

# Software Engineering

# Introduction to Software Engineering

1122SE01

MBA, IM, NTPU (M5010) (Spring 2024)  
Wed 2, 3, 4 (9:10-12:00) (B3F17)

Min-Yuh Day, Ph.D,  
Associate Professor

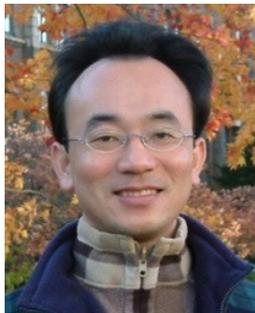
Institute of Information Management, National Taipei University

<https://web.ntpu.edu.tw/~myday>

2024-02-21



<https://meet.google.com/ish-gzmy-pmo>





# Min-Yuh Day, Ph.D.



2020 Cohort



2020 Cohort



Accredited Educator



Solutions Architect Associate



Cloud Practitioner

**Associate Professor, Information Management, NTPU**

**Visiting Scholar, IIS, Academia Sinica**

**Ph.D., Information Management, NTU**

**Director, Intelligent Financial Innovation Technology, IFIT Lab, IM, NTPU**

**Associate Director, Fintech and Green Finance Center, NTPU**

**Artificial Intelligence, Financial Technology, Big Data Analytics,  
Data Mining and Text Mining, Electronic Commerce**



# Course Syllabus

## National Taipei University

### Academic Year 112, 2<sup>nd</sup> Semester (Spring 2024)

- **Course Title: Software Engineering**
- **Instructor: Min-Yuh Day**
- **Course Class: MBA, IM, NTPU (3 Credits, Elective)  
GMBA in Finance; SHM; IPUG**
- **Details**
  - **In-Person and Distance Learning EMI Course  
(3 Credits, Elective, One Semester) (M5010)**
- **Time & Place: Wed, 2, 3, 4, (9:10-12:00) (B3F17)**
- **Google Meet: <https://meet.google.com/ish-gzmy-pmo>**



[https://meet.google.com/  
ish-gzmy-pmo](https://meet.google.com/ish-gzmy-pmo)



# Course Objectives

1. Understand the **fundamental concepts and research issues of software engineering**.
2. Equip with **Hands-on practices of software engineering**.
3. Conduct **information systems research in the context of software engineering**.

# Course Outline

- This course introduces the **fundamental concepts, research issues, and hands-on practices of software engineering.**
- **Topics include:**
  1. Introduction to Software Engineering
  2. Software Products and Project Management: Software product management and prototyping
  3. Agile Software Engineering: Agile methods, Scrum, and Extreme Programming
  4. Features, Scenarios, and Stories
  5. Software Architecture: Architectural design, System decomposition, and Distribution architecture
  6. Cloud-Based Software: Virtualization and containers, Everything as a service, Software as a service
  7. Cloud Computing and Cloud Software Architecture
  8. Microservices Architecture, RESTful services, Service deployment
  9. Security and Privacy; Reliable Programming
  10. Testing: Functional testing, Test automation, Test-driven development, and Code reviews
  11. DevOps and Code Management: Code management and DevOps automation
  12. Case Study on Software Engineering

# Core Competence

- **Exploring new knowledge in information technology, system development and application 80 %**
- **Internet marketing planning ability 10 %**
- **Thesis writing and independent research skills 10 %**

# Four Fundamental Qualities

- **Professionalism**
  - **Creative thinking and Problem-solving 30 %**
  - **Comprehensive Integration 30 %**
- **Interpersonal Relationship**
  - **Communication and Coordination 10 %**
  - **Teamwork 10 %**
- **Ethics**
  - **Honesty and Integrity 5 %**
  - **Self-Esteem and Self-reflection 5 %**
- **International Vision**
  - **Caring for Diversity 5 %**
  - **Interdisciplinary Vision 5 %**

# College Learning Goals

- **Ethics/Corporate Social Responsibility**
- **Global Knowledge/Awareness**
- **Communication**
- **Analytical and Critical Thinking**

# Department Learning Goals

- **Information Technologies and System Development Capabilities**
- **Internet Marketing Management Capabilities**
- **Research capabilities**

# Syllabus

Week	Date	Subject/Topics
1	2024/02/21	Introduction to Software Engineering
2	2024/02/28	Peace Memorial Day (Day Off)
3	2024/03/06	Software Products and Project Management: Software product management and prototyping
4	2024/03/13	Agile Software Engineering: Agile methods, Scrum, and Extreme Programming
5	2024/03/20	Case Study on Software Engineering I
6	2024/03/27	Features, Scenarios, and Stories
7	2024/04/03	Make-up holiday for NTPU Sports Day (No Classes)
8	2024/04/10	Midterm Project Report

# Syllabus

Week	Date	Subject/Topics
9	2024/04/17	Software Architecture: Architectural design, System decomposition, and Distribution architecture
10	2024/04/24	Cloud-Based Software: Virtualization and containers, Everything as a service, Software as a service; Cloud Computing and Cloud Software Architecture
11	2024/05/01	Case Study on Software Engineering II
12	2024/05/08	Microservices Architecture, RESTful services, Service deployment
13	2024/05/15	Industry Practices of Software Engineering

# Syllabus

**Week Date Subject/Topics**

**14 2024/05/22 Security and Privacy; Reliable Programming;  
Testing: Functional testing, Test automation,  
Test-driven development, and Code reviews;  
DevOps and Code Management:  
Code management and DevOps automation**

**15 2024/05/29 Final Project Report I**

**16 2024/06/05 Final Project Report II**

# Teaching Methods and Activities

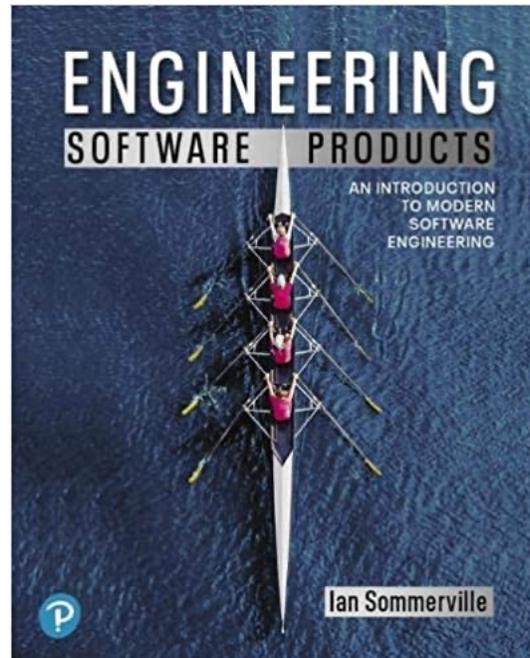
- **Lecture**
- **Discussion**
- **Practicum**

# Evaluation Methods

- **Individual Presentation 60 %**
- **Group Presentation 10 %**
- **Case Report 10 %**
- **Class Participation 10 %**
- **Assignment 10 %**

# Required Texts

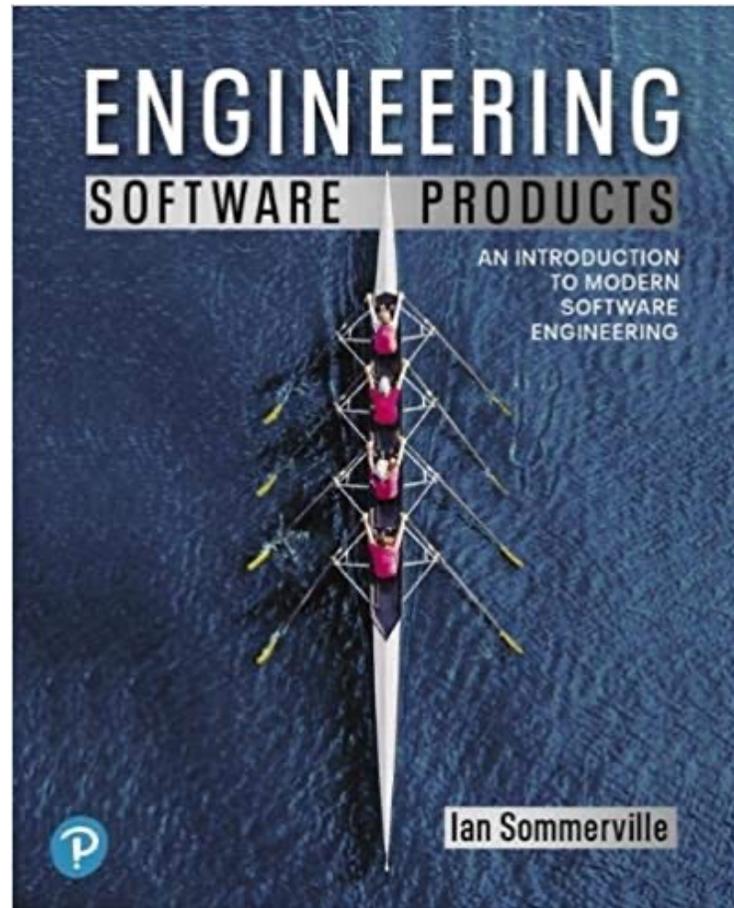
- **Ian Sommerville (2019),  
Engineering Software Products:  
An Introduction to Modern Software Engineering,  
Pearson.**



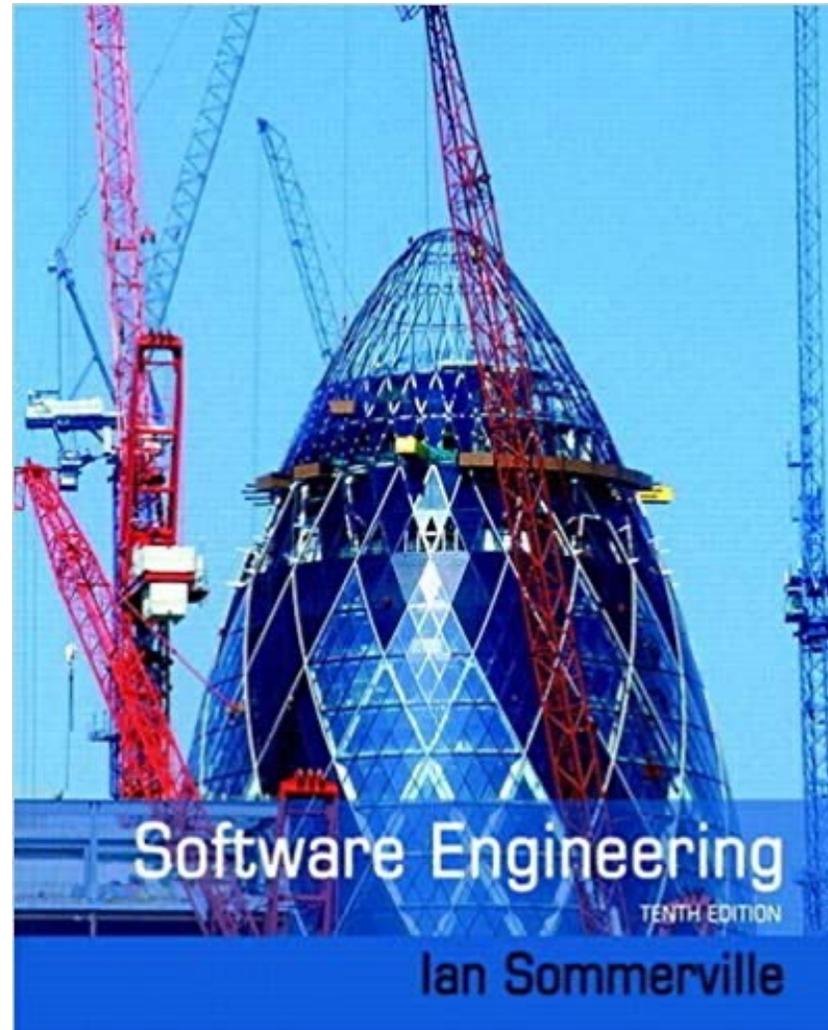
# Reference Books

- Ian Sommerville (2015),  
Software Engineering,  
10th Edition, Pearson.
- Titus Winters, Tom Manshreck, and Hyrum Wright (2020),  
Software Engineering at Google: Lessons Learned from Programming Over  
Time, O'Reilly Media.
- Project Management Institute (2017),  
Agile Practice Guide, PMI
- Project Management Institute (2021),  
A Guide to the Project Management Body of Knowledge (PMBOK Guide) –  
Seventh Edition and The Standard for Project Management, PMI

Ian Sommerville (2019),  
**Engineering Software Products:**  
An Introduction to Modern Software Engineering,  
Pearson.

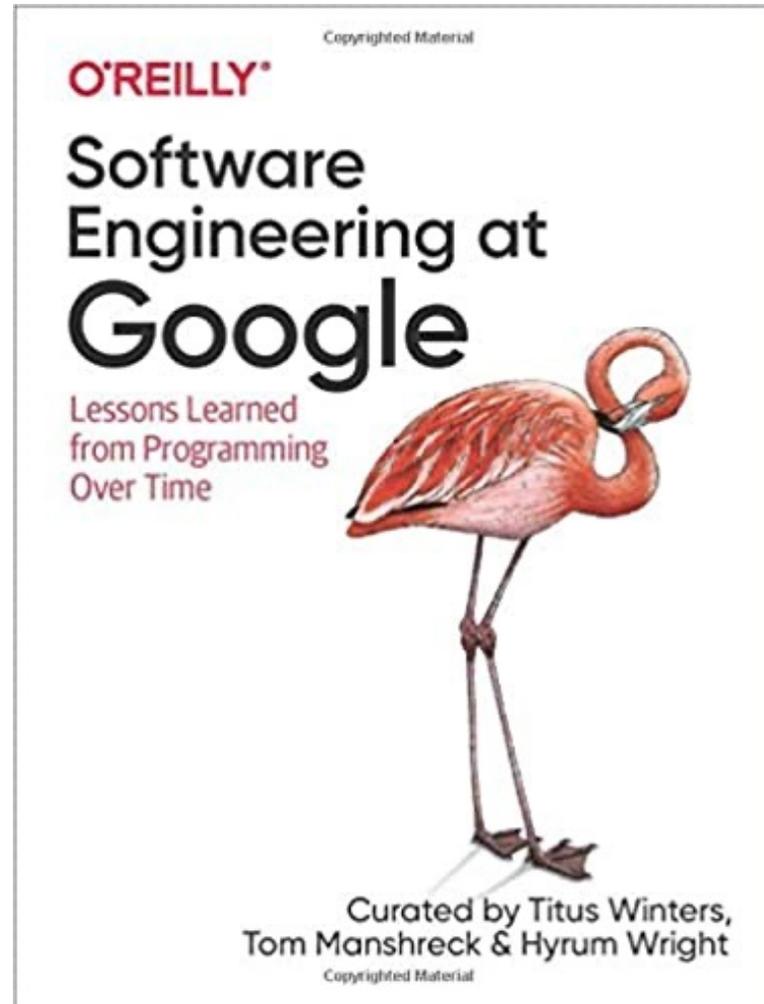


Ian Sommerville (2015),  
**Software Engineering,**  
10<sup>th</sup> Edition, Pearson.



Titus Winters, Tom Manshreck, and Hyrum Wright (2020),

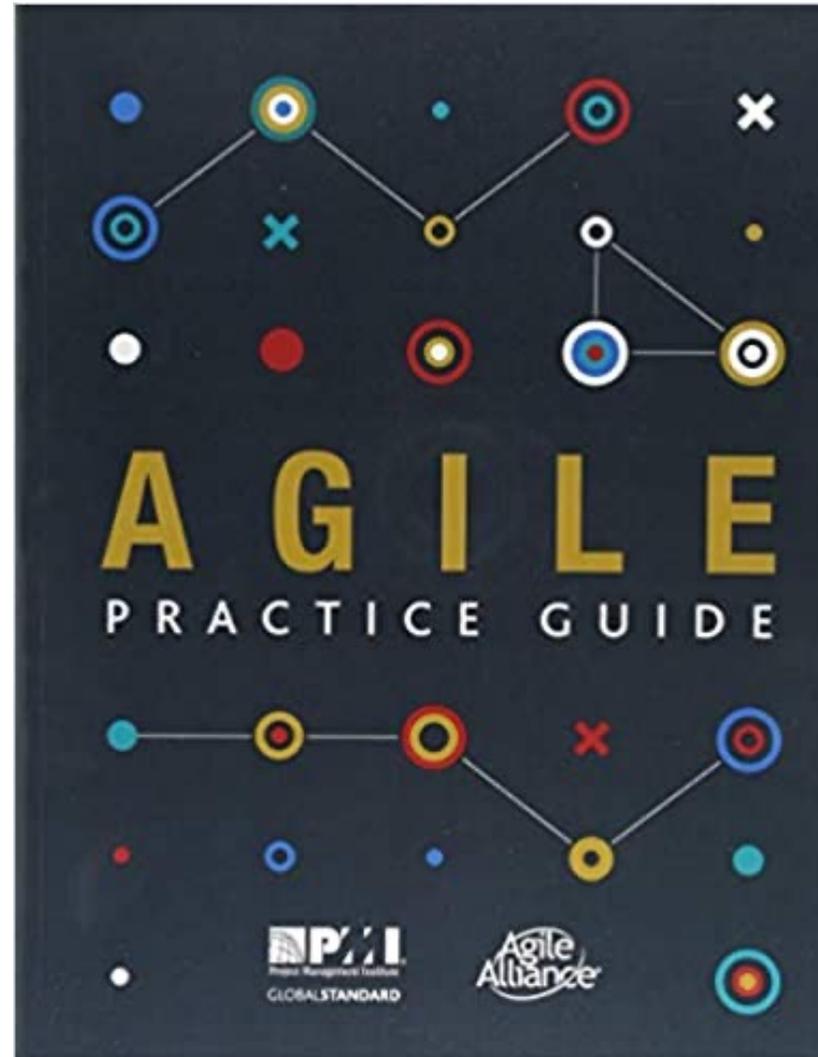
**Software Engineering at Google:**  
Lessons Learned from Programming Over Time,  
O'Reilly Media.



