Software Design Primer

The SDLC

- Software Design Life Cycle
  - Requirements (elicitation and specification)
  - Design
  - Construction
  - Testing
  - Maintenance

Requirements

- Functional
  - What the software must do
  - Testable
- Non-functional
  - Constraints or quality requirements
  - Types: performance, maintainability, safety, reliability, security, interoperability, …
- Quantifiable
  - avoid vague requirements – use quantitative where appropriate

SWEBOK v3 Chapter 1, Section 1

Requirements

- Elicitation techniques
  - Interviews, scenarios, prototypes, facilitated meetings, observation, user stories

Design

- “the process of defining the architecture, components, interfaces, and other characteristics or a system or component” *ISO/IEC/IEEE 24765:2010 Systems and software engineering – Vocabulary*
- Two activities
  - Architectural design: top-level structure and identifies components
  - Detailed design: enough detail to build each component
- Key issues
  - Concurrency, event handling, data persistence, component distribution across hardware, exception handling and fault tolerance, interaction with users, security (authorization, attacks, cryptography)

SWEBOK v3 Chapter 2, Sections 1,2

Design

- UI design
  - Principles: learnability, familiarity, consistency, low surprise, recoverability, user guidance, user diversity
  - Modalities: question-answer, direct manipulation, menu selection, form fill-in, command language, natural language
- Design notations
  - Structural: class and object diagrams, entity-relationship diagrams, …
  - Behavioural: DFDs, flowcharts, state charts, …
  - Strategies: function-oriented, object-oriented, component-based, …

SWEBOK v3 Chapter 2, Sections 4,6

Construction

- Fundamentals
    - Minimize complexity, anticipate change, construct for verification, reuse, standards
- Test-driven development
    - Writing test cases before writing code
- Tools
    - IDEs, GUI builders, test frameworks, profiling

SWEBOK v3 Chapter 3, Sections 1,5

Testing

- Levels
  - Unit, integration, system
- Objectives
  - Acceptance, regression, performance, security, stress, recovery, usability

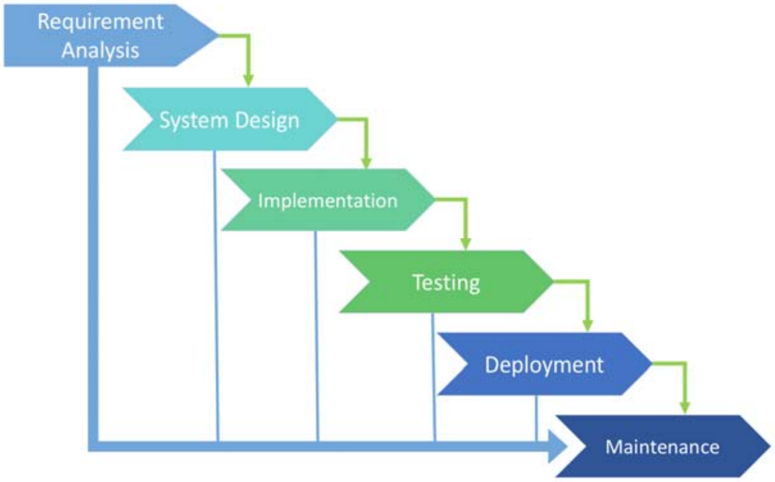
SWEBOK v3 Chapter 4, Section 2

Maintenance

- Needed to
  - Correct faults
  - Improve design
  - Implement enhancements
  - Interface to new systems
  - Migration
  - Retirement

