Architectual Views

Software Architecture

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Interesting Software is Complex

Many aspects to the design of its architecture.

Architectural Design

Managing technical complexity.

Question

How do you describe a complex architecture, without making it too difficult to understand?

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Answer

Architectural Views

– Only consider one aspect at a time.

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  - context, structure, behaviour, infrastructure

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  - concepts, service, logical, physical resource, architecture foundation

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- The Open Group Architecture Framework (TOGAF) *[Forum, 2022]*
- ISO/IEC/IEEE 42010:2011 *[iso, 2022]*

Diagrams & Notation

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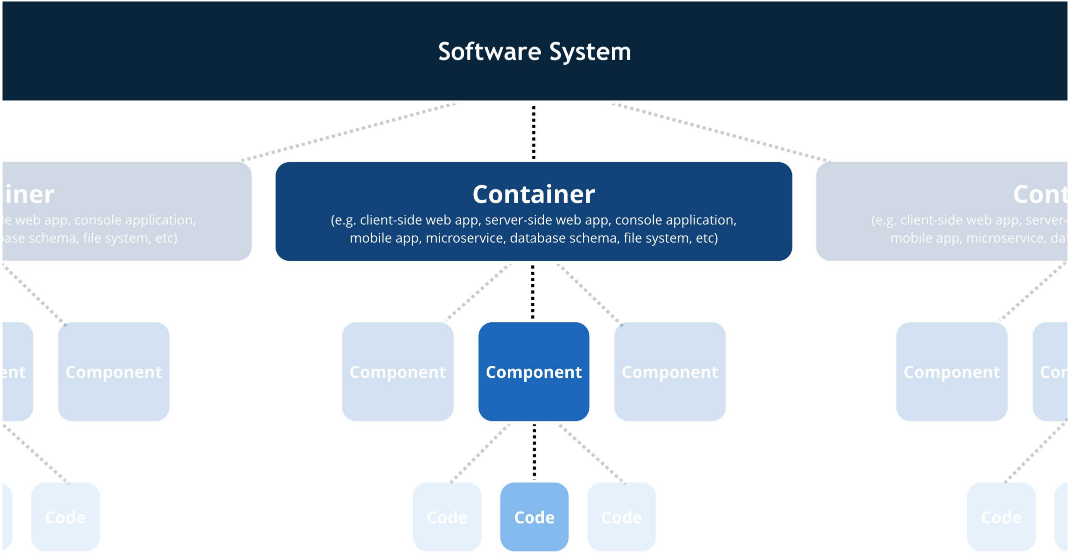
- C4 – informal, simple structure *[Brown, 2023]*
- UML – formal, well-defined language *[uml, 2017]*
- You probably don't want to know about alternatives

C4 Model: Levels


Software System
iner
le web app, console application,
base schema, file system, etc)
Container
(e.g. client-side web app, server-side web app, console application,
mobile app, microservice, database schema, file system, etc)
Cont
(e.g. client-side web app, server-
mobile app, microservice, dat
ent
Component
Component
Component
Component
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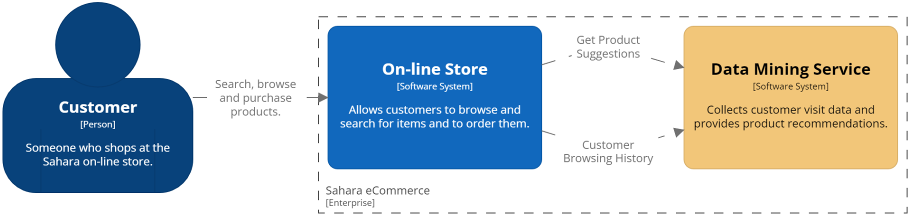
Code
Code
Code
Code

