Building Software Systems

Lecture 1.1
Solution Architecture

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Let us talk about Registration – again !!

There is a step in the overall process – Physical Registration

- You may have been asked to report to a particular venue in a particular timeslot for the same
- The question is – **Why**?
- You may already know the answer – to check for your physical presence in the campus
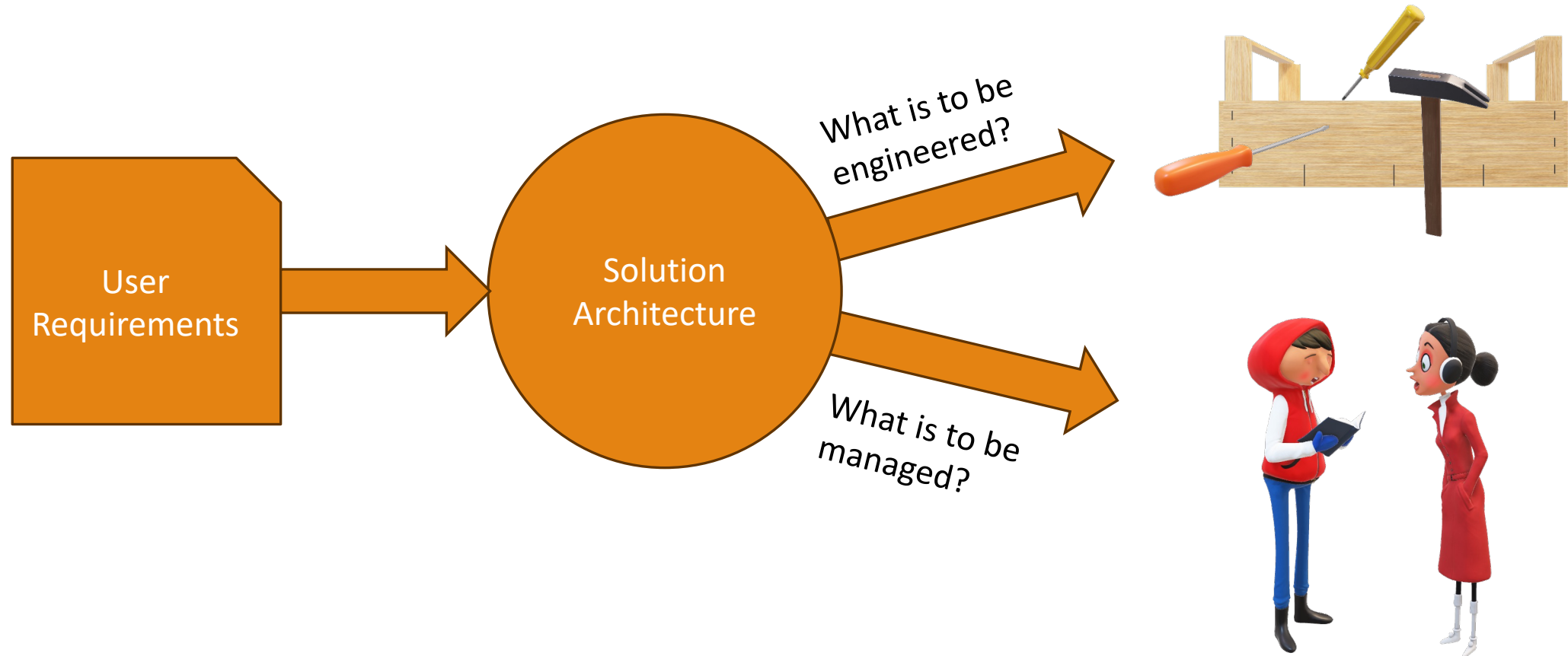- It is essential towards ensuring that you do not extend your vacations beyond the actual vacation ;-)

Can we build a software solution for this step too?

