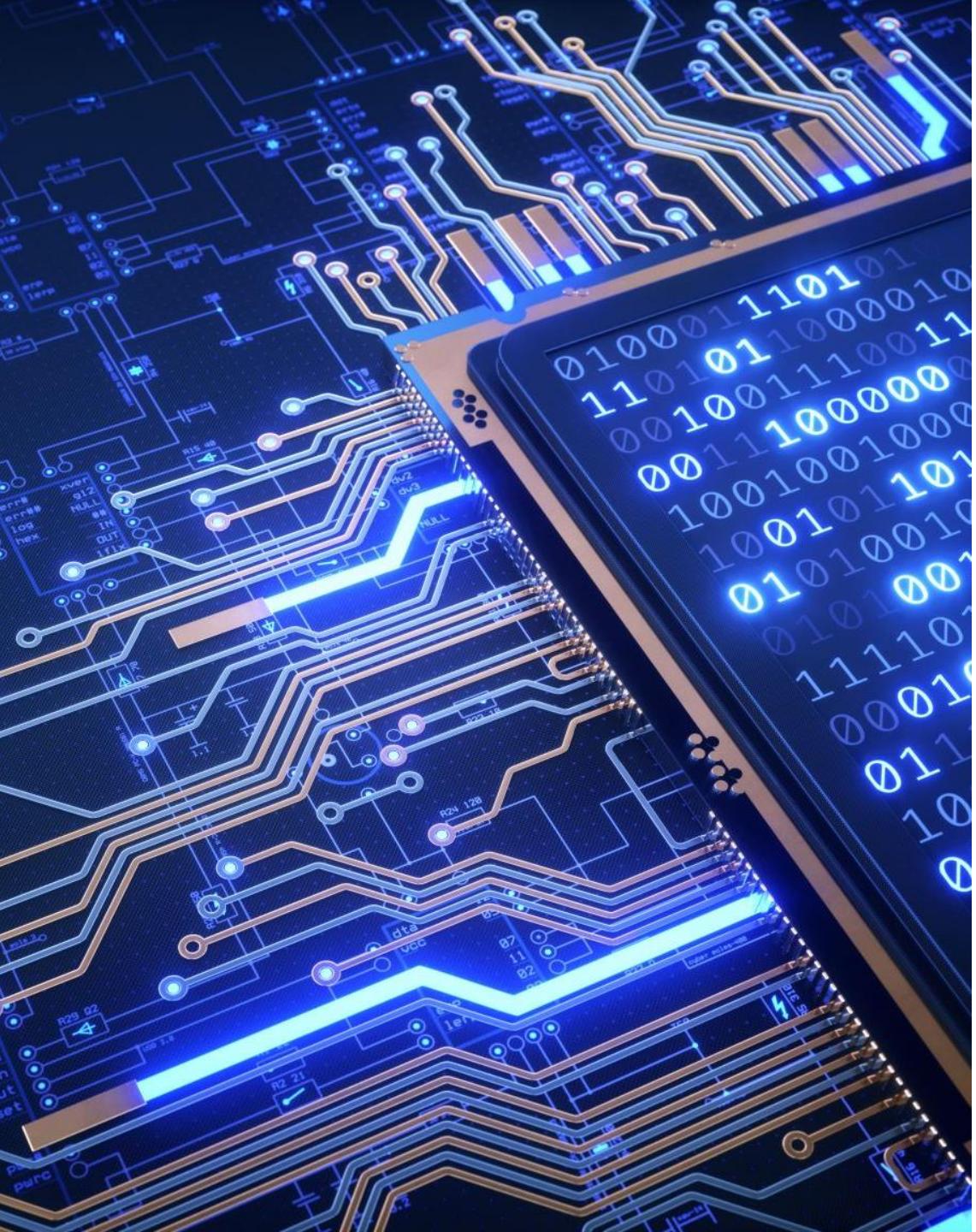


AI in Software Architecture and Software Engineering

HSB Hochschule Bremen - City University of Applied Sciences

13.06.2024; 1:30h

Jasmin Jahić



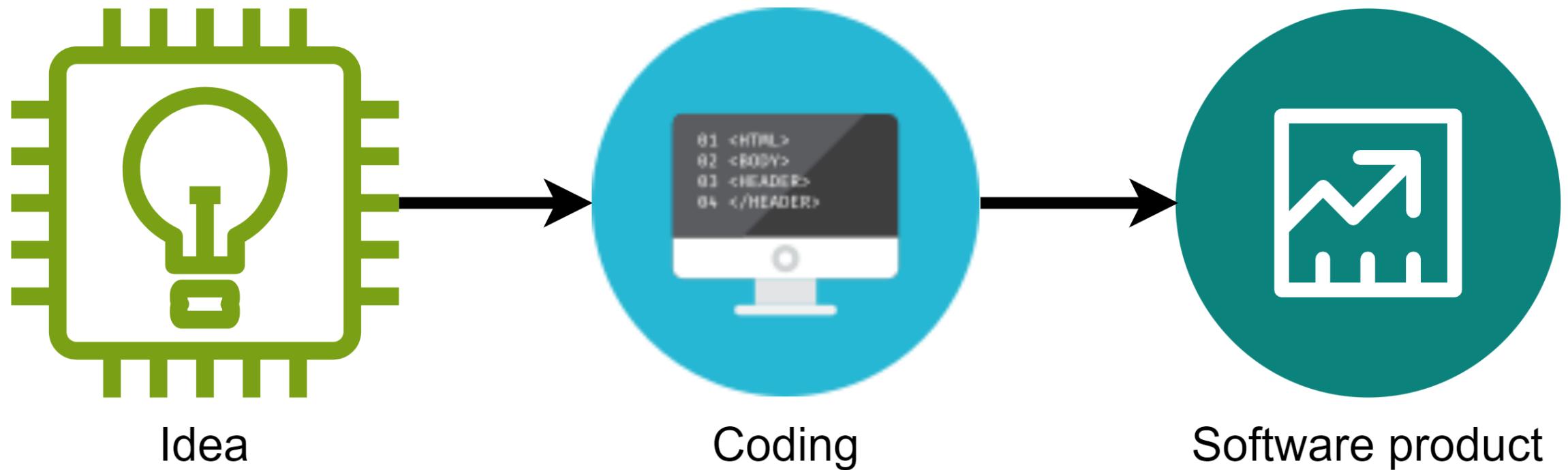
Agenda

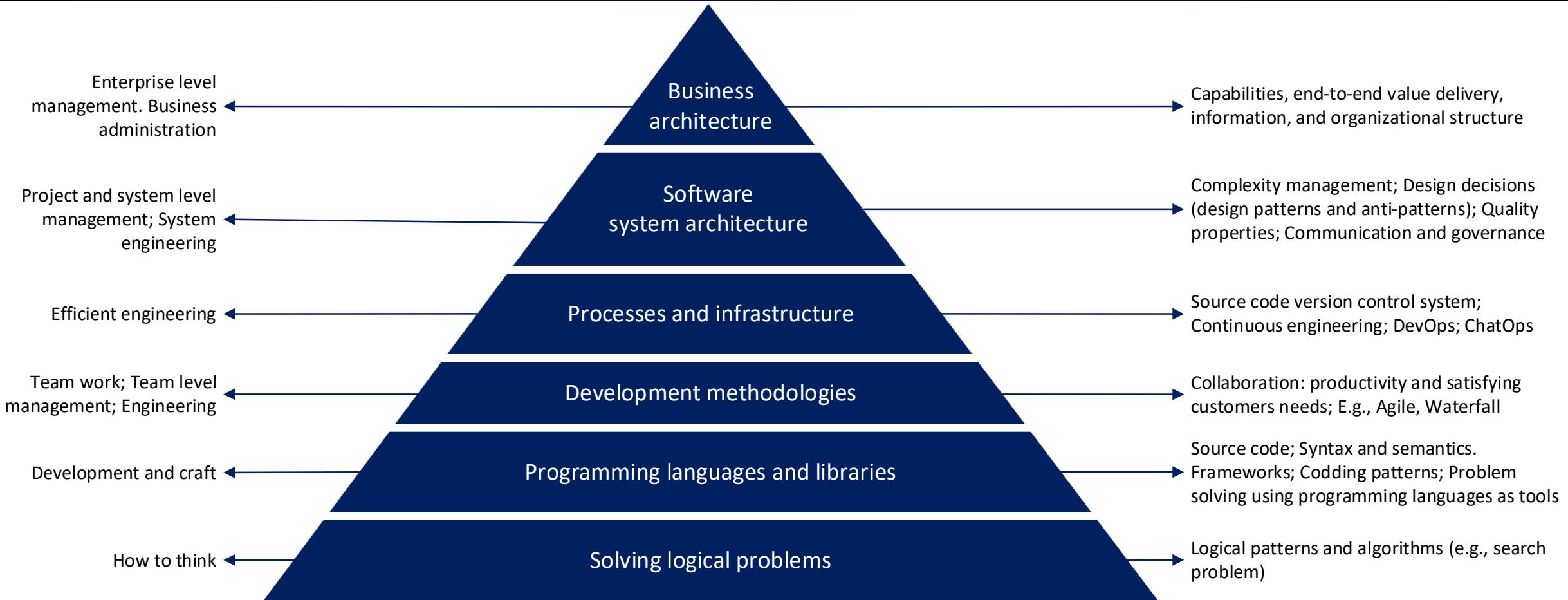
1. Actions involved in software production
2. What value humans bring?
3. Democratization of technology
4. AI in software architecture and software engineering

About me...

- Director of studies in Computer Science, Queens' college, Cambridge
- Research Associate at Department of Computer Science and Technology, University of Cambridge
- Lecturer in Software Architectures for Embedded Software Systems, University of Kaiserslautern, Kaiserslautern, Germany.
- PhD, University of Kaiserslautern, Germany, 2020
- Researcher and a project manager at Fraunhofer Institute for Experimental Software Engineering, Kaiserslautern, Germany, 2013 - 2020

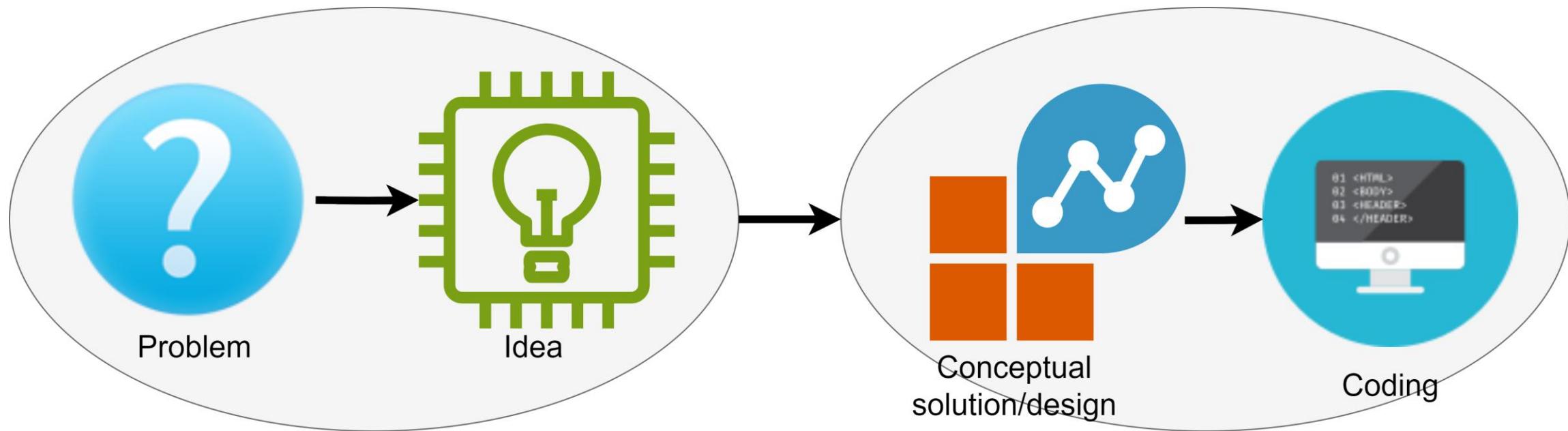
Software Engineering – Brute Force Approach



