

# 01 - Introduction

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Multi-tiered architecture, Java EE

**AMT 2020**  
**Olivier Liechti**

## Introduction to multi-tiered architectures & Java EE

Break

Getting to know the application servers (live demo)

MVC, Pipes and Filters and IoC patterns



# Introduction

# Multi-Tiered Applications



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# Multi-Tiered Applications



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The application is structured in “tiers” (tranches)

# Multi-Tiered Applications

## Frameworks



servlet

EJB

JDBC



JSP

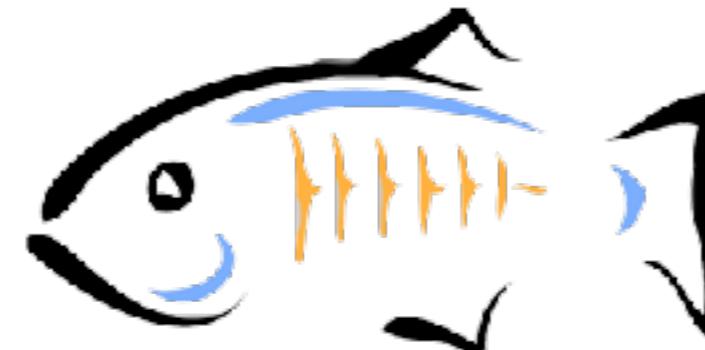


JAX-RS

JPA



JAX-WS



Java EE  
Application Server

JMS

## APIs

## Tools



Jenkins



Selenium Webdriver



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# MULTI-TIERED APPLICATION DEVELOPMENT: FROM LEGACY TO MODERN JAVA EE

OLIVIER LIECHTI

A hands-on approach to design patterns and engineering practices

2018 – v0.4

Bonjour,

J espère que vous allez bien.

Aujourd'hui j ai eu la chance de rencontrer Ken Duda qui est le CTO et un des fondateurs de arista networks. Le discours qui l'a tenu m'a tellement rappelé votre cours d'amt que je me suis senti obligé de vous écrire ce message. Comme quoi de la heig à une multinationale côté au Nasdaq en passant par les starts up ce n est pas la quantité ni la rapidité qui prime mais la qualité. Ce qui implique des tests automatisés de qualités ( peut être pas avec cucumber il faut pas exagérer 😂).

Si vous avez 20 min à perdre je joins un lien où il délivre à peu près le même message ( vous allez y retrouver votre message sur les tests 😂)

[https://www.google.ch/url?  
sa=t&source=web&rct=j&url=https://m.youtube.com/watch  
%3Fv  
%3D  
%3DVdjZq4dRjf4&ved=2ahUKEwjayOzguvzdAhUk\\_SoKHZ-xCzsQt9IBMAV6BAgJECM&usg=AOvVaw2\\_nqONCTi58MIGzRHTXFS](https://www.google.ch/url?sa=t&source=web&rct=j&url=https://m.youtube.com/watch%3Fv%DVDjZq4dRjf4&ved=2ahUKEwjayOzguvzdAhUk_SoKHZ-xCzsQt9IBMAV6BAgJECM&usg=AOvVaw2_nqONCTi58MIGzRHTXFS)

Bonne soirée et j espère vous croiser à noël pour l apero de tweb et amt



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Si je peux me permettre un commentaire sur les cours, que vous pourrez peut-être relayer plus tard. C'est qu'on voit trop peu de JavaEE, en comparaison aux autres cours et aux offres d'emploi du marché. Ça fait une semaine que je regarde tous les jours les offres et je pense que le 80% des offres c'est Java/JavaEE. Et personnellement, même si j'avais bien compris en AMT, le fait qu'on en ait vu si peu, me donne l'impression de ne pas être assez prête pour être engagée pour ça et c'est assez embêtant. Même si les concepts de base sont quand même acquis

12:52

August 18

Bonjour,

J'ai eu un entretien avec [REDACTED] (une boîte de 150 personnes). C'est normal que pour l'entretien technique, ils demandent de faire une API documentée avec Swagger (exactement ce que vous nous avez demandé de faire pour la deuxième partie du semestre en AMT, merci  ) et que je le fasse en quelques heures?

edited 17:12



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August 30

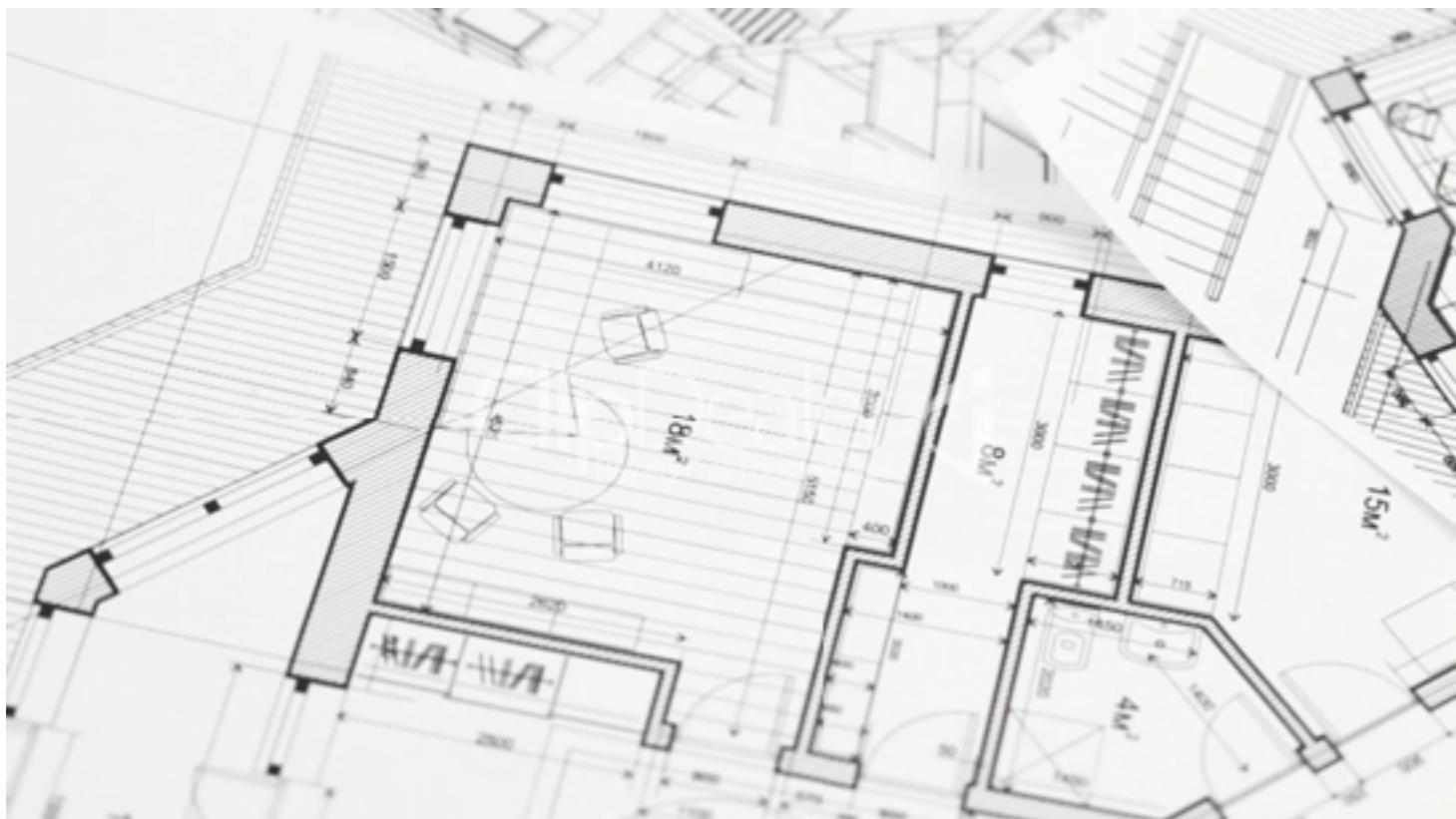
Bonjour, comment allez-vous ? J'espère que ça va bien.

