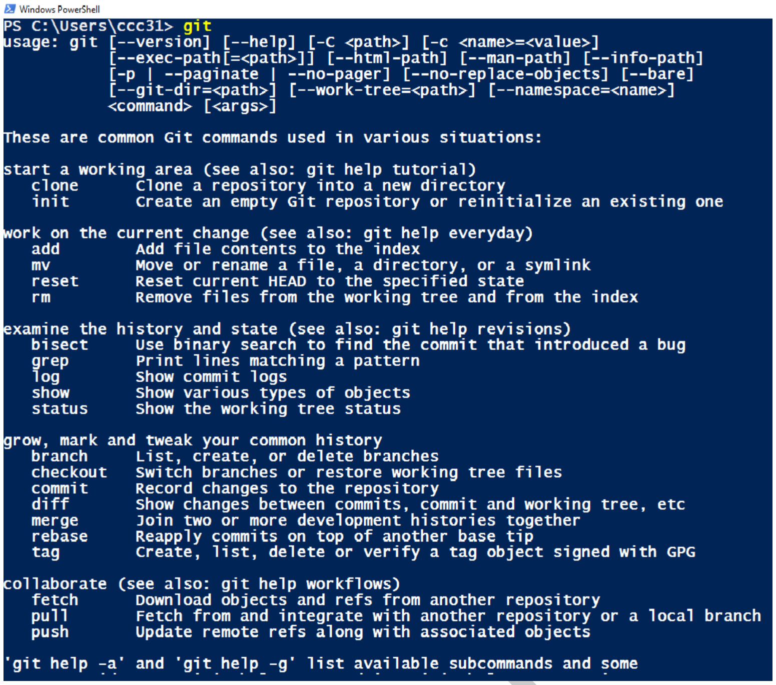
Setup has finished installing Git on your computer. The application may be launched by selecting the installed shortcuts.

Click Finish to exit Setup.

□ Launch Git Bash

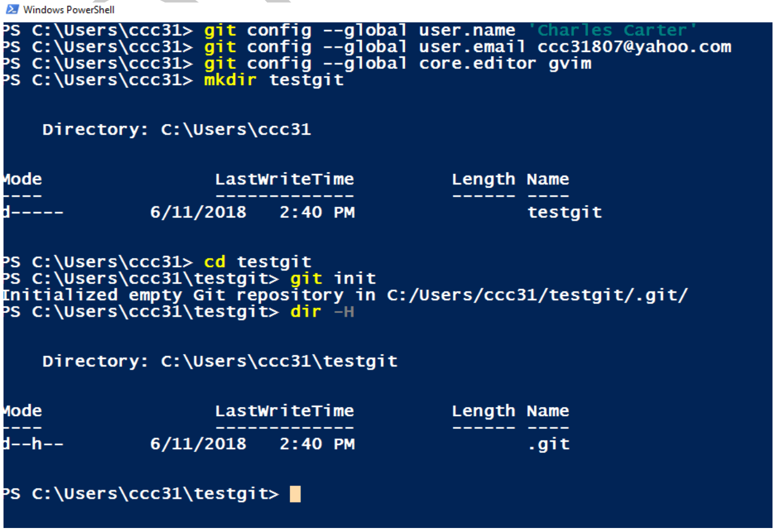
☑ View Release Notes

Figure A.15:



```
PS C:\Users\ccc31> git
usage: git [--version] [--help] [-C <path>] [-c <name>=<value>]
           [--exec-path[=<path>]] [--html-path] [--man-path] [--info-path]
           [-p | --paginate | --no-pager] [--no-replace-objects] [--bare]
           [--git-dir=<path>] [--work-tree=<path>] [--namespace=<name>]
           <command> [<args>]

These are common Git commands used in various situations:

start a working area (see also: git help tutorial)
   clone      Clone a repository into a new directory
   init       Create an empty Git repository or reinitialize an existing one

work on the current change (see also: git help everyday)
   add        Add file contents to the index
   mv         Move or rename a file, a directory, or a symlink
   reset      Reset current HEAD to the specified state
   rm         Remove files from the working tree and from the index

examine the history and state (see also: git help revisions)
   bisect     Use binary search to find the commit that introduced a bug
   grep       Print lines matching a pattern
   log        Show commit logs
   show       Show various types of objects
   status     Show the working tree status

grow, mark and tweak your common history
   branch     List, create, or delete branches
   checkout   Switch branches or restore working tree files
   commit     Record changes to the repository
   diff       Show changes between commits, commit and working tree, etc
   merge      Join two or more development histories together
   rebase     Reapply commits on top of another base tip
   tag        Create, list, delete or verify a tag object signed with GPG

collaborate (see also: git help workflows)
   fetch      Download objects and refs from another repository
   pull       Fetch from and integrate with another repository or a local branch
   push       Update remote refs along with associated objects

'git help -a' and 'git help -g' list available subcommands and some
```