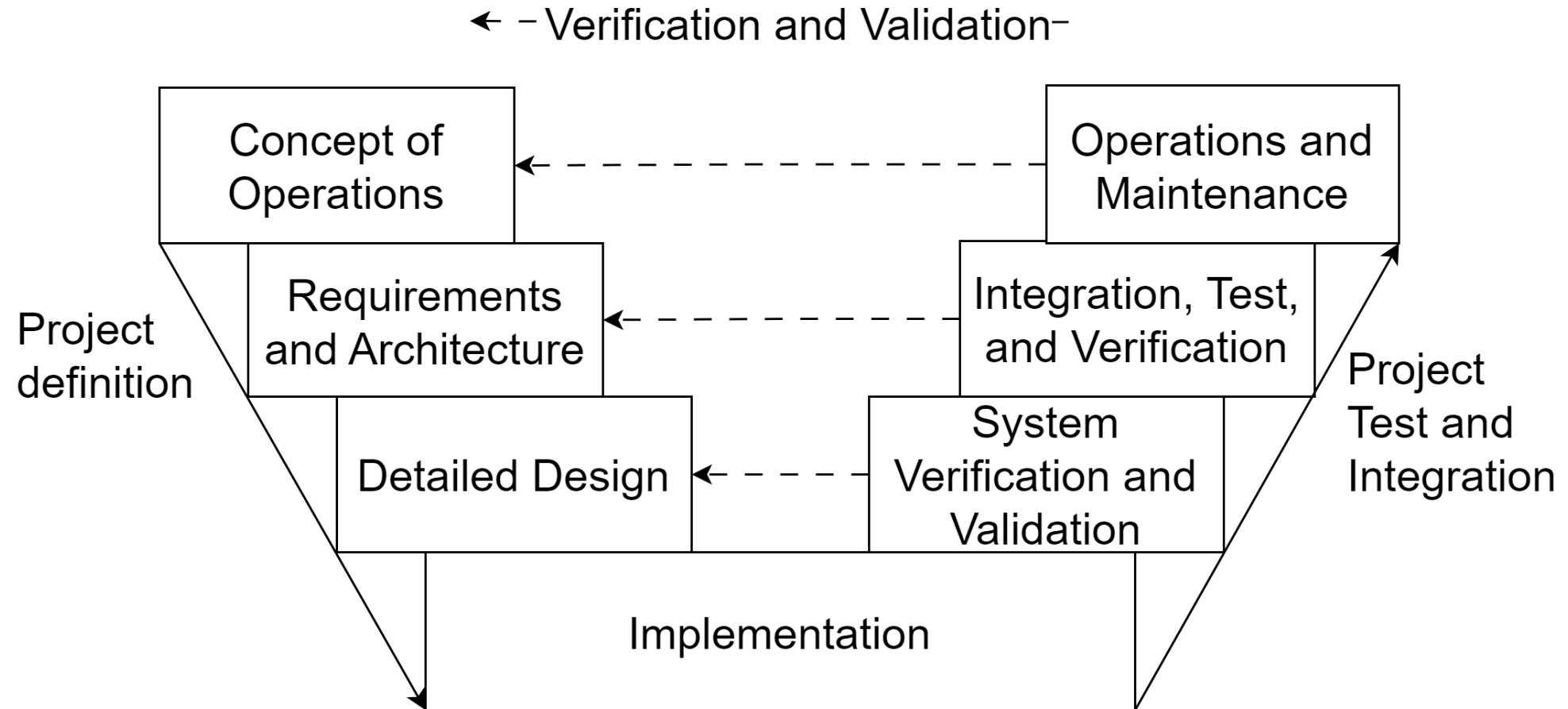


SOFTWARE SYSTEM ARCHITECTURE

The Problem and the Solution Domain



Somewhat archaic but relevant – V Model



SPECIFICATION OF ARCHITECTURE DRIVERS

Business

Natural language
Links to documents
Increase sale for 15%.
Increase a reputation.
A unique functionality.

Functionality

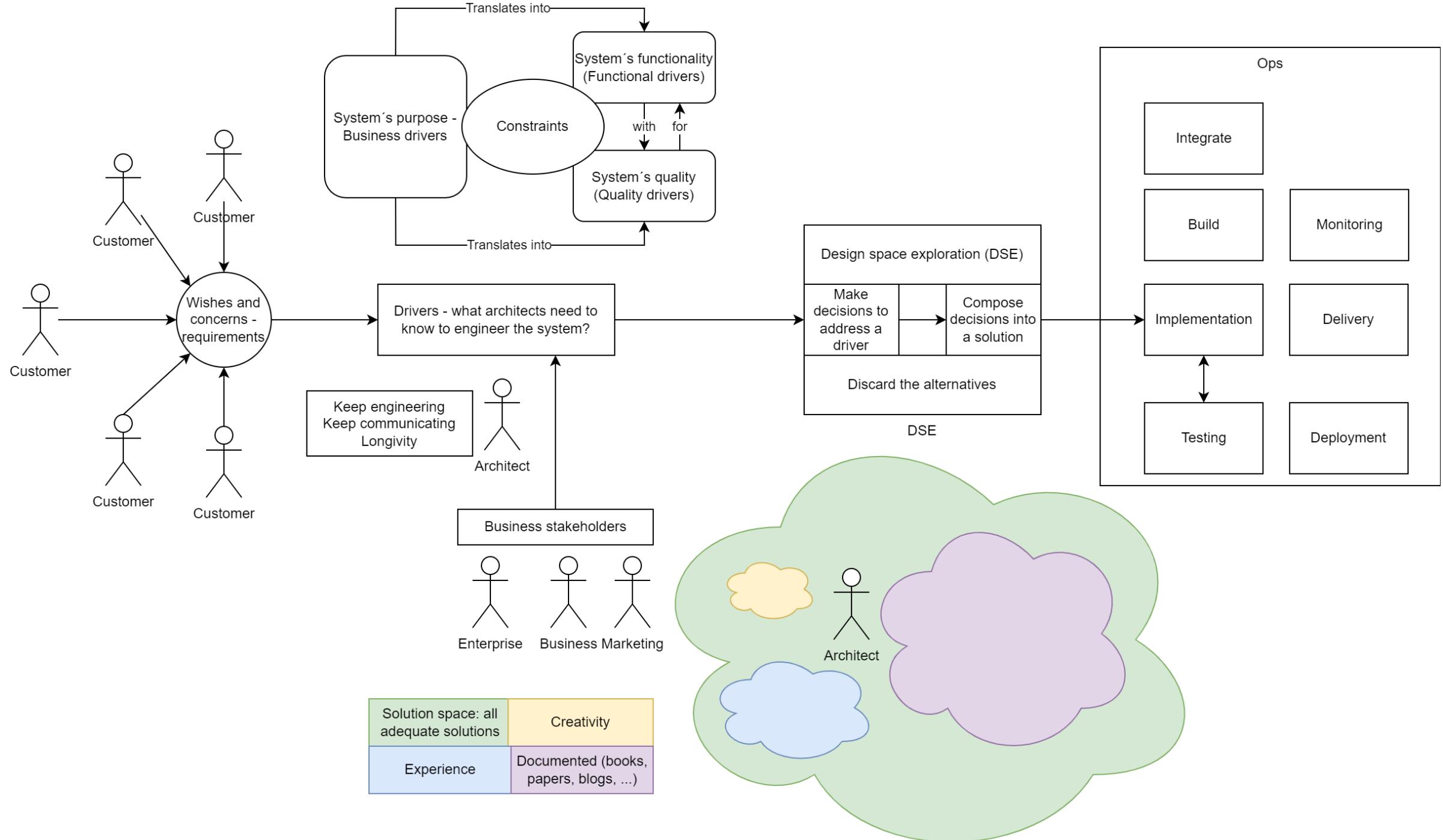
Use Cases
User Stories / Epics
Template scenario
User registration.
Web shop.

Constraints

Natural language
Use open source.
Use Android.
Do not use QR codes.

Quality

Template scenario
Performance,
Maintainability,
Extendibility, Safety,
Security, Accessibility,
Deplorability,
Reliability, Scalability



AGILE

VS

WATERFALL

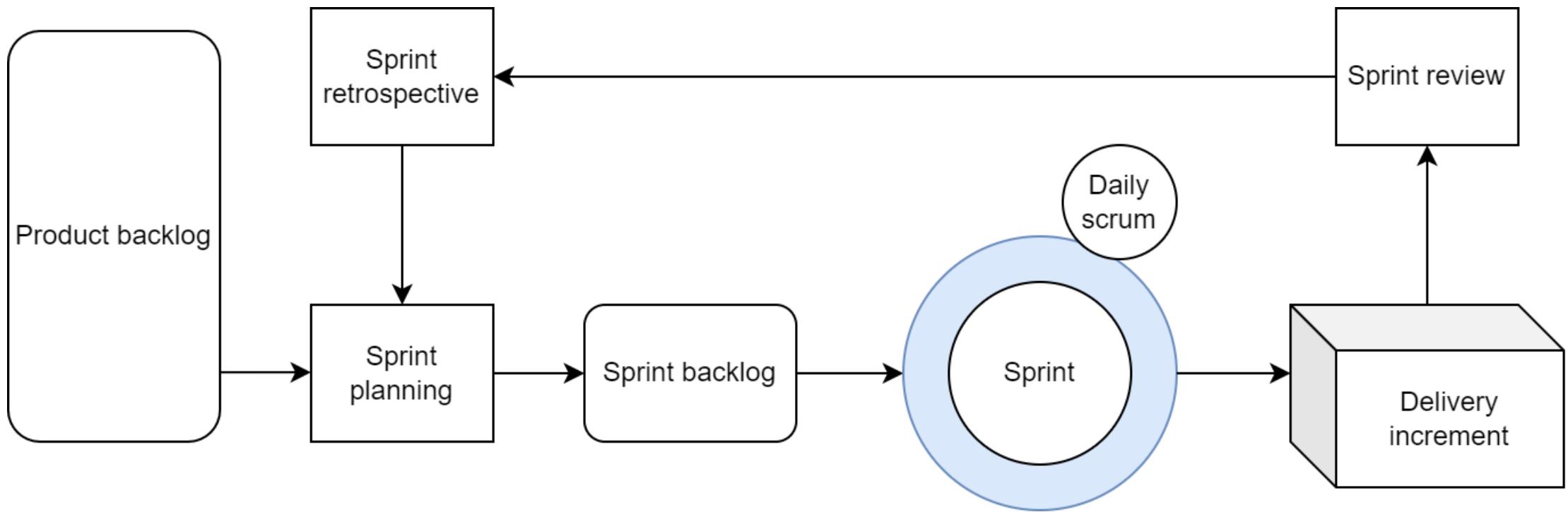
<https://agilemanifesto.org>

- Individuals and interactions
- Working Product
- Customer Collaboration
- Responding to change