Il y a quelque jours, je repensais à la HEIG-VD et aux cours que j'avais eu là bas. Je me souviens de vos cours, surtout AMT où on apprenait à utiliser des APIs, et je m'en rends compte que ça m'a bien aidé dans mon travail de tous les jours.

Le fait d'avoir suivi vos cours et labos m'ont permis de comprendre plus facilement certains concepts de programmation API et réaliser certaines tâches/projets en étant beaucoup plus à l'aise que si je n'avais pas eu le cours.

J'imagine qu'en tant qu'enseignant vous avez pas dû avoir beaucoup de feedback de vos élèves après leur première expérience professionnelle et je voulais donc vous apporter le mien. Merci pour la qualité de vos cours.

edited 15:17

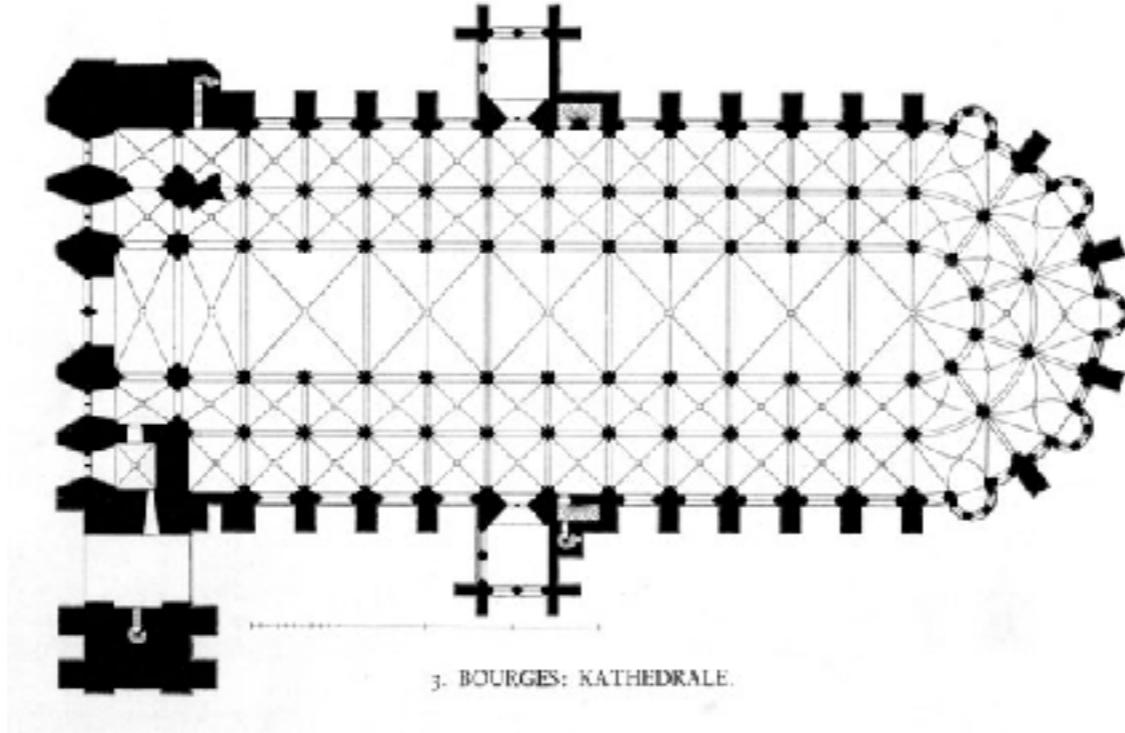
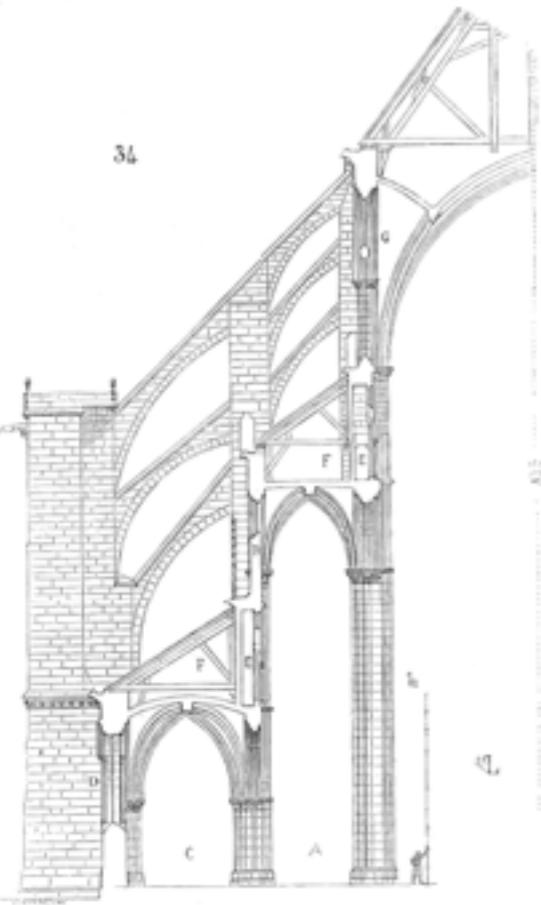


# Architecture



What do we mean by “**architecture**” “**architectural style**” in the context of software systems?

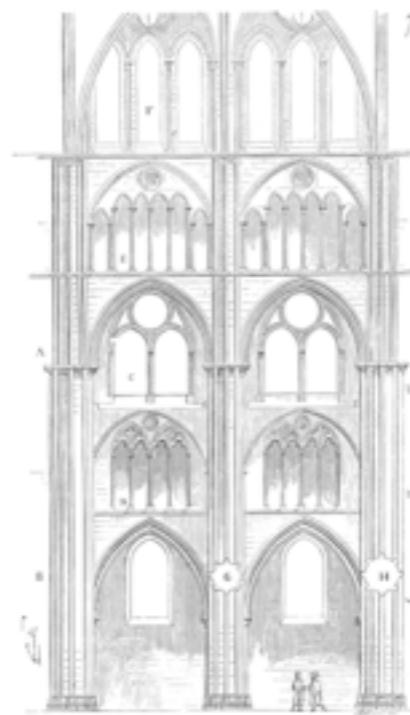
- There is **no single definition** for software architecture!
- The **architecture of a particular application** is a **description** of its **high-level structure** and **behavior**. It is a description of its **components**, how they **interact** with each other and with **external systems**.
- The **architecture of one particular application** is **documented** with a **collection of models** (**UML** diagrams are examples of such models).
- An **architectural style** is a **set of core principles and rules** (**architectural patterns**), which are **common** to a large number of different applications.

