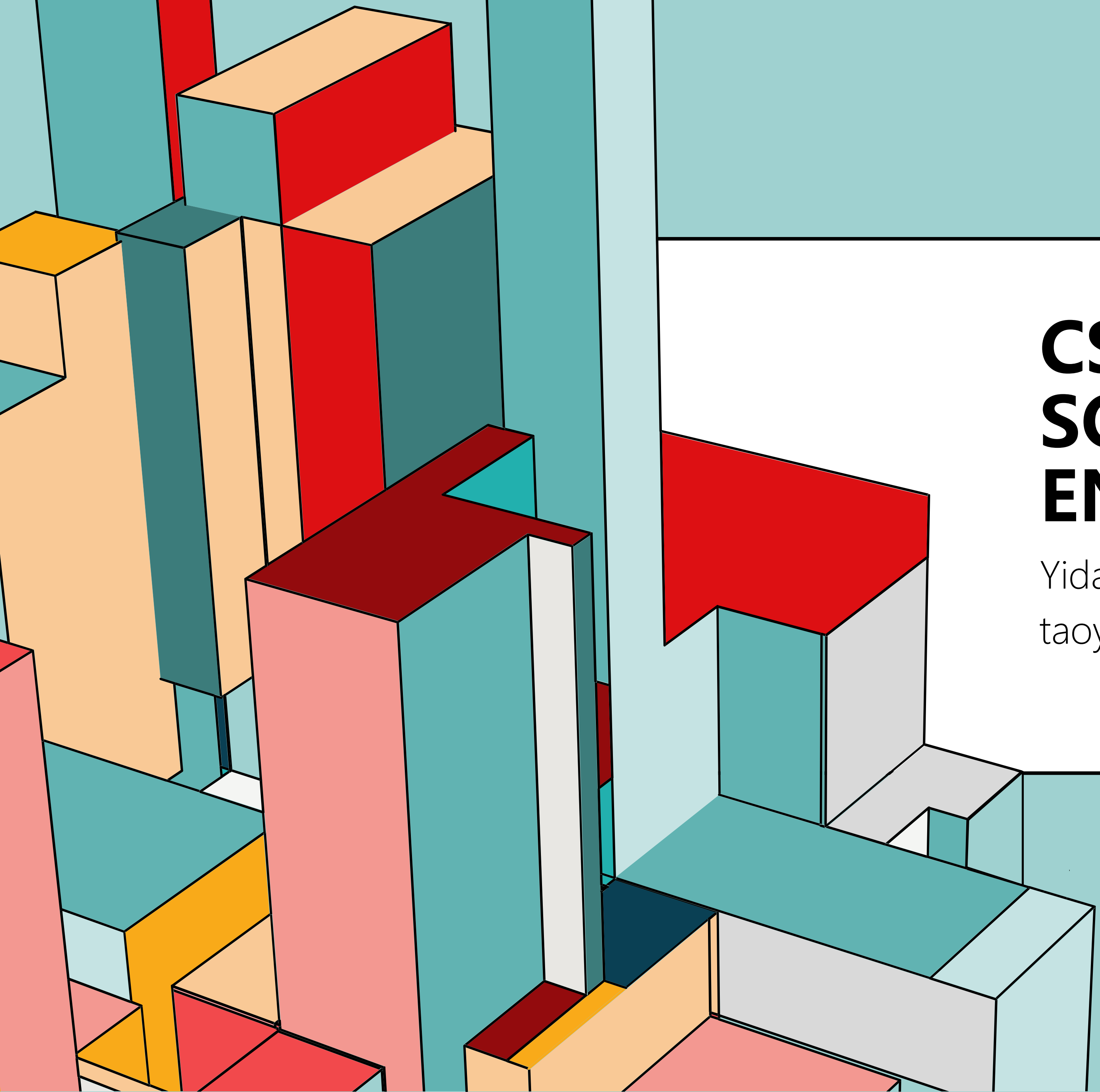

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CS304 SOFTWARE ENGINEERING

Yida Tao
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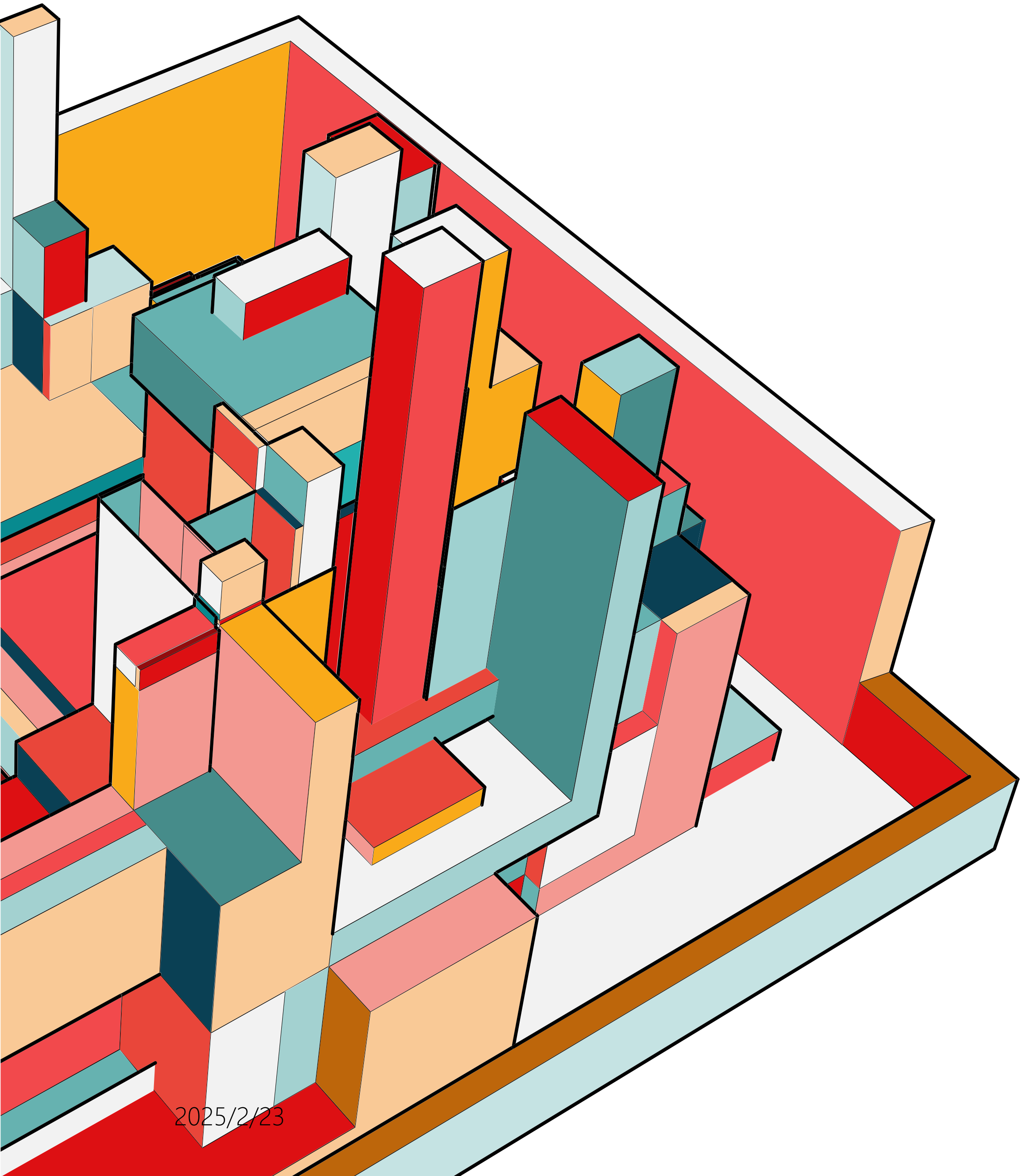
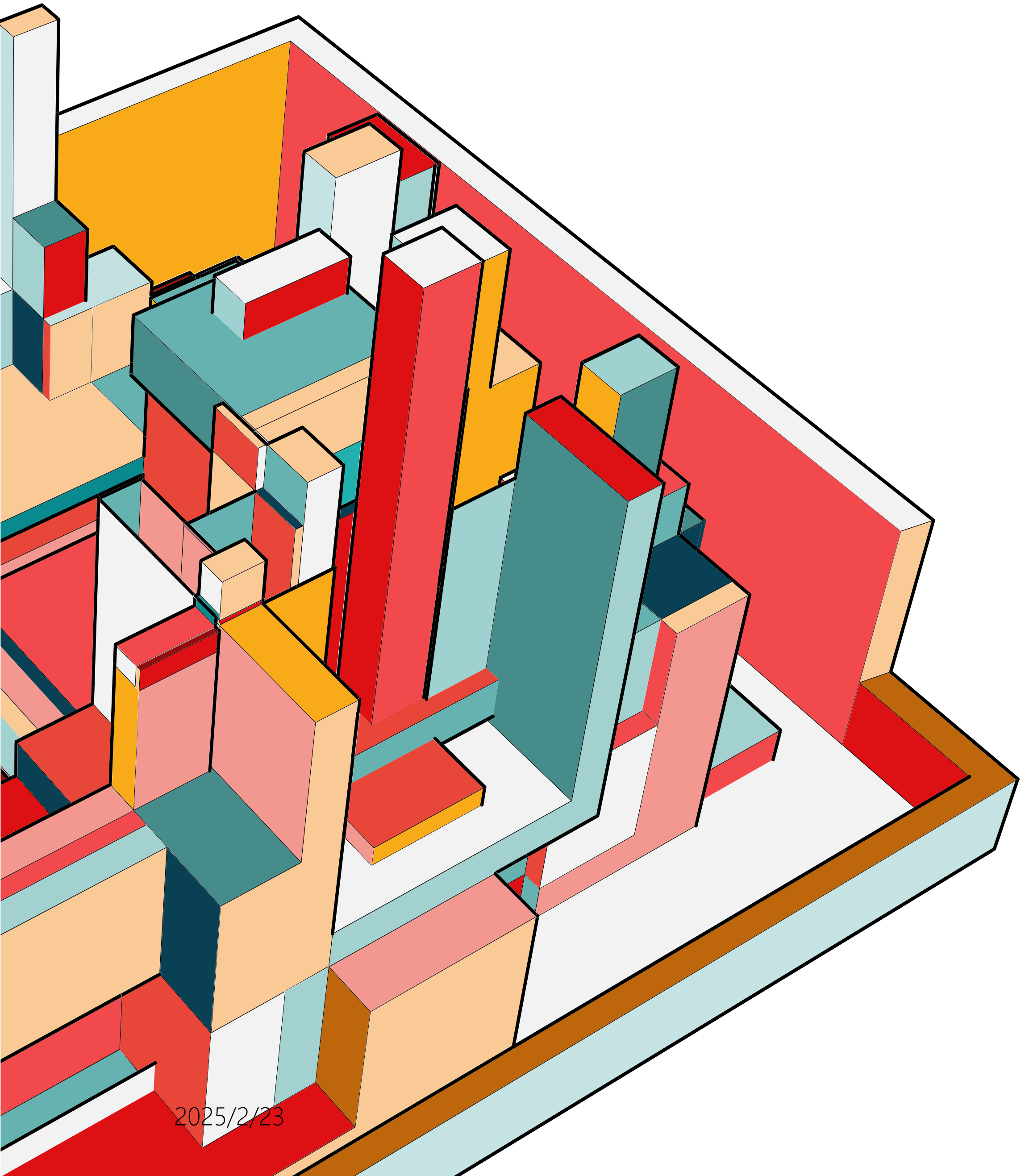


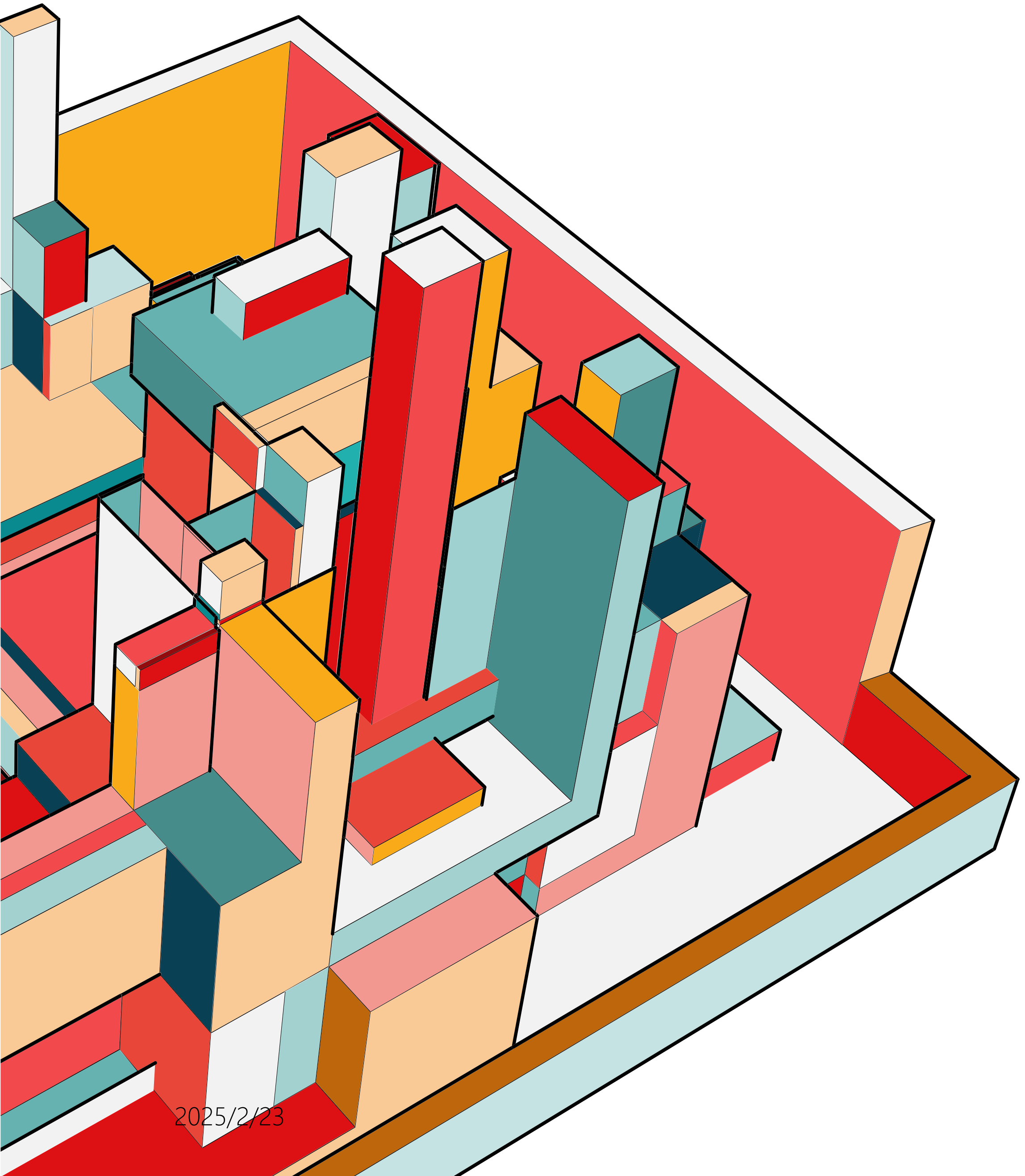
PREVIOUSLY

- **Programming assignment vs. Software**
- **Coding vs. Building a software**
- **Quality and efficiency**



PREVIOUSLY

- Writing code is easy
- Engineering good software system is HARD
  - Different roles are involved
  - Many aspects of complexity (time, scale, etc.)
  - Trade-offs & making good decisions

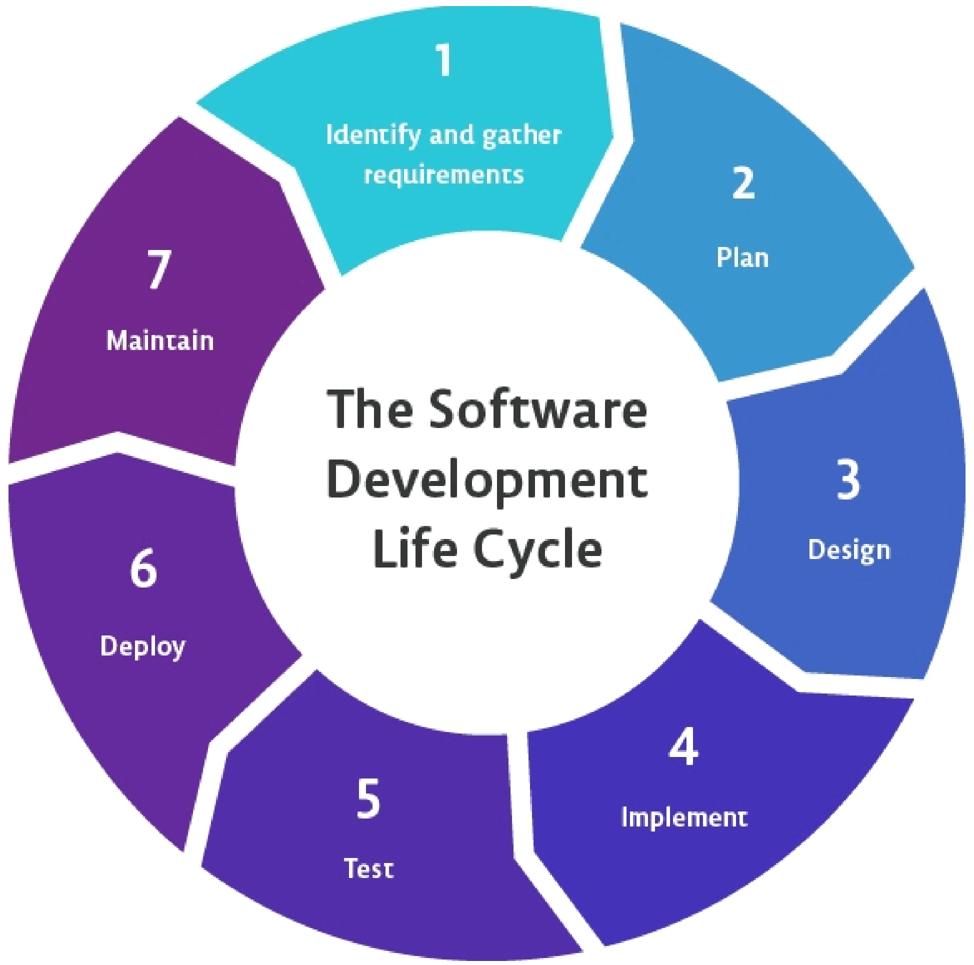


LECTURE 2

- Overview of software process
- Process models
- Agile & Scrum
- DevOps

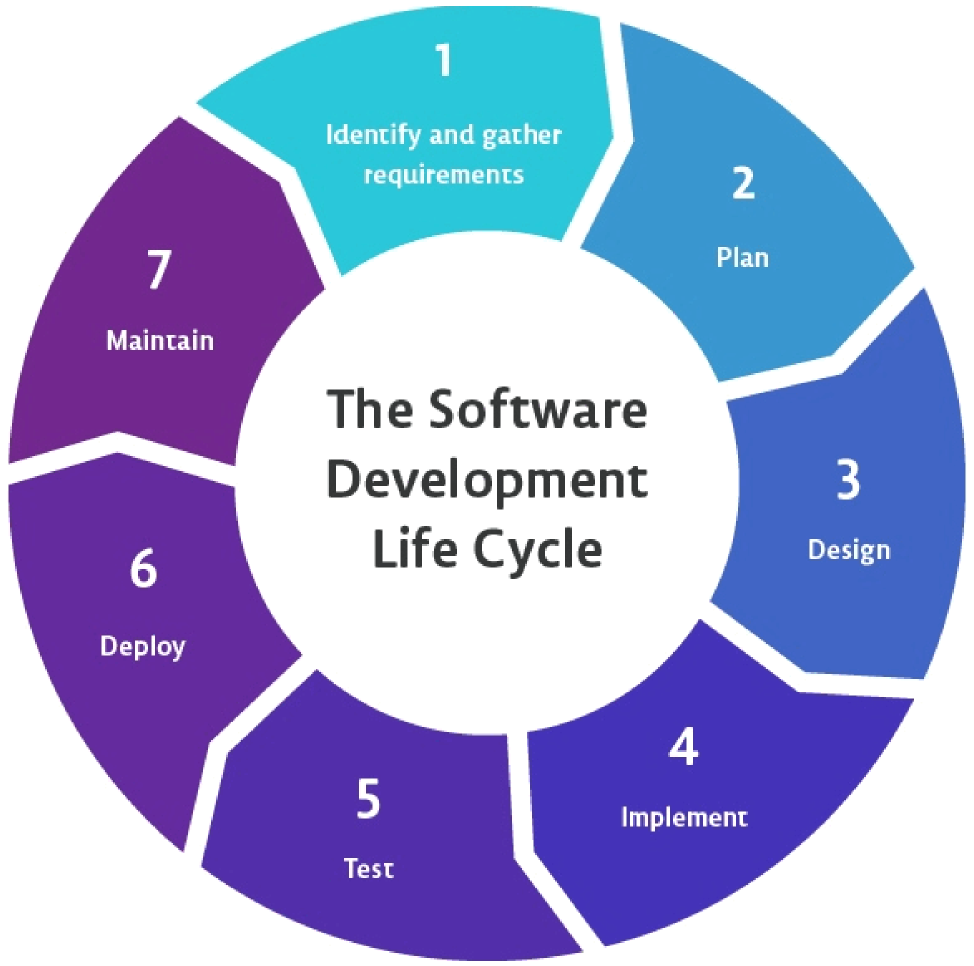
7 PHASES IN SOFTWARE LIFECYCLE

How do we put these phases together to build a software?


