

Software Engineering

CS305, Autumn 2020

Week 2

Last Week...

- Software Engineering Overview
 - What is it? Why needed? How to manage complexity?
 - Different software process models
 - How to choose a model? factors to consider
 - Tools for developer productivity

Git

- Version Control System
 - Manage versions of your code – access to different versions when needed
 - Lets you collaborate
- ‘Repository’ – term used to represent storage
 - *Local* and *Remote* Repository



Remote



Local

Your desktop,
laptop, server

Git – Creating Repositories

- Two ways:
 1. 'Clone' / Download an existing repository from GitHub
 2. Create local repository first and then make it available on GitHub

git clone for creating local working copy

- ‘Clone’ / Download an existing repository from GitHub – get your own copy of source code
 - git clone (when a remote repository on GitHub.com exists)

```
nikhilh@ndhpc01:~$ git clone git@github.com:IITDhCSE/dem0.git
Cloning into 'dem0' ...
remote: Enumerating objects: 3, done.
remote: Counting objects: 100% (3/3), done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
Receiving objects: 100% (3/3), done.
nikhilh@ndhpc01:~$
```

Git init for initializing local repository

– Create local repository first and then make it available on GitHub

1. `git init` - converts a directory to Git local repo

```
nikhilh@ndhpc01:~$ mkdir dem0
nikhilh@ndhpc01:~$ cd dem0/
nikhilh@ndhpc01:~/dem0$ git init
Initialized empty Git repository in /home/nikhilh/dem0/.git/
nikhilh@ndhpc01:~/dem0$ ls -a
.  ..  .git
```

git add for staging files

2. `git add` – ‘stage’ a file i.e. prepare for saving the file on local repository

```
nikhilh@ndhpc01:~$ ls -a dem0/  
.  ..  README  
nikhilh@ndhpc01:~$ cd dem0/  
nikhilh@ndhpc01:~/dem0$ git init  
Initialized empty Git repository in /home/nikhilh/dem0/.git/  
nikhilh@ndhpc01:~/dem0$ git add README
```

Note that creating a file, say, README2 in dem0 directory does not *automatically* make it part of the local repository

git commit for saving changes in local repository

3. `git commit` - 'commit' changes i.e. save all the changes (adding a new file in this example) in the local repository

```
nikhilh@ndhpc01:~/dem0$ git commit -m "Saving the README file in local repo."  
[master (root-commit) 99d0a63] Saving the README file in local repo.  
1 file changed, 1 insertion(+)  
create mode 100644 README
```

How to save changes done when you must overwrite an existing file?

4. `git branch -M master` – rename the current as 'master' (-M for force rename even if a branch by that name already exists)

```
nikhilh@ndhpc01:~/dem0$ git branch -M master
```

5. git remote add origin

`git@github.com:IITDhCSE/dem0.git` - prepare the local repository to be managed as a tracked repository

```
nikhilh@ndhpc01:~/dem0$ git remote add origin git@github.com:IITDhCSE/dem0.git
```

command to manage remote repo.

associates a name 'origin' with the remote repo's URL

The URL of the repository on GitHub.com.

- This URL can be that of any other user's or server's address.
- uses SSH protocol
 - HTTP protocol is an alternative. Looks like:
`https://github.com/IITDhCSE/dem0.git`

git push for saving changes in remote repo

6. `git push -u origin master` – ‘push’ or save all the changes done to the ‘master’ branch in local repo to remote repo. *(necessary for guarding against deletes to local repository)*

```
nikhilh@ndhpc01:~/dem0$ git push -u origin master
Enumerating objects: 3, done.
Counting objects: 100% (3/3), done.
Delta compression using up to 12 threads
Compressing objects: 100% (2/2), done.
Writing objects: 100% (3/3), 284 bytes | 47.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0)
To github.com:IITDhCSE/dem0.git
 * [new branch]      master -> master
Branch 'master' set up to track remote branch 'master' from 'origin'.
```

syntax: `git push <remotename> <branchname>`

what does the `-u` option do?