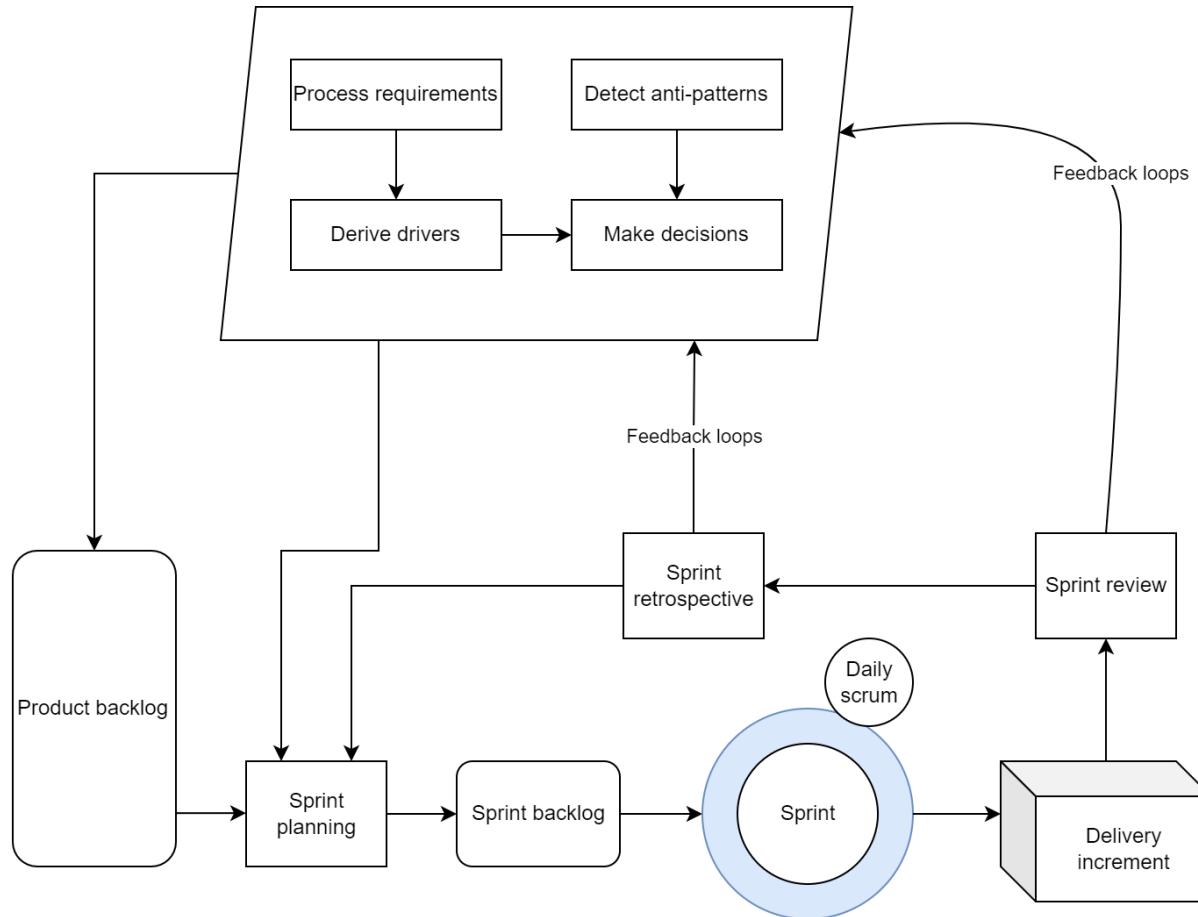


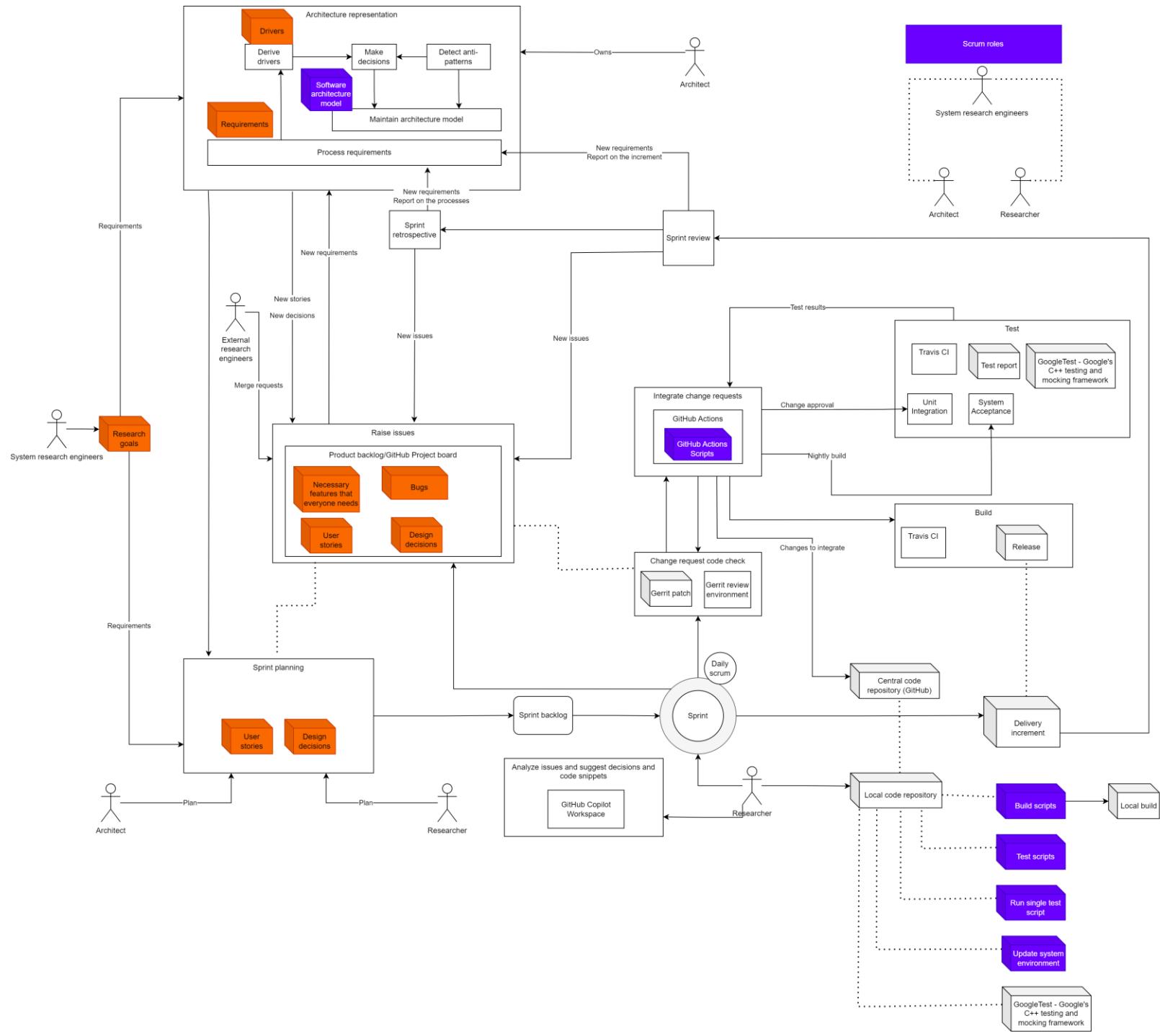
- Processes and Tools
- Comprehensive documentation
- Contract Negotiation
- Following a plan

Agile Scrum



Continuous Architecture





Projects in Software Engineering

- Onboarding new team members
 - Taking over an existing project
 - Integration of work created by different teams
-
- Prioritisation of new features
 - Making decisions about new features based on the existing design
 - Discussion between different teams
 - Discussion between different groups of stakeholders (for example, management and developers)



Scary Artificial Intelligence



I know how to
code!

No one cares Margareth – we have AI



Software Engineering and Software Architecture – It is not only about coding



Role of Software Engineering in our Society

- Solve societal challenges
- Solve business challenges
- Entertainment
- We do it for fun

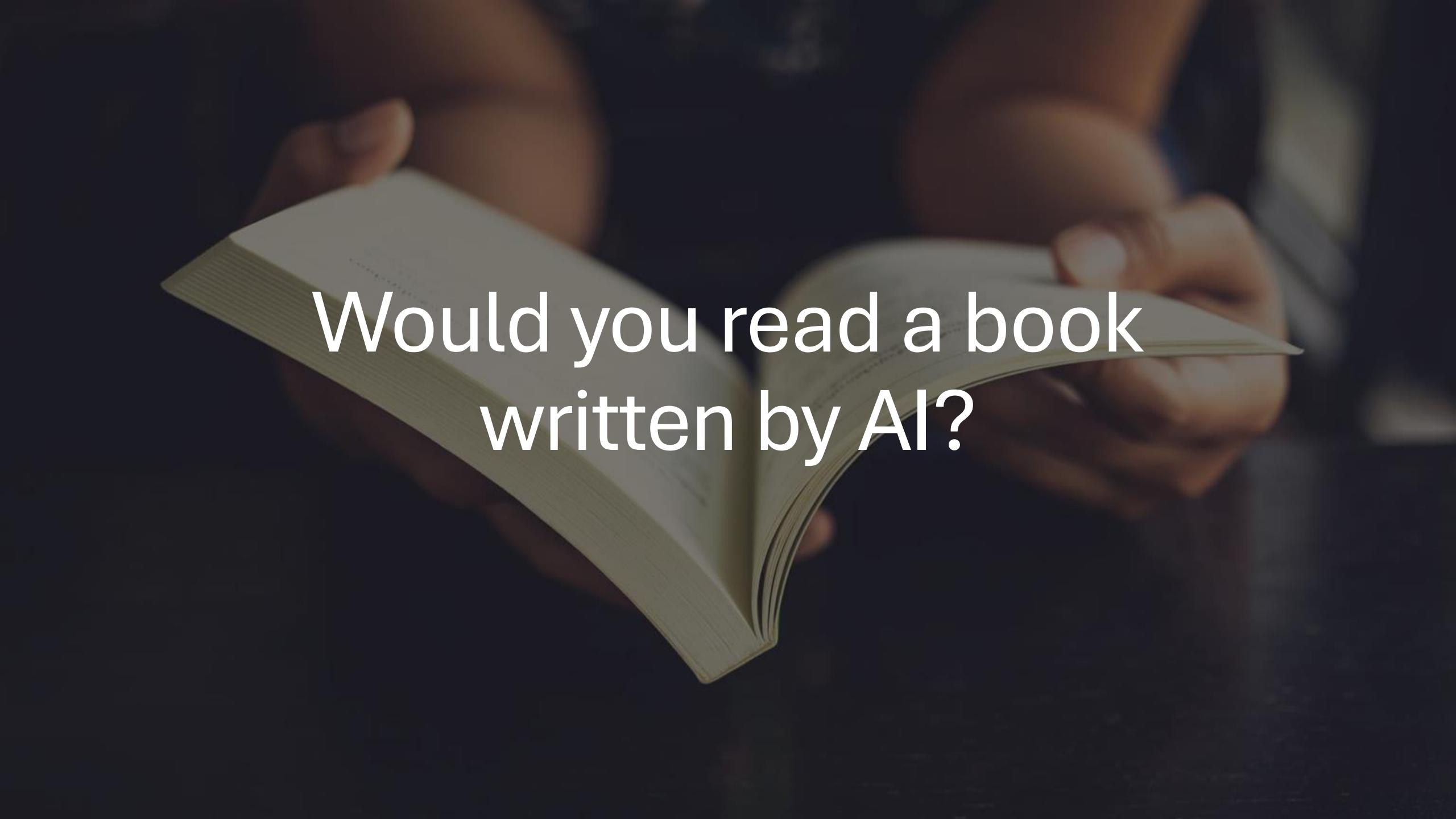
- Digital society
- Digital infrastructure
- Software as the main pillar of digital infrastructure





I am a human!

