# CS 4530: Fundamentals of Software Engineering
# Module 1.2: Requirements and User Stories

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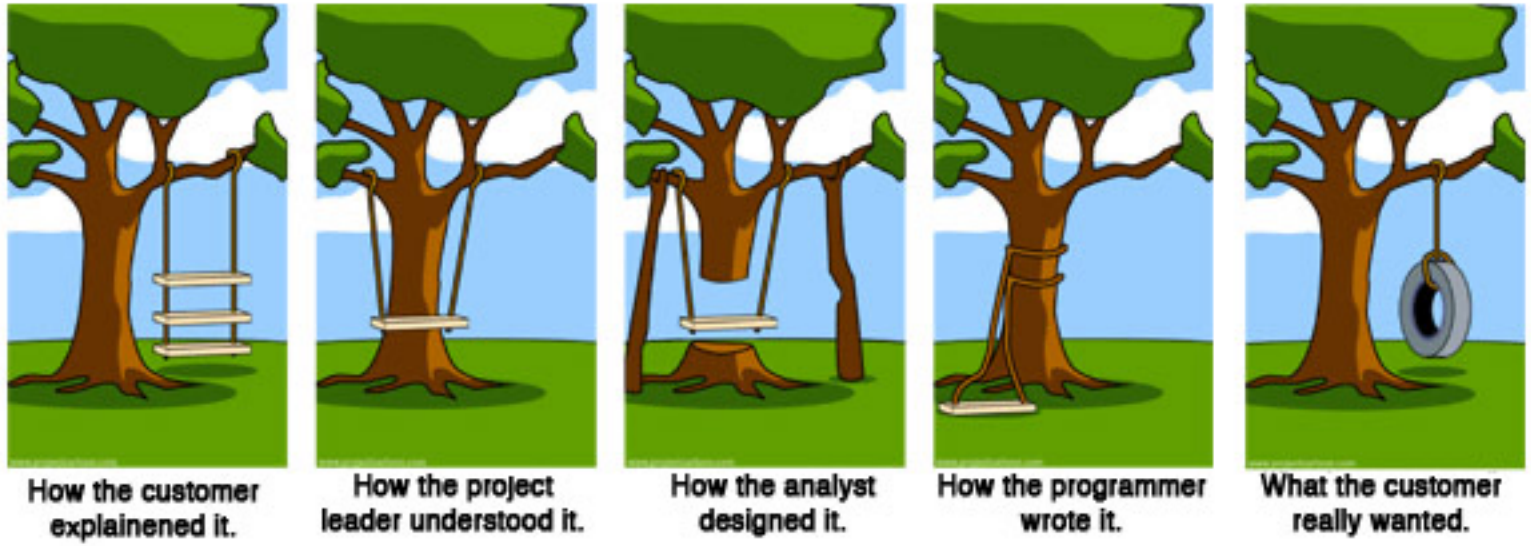
# Learning Goals for this Lesson

- At the end of this lesson, you should be able to
  - Appreciate the requirements analysis process. This includes being able to:
    - explain the overall purposes of requirements analysis.
    - enumerate and explain 3 major dimensions of risk in Requirements Analysis.
  - Learn requirements specification tools. This includes being able to:
    - document requirements user stories.
    - track the completion of requirements using conditions of satisfaction.
    - explain the difference between functional and non-functional requirements.
  - Understand requirements gathering methods. This includes being able to:
    - describe Value Sensitive Design (VSD).
    - understand how VSD is applied to reason about requirements.
    - integrate VSD with user stories.

# Overall question:
# How to make sure we are building the right thing




Requirements Analysis

Planning & Design

Implementation

# Why is requirements analysis hard?

## Problems of understanding

Do users know what they want?

Do users know what we don't know?

Do we know who are users even are?

## Problems of scope

What are we building?

What non-functional quality attributes are included?