Git – Releasing Code

– Tagging

- Check for unsaved changes in local repository.

```
nikhilh@ndhpc01:~/dem0$ git status .
On branch master
Your branch is up to date with 'origin/master'.

nothing to commit, working tree clean
```

- Create a tag and associate a comment with that tag

```
nikhilh@ndhpc01:~/dem0$ git tag -a VERSION1 -m "Release version 1 implements feature XYZ"
```

- Save tags in remote repository

```
nikhilh@ndhpc01:~/dem0$ git push --tags
Enumerating objects: 1, done.
Counting objects: 100% (1/1), done.
Writing objects: 100% (1/1), 191 bytes | 95.00 KiB/s, done.
Total 1 (delta 0), reused 0 (delta 0)
To github.com:IITDhCSE/dem0.git
 * [new tag]          VERSION1 -> VERSION1
```

Git – Recap..

- Please read <https://git-scm.com/book/en/v2> for details

1. `git clone` (creating a local working copy)
2. `git add` (staging the modified local copy)
3. `git commit` (saving local working copy)
4. `git push` (saving to remote repository)
5. `git tag` (Naming the release with a label)
6. `git push --tags` (saving the label to remote)

Requirements Engineering

- Why Engineering?

Requirements Engineering – Recall..

- Establish stakeholders' needs that are to be satisfied by the software
- Why Important?
 - Cost of correcting errors
 - Grows exponentially as we move to maintenance phase
- How to get it right?
 - Elicit, Analyze, Specify, Validate, Manage - *Iterate*

Requirements Engineering (RE)

Understanding purpose is important to meet *quality*
– *fitness for purpose*

Not a stage / phase

Requirements Engineering (RE) is a set of activities concerned with identifying and communicating the purpose of a software-intensive system, and the contexts in which it will be used. Hence, RE acts as the bridge between the real-world needs of users, customers, and other constituencies affected by a software system, and the capabilities and opportunities afforded by software-intensive technologies

How and where the system will be used?

Software + (context + hardware)
often taken for granted

Communicating is as important as analysis

Identify what is possible..

Identify all parties involved – not just customer, user

Identify what is needed?

Purpose

- Software is designed for a purpose
 - If it doesn't work well then either:
 - the designer didn't understand the purpose well
 - or the software is used for a purpose different from the intended one
 - or the development team is incompetent
 - The purpose is often complex:
 - Many different kinds of people and activities
 - Conflicting interests among them
 - The purpose is found in human activities
 - E.g. Purpose of a banking system comes from the business activities of banks and the needs of their customers
- *Identifying purpose is part of RE*

*Inadequate understanding of the purpose leads to poor **quality** software*

Quality

- Quality is determining software's fitness for purpose

$f(\text{software}, \text{purpose})$

Function of software and purpose

Communicate

- Proactively communicate with customer to discover their *needs*
- Communicate system description to stakeholders
 - users, customers, developers, *constituencies*
 - Formal:
 - Shall statements, document templates, state transition diagrams, detailed mathematical specification
 - Informal:
 - User stories, use cases
- *Developing requirements document is part of RE*

Stakeholders

- Another team, a client, user, developer, all affected by the software (constituencies) are stakeholders
- *Identifying stakeholders is part of RE*
- *Identifying their needs is part of RE*

Software Intensive System

- A Software Intensive System consists of software + hardware + context
 - E.g. In a bank ATM service, the customer interacts with the ATM machine through the software, which runs on the hardware, and the context is the banking system.
- Often hardware and context are ignored
 - leads to poor quality software
- *Identifying context (when and how the software will be used) is part of RE*

Constraints, Capabilities, and Opportunities

- Different stakeholders might have conflicting needs
- Irrelevant needs identified may create inconsistencies
- *Identify the constraints to know what is possible and what expertise is needed – part of RE*