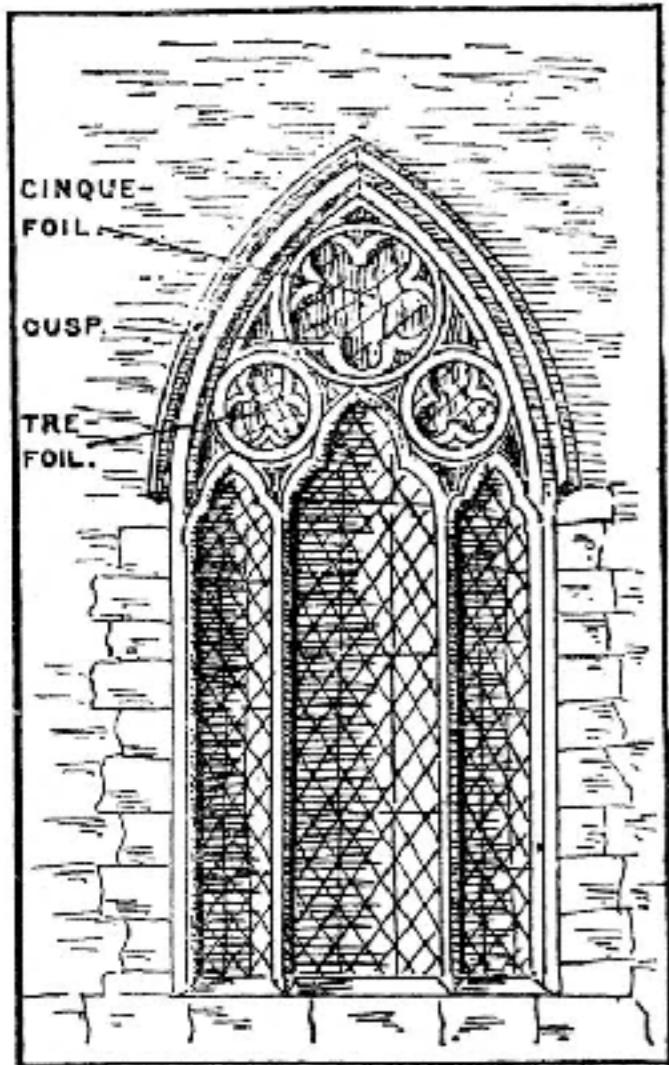
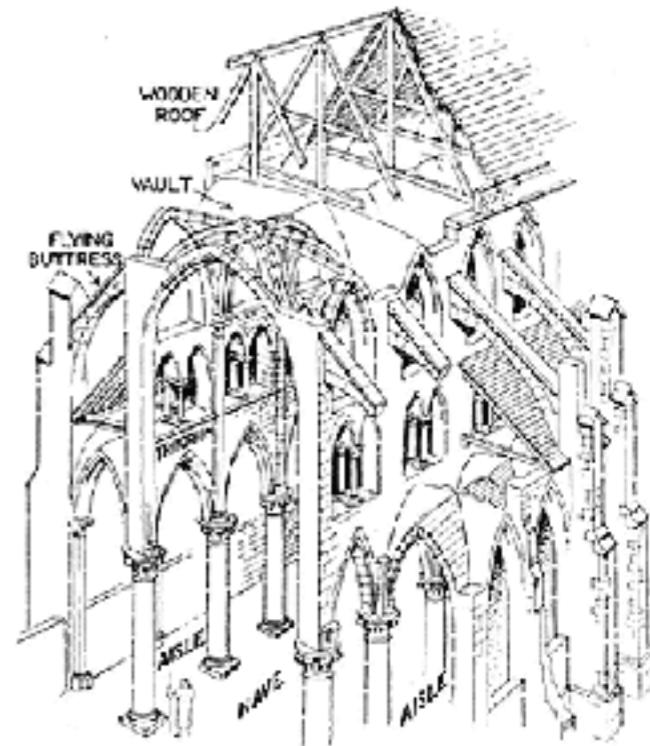
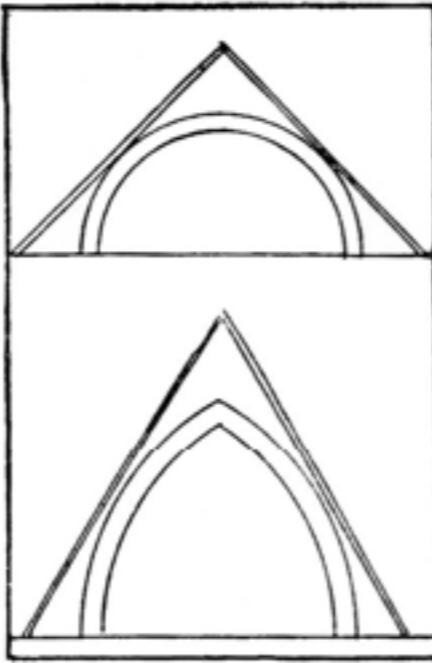
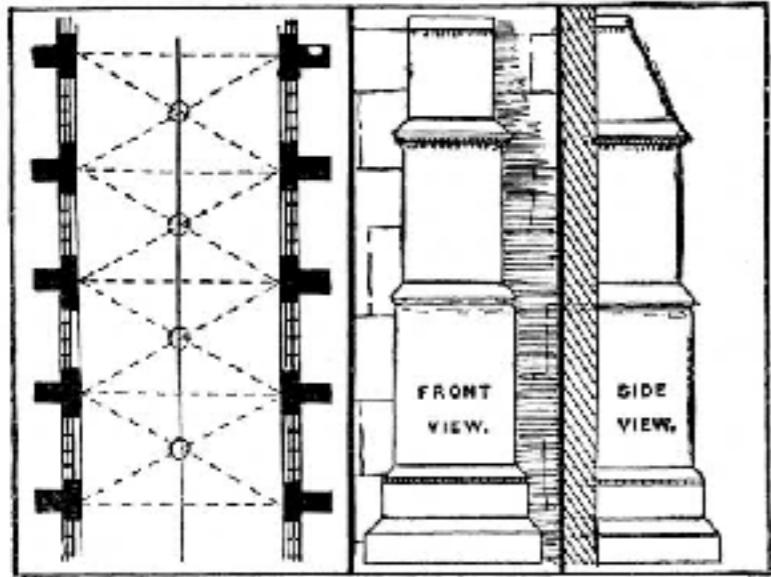


# The Architecture of Bourges Cathedral

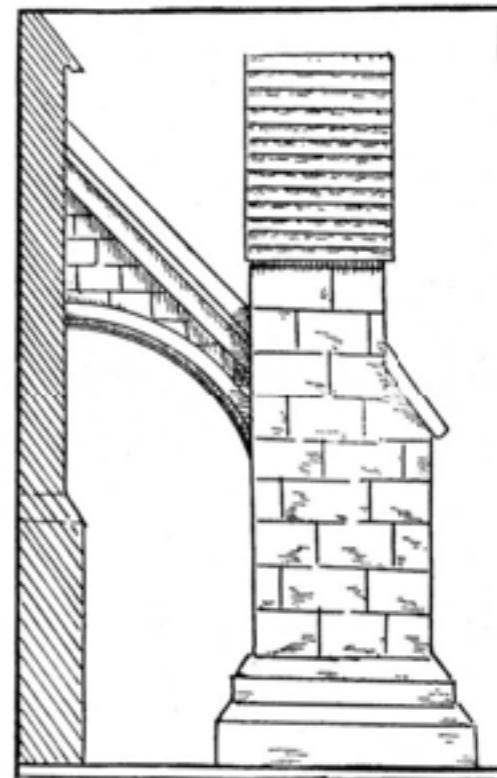


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# The Gothic Architectural Style





## What are some of the well-known **architectural styles?**

- The client-server architectural style
- The 3-tiered architectural style
- **The multi-tiered architectural style**
- The RESTful architectural style
- The service oriented architectural style
- The event-driven architectural style
- The layered architectural style

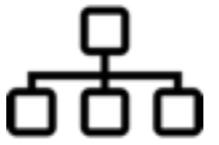
Architectural styles are **not mutually exclusive**. Many applications combine patterns from several styles!