SWEBOK v3 Chapter 5, Section 1

SDLC Processes: Waterfall

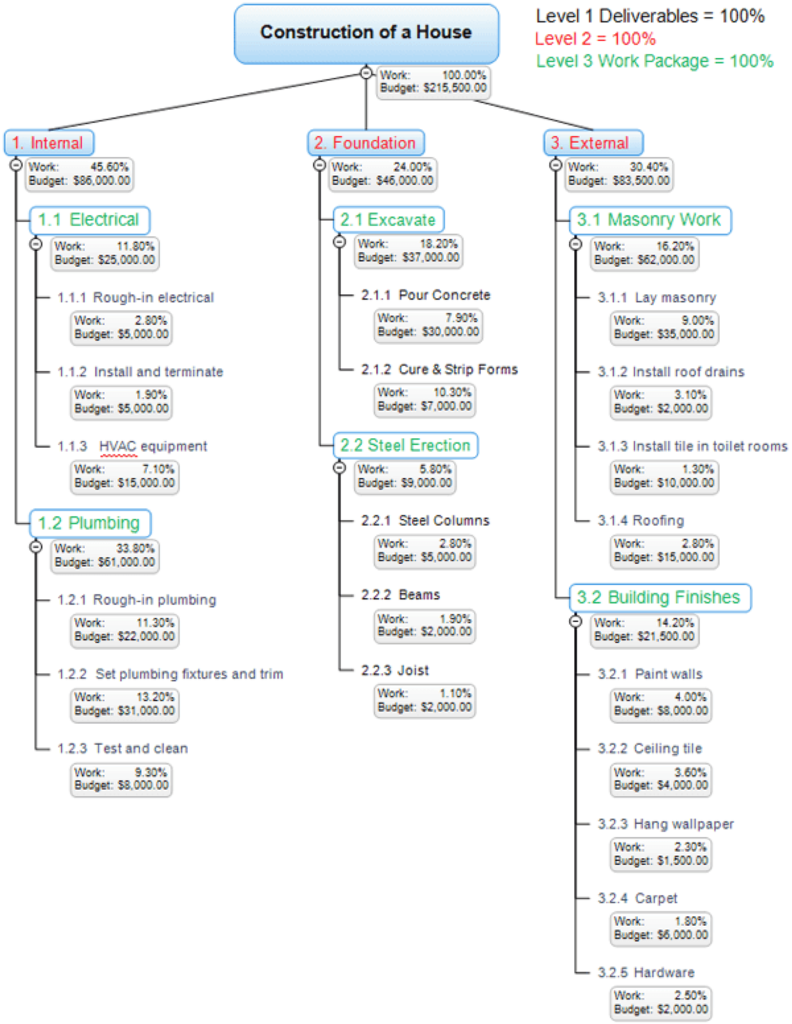


https://existek.com/blog/sdlc-models/

- One stage finishes before next starts
- Requires stable, comprehensive requirements
  - A late change in requirements requires revisiting all stages
- Heavy on documentation
- System testing happens late
- Appropriate for safety-critical applications

SDLC Processes: Waterfall

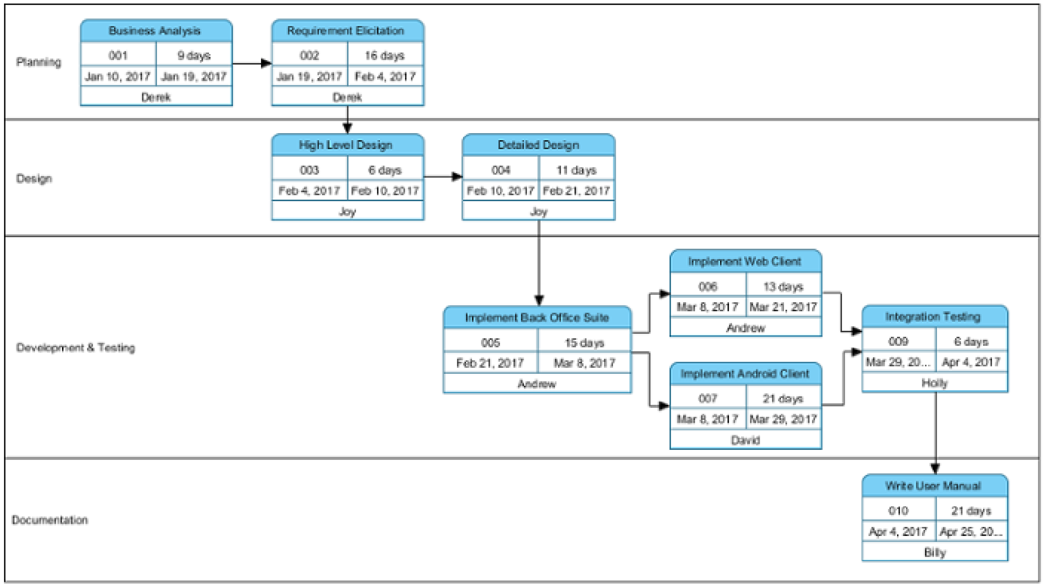
- Lends itself to structured project planning
  - *Work Breakdown Structures (WBS)*
    - 100% rule



https://www.workbreakdownstructure.com/img-content/work-breakdown-structure-example.png

