

# TOWARDS SKILL BUILDING TO MEET EVOLVING JOB MARKET DEMAND – “BRIDGING THE GAP” ERASMUS+ PROJECT PERSPECTIVE

**Costin Bădică**<sup>1</sup>, Ionuț Murarețu<sup>1</sup>, Daniel-Costel Bouleanu<sup>1</sup>, Alexandra Vultureanu-Albiși<sup>1</sup>, Kalliopi Kravari<sup>2</sup>, Periklis Chatzimisios<sup>2</sup>, Dimitrios Sarafis<sup>3</sup>, Konstantinos Karamitsios<sup>3</sup>, Tatyana Koukoleva<sup>4</sup>

<sup>1</sup>University of Craiova, Romania

<sup>2</sup>International Hellenic University, Thessaloniki, Greece

<sup>3</sup>My Company Projects O.E., Thessaloniki, Greece

<sup>4</sup>Regional center for vocational training and education to CCI, Blagoevgrad, Bulgaria

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# Talk Outline

- Context and Motivation
- Project Overview
- Some Results and Discussions

# Context and Motivation



- The job market is continuously evolving.
  - The specific occupations, skills, competences and qualifications of people change over time, as does their description ⇒ **Effective intelligent communication and information exchange between the job market and the education and training sector is vital.**
  - For the individual job seeker there is a need for approaches that combine practical tools with motivation and mentoring support ⇒ **Skill-matching is not enough, skill-building is needed.**

# Project Objectives



- Development of intelligent ICT tools for:
  - **Searching** for jobs and matching them with individual profiles (i.e. CVs).
  - **Searching** for educational resources and matching them with individual profiles or job descriptions.
  - **Skill building** with the help of virtual assistants empowered by intelligent agents that will handle each participant as a unique case.

# Project Consortium

## ■ Greece

- International Hellenic University, Thessaloniki
- My Company Projects O.E., Thessaloniki



## ■ Romania

- University of Craiova



## ■ Bulgaria

- Regional Center for vocational education training to CCI – Blagoevgrad



- Problem area, State-of-the-art and mockup demos
  - Design solution framework;
  - Investigate Semantic web technologies (metadata, ontologies, logic & inference, intelligent agents)
  - State-of-the-art investigation;
  - Design, implement document mockup demos.
- Bridging the Gap Web Platform

- Tools development and Integrations with external systems & semantic intelligent bridging
  - Tool for CV annotation
  - Tool for job vacancy (JV) annotation
  - Tool for UoL annotation
  - Intelligent services for matching, integration with learning providers, prediction of curricula needs



- Development and Integration with the agent-based module
  - Design & Implement agent-based architecture
  - Design & Implement Intelligent service for skill-building
  - Design & Implement Intelligent service for predicting needs



# Regional Center for Vocational Training and Education to CCI



- Workshops (4):
  - Job seekers, job offering companies, learning providers
  - Development and translation of training and trainer materials
  - Workshop organization
- Objectives:
  - Bridging the gap among job seekers and job offering companies.
  - Improve understanding of participant stakeholders of skills needs and trends in the job market.

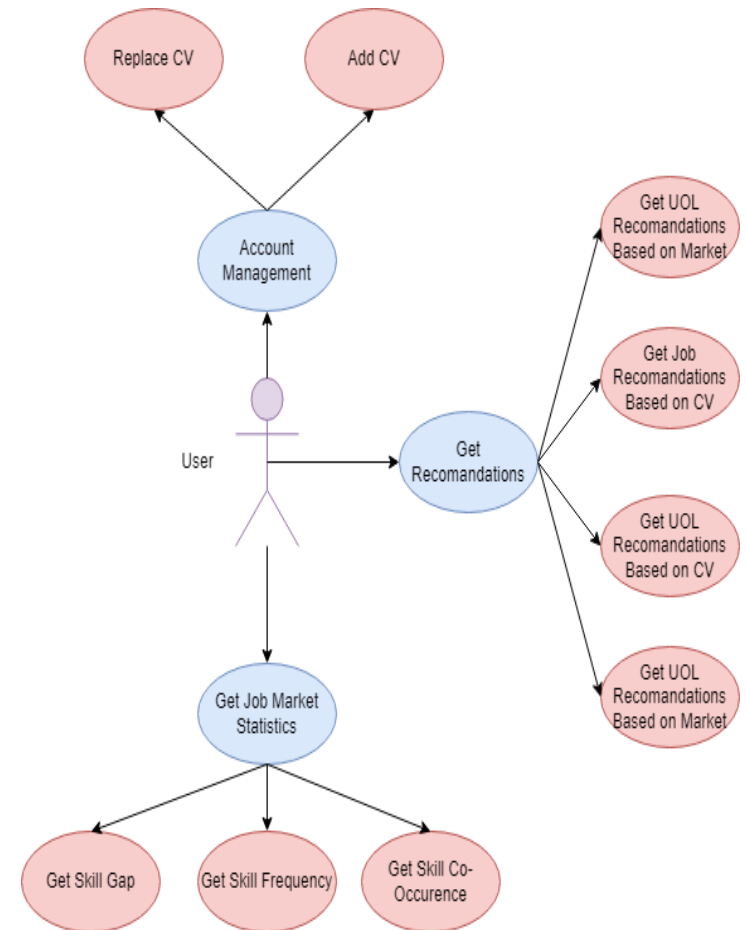
# Prototype Tools and Semantic Technologies