The Software Development Life Cycle
1
Identify and gather requirements
2
Plan
3
Design
4
Implement
5
Test
6
Deploy
7
Maintain

SOFTWARE PROCESS

Software process (软件过程) is a set of related phases/activities that take place **in certain order**, and leads to the production of a software product.


The Software Development Life Cycle
1 Identify and gather requirements
2 Plan
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4 Implement
5 Test
6 Deploy
7 Maintain

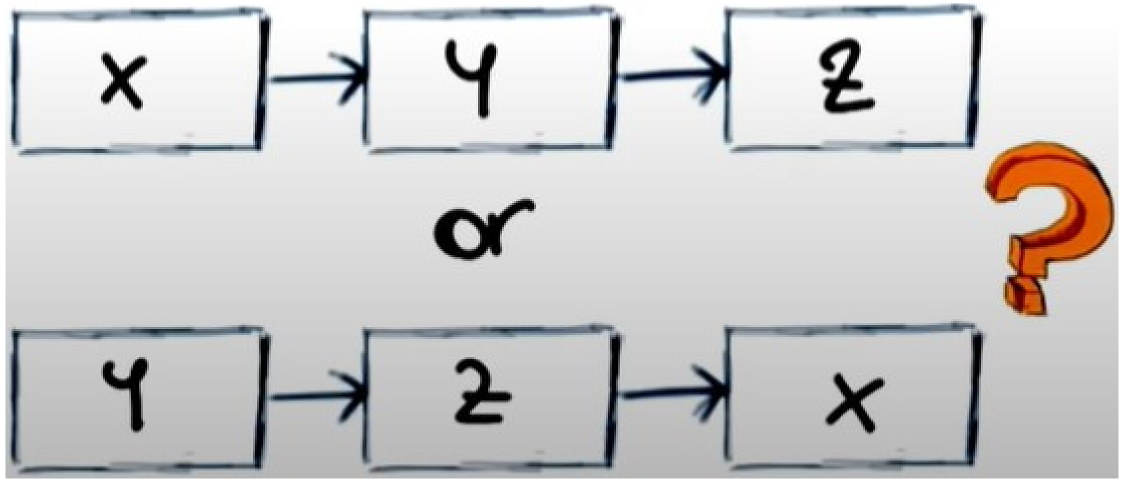
WHY SOFTWARE PROCESS?

- Organizations want a well-defined, well-understood, repeatable software process
- Benefits
  - New team members know what to do
  - Know what's been done
  - Estimate time to completion, costs, etc.
  - Follow and repeat good practices

SOFTWARE PROCESS MODELS

Software process models (or software lifecycle model) were originally proposed to bring order to the chaos of software development, it determines

- The order of these phases
- The criteria for transition of each phase



SOFTWARE PROCESS MODELS

Software process models fall on a **continuum**

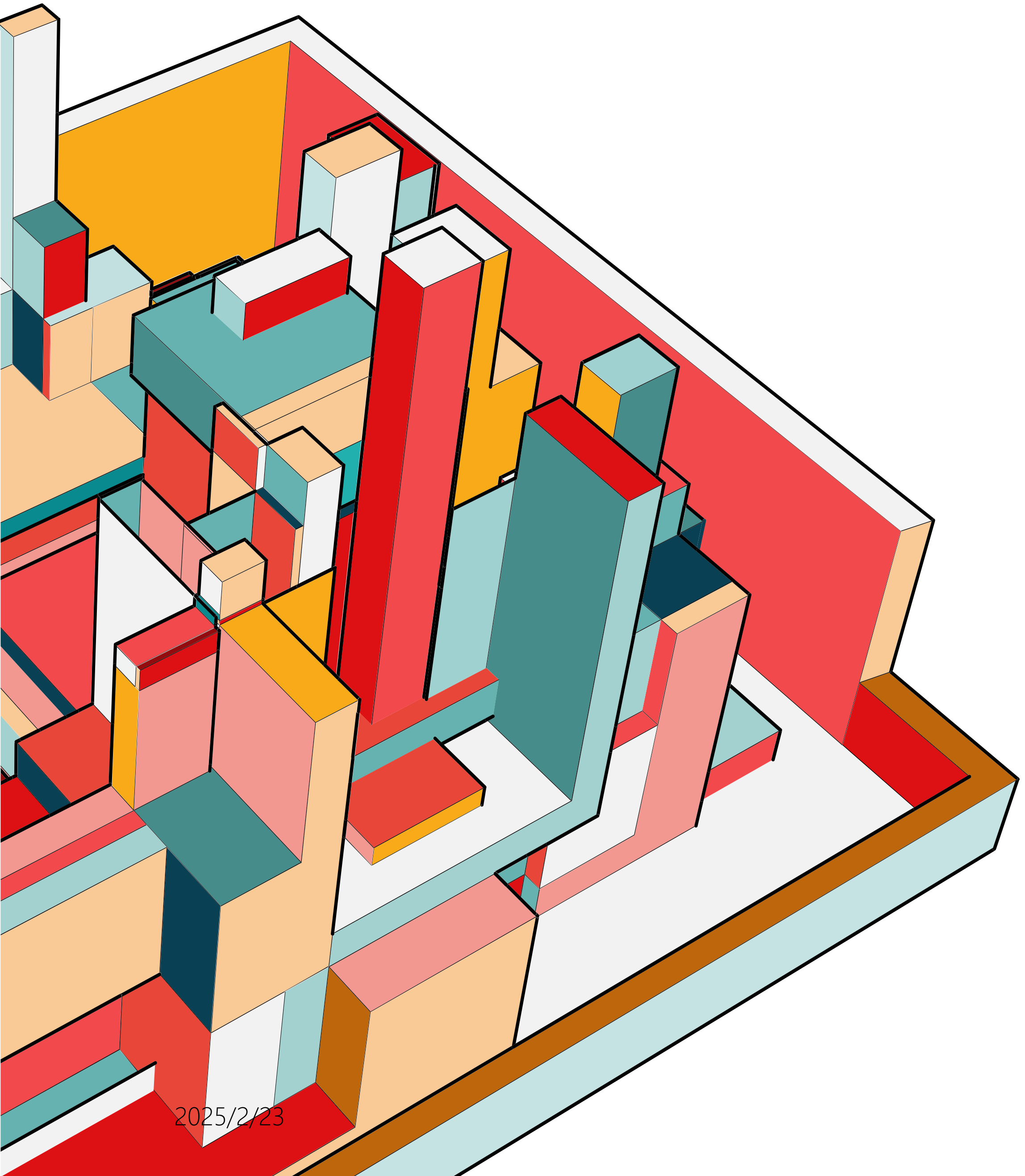
Planning is incremental and it is easier to change the process to reflect changing customer requirements.

All of the process activities are planned in advance and progress is measured against this plan.

Agile

Plan-driven

There is no ideal process and most organizations have developed their own software development processes by finding a balance between plan-driven and agile processes.



LECTURE 2

- Overview of software process
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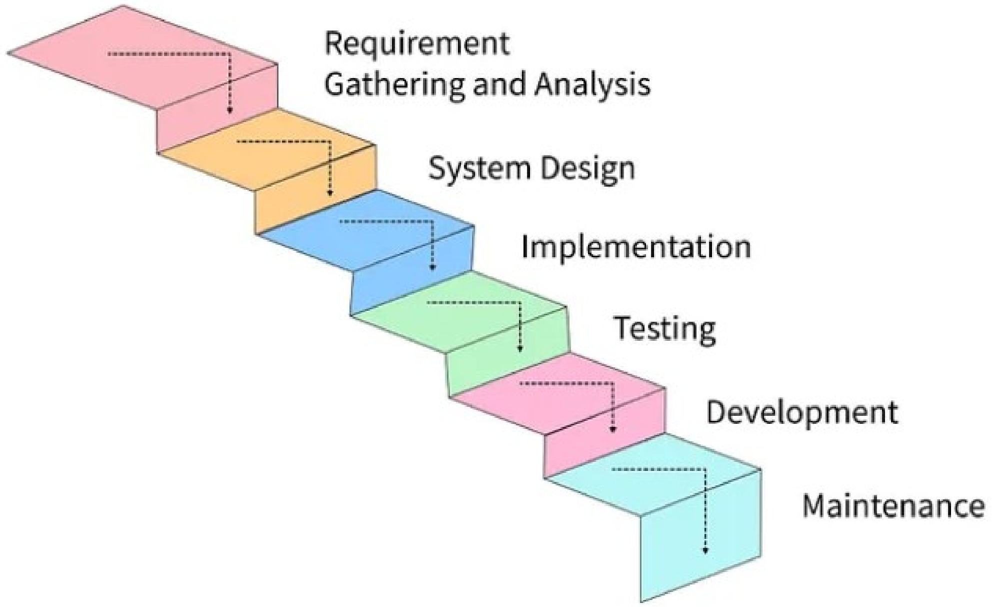
THE WATERFALL MODEL

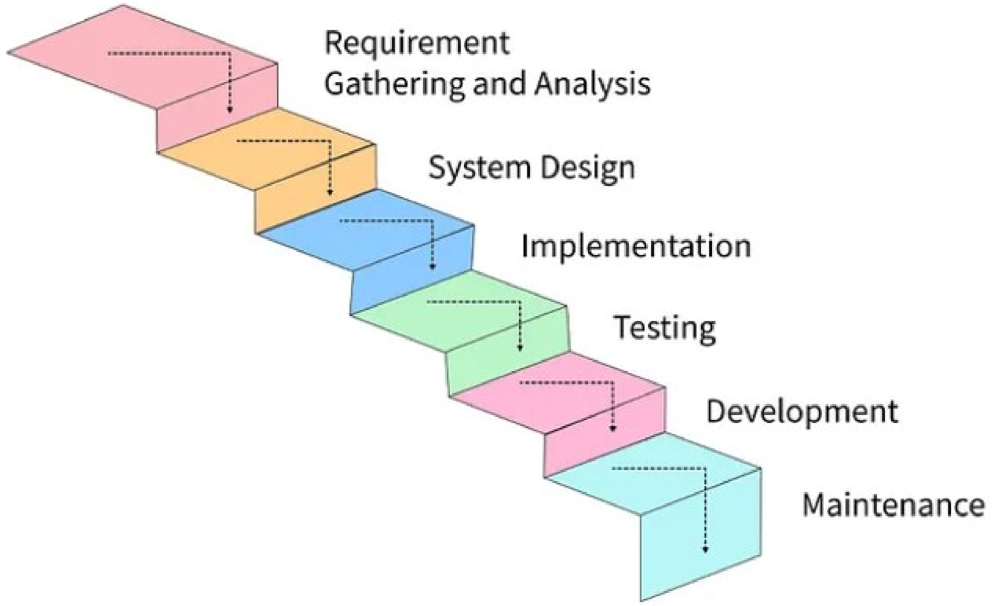
The waterfall model is a sequential and linear approach for software development process



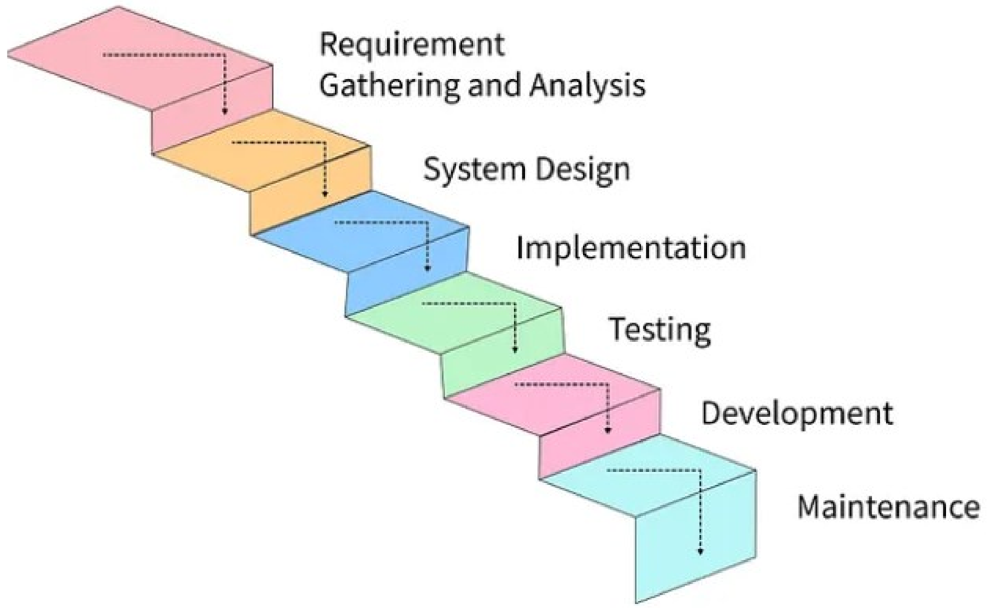
THE WATERFALL MODEL

- In principle, the result of each phase is one or more documents that are approved
- A phase should not start until the previous phase has finished. No overlap between phases.

Sequential phases, flow downwards in one direction, hence the name "waterfall"



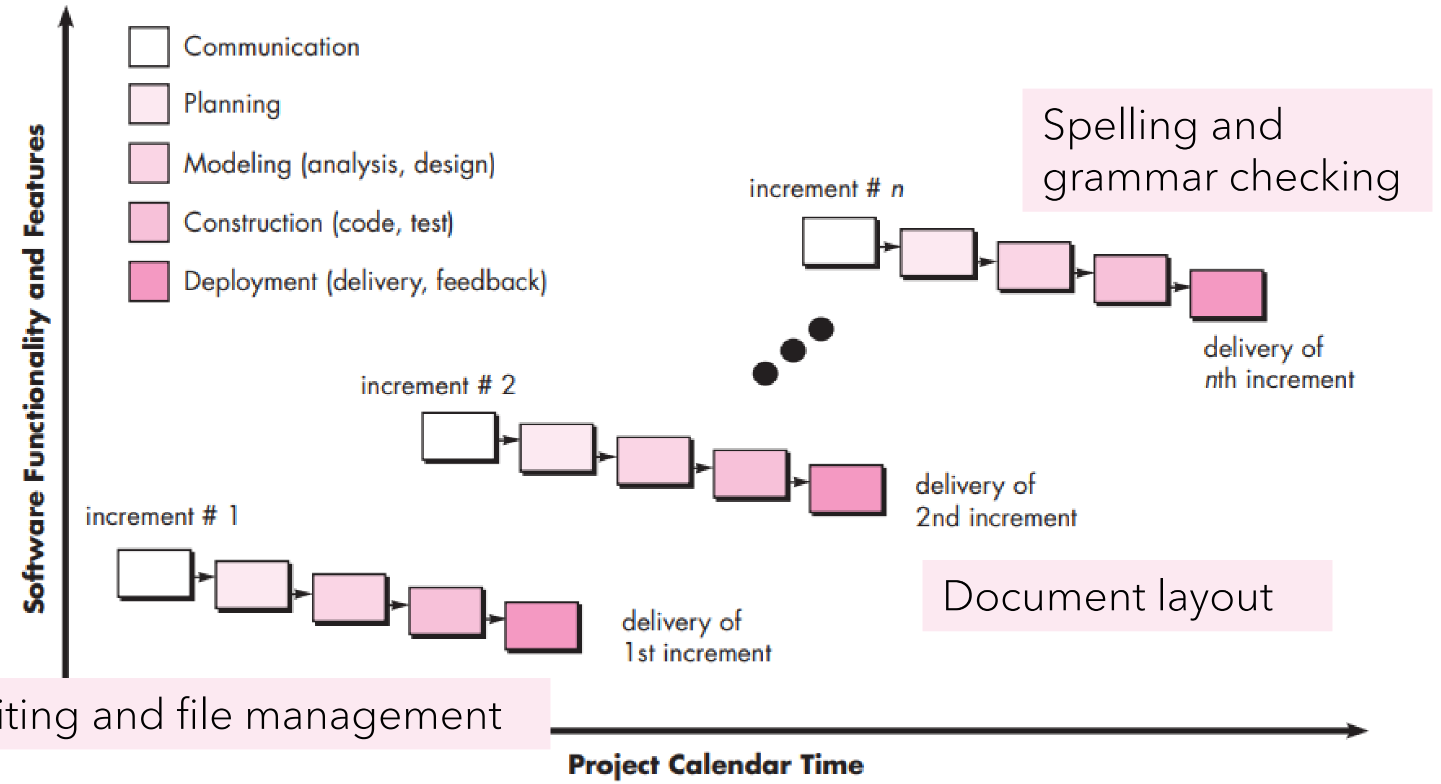
PROBLEMS?



The waterfall model might be adapted only when requirements are well defined and reasonably stable.