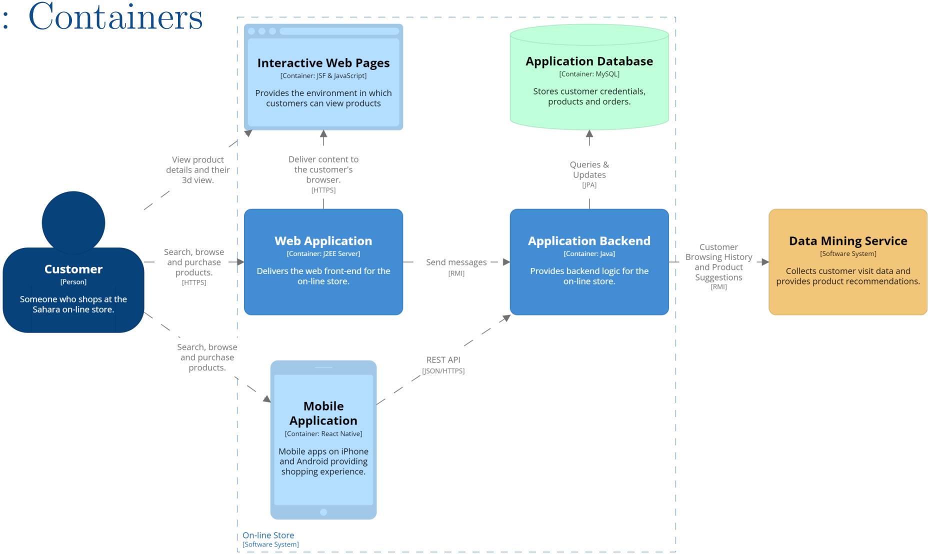
C4 Model: Context



Customer
[Person]
Someone who shops at the Sahara on-line store.
Search, browse and purchase products.
On-line Store
[Software System]
Allows customers to browse and search for items and to order them.
Get Product Suggestions
Customer Browsing History
Data Mining Service
[Software System]
Collects customer visit data and provides product recommendations.
Sahara eCommerce
[Enterprise]

How software system fits into broader *environment*

C4 Model: Containers



Interactive Web Pages
[Container: JSF & JavaScript]
Provides the environment in which customers can view products

Application Database
[Container: MySQL]
Stores customer credentials, products and orders.

View product details and their 3d view.

Deliver content to the customer's browser.
[HTTPS]

Queries & Updates
[JPA]

Customer
[Person]
Someone who shops at the Sahara on-line store.

Search, browse and purchase products.
[HTTPS]

Web Application
[Container: J2EE Server]
Delivers the web front-end for the on-line store.

Send messages
[RMI]

Application Backend
[Container: Java]
Provides backend logic for the on-line store.

Customer Browsing History and Product Suggestions
[RMI]

Data Mining Service
[Software System]
Collects customer visit data and provides product recommendations.

Search, browse and purchase products.

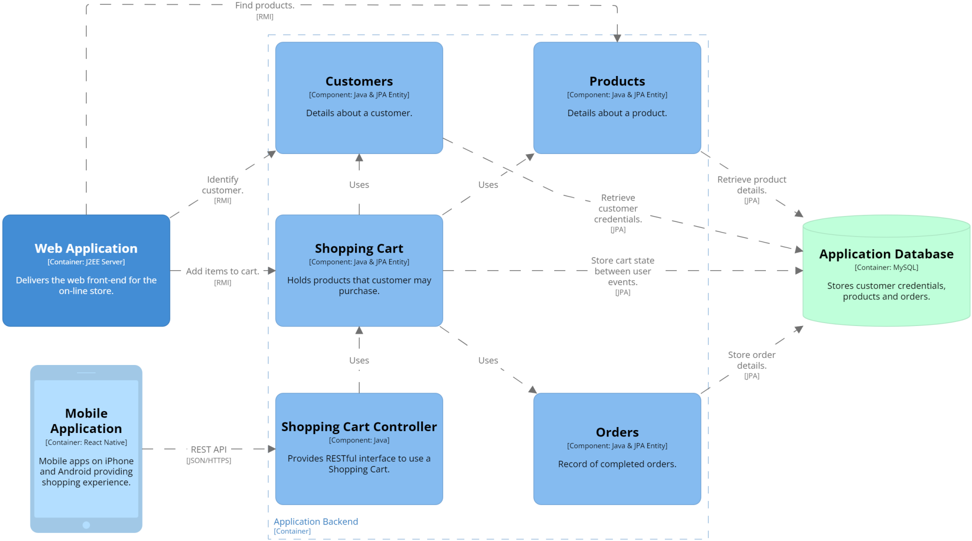
REST API
[JSON/HTTPS]

Mobile Application
[Container: React Native]
Mobile apps on iPhone and Android providing shopping experience.