- Probably we can – it will require a fool-proof technical solution to confirm your location on the global map
- We can probably build it using a combination of location-based apps merged with biometric authentication
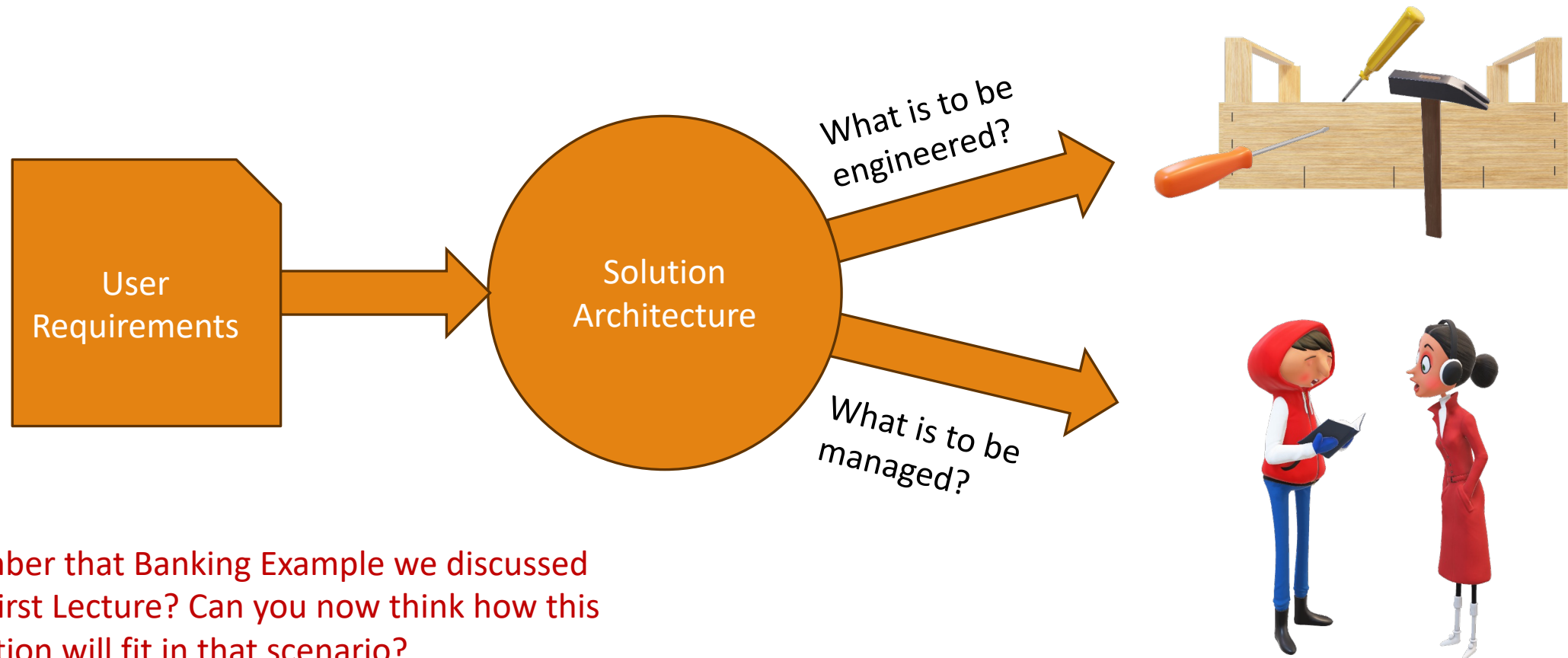
So why haven't we built it?

