Educational Service Platform for Artificial Intelligence Resources

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Abstract—The Educational service platform developed in the project "Research on AI- and Simulation-Based Engineering at Exascale" (RAISE)[*] is presented. The platform contains RAISE's educational resource portfolio focusing on Artificial Intelligence linked also to its application on High-Performance Computers. The online Educational services platform contains information on forthcoming training events and information on diverse learning resources. The structure and choice of the elements and the employed technologies and the design of the platform are described. In addition, the portfolio development process is elaborated. Information on degree programs, separate courses on Artificial Intelligence and other domain-specific and interdisciplinary educational resources from the project partners, and from other projects and educational resource providers are collected on the platform.

Index Terms—*Artificial Intelligence, High Performance Computing, educational service platform, course portfolio*

I. INTRODUCTION

The application of Artificial Intelligence (AI) is spreading throughout different fields. It is fostered by the development of computational resources allowing to perform calculations at high speeds combined with the advances in research of AI methods and applications. Developing educational resources to spread the AI knowledge across the disciplines is found to be highly important [1].

The European Union (EU) supports the establishment of European Centers of Excellence (CoEs). One such center is the CoE "Research on AI- and Simulation-Based Engineering at Exascale" (RAISE). The project aims to accelerate the knowledge transfer to academia, industry, and among the partners of the project. It is planned to create a European network to provide best practices developed in RAISE and to support the industry, SMEs, and academia in AI applications

on High-Performance Computing (HPC) systems. Education and training are important components to reach these aims and to attract new user communities. Analyses predict that the introduction of AI in the industry will foster ongoing developments in many aspects [2].

Education and training resources on AI applications in different domains that make use of HPC, as well as courses on interdisciplinary topics based on research results from the project partners must be organized in the best way to make them easily accessible for potential users. User expertise must be taken into account when offering training resources to effectively close their knowledge gap. There are already a lot of education and training resources available, which could be collected and offered, including Open Educational Resources (OER). The education and training resources may have quite diverse formats; however, to simplify the description in this work, the term "course" is used for all of them.

This paper presents the CoE RAISE's Educational service platform [3] containing information on educational resources for lifelong learning in AI and related HPC applications – from newbies and potential users to advanced practitioners. The paper is organized as follows. In Section II, the functional design elements of the Educational service platform and the structure, formats, and other useful aspects of training resources aggregation are presented. Next, in Section III, the platform in action is introduced and it is shown how a course portfolio can be created. Finally, in Section IV, conclusions are drawn.

II. STRUCTURE OF THE EDUCATIONAL SERVICE PLATFORM

There exist several education and training web portals belonging to organizations, enterprises, or projects offering courses. A common component of these portals is a course portfolio that includes search functionality. Another typical component is a list of forthcoming training events. The implementation of these two components varies among different

portals. It was decided that CoE RAISE's Educational services platform in its first version will also feature these two components – a course portfolio with a search function and a list of forthcoming educational and training events. Fig. 1 illustrates the Educational Service platform accessed via web browser [3]. In comparison to other portals, RAISE's platform focus only on AI-related educational and training resources.
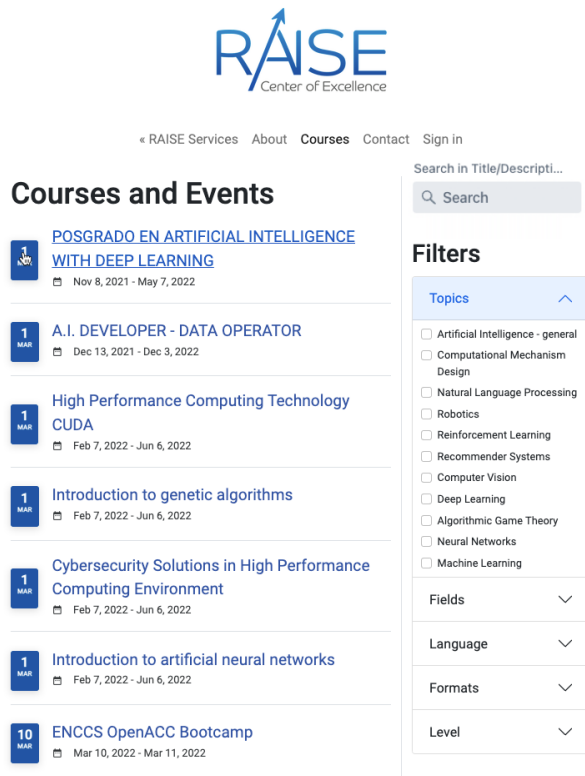

Fig. 1. Educational Service platform with an implemented classification system for courses filtering.