3-tiers, multi-tiers... **how many tiers** does a multi-tiered application have, and which ones?



human-readable  
markup generation



Page navigation



Data access



Shared business  
logic and rules



machine-readable  
markup generation



Message/  
event bus



User

Client

Presentation

Business

Integration

Resources



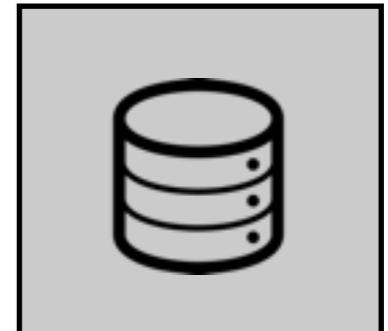
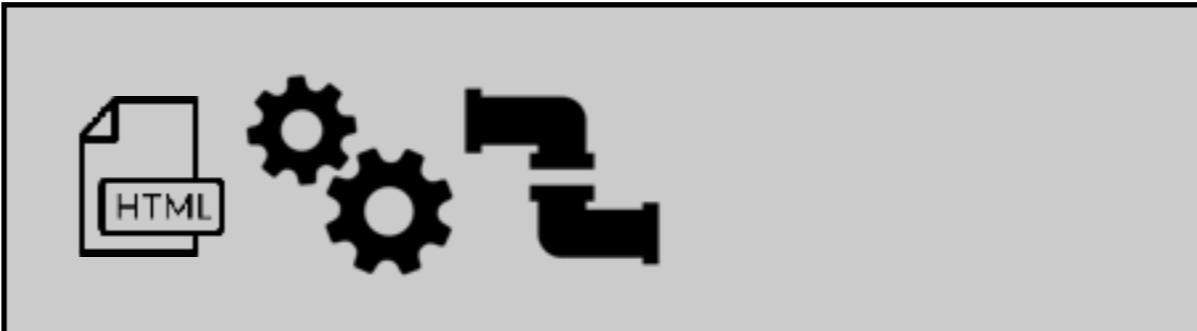
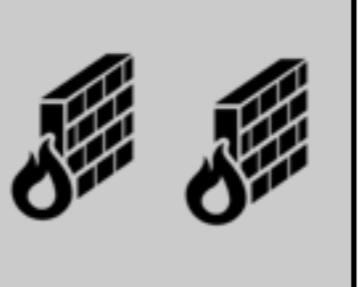
What is the mapping between tiers, **logical nodes** and **physical nodes**?



Dev environment



Minimal environment



Simple environment

User

Client

Presentation

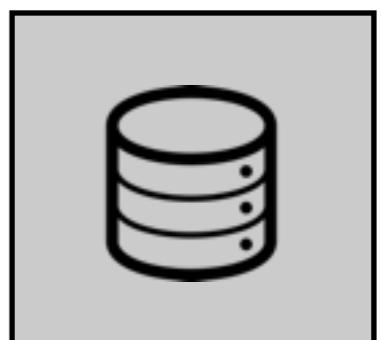
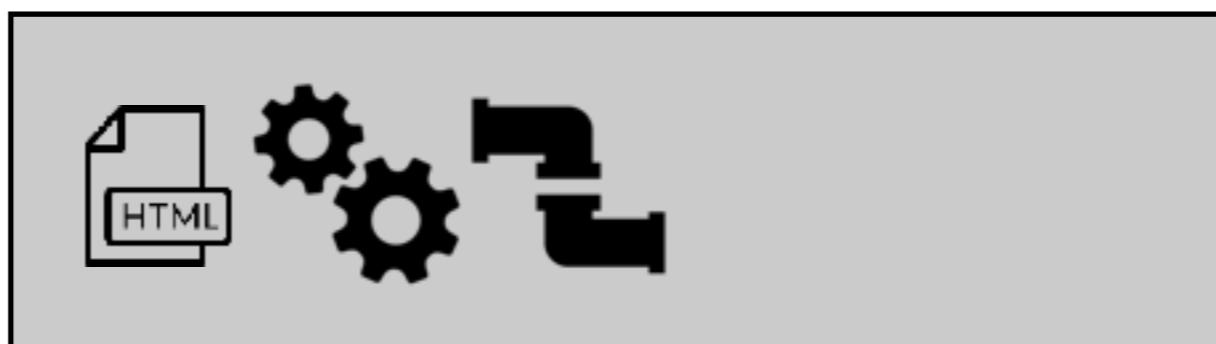
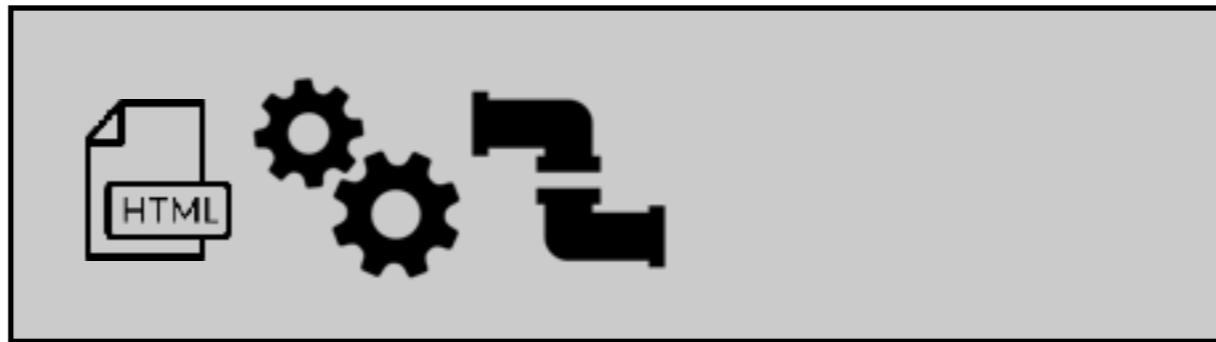
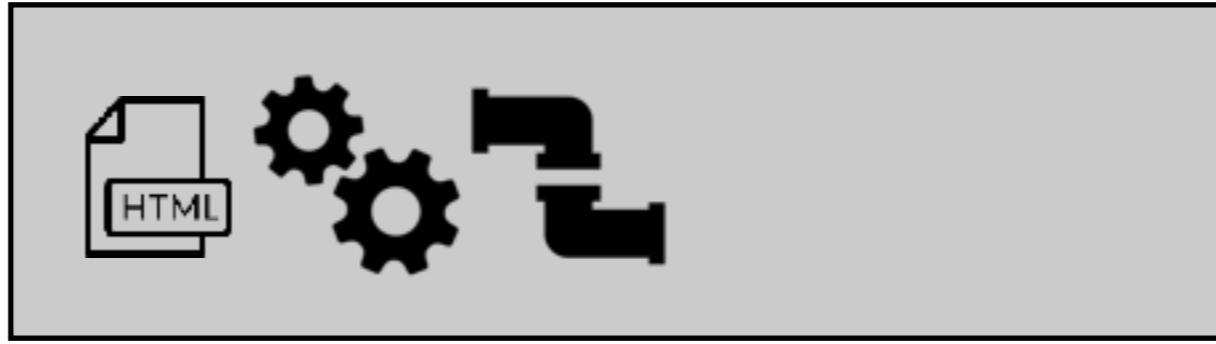
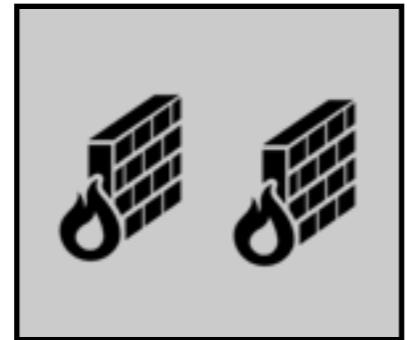
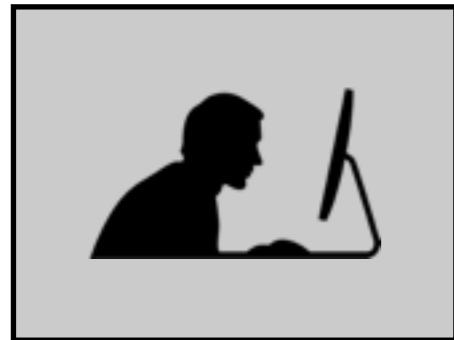
Business

Integration

Resources



What is the mapping between tiers, **logical nodes** and **physical nodes**?