SDLC Processes: Waterfall

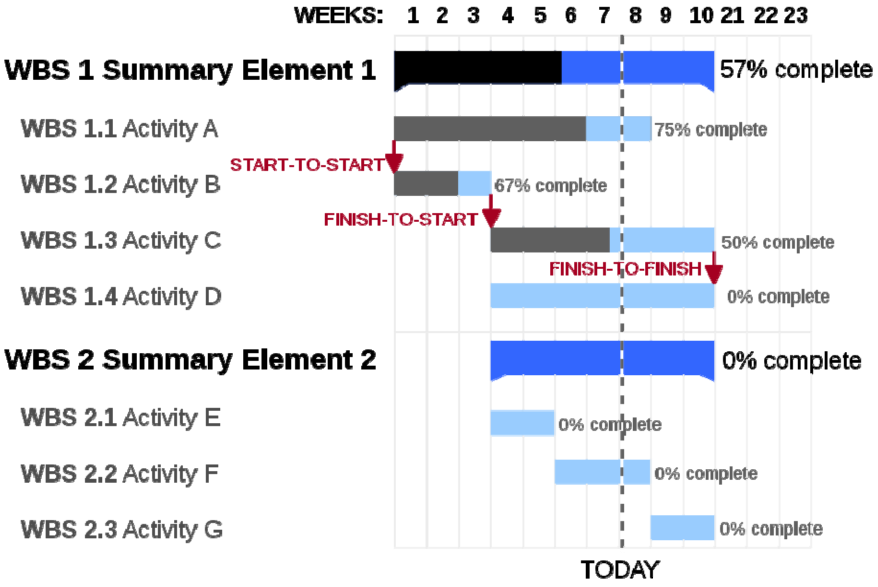
- Lends itself to structured project planning
    - Work Breakdown Structures (WBS)
        - 100% rule
    - *PERT schedule analysis*
        - Nodes connected by dependencies
        - Earliest start times calculated starting a nodes with no predecessors
        - Latest finish times back-propagated from nodes with no successors
        - Identify critical path and slack



https://www.visual-paradigm.com/support/documents/vpuserguide/4370/4373/86388_drawingapert.html

SDLC Processes: Waterfall

- Lends itself to structured project planning
  - Work Breakdown Structures (WBS)
    - 100% rule
  - PERT schedule analysis
    - Identify critical path and slack
  - *Gantt chart*
    - Graph project timeline and track progress
- Can do all this with Microsoft Project (free download)

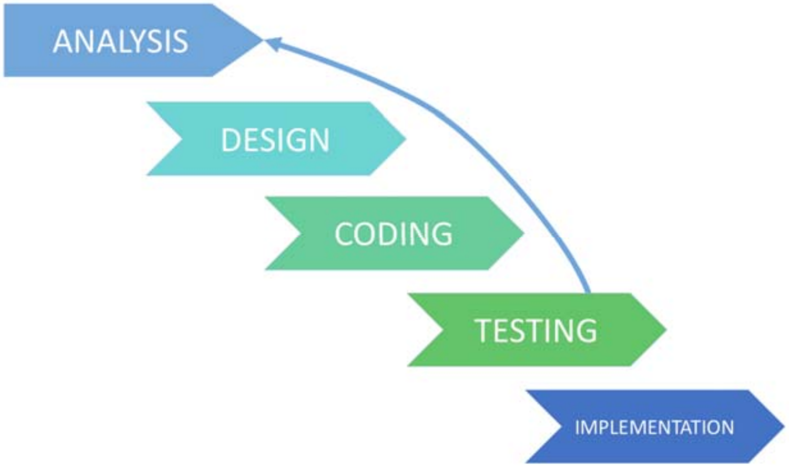


By GanttChartAnatomy.png: Original uploader was Garrybooker at en.wikipediaLater versions were uploaded by Abdull at en.wikipedia.derivative work: Malyszkz (talk) - GanttChartAnatomy.png, Public Domain, https://commons.wikimedia.org/w/index.php?curid=15018988