- It is because it may require a lot of resources to do so – in terms of money and time
- Not to mention, it might initiate a cat-and-mouse game between the Automation Team and Students …
- … with the Students attempting to fool the system (to extend their vacation time :P) …
- … and the Automation Team attempting to plug each such gap !!
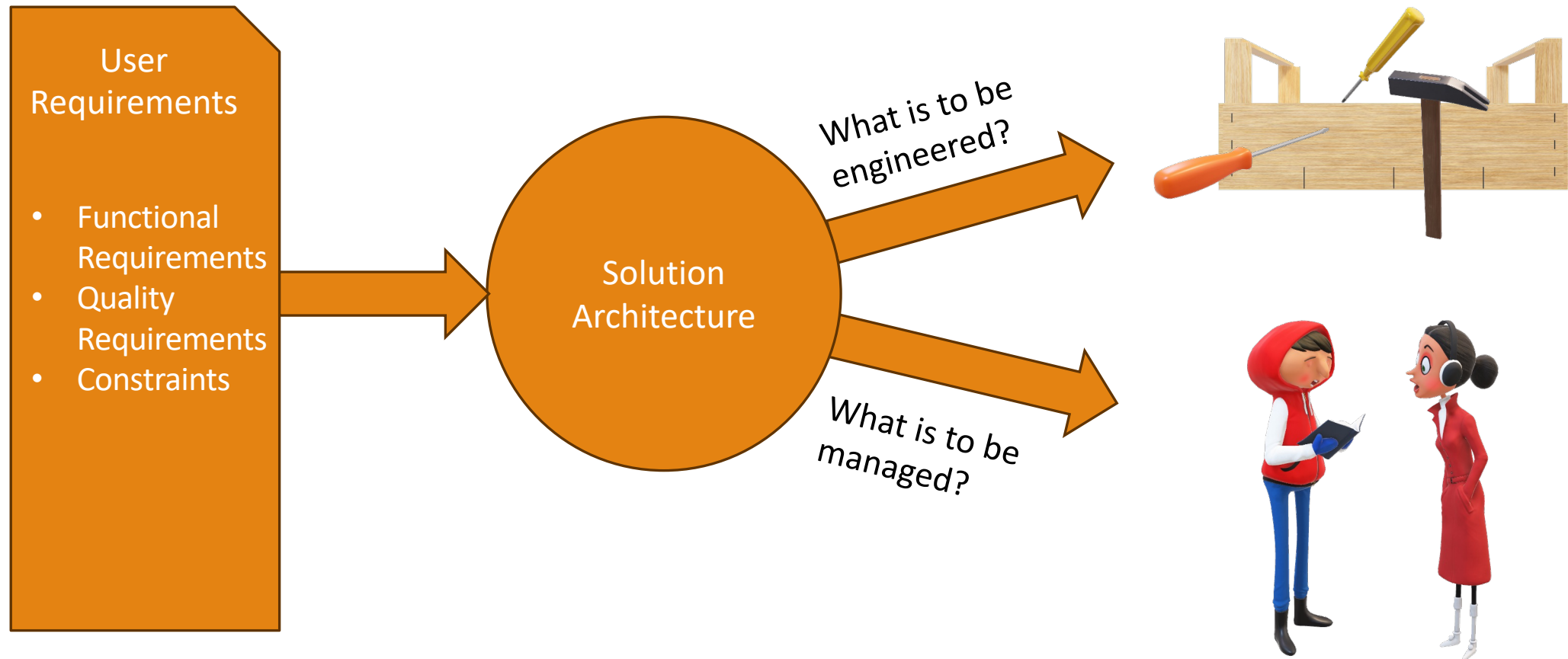
Solution Architecture – Overview

User Requirements → Solution Architecture

What is to be engineered?

What is to be managed?

Solution Architecture – Overview

User Requirements

Solution Architecture

What is to be engineered?

What is to be managed?

Remember that Banking Example we discussed in the first Lecture? Can you now think how this bifurcation will fit in that scenario?

Dissecting the Requirements

User Requirements

- Functional Requirements
- Quality Requirements
- Constraints

Solution Architecture

What is to be engineered?

What is to be managed?

Types of Requirements (1/3)

Functional Requirements

◦ Functional Requirements capture the "core" expectations of the user from product

◦ For instance, "we need a web portal for the Hostel to receive Mess Bill and Fine Payments"

◦ Functional Requirements usually answer the question "*what* is to be made?"

◦ They are often captured in the form of Use cases or User stories

The most common format for expressing user stories is one suggested by Mike Cohn [1]

◦ It involves asking the user to fill up a form/formatted document that asks the user to express their stories

◦ The format asks the user to provide a *title*, a *description*, at least one *example* and the *satisfying conditions*

Sample User Stories for an Airline Chatbot

7.1.1   Search for a flight.

- Description: As a customer of Chanakya Airlines, I want to search for a flight between two cities on a particular date.
- Example: As a customer of Chanakya Airlines, I want to know about all the flights, if there are any, between Delhi and Mumbai on coming Friday.
- Conditions of Satisfaction:
  – The user shall be prompted to supply a source, a destination and a date.
  – A list of applicable flights (if any) shall be shown.
  – Nice to have - show only day or night flights (as per user's preference).

