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# Runtimes for Concurrency and Distribution

Project: Exploration of orchestration challenges in a  
microservice-based application

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1. Report corrections
2. Take-home message
3. Learning outcome
4. CFU evaluation
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After reading the comments, I realized that I missed some notions in the report:

- Theoretical definitions (Microservices, REST, ...)
- Tool descriptions (Swagger, OpenAPI, RabbitMQ, ...)
- Components behavior (Nodeport, Ingress, ...)

In the earliest version of the report I included these sections, but I had to cut them to respect the 10 pages limit.

As a technical report, I focused more on explaining the project itself and the implementation details.

# My responses to the "B" comments

The Horizontal Pod Autoscaler (HPA) was not working as expected: Pods were not scaling up when multiple requests were sent to the service.

**My mistake:** I stopped looking for a solution after the first assumption that made sense to me.

New debugging session:

```
lucam@pop-os ➤ kubectl get hpa
```

NAME	REFERENCE	TARGETS	MINPODS	MAXPODS	REPLICAS	AGE
users-ms-deployment	Deployment/users-ms-deployment	cpu: <unknown>/50%	1	10	1	10d

```
lucam@pop-os ➤
```

Something seems to be wrong with the metrics-server. The HPA is not able to retrieve the metrics from the metrics-server.

# The HPA problem



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**Microservices updates are easy or not?** In the report I begin by saying that microservices updates are hard but then I show that they are pretty easy.

- Without orchestration, updates are very challenging.
- With Kubernetes are more manageable but still require proper planning.

The "latest" tag leads to:

- Unpredictability
- Inconsistent updates
- Difficult in debugging and replication

Instead, use tags consistent with a version control strategy to ensure stability and traceability.

This approach allows for precise control over which image version is deployed, facilitating easier rollbacks and consistent environments across development, testing, and production stages.



The focus of the presentation is on:

- Why virtualization, abstraction and orchestration
- How abstraction works in containerization
- The notion of business domain separation
- The separation between connection state and application state
- The problems encountered with the Horizontal Pod Autoscaler

# Missing bibliography



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Microservices are much more complex than traditional monolithic applications. They require an experienced architectural view because even if tools are available to simplify the orchestration, the complexity of the system requires a deep understanding of the underlying concepts of distributed systems.

These are the key concepts I learned both from the course and the project:

- Tools and technologies are worthless without a clear understanding of the underlying concepts.
- Abstraction and virtualization are much more important than I thought.
- Microservices are interesting but the choice of implementing them should be driven by actual needs, not just because they are trendy.

6 CFU equals to 150 hours of work.

How I spent my time:

- Lessons:  $\sim 48$  hours
- Study:  $\sim 50$  hours
- Project: 10 weeks,  $\sim 6/8$  hours per week (60 hours)

Good balance between lessons and project, consistent with the CFU assigned.

## Good points

- Very interesting topics that connect basic C.S. concepts with more advanced and real-world applications.
- I enjoyed the interactions between the students and the professor, especially for flipped classroom lessons.
- It would have been interesting to have more discussion sessions.

## Improvements

- I felt a little lost during the project development. It is hard to start from scratch without a clear idea of what are the expectations.

Extra slides for missing definitions:

- Microservices definitions
- REST architectural style
- What are Swagger and OpenAPI
- Why choosing GO as programming language
- The choice of implementing common and basic microservices

Thank you for your attention!



“Microservices are **independently** releasable services that are modeled around a **business domain**. A service encapsulates functionality and makes it accessible to other services via **networks**” <sup>1</sup>

“A microservice is an architectural pattern that arranges an application as a collection of **loosely coupled, fine-grained services**, communicating through lightweight protocols” <sup>2</sup>

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<sup>1</sup>Sam Newman, Building Microservices

<sup>2</sup>Martin Fowler, Microservices

REST (Representational State Transfer) is a web architecture style using standard HTTP methods (GET, POST, PUT, DELETE) to interact with resources via URLs.

- POST: /users (create a new user)
- GET: /users/id (get a user by id)
- GET: /users (get all users)
- PUT: /users/id (update a user by id)
- DELETE: /users/id (delete a user by id)

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Microservices are language-agnostic, so they can be written in any language as long as they support necessary communication protocols.

It is also possible to have different microservices written in different languages as long as they can communicate with each other.

GO was chosen for the project because it has native support for web server making development easier and faster. <sup>3</sup>

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<sup>3</sup>Thanks to the concurrency features of the language, and the native support for web standards, both Docker and Kubernetes are written in GO.

Why implementing common and basic microservices such as users, auth, and notifications?

- The goal was to learn about orchestration, not to develop impressive features.
- I didn't want to lose time by thinking of exceptional use cases.
- Those are component that I could find in any future project.

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# What are Swagger and OpenAPI



## Swagger

Swagger is a set of open-source tools built around the OpenAPI Specification that can help in design, build, document and consume REST APIs.

## OpenAPI

OpenAPI Specification is a specification for building APIs. It is a language-agnostic specification that describes the structure of REST APIs.

In the project i used OpenAPI to define the API of the application and Swagger to have a GUI for reading the API documentation and test the endpoints.

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