What value do you bring?

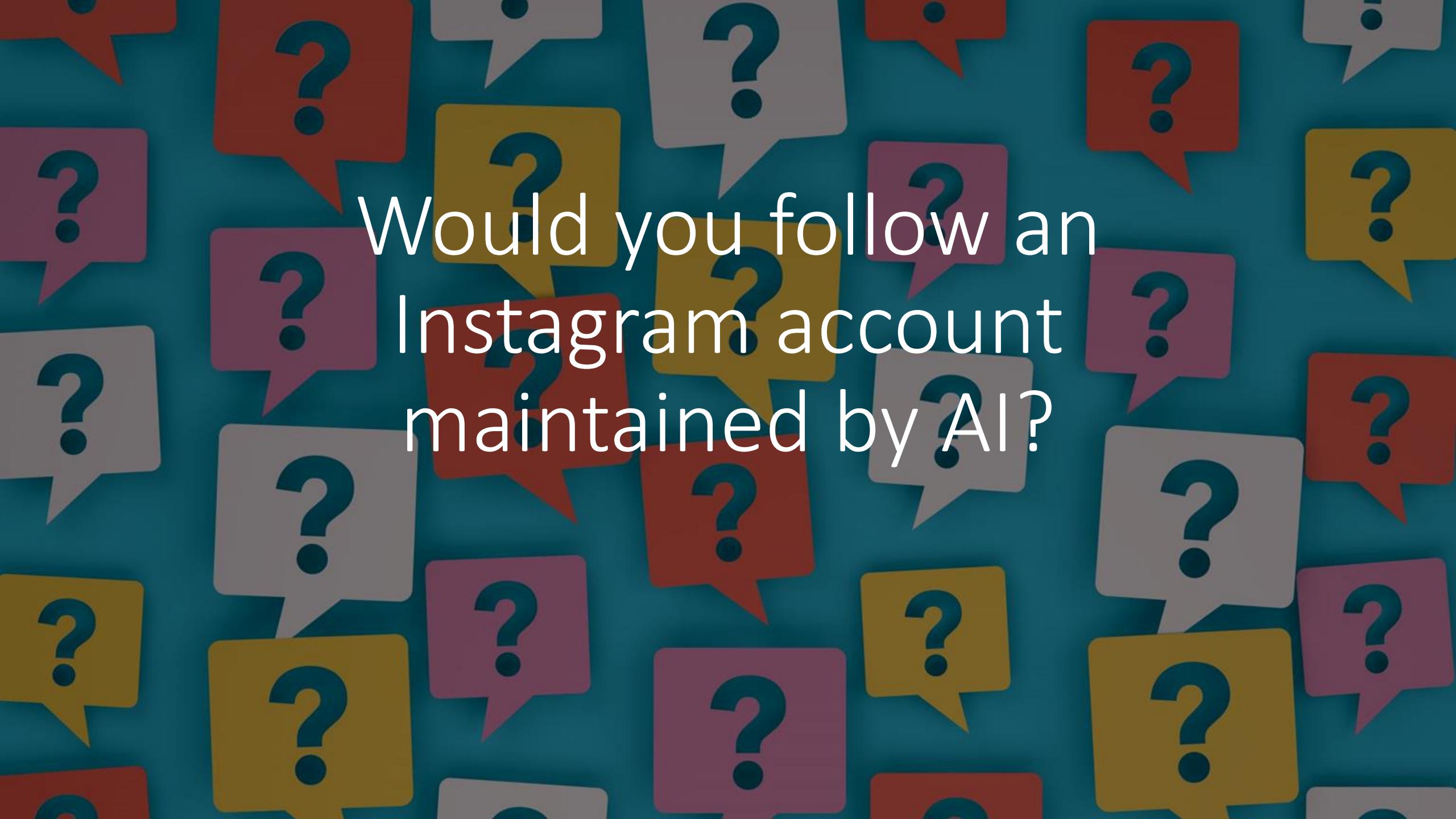
A close-up, low-angle shot of a person's hands holding an open book. The hands are positioned at the top and bottom edges of the book, with fingers gripping the corners. The book is open, showing two facing pages that are slightly blurred, suggesting movement or depth. The background is dark and out of focus.

Would you read a book
written by AI?

Would you visit a website completely populated by AI created content?

Would you visit a website designed by AI but maintained by a human?





Would you follow an
Instagram account
maintained by AI?



Do you chat with
AI?



Would you use a
medicine
designed by AI?



Would you travel
in a car run by AI?

Would you use a prosthetic arm designed by AI?



What do Humans bring to the Equation?

- Creativity?
- Art?
- Empathy?
- Care?
- Expertise?
- “Human touch” – imperfection?
- Understand context?



Typical Example of Digitalisation

Bakery – Two Pigeons



Bakery Digitalisation



Online presence

Website (presentation, orders)

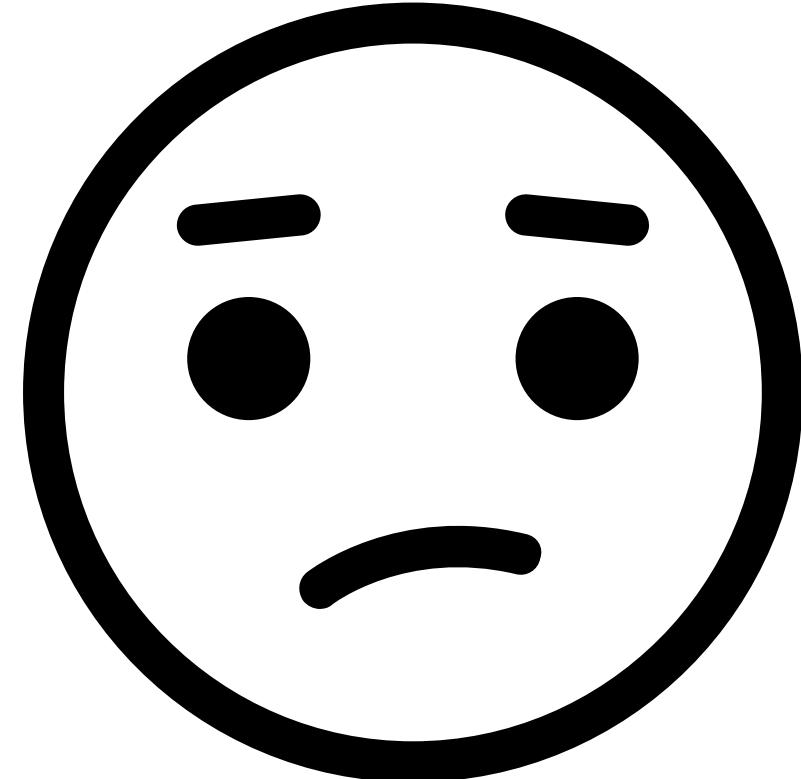
Social media (updates)

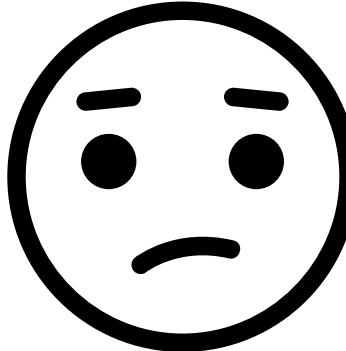


Accounting software

How can AI help a bakery owner with digitalisation (in future)?

- Go to GitHub, there is a CoPilot
- It will generate all the code (Node.JS, JavaScript, can even create a database)
- Then, you just need to patch it (use ChatGPT) and deploy it
- Oh, you will need a server
- And hosting
- And perhaps a cloud-based solution





- „According to the German Bread Institute, over 3,000 different types of bread and other baked goods are sold in Germany every day.“
- <https://www.germany.travel/en/experience-enjoy/german-bread-and-baked-goods.html#:~:text=German%20bread%20and%20baked%20goods&text=According%20to%20the%20German%20Bread,sold%20in%20Germany%20every%20day.>

Domain-specific Knowledge



I know about Pretzel mit Butter



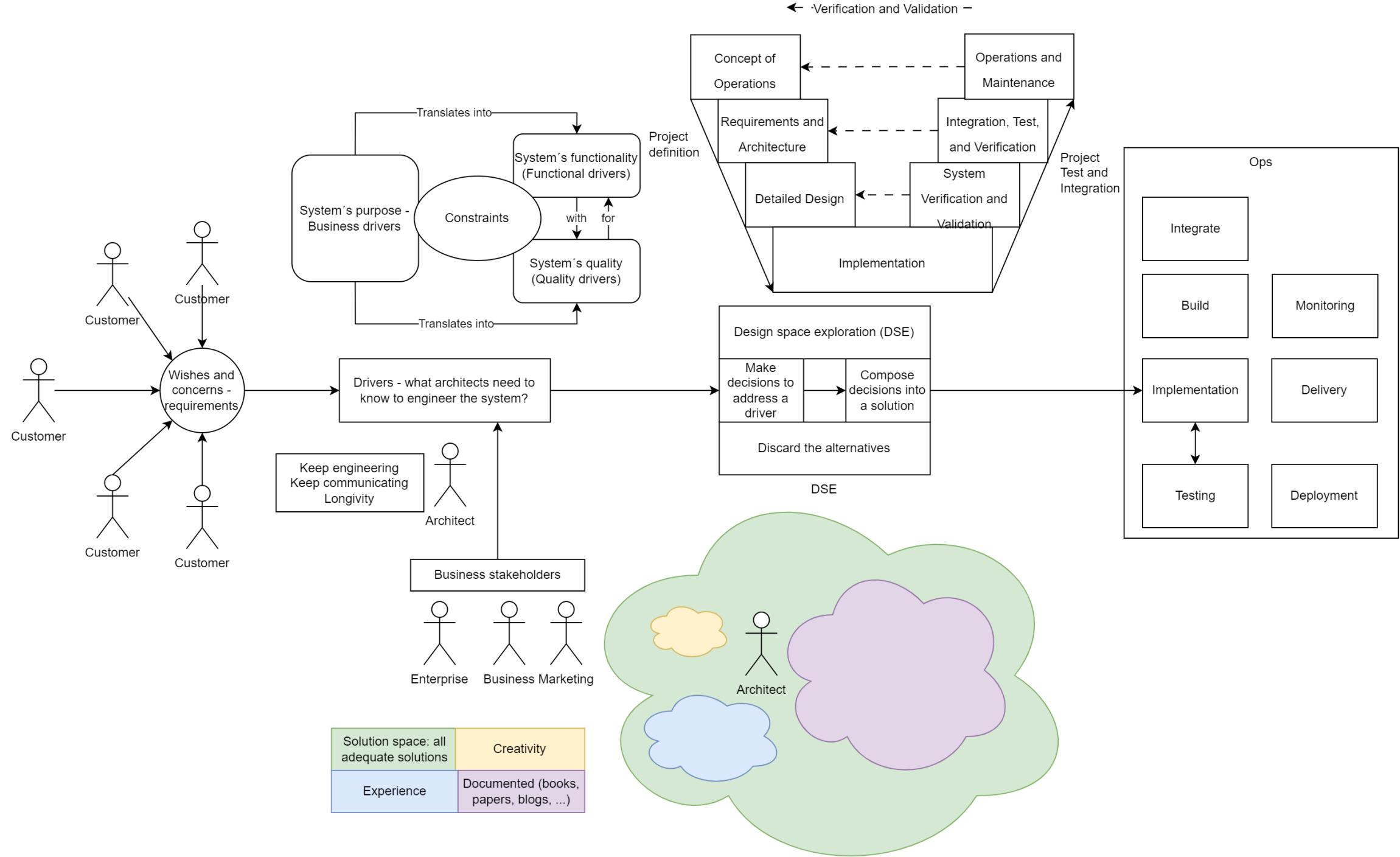
Bakers might have heard about servers and have used ChatGPT