7.1.2   Book tickets on a flight.

- Description: As a customer of Chanakya Airlines, I want to book one or more tickets on a particular flight for a particular date.
- Example: As a customer of Chanakya Airlines, I want to book a ticket on the flight EX-101 for tomorrow.
- Conditions of Satisfaction:
  – The user shall be prompted to supply an email and the date of booking.
  – On success, the user shall be given a Booking Id for future reference.

Samples of the story expression format for a fictitious enterprise called Chanakya Airlines, for building a chatbot to be deployed on their web portal [2]

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◦ You may not receive such cooperation from all the stakeholders in many cases …

◦ … and in some cases, some stakeholders may not be available to you for comment

◦ In such cases, you will have to talk to the (available and willing) stakeholders, and create these stories yourself

Types of Requirements (2/3)

Quality Requirements

◦ Quality Requirements describe the expected quality that the product is expected to meet

◦ For instance, "the portal shall remain responsive, even if all hostel residents attempt to visit it simultaneously"

◦ If you feel the above example is not too clear, you are not wrong !!

◦ Quality Requirements are usually not well-formed in most cases (in fact, sometimes they are absent altogether)

◦ It is because end-users often cannot comment on Quality Requirements, unless you ask them explicitly

The RASP attributes

◦ While Quality Requirements can be mentioned across multiple dimensions, …

◦ … the most common aspects about which you should usually query the end-users are the RASP attributes

◦ **R**eliability refers to the ability of the system to function in an error-free fashion

The Big Billion Day by Flipkart used to start a meme riot which really dented their Reliability
Source: Unknown (A good Google Search yielded the result)

Types of Requirements (2/3)

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The RASP attributes

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- ... the most common aspects about which you should usually query the end-users are the RASP attributes
- **R**eliability refers to the ability of the system to function in an error-free fashion
- **A**vailability refers to the ability of the system to serve the end-user, when the user wished to access it
- **S**ecurity refers to the ability of the system to resist or foil attacks and unauthorised access attempts
- **P**erformance refers to the responsiveness of the system under expected or planned load

Types of Requirements (3/3)

Constraints

◦ Constraints are not really requirements, they are essentially bindings

◦ For example, "the maximum amount of storage space for the portal cannot exceed 100 MB including all files"

◦ They are the decisions which are already made for you by the stakeholders – you cannot circumvent them

◦ The most common constraint for a software project is *cost* or *budget* – you cannot exceed that !!

Other common constraints my include

◦ Delivery Deadline – Not meeting the delivery deadlines may incur penalties (depending on the project contract)

◦ Technology – If your team is only familiar with selected development platforms, you cannot pick anything else

◦ Process Restrictions – The business processes may exert restrictions which can limit the system's ability

Out of all the Requirements we discussed, the Quality Requirements are of highest importance to us

◦ We will talk about them in greater detail in the next Lecture

Solution Architecture – An Example

Are you old enough to have experienced the "old" IRCTC website?

A screengrab of IRCTC website from early 2005
Source: https://web.archive.org/web/20050101014242/http://irctc.co.in/

Solution Architecture – An Example

Are you old enough to have experienced the "old" IRCTC website?