A. Course description criteria and classification

1) Description criteria: In order to choose the appropriate course description criteria and to implement an efficient search functionality, a review of the structures of several HPC-related training portals – PRACE (Partnership for Advanced Computing in Europe) Training portal, EuroCC (National Competence Centres in the framework of EuroHPC) Access portal, and FutureLearn portal – was performed.

From the review of existing training portals, the main criteria elements for the course description were identified. There was an attempt to minimize the number of a course descriptive elements that will be filled in while adding a new course. It was decided that for every course uploaded to the database the following information should be provided: course title, short description, learning outcomes (knowledge and skills obtained by the trainee of the course), name of the provider, and link to the website with a full description of the course and registration information. Some items such as prerequisites and tools (what previous education is needed

and what equipment or software tools are needed), start and end dates of the event, information on registration availability, price, and availability of certificate are treated as optional for adding a new course.

2) Course classifiers: In addition to general course information, every course must be classified by choosing one or up to three different options from five criteria groups: *Topic*, *Level*, *Field*, *Format*, and *Language* (see Fig. 1 for more detailed information).

a) Topic: Under the *Topic* classifier, 12 most common areas from the field of AI were identified: Artificial Intelligence (general), Computational Mechanism Design, Natural Language Processing, Robotics, Reinforcement Learning, Recommendation Systems, Computer Vision, Deep Learning, Algorithmic Game Theory, Neural Networks, and Machine Learning. New *Topics* can be added to the platform.

b) Levels: From course *Levels* one of four feasible options can be selected: Potential users, Beginners, Intermediate, and Advanced. For the course Field classifier, one can select between eight science and application areas.

c) Field: One can choose between eight science, study and application areas.

d) Languages: Eight built-in platform languages cover most of the languages spoken by CoE RAISE project partners. The languages that are used on the platform at the moment of paper writing are English, German, Spanish, Dutch, French, Icelandic, Italian and Latvian.

Fig. 2 presents a screenshot from the running platform with the view on the five previously discussed filtering categories and first-level criteria. Also, the figure depicts criteria selection options and validation requirements while uploading or modifying the course information.
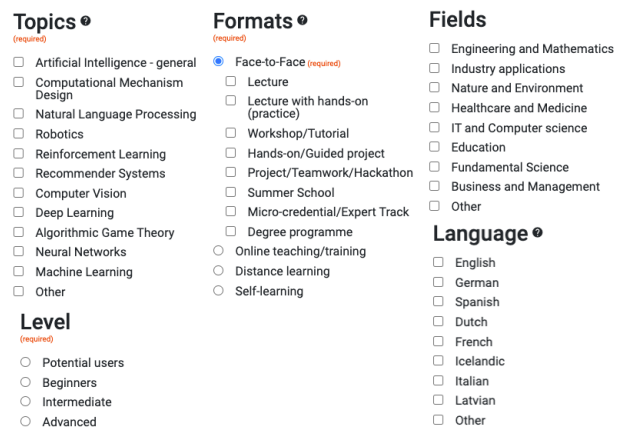

Fig. 2. Filter categories and first-level criteria used on the platform.

The course and educational resource *Formats* may be diverse and combined. Therefore, a two-level *Format* system was introduced. At first, one out of four non-overlapping options must be selected: *Face-to-Face*, *Distance learning*, *Online teaching/training*, and *Self-learning*. Then, for the selected main *Format*, several options (one or more) can be

chosen. For example, under the *Face-to-Face* selection, several additional options are available: *Lecture*, *Lecture with hands-on (practice)*, *Workshop / Tutorial*, *Hands-on/Guided project*, *Project / Teamwork / Hackathon*, *Summer School*, *Micro-credential / Expert Track*, or *Degree program*. On this selection level, a single or a combination of several sub-formats can be chosen for the specific course.