- Services for:
  - ❑ Parsing CVs, job descriptions and open courses descriptions
  - ❑ Semantically matching them to occupations and job vacancies
  - ❑ Assigning skill deficits to courses provided by educational agents
- Semantic Web Technologies:
  - ❑ SW Ontologies for representing the taxonomy "European Skills, Competences, qualifications and Occupations" known as ESCO.
  - ❑ SW query language SPARQL

# Use Cases

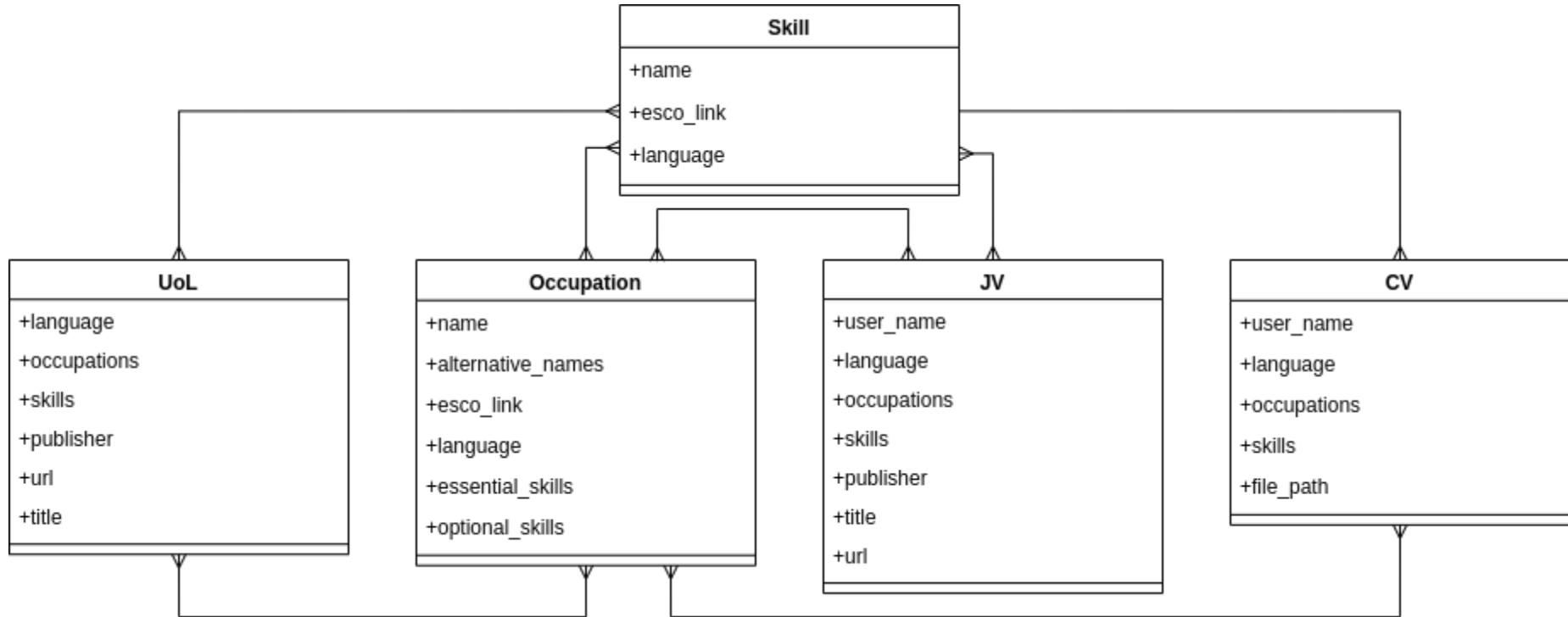
- **Recommend** JVs to a job seeker
- **Recommend** a few occupations to a job seeker
- **Recommend** a few courses to a job seeker
- **Help** a company improve a JV's description
- **Help** a course offering company improve a course's description
- **Perform** job market summary analysis
- **Recommend** personalized plan for skill improvement (open or low-cost educational activities)



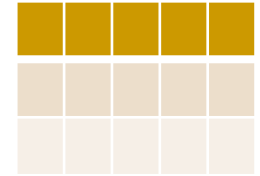
# Data Model



- Current version is based on a simplified version of ESCO
- ESCO ontology defines 3008 occupations and 13890 skills.