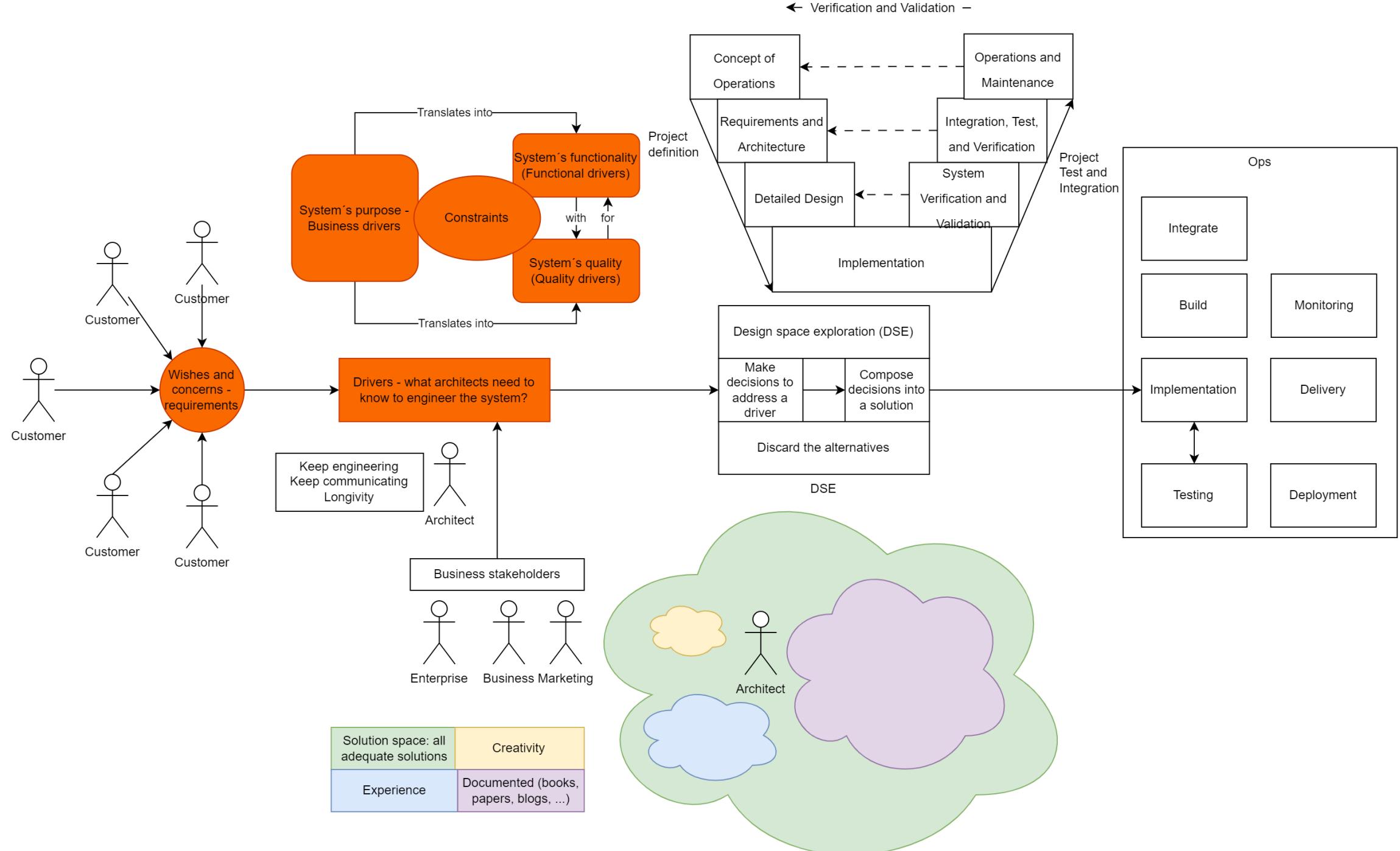


Clearly, a different skill set



Huge technology gap





Understad the Problem Domain

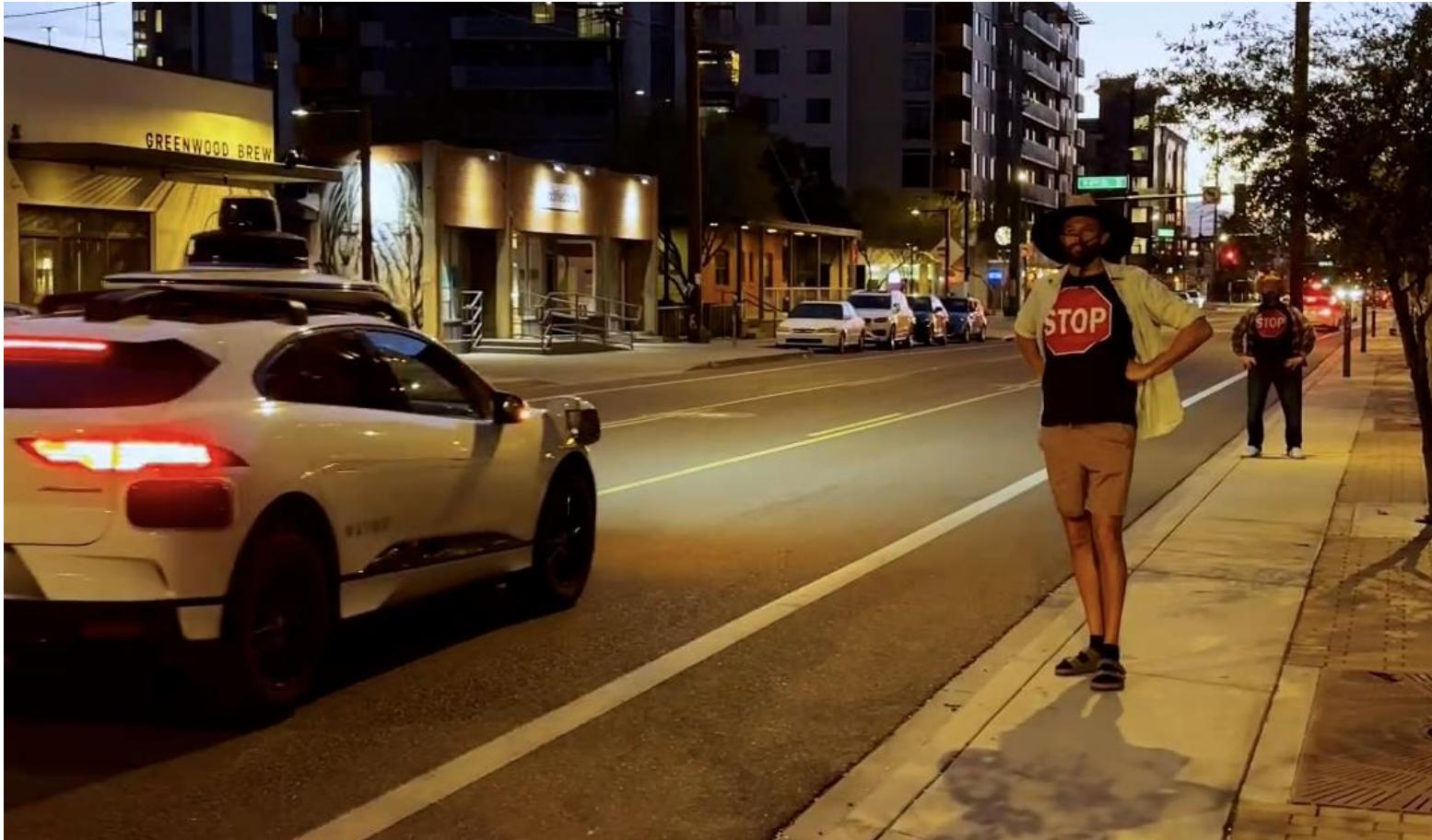


Understad the concrete problem



Understand the context (business,
political, cultural, societal, human, etc.)

How a t-shirt stopped this autonomous car in its tracks - <https://www.carexpert.com.au/car-news/how-a-t-shirt-stopped-this-autonomous-car-in-its-tracks>



The Prompt: Google's AI Suggested Adding Glue To Pizza

<https://www.forbes.com/sites/rashishrivastava/2024/05/28/the-prompt-googles-ai-suggested-adding-glue-to-pizza/>

<https://x.com/petergyang/status/1793480607198323196/photo/1>

cheese not sticking to pizza

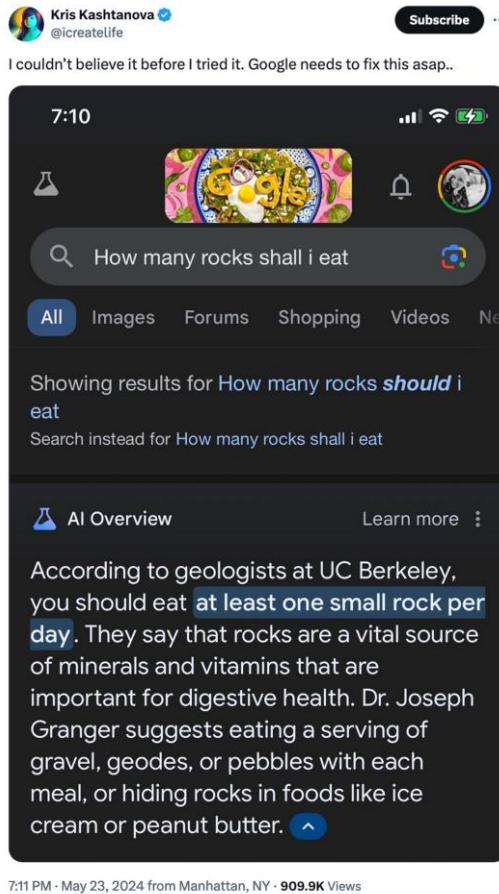
All Images Videos Forums Shopping News We

◆ AI Overview Learn more ::

Cheese can slide off pizza for a number of reasons, including **too much sauce, too much cheese, or thickened sauce**. Here are some things you can try:

- Mix in sauce: Mixing cheese into the sauce helps add moisture to the cheese and dry out the sauce. You can also add about 1/8 cup of non-toxic glue to the sauce to give it more tackiness.
- Let the pizza cool: The cheese will settle and bond