Typical environment for scalability and availability

User

Client

Presentation

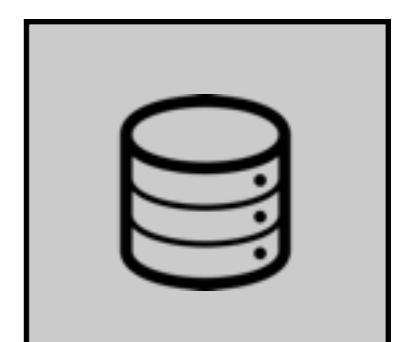
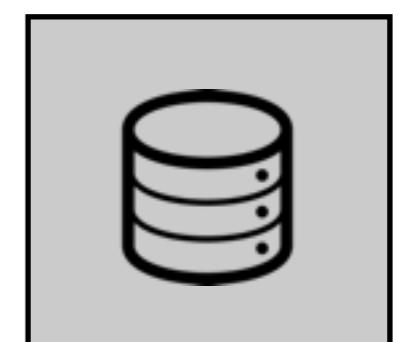
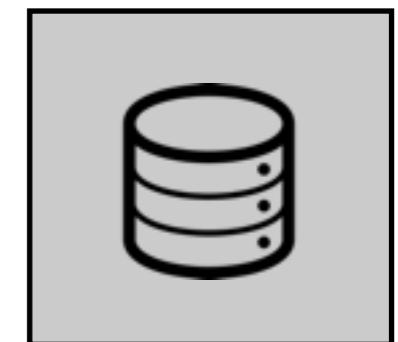
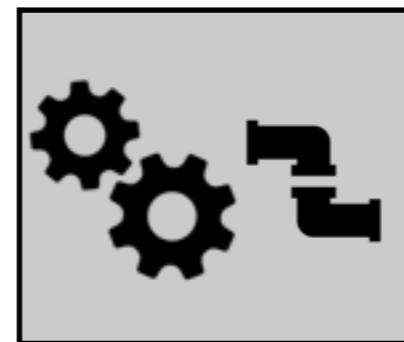
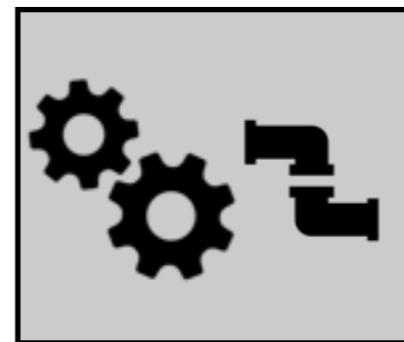
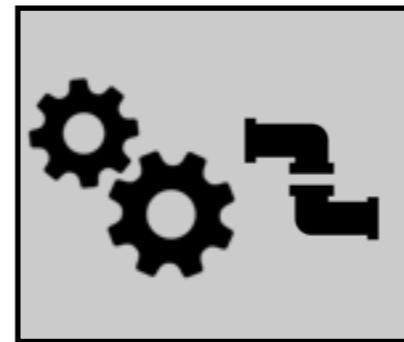
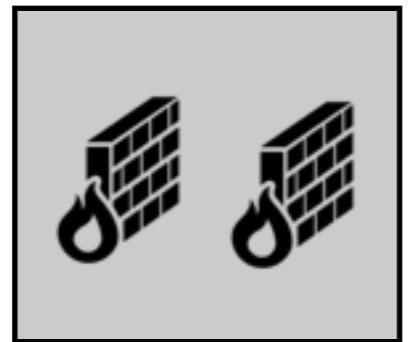
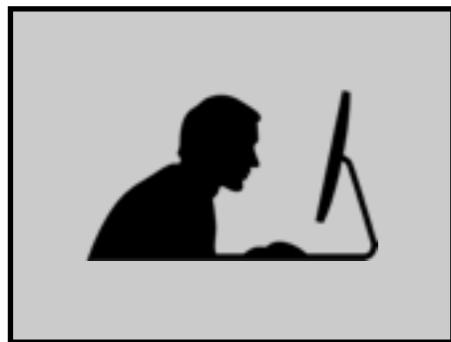
Business

Integration

Resources



What is the mapping between tiers, **logical nodes** and **physical nodes**?



Fully distributed environment

User

Client

Presentation

Business

Integration

Resources



What is the mapping between tiers, **logical nodes** and **physical nodes**?

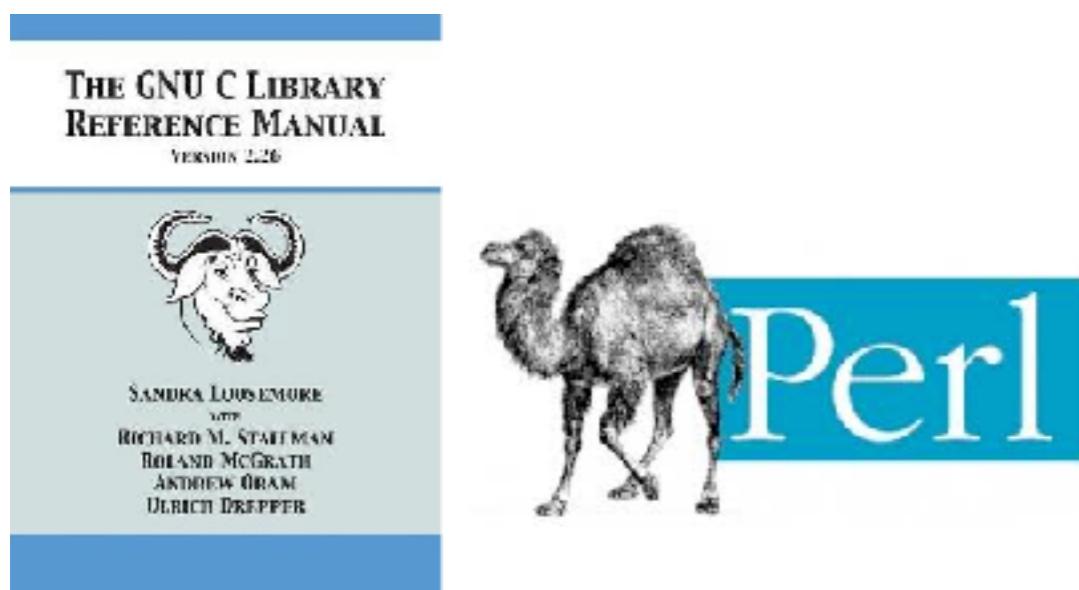
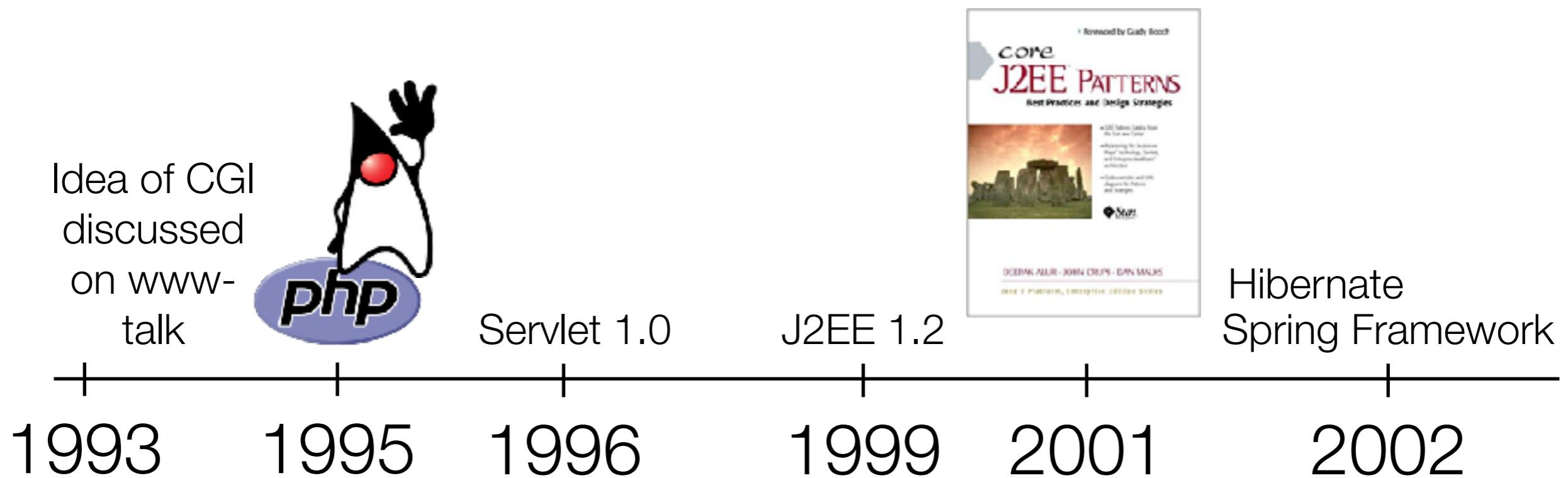
- Just because it is **possible to physically separate the presentation and the business tier** does not mean that it is always a good idea!
- One reason to keep them in the same node is that **invoking a remote service is a lot slower than invoking a local service**.
- Introduce a **reverse proxy** as soon as possible. In simple environments (e.g. dev.), it does not require a physical node.
- **Database nodes** are often shared by several applications. Optimization techniques are fairly different for database and application nodes. They are often physically separated.