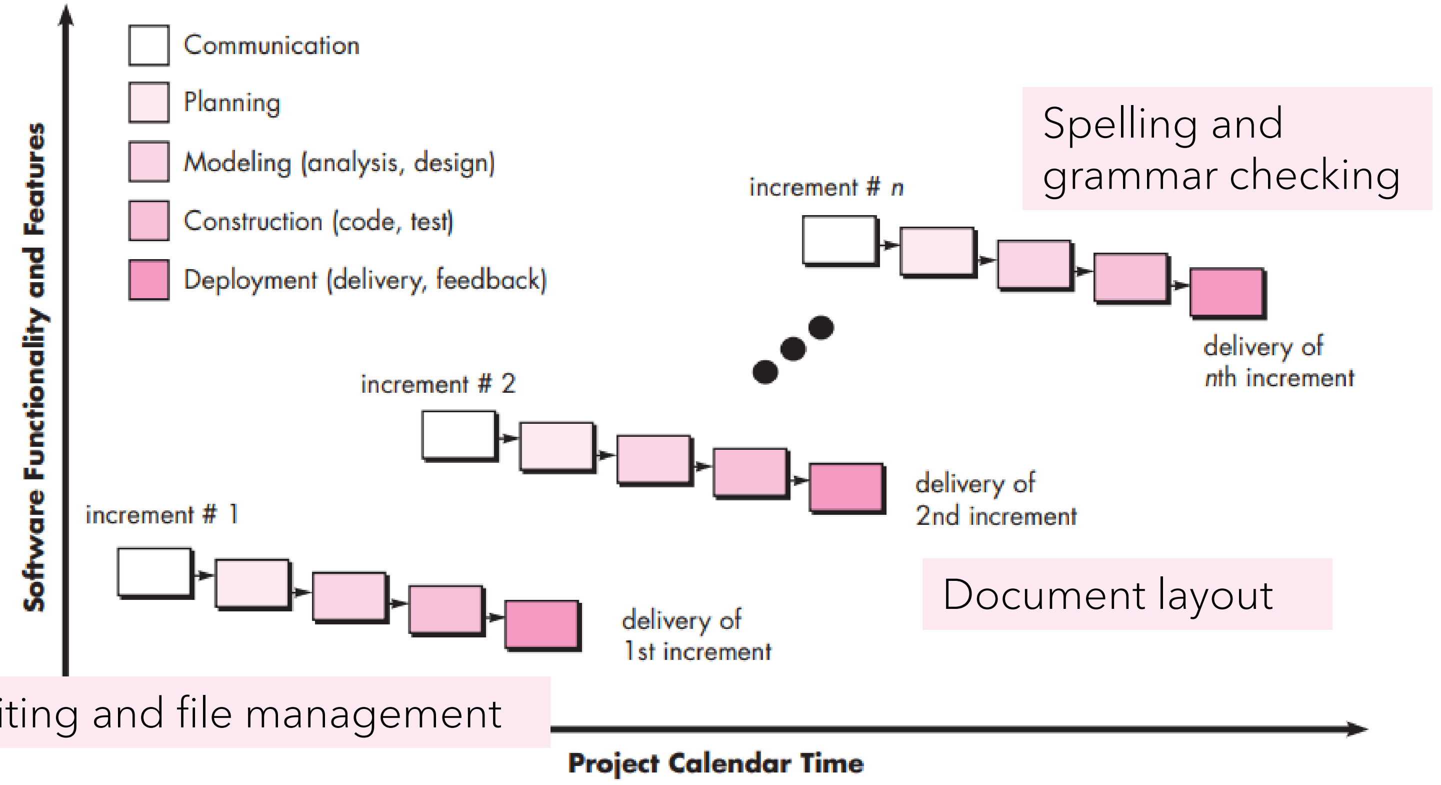
INCREMENTAL PROCESS MODELS

- The incremental model (增量模型) combines elements of linear and parallel process flows
- Each linear sequence produces deliverable “increments” of the software
- The first increment is often a core product with the basic requirements addressed. Supplementary features are developed in subsequent increments.


Communication
Planning
Modeling (analysis, design)
Construction (code, test)
Deployment (delivery, feedback)
Software Functionality and Features
increment # n
delivery of nth increment
increment # 2
delivery of 2nd increment
increment # 1
delivery of 1st increment
Project Calendar Time
Spelling and grammar checking
Document layout
Basic editing and file management

INCREMENTAL PROCESS MODELS PROS

- Reducing cost due to requirement changes
- Easier to get customer feedback and adapt
- Easier to test and debug during a smaller iteration
- More rapid delivery and deployment of useful software
- Particularly useful when staffing is unavailable for a complete implementation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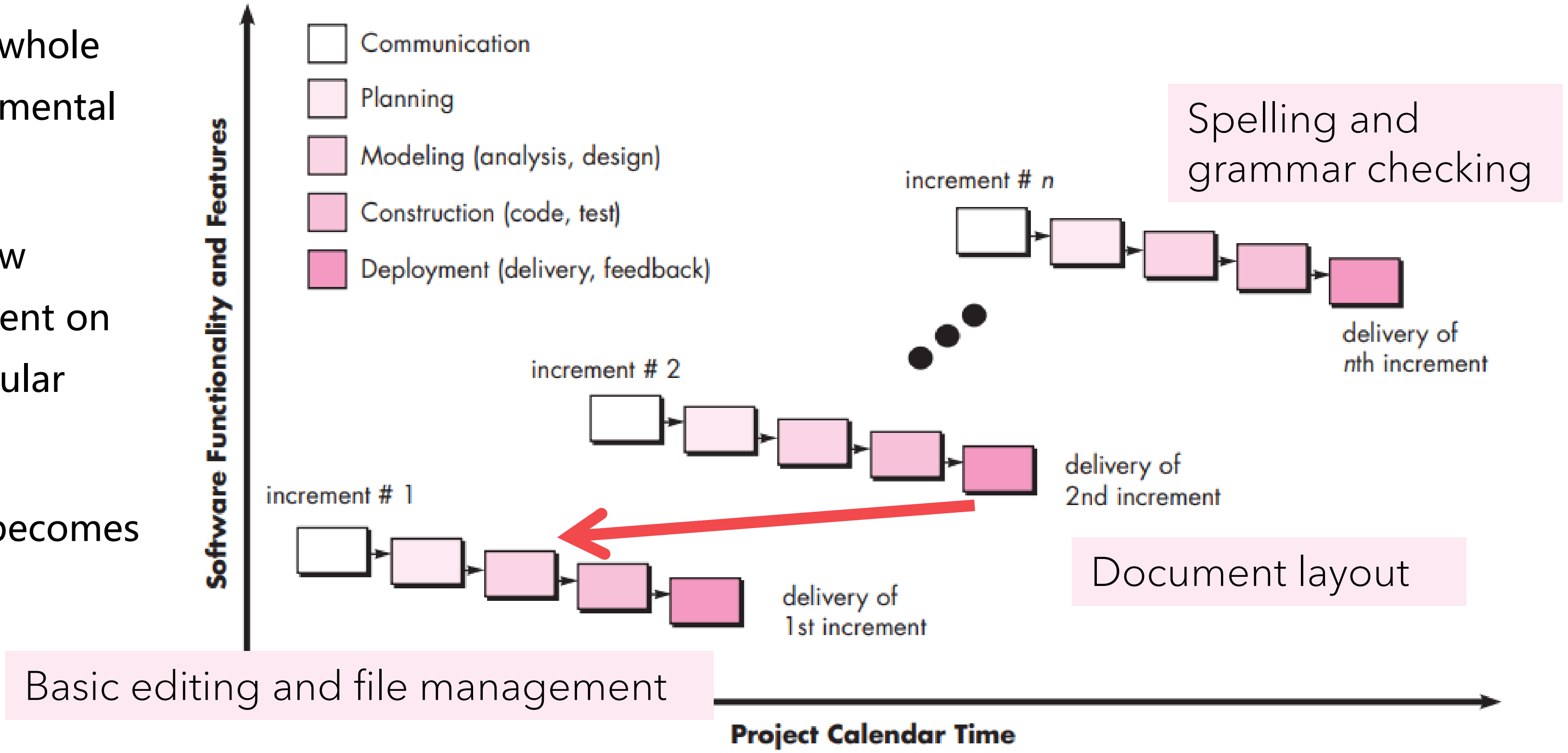
increment # 1
delivery of 1st increment
increment # 2
delivery of 2nd increment
increment # n
delivery of nth increment
Spelling and grammar checking
Document layout
Basic editing and file management
Project Calendar Time

INCREMENTAL PROCESS MODELS CONS

- Needs good planning and design of the whole system before breaking it down for incremental builds
- System structure tends to **degrade** as new increments are added. Unless effort is spent on **refactoring** to improve the software, regular change tends to corrupt its structure.
- Incorporating further software changes becomes increasingly difficult and costly.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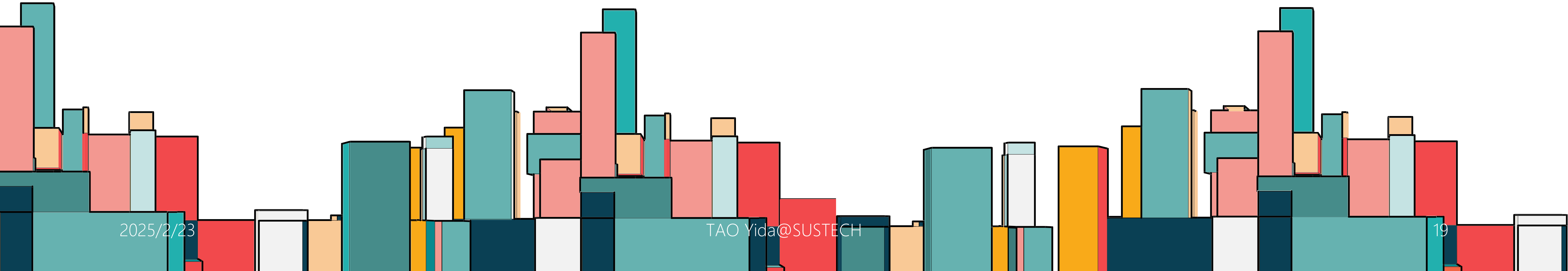
IS SOFTWARE DEVELOPMENT A LINEAR PROCESS?



EVOLUTIONARY PROCESS MODELS

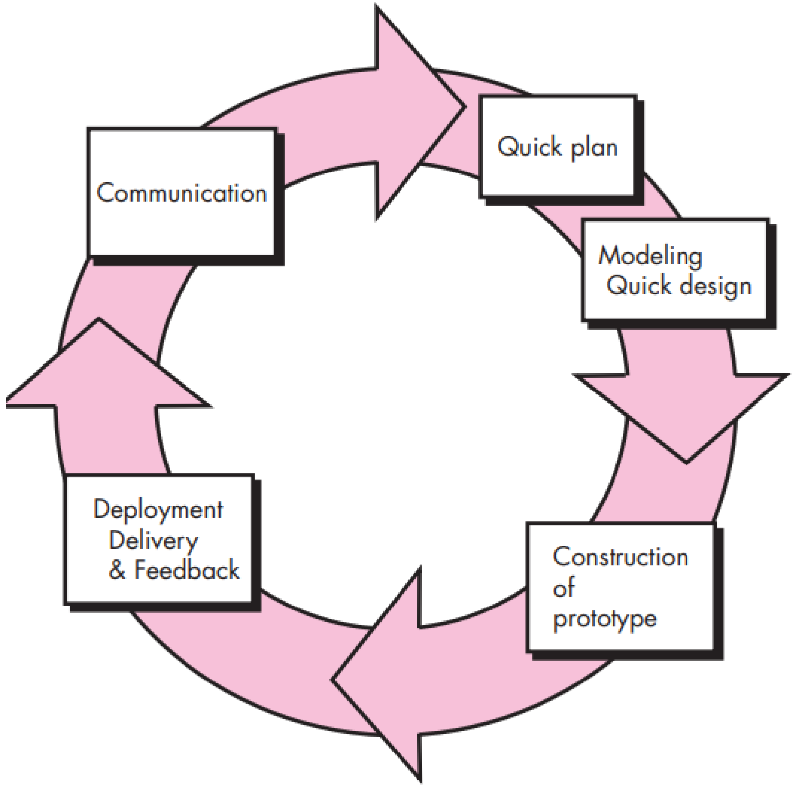
- Evolutionary models are iterative (迭代), which is explicitly designed to accommodate a product that evolves over time.
- Early evolutionary process models: prototyping and the spiral model

PROTOTYPING

- Prototyping (原型开发) might be used when customers define a set of general objectives for software, but do not identify detailed requirements for functions and features

- The prototype iteration begins with communication, followed by quick planning and modeling, which lead to the construction of a prototype that can be delivered and evaluated

- Customers could quickly see what appears to be a working version of the software and give feedback

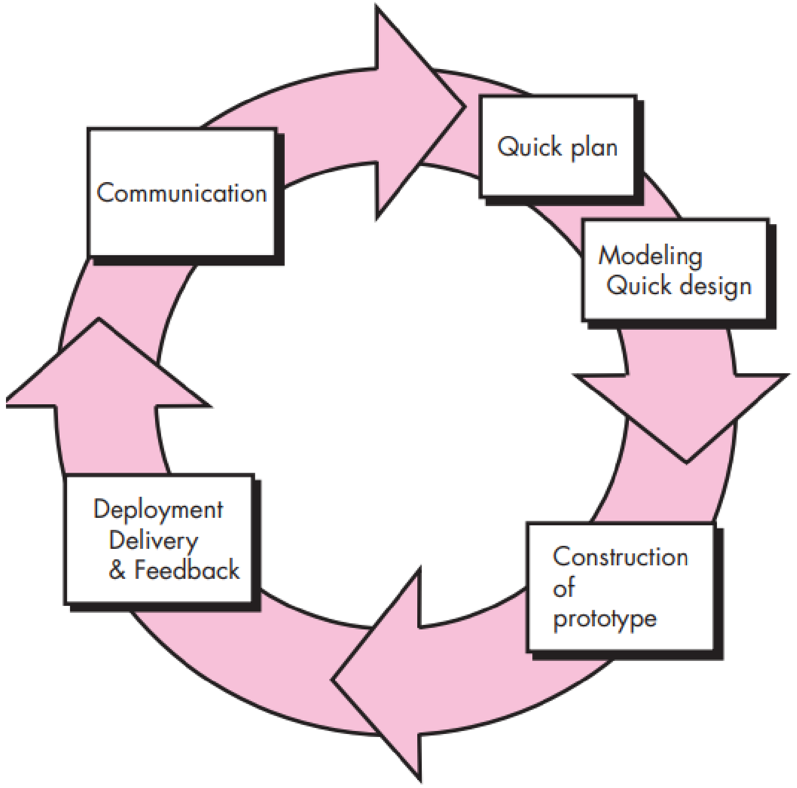


PROTOTYPING

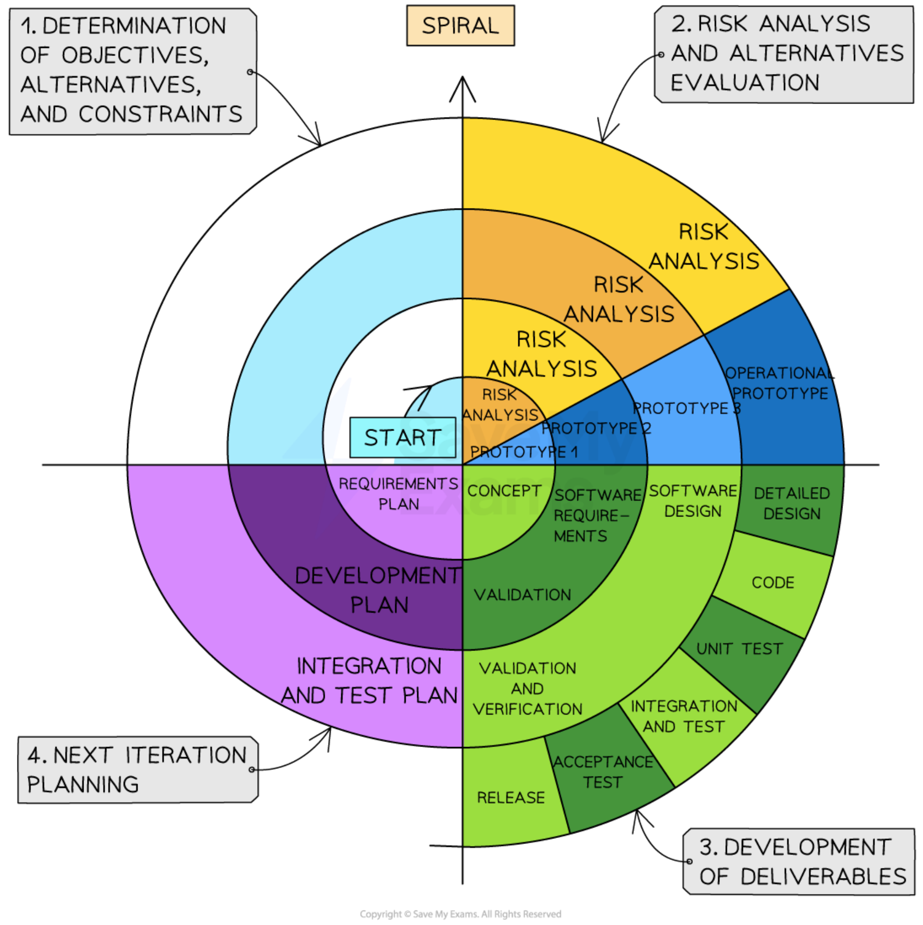
- Developers often make implementation compromises, e.g., inappropriate OS, PL, and inefficient algorithms, in order to get a prototype working quickly
- The prototype is often discarded (at least in part), and the actual software is engineered with an eye toward quality.

✓ Prototyping should be used when the requirements are not clearly understood or are unstable

✓ Prototyping can also be used for developing UI or complex, high-tech systems in order to quickly demo the feasibility

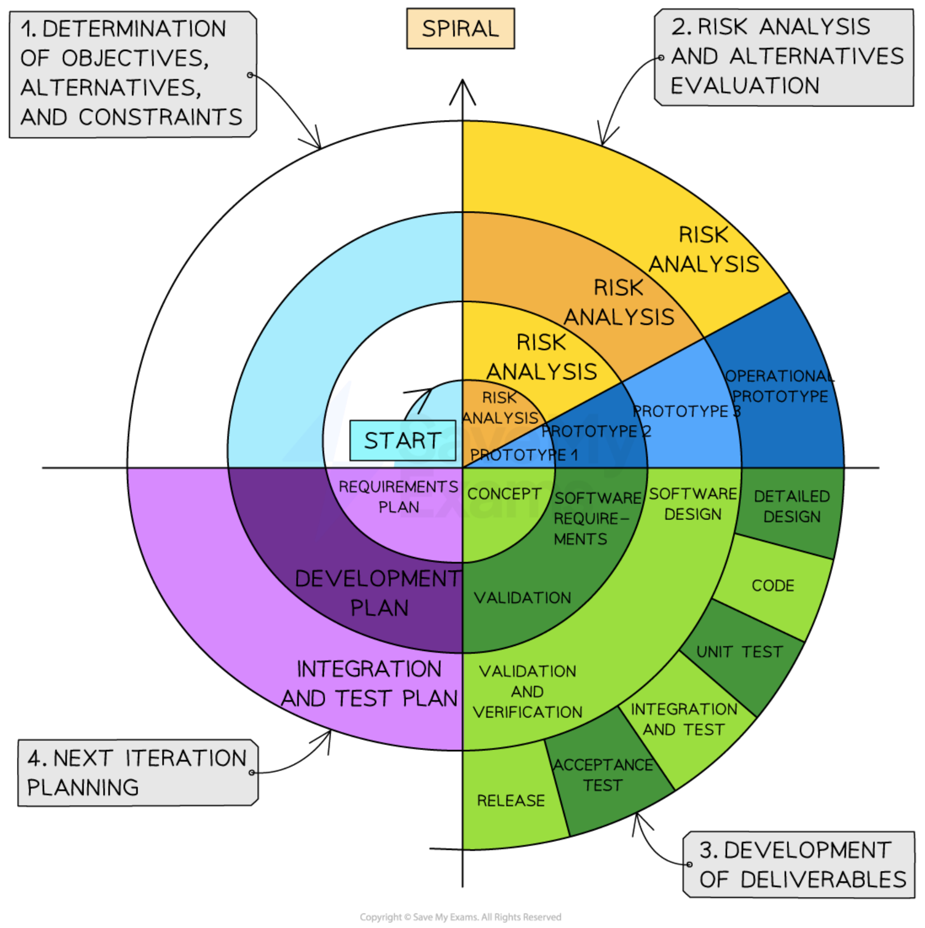


THE SPIRAL MODEL



- The spiral model couples the iterative nature with the controlled and systematic aspects of the waterfall model
- Using the spiral model, software is developed in a series of evolutionary releases.
- During early iterations, the release might be a model or prototype.
- During later iterations, increasingly more complete versions of the engineered system are produced

THE SPIRAL MODEL



Pros

- Effectively reducing potential risks
- Features can be updated because of the iterative nature
- Better for high-risk project, e.g., banking, medical systems