Figure A.16:



```
PS C:\Users\ccc31> git config --global user.name 'Charles Carter'
PS C:\Users\ccc31> git config --global user.email ccc31807@yahoo.com
PS C:\Users\ccc31> git config --global core.editor gvim
PS C:\Users\ccc31> mkdir testgit


    Directory: C:\Users\ccc31


Mode                LastWriteTime         Length Name
----                -------------         ------ ----
d-----        6/11/2018   2:40 PM                testgit


PS C:\Users\ccc31> cd testgit
PS C:\Users\ccc31\testgit> git init
Initialized empty Git repository in C:/Users/ccc31/testgit/.git/
PS C:\Users\ccc31\testgit> dir -H


    Directory: C:\Users\ccc31\testgit


Mode                LastWriteTime         Length Name
----                -------------         ------ ----
d--h--        6/11/2018   2:40 PM                .git


PS C:\Users\ccc31\testgit>
```

Figure A.17:

Appendix B

Poor Man's Console MVC

by Grzegorz Ziemonski,
Apr. 21, 2017,
Source: `https://dzone.com/articles/poor-mans-console-mvc`
Note: This implementation uses the Java programming language, not C#.

As MVC has gotten more muddled, it's important to remember that there should be a clear connection between controllers and concepts.

After two posts of pure theory about the MVC Pattern Language, I was looking to provide some practical examples. The technical part is easy everybody already knows how to implement that in various ways, but I couldnt figure out how to show the whole mental models part of it. In the end, I came up with what follows an MVC Pet Clinic in the console!

As we learned in the previous posts, on the idea level, MVC is most concerned with understanding the users way of thinking. Therefore, we wont jump straight into code here. Instead, well visit a real pet clinic on the outskirts of your town and watch our user at work.

B.1 She Ain't a Computer Lady

The clinic that hired you is actually a small office that consists of a few rooms, the most important being the visiting room. The old lady that runs the place has no computer at the moment and you keep wondering why does she want to pay so much money for dedicated software. After a while, you conclude that this is exactly the kind of person who needs a dedicated piece of software. If you tried to give her the Springs Pet Clinic and call it a day, she'd be totally lost in it. You need to create a habitable environment for her, as she'll be learning both using the computer and your program at the same time.

B.2 Gathering Requirements

Instead of acting like an idiot and asking the old lady for the requirements directly, you sit quietly and watch her work for a few hours. This gives you a pretty good idea of her workflow.

She keeps track of all her visits inside a calendar. When somebody calls to schedule a visit, she asks about the persons name, pet names and preferred visit time. Then, when both sides agree on the time of the visit, she notes it down in her calendar.

When the visit time comes, the old lady takes out pets files, which contain all important information about their health history. Then she takes care of the pet itself. Not much interesting stuff here. She makes the same youre so lovely face every time and solves all kinds of problems from a pet being actually sick to being moody and not wanting to play with its owner (sigh). After she finishes the care-taking stuff, she sits down and writes a short summary of the visit. The summary consists of two parts course and recommendations. She always writes down two copies one for the owner and one to put in the pets file.

B.3 Modeling the Domain

You tried talking to the woman about the veterinary domain but it seems that talking to her about abstract terms and relationships is as productive as talking with you about Malaysian poetry of the 19th century. Luckily, the concepts behind scheduling a visit seem easy enough to create the first prototype without creating an advanced domain model. You start off with something like this:

B.4 Whats in the Lady's Head?

As we said before, simply creating a CRUD for visits, pets, and owners is not enough. We want better than this. Therefore, we have to look for things that will make the user instantly familiar with our software; something that improves his workflow instead of completely turning it around. In the case of our vet lady, these things would be the visit calendar and the pet files.

The physical calendar that the lady uses looks like a big notebook in which every two pages represent a single week. When a visit is scheduled, she notes things down using a specific format: hour goes first, then the owners name and the pets in the end.