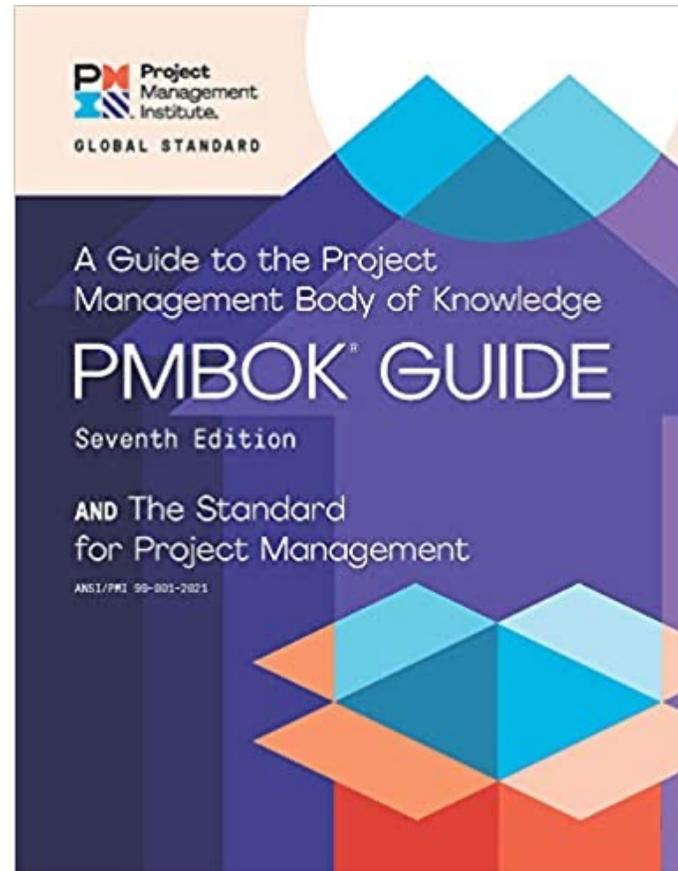
Project Management Institute (2017),

# Agile Practice Guide

PMI

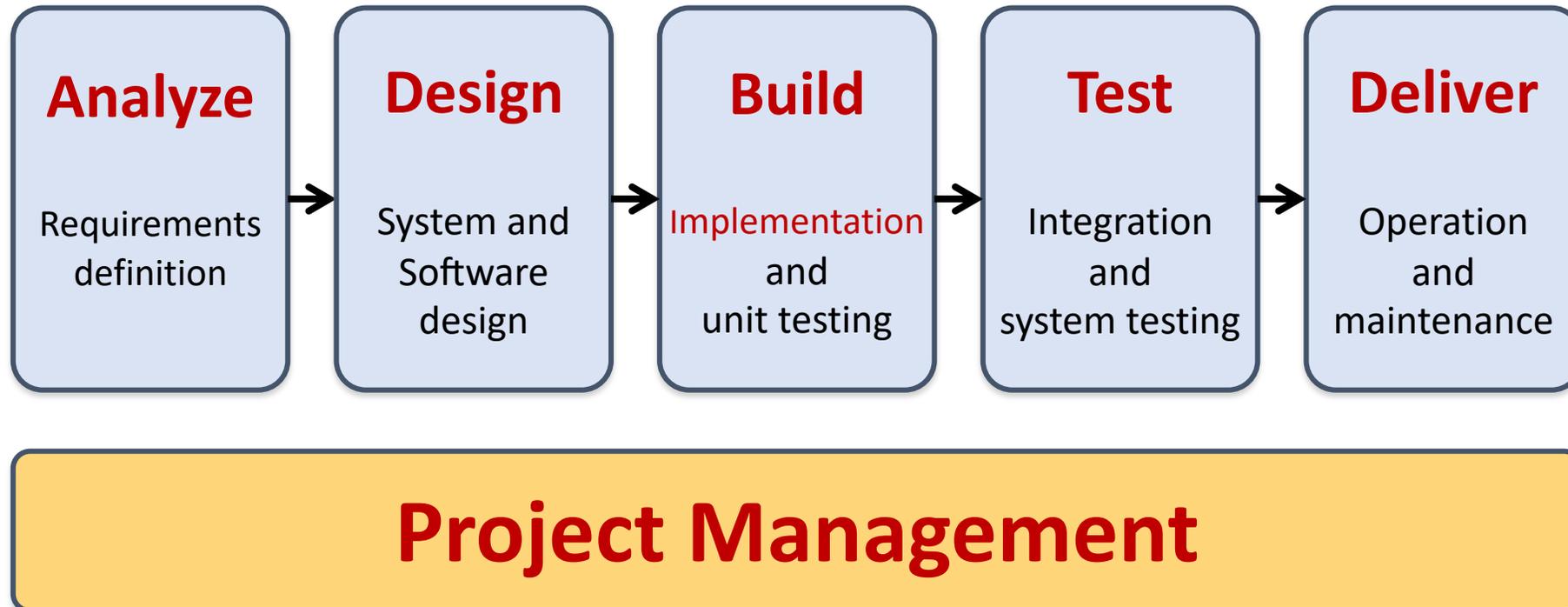


Project Management Institute (2021),  
**A Guide to the  
Project Management Body of Knowledge  
(PMBOK Guide) –  
Seventh Edition and The Standard for Project Management**



# Software Engineering

# Software Engineering and Project Management



**Information Management**

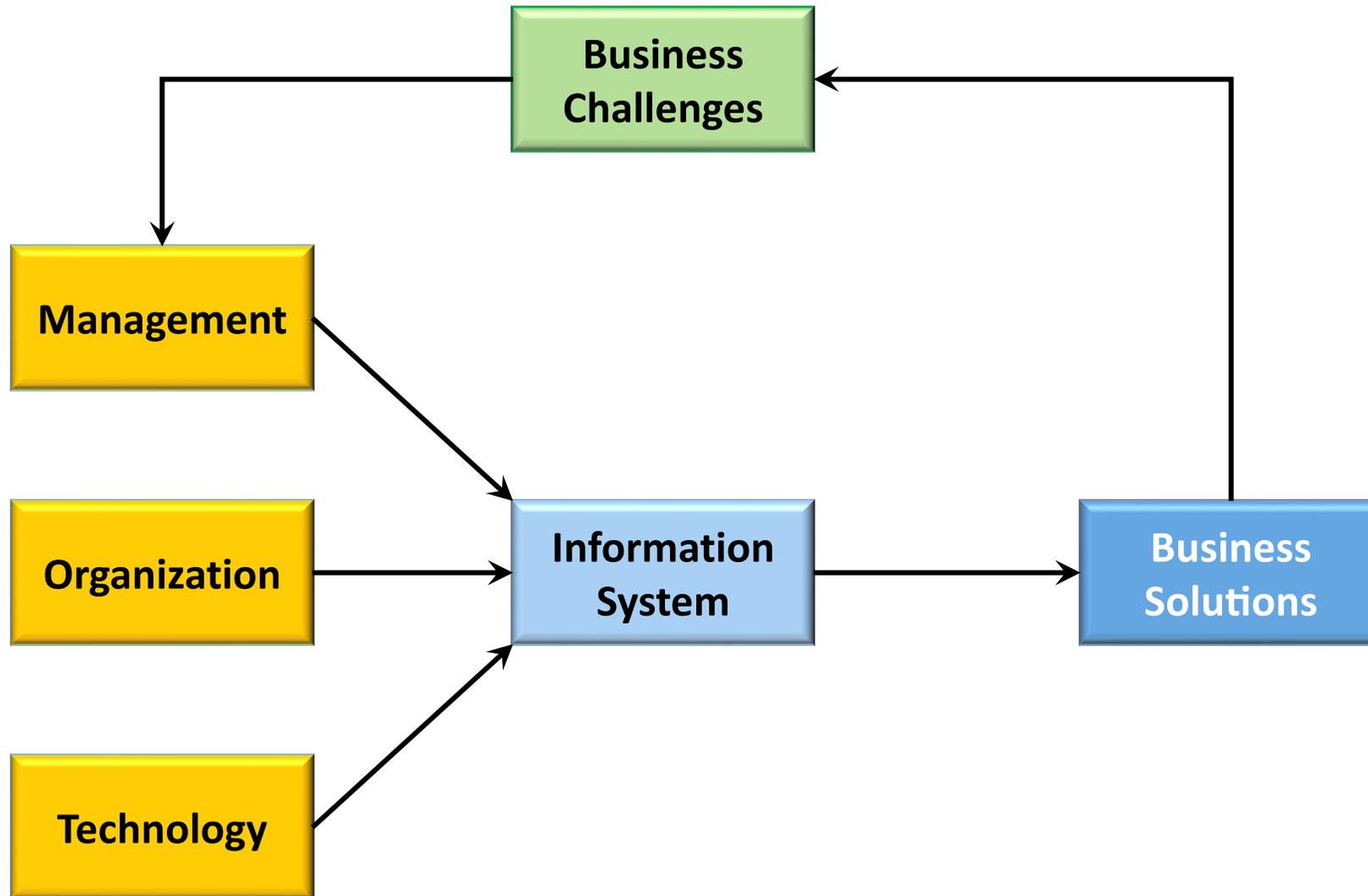
**Management  
Information Systems (MIS)**

**Information Systems**

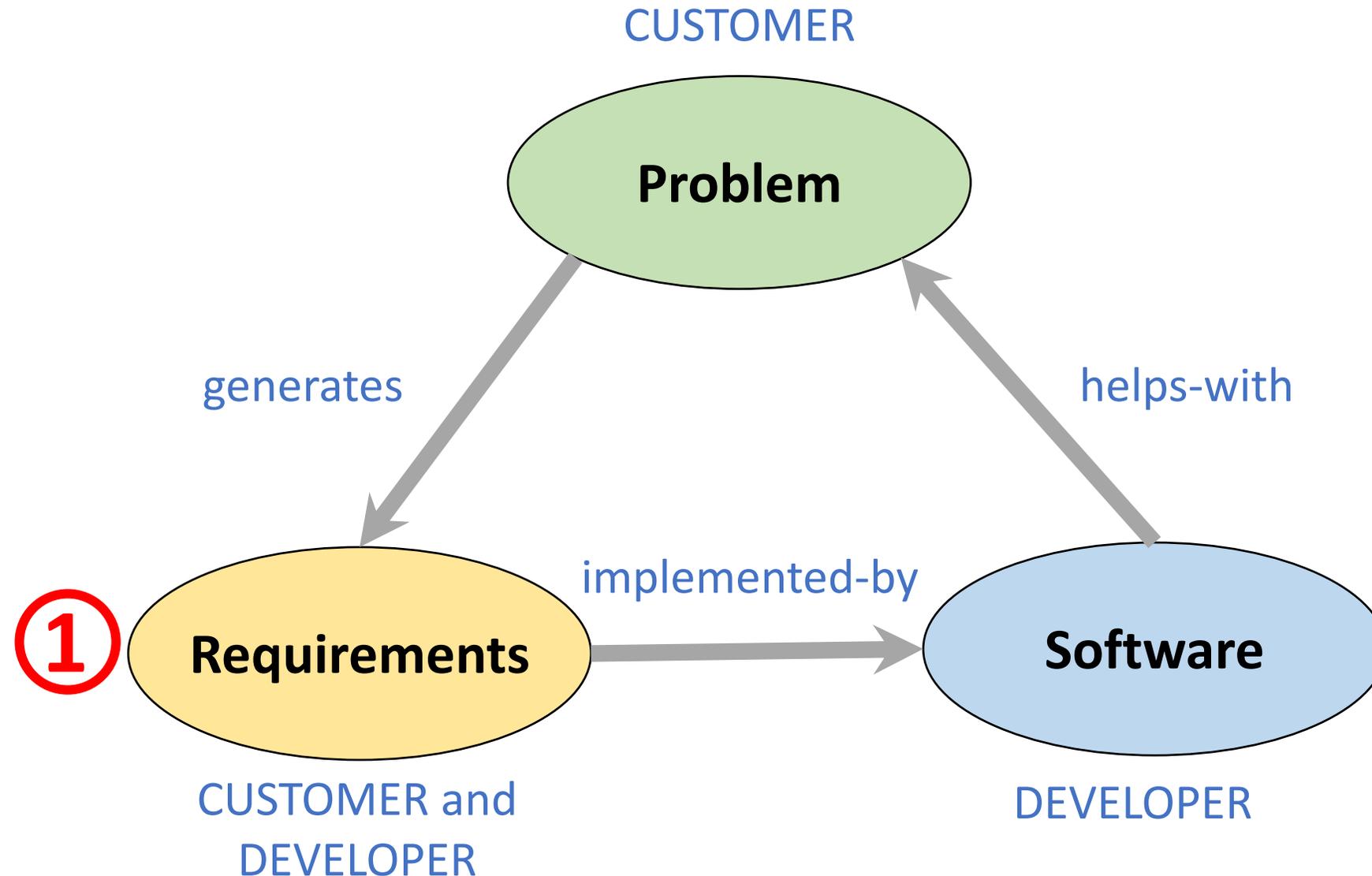
# Information Management (MIS) Information Systems



# Fundamental MIS Concepts



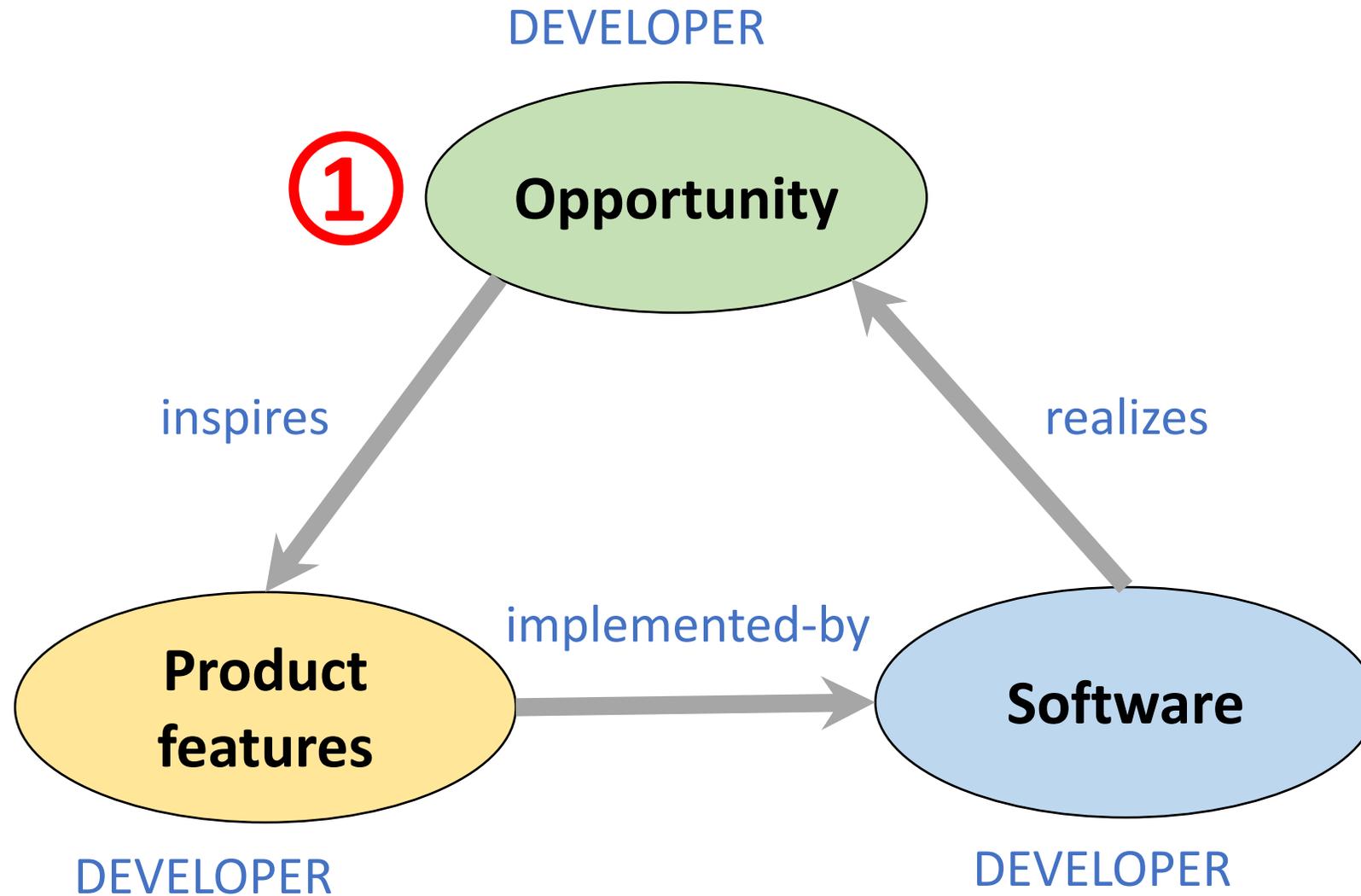
# Project-based software engineering



# Project-based software engineering

- The starting point for the software development is a set of 'software requirements' that are owned by an external client and which set out what they want a software system to do to support their business processes.
- The software is developed by a software company (the contractor) who design and implement a system that delivers functionality to meet the requirements.
- The customer may change the requirements at any time in response to business changes (they usually do). The contractor must change the software to reflect these requirements changes.
- Custom software usually has a long-lifetime (10 years or more) and it must be supported over that lifetime.