Cons

- Risk analysis highly rely on experts
- Complex and costly

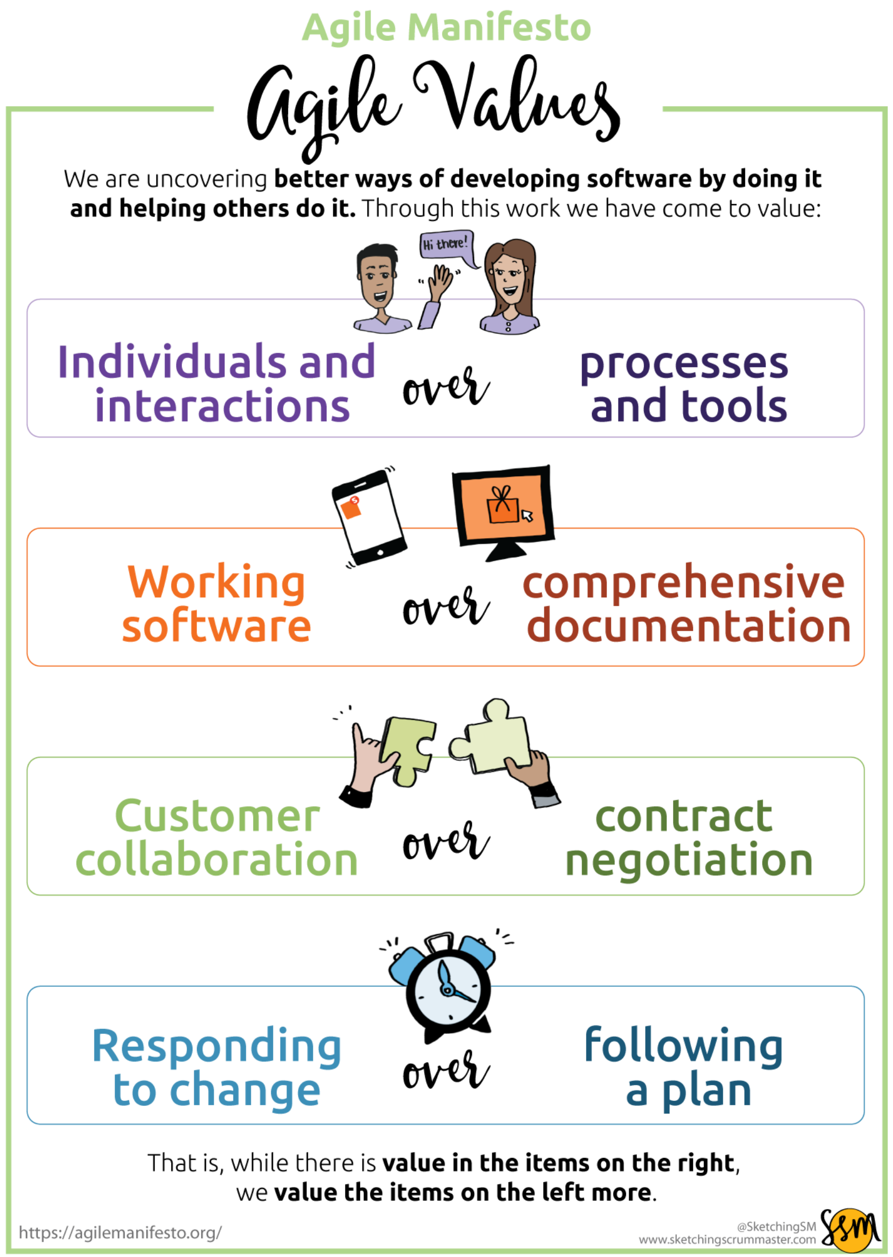
PLAN-DRIVEN SOFTWARE PROCESS MODELS

Software engineers are not robots. They exhibit great variation in working styles; significant differences in skill level, creativity, orderliness, consistency, and spontaneity. Some communicate well in written form, others do not

As consistency in action is a human weakness, high-discipline methodologies are **fragile**

Agile Plan-driven

FRAGILE



Agile Manifesto

Agile Values

We are uncovering **better ways of developing software by doing it and helping others do it.** Through this work we have come to value:

Individuals and interactions	over	processes and tools
Working software	over	comprehensive documentation
Customer collaboration	over	contract negotiation
Responding to change	over	following a plan

That is, while there is **value in the items on the right**, we **value the items on the left more**.

https://agilemanifesto.org/

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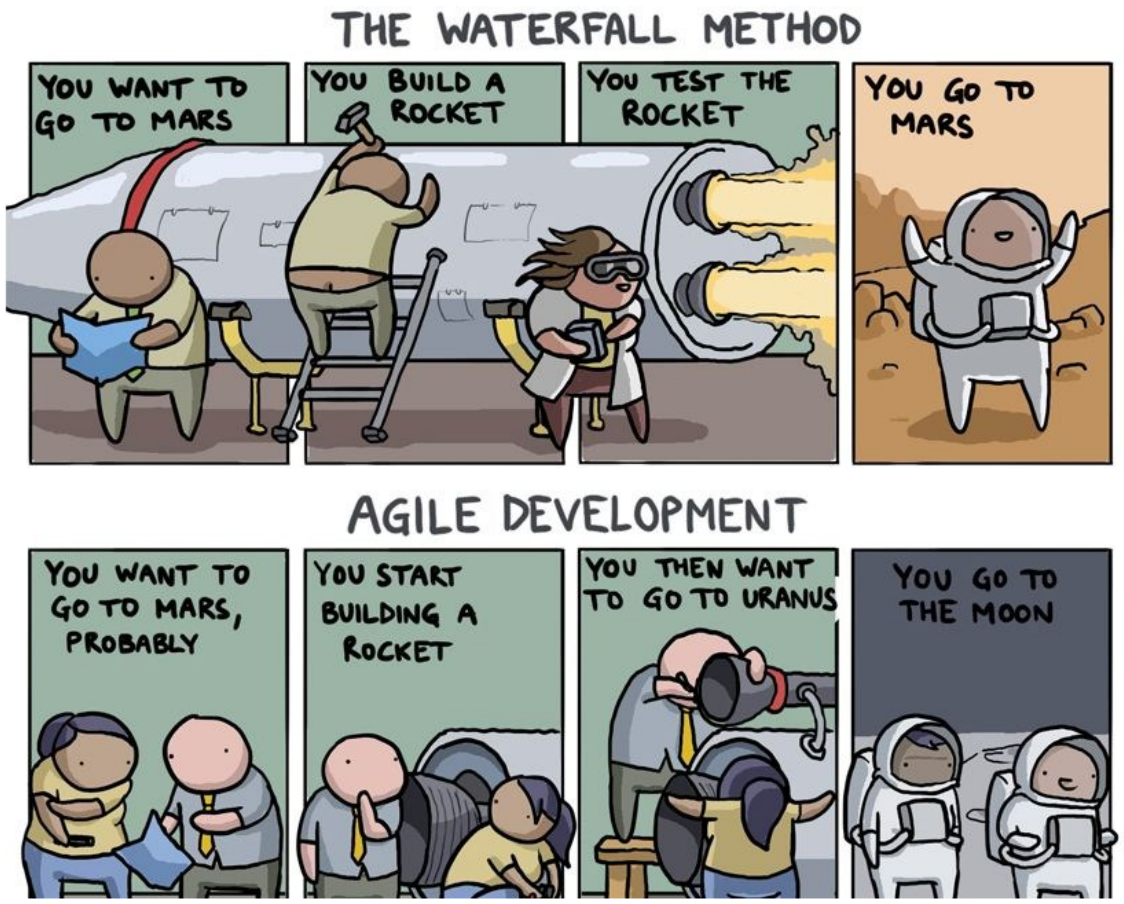
AGILE VALUES

In 2001, Kent Beck and 16 other noted software developers, writers, and consultants signed the "Manifesto for Agile Software Development." (敏捷软件开发宣言)

Agile, in the context of software engineering, refers to the methods and best practices for organizing projects based on the values and principles documented in the Agile Manifesto.

AGILE VS. WATERFALL



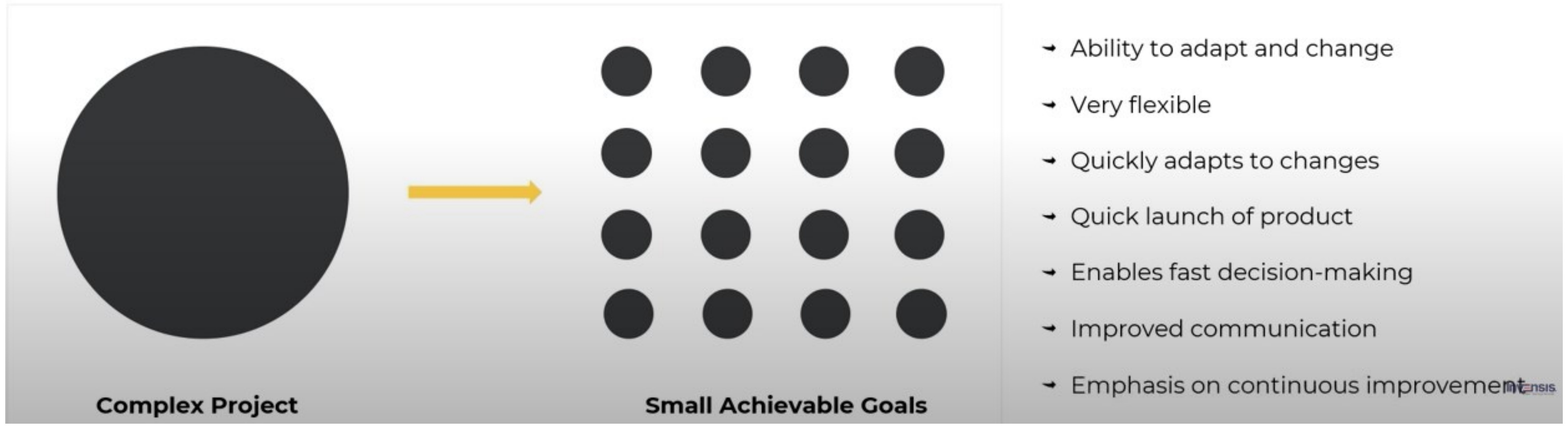
https://www.pinterest.com/pin/678917712570197228/

WHAT IS AGILE, EXACTLY?

Agile (敏捷), in general, is the ability to create and respond to change.

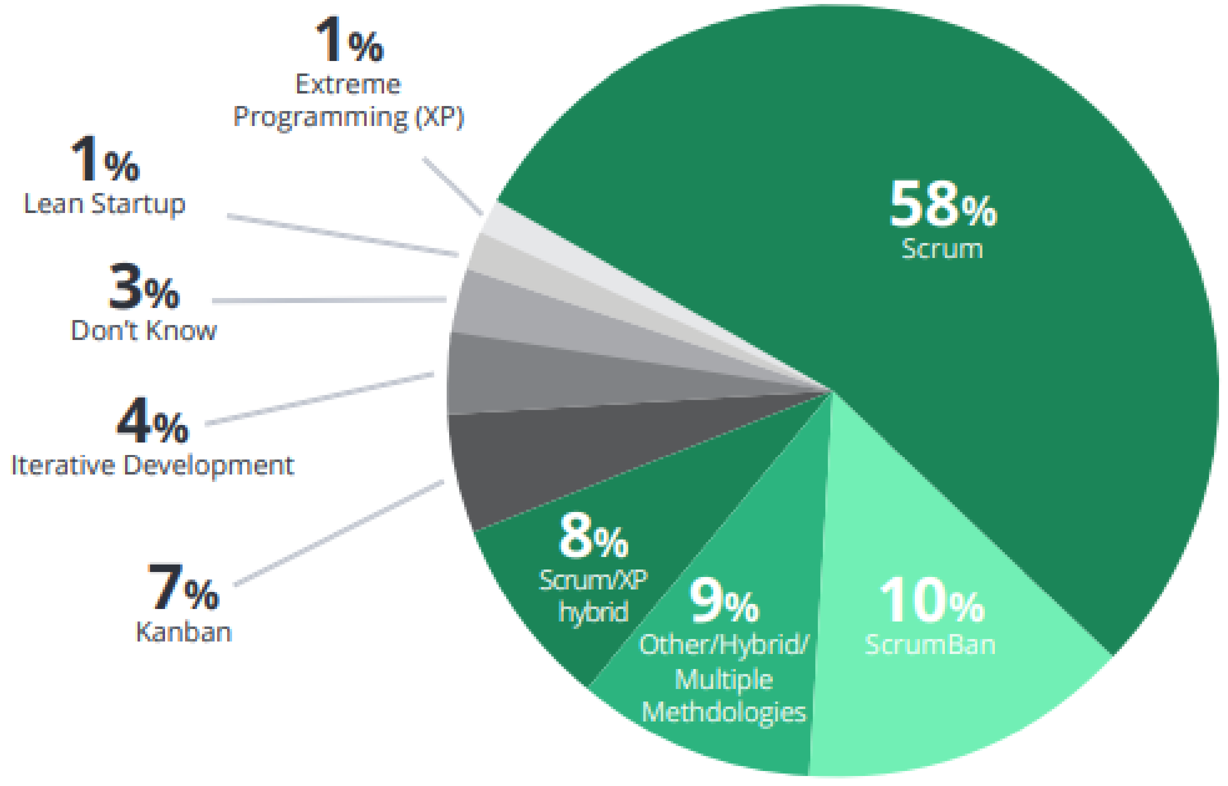
WHAT IS AGILE, EXACTLY?

- Agile is an **iterative** approach to project management and software development that helps teams deliver value to their customers faster and with fewer headaches
- An agile team delivers work in **small**, but **consumable, increments**. Requirements, plans, and results are **evaluated continuously** so teams have a natural mechanism for **responding to change quickly**.



- Ability to adapt and change
- Very flexible
- Quickly adapts to changes
- Quick launch of product
- Enables fast decision-making
- Improved communication
- Emphasis on continuous improvement

AGILE METHODOLOGY



Total exceeds 100% due to rounding.

Source: 14th Annual State of Agile Report

- However, there is NO one right way to implement Agile
- There are many different types of agile methodologies

THE ORIGIN OF SCRUM

- The term "scrum" was borrowed from the game of rugby, to stress the importance of teamwork to quickly adapt to unexpected, complicated situations
- Process of sport games = Process of software development

SCRUM ROLES

Product Owner

Define and adjust product features; Accept or reject work results

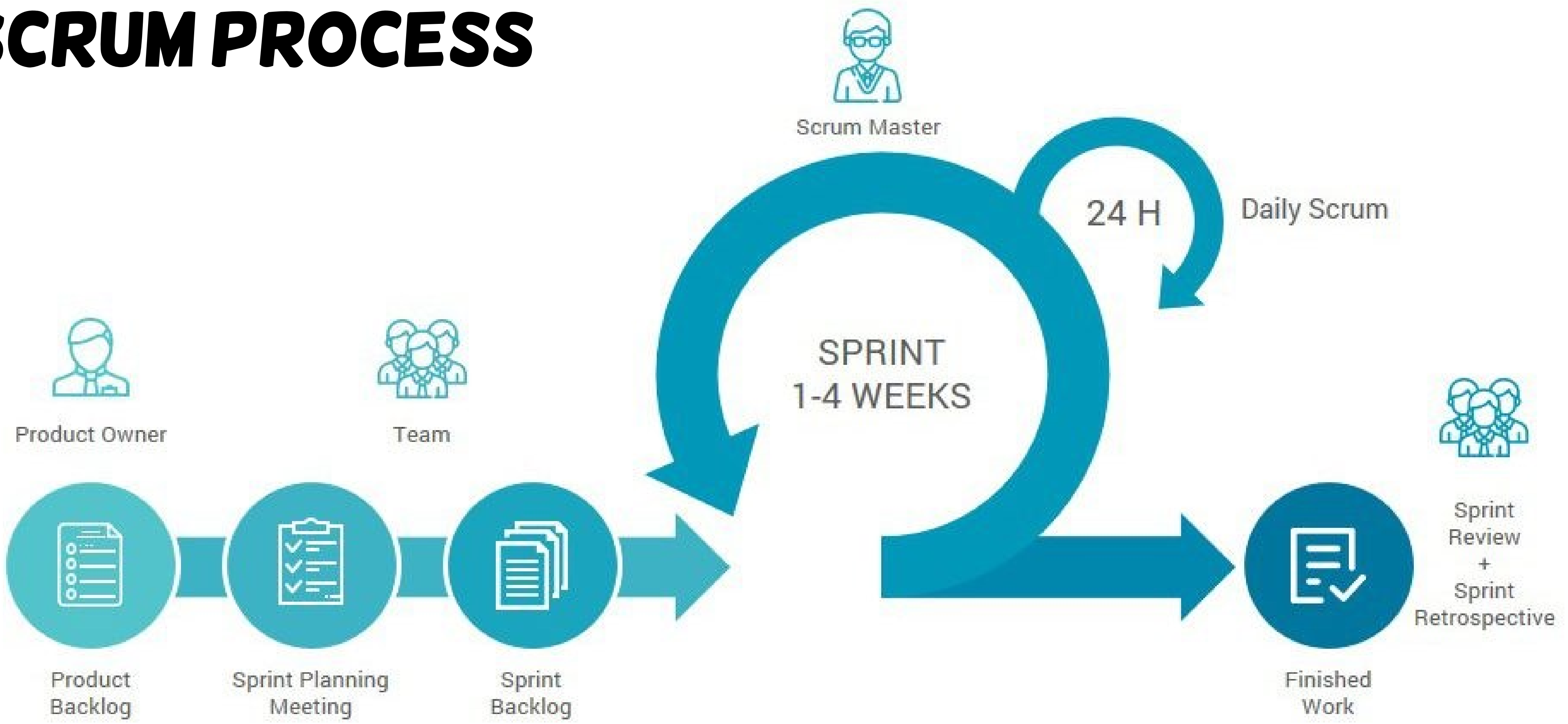
Scrum Master

Coach the team and enact Scrum values and principles

Scrum Team

Cross-functional members like developers, testers, designers (Typically 5-9 size)