# Data Set



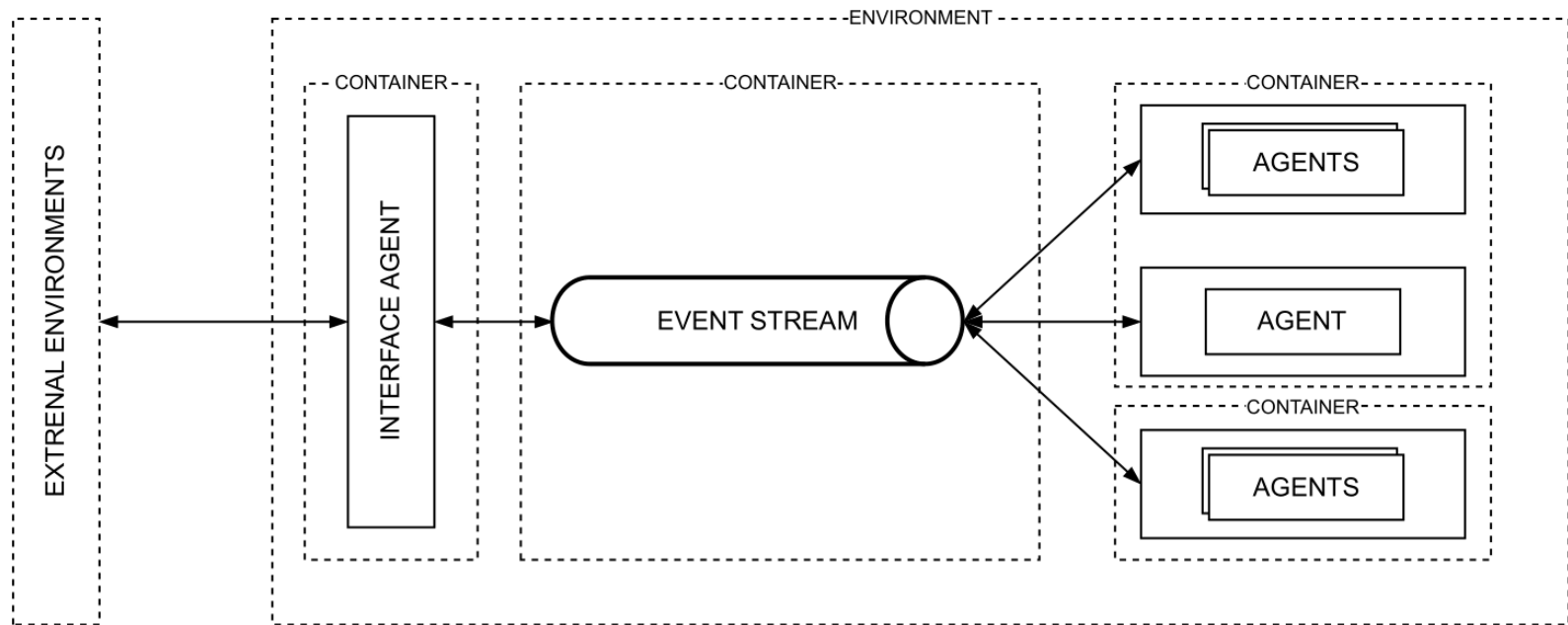
- Project partners collected initial experimental data with the IT job market in the Balkan region (Greek, Romanian, Bulgarian).
- At the time of conducting experiments, data set contains:
  - 109 CVs
  - 730 JVs
  - 750 UoLs