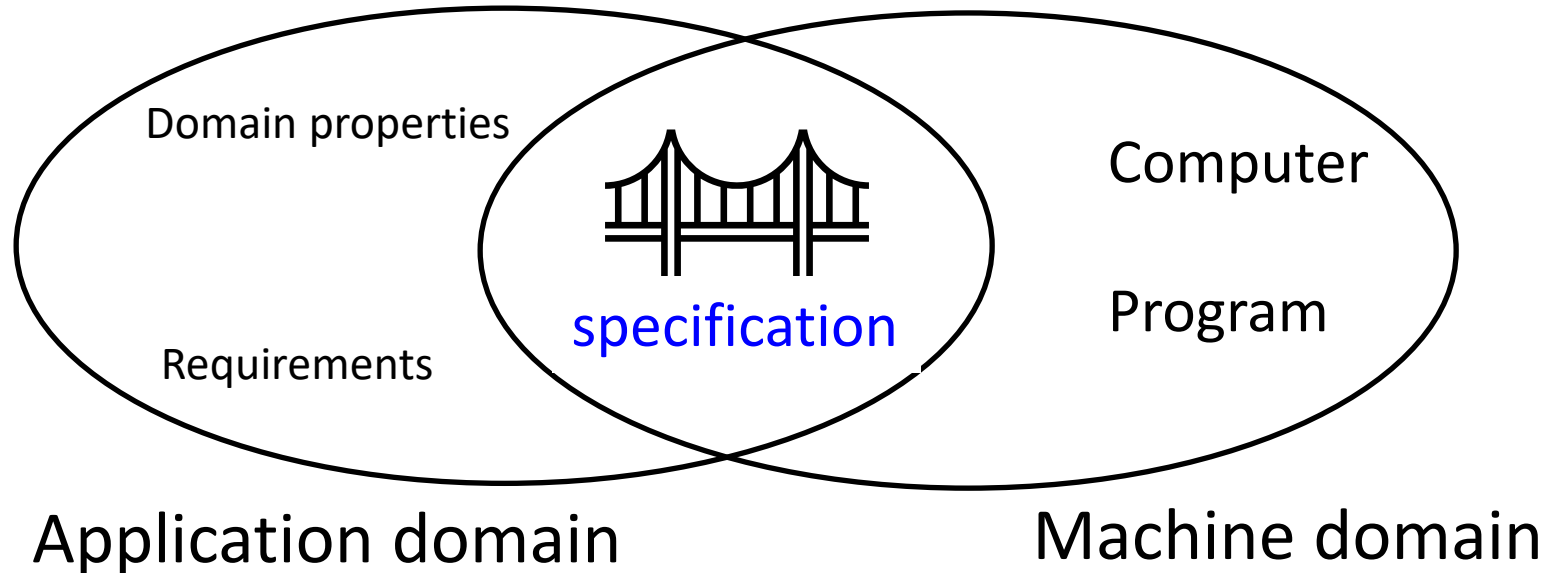
Requirements Engineering - Tasks

- Establishing the services that the customer requires from the system and the constraints under which it operates and is developed
 1. *Identify stakeholders and their needs*
 2. *Identify purpose*
 3. *Identify constraints and capabilities*
 4. *Identify context*
 5. *Develop a software specification*

Requirements

- Property of the system
- System analyst and the customer together generate it
- Should focus on **what** and not **how**
 - What the system is supposed to do?
 - ~~How the system is supposed to do?~~
 - May include what the system is not supposed to do
 - Should include error handling (and/or recovery) methods

Requirements - where do they come from?



Specification captures properties that are observable in both domains

Requirements - types

- Two types: functional and non-functional
 - Functional Requirements
 - What the system must do w.r.t. a set of computations
 - E.g. press a button to turn on the light
 - Non-functional Requirements
 - About quality, security, interoperability, cost, performance etc.
 - How do we check if the software satisfies a non-functional requirements?

Requirements - types

- Another distinction: user and system
 - User Requirements
 - Written for customers in a non-technical language
 - System Requirements
 - Written for developers in a formal language. Developers must be able to build a system based on these requirements
- Both user and system requirements must be defined

Properties of a Requirement

- Should be simple
- Should be testable
- Should be organized
 - Related requirements are grouped
 - Priorities indicated (mandatory, nice-to-have, superfluous)
- Should be *traceable*

Traceability

- Is the [link](#) between requirements, their sources, and the system design
- Source traceability
 - Requirement -> stakeholders who proposed these requirements
- Requirements traceability
 - Requirement -> dependent requirement(s)
- Design traceability
 - Requirement -> design

Requirements Specification Document

- End goal: **complete** and **pertinent**
- Serves dual purposes:
 - Is the contract
 - Can be used to bid for contract