# Product software engineering

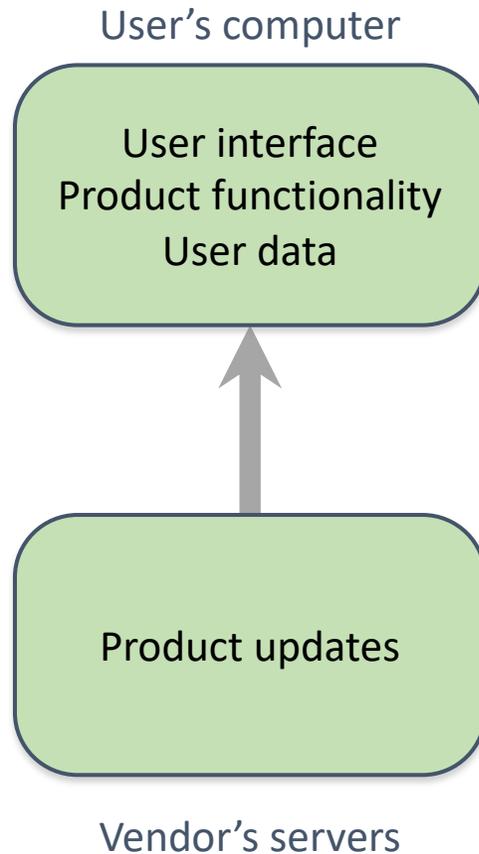


# Product software engineering

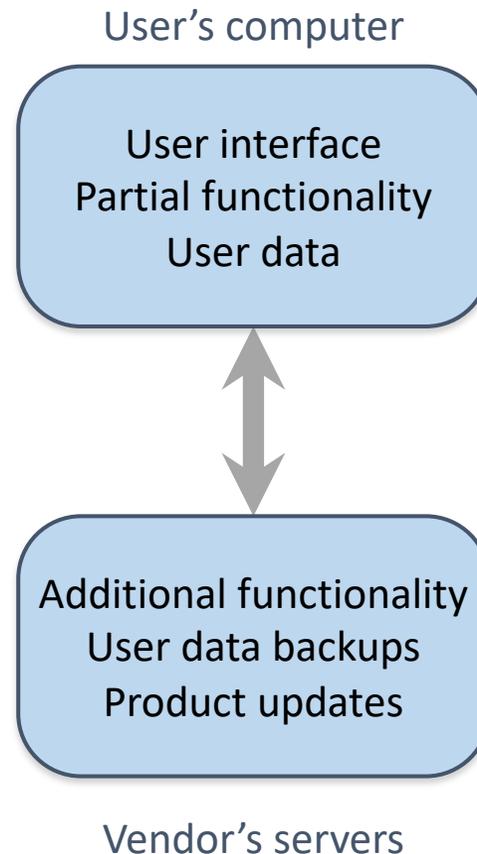
- The starting point for product development is a **business opportunity** that is identified by individuals or a company.  
They develop a software product to take advantage of this opportunity and sell this to customers.
- The company who identified the opportunity **design and implement a set of software features** that realize the opportunity and that will be useful to customers.
- The software development company are responsible for deciding on the development timescale, what features to include and when the product should change.
- Rapid delivery of software products is essential to capture the market for that type of product.

# Software execution models

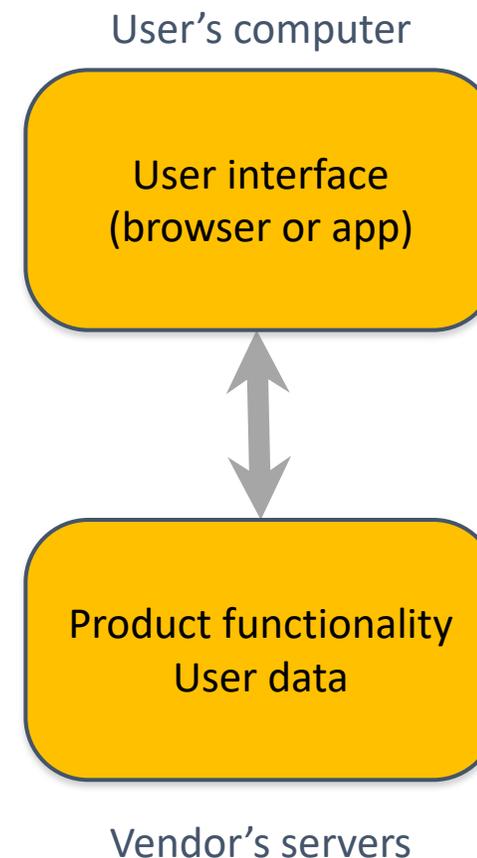
## Stand-alone execution



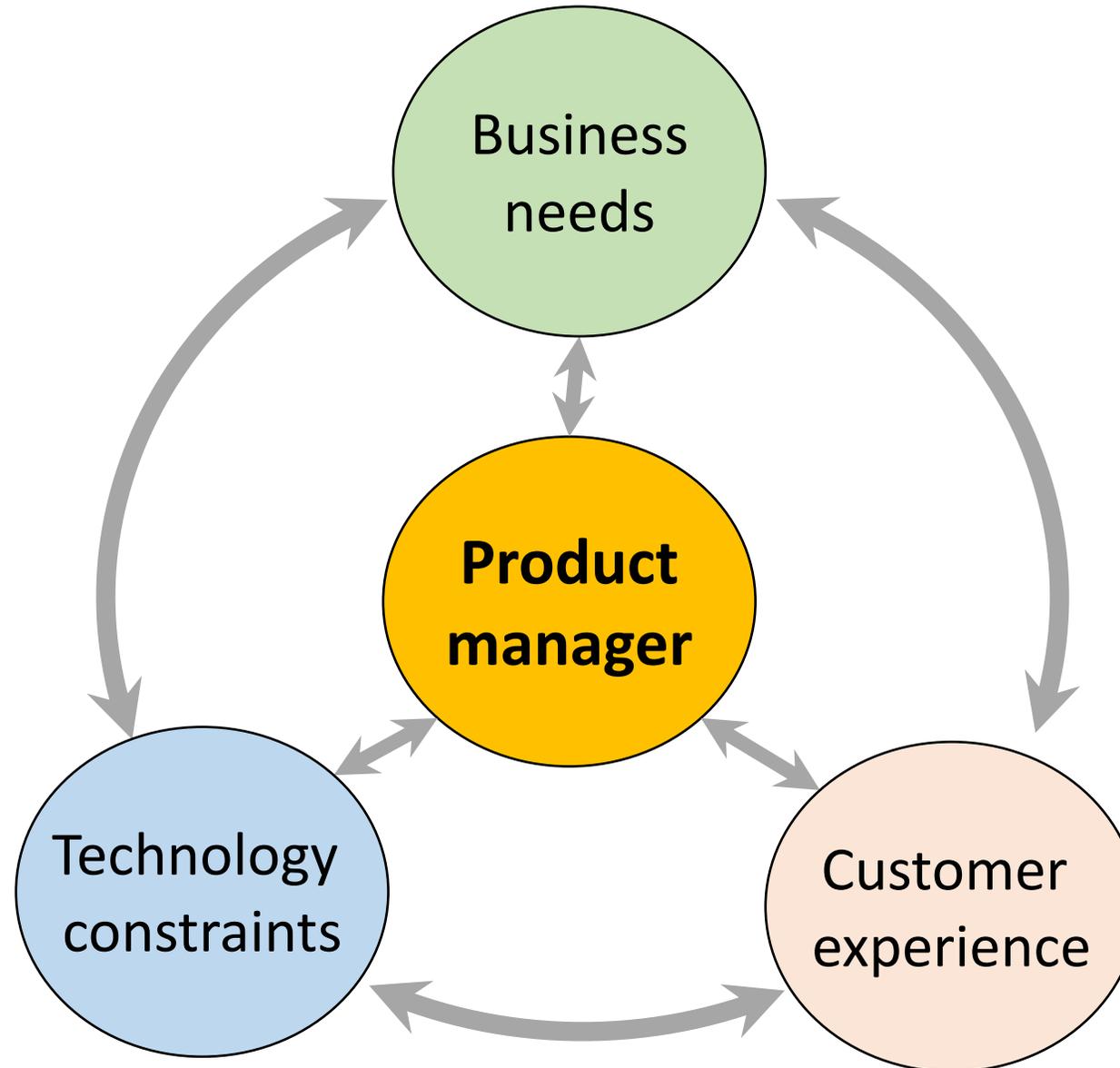
## Hybrid execution



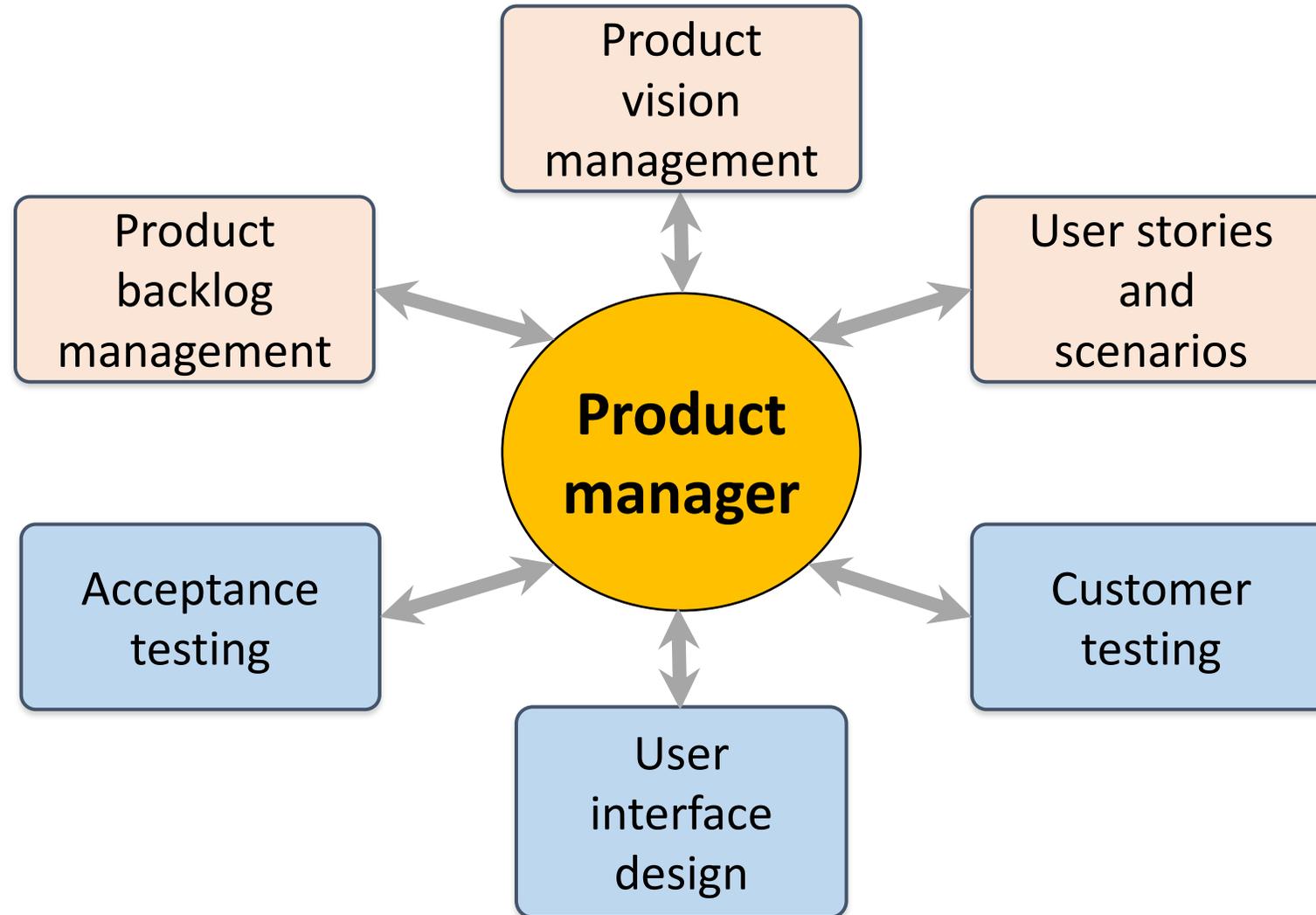
## Software as a service



# Product management concerns

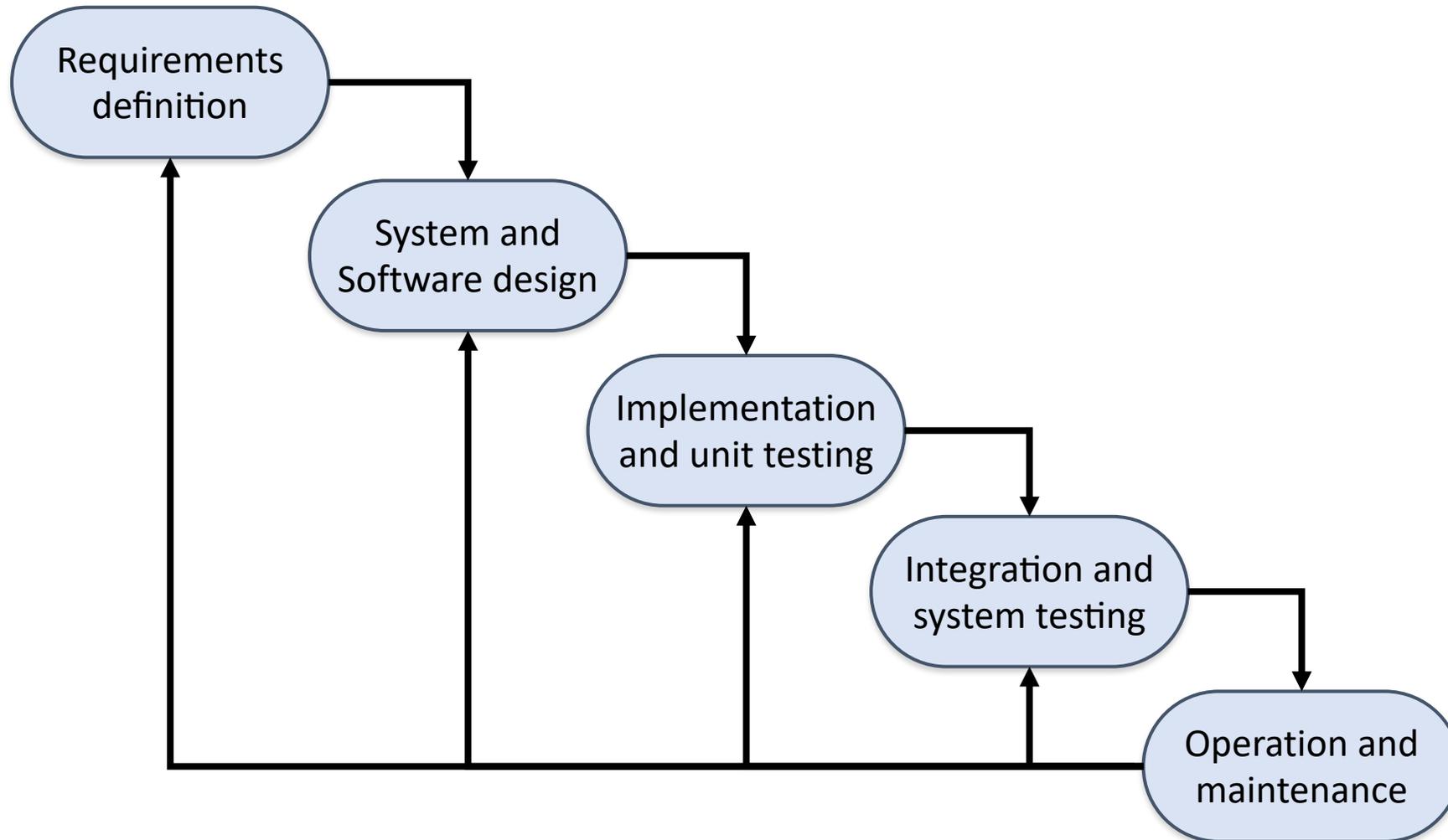


# Technical interactions of product managers



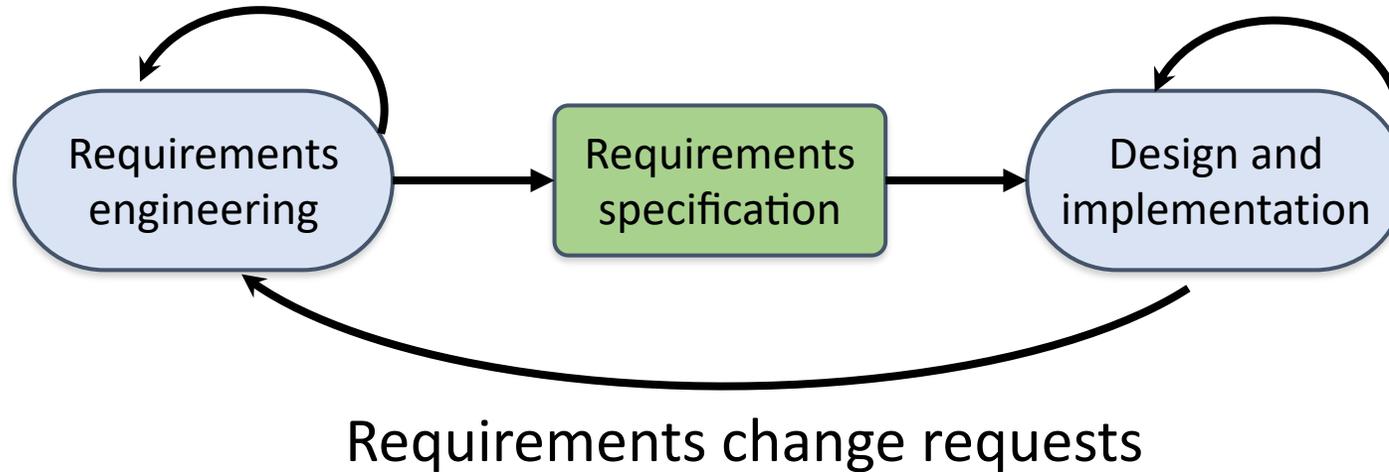
# Software Development Life Cycle (SDLC)

