CS207 Software Design

Agile & Scrum

What is software engineering?

- A systematic, disciplined, quantifiable approach to development
  - We attempt to formalize software development in order to develop best practices to ensure quality and consistency
  - Structural engineers are responsible if their bridge falls apart – we want the same accountability for software developers
- Recognizing problems that are already solved and applying known solutions can ensure a higher level of consistency
  - We do not always need to reinvent the wheel

Software Engineering Components

- Requirements analysis
- Design
- Construction
- Testing
- Validation
- Maintenance

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The early days of software development

- In the early days, the cost of developing software was relatively small compared to the hardware cost
- The software was offered for free to the customers who purchased the computing equipment

Issues today

- Large software projects cost tens of millions (or even hundreds of millions) of dollars to produce, employing hundreds of developers, and other team members of all sorts
- Keeping this massive projects on-time and on-budget has become a huge priority, and for the most part a huge nightmare
- Companies are less willing to take risks and innovate since they are not guaranteed a success in the market
- Developers are expected to work long hours, putting their health and other factors at risk

From lone wolf to team member

- Initially, software was often written by a single developer
- As software became more complex there became a need to scale and grow out teams of people to work on a single property
- Increased budgets / risk caused companies to start finding ways to try and minimize these potential pitfalls

Reducing the risk

- To reduce the risk, many companies adopted waterfall-style methodologies used by other industries.
- Waterfall methodology employed the idea of developing a large software project through a series of phases.
- Each phase lead to a subsequent phase more expensive than the previous.
- The initial phases consisted of writing plans about how to build the software.
- The software was written in the middle phase.
- The final phase was integrating all the software components and testing the software. Each phase was intended to reduce risk before moving on to more expensive phases.

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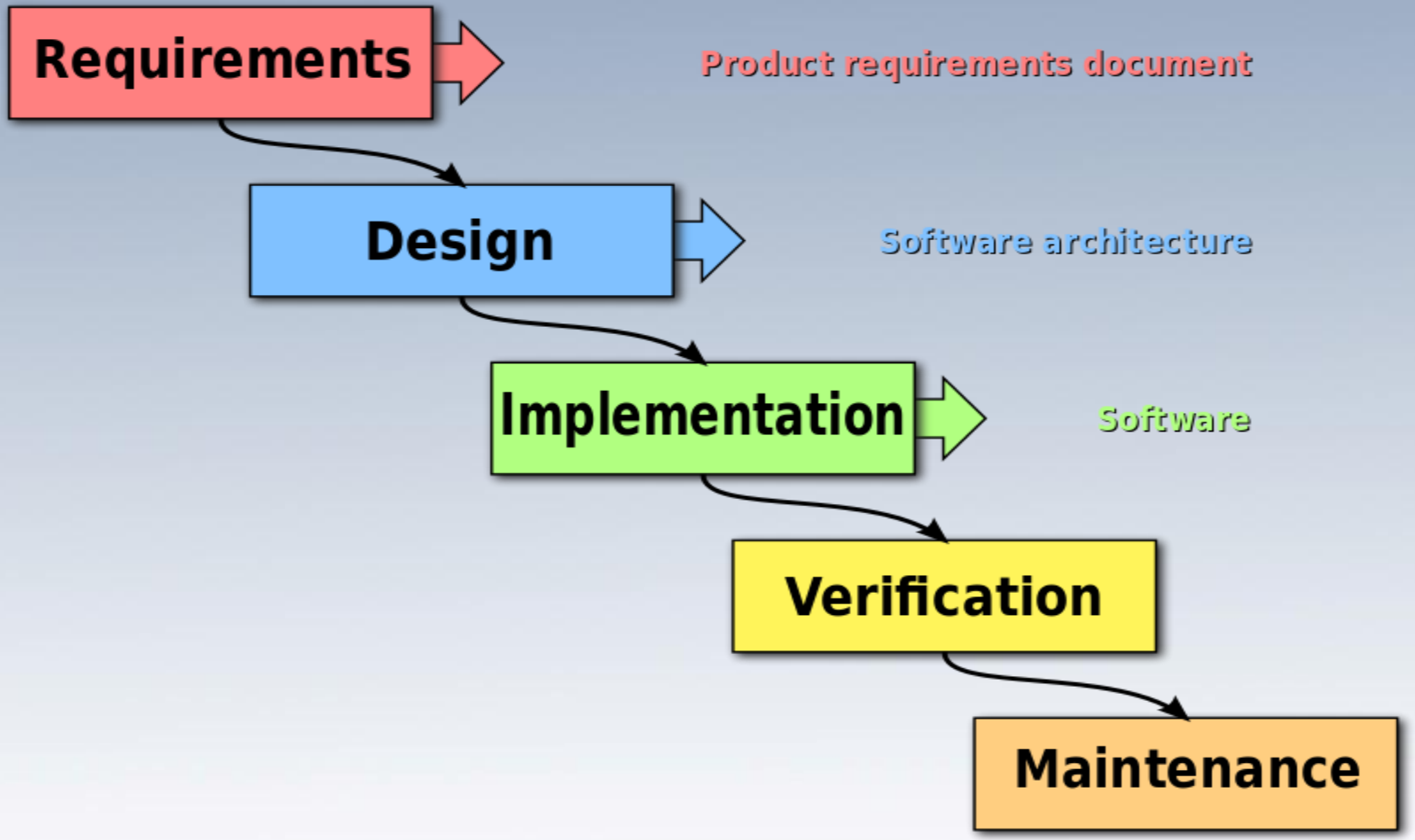
The waterfall model