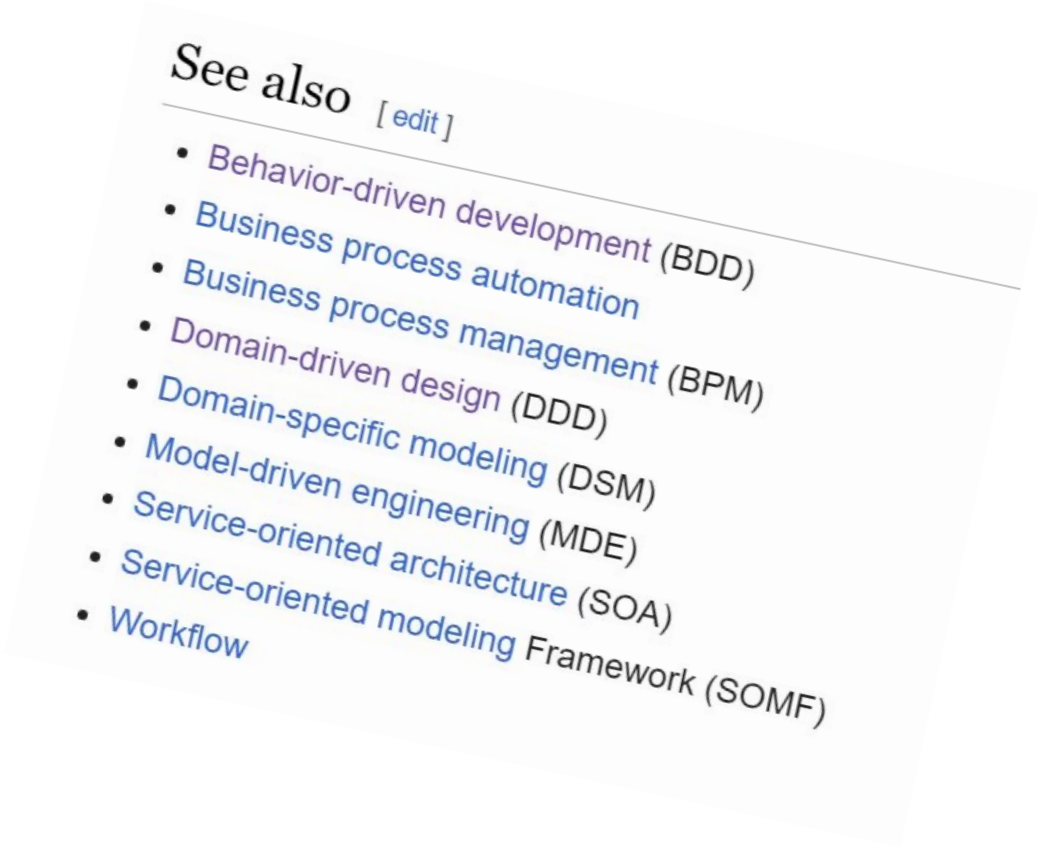
## Problems of volatility

Changing requirements over time



# How do we capture the requirements?

- There are many methodologies for this.
- Often described as $x$-Driven Design (for some $x$)
- They differ in scope & details, but they have many features in common.


See also [edit]

- Behavior-driven development (BDD)
- Business process automation
- Business process management (BPM)
- Domain-driven design (DDD)
- Domain-specific modeling (DSM)
- Model-driven engineering (MDE)
- Service-oriented architecture (SOA)
- Service-oriented modeling Framework (SOMF)
- Workflow

# Common Elements

1. Meet with stakeholders
2. Develop a common language
3. Collect desired system behaviors
4. Document the desired behaviors
5. Iterate and refine!!

# Different Methodologies Produce Different Forms of documentation

TDD: executable tests

BDD: "scenarios"