On-line Store
[Software System]

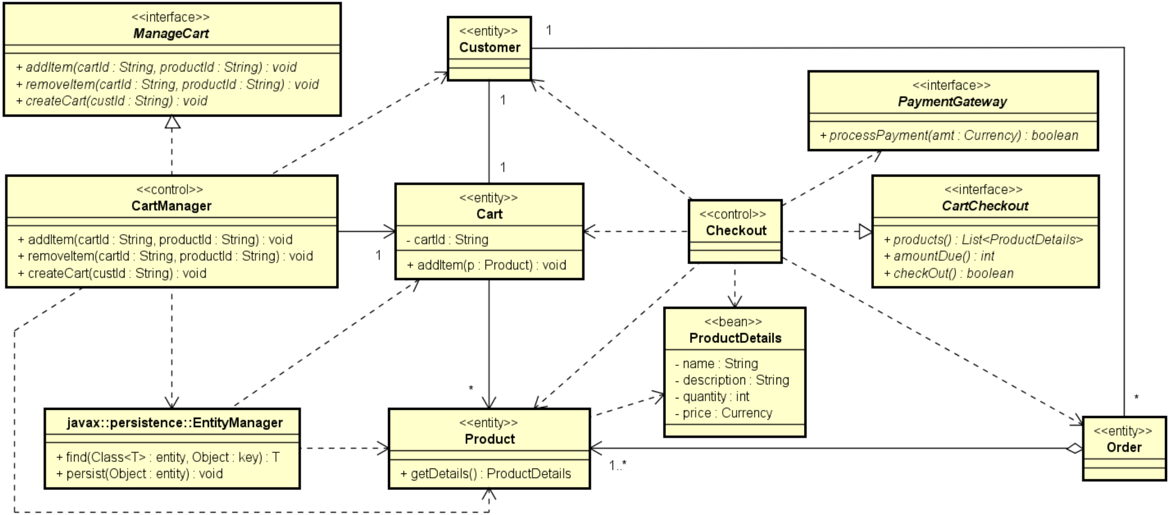
Structure of the software system

C4 Model: Components


Find products.
[RMI]
Customers
[Component: Java & JPA Entity]
Details about a customer.
Products
[Component: Java & JPA Entity]
Details about a product.
Identify customer.
[RMI]
Uses
Uses
Retrieve product details.
[JPA]
Retrieve customer credentials.
[JPA]
Web Application
[Container: J2EE Server]
Delivers the web front-end for the on-line store.
Add items to cart.
[RMI]
Shopping Cart
[Component: Java & JPA Entity]
Holds products that customer may purchase.
Store cart state between user events.
[JPA]
Application Database
[Container: MySQL]
Stores customer credentials, products and orders.
Uses
Uses
Store order details.
[JPA]
Mobile Application
[Container: React Native]
Mobile apps on iPhone and Android providing shopping experience.
REST API
[JSON/HTTPS]
Shopping Cart Controller
[Component: Java]
Provides RESTful interface to use a Shopping Cart.
Orders
[Component: Java & JPA Entity]
Record of completed orders.
Application Backend
[Container]

Elements that implement a container

C4 Model: Code



<<interface>>
ManageCart

+ addItem(cartId : String, productId : String) : void
+ removeItem(cartId : String, productId : String) : void
+ createCart(custId : String) : void

<<entity>>
Customer

<<interface>>
PaymentGateway

+ processPayment(amt : Currency) : boolean

<<control>>
CartManager

+ addItem(cartId : String, productId : String) : void
+ removeItem(cartId : String, productId : String) : void
+ createCart(custId : String) : void

<<entity>>
Cart

- cartId : String

+ addItem(p : Product) : void

<<control>>
Checkout

<<interface>>
CartCheckout

+ products() : List<ProductDetails>
+ amountDue() : int
+ checkOut() : boolean

<<bean>>
ProductDetails

- name : String
- description : String
- quantity : int
- price : Currency

javax::persistence::EntityManager

+ find(Class<T> : entity, Object : key) : T
+ persist(Object : entity) : void

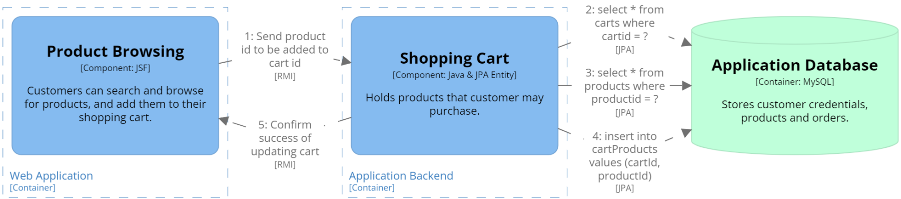
<<entity>>
Product

+ getDetails() : ProductDetails

<<entity>>
Order

Structure of code implementing a component

C4 Model: Dynamic



Product Browsing

[Component: JSF]

Customers can search and browse for products, and add them to their shopping cart.

Web Application

[Container]

1: Send product id to be added to cart id

[RMI]

5: Confirm success of updating cart

[RMI]

Shopping Cart

[Component: Java & JPA Entity]

Holds products that customer may purchase.

Application Backend

[Container]

2: select * from carts where cartid = ?