Waterfall continued

- Each phase is more expensive than the previous
  - More time spent in the earlier phases translates to savings later on down the line
- Projects should not return to a previous stage once they have moved on
  - Extremely linear and rigid
  - Does not allow for many revisions or change things not considered in the design phase

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Why old methodologies failed

- The mains reason is the so-called “cognitive friction” – the resistance encountered by a human intellect when engaged with a complex system of rules that change as the problem changes.
- Example: violin is a complex instruments but never enters a “meta-state” in which various inputs make is sound like a piano or bell. Although violin’s behaviour is complex, it is predictable.
- On a computer screen, everything is filled with cognitive friction. Even a simple interface as www presents the user with a more intense mental engagement because all you can do is click on a hyperlink, but what the link points to can change independently of the pointer without any outward indication.
- So the hyperlink’s function is actually a hyperfunction!

What goes wrong?

- Unachievable ship date (features keep changing during development)
- Going into production too soon
- Adding people late to the project (count how much time do new people to come up to speed!)
  - Fred Brooks law
- Underestimating technical challenges

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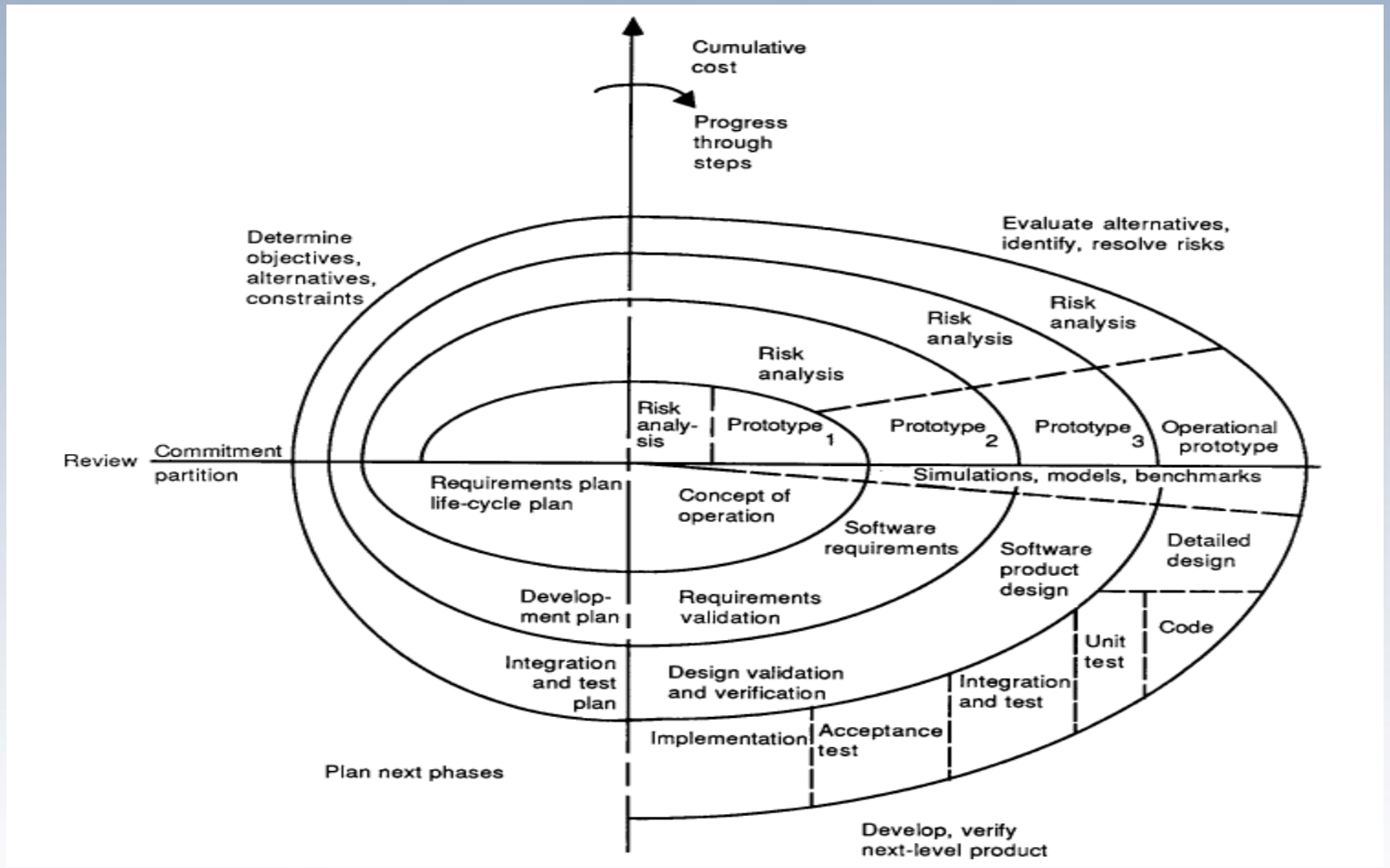
Early alternatives – spiral model



Alternative Methodologies

- As companies began to realize that the waterfall method was failing them (large projects were failing completely or going way over budget) alternatives were sought