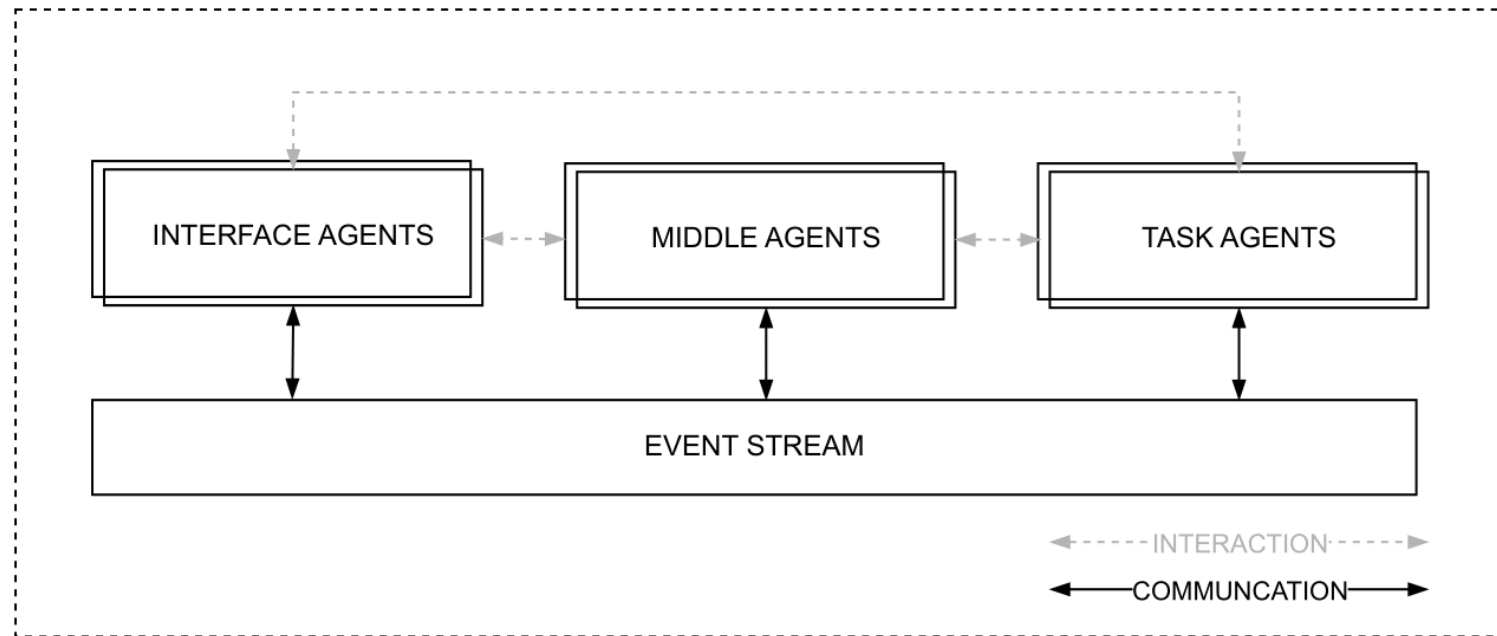
# Microservice-Based MAS Framework



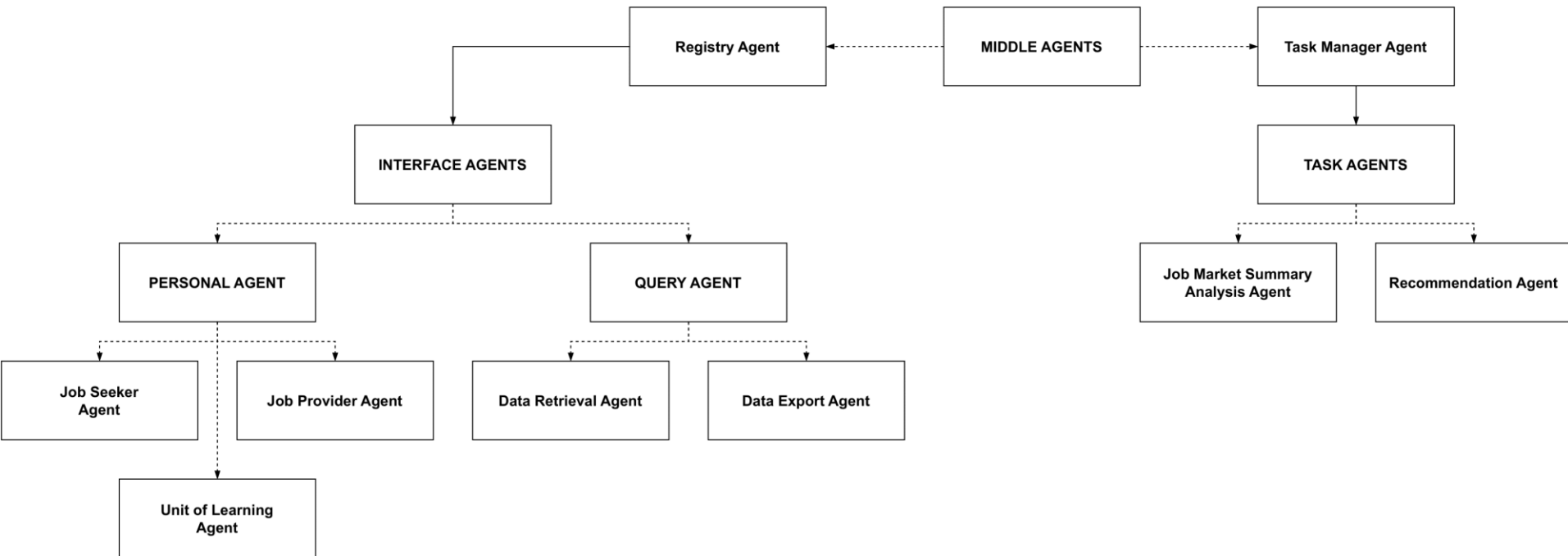
- Single agents or groups of agents are deployed as services running inside a container.
- Agents communicate via an event stream.