The proposed classification system is available for open access and evaluation in practice [3].

B. Searching for the best-fit course

Nowadays, the number of education and training courses as well as other resources is continuously growing. Therefore, finding the most appropriate resource for a user is not easy. The platform enables potential users to find the right course or follow training events by searching and filtering options.

a) Searching using filters: Finding courses and events using filters is tightly linked to the course criteria set - *Topic*, *Level*, *Field*, *Format* and *Language*. On our platform, we developed the following course filtering guidelines:

- select neither, one or more options from all the Filters first-level categories;
- select only one specific item from the Formats category;
- select one or more items from the Formats second-level, also mentioned as sub-format;
- minimise criteria overlapping.

b) Searching by keywords: Another option is using keywords to search a specific text string. The search engine can find that string in the course title, description, or institution name.

To illustrate the process, Fig. 3. presents a screenshot from the use case after filtering courses on Neural networks *Topic* offered as *Online Teaching/Training Lecture* with hands-on (practice).
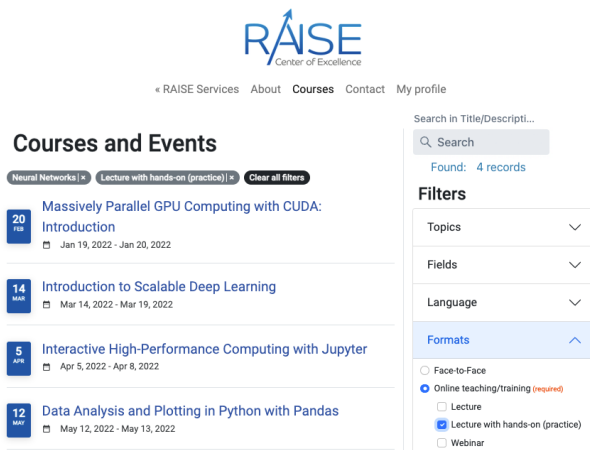

Fig. 3. Result of filtering of *Neural networks*-related courses and applying the *Online Teaching* format.

We had implemented and tested the mentioned rules before we launched the platform. A conclusion on the efficiency of this approach can be completed and commented on by the users later.

C. Technology, design and platform access

The Educational services platform consists of standard solutions and emerging technologies to organize comprehensive web-based communications. The platform can be accessed on the global project website [4] from the sub-page *Services/Training platform*.

1) Platform technology: The platform is a web-based communication system preserving the functionality of usage of standard desktop computers or mobile devices like phones or tablets connecting to the remote web interface. Therefore, our system has a standard web interface allowing access to public or private platform resources. The platform consists of four running services represented to the outer world via web page menu items: (1) *About*, (2) *Courses*, (3) *Contact* and (4) *Sign in*. On the back-end, the platform operates on resources which are utilised mainly during filtering, searching processes and preparing views for web browsers on users devices. For the data storage, we use a persistent database.

2) About page: The *About page* is a default landing page for platform users. After accessing the About page, we give basic platform usage instructions and clarify how to use course classifiers in practice.

3) Courses page: The *Courses* page consists of two components panels. On the right panel, positioned the filtering components: search component and the *Filters* panel. On the left panel we have the list of the courses registered in the persistent platform database. Initially, the list displays only currently or in the future active events and open courses. By clicking on the course component, the user can open a detailed course view. On the right panel we designed components for searching and filtering. Initially, searching text field is empty and no filters applied, however, on the Filters accordion panel, we initially programmed the Topics group to be open.

4) Contact form: By filling out the form and following submission, the user informs the staff about the intention of contributing to the platform. Only after approving the purpose of the potential user to become the active collaborator one can get accepted by the staff receiving the acceptance letter in a form of an email message. In the case of approval the user receives platform access details and the assigned role on the platform.