## The waterfall model

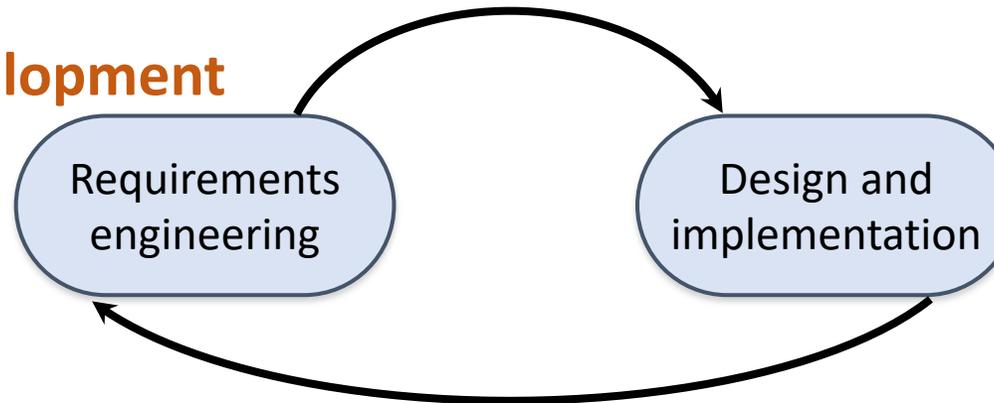


# Plan-based and Agile development

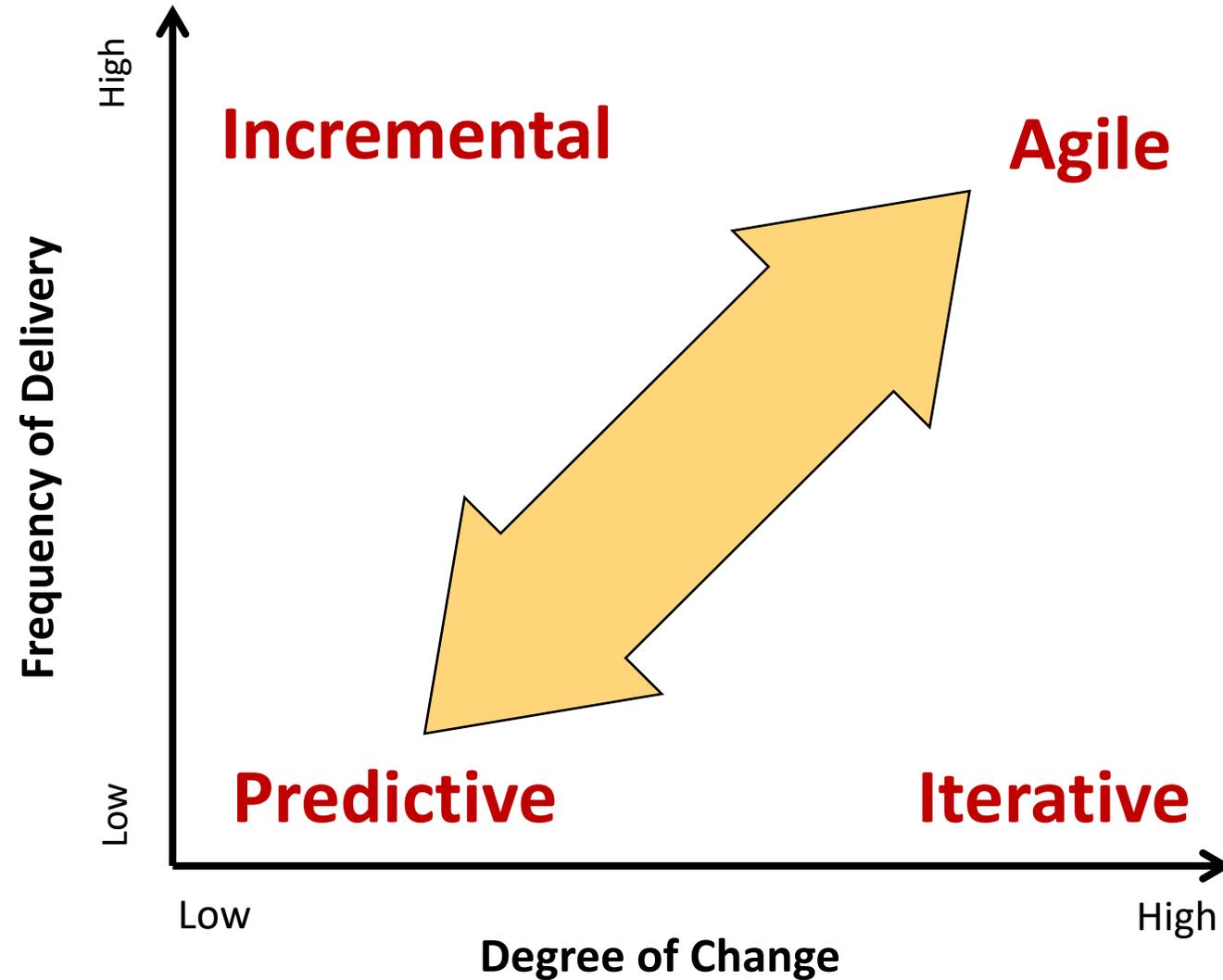
## Plan-based development



## Agile development



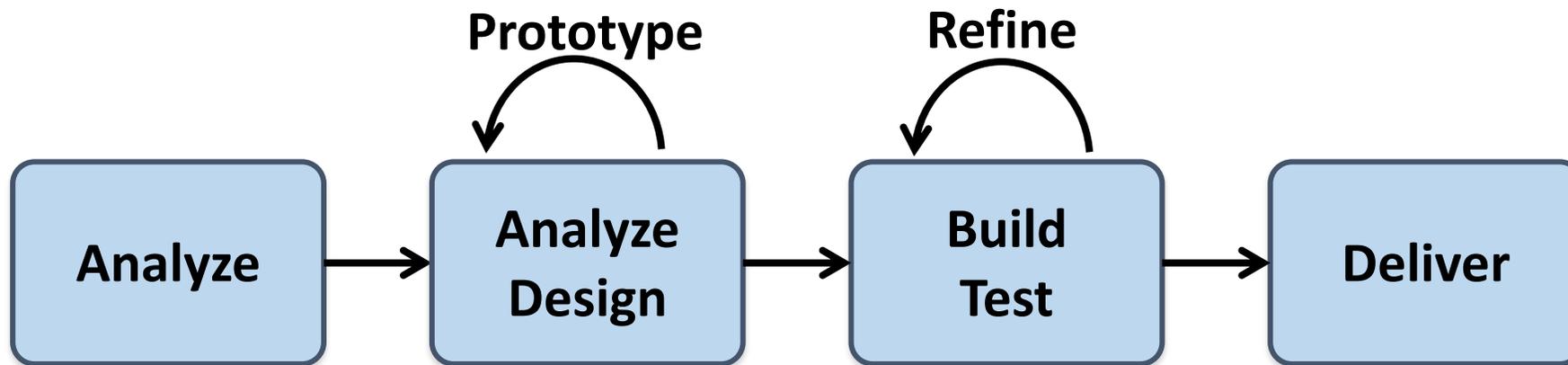
# The Continuum of Life Cycles



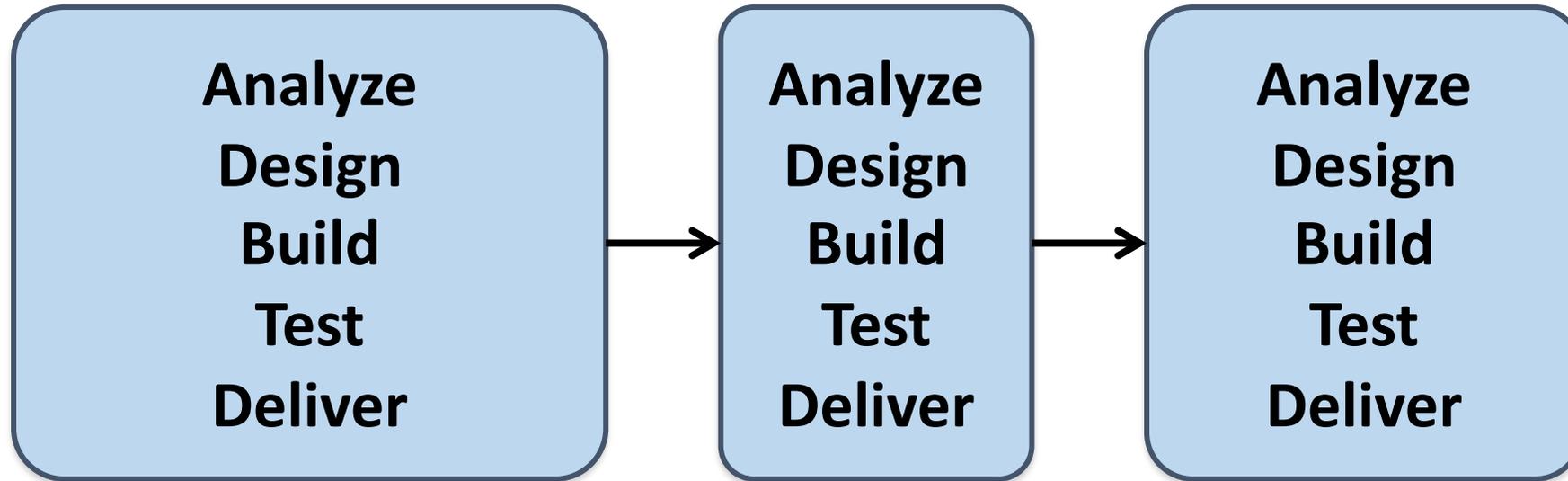
# Predictive Life Cycle



# Iterative Life Cycle

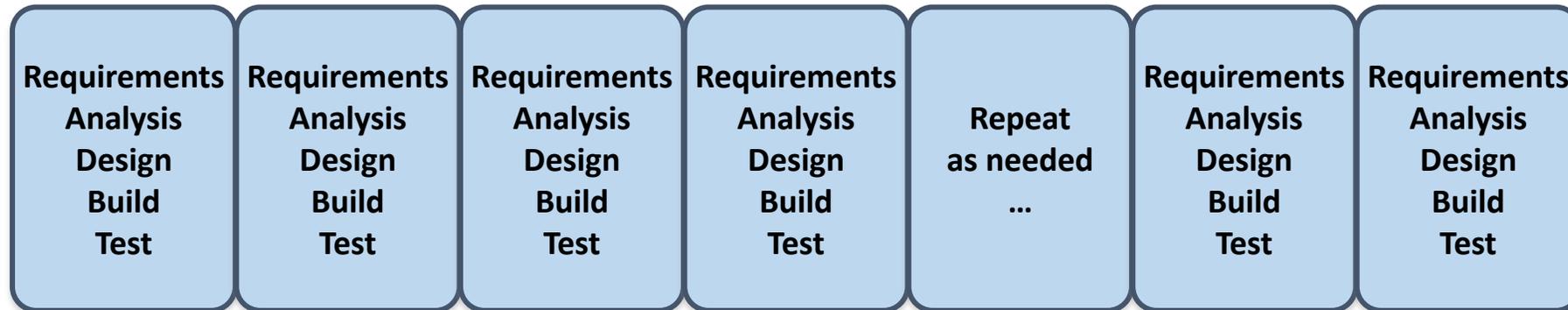


# A Life Cycle of Varying-Sized Increments

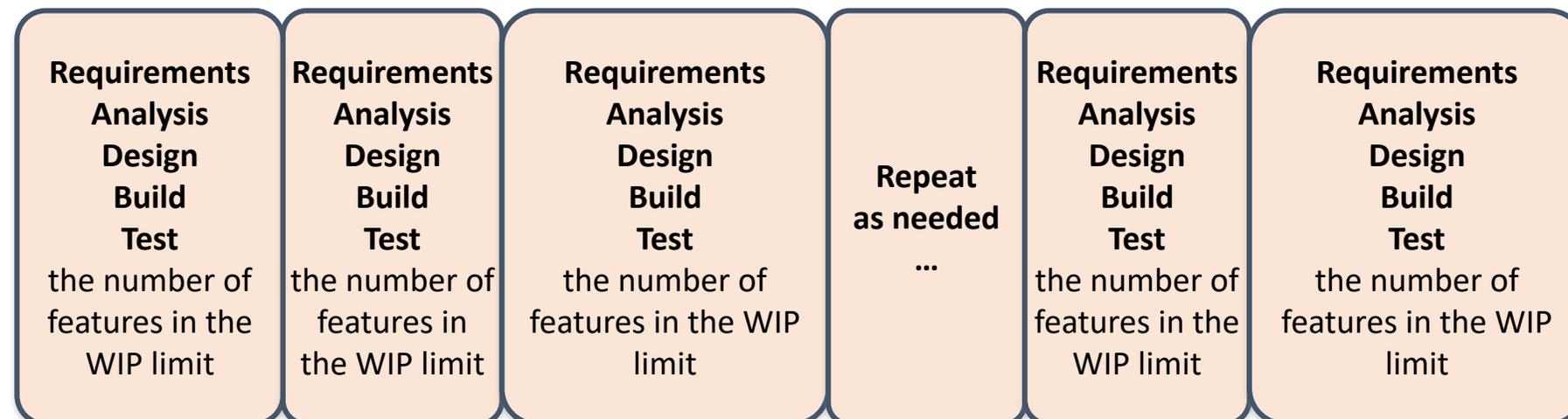


# Iteration-Based and Flow-Based Agile Life Cycles

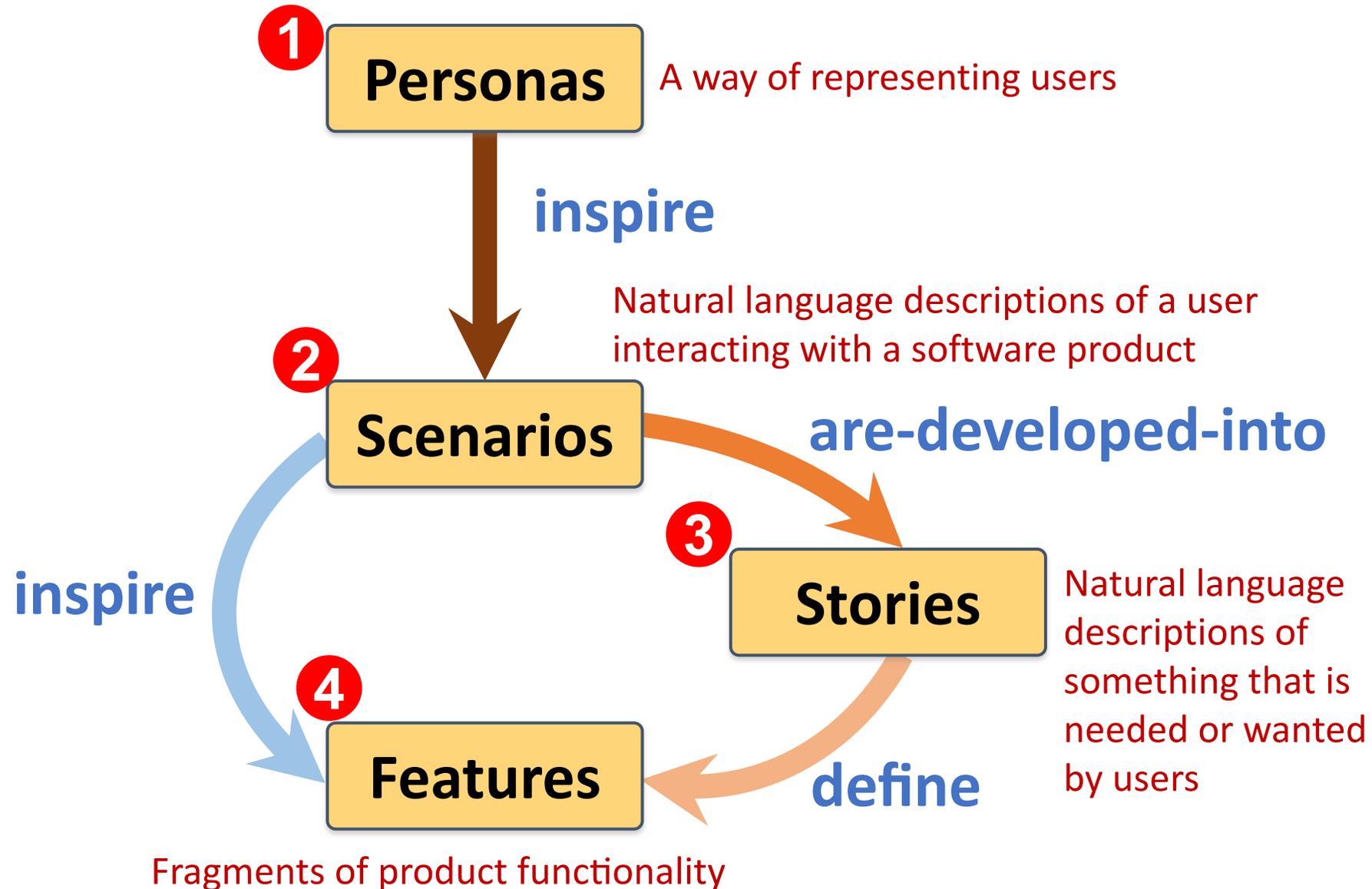
## Iteration-Based Agile



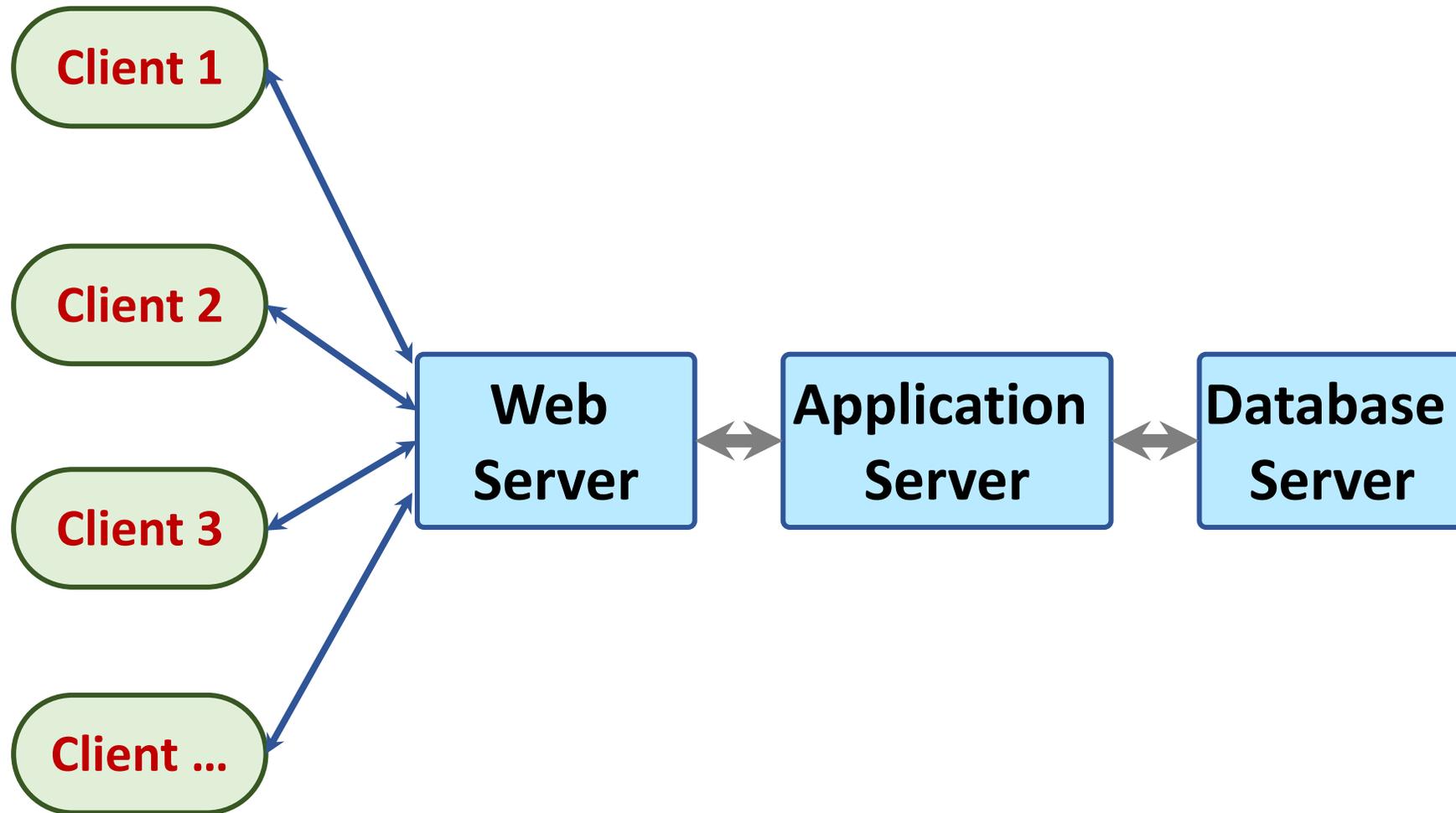