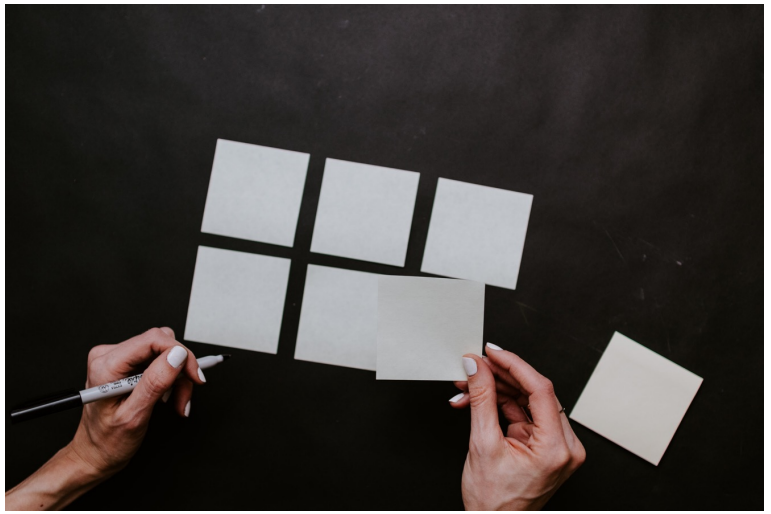
DDD: an OO architecture

# We'll use a least-common-denominator approach: user stories

# User Stories document requirements from a *user's* point of view

*As a <role> I want*
*<some capability>*
*so that I can <get some benefit>*

User stories specify what should happen, for whom, and why



# Properties of a user story

- short: fits on a 3x5 card
- may have prerequisites
- has *conditions of satisfaction* that expand on the details
- has a priority
- satisfies the INVEST criteria (more on this later)

# Examples:

- As a online blackjack player, I want a game of blackjack implemented so that I can play blackjack with other users. (Essential)
- As a citizen, I want to be able to report potholes so that the town can do something about them. (Essential)
- As a College Administrator, I want a database to keep track of students, the courses they have taken, and the grades they received in those courses, so that I can advise them on their studies. (Essential)

# Conditions of Satisfaction fill in details of the desired behavior

- Each condition of satisfaction
  - Describes a testable behavior, from the user's point of view
  - Must have a priority
  - Should be numbered within its user story

# Examples

- 1.1 There should be an accessible blackjack table (Essential)
- 1.2 A user can initiate a game of blackjack (Essential)
- 1.3 Users can enter a blackjack table as a player if no other player is currently occupying the slot (Essential)
- 1.4 Players can successfully hit (take a card) each turn (Essential)
- 1.5 Players can successfully stand (refrain from taking a card) each turn (Essential)
- 1.6 Players successfully win if the dealer goes above 21 before me (Essential)

# Priorities

- **Essential** means the project is useless without it.
- **Desirable** means the project is less usable without it, but is still usable.
- **Extension** describes a user story or COS that is may not be achievable within the scope of the project. These might be things you'd want "in the next version".

# Minimum Viable Product

- The set of essential user stories constitutes the minimum viable product (MVP)
- A user story is "implemented " when all its essential COSs are implemented.
- Caution: when proposing a project, don't make your MVP too hard to complete (but don't make it too easy, either)

# The MVP and Your Project Grade

- On your project, you will get 200 points (out of a total of 400) for code submission:
  - MVP (all essential user stories and their essential COSs delivered): 100 points
  - Extra features (desirable and/or optional features): 50 points
  - Testing: 50 points
- SO: be realistic about what you call "essential" ☺

# Yet another example: a University Transcript database

# User Story

- As a College Administrator, I want a database to keep track of students, the courses they have taken, and the grades they received in those courses, so that I can advise them on their studies.

# Satisfaction Conditions

The database should allow me to:

1. Add a new student to the database
2. Add a new student with the same name as an existing student.
3. Retrieve the transcript for a student
4. Delete a student from the database
5. Add a new grade for an existing student
6. Find out the grade that a student got in a course that they took

# Non-Functional Requirements capture the *quality goals* of the system:

- As developers, we often spend most of our time and effort on features (i.e., functional requirements).
- But there is more ….
- What other properties might a customer want to know about the product?
  - How quickly can a transcript be retrieval? (Performance)
  - How many student transcripts can our system store? (Scalability)
  - How long did I spend on the phone with support to set up the software? (Usability)
  - After my system is setup, is the access controlled at all? (Security)
  - Are these any times when I can't use this system? (Availability)

# Example:

- “With a 4-core server and 16 GB RAM, the system should be able to service at least 200 simultaneous clients with less than 300ms latency”