◦ People struggled daily with booking tickets using the website

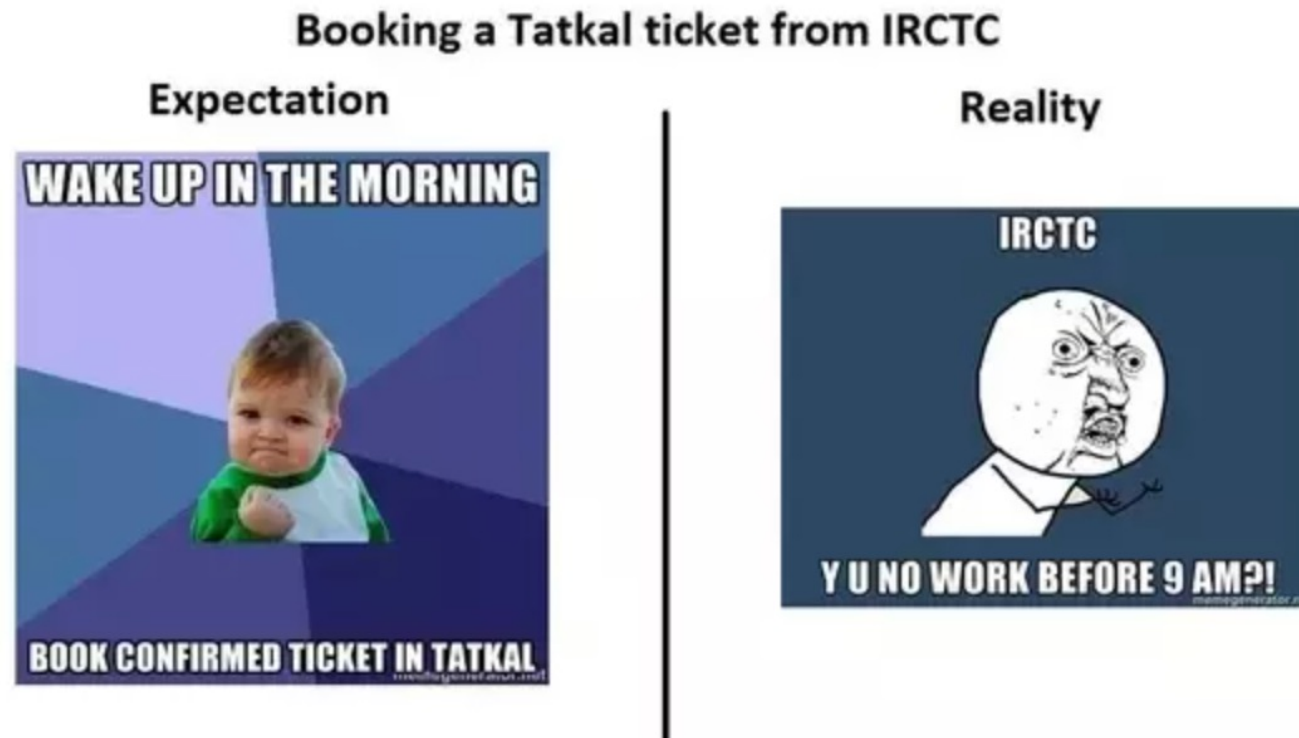◦ The most painful part was booking a Tatkal Ticket (I guess it still is today, but things used to be worse)

Just one of the many memes that people made over IRCTC-related woes
Source: https://www.quora.com/What-does-it-feel-like-to-book-a-ticket-through-IRCTC

Solution Architecture – An Example

Are you old enough to have experienced the "old" IRCTC website?

- ◦ People struggled daily with booking tickets using the website
- ◦ The most painful part was booking a Tatkal Ticket (I guess it still is today, but things used to be worse)
- ◦ There was a major challenge that the website had to adhere – very high "peak loads"
- ◦ Here, the load essentially meant the number of concurrent user logins on the website
- ◦ At 8 a.m. the website used to show a visible performance hit; often it became unavailable as well

The Railways decided to handle the problem in the "process" part

"Tatkal Load" was shifted to 10 a.m. to shorten the peak load requirements
Source:

https://wr.indianrailways.gov.in/view_detail.jsp?lang=0&id=0,4,268&dcd=910&did=13418405950865F7BCF73B186BDF02C9104656443A6F4.web107
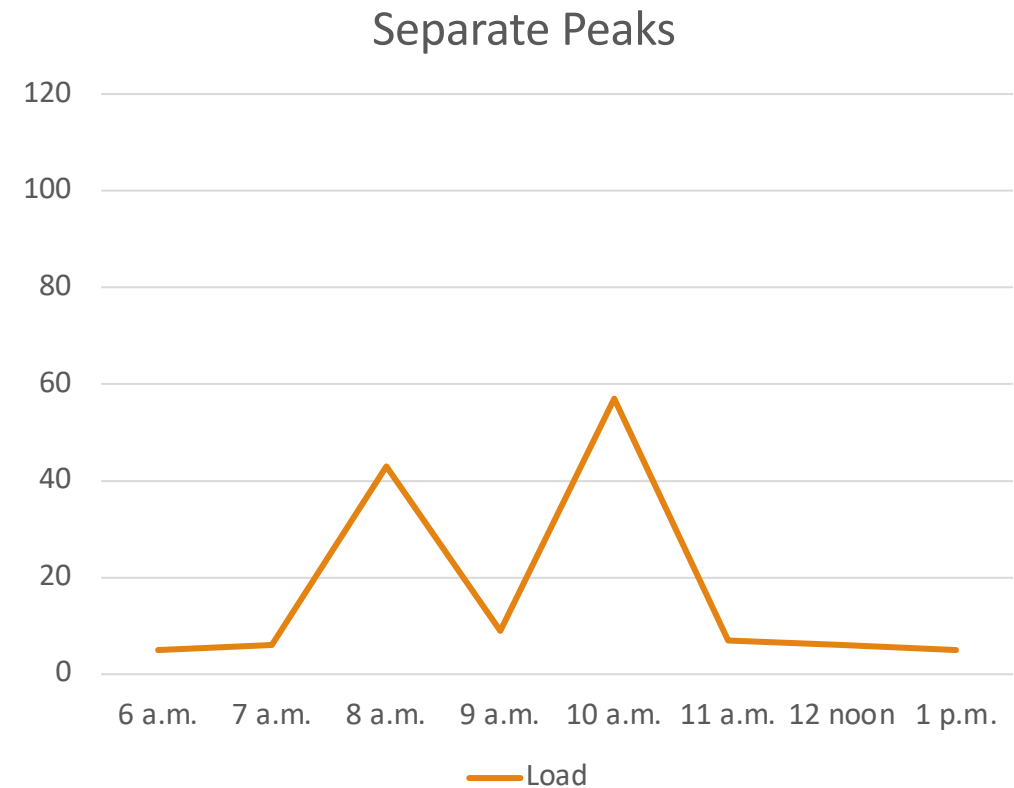
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The Railways decided to handle the problem in the "process" part