SDLC Processes: Agile

- https://dzone.com/articles/3-styles-agile-iterative
  1. Iterative
  2. Incremental
  3. Evolutionary

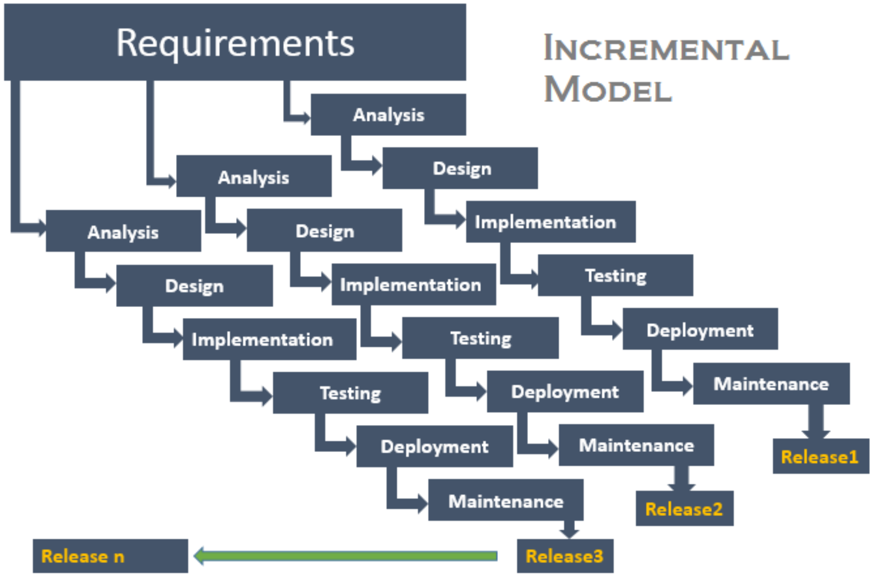
SDLC Processes: Agile - Iterative



https://existek.com/blog/sdlc-models/

- Requirements may all be known a priori but they are added in stages
  - New requirements are added each iteration
  - High priority / high risk requirements are added early
- Useful for big corporations, banks

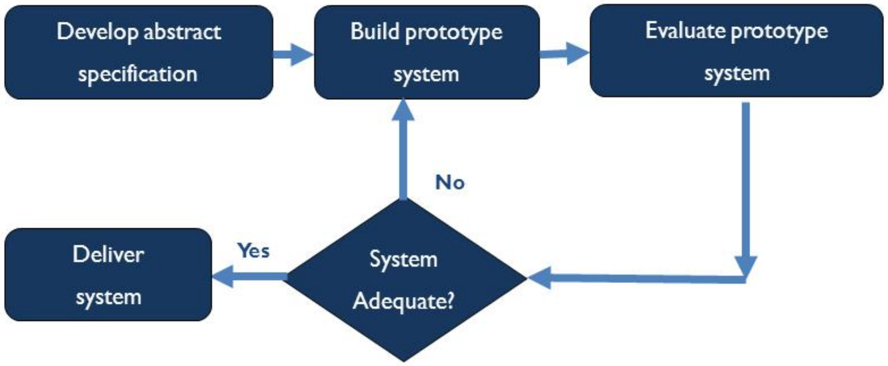
SDLC Processes: Agile - Incremental



http://testingfreak.com/incremental-model-software-testing-advantages-disadvantages-incremental-model/

- Similar to iterative but each increment is released to customer for feedback

SDLC Processes: Agile - Evolutionary



http://crackmba.com/wp-content/uploads/2012/02/Evalutionalry-prototype.jpg

- No requirements document
  - Start with a goal – single sentence or paragraph
- Prototypes are shown to customers for feedback
- Common in start-ups

Wireframing

- Designing an apps navigation and user interface
  - Ranges from paper prototype to interactive prototype
- Paper prototyping
  - Can be made interactive e.g. marvelapp.com
- Opensource GUI prototyping software
  - pencil.evolus.vn
- Useful for early customer feedback

Tools used in F18/W19

- user stories,issue tracking - PivotalTracker
  - Only 30 days free
- interface design - Figma
- frontend – ReactJs, ReactNative, Flutter
- backend – Firebase
- version control – github.com, git.uwaterloo.ca