# Agent Types and Their Interaction



# Multi-Agent System Architecture





# Some Analytics

$$Y = F(X_1, X_2, \dots, X_n)$$

- **Skill Demand and Supply**  $\Rightarrow$  their current values on the job market.
- **Skills Co-occurrence**  $\Rightarrow$  how do skills co-occur in the same context.
- **CV2CV similarity**  $\Rightarrow$  similarity between two CVs.
- **CV2JV matching score**  $\Rightarrow$  defines the similarity between a CV and a JV.
- These metrics are evaluated by modeling entities (CVs and JVs) as **bags of skills**.

# Skill Gap Analysis



- Aims to identify the skills that are in high demand but in short supply in the labor market.
- Evaluates the gap between required skills in JVs and available skills in CVs is assessed.

***Skill Gap = |JVs Required Skills – CVs Available Skills|***

# Sample Results

Index	Skill	Skill-CVs Occ.	Skill-JVs Occ.	Skill-CVs Occ. %	Skill-JVs Occ. %	Skill Diff.	Skill Diff. %
2414	personal development	1	37	0.970	6.324	-36	-5.353
5216	DevOps	3	42	2.912	7.179	-39	-4.266
12465	Angular	3	42	2.912	7.179	-39	-4.266
4495	Source (digital game creation systems)	4	45	3.883	7.692	-41	-3.808
3909	Trademarks	4	42	3.883	7.179	-38	-3.295
225	hybrid model	0	18	0.0	3.076	-18	-3.076
739	implement ICT recovery system	0	18	0.0	3.076	-18	-3.076
7511	SQL Server	3	35	2.912	5.982	-32	-3.070
5333	data protection	1	23	0.970	3.931	-22	-2.960
6141	SQL	19	125	18.446	21.367	-106	-2.920

Table 4: Skill Gap Example (Top 10 % Difference)

# Research Papers

- Daniel-Costel Bouleanu, Costin Bădică, Kalliopi Kravari (2023). *Using SHAP-Based Interpretability to Understand Risk of Job Changing*. In: Braubach, L., Jander, K., Bădică, C. (eds) Intelligent Distributed Computing XV. IDC 2022. Studies in Computational Intelligence, vol 1089. Springer, Cham. [https://doi.org/10.1007/978-3-031-29104-3\\_5](https://doi.org/10.1007/978-3-031-29104-3_5)
- Ioannis - Aris Kostis, Dimitrios Sarafis, Konstantinos Karamitsios, Konstantinos Kotrotsios, Kalliopi Kravari, Costin Badica. Periklis Chatzimisios, *Towards an Integrated Retrieval System to Semantically Match CVs, Job Descriptions and Curricula*. In 26th Pan-Hellenic Conference on Informatics (PCI 2022), November 25-27, 2022, Athens, Greece. ACM. <https://doi.org/10.1145/3575879.3575985>
- Ionut Muraretu, Daniel-Costel Bouleanu, Alexandra Vultureanu-Albisi, Costin Badica, Dimitrios Sarafis, Kalliopi Kravari and Periklis Chatzimisios. *A Microservice-Based Multi-Agent System for the Job Market*, accepted at 16th International Symposium on Intelligent and Distributed Computing, IDC'2023, Hamburg, Germany (accepted)

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# Web Pages

- Project Web page:

- <https://bridgingthegaproject.eu/>

BRIDGING  
THE — GAP

AI-enabled versatile skill matching  
tool to assist the less privileged

- Workshop Web page:

- <https://www2.informatik.hu-berlin.de/~wwwcompsoft/intkoop/daad/2023/agenda.html>