# Other non-functional requirements

- Accessibility
- Availability
- Capacity
- Efficiency
- Performance
- Privacy
- Response Time
- Security
- Supportability
- Usability

# Still more non-functional requirements

- Qualities that reflect the evolution of the system
  - Testability
  - Maintainability
  - Extensibility
  - Scalability

# Writing User Stories: INVEST

- Independent
- Negotiable
- Valuable (has value to client)
- Estimable (able to estimate development effort)
- Small
- Testable

As a <role> I want <capability> so that I can <get some benefit>

# Value Sensitive Design (VSD) is an ethical Framework to gather requirements

- Until now we have learned about the methods to document requirements – user stories and conditions of satisfaction.
- But how do we come up with requirements in the first place?
  - One approach is to use an ethical framework called Value Sensitive Design (VSD) to systematically help us reason about the several design choices that go into coming up with requirements.
- But, why VSD?
  - Design choices made during developing software (or any technology) often implicate human values!
  - Ignoring values in the requirements and design process is **irresponsible**.

# Value Sensitive Design (VSD) in Brief

VSD is a(n) . . .

**Outlook** for seeing the values in technology design

**Process** for making value-based choices within design

- Combines **empirical**, **value**, and **technical** investigations
- Design solutions that incorporate the values held by **stakeholders**
- Considers problems and solutions from **diverse perspectives**

VSD is not . . .

A moral framework or system of ethics

- It does not prescribe decisions to make
- It incorporates values reflections in the choosing process

It is not an algorithm for making decisions

- Often, there are no easy answers
- Takes sustained commitment

# Motivating Example – Informed Consent

## Empirical Investigation:

- Understand what we mean by informed consent, encompasses:
  - Disclosure. Do we know the pros and cons of taking an action?
  - Comprehension. Do we understand the disclosures?
  - Voluntariness. Is there coercion or manipulation?
  - Agreement. Is there a clear opportunity to consent or not?
  - Competence. Are we capable to give consent?

## Values Investigation:

- Who are the direct and indirect stakeholders?
- Do the stakeholders have conflicting values?
- How can we resolve them?

## Technical Investigation:

- What are the technical mechanisms for implementing informed consent.
  - One way => cookie consent management system.
  - Websites use them to obtain and manage user permission for using cookies.

# Integrating User Stories With VSD

Stakeholders identified:

- Site users
- Site owners

Values identified:

- Privacy
- Accountability
- Transparency

User Story Examples:

❖ As a Stack Overflow user, I want to clearly understand what personal data Stack Overflow collects through cookies and control which cookies are set so that I can make an informed choice about my privacy while still accessing the programming help I need. (Essential)

❖ As a Stack Overflow site owner, I want to implement transparent cookie consent processes that comply with regulations while maintaining user engagement so that I can build user trust, avoid legal penalties, and sustain my business model without losing essential functionality. (Essential)

# Conditions of Satisfaction (Informed Consent)

## User Story and COS:

- As a Stack Overflow user, I want to clearly understand what personal data Stack Overflow collects through cookies and control which cookies are set so that I can make an informed choice about my privacy while still accessing the programming help I need. (Essential)
  - The system should display a clear cookie banner explaining what personal data is collected before any cookies are set (Essential)
  - Users should be able to access granular cookie controls to accept/reject specific categories (functional, analytics, advertising, personalization) (Desirable)
  - The system should provide a “privacy dashboard” showing what data has been collected about the user over time (Extension)

## User Story and COS:

- As a Stack Overflow site owner, I want to implement transparent cookie consent processes that comply with regulations while maintaining user engagement so that I can build user trust, avoid legal penalties, and sustain my business model without losing essential functionality. (Essential)
  - Cookie data containing personal information should be encrypted both in transit and at rest to prevent unauthorized access. (Essential)
  - The system should automatically expire cookies based on predefined retention periods. (Essential)
  - The system should allow users to read and search posts even if they reject data collection on cookies. (Desirable)
  - The platform should implement automated data retention policies that permanently delete expired cookie data. (Extension)

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