5) Authentication and security: On the first hand, the platform implements contemporary security standards, principles and techniques like OAuth 2.0 - the industry-standard protocol for authorisation, Multi-factor Authentication (MFA) or Single Sign-on method (SSO). On the other hand, we also elaborated an internal roles hierarchy corresponding to our needs. On the platform, we utilize five roles: (1) *Anonymous* or *Unregistered* web user, (2) *Subscriber*, (3) *Proposer*, (4) *Moderator* and (5) *Supervisor*. *Unregistered user* authorised only to view the public content, search and apply platform Filters. Each next role in the sequence has wider authority. Registered platform users can send a message to the developers and maintainers via the private platform network and therefore enhance the user's experience. A *Supervisor user* can control other users access and has full access to the platform analytic.

The platforms developers endeavoured to make the Educational services platform easy to explore educational resources and training alternatives in the AI field and receive or upload information on forthcoming training events. In addition to this, periodic platform upgrades and regular technical maintenance are scheduled.

III. BUILDING THE COURSE PORTFOLIO

After the development of the Educational service platform, the next step was to collect and update the course portfolio. In the CoE RAISE project, updates are planned once a year (M12, M24, M36) to report the achievements describing the changes of the education portfolio in accordance with the CoE RAISE developments and industrial/academic needs, as well as feedback from users.

As the first step, degree programs, separate courses, and other AI, HPC, domain-specific and interdisciplinary educational resources from the CoE RAISE project partners were collected, as well as from other projects and networks the RAISE partners are involved in. Among the project partners, there are three universities offering degree programs - RWTH Aachen University, University of Iceland (UOI), Riga Technical University (RTU), and the Cyprus Institute (CyI). Education and training is offered also by two HPC centers – the Jülich Supercomputing Centre (JSC) at Forschungszentrum Jülich, the Barcelona Supercomputing Center (BSC), and the European Organization for Nuclear Research (CERN). The project partner Flanders Make VZW (FM) represents industry, however, they also uploaded information on training events in Dutch and English.

RWTH Aachen University is fostering education in AI with special offers for students [5] and is planning to develop an AI degree program with Massive Open Online Courses (MOOCs).

The CoE RAISE project partners are also involved in the Partnership for Advanced Computing in Europe (PRACE), Network of the Centers of Excellence in HPC (FocusCoE net), European High-Performance Computing (EuroHPC), as well as other projects and networks. The PRACE portal has a training portal [6] and also a new upgraded version [7] of it.

FocusCoE is the network of the European HPC CoEs and CoE RAISE is one of the partners of this network. The network can be accessed from the website [8], which provides access to the training registry [9] of the network partners.

EuroHPC has created a portal [10] for different services including education and training. In this portal, several options appear under Training and Events. This portal is still under development and it is planned to provide a unified database for EuroHPC-related project courses. Information on courses on AI and HPC topics available in these projects and networks were uploaded to our Educational services platform.

Global companies such as Amazon, Google, IBM, and Microsoft are also organizing training events in AI, and information from these resources is included in RAISE's platform. As an example, Amazon Web Services have established the Machine Learning University [11].

Courses in AI are also offered by some of the most popular MOOC providers. For example, IBM has signed a collaboration contract with Coursera on organizing and hosting their learning program "IBM AI Enterprise Workflow Specialization" [12]. Udacity [13] offers AI program that includes 18 courses. They also offer eight different schools, for example, the School of Artificial Intelligence [14]. Udemy [15] is also offering AI as one of the topics while searching for available courses.

In the first year of the CoE RAISE project, the Educational service platform has gathered altogether 78 courses, including 31 courses offered by the project partners. Most of the courses are at the Intermediate level (47) and just two courses related to the Advanced level.

IV. CONCLUSIONS

With the support of the CoE RAISE project, the Educational service platform with a search function and educational resource portfolio in AI and related HPC applications collected for lifelong learning was created. The proposed classification system, used on Educational services platform, is a novelty that CoE RAISE project offers for open access and evaluation in practice. The platform as an IT product and the portfolio content will be the subject of continuous updates and developments as new education and training events are taking place and new educational resources are being developed.

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