[JPA]

3: select * from products where productid = ?

[JPA]

4: insert into cartProducts values (cartId, productId)

[JPA]

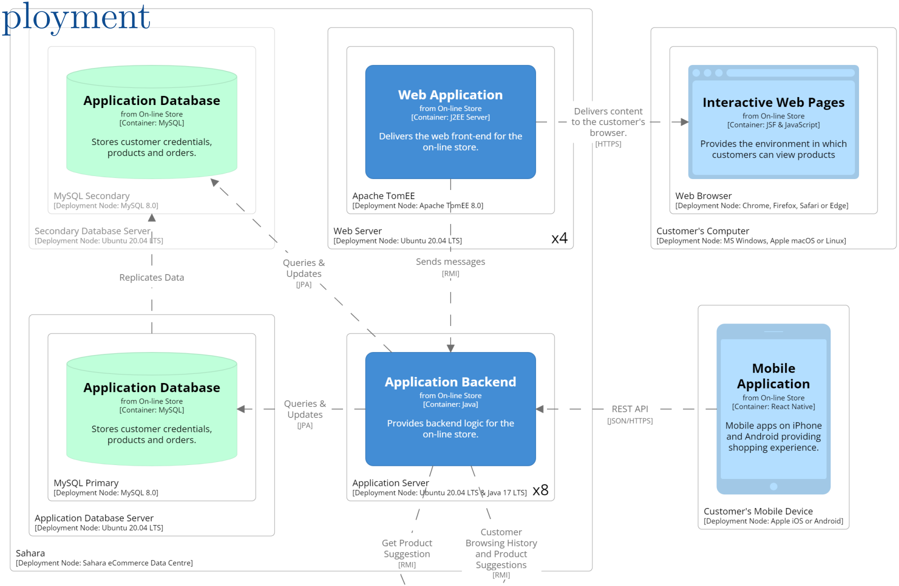
Application Database

[Container: MySQL]

Stores customer credentials, products and orders.

How parts of the model *collaborate* to deliver *behaviour*

C4 Model: Deployment



Application Database
from On-line Store
[Container: MySQL]

Stores customer credentials, products and orders.

MySQL Secondary
[Deployment Node: MySQL 8.0]

Secondary Database Server
[Deployment Node: Ubuntu 20.04 LTS]

Web Application
from On-line Store
[Container: J2EE Server]

Delivers the web front-end for the on-line store.

Apache TomEE
[Deployment Node: Apache TomEE 8.0]

Web Server
[Deployment Node: Ubuntu 20.04 LTS]

x4

Delivers content to the customer's browser.
[HTTPS]

Interactive Web Pages
from On-line Store
[Container: JSF & JavaScript]

Provides the environment in which customers can view products

Web Browser
[Deployment Node: Chrome, Firefox, Safari or Edge]

Customer's Computer
[Deployment Node: MS Windows, Apple macOS or Linux]

Replicates Data

Queries & Updates
[JPA]

Sends messages
[RMI]

Application Database
from On-line Store
[Container: MySQL]

Stores customer credentials, products and orders.

MySQL Primary
[Deployment Node: MySQL 8.0]

Application Database Server
[Deployment Node: Ubuntu 20.04 LTS]

Queries & Updates
[JPA]

Application Backend
from On-line Store
[Container: Java]

Provides backend logic for the on-line store.

Application Server
[Deployment Node: Ubuntu 20.04 LTS & Java 17 LTS]

x8

REST API
[JSON/HTTPS]

Mobile Application
from On-line Store
[Container: React Native]

Mobile apps on iPhone and Android providing shopping experience.

Customer's Mobile Device
[Deployment Node: Apple iOS or Android]

Get Product Suggestion
[RMI]

Customer Browsing History and Product Suggestions
[RMI]

Sahara
[Deployment Node: Sahara eCommerce Data Centre]

Infrastructure on which system will be deployed

4+1 Views

Logical – *Structure* of how the software is implemented

- components/classes, relationships, interactions

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Process – *Dynamic* behaviour

- concurrency & distribution, fault tolerance, process control, ...

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Development – *Organisation* of the software in the development environment

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Physical – *Map* executable software containers to hardware

- address non-functional requirements
  - availability, reliability, scalability, throughput, ...

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Scenario – *Demonstrate* functionality delivered by architecture

- use case details
  - *drive* functional design of architecture
  - *validate* design of architecture
  - *illustrate* purpose of architecture

Reading...

“Architectural Views” Notes[1] *[Thomas and Webb, 2023]*

[1] Remember, I said you had to read the notes.

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