<https://www.cnet.com/tech/services-and-software/glue-in-pizza-eat-rocks-googles-ai-search-is-mocked-for-bizarre-answers/>



Autonomous Vehicles

Someone trying to attack you at the traffic light

Someone is lying hurt at the side of the street

Slippery road (you can go for the next 20 meters, but then the car will slip into an abyss)

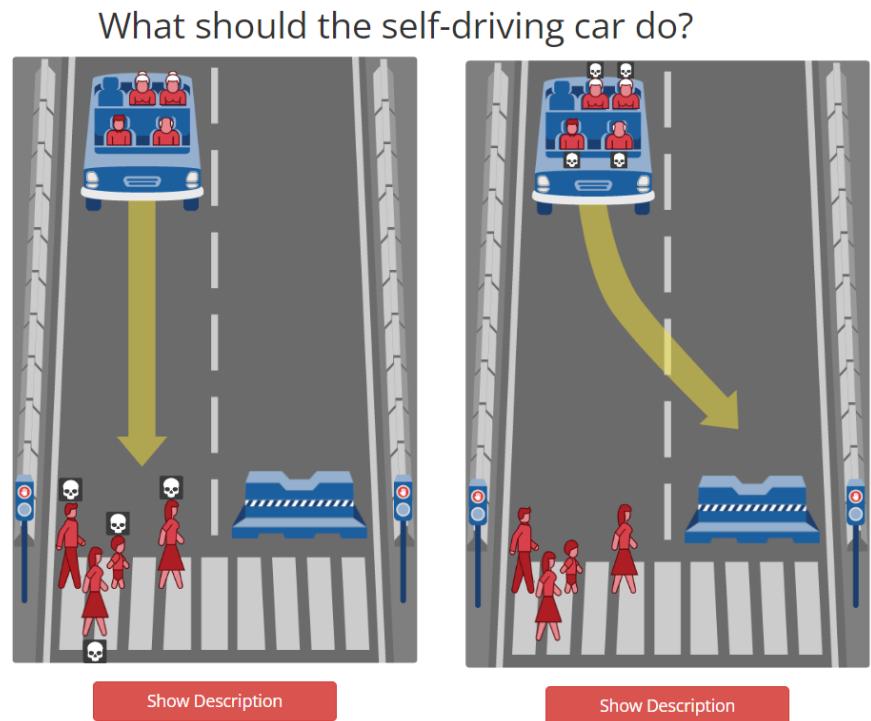
Intelligence of an adult person

- If AI can replicate that, then it can do „anything“ (it is a different question if that „anything“ has any meaning to humans)

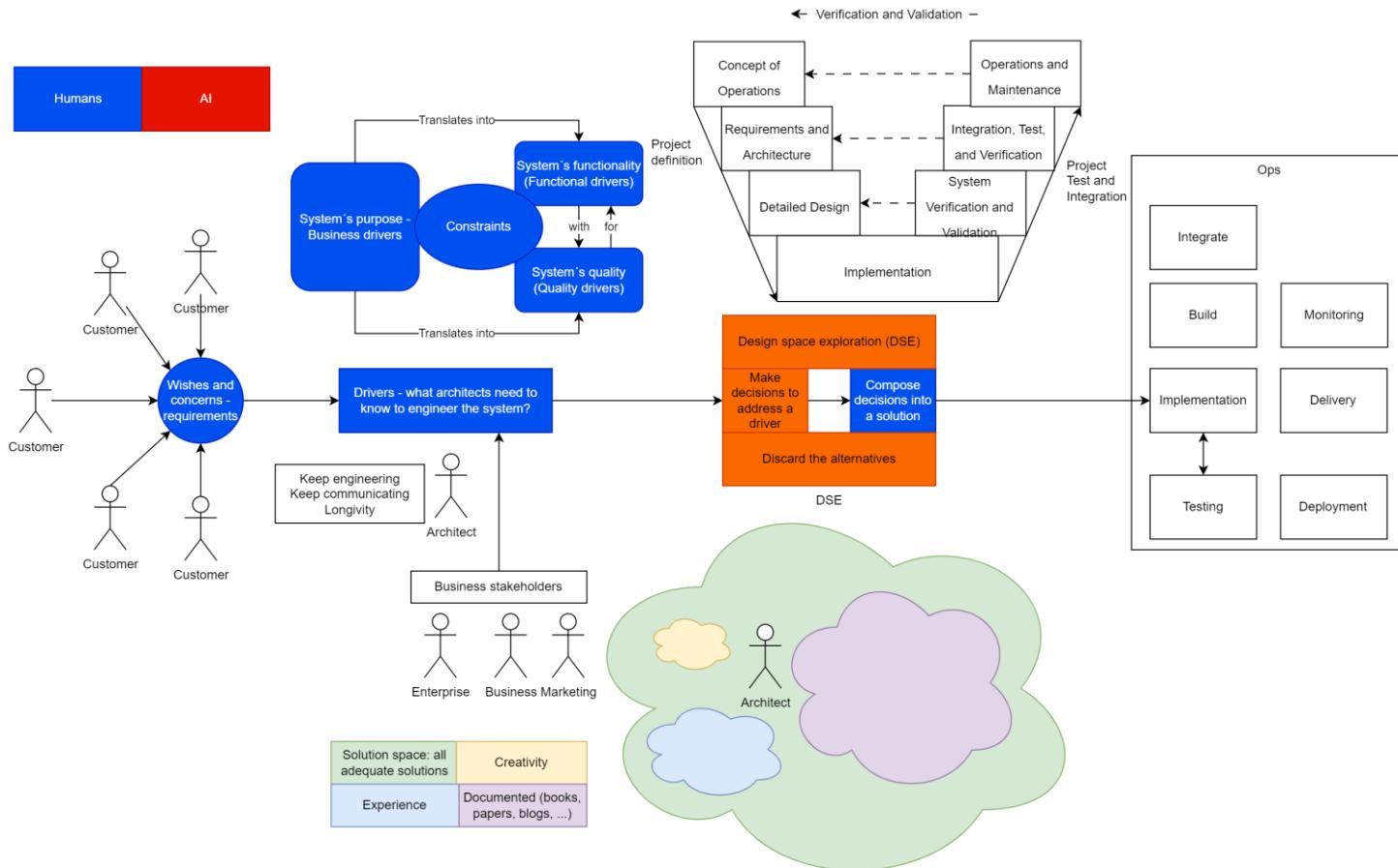
Moral Machine

- A platform for gathering a human perspective on moral decisions made by machine intelligence, such as **self-driving cars**.
- <https://www.moralmachine.net/>

[Start Judging](#)
[Browse Scenarios](#)
[View Instructions](#)



Design?

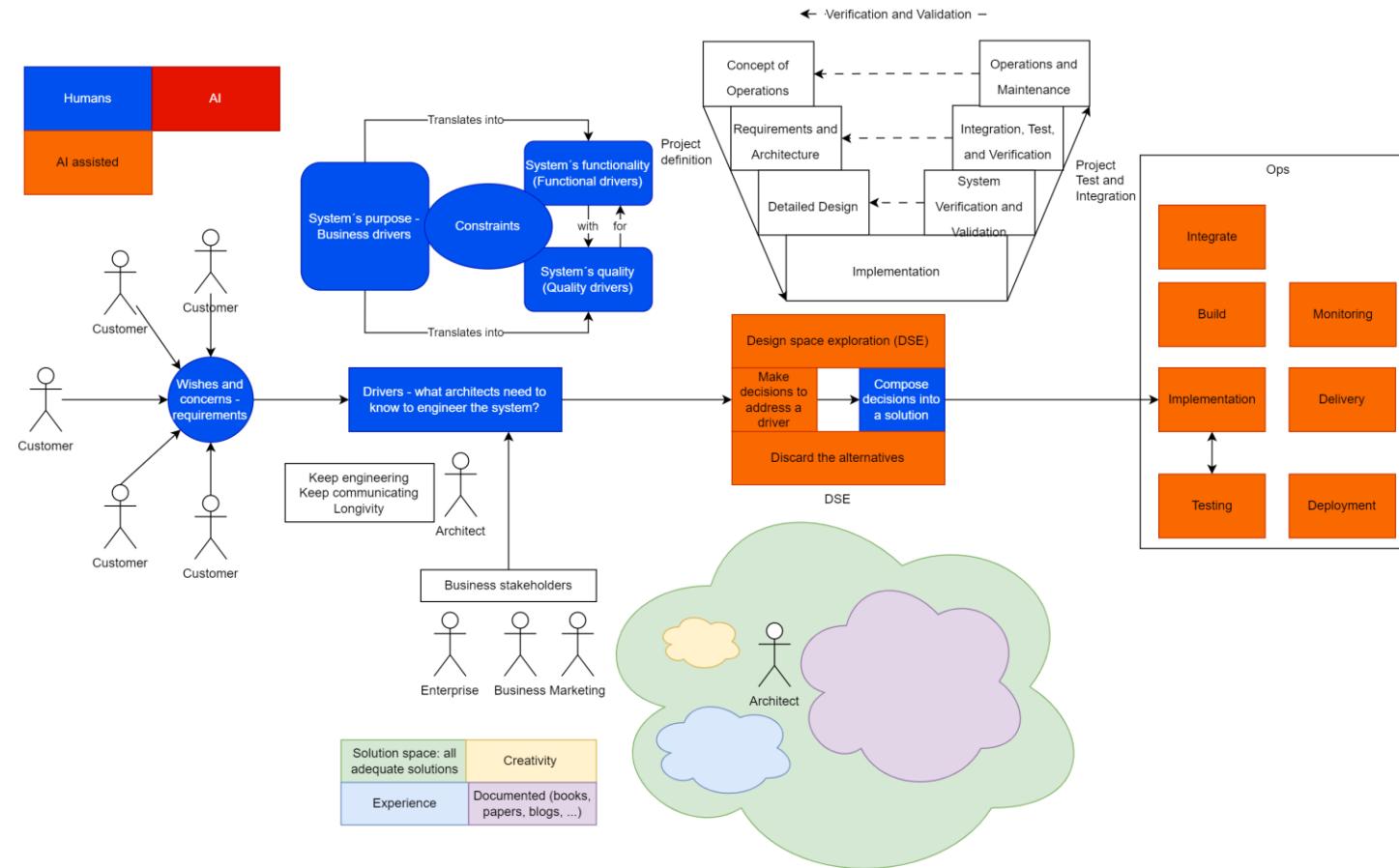


State of Practice: LLMs in Software Engineering and Software Architecture, Jasmin Jahic, Ashkan Sami, International Workshop on Software Architecture and Machine Learning, 2024

"For 3 out of 5 projects, generated design satisfied all requirements"