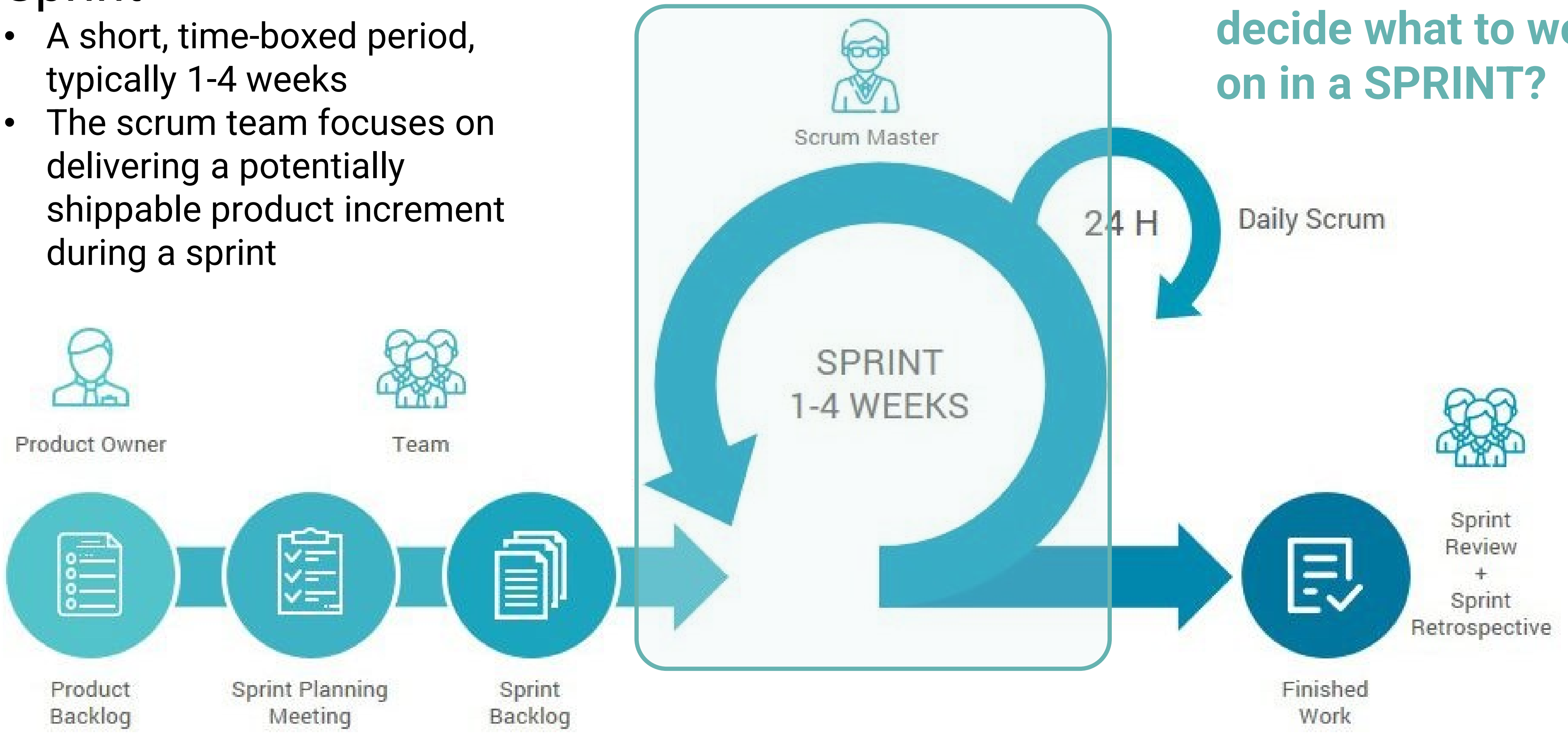
SCRUM PROCESS



Sprint

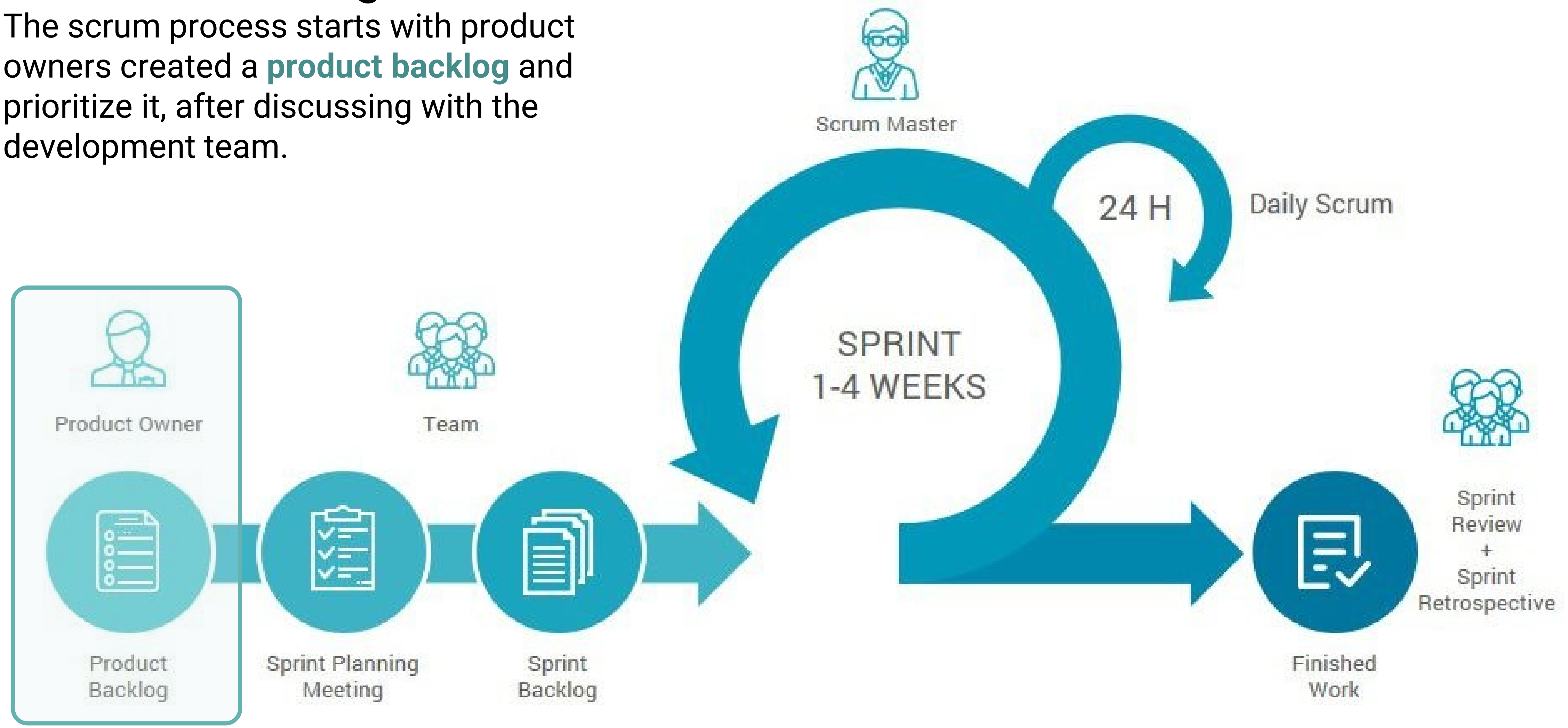
- A short, time-boxed period, typically 1-4 weeks
- The scrum team focuses on delivering a potentially shippable product increment during a sprint

How do people decide what to work on in a SPRINT?



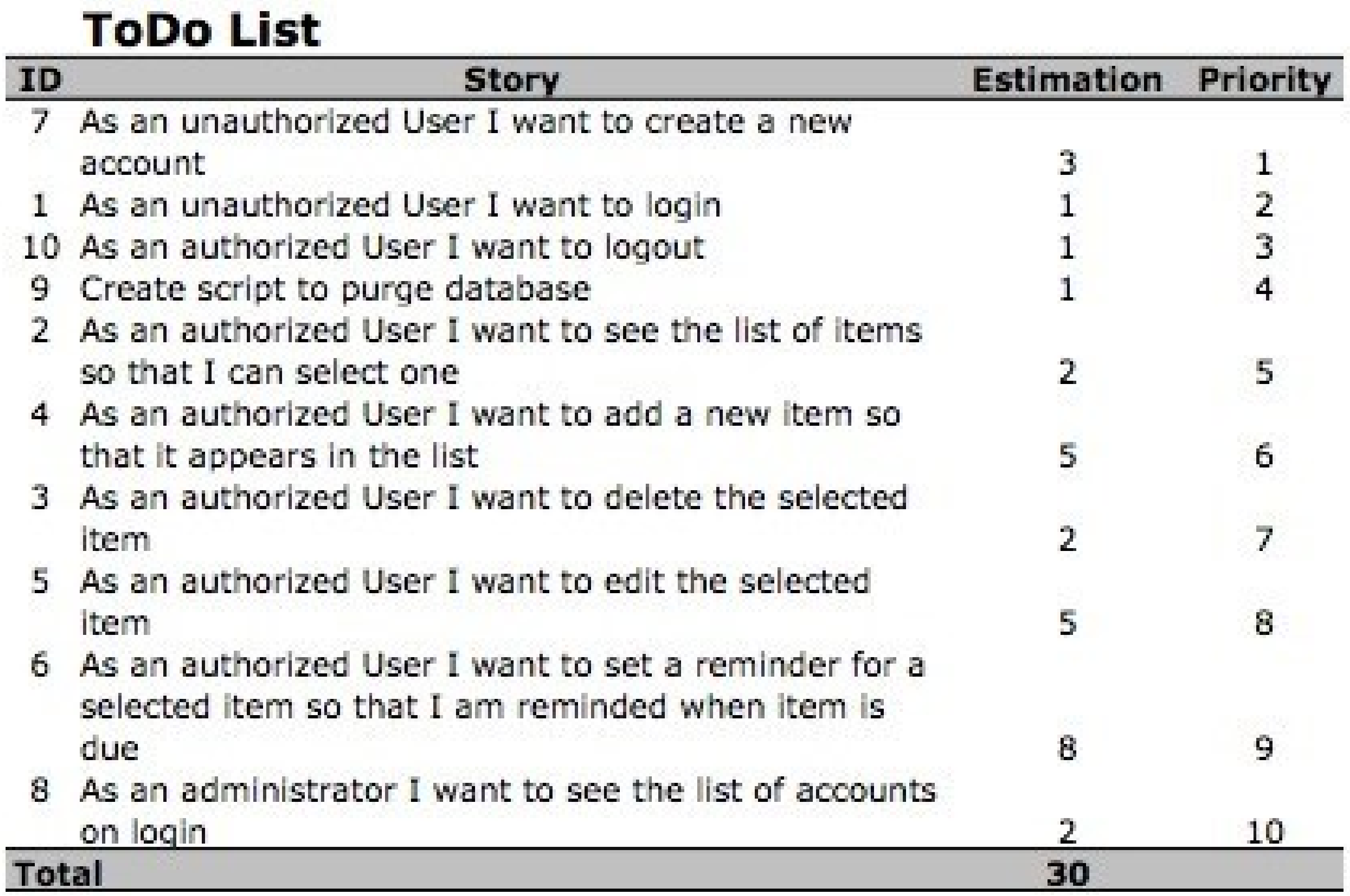
Product Backlog

The scrum process starts with product owners created a **product backlog** and prioritize it, after discussing with the development team.



EXAMPLE OF PRODUCT BACKLOG

More details on week 3

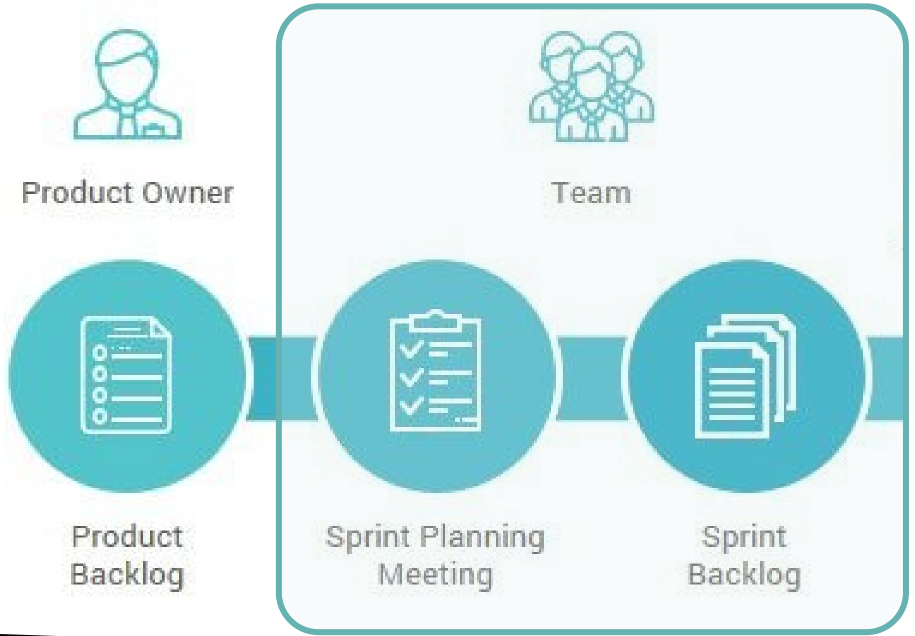


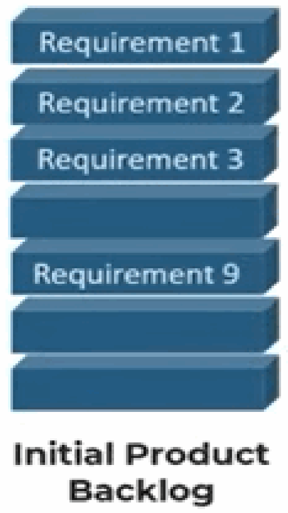
ToDo List

ID	Story	Estimation	Priority
7	As an unauthorized User I want to create a new account	3	1
1	As an unauthorized User I want to login	1	2
10	As an authorized User I want to logout	1	3
9	Create script to purge database	1	4
2	As an authorized User I want to see the list of items so that I can select one	2	5
4	As an authorized User I want to add a new item so that it appears in the list	5	6
3	As an authorized User I want to delete the selected item	2	7
5	As an authorized User I want to edit the selected item	5	8
6	As an authorized User I want to set a reminder for a selected item so that I am reminded when item is due	8	9
8	As an administrator I want to see the list of accounts on login	2	10
Total		30	

Sprint Backlog

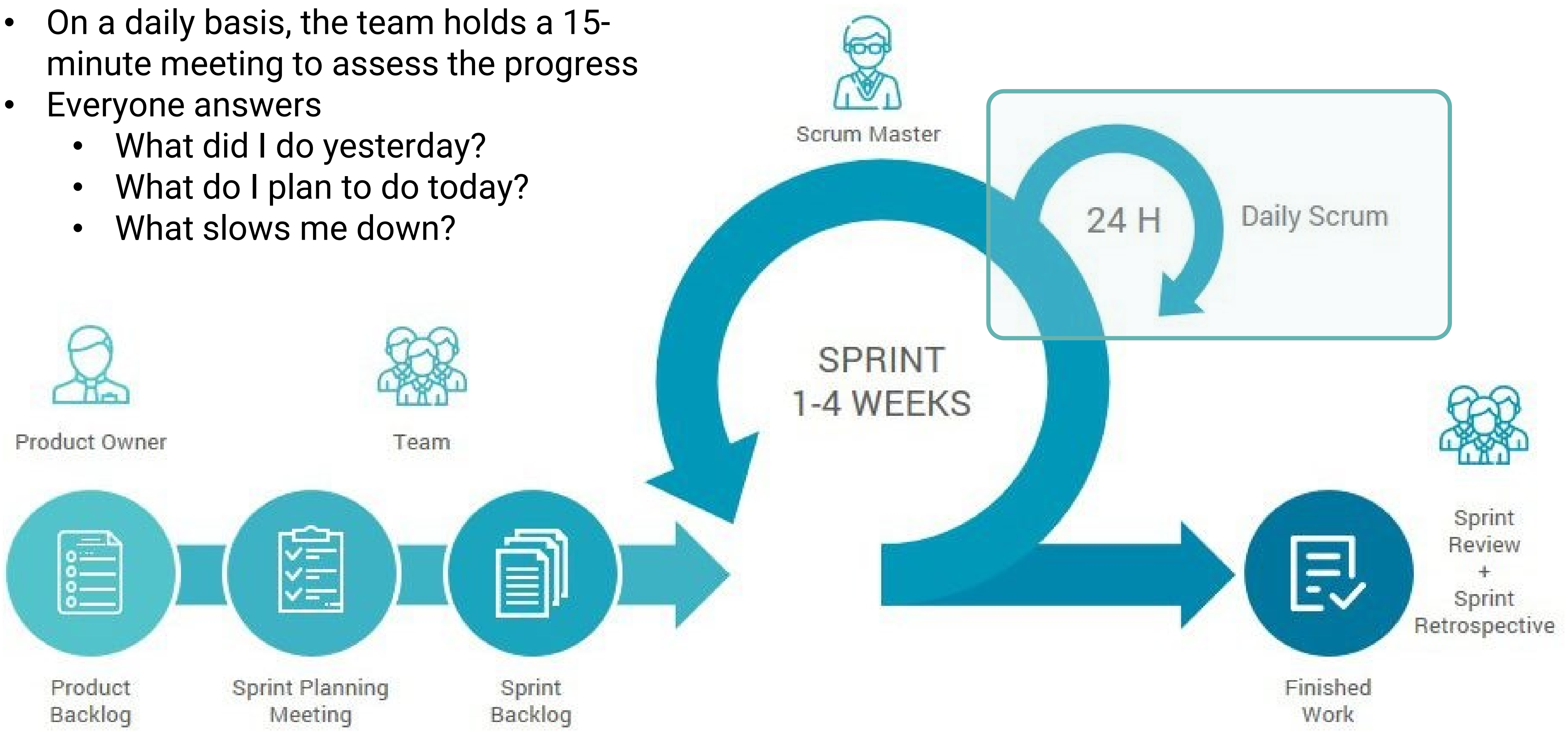
Next, the whole team attend the Sprint Planning Meeting to select the items to deliver in the next sprint, which forms the Sprint Backlog.





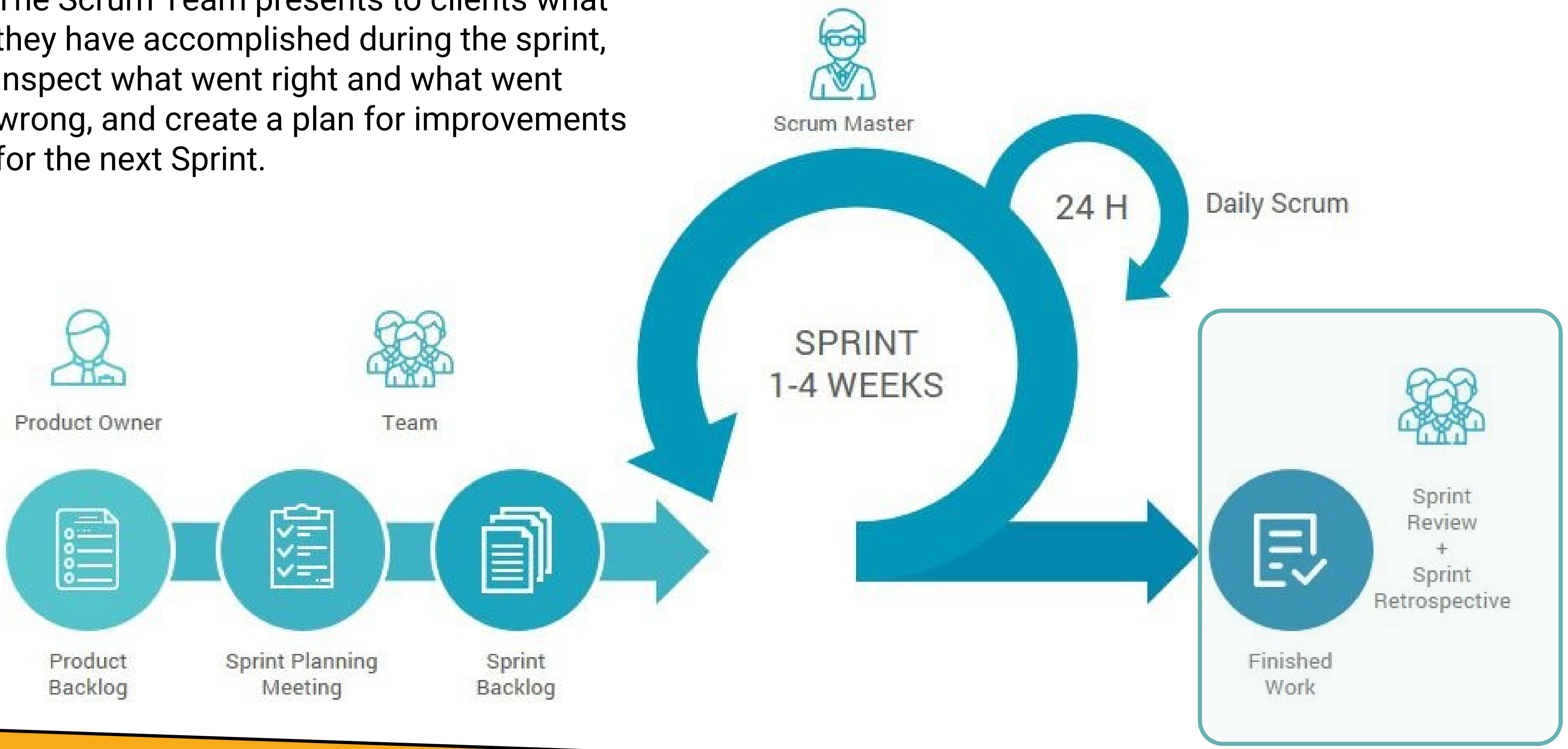
Daily Scrum

- On a daily basis, the team holds a 15-minute meeting to assess the progress
- Everyone answers
  - What did I do yesterday?
  - What do I plan to do today?
  - What slows me down?



