Servicios y Aplicaciones Distribuidas

2022/2023

Presentation and Overview

MUIInf

SAD

Why this course

- Most current day software
  - Is distributed in nature (example: what we are doing right now!)
    - Many different components
      - Client interacting with user
      - One or several servers communicating with those clients
        - » Often servers also communicate among themselves
  - Do so providing a "service"
    - Users are saved the trouble of managing software
  - Use the Cloud approach for agile deployment
    - Different models for deployment and management
  - Need to also consider other approaches
    - P2P
      - A particularly fruitful application line is Blockchain

Overview: Goals of the course

- Four main goals
  - Discuss the importance of architecture in software
  - Present the concept of Software Service as a fundamental structuring principle
  - Discuss the importance of distributed systems and services in today's software world
  - Present the Principles under which services are provided and architected
  - Present the main problems and technologies available
  - Learn through practice:
    - Give the student the chance to confront the implementation of a service using current-day technologies to overcome the difficulties.

Focus areas

- Main focus areas
  - Fundamental concepts
  - Programming Coordination in Distributed Systems
  - Architectural approaches
    - Client/Server
    - Messaging
    - P2P
    - Microservices
  - Cloud Computing & SaaS
  - Practical Considerations
  - Technologies
- Hands-on project

Fundamental Concepts

- Apps vs Services
- Distributed Systems
- State
- Coordination and consistency
- Implementing services (SaaS)
  - Main difficulties
  - PaaS example

Programming coordination

- Shared state concurrency control (refresher)
- CSP and Hoare's coordination model
- Asynchronous programming
  - Promises
  - Streams/Event sourcing
  - Message Queues

Architectural approaches

- Goals
  - Scalability
  - Fault tolerance
  - Maintainability
- Client/Server and centralized systems
- Messaging and Reactive/Async systems
- P2P
  - P2P in action: Blockchain

- Cloud Computing
  - Enabling technologies
    - Everything virtual
  - Trends in software business models
  - Main models
    - IaaS
    - PaaS
    - SaaS
      - Multi-tenancy
      - Deviations

Practical considerations

- Quality of Service
  - SLA and QoS guaranties
  - Reliability and Scalability
- Consistency
  - The CAP theorem
- Security
  - Authentication & Authorization
- Service deployment and management

- Event-driven programming
  - Node.js
  - Promises & observables
- ZeroMQ
  - State-less message queues
- Message queues
  - Kafka
- Light virtualization
  - Containers
  - Docker
- PaaS example: KPaaS over Kubernetes

- SaaS
  - Multi-component Service
  - Implemented on top of a PaaS (attempt)
    - Provided to you
    - Using Docker images/containers
      - Will need to create account on docker hub

Grading

- Two tests
  - 50% of the grade (25% Theory, 25% Seminars and Labs)
- Portfolio 25%
  - Work proposed during seminars
- Project 25%

- On-campus
  - Seminars
  - Theory
  - Labs

Lab Setup

- Linux Advised
- OSX and Windows 10 can work
- Software:
  - Docker
    - Docker desktop is advisable
    - Use specific docker images to develop
- Deployments on specific PaaS made available from Master's cooperating entity
  - In the form of a PaaS
  - Need to build docker images
- Gitlab UPV
  - GIT repos within the SAD/2022-2023 namespace.
    - One per team
  - Image registry

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  - L1-SAD (Labs)
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  - TS1-SAD (Seminars)
- **Tutorships on Demand** (e-mail) and remote

References

- The NIST Definition of Cloud computing (Peter Mell, Timothy Grance)
- Sistemas distribuidos : principios y paradigmas (Andrew S. Tanenbaum)
- The architecture of open source applications : elegance, evolution, and a few fearless hacks (Amy Brown , Greg Wilson)
- Understanding fault-tolerant distributed systems (Cristian, Flaviu)
- Web services : concepts, architectures and applications (Gustavo Alonso et al)
- RESTful web services (Leonard Richardson, Sam Ruby)
- https://docs.kumori.systems (PaaS documentation)
- https://docker.com (more information about docker)
- Bitcoin and Cryptocurrency Technologies (*Arvind Narayanan et al…*), https://d28rh4a8wq0iu5.cloudfront.net/bitcointech/readings/princeton_bitcoin_book.pdf?a=1