◦ This reduced the resources required by the website for acceptable performance

Coinciding vs Separate Peak Scenarios

Coinciding vs Separate Peak Scenarios

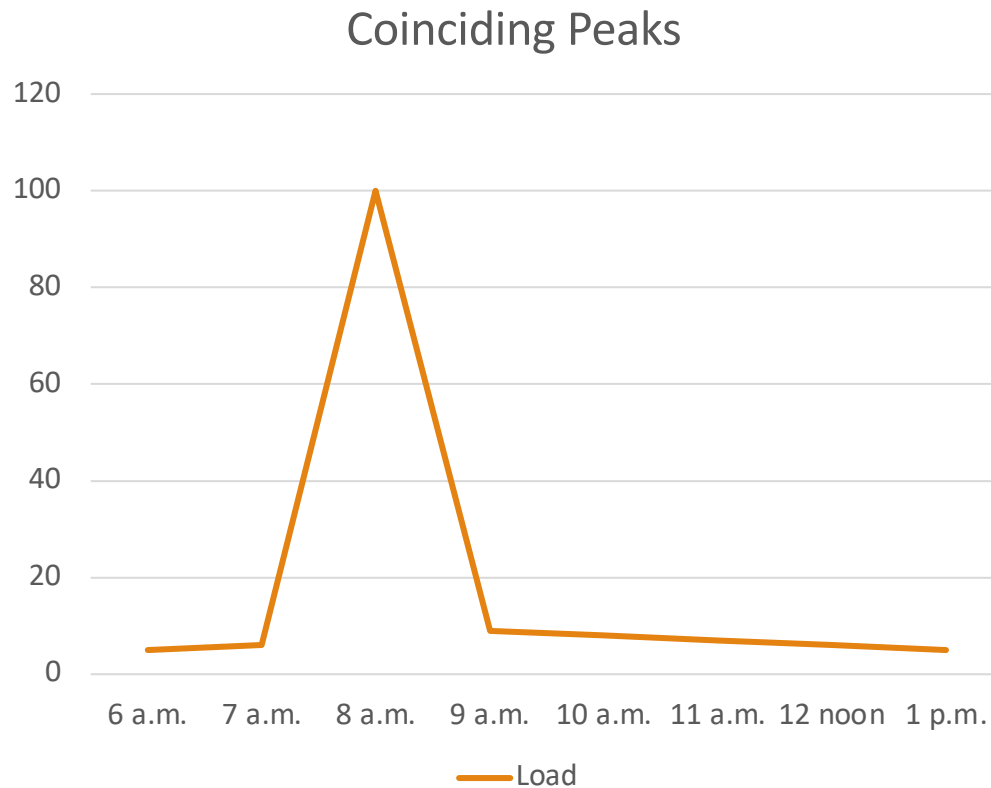# Solution Architecture – An Example

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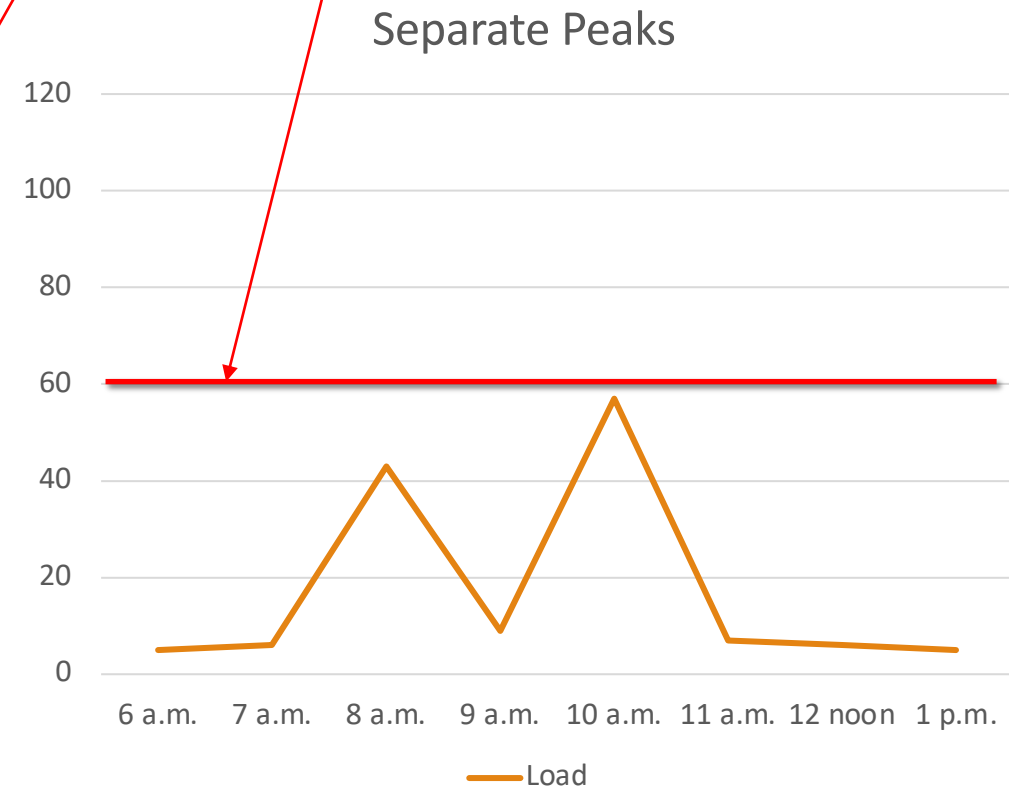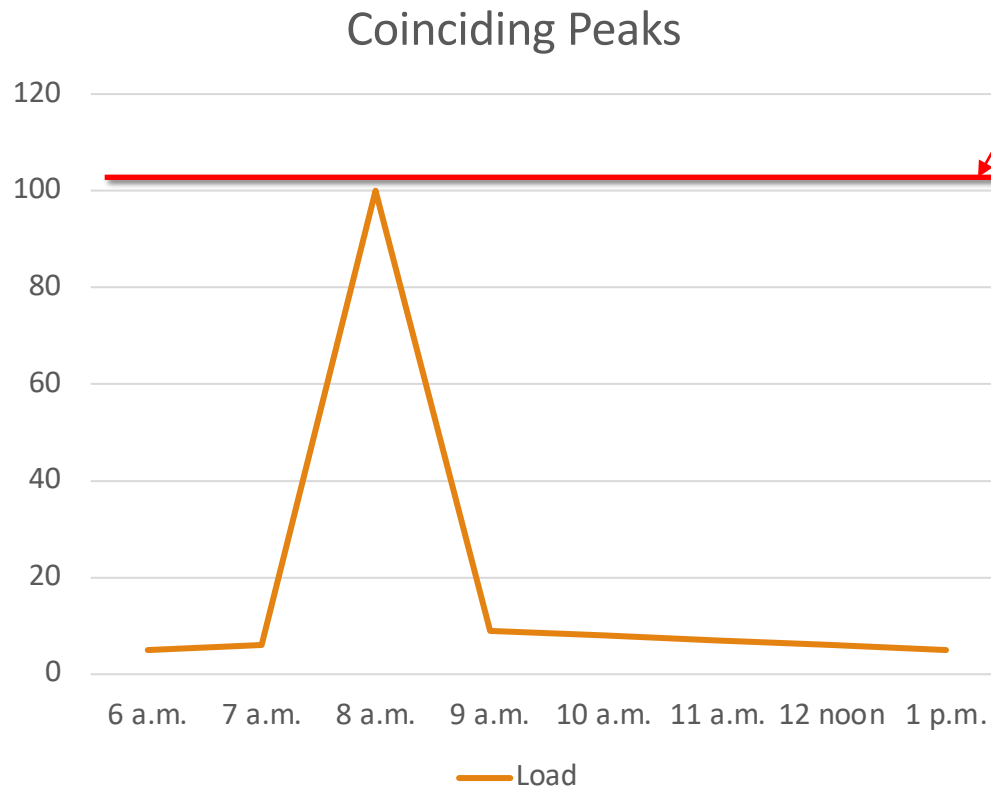The Railways decided to handle the problem in the "process" part