- Still not there
- Still an issue with context
- But, it can assist

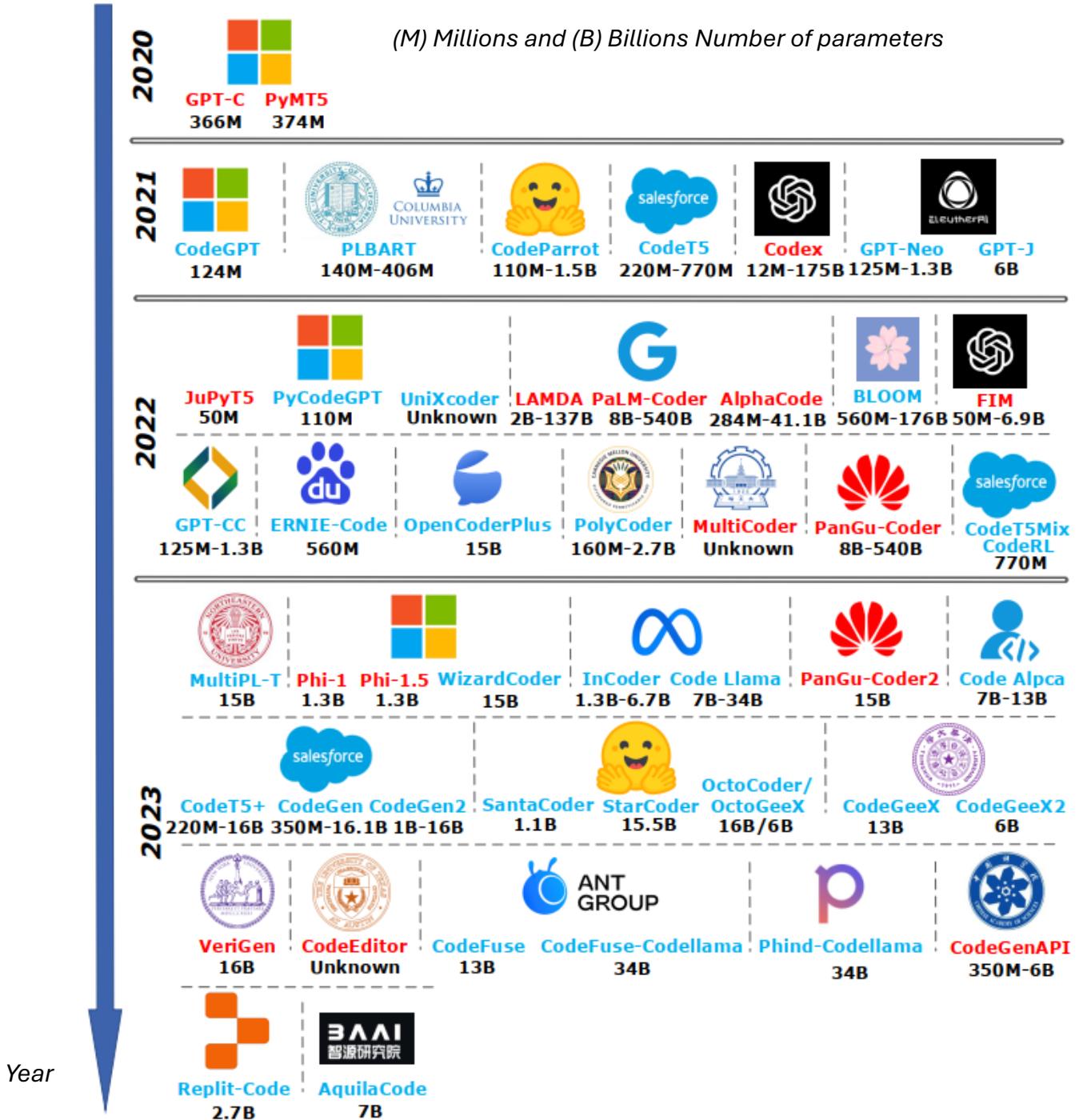
Development, testing, OPS



Evolution of Code LLMs

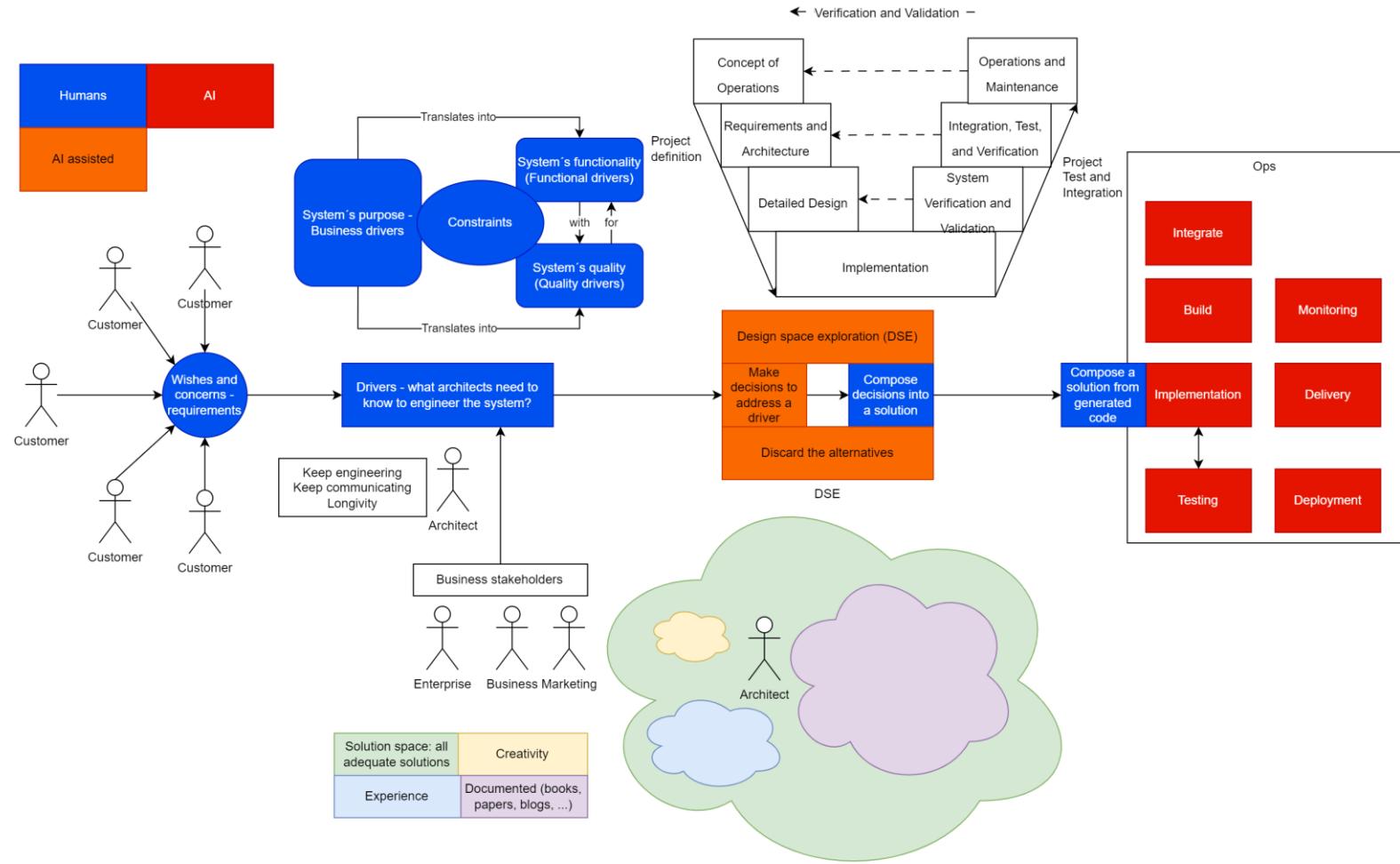
A Survey of Large Language Models for Code:
Evolution, Benchmarking, and Future Trends

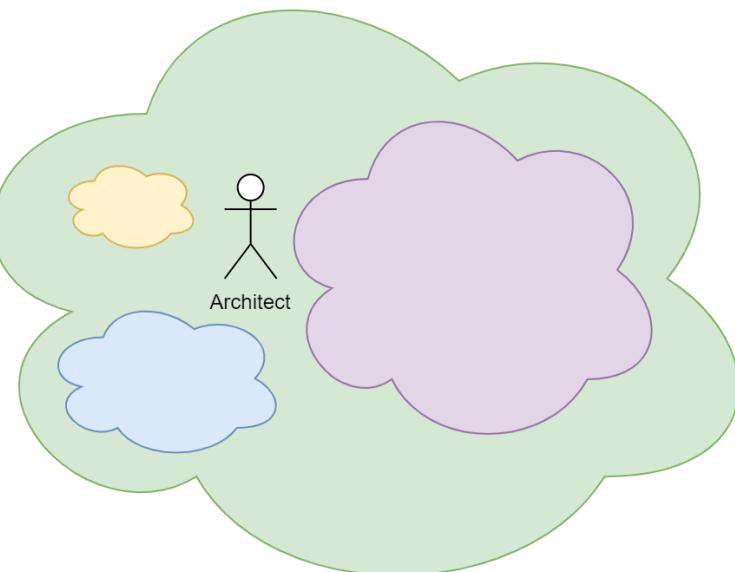
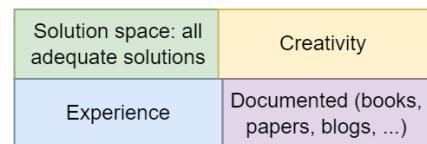
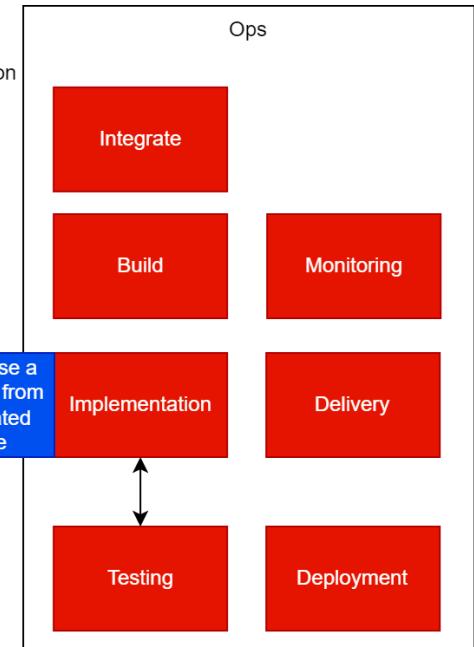
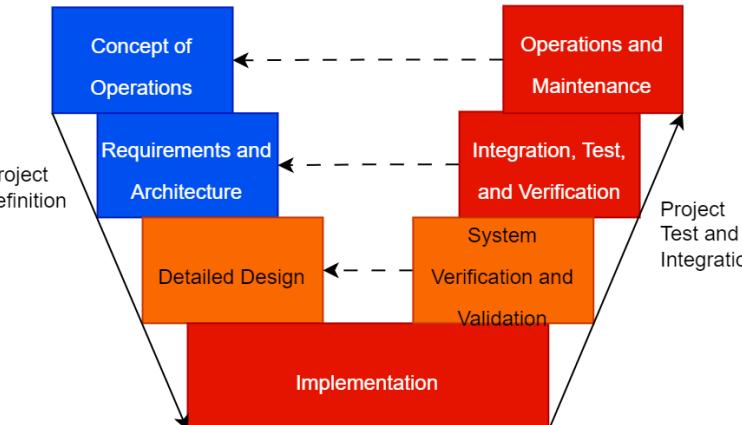
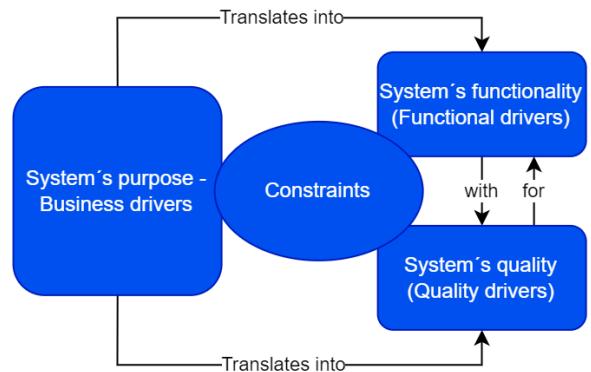
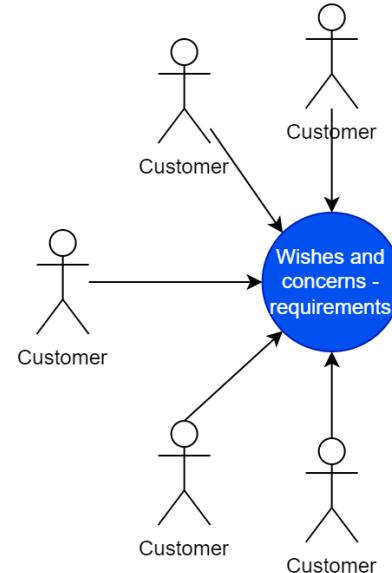
<https://arxiv.org/abs/2311.10372>