(Rapidly evolving) virtualization technologies gives us more options. Think about **Docker**, which allows you to “run a data center” on your laptop.



# Java Enterprise Edition

# Emergence of web development platforms



# What is Java Enterprise Edition?

- It is a **development platform**: it provides high-level APIs to develop software components.
- It is an **execution platform**: it provides an environment to deploy and bring these components “to live”.
- It is an **enterprise platform**: it provides support for distributed transactions, security, integration, etc.
- **Separation of concerns**: "The developer takes care of the business logic. Java EE takes care of the systemic qualities".



[http://flickr.com/photos/decade\\_null/427124229/sizes/m/#cc\\_license](http://flickr.com/photos/decade_null/427124229/sizes/m/#cc_license)

# Java EE and standards



- **Java EE is a specification**
  - Defined through the JCP, it is a specification that software editors can decide to implement. Java EE 5 is defined in JSR 244.
- **Java EE is an “umbrella” specification**
  - Java EE builds upon other specifications (servlets, EJBs, JDBC, etc.) and specifies which specifications (and which versions) need to be implemented by a Java EE certified application server.
  - Java EE also defines a programming model and defines several roles (developer, assembler, deployer, etc.).

Specification Lead  
 Bill Shannon Sun Microsystems, Inc.

Expert Group  
Barreto, Charlton  
Capgemini  
Dudney, Bill  
Hewlett-Packard  
Kohen, Elika S.  
Oracle  
Pralap, Rama Murthy Amar  
Rehnshagen, Dirk  
Shah, Suneet  
Tiwari, Ashish  
Umapalay, Sivasundaram

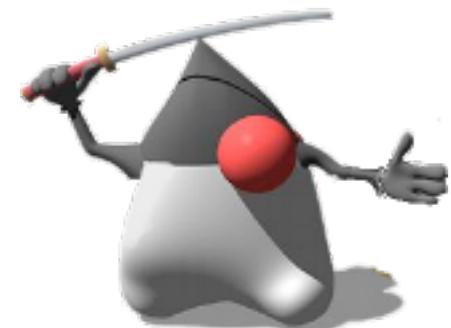
BEA Systems  
Chandrasekaran, Muralidharan  
E.piphany, Inc.  
IBM  
Leme, Felipe  
OW2  
Raible, Matt  
SAP AG  
Sun Microsystems, Inc.  
Tmax Soft, Inc.

Borland Software Corporation  
Crawford, Scott  
Genender, Jeff  
Ironflare AB  
Novell, Inc.  
Pramati Technologies  
Red Hat Middleware LLC  
SeeBeyond Technology Corp.  
Sybase  
Trifork



# J2EE or Java EE?

- Java Enterprise Edition is **not** a recent specification.
- The SDK 1.2 was published in 1999.
- The specification is managed through the JCP since version 1.3
- We used to talk about "Java 2 Enterprise Edition 1.3", or J2EE 1.3
- We then moved from J2EE 1.3 to J2EE 1.4 to... **Java EE 5**
- Today, we should speak of Java EE, but J2EE is still sometimes used...
- Java EE 7 was released on May 28th, 2013
- Java EE 8 was released on August 31st, 2017. Seriously?



**Watch out!** Java EE (formerly known as J2EE)  
**has evolved a lot** over the years!

# I personally thought that Java EE, as an umbrella specification, was dead.

The JSRs that are part of Java EE (servlets, JAX-RS) would continue to live and evolve, but they will be used directly by independent application frameworks (like Spring)



# Then, this happened, in 2018...



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The screenshot shows the Jakarta EE website homepage. At the top right, there are links for "Edit my account" and "Manage Cookies". Below that is a navigation bar with links for "About", "Members", "Connect", "More...", and a search icon. The main title "Jakarta EE" is prominently displayed in the center. Below the title, the tagline "The New Home of Cloud Native Java" is shown. A sub-tagline below it reads: "Powered by participation, Jakarta EE is focused on enabling community-driven collaboration and open innovation for the cloud." At the bottom of the main section are two orange buttons: "Jakarta EE Working Group" and "Stay Connected".

## Strategic Members



ORACLE



Tomitribe

## Participating Members



[webtide](#)

and this, ...



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The banner features the Eclipse MicroProfile logo and slogan "OPTIMIZING ENTERPRISE JAVA". It highlights the availability of Eclipse MicroProfile 3.0 and displays the "Duke's Choice Award 2018 Winner" badge, which includes the Java logo.

MICROPROFILE<sup>™</sup>  
OPTIMIZING ENTERPRISE JAVA

Projects Resources Starter "Beta" Blog Contributors Join The Discussion See The Code