## Flow-Based Agile



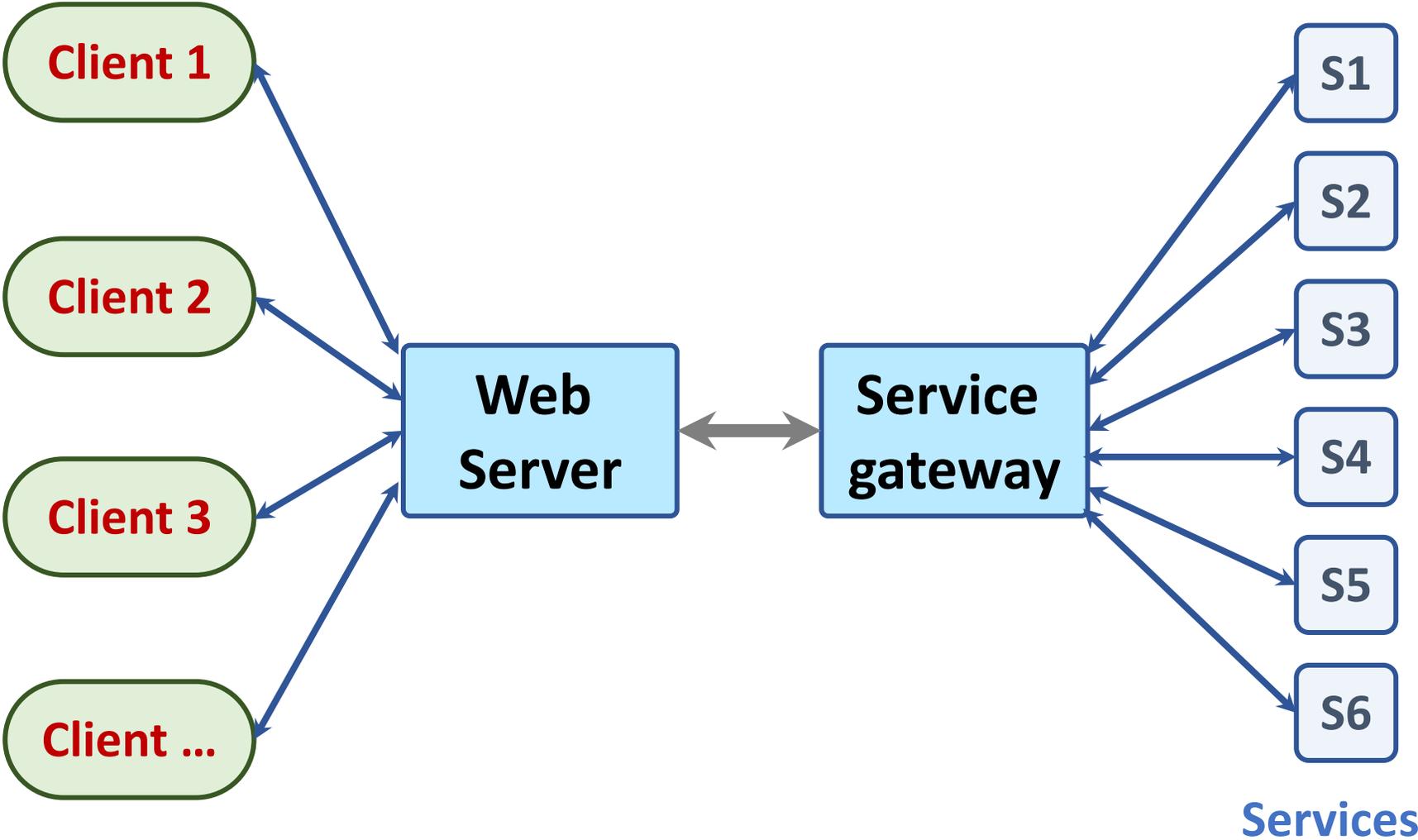
# From personas to features



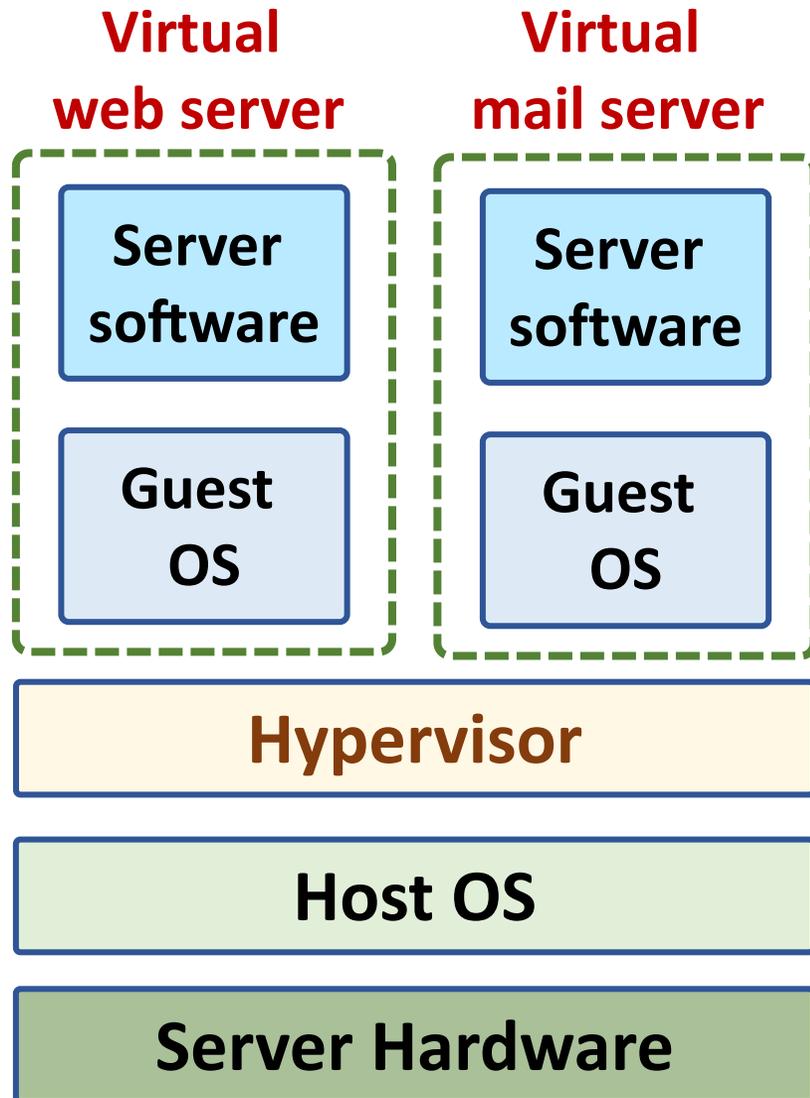
# Multi-tier client-server architecture



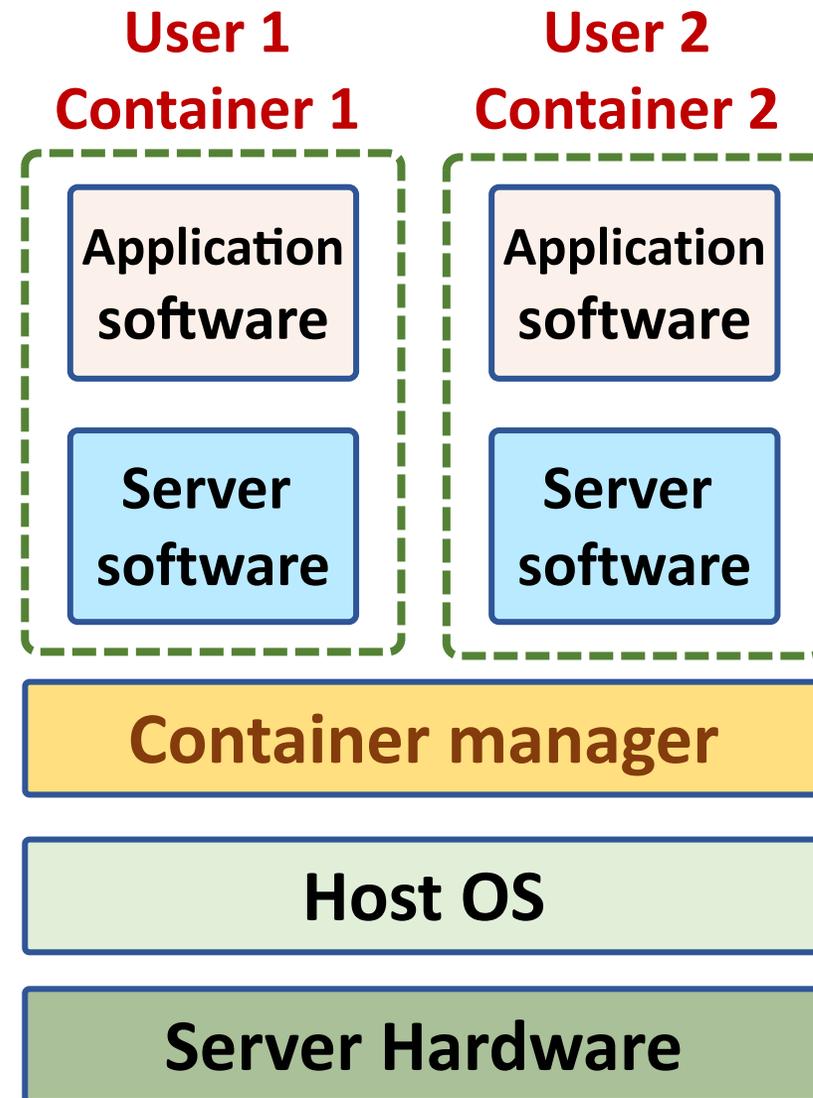
# Service-oriented Architecture



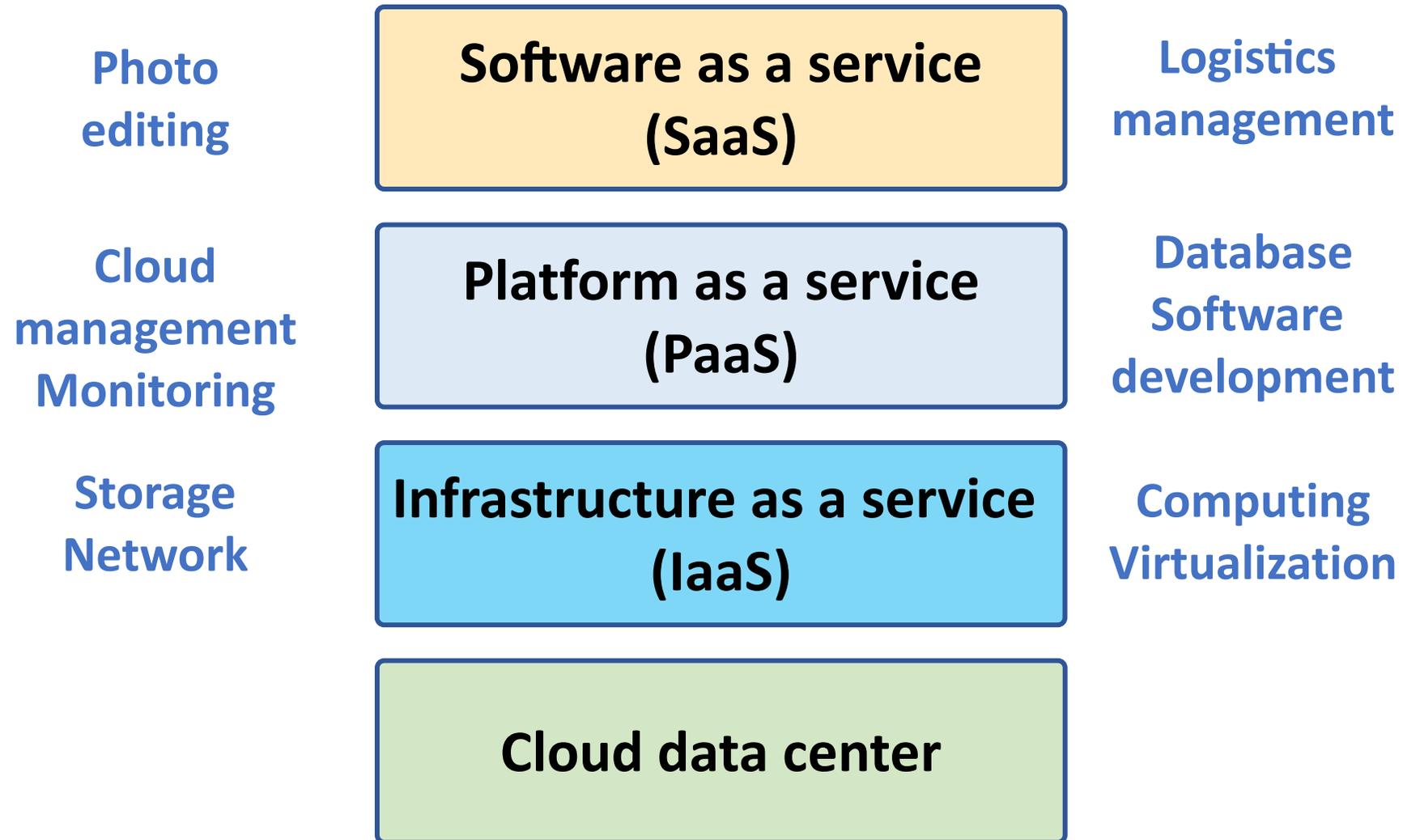
# VM



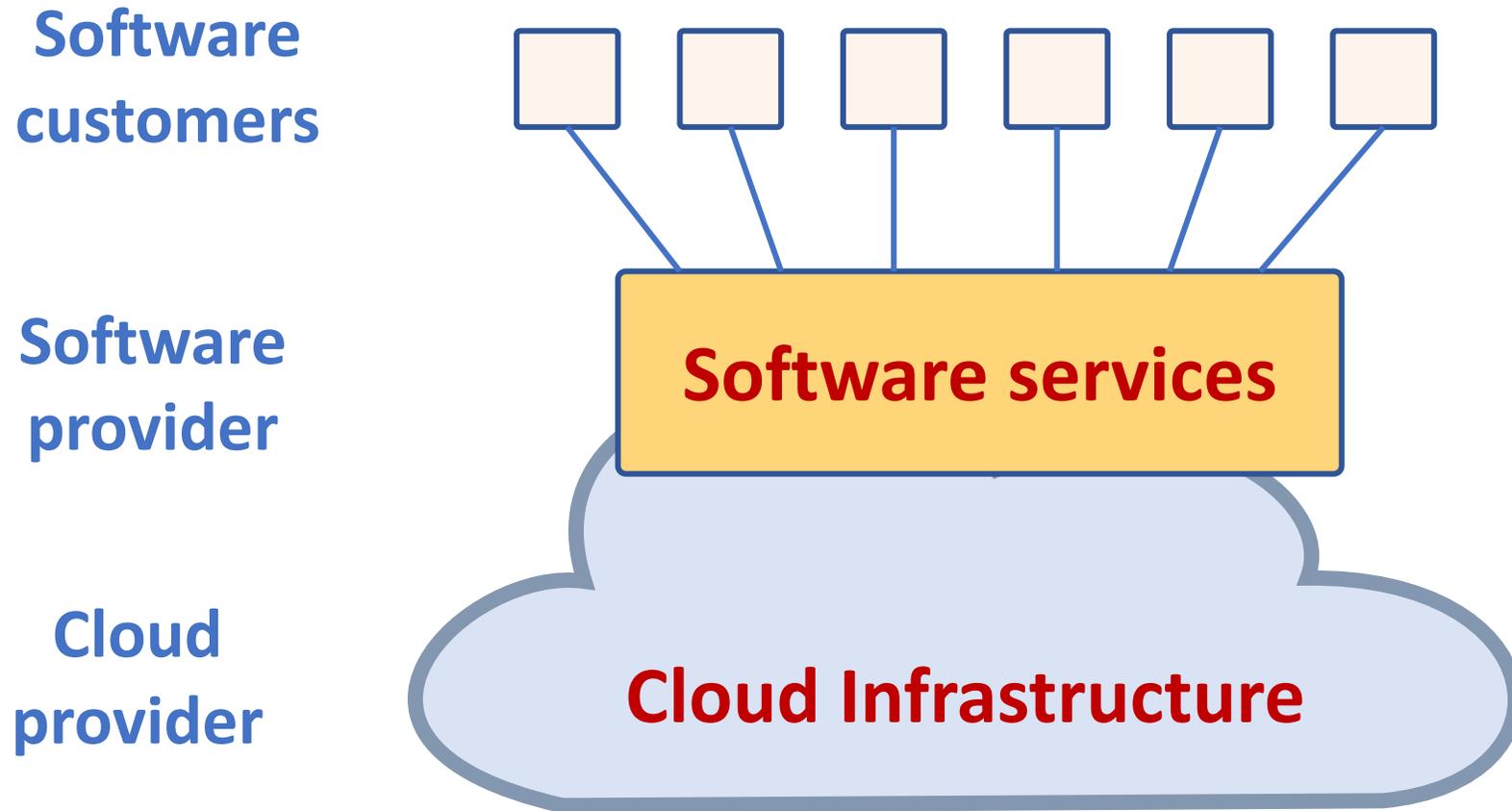
# Container



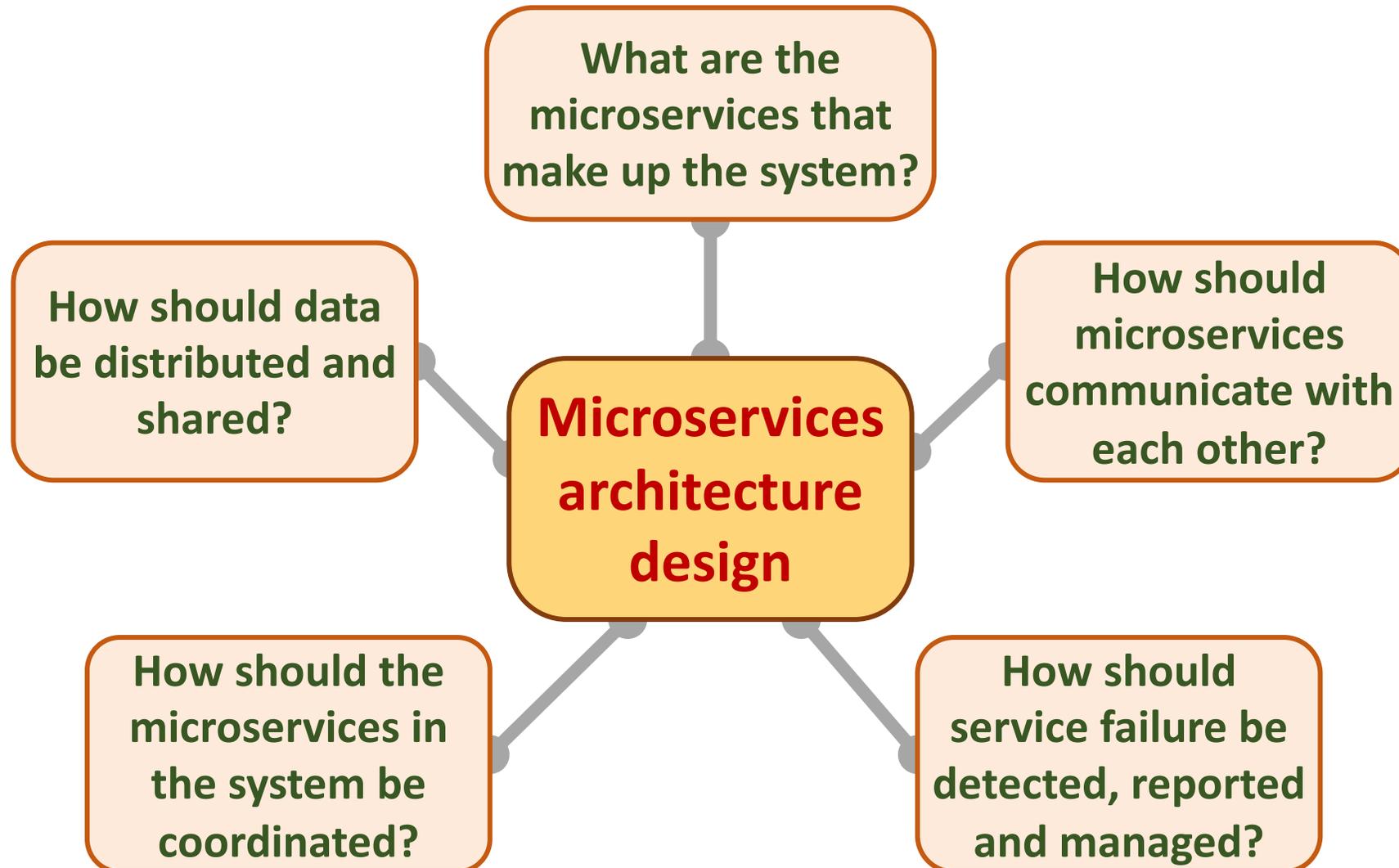
# Everything as a service



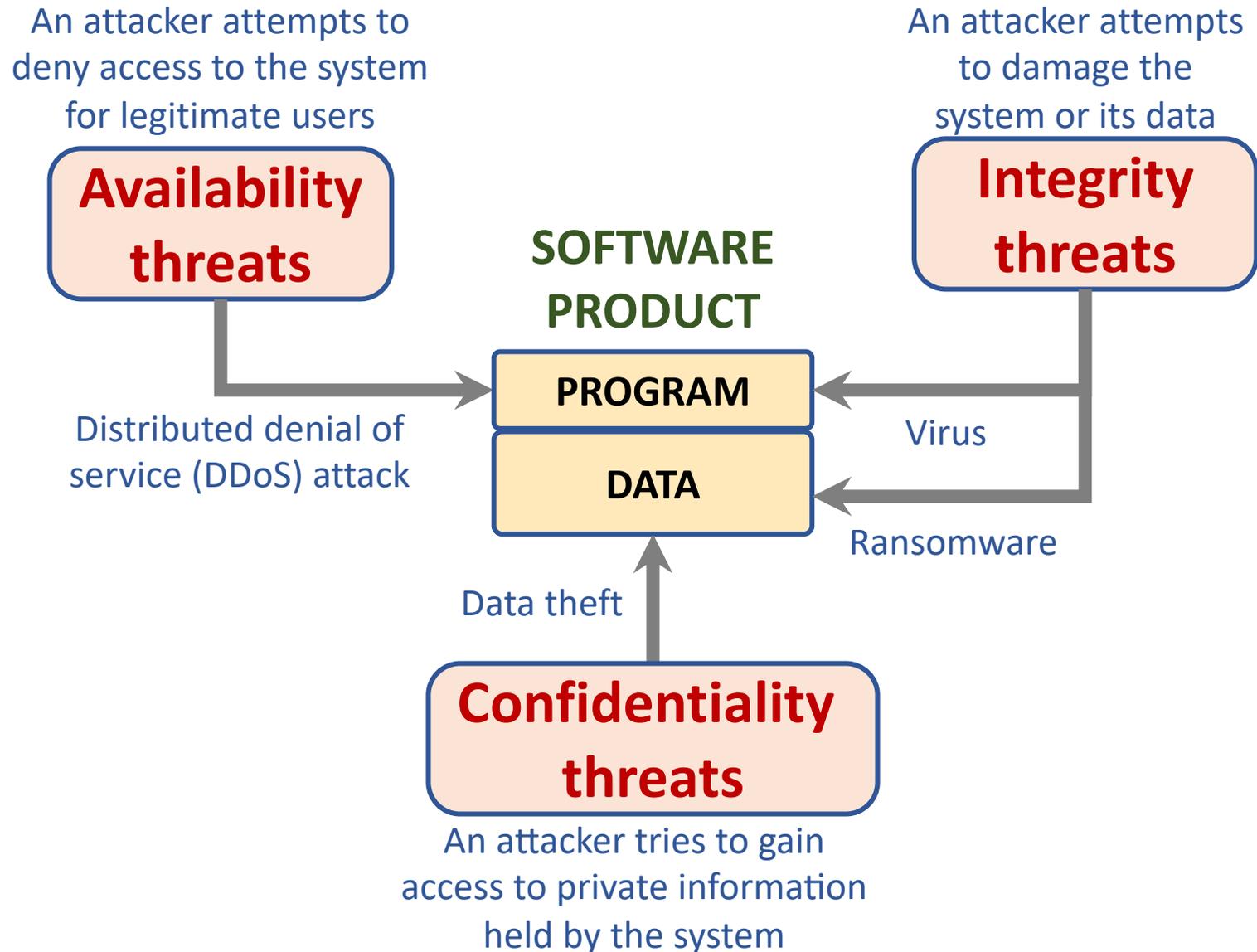
# Software as a service



# Microservices architecture – key design questions



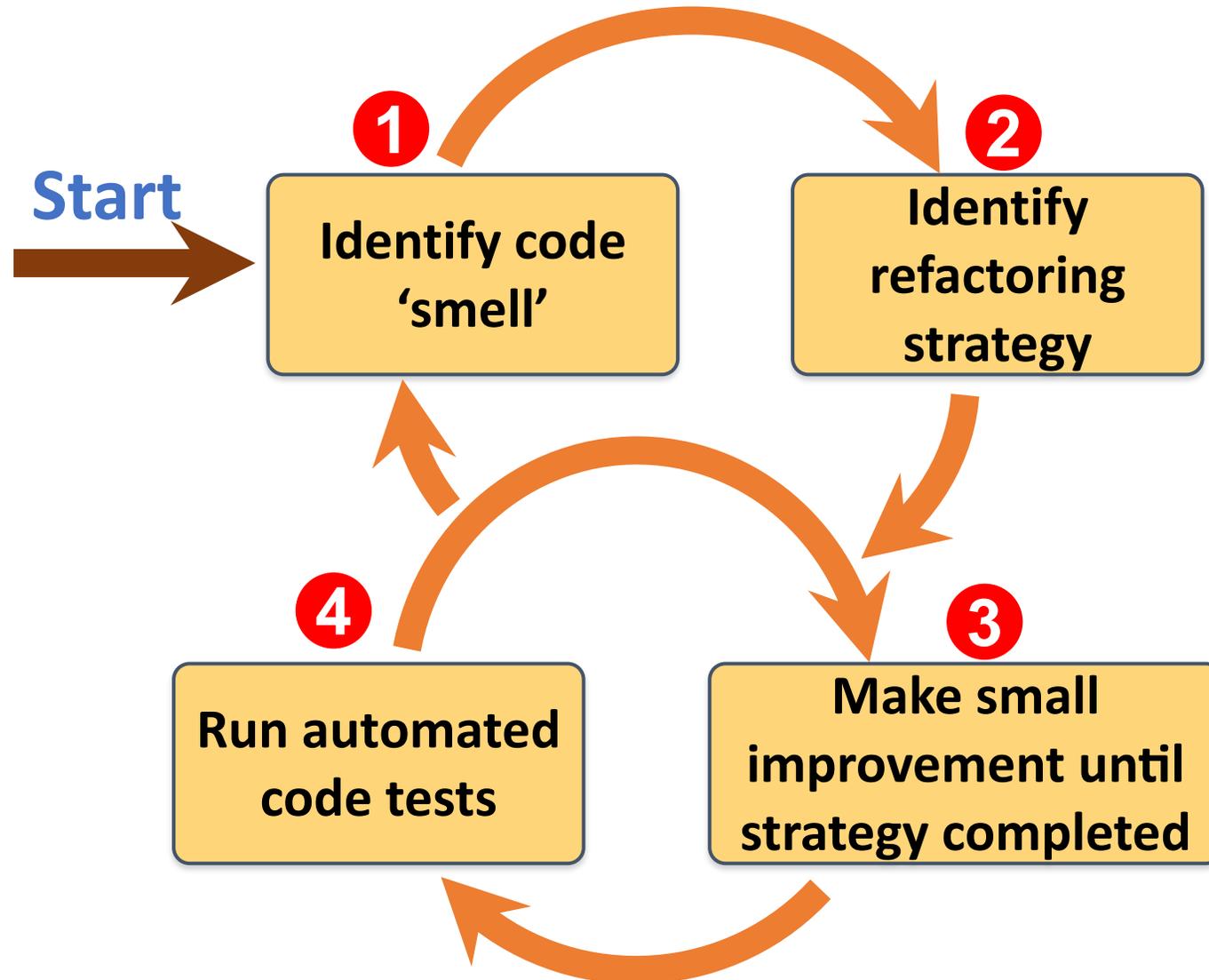