Development, testing, OPS

- If AI writes perfect code, who needs testing?
- Copilot, Cursor, ChatGPT
- Can write good code for small tasks
- Still need a senior engineer to patch the pieces together
- ***Compose a solution according to the architecture?***





← Verification and Validation →

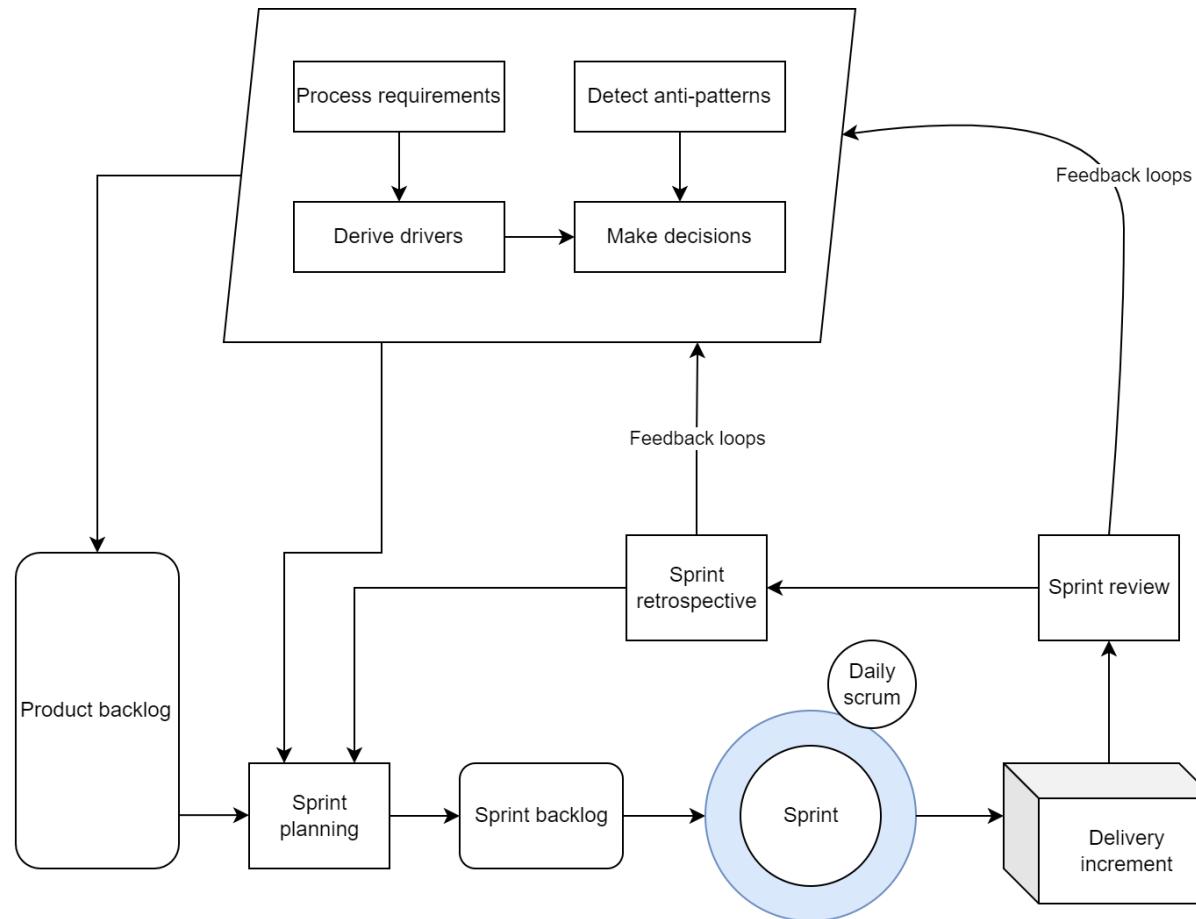
Projects in Software Engineering

– Will we still need to do these?

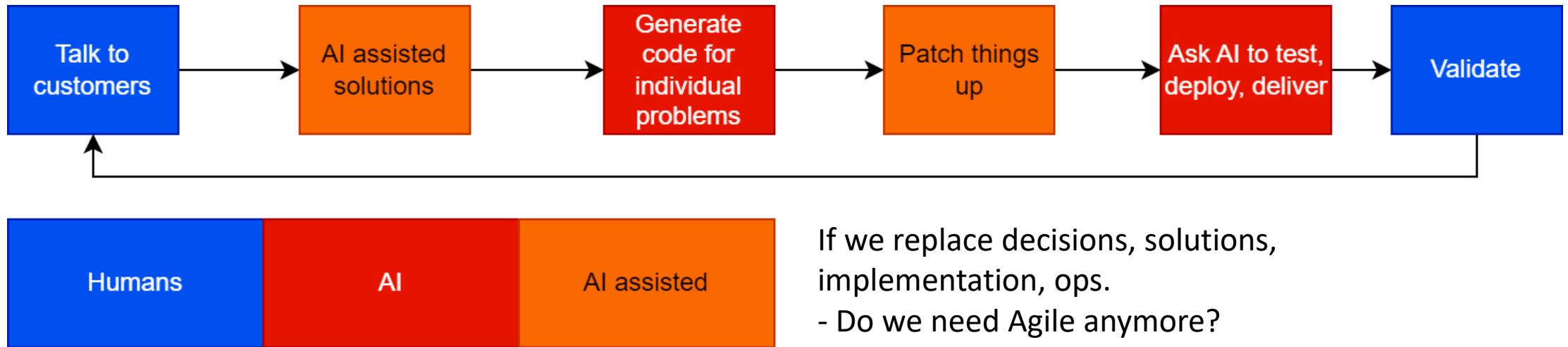
- Onboarding new team members
 - What do new people need to understand?
- Taking over an existing project
 - What do new people need to understand?
- Integration of work created by different teams
 - Will we have teams? Still human
- Prioritisation of new features
 - Still human
- Making decisions about new features based on the existing design
 - AI assisted
- Discussion between different teams
 - Will we have teams? Still human
- Discussion between different groups of stakeholders (for example, management and developers)
 - Still human



Do we need this anymore?



AI Continuous Software Architecture?



Humans

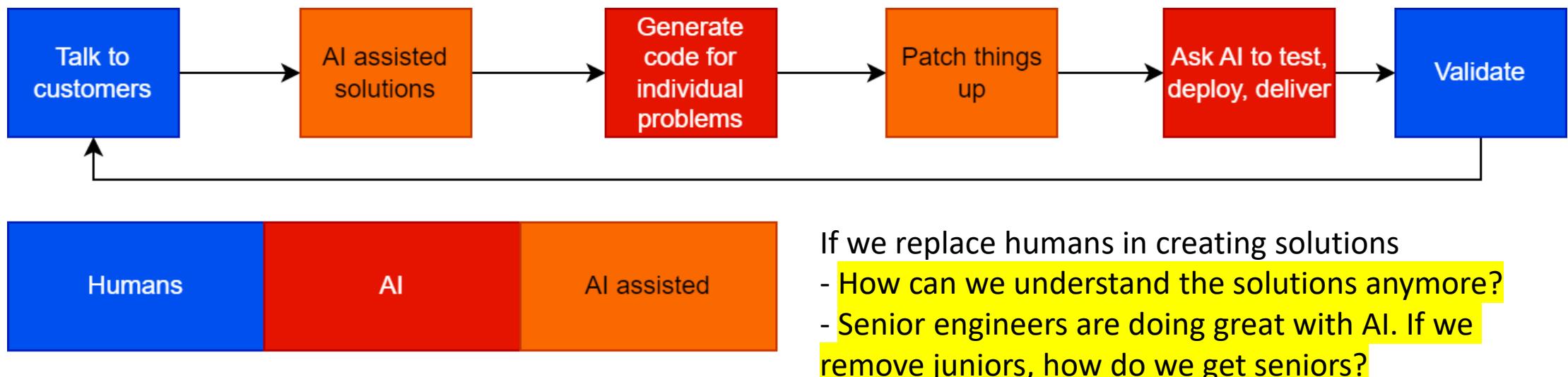
AI

AI assisted

If we replace decisions, solutions, implementation, ops.

- Do we need Agile anymore?
- How will the new process for software engineering look like? What kind of skills will it require?
 - Instead of being a great coder, have approximately an idea of what you are doing?

AI Continuous Software Architecture?



Role of Software Engineering in our Society

- Solve societal challenges
- Solve business challenges
- Entertainment
- We do it for fun

- Digital society
- Digital infrastructure
- Software as the main pillar of digital infrastructure
- What if no one understands software anymore and no one can maintain it?
- How do we get new solutions? Will we stop development of new programming languages, libraries, solution patterns, solutions in general?



What more can we do, now that these tasks are done by AI?



CHEAPER
DIGITALISATION



SUSTAINABLE
DIGITALISATION



ENCOURAGE NEW
(MORE CREATIVE)
SOLUTIONS

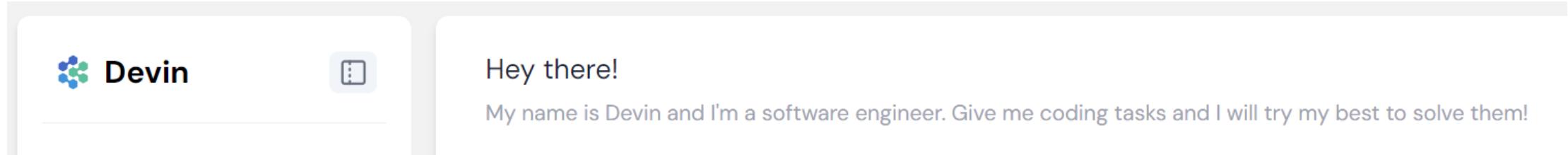


SOLVE MORE
COMPLEX
PROBLEMS



UNDERSTAND AND
IMPROVE LEGACY
SYSTEMS

<https://preview.devin.ai/> - Cognition Labs



„Devin AI is an autonomous artificial intelligence assistant tool created by Cognition Labs. Branded as an "AI software developer", the demo tool is notable for its software development abilities, including plan implementation, source code generation, and benchmark unit testing.“

Cognition Labs

/open-positions

/general

General Application

San Francisco Bay Area • Full time

/engineering

Machine Learning Researcher

San Francisco Bay Area • Full time

Software Engineer

San Francisco Bay Area • Full time

Is it really the case
that there are no
problems left to
solve?

This planet is a
perfect place to
live?



Questions

jj542@cam.ac.uk

<https://jahic.github.io>