- A gradual trend was in methods that used an incremental development of product using iterations (almost like smaller waterfalls)
  - Iterations could be only a few weeks, but still included the full cycle of analysis, design, coding, etc.
- These various lightweight development methods were later referred to as **agile** methodologies

Agile Manifesto

- We 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
  - (there is value to the items on the right, but the left is valued more)

Agile frameworks

- Agile refers to a number of different frameworks that share these values:
  - Extreme programming (XP) (advocates frequent "releases" in short development cycles, which is intended to improve productivity and introduce checkpoints at which new customer requirements can be adopted; also programming in pairs)
  - Scrum (a flexible, holistic product development strategy where a development team works as a unit to reach a common goal)
  - Lean software development:
    - Eliminate waste, amplify learning, decide as late as possible, deliver as fast as possible, empower the team, build flexibility in, see the whole

Why use Agile?

- Demand for higher quality, with lower cost
- Post-mortems of various projects lead to a lot of knowledge gain about what went right / wrong during the development phase
  - With the waterfall model, we do not have a clear way to predict the future, so these lessons are always in hindsight
  - Smaller, iterative schedules mean problems can be identified / address much earlier in the cycle

Using iterative development

- Iterative design means we build a product in small steps
  - Incrementally add features
  - Software is in working condition at least every few weeks
  - Allows people to test earlier in the development cycle