The pet files are cardboard folders containing all of the summaries from the previous visits and occasionally some other medical documentation. The old lady keeps them in a desks locker, sorted alphabetically so that she can find the right one faster when the visit starts.

B.5 Implementing a Visit Calendar

The visit calendar will become a business object in our system. Since there will be quite a lot console printing and input parsing, well separate it into the famous MVC triplet: model, view, and controller. This triplet should work together to give the lady a feeling that shes working with her old calendar, just that the calendar is now computerized. Therefore, well keep the weekly grouping of visits and allow her to switch the weeks like shed be flipping pages in her old calendar. Well also print the visit information in a format similar to the one she used in her old calendar. I did some basic implementation, lets take a look at it.

B.6 Controller

So far our controller recognizes three commands: next and previous, which change the calendars week, and add, which allows for adding a visit to the calendar:

Listing B.1: The Controller

```java
public class VisitCalendarController implements Controller {
    // field, c-tor
    public boolean execute(String command) {
        if ("next".equals(command)) {
            visitCalendar.nextWeek();
            return true;
        }
        if ("previous".equals(command)) {
            visitCalendar.previousWeek();
            return true;
        }
        if (command.startsWith("add")) {
            parseAdd(command);
            return true;
        }
        return false;
    }
    // parseAdd method
}
```

B.7 Model

The model is responsible for holding the information about the currently selected week and allows manipulating the underlying visits. By the means of changed() method, it lets the view know whenever something changes in the calendar:

Listing B.2: The Model

```
public class VisitCalendar extends Model {
    static final DayOfWeek[] OPEN_DAYS = {MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY, SATURDAY
        };
    private Week currentWeek;
    private Visits visits;
    // c-tor
    Week getCurrentWeek() {
        return currentWeek;
    }
    void nextWeek() {
        this.currentWeek = currentWeek.next();
        changed();
    }
    void previousWeek() {
        this.currentWeek = currentWeek.previous();
        changed();
    }
    List<Visit> visitsOn(DayOfWeek day) {
        return visits.on(currentWeek.get(day));
    }
    void addVisit(DayOfWeek dayOfWeek, LocalTime time, String ownerName, String[] petNames) {
        // stuff
        changed();
    }
}
```

B.8 View

The view displays weekly visits in a format similar to the one already used by the vet lady and accepts users commands:

Listing B.3: The View

```
public class VisitCalendarView implements View {
    // fields, c-tor
    public void modelChanged() {
        show();
    }
    public void show() {
        show(visitCalendar.getCurrentWeek());
        for (DayOfWeek day : VisitCalendar.OPEN_DAYS)
            show(day);
        askForCommand();
    }
    private void show(Week week) {
        System.out.println(week.getStart() + "␣-␣" + week.getEnd());
    }
    private void show(DayOfWeek day) {
        System.out.println(day + ":");
        show(visitCalendar.visitsOn(day));
    }
    private void show(List<Visit> visitsOnDay) {
        if (visitsOnDay.isEmpty()) {
            System.out.println("No␣visits!");
        } else {
            visitsOnDay.forEach(this::show);
        }
    }
    private void show(Visit visit) {
        System.out.println(visit.getTime() + ":␣" + visit.getOwnerName());
        System.out.println("Pets:␣" + visit.getPetNames());
    }
    private void askForCommand() {
        try (Scanner scanner = new Scanner(System.in)) {
            String command;
            do {
                command = scanner.nextLine();
            } while (!controller.execute(command));
        }
    }
}
```

B.9 Conclusion and Next Steps

Thats everything I did in this prototype so far. The whole source code is available here.[1] As you probably noticed, theres no technical rocket science in there and not even any new concept at the first glance. I think the most important thing about this example is that the user is communicating directly with the business objects. Shes not talking to some generic VisitController, which talks to some generic VisitService. Instead, were exposing her to communication with an object she already knows the VisitCalendar.

In the next post, I'll try to move our visit calendar to the web and we'll see how the concept of business objects plays with so-called Web MVC frameworks like Spring MVC. If I have enough time (which is unlikely, but possible), I'll try to add the second business object to the system the pet files. Obviously, if someone from the readership wants to try their strengths in doing that, pull requests are welcome!

[1] https://github.com/tidyjava/console-mvc-pet-clinic

Last note

The last word.