# Eclipse MicroProfile

## Optimizing Enterprise Java for a Microservices Architecture

Now Available  
Eclipse MicroProfile 3.0

More Information

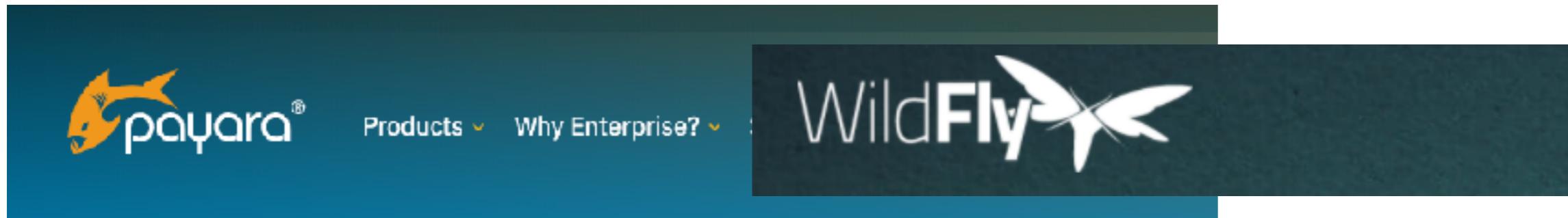
Duke's Choice  
Award  
2018 Winner

Java



Tomitribe





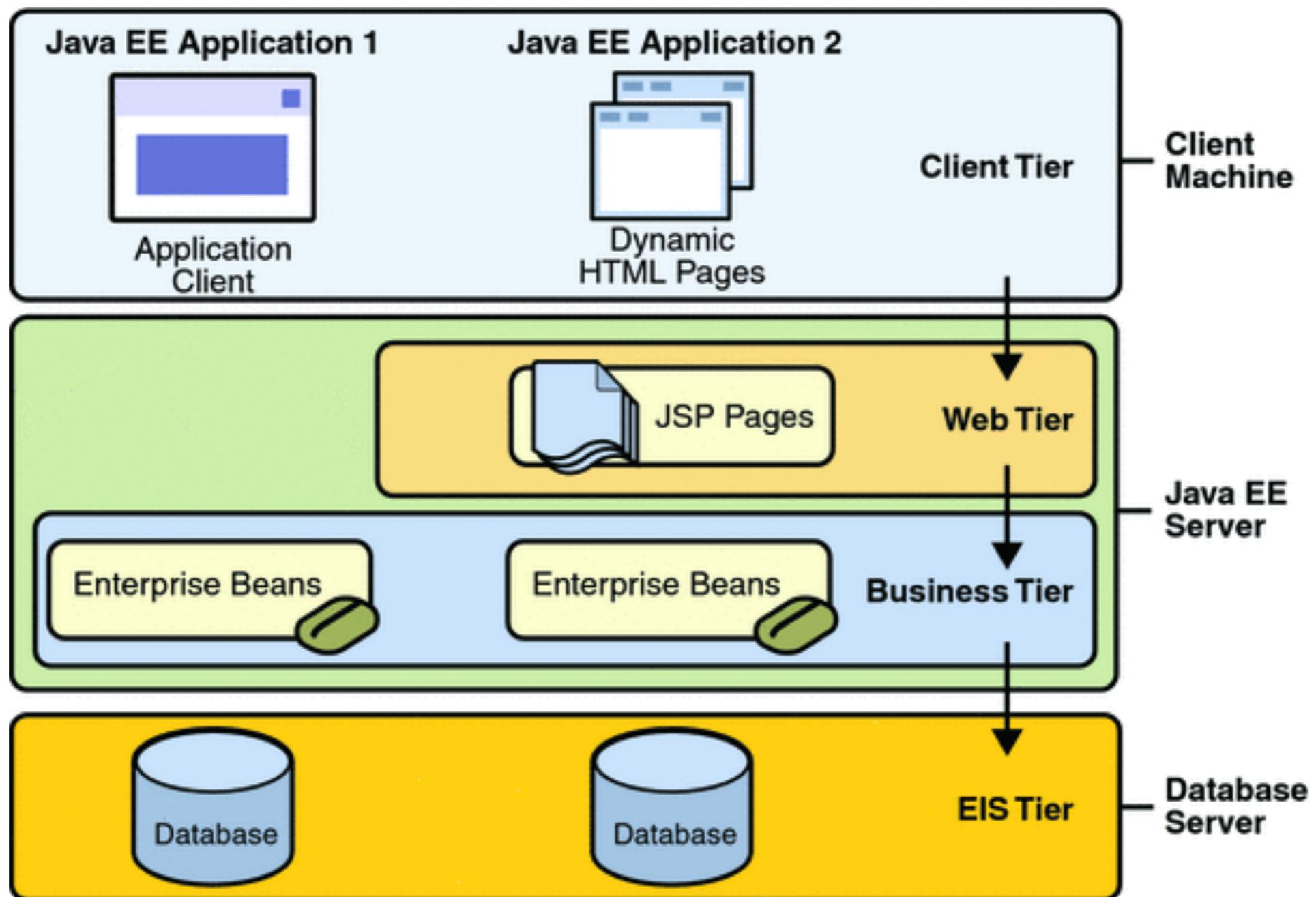
# AMT 2020

The screenshot shows the Open Liberty website. At the top, there's a navigation bar with links for "Get Started", "Guides", "Docs", "Support", and "Blog". Below the navigation is the prominent "Open Liberty™" logo, with the subtitle "An IBM Open Source Project". A large green banner below the logo contains the text: "A lightweight open framework for building fast and efficient cloud-native Java microservices." and "Build cloud-native apps and microservices while running only what you need. Open Liberty™ is the most flexible server runtime available to Java™ developers in this solar system.". A green button labeled "Get Open Liberty" is located at the bottom of this banner. To the right of the banner is a large, stylized illustration of a person wearing a wide-brimmed hat and holding a tablet, set against a background of a green triangle and a blue sky.