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Agile Team Management

- From the bottom up
- Teams are empowered to manage the smallest level of details, while leaving the higher levels to upper management
- Teams upon seeing the small amount of ownership they get from solving smaller problems take on responsibility for larger problems
  - Head off issues before they become major problems
  - Individuals solve problem with their colleagues

An Agile Project

- An agile project consists of a series of iterations of development
- Each interval usually lasts only two to four weeks
- Developers implement features during each iteration that add value to the project
  - The features are called **user stories**

Iterations

- Each iteration contains a full development cycle
  - Analysis
  - Design
  - Coding
  - Testing
- The product is reviewed at the end of each iteration
  - Results are used to direct future iterations

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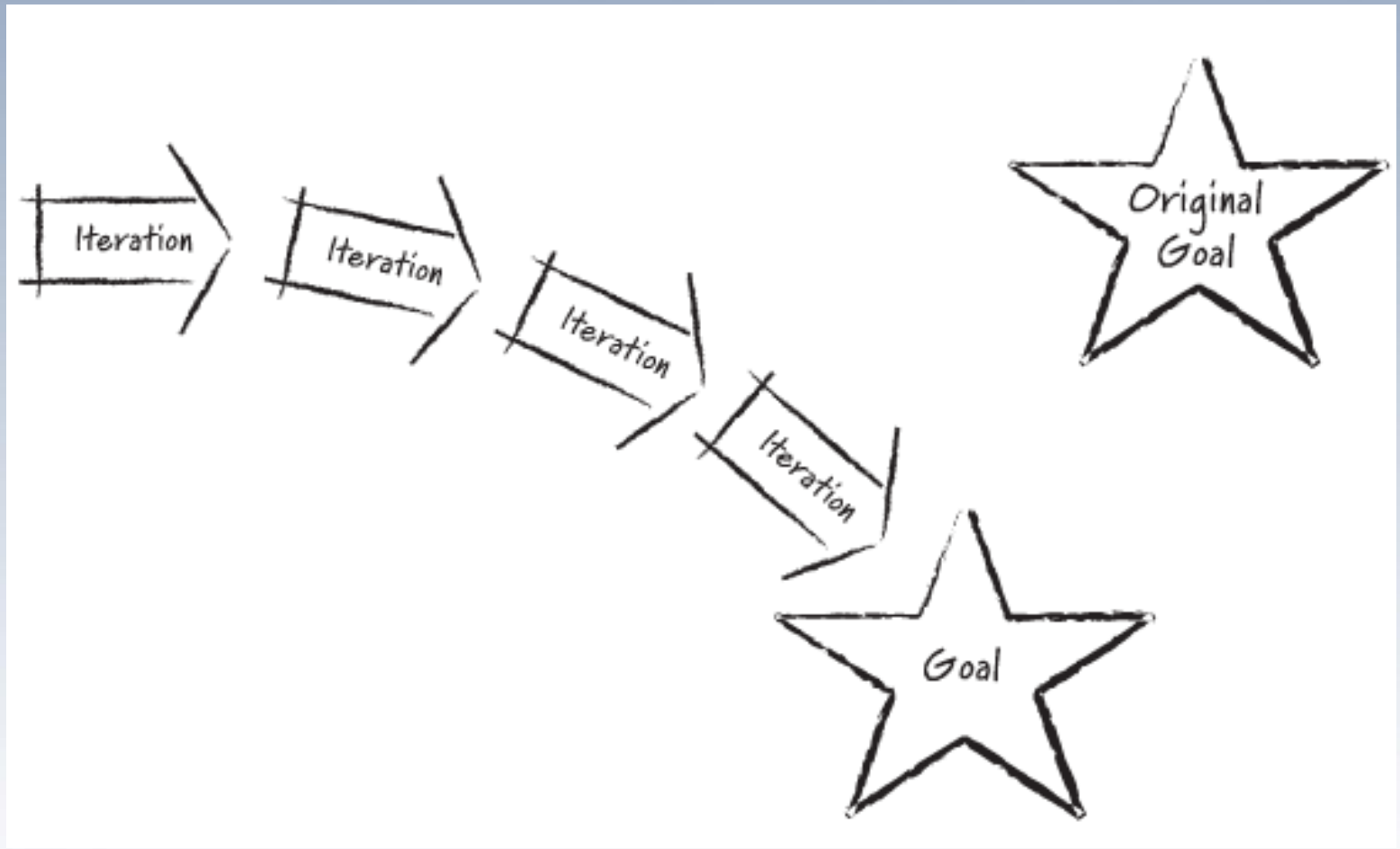
Iterations