◦ This reduced the resources required by the website for acceptable performance

◦ In fact, they realized that this strategy works, and used it again later to further shorten and distribute peaks

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News / LATEST / Economy Politics / Railway tatkal ticket booking timings changed from today   ✏ Feedback

Railway tatkal ticket booking timings changed from today

The Railways has staggered the schedule for AC and non-AC classes to 10 AM onwards and 11 AM onwards, respectively. The move is expected to reduce the load on the ticketing site and booking windows.

BT Online Bureau
New Delhi, Updated Jun 15, 2015, 4:24 PM IST

"Tatkal Load" was further split into two separate peaks
Source: https://www.businesstoday.in/latest/economy-politics/story/railway-tatkal-ticket-booking-timings-changed-from-today-48301-2015-06-15

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To summarise

Whenever posed with an IT problem, you should first think about a Solution Architecture

- As a part of the architecture, you need to decide the features that will be built in the software solution …
- … as well as decide upon the parts of the solution that will be managed by involved stakeholders

The Architecture attempts to satisfy the requirements for the product

- The requirements can be represented in terms of expected functionality, quality expectations …
- … or can be expressed as constraints that the product (and development) must honour

Homework

Think about a web portal for your Hostel (if it already exists, think about improving it)
- ◦ Discuss with another person from your Hostel about the possible functional requirements
- ◦ Try to also put in some Quality Requirements as well as Constraints

Design a Solution Architecture for the portal
- ◦ For instance, shall the bill payment and update procedure be automated or semi-automated
- ◦ What data formats will your portal understand? JSON? Excel? PDF?

References

1. Mike Cohn. 2013. User Stories and User Story Examples by Mike Cohn. https://www.mountaingoatsoftware.com/agile/user-stories. (Accessed on 07/01/2024).

2. Srivastava, S., Kalra, S. and Prabhakar, T.V., 2020, July. Contextual Reactive Pattern on Chatbot building Platforms. In Proceedings of the European Conference on Pattern Languages of Programs 2020 (pp. 1-8).