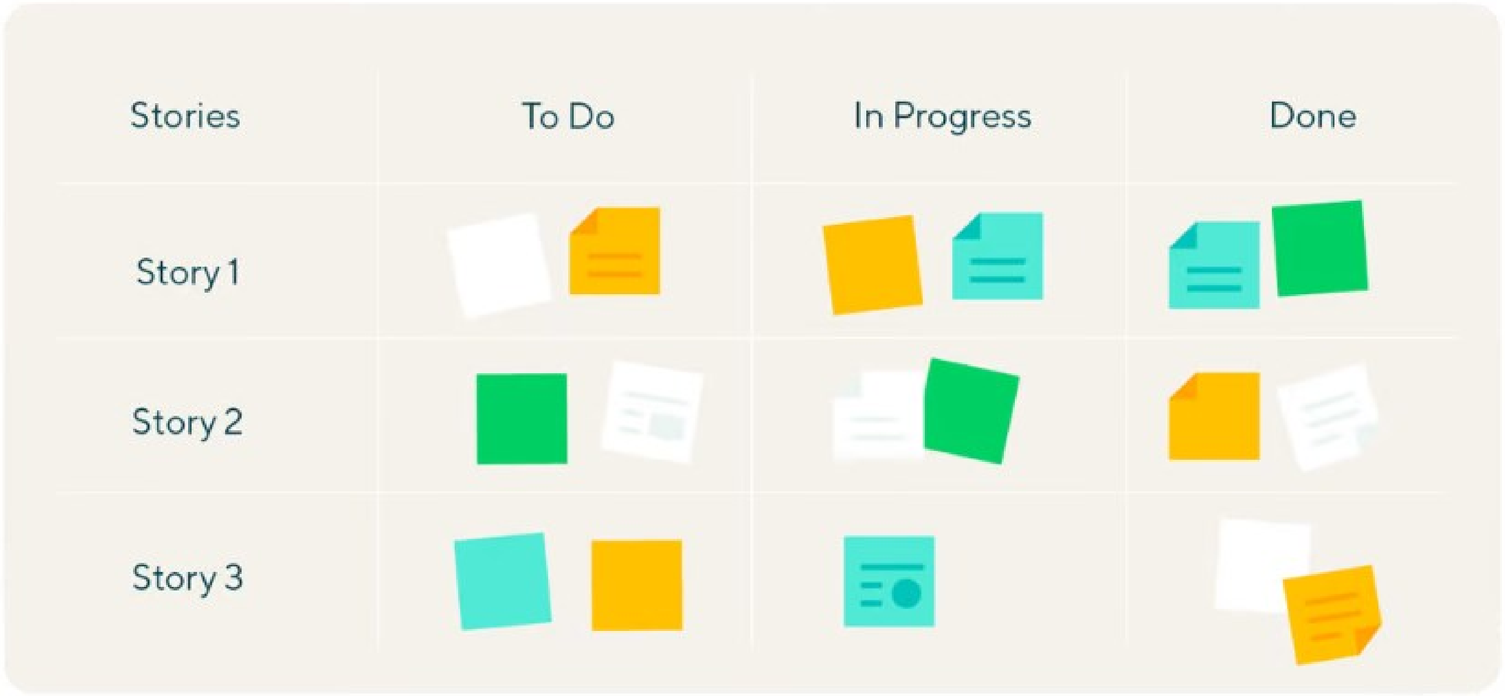
Sprint Review & Retrospective

The Scrum Team presents to clients what they have accomplished during the sprint, inspect what went right and what went wrong, and create a plan for improvements for the next Sprint.

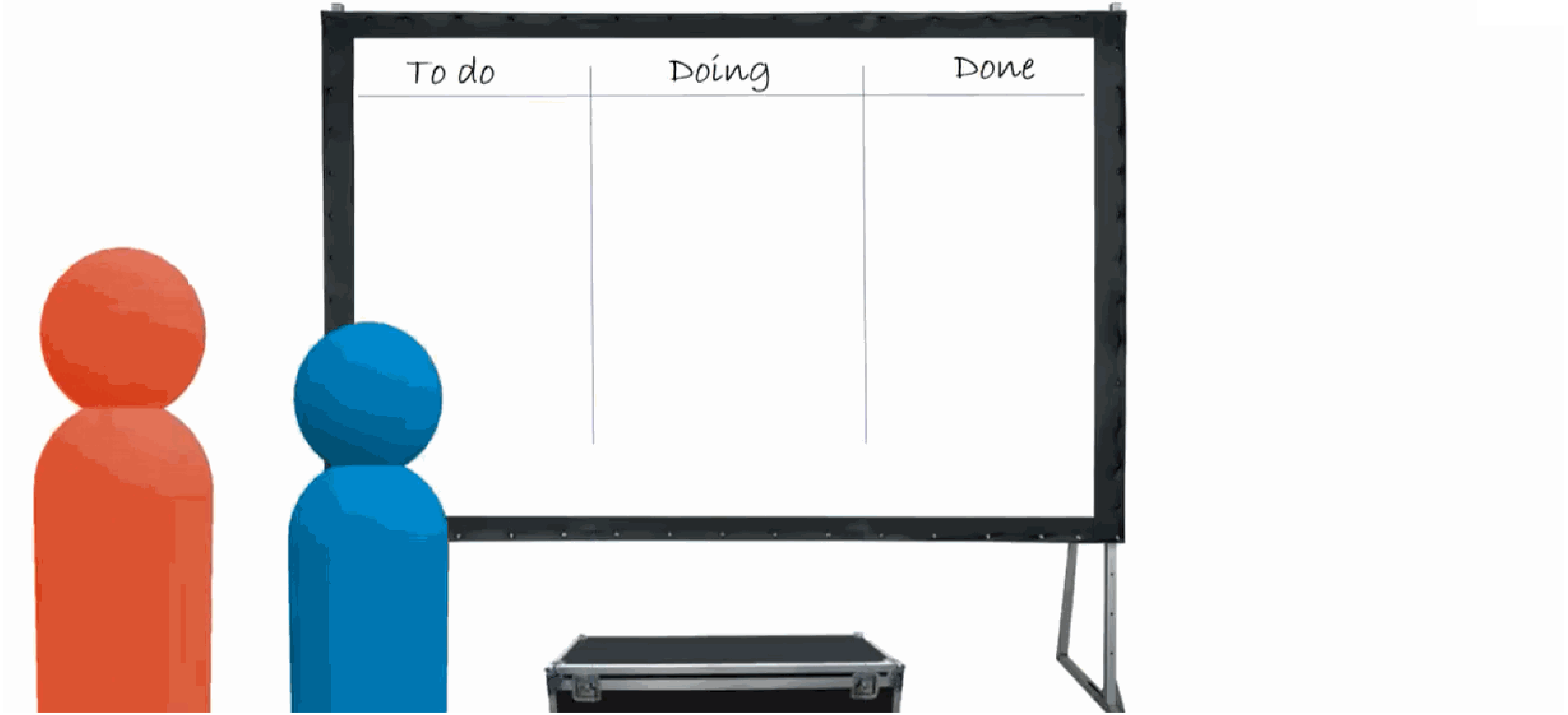


SCRUM BOARDS

- A Scrum Board is a tool that helps Scrum Teams make Sprint Backlog items visible.
- The board is traditionally divided up into three categories: To Do, Work in Progress and Done.

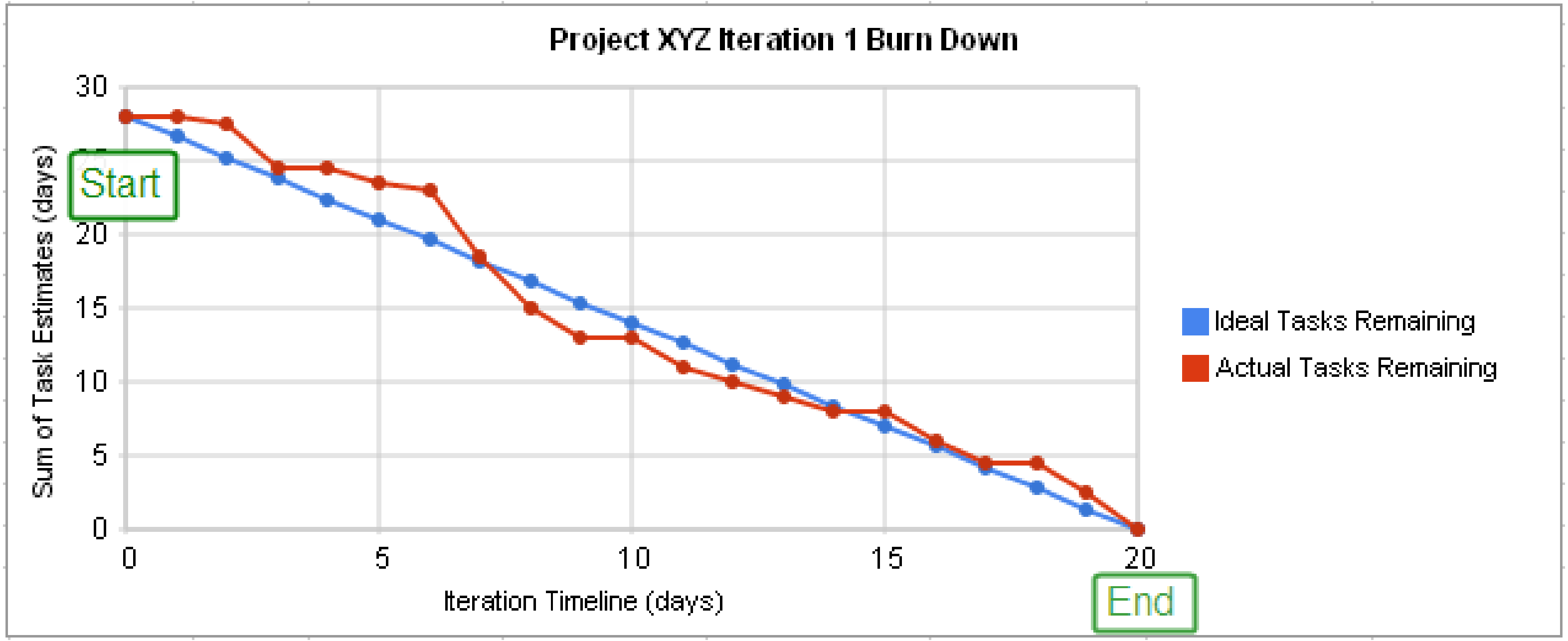


The scrum master



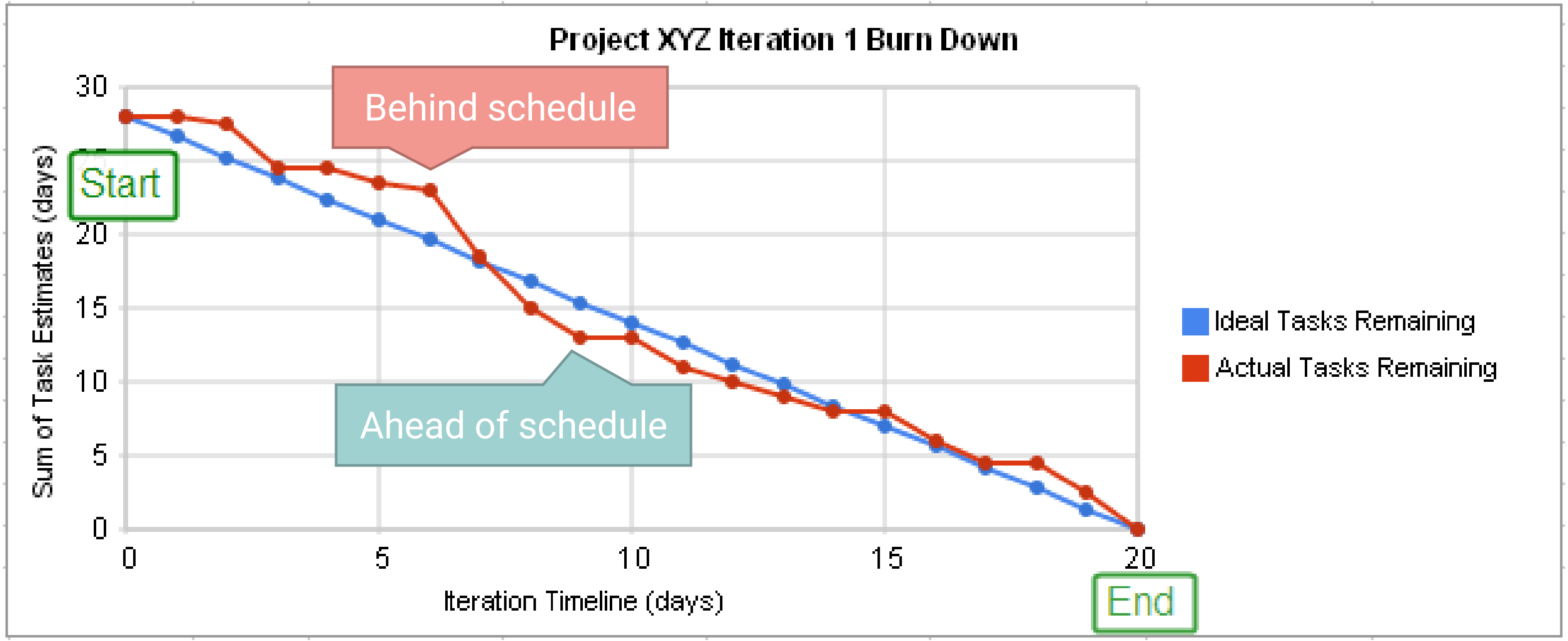
BURNDOWN CHARTS

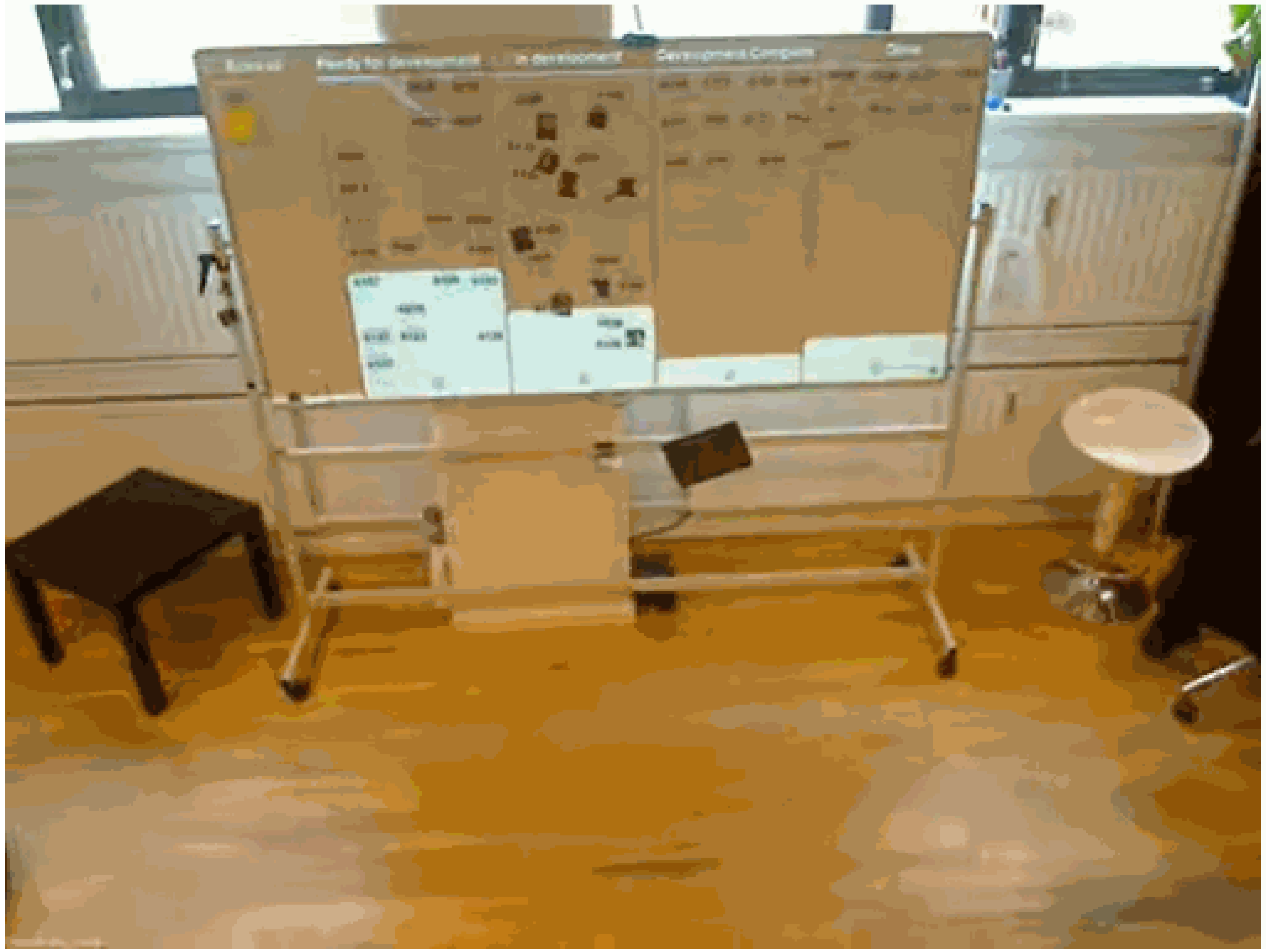
- A graphical representation of work left to do versus time.
- The backlog or effort remaining is often on the Y-axis, with time in the sprint along the X-axis
- Useful for predicting when all of the work will be completed



BURNDOWN CHARTS

- The top left corner is your starting point, and the successful project end is the bottom right.
- A straight line from start to finish represents your ideal work remaining
- A second line represents the actual work remaining





SCRUM BOARD AND BURNDOWN CHARTS IN ACTION

https://www.scruminc.com/sprint-burndown-chart/

SCRUM SUMMARY

Roles	Ceremonies	Artifacts
Product Owner	Sprint Planning	Product Backlog
Scrum Master	Daily Scrum	Sprint Backlog
Scrum Team	Sprint Review	Burndown Charts
	Sprint Retrospective	

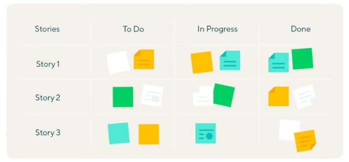
SCRUM CASE STUDY

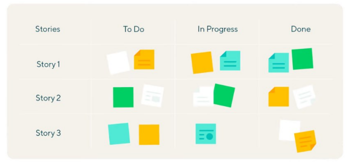
The adoption of Scrum by Google's marketing team led to a 30% improvement in campaign effectiveness and a 20% improvement in teamwork.

Scrum was adopted by Tesla for their autonomous driving project, which led to a 15% acceleration of the development cycle and a 10% decrease in errors.

Cisco switch from waterfall to agile for the billing platform, which led to 40% decrease in defect rate and 14% increase in defect removal.