# Types of security threat



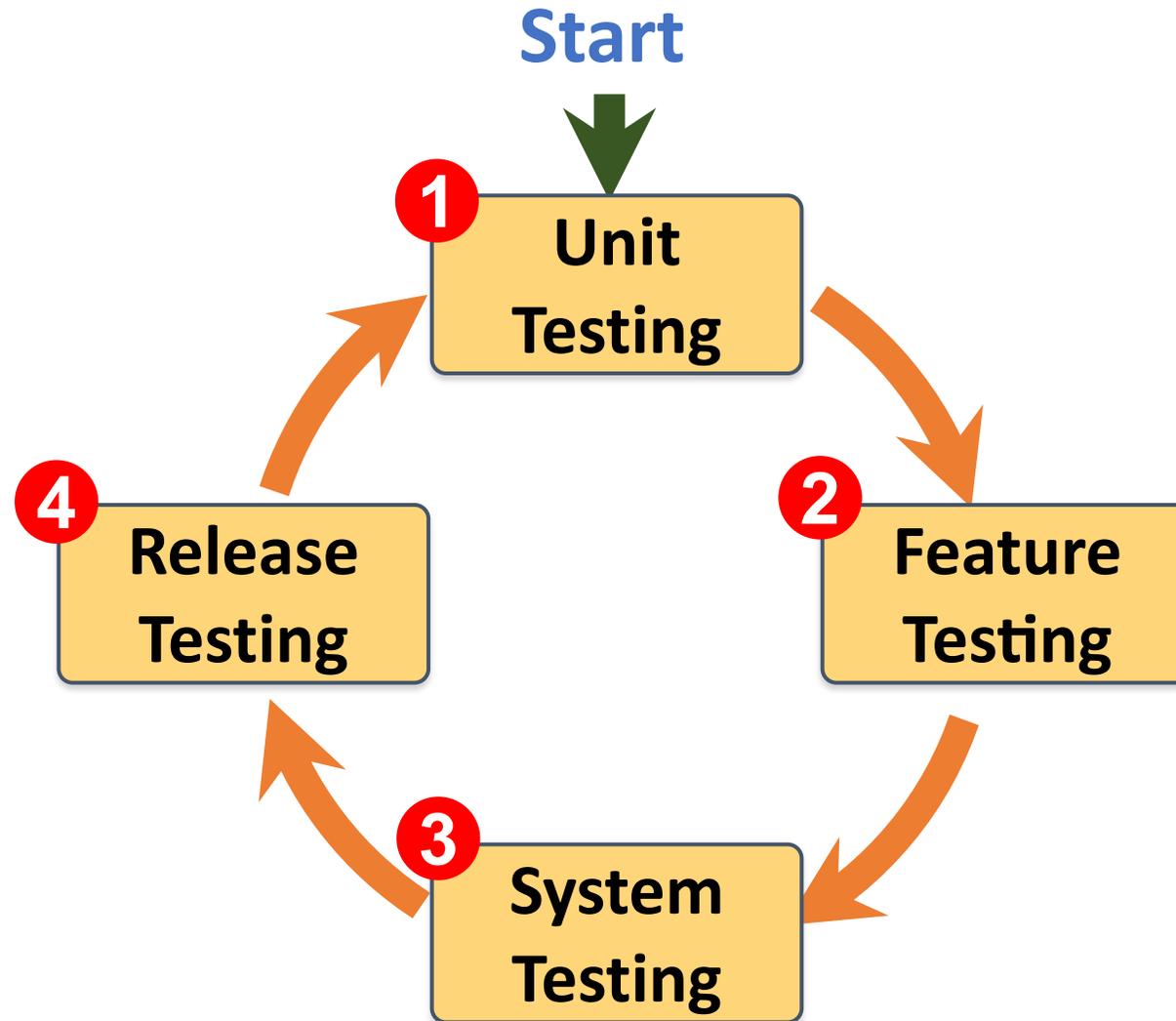
# Software product quality attributes



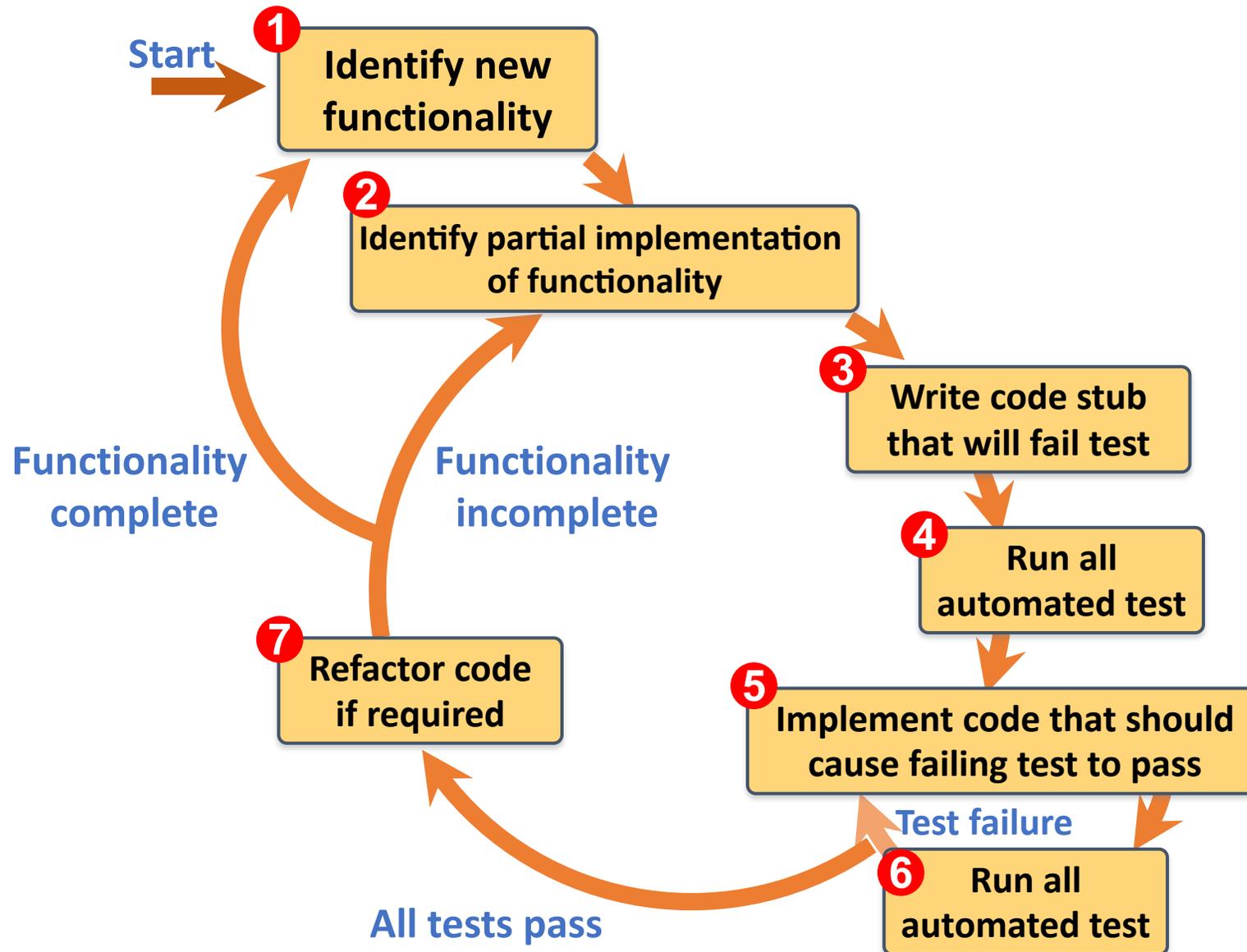
# A refactoring process



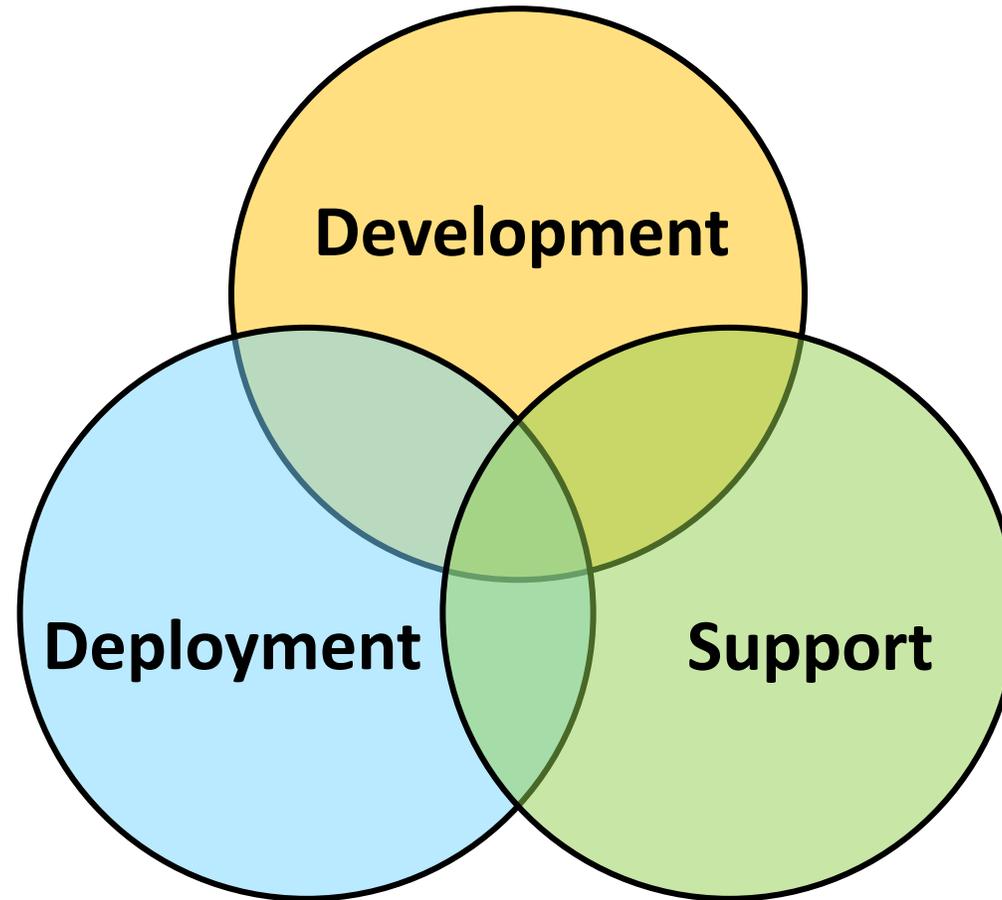
# Functional testing



# Test-driven development (TDD)

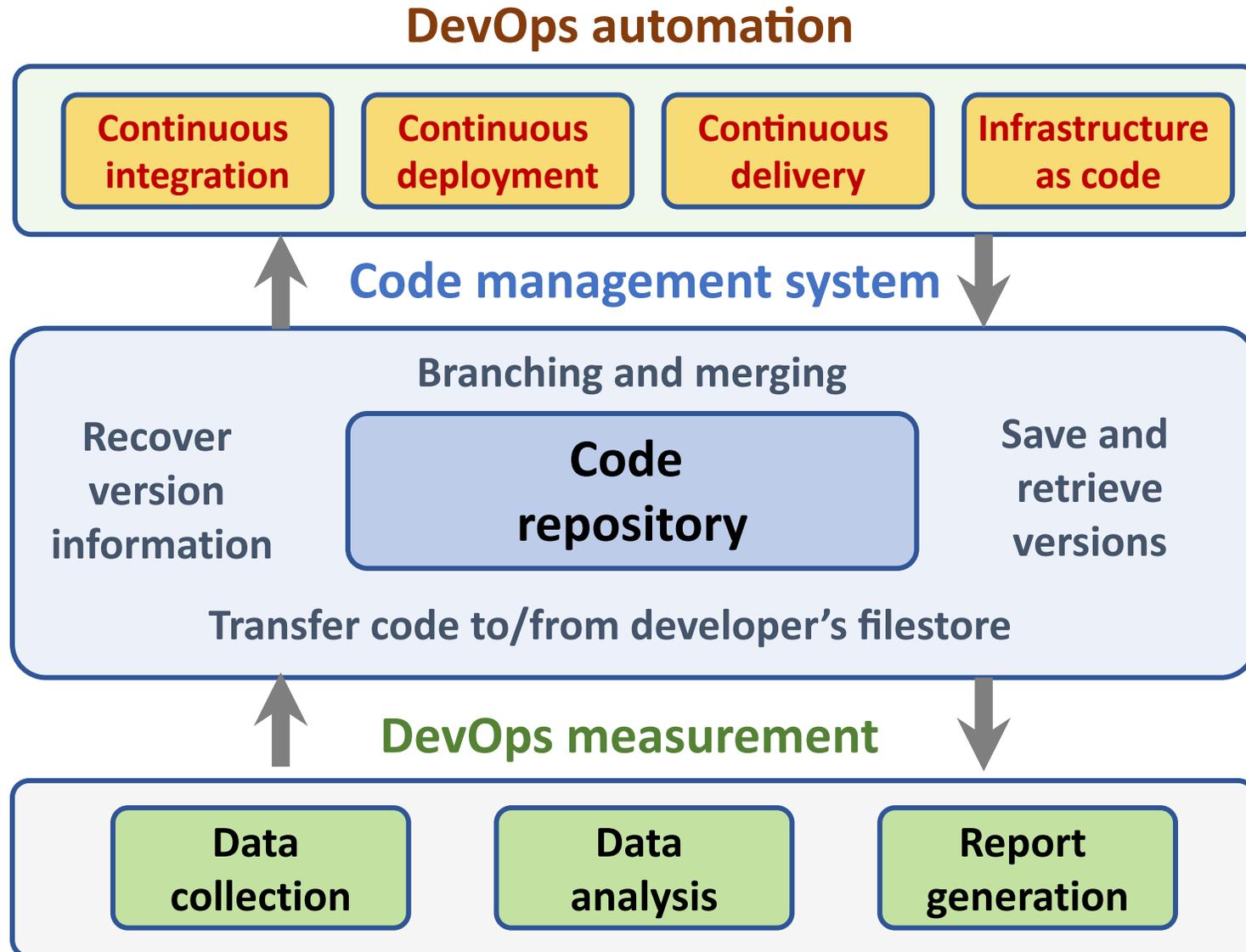


# DevOps



## Multi-skilled DevOps team

# Code management and DevOps



# Marketing

**Marketing**  
“**Meeting**  
**needs**  
**profitably**”

# Marketing

**“Marketing is an organizational function and a set of processes for creating, communicating, and delivering value to customers and for managing customer relationships in ways that benefit the organization and its stakeholders.”**

# Marketing Management

# Marketing Management

**“Marketing management is the  
art and science  
of choosing target markets  
and getting, keeping, and growing  
customers through  
creating, delivering, and communicating  
superior customer value.”**

# Marketing Management

- 1 Understanding Marketing Management
- 2 Capturing Marketing Insights
- 3 Connecting with Customers
- 4 Building Strong Brands
- 5 Creating Value
- 6 Delivering Value
- 7 Communicating Value
- 8 Conducting Marketing Responsibly for Long-term Success