AWS credits

- One student per team fill out https://forms.gle/quPQaXzApuzbkGLD6
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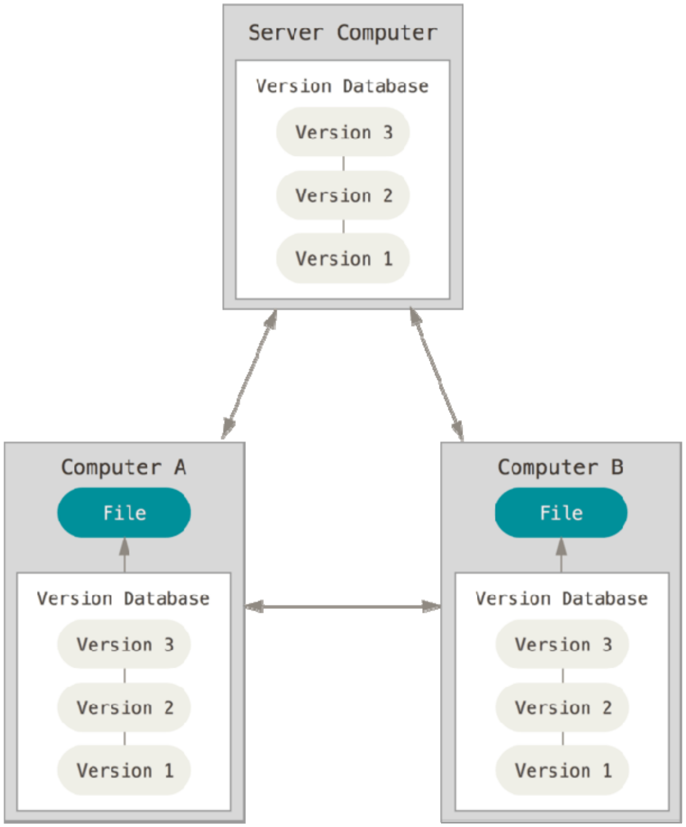
Git

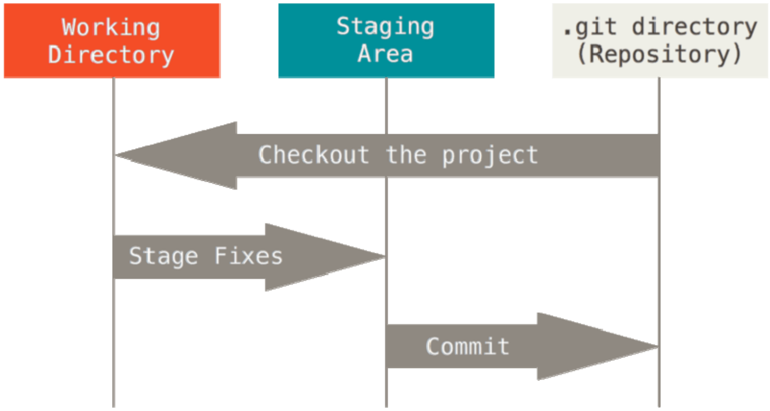
- Documentation
  - https://git-scm.com/doc
- Distributed version control
  - Clients mirror the repo



https://git-scm.com/book/en/v2/images/distributed.png

Git

- Clone – makes a local copy of the repository
  - git clone repoURL
- Edit – modify files in working tree
- Selectively add changes for next comment
  - git add .   (changes in current dir)
  - git add -A (changes throughout tree)
- Commit to Git directory
  - git commit -m “my changes”



https://git-scm.com/book/en/v2/images/areas.png

Git

- Checking changes
  - git status
  - git diff (only shows unstaged changes)
- Reverting an unstaged change
  - git checkout modified_filename
- Reverting a staged change
  - git reset HEAD staged_filename

Git

- See remote server (often called origin)
  - git remote
- Fetch all data from remote project
  - git fetch

Git

- Use branches to add features, fix bugs
- Branches
  - git branch branchname (creates local branch)
  - git checkout branchname
  - git checkout master (switch to master branch)
  - git pull (get updates from remote)
  - git merge branchname (merge branch changes into master)
  - git branch -d branchname (delete branch)
  - git push origin branchname (push to server)
  - git push (push changes to remote)

Git

- Pull requests
  - Fork a repo
  - Edit your copy and push to your remote master
  - Issue pull request to original repo
  - Owner can choose to pull changes into their repo