APPLYING SCRUM IN OUR TEAM PROJECT





Week 1
Team up

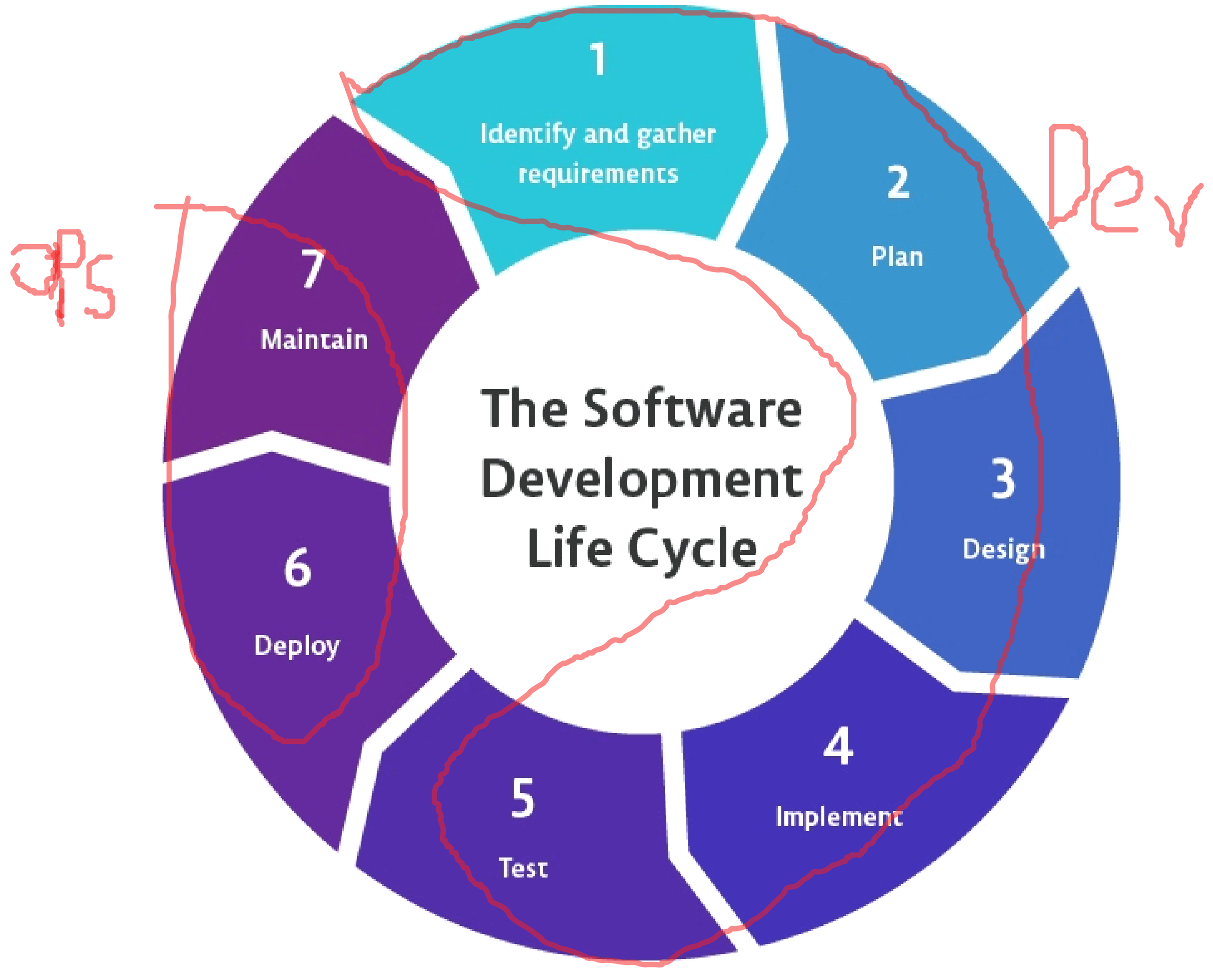
Week 5
Proposal

Week 9
Sprint 1

Week 16
Sprint 2

AGILE SEEMS GOOD.

Anything missing?



1
Identify and gather requirements
2
Plan
3
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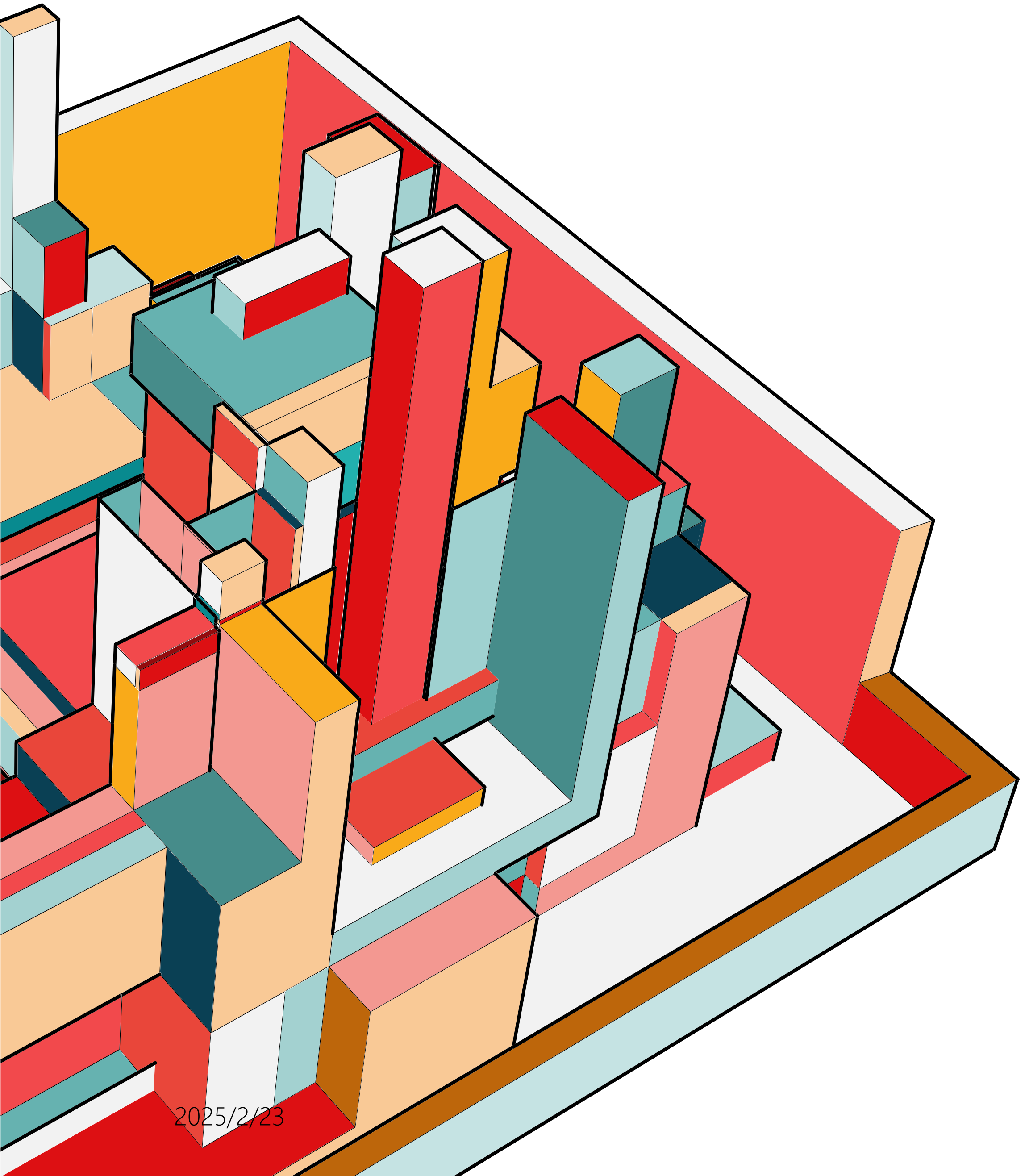
6
Deploy
7
Maintain
The Software Development Life Cycle
Dev
Ops



LECTURE 2

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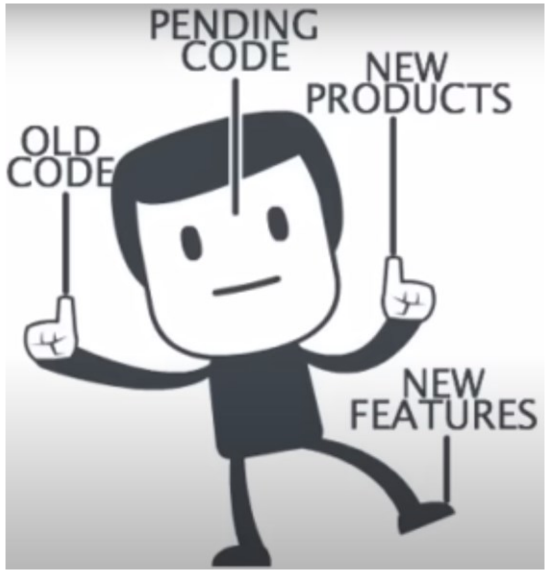
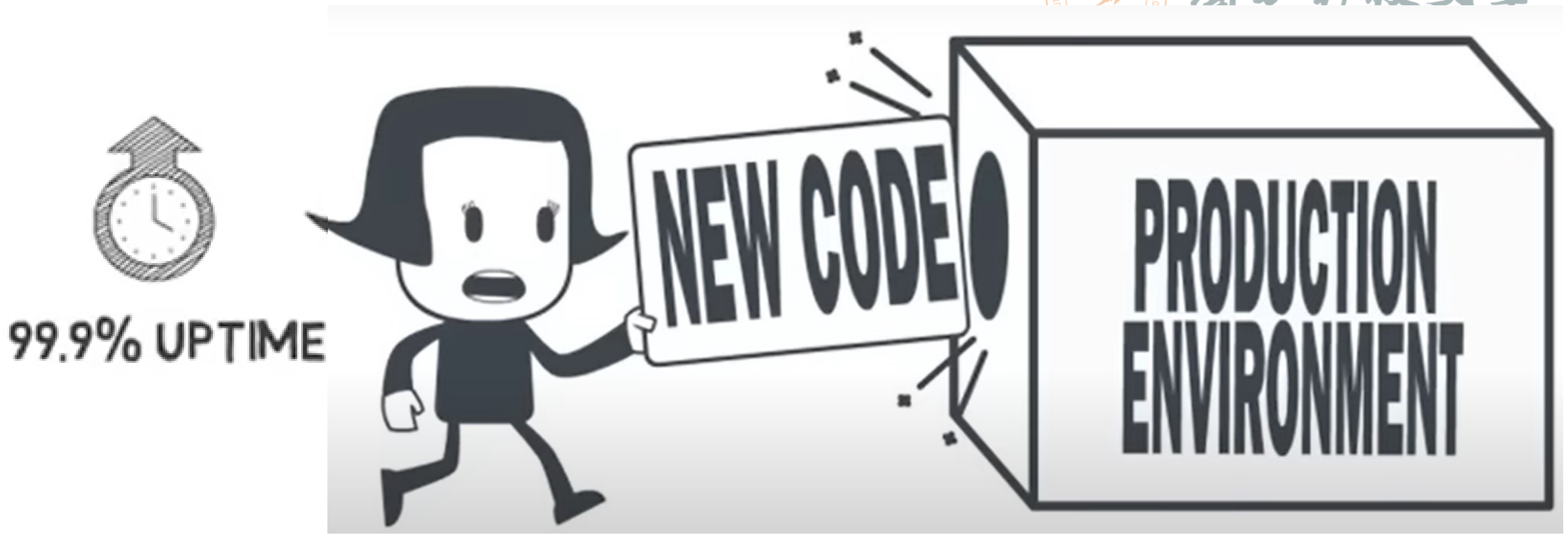
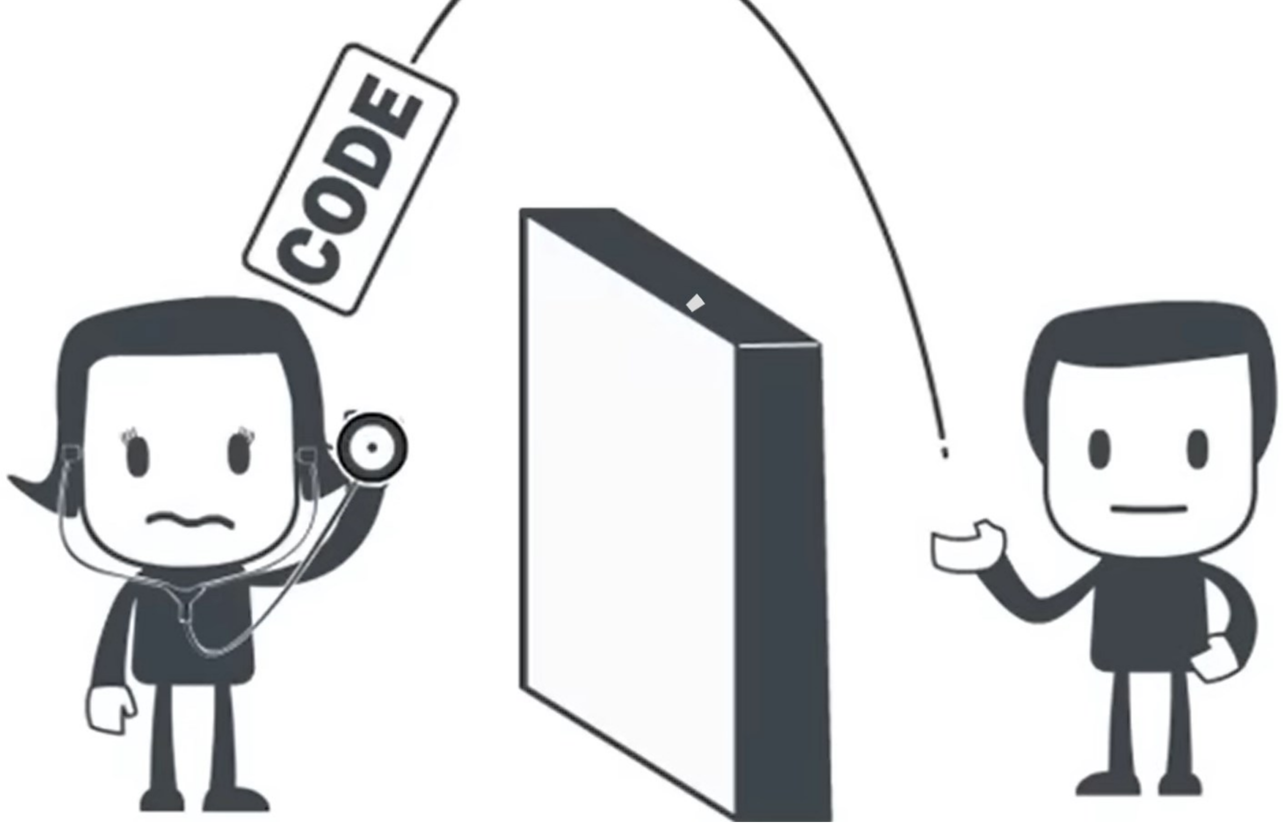




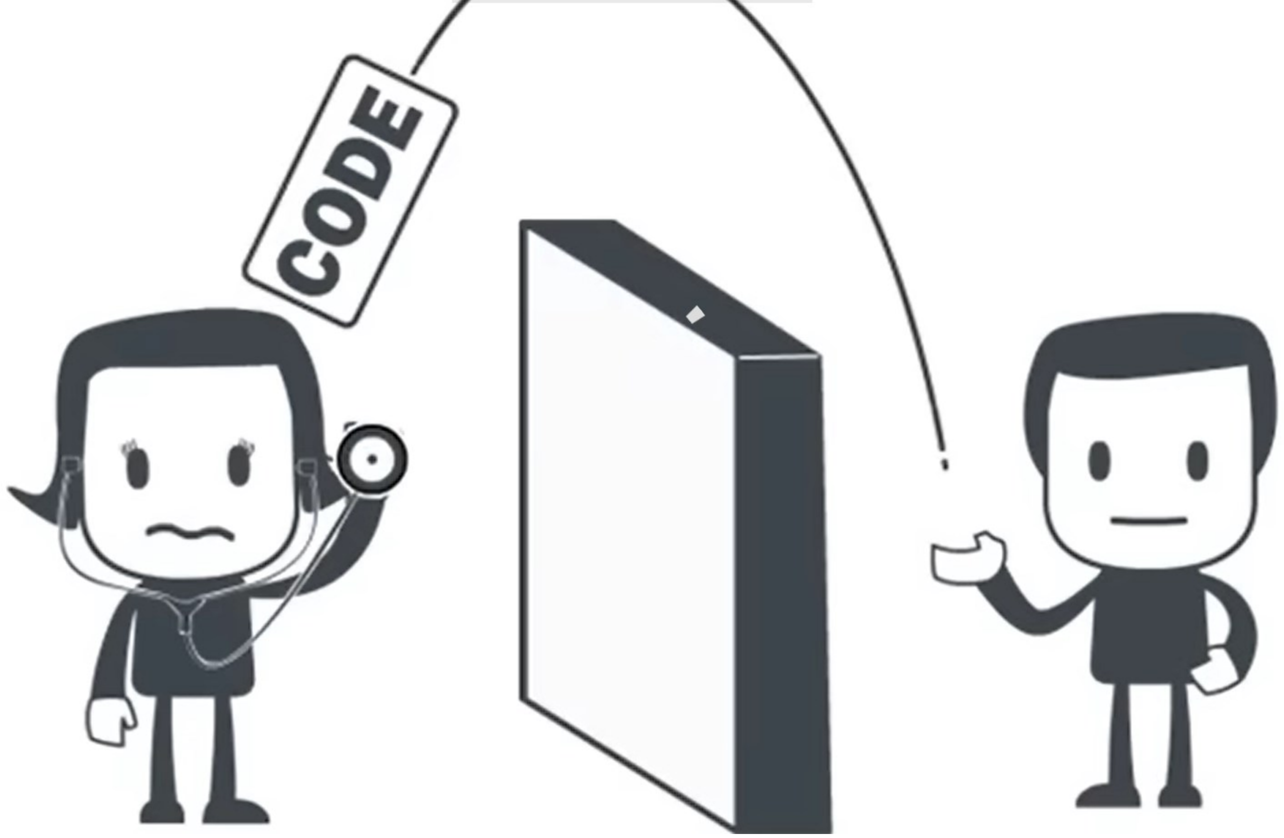
Dev (开发团队) responsibility:
- Design
- Develop
- Test
- Document

Ops (运维团队) responsibility:
- Deploy
- Release
- Stability of service
- Manage infrastructure
- Maintain & Feedback



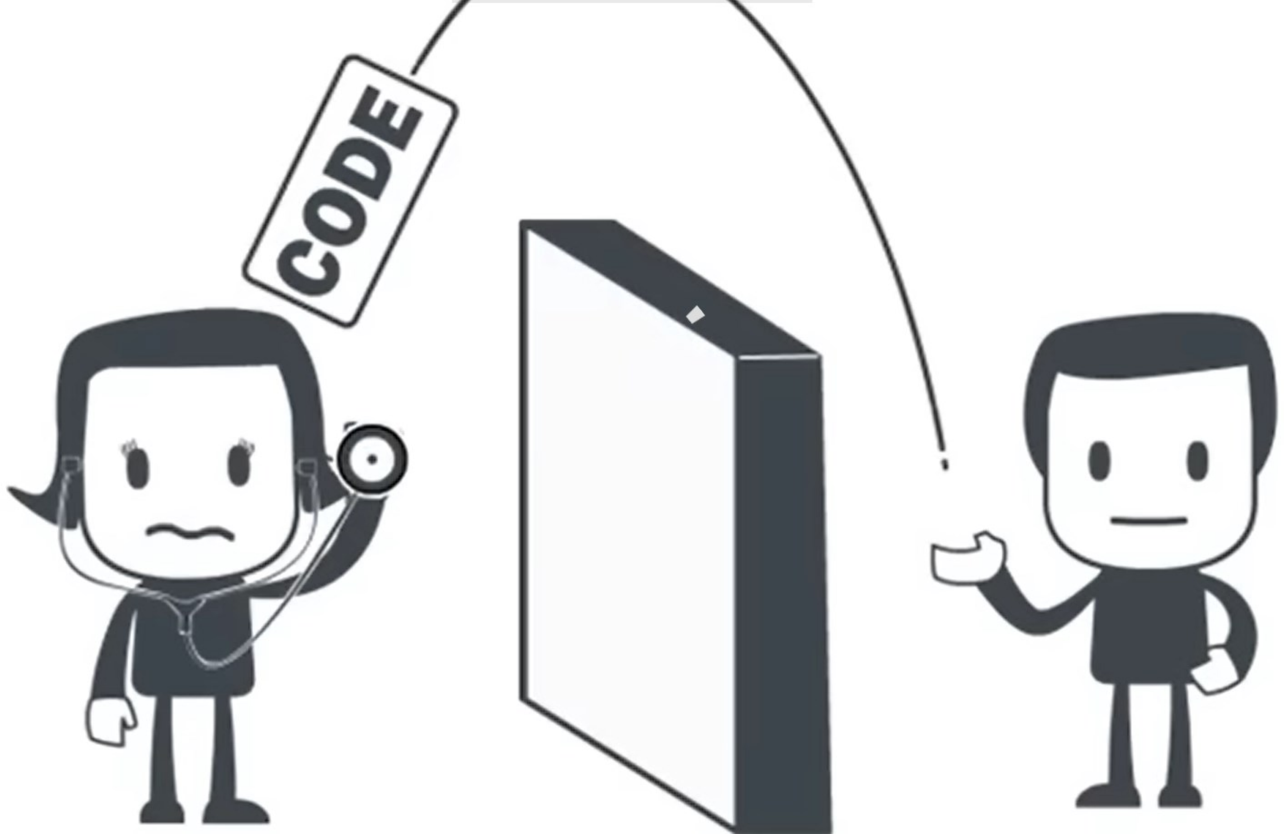
In traditional IT operations, Dev and Ops teams typically work sequentially and individually

Problems?