Sprints

- In traditional agile development (outside of the game industry) software is brought to release level every few months
  - They use releases, which are sets of sprints, to produce shippable versions of their products
- Agile projects use these sprints as milestones for deliverables such as “near shippable”

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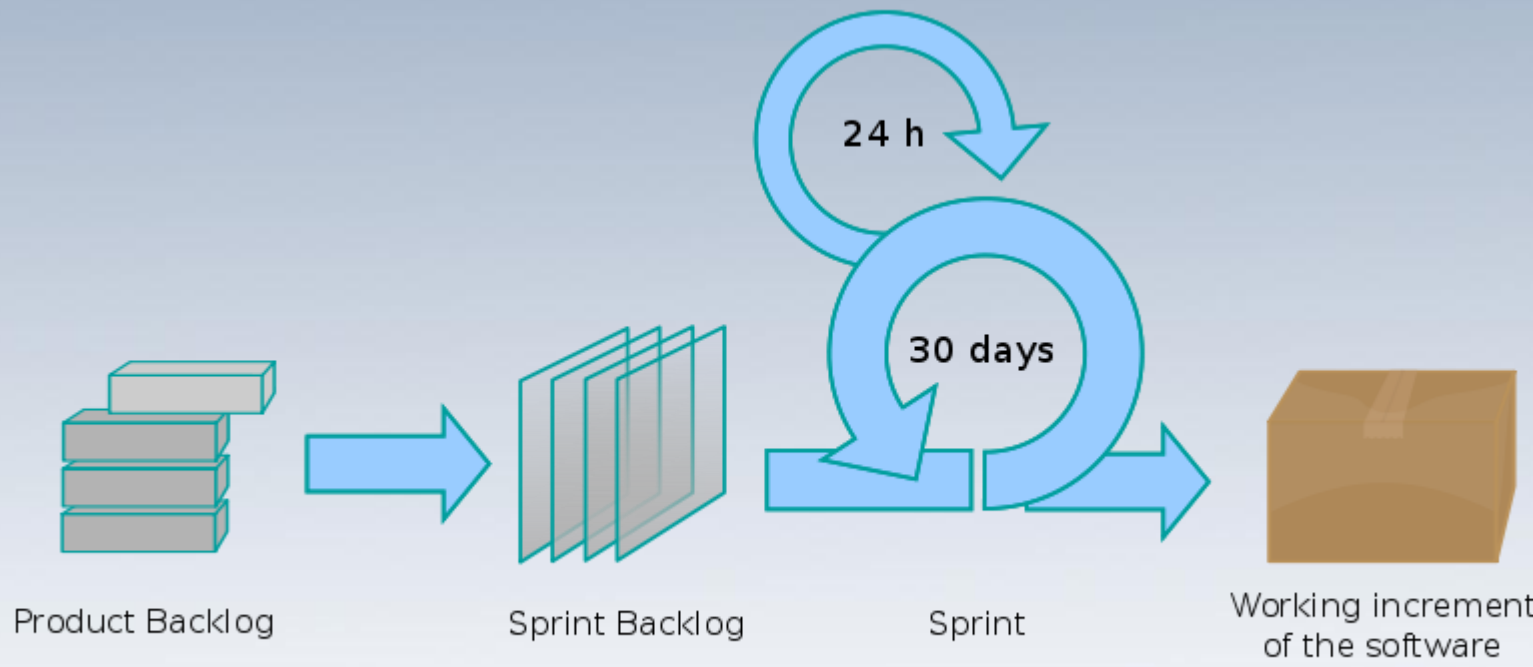
Scrum