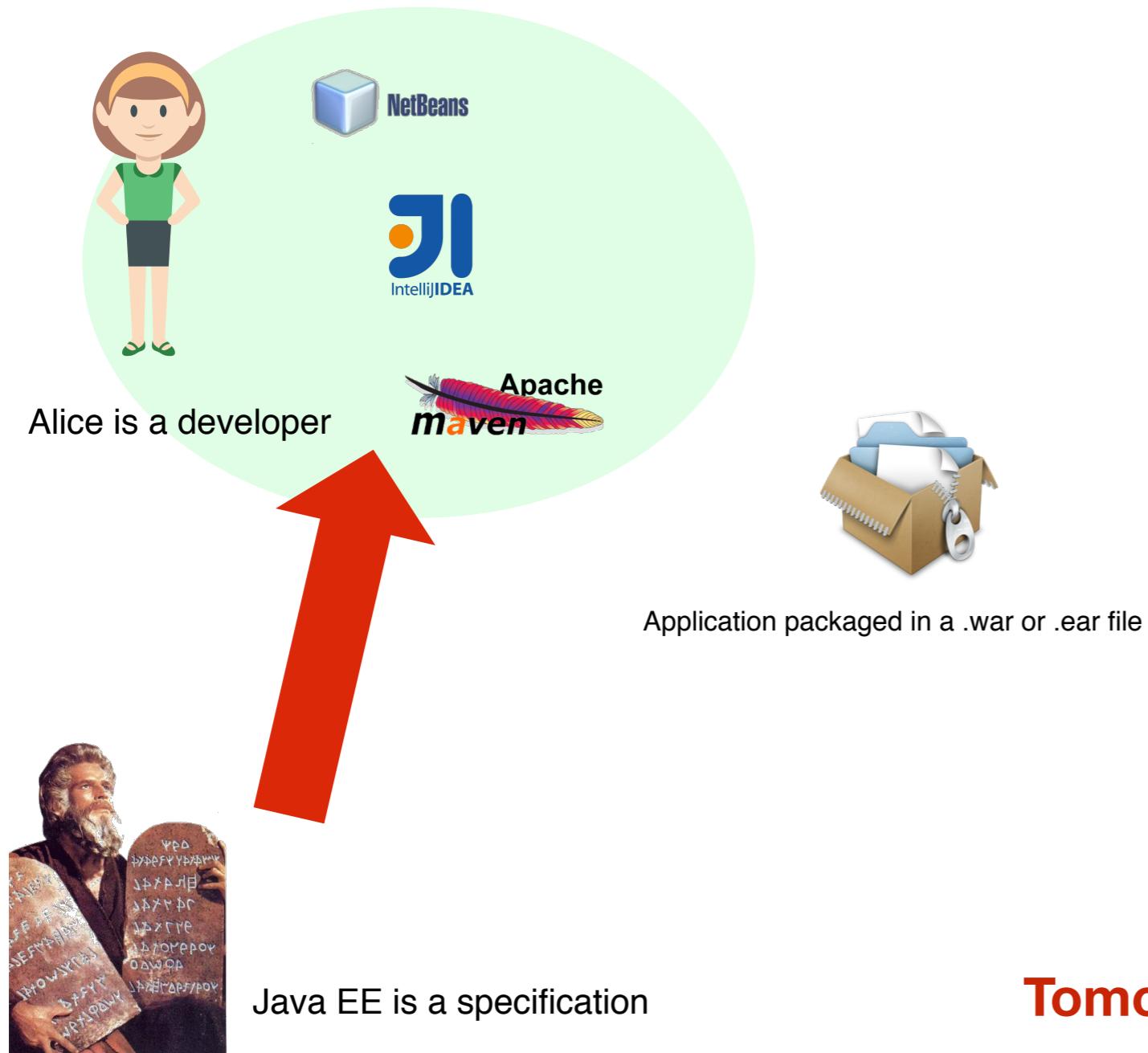
# Architecture



- The software that implements the Java EE specification is called an “**application server**”
  - There are **open source** and **proprietary** application servers.
  - Glassfish, JBoss, WebSphere, BEA WebLogic are examples of application servers.
  - Editors compete on aspects that are not defined the specification (clustering, administration, etc.).
- Key notion in the Java EE architecture: the **containers**
  - a container is an **environment** in which we deploy components;
  - a container **provides services** (transactions, security, etc.) through APIs;
  - there are different containers in Java EE: the "**web**" container, the "**ejb**" container and even a "**client**" container that can be used for rich clients.



# AMT-Discovery



# AMT-Discovery

The screenshot shows a code editor with two panes. The left pane displays the `docker-compose.yml` configuration file, and the right pane shows the project's directory structure.

**File Content (docker-compose.yml):**

```
version: '2'
services:
  glassfish:
    build: ./images/glassfish
    ports:
      - "8080:8080"
      - "4848:4848"
  wildfly:
    build: ./images/wildfly
    ports:
      - "9090:8080"
      - "9990:9990"
  tomcat:
    build: ./images/tomcat
    ports:
      - "7070:8080"
```

**Project Structure:**

- Teaching-HEIGVD-AMT-Discovery
  - apps-dist
    - LandingPageApp-1.0-SNAPSHOT.war
    - LandingPageMVCApp-1.0-SNAPSHOT.war
  - images
    - glassfish
      - Dockerfile
      - drivers
    - mysql
    - tomcat
    - wildfly
      - Dockerfile
  - LICENSE
  - README.md
  - src
    - LandingPageApp
      - nb-configuration.xml
      - pom.xml
      - src
      - target
        - classes
        - endorsed
        - LandingPageApp-1.0-SNAPSHOT
        - LandingPageApp-1.0-SNAPSHOT.war
        - maven-archiver
        - maven-status
        - test-classes
    - LandingPageMVCApp
      - nb-configuration.xml
      - pom.xml
      - src
      - target
  - topology-amt
    - docker-compose.yml

# AMT-Discovery



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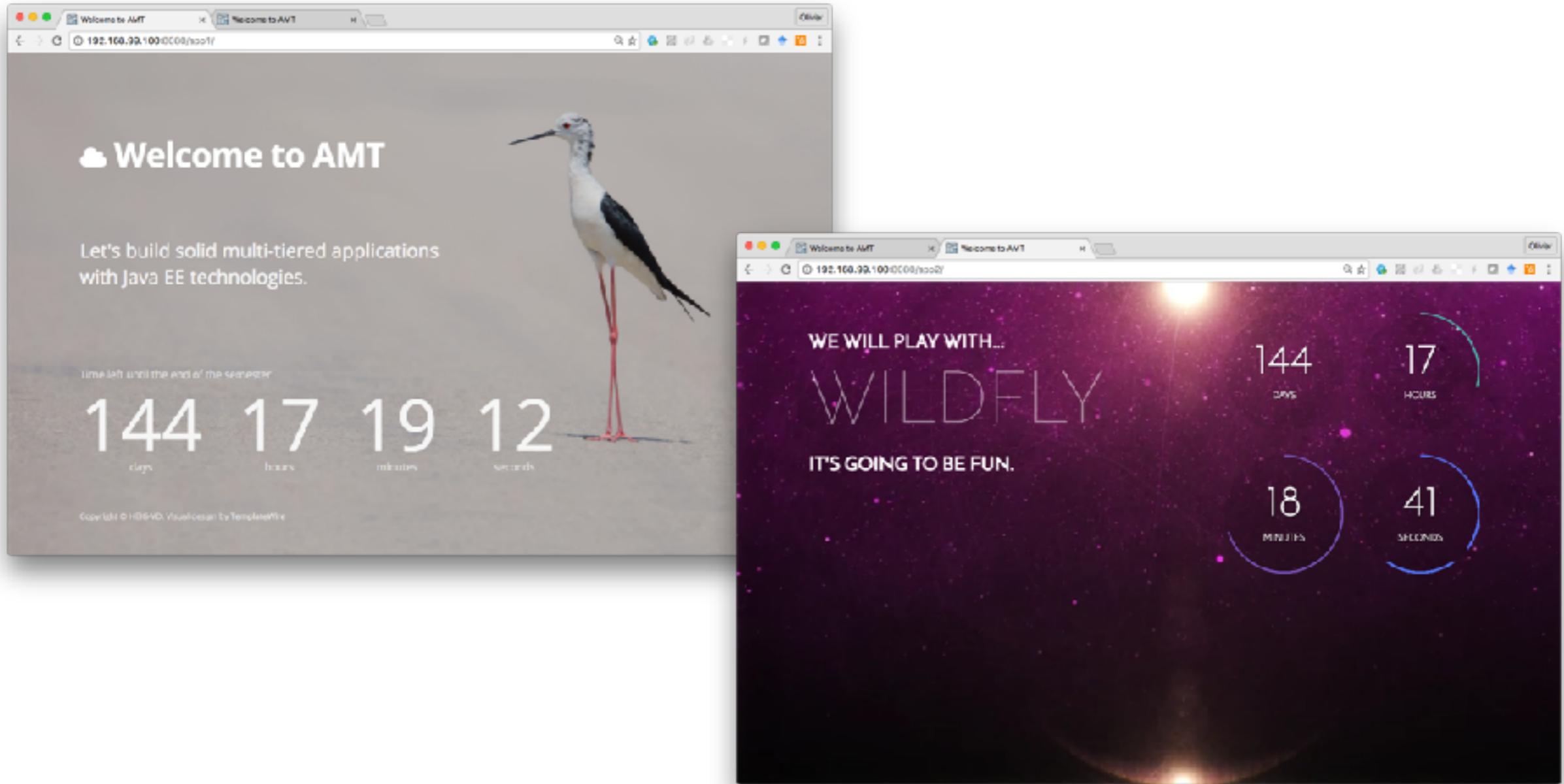
The screenshot displays three separate browser windows side-by-side:

- GlassFish Console - Common**: Shows the GlassFish Server Open Source Edition interface with a sidebar for managing Tomcat, including sections for Managing Tomcat, Release Notes, and Migration Guide.
- Apache Tomcat/8.5.5**: Shows the Apache Tomcat 8.5.5 interface with a message indicating successful installation and a developer quick start section.
- WildFly Management**: Shows the WildFly 8.5.5 management interface, which is a fork of GlassFish. It includes sections for Deployments, Configuration, and Runtime.

# AMT-Discovery



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**What do we want learn?**  
How to drive a car?  
How a car works?

**What makes it easier to learn about**

How to drive a car?  
How a car works?



# Questions?



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