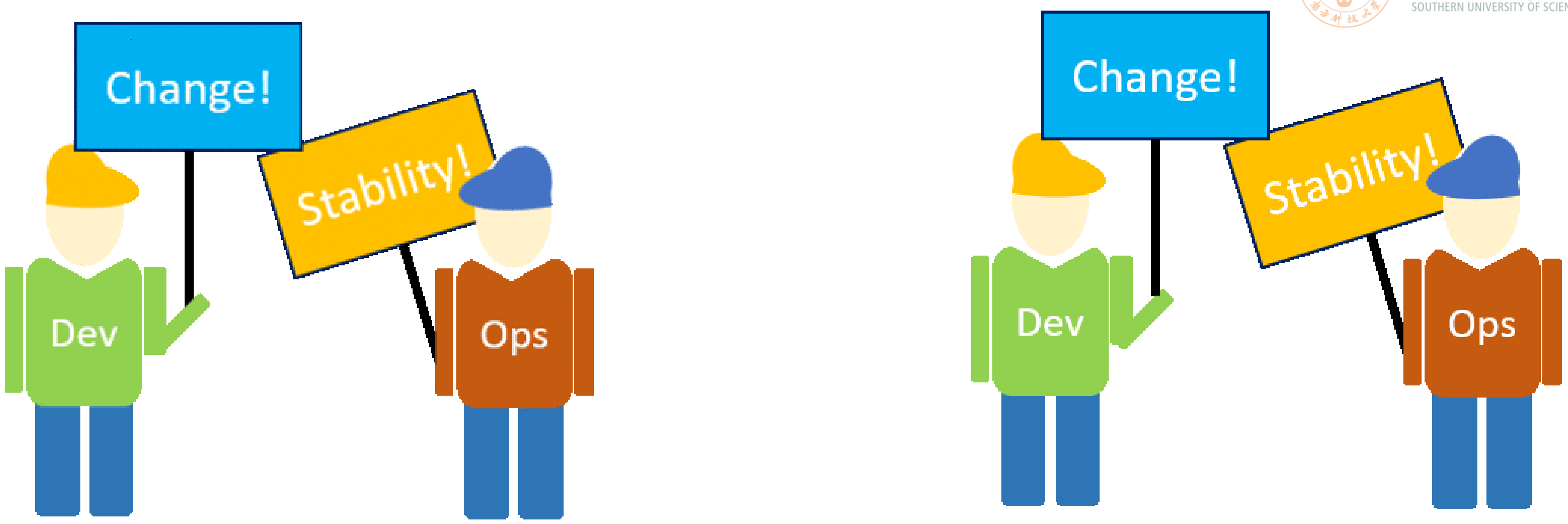
Problem 1: “It works on my machine. It’s your problem now.”

- In traditional software organization, dev-to-ops handoffs are typically one-way, often limited to a few scheduled times in an application's release cycle
- Once in production, the operations team take charge



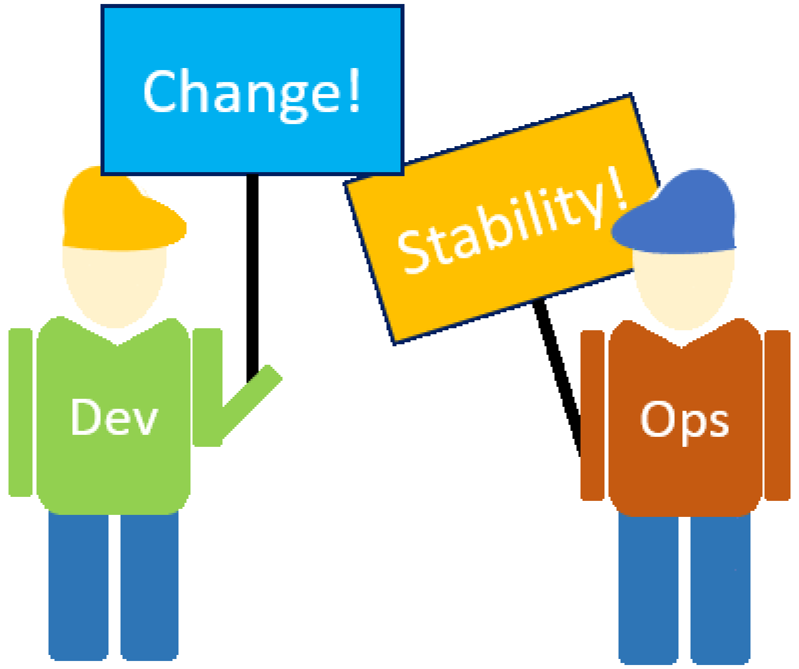
Problem 2: slow feedback, long time to ship

- If there are bugs in the code, the virtual assembly line of Devs-to-QAs-to-OPs is revisited with a patch, with each team waiting on the other for next steps, which might take weeks
- Such a model comes with significant overhead and extends the timeline



Reason: Conflicting objectives for Devs and Ops

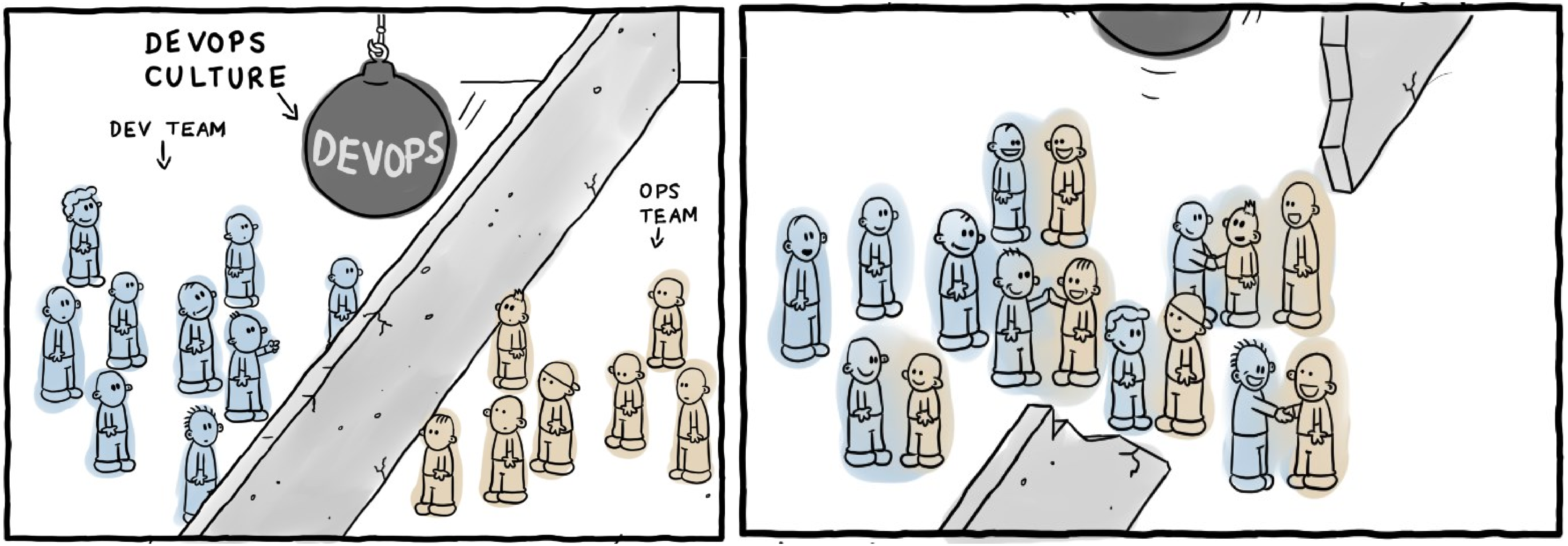
Image source: https://ralfneubauer.info/devops-gifs-reactions/



DevOps: Dev and Ops working closely and collaboratively with the same objective

Image source: https://ralfneubauer.info/devops-gifs-reactions/

BEFORE/AFTER DEVOPS



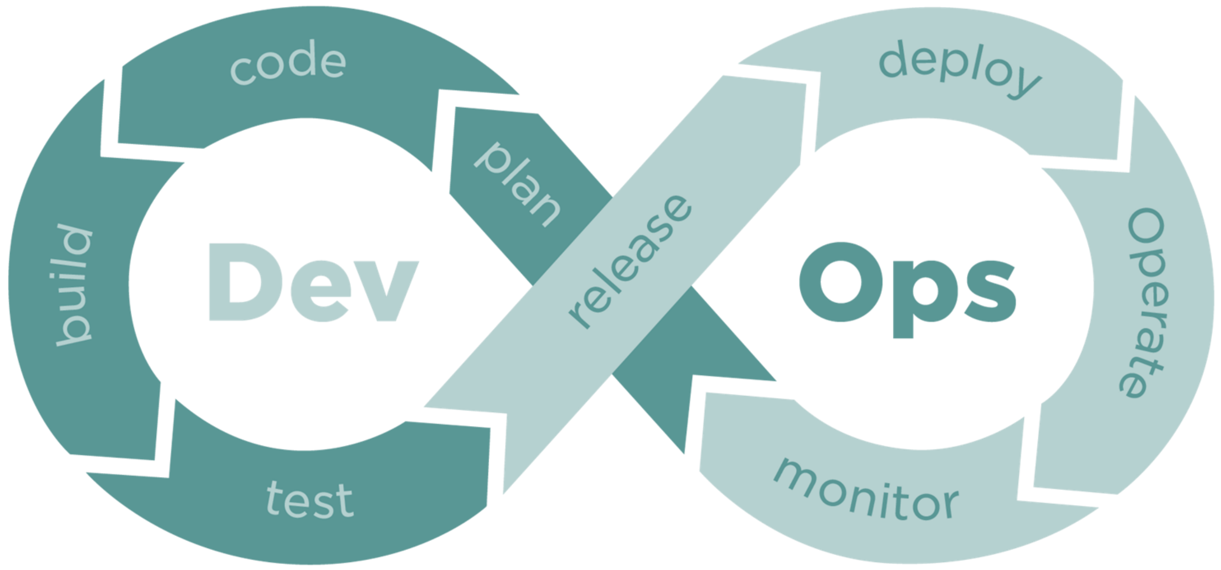
https://turnoff.us/geek/devops-explained/

DEVOPS

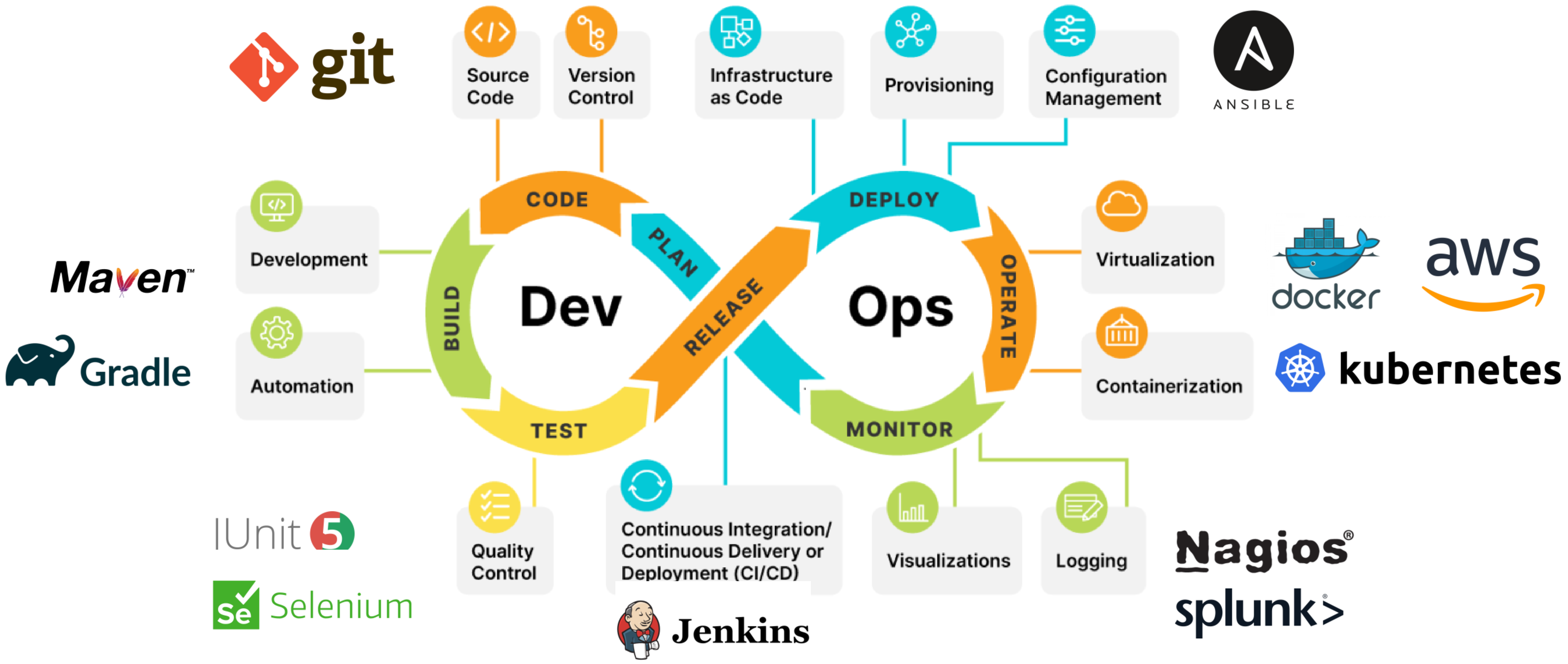
A culture, practice, and set of tools that integrate development (Dev) and operations (Ops).

Key principles

- Collaboration: Bridges the gap between developers and IT operations.
- Automation: Automates builds, testing, and deployments.
- Monitoring & Feedback: Uses real-time monitoring to improve system performance and user experience.



DEVOPS PHASES & TOOLS

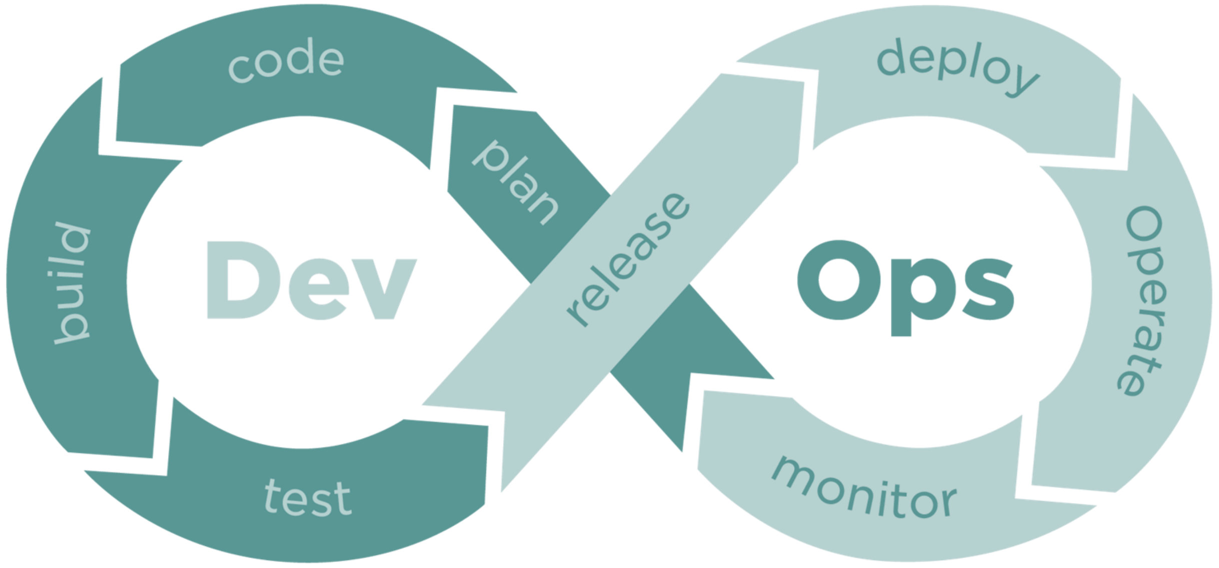


DEVOPS

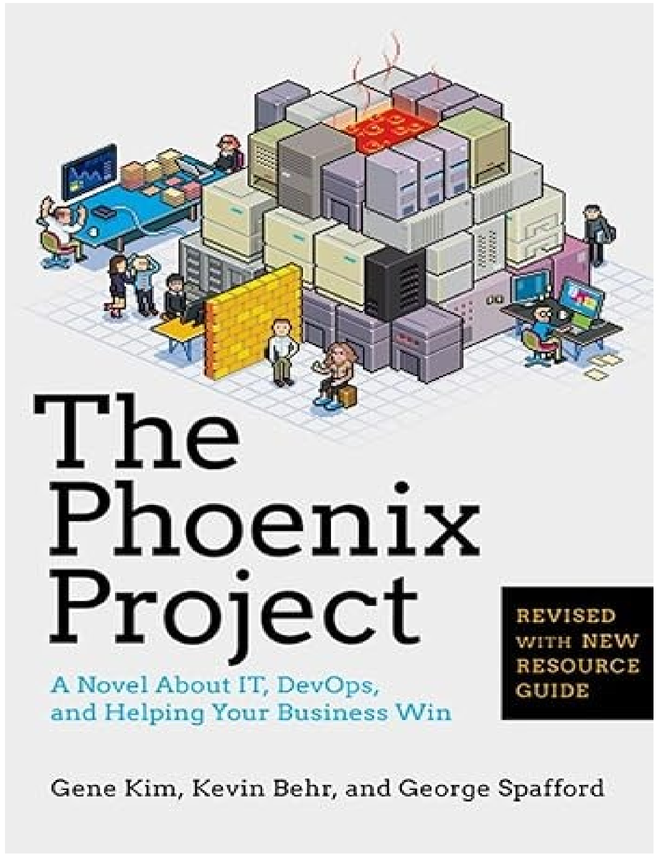
A culture, practice, and set of tools that integrate development (Dev) and operations (Ops).

Benefits

- Faster software releases
- Faster feedback
- Improved system reliability and stability
- Reduced deployment failures and rollback times
- Increased efficiency and resource utilization



READINGS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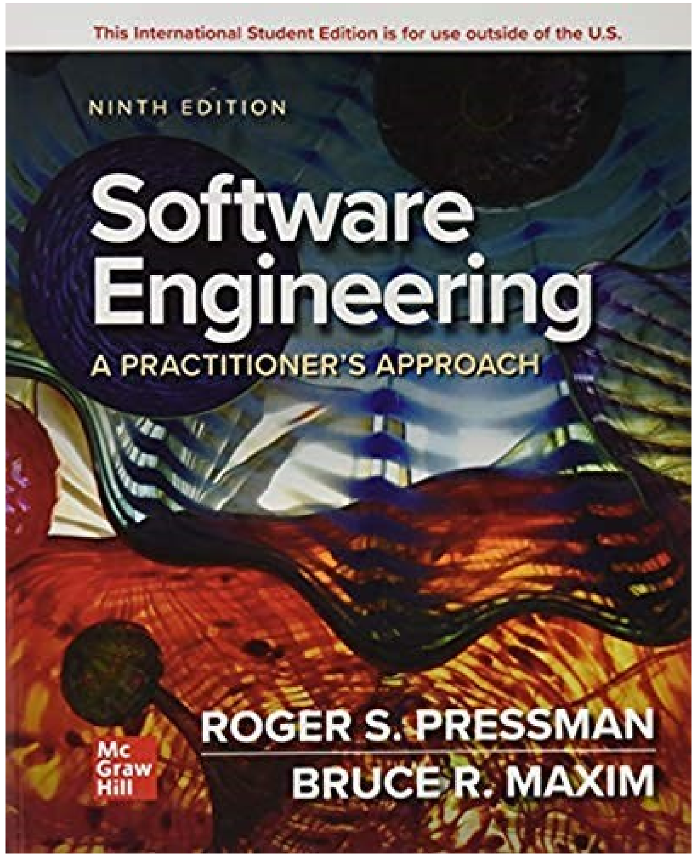
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- Chapter 3: Agile Development

NEXT

- Software Requirements