# **Generative AI and LLM**

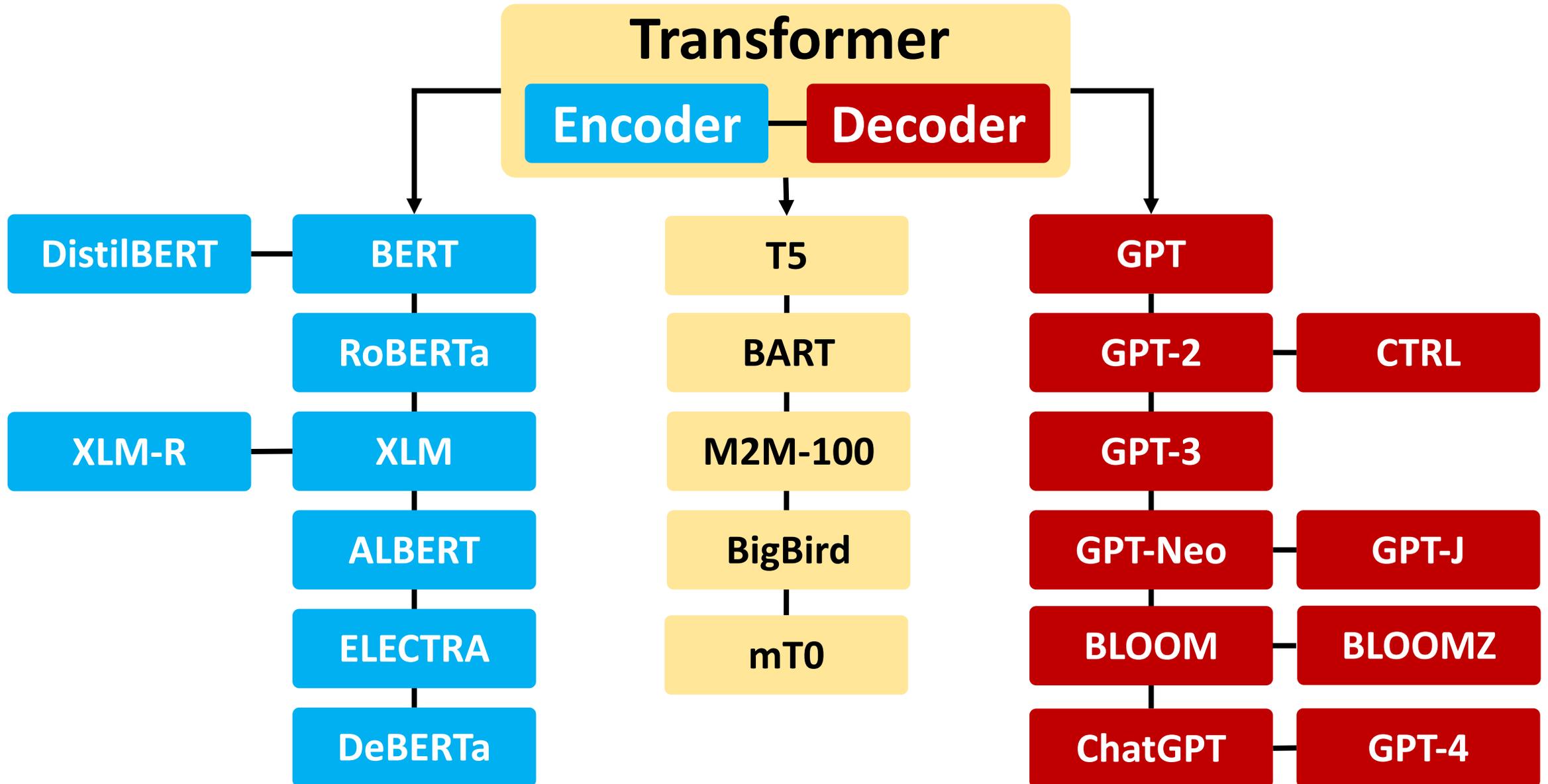
**for**

# **Agile AI Software Engineering**

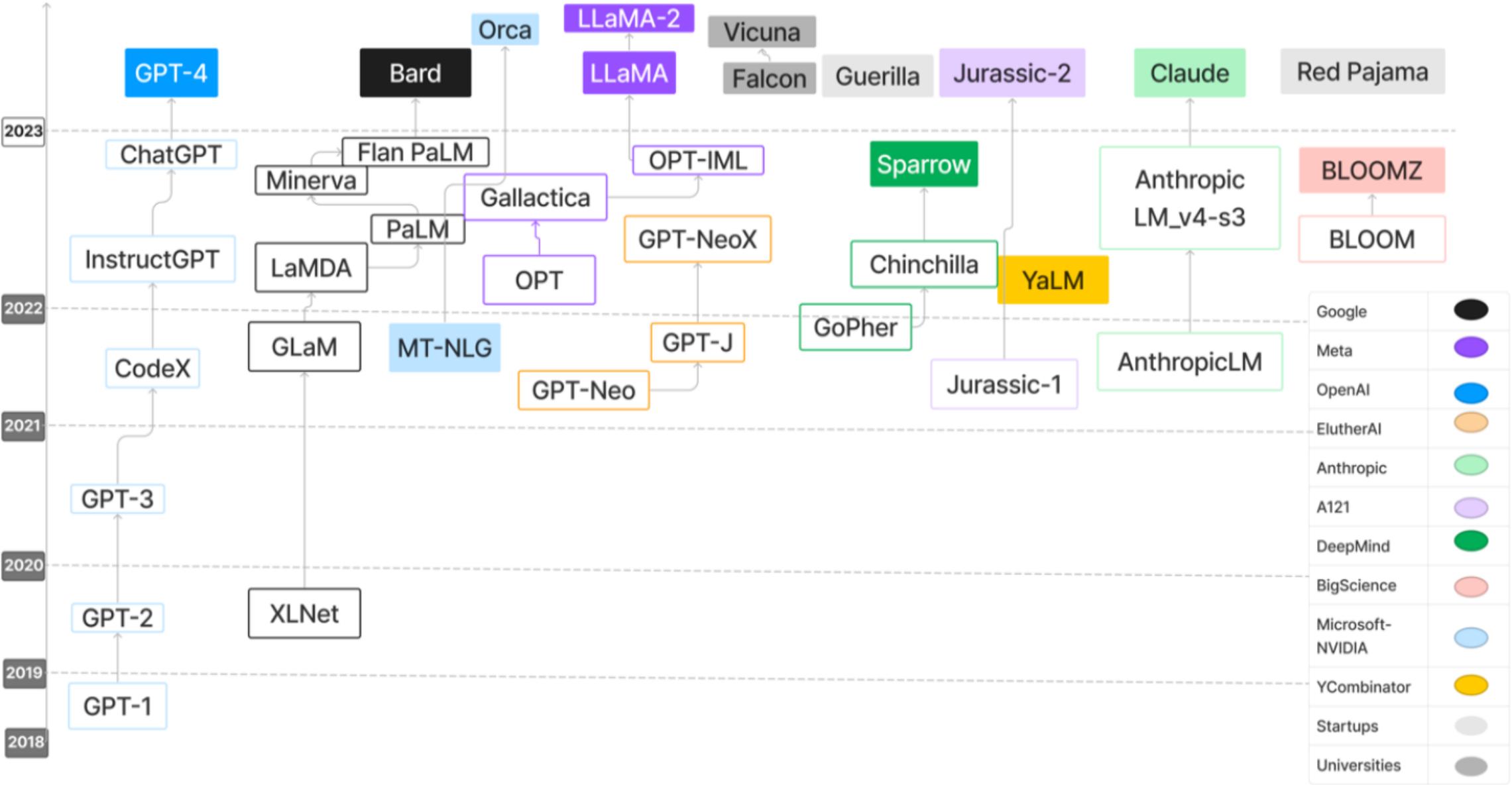
# Generative AI

**Text, Image, Video, Audio  
Applications**

# Transformer Models



# Large Language Models (LLMs)



Source: Hadi, Muhammad Usman, Rizwan Qureshi, Abbas Shah, Muhammad Irfan, Anas Zafar, Muhammad Bilal Shaikh, Naveed Akhtar, Jia Wu, and Seyedali Mirjalili. "Large language models: a comprehensive survey of its applications, challenges, limitations, and future prospects." Authorea Preprints (2023).

# Four Paradigms in NLP (LM)

Paradigm	Engineering	Task Relation
a. Fully Supervised Learning (Non-Neural Network)	Feature (e.g. word identity, part-of-speech, sentence length)	
b. Fully Supervised Learning (Neural Network)	Architecture (e.g. convolutional, recurrent, self-attentional)	
<b>Transfer Learning: Pre-training, Fine-Tuning (FT)</b>		
c. Pre-train, Fine-tune	Objective (e.g. masked language modeling, next sentence prediction)	
<b>GAI: Pre-train, Prompt, and Predict (Prompting)</b>		
d. Pre-train, Prompt, Predict	Prompt (e.g. cloze, prefix)	

# Popular Generative AI

- **OpenAI ChatGPT (GPT-3.5, GPT-4)**
- **OpenAI DALL·E 3**
- **Perplexity.ai**
- **Chat.LMSys.org**
- **ChatPDF**
- **Stable Diffusion**
- **Video: D-ID, Synthesia**
- **Audio: Speechify**

# OpenAI ChatGPT (GPT-4, GPT-3.5)

 ChatGPT 4 ▾

-  GPT-4   
With DALL-E, browsing and analysis  
Limit 40 messages / 3 hours
-  GPT-3.5  
Great for everyday tasks
-  Plugins



How can I help you today?

Suggest fun activities  
for a family of 4 to do indoors on a rainy day

Help me pick  
a birthday gift for my mom who likes gardening

Design a database schema  
for an online merch store

Give me ideas  
for what to do with my kids' art

 Message ChatGPT...



ChatGPT can make mistakes. Consider checking important information.

<https://chat.openai.com/>



# Perplexity.ai



Anonymous Like



New Thread

Home

Discover

Library

Login

Sign Up

### Try Pro

Upgrade to Claude-2 or GPT-4, boost Copilot uses, and upload more files.

Learn More

Download



## Large Language Models for Data Science

### Sources

What Is a Large Language Model and What Can...

snowflake · 1

What are Large Language Models? | NVIDIA

nvidia · 2

Catch Up On Large Language Models | by...

towardsdatascien... · 3



View 3 more

### Answer

Large Language Models (LLMs) are advanced AI systems designed to understand human language intricacies and generate intelligent, creative responses to queries <sup>1</sup>. They are deep learning algorithms that can recognize, summarize, translate, predict, and generate content using very large datasets <sup>2</sup>. LLMs are trained on enormous data sets typically measured in petabytes, sourced from books, articles, websites, and other text-based sources <sup>1</sup>. They are dynamic tools that are continuously updated and refined as new data becomes available <sup>1</sup>.

In the field of data science, LLMs can potentially transform how teams source, manage, and analyze data <sup>1</sup>. They are used in numerous data science applications, and their ability to process and interpret vast amounts of text data has made them an indispensable part of m

Ask follow-up...

Copilot



social media posts or customer reviews, to determine whether the overall sentiment is

<https://www.perplexity.ai/>



# Chat with Open Large Language Models

[chat.lmsys.org](https://chat.lmsys.org)

## ✂ Chatbot Arena ✂ : Benchmarking LLMs in the Wild

[Mixtral of experts](#): A Mixture-of-Experts model by Mistral AI

[Gemini](#): Gemini by Google

[GPT-4-Turbo](#): GPT-4-Turbo by OpenAI

[Claude Instant](#): Claude Instant by Anthropic

[Llama2-70B-SteerLM-Chat](#): A Llama fine-tuned with SteerLM method by NVIDIA

[Starling-LM-7B-alpha](#): An open model trained using RLAI by Berkeley

[Llama 2](#): Open foundation and fine-tuned chat models by Meta

[Code Llama](#): Open foundation models for code by Meta

[Qwen 1.5](#): A large language model by Alibaba Cloud

[DeepSeek LLM](#): An advanced language model by DeepSeek

[GPT-3.5](#): GPT-3.5-Turbo by OpenAI

[Nous-Hermes-2-Mixtral-8x7B-DPO](#): Nous Hermes finetuned from Mixtral 8x7B

[pplx-online-llms](#): Online LLM API by Perplexity AI

[Tulu 2](#): An instruction and RLHF model by UW/AllenAI

[Vicuna](#): A chat assistant fine-tuned on user-shared conversations by LMSYS

[WizardLM](#): An instruction-following LLM using evol-instruct by Microsoft

[Bard](#): Bard by Google

[StripedHyena-Nous](#): A chat model developed by Together Research and Nous Research.

[Claude](#): Claude 2 by Anthropic

[OpenChat 3.5](#): An open model fine-tuned on Mistral-7B using C-RLFT

[OpenHermes-2.5-Mistral-7B](#): A mistral-based model fine-tuned on 1M GPT-4 outputs

[Yi-Chat](#): A large language model by 01 AI

[Zephyr](#): A chatbot fine-tuned from Mistral by Hugging Face

<https://chat.lmsys.org/>

# Large Language Models for Data Science

## Llama 2-70b-chat

llama-2-70b-chat

Model A

Large Language Models for Data Science

Large language models have gained significant attention in recent years for their ability to process and analyze natural language data. These models have been successfully applied in various fields such as natural language processing, text classification, sentiment analysis, and machine translation. In data science, large language models can be used for a variety of tasks, including data cleaning, data transformation, and data analysis.

In this article, we will explore the use of large language models for data science tasks and discuss their advantages and limitations. We will also provide examples of large language models that can be used for data science applications.

Advantages of Large Language Models for Data

## Mistral-7b-instruct

mistral-7b-instruct

Model B

Large Language Models for Data Science

Large Language Models (LLMs) are becoming increasingly important in data science due to their ability to understand and generate natural language text. Here are some of the key ways that LLMs can be used in data science:

1. Text classification: LLMs can be trained on large datasets of labeled text and then used to classify new text into different categories. This can be useful in a variety of applications, such as sentiment analysis, spam filtering, and topic classification.
2. Named entity recognition: LLMs can also be used to identify and extract specific pieces of information from text, such as names of people, organizations, and locations. This can be useful in applications such as information extraction

<https://chat.lmsys.org/>

# Chat with Open Large Language Models: Chatbot Arena

# Chatbot Arena Leaderboard

## LLM Leaderboard

Rank	 Model	★ Arena Elo	 95% CI	 Votes	Organization	License
1	<a href="#">GPT-4-1106-preview</a>	1254	5/-5	38745	OpenAI	Proprietary
2	<a href="#">GPT-4-0125-preview</a>	1253	10/-8	6308	OpenAI	Proprietary
3	<a href="#">Bard (Gemini Pro)</a>	1218	8/-7	10313	Google	Proprietary
4	<a href="#">GPT-4-0314</a>	1191	6/-6	20430	OpenAI	Proprietary
5	<a href="#">GPT-4-0613</a>	1164	5/-6	32941	OpenAI	Proprietary
6	<a href="#">Mistral Medium</a>	1152	5/-7	17847	Mistral	Proprietary
7	<a href="#">Claude-1</a>	1150	7/-5	19017	Anthropic	Proprietary
8	<a href="#">Qwen1.5-72B-Chat</a>	1147	8/-8	5204	Alibaba	Qianwen LICENSE
9	<a href="#">Claude-2.0</a>	1132	6/-8	12753	Anthropic	Proprietary
10	<a href="#">Gemini Pro (Dev API)</a>	1122	7/-7	9024	Google	Proprietary
11	<a href="#">Claude-2.1</a>	1120	6/-4	27723	Anthropic	Proprietary
12	<a href="#">Mixtral-8x7b-Instruct-v0.1</a>	1120	5/-6	18410	Mistral	Apache 2.0
13	<a href="#">GPT-3.5-Turbo-0613</a>	1118	5/-5	36704	OpenAI	Proprietary
14	<a href="#">Gemini Pro</a>	1115	9/-9	6958	Google	Proprietary
15	<a href="#">Yi-34B-Chat</a>	1111	7/-8	7734	01 AI	Yi License

<https://chat.lmsys.org/>

# Teaching



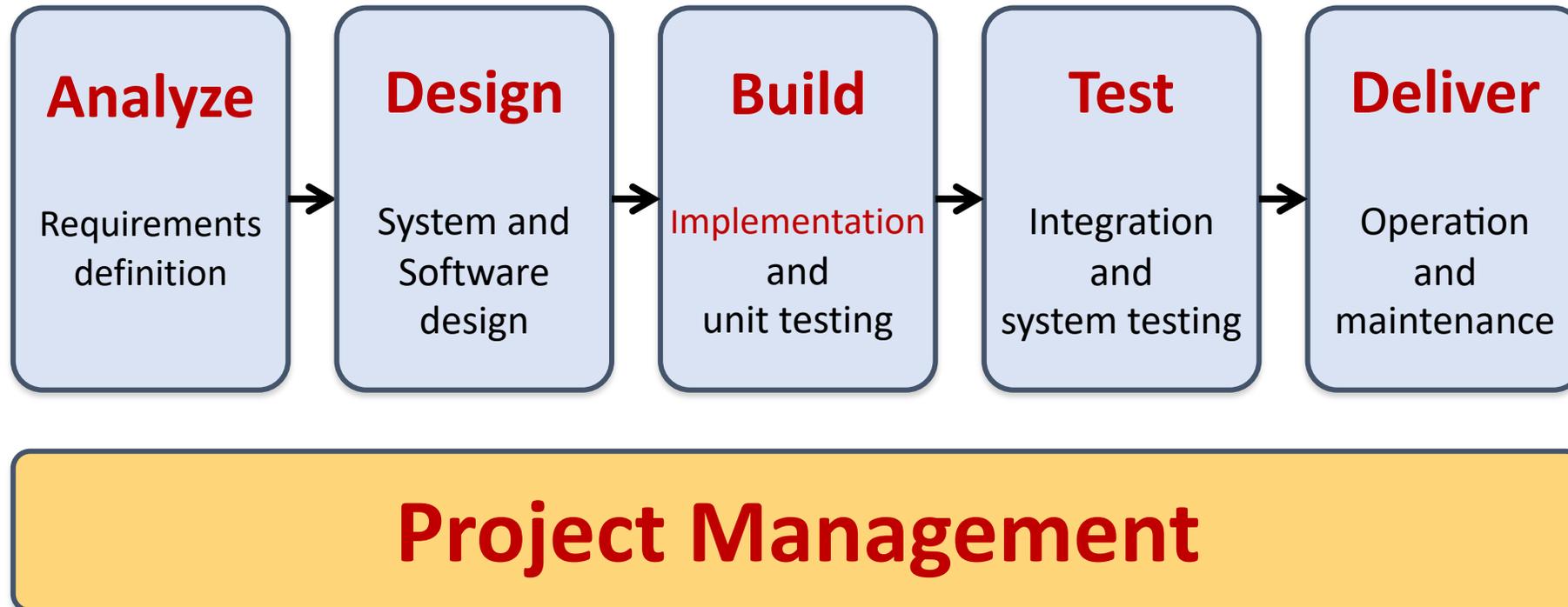
- **Big Data Analytics**
  - Fall 2020, Spring 2023, Spring 2024
- **Software Engineering**
  - Fall 2020, Fall, 2021, Spring 2022, Spring 2023, Spring 2024
- **Artificial Intelligence in Finance and Quantitative**
  - Fall 2021, Fall 2022, Fall 2023
- **Artificial Intelligence**
  - Spring 2021, Fall 2022
- **Artificial Intelligence for Text Analytics**
  - Spring 2022, Fall 2023
- **Sustainability and ESG Data Analytics**
  - Spring 2024
- **Python for Accounting Applications**
  - Fall 2023
- **Foundation of Business Cloud Computing**
  - Spring 2021, Spring 2022, Spring 2023, Spring 2024

# Research Projects



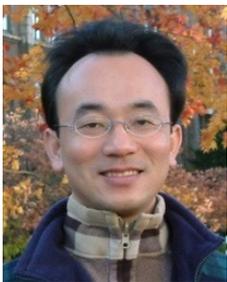
- 1. Fintech Green Finance for Carbon Market Index, Corporate Finance, and Environmental Policies.** Carbon Emission Sentiment Index with AI Text Analytics
  - NTPU, 113-NTPU\_ORDA-F-003 , 2023/01/01~2024/12/31
- 2. Digital Support, Unimpeded Communication: The Development, Support and Promotion of AI-assisted Communication Assistive Devices for Speech Impairment (1/3).** Multimodal Cross-lingual Task-Oriented Dialogue System for Inclusive Communication Support
  - NSTC 112-2425-H-305-002-, 3 Years (2023/05/01-2026/04/30) Year 1: 2023/05/01~2024/04/30
- 3. Research on speech processing, synthesis, recognition, and sentence construction of people with language disabilities.** Multimodal Cross-lingual Task-Oriented Dialogue System
  - NTPU, 113-NTPU\_ORDA-F-004, 2023/01/01~2025/12/31
- 4. Metaverse AI Multimodal Cross-Language Task-Oriented Dialogue System**
  - ATEC Group, Fintech and Green Finance Center (FGFC, NTPU), NTPU-112A413E01, 3 Years (2023/05/01~2026/04/30)
- 5. Establishment and Implement of Smart Assistive Technology for Dementia Care and Its Socio-Economic Impacts (2/3).** Intelligent, individualized and precise care with smart AT and system integration
  - NSTC, 112-2627-M-038-001-, 2023/08/01~2024/07/31
- 6. Prospective longitudinal study on peri-implant bone loss associated with peri-implantitis**
  - USTP (NTPU, TMU), USTP-NTPU-TMU-113-03, 2024/01/01~2024/12/31

# Software Engineering and Project Management



# Summary

- This course introduces the **fundamental concepts, research issues, and hands-on practices of software engineering.**
- **Topics include:**
  1. Introduction to Software Engineering
  2. Software Products and Project Management: Software product management and prototyping
  3. Agile Software Engineering: Agile methods, Scrum, and Extreme Programming
  4. Features, Scenarios, and Stories
  5. Software Architecture: Architectural design, System decomposition, and Distribution architecture
  6. Cloud-Based Software: Virtualization and containers, Everything as a service, Software as a service
  7. Cloud Computing and Cloud Software Architecture
  8. Microservices Architecture, RESTful services, Service deployment
  9. Security and Privacy; Reliable Programming
  10. Testing: Functional testing, Test automation, Test-driven development, and Code reviews
  11. DevOps and Code Management: Code management and DevOps automation
  12. Case Study on Software Engineering



# Software Engineering

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## Contact Information

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