Scrum

- Scrum is mainly about the management of software development projects
- Sprint
  - Basic unit of development in a scrum
  - Fixed-length – typically from one week to a month
  - Each sprint begins with a planning meeting to determine the tasks for the sprint and estimates are made
  - During each sprint a potentially deliverable product is produced
    - Features are pulled from a product backlog – a prioritized set of high-level work requirements

Scrum

- During a sprint, there are daily scrum meetings
  - Daily scrum or daily standup
  - No more than 15 minutes
  - Meeting must start on-time, and happen at the same location
  - Each member answers the following:
    - What have you done since yesterday?
    - What are you planning on doing today?
    - Any impediments or stumbling blocks?
  - A scrum master will handle resolving any impediments outside of this meeting

Key features of a scrum

- During a project a customer may change their minds about what they want / need
  - Accepts that the problem cannot be fully understood or defined, instead allows teams to delivery quickly and respond to changes in a timely manner

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What is Scrum?

- A framework for creating complex products
- Creates an incremental and interactive development process
- Is self-managing
- Uses cross-disciplined teams
- An ever-changing, never-ending pursuit of improvement
- Consists of simple rules, but these rules vastly improve how teams work together

What scrum is not

- It is not a processor or methodology
- It is not specific enough to tell programmers, artists, QA, producers, etc. how to do their jobs
  - Companies merge their own practices into the scrum framework to create a new methodology

Process

- Software development, using scrum, progresses in two to four week iterations called sprints
  - Teams are generally 6-10 people in size and consist of a range of disciplines (not just programming)
- Sprints start with a **sprint planning meeting**
  - Each team selects a set of features from the **product backlog** – a prioritized list of features, each feature is referred to as a **product backlog item (PBI)**
  - The team creates time estimates for each PBI to create a **sprint backlog**
  - Teams only select features that they believe are achievable

Process continued

- Teams have daily 15-minute meetings (called the **daily scrum**)
  - Progress and any impediments to work are shared
  - Meetings are strictly limited to 15 minute **timeboxes**, regardless of whether or not the agenda is met
- At the end of a sprint, a **potentially shippable** version of the software has been created
  - Stakeholders (to be defined later) have a **sprint review meeting** to determine if the goals of the sprint were met and make adjustments as needed to the product backlog
- There may also be a **sprint retrospective** – sort of like a mini post-mortem

Scrum Principles

- Although scrum practices will evolve and be adapted to suit each individual team / project, a number of core principles should be upheld:
  - **Empiricism**: inspect and adapt – respond to emerging changes
  - **Emergence**: we can't know everything about a design at the start, so we can capitalize on a emerging features as they become apparent
  - **Timeboxing**: scrum delivers value on a regular basis, allows project to be synchronized and micro-steered throughout
  - **Prioritization**: some features are more important to stakeholders than others. Features are developed based on their value
  - **Self-organization**: small, cross-disciplined teams are given power to organize their membership, manage processes and create the best possible product within timeboxes

Product Backlog

- Prioritized list of requirements (called PBI's)
- The product backlog can change after each sprint
  - New PBI's that weren't thought of can be added
  - PBI's that are no longer needed can be removed
  - Priorities can be updated

Sprints

- The overall objective of a sprint is called the sprint goal
  - Sprint goals remains unchanged throughout the sprint
  - At the end of a sprint the stakeholders are shown a new version of the game which demonstrates the sprint goal
- Sprints produce vertical slices of functionality
  - Each sprint contains design, coding, testing, debugging and optimization
- Many features will require multiple sprints to develop
  - Each sprint must still demonstrate value
  - Allows for uncertainty or risk to be removed from the project as early as possible

Scaling Scrum

- Scrum teams should have less than a dozen members
- Larger teams are supported through scaling
  - A number of Scrum teams work in parallel
  - Work is coordinated through practices like the scrum of scrums

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Sprint basic rules

- Sprint are timeboxed, usually two to four weeks in length
- The team commits to completing a print goal
- No additions or changes are made by anyone outside the team

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Sprint Planning

- A the beginning of a sprint, teams meet with stakeholder to plan the next sprint over two meetings:
  - Sprint prioritization meeting
  - Sprint planning meeting