H2020-INFRAEDI-2018-2020

Educational portfolio document

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Executive Summary

The “Research on AI- and Simulation-Based Engineering at Exascale” (RAISE) project, as a Center of Excellence in Artificial Intelligence (AI) at Exascale, aims to accelerate knowledge transfer to academia, industry, and among the partners. It will support communities with less developed expertise. Education and training are important components to achieve these aims and to foster the development of Europe’s competitiveness on the global market.

Task 6.1 *“Training and education as services”* of Work Package 6 *“Outreach and Services”* of RAISE develops an education and training platform. It furthermore collects a portfolio of courses and training material related to AI, High-Performance Computing (HPC), and domain-specific and interdisciplinary topics. The platform with the collected course portfolio will serve the existing and potential user communities to bridge the knowledge gap in application and development of relevant tools.

The first portfolio of educational and training resources was compiled a year ago in project month M12 and was described in D6.2 “Educational portfolio document”. This document presents the continuation of the process. The development process of the portfolio as well as the upgrade of the platform are presented. This is based on the review and analysis of the portal structure of EuroHPC, EuroCC Access, and the Partnership for Advanced Computing in Europe (PRACE). The course portfolio is complemented with education and training resources from professional and academic organizations. The educational portfolio will be updated regularly.

1 Introduction

The netwok of the European Center of Excellence in Exascale Computing “Research on AI- and Simulation-Based Engineering at Exascale” (CoE RAISE) continuously develops and provides best practices, support, and education for industry, Small- and Medium-Sized Enterprises (SMEs), academia, and High-Performance Computing (HPC) centers. This helps to attract new user communities and one of the essential elements in this is the work of Task 6.1 *“Training and education as a services”*, which is part of Work Package (WP) 6 *“Outreach and Services”* of CoE RAISE. The task started with the development of the Educational services platform[1] (provided in project month M6), see Deliverable D6.1, which is operational and has been moved from the cloud to the HPC servers of the Riga Technical University (RTU) recently. The users can find information on forthcoming training events and can search for courses already uploaded to the platform. Upgrade and extension of the Educational service platform is ongoing.

It is planned to report once a year (M12, M24, M36) on achievements describing changes of the education portfolio in accordance with the CoE RAISE developments and industrial/academic needs. The first Deliverable D6.2 created in M12 decribed a next step in the development of the Educational service platform by intensifying the collecting and updating of the course portfolio. This Deliverable D6.3, created in M24, describes the continuing process of upgrading the Educational service platform and the further development of the course portfolio.

At this stage, it was again recognized that the diversity of different educational resources is larger and the existing classification of the resources had to be upgraded and extended. Degree programs, separate courses, books, articles, and other AI, HPC, domain-specific and interdisciplinary educational resources from the professional and academic organizations were found and added to the portfolio. Based on the community requirements and the developments in the project, courses and training events organized by CoE RAISE partners will be advanced to be tailored for the communities’ special needs. Based on the user needs and to fill the knowledge gap, courses will be offered as a knowledge transfer to the scientific and industrial communities of the RAISE network. This also includes the development of special workshops for the communities. The courses, trainings, and workshops will be offered via webinars and e-learning courses, as well as on-site at the contributor’s location if conditions allow. It was recognized from the review of the portals, that the traditional synchronous in-person and online-teaching practice still prevails.

In the following, an overview of the Educational services system upgrades based on user experiences and analysis of other existing platforms is first presented in Sec. 2. This is followed by a presentation of the educational resource portfolio available from professional organizations such as the Institute of Electrical and Electronic Engineers (IEEE)[2], European Information Technologies Certification Institute (EITCI)[3], Massachusets Institute of Technology (MIT)[4], Harvard University[5], and other providers in Sec. 3. The document closes with some conclusions in Sec. 4.

[1] Educational service platform https://raise.learning.lv/courses
[2] IEEE https://www.ieee.org
[3] EITCI https://eitci.org
[4] MIT https://www.mit.edu
[5] Harvard University https://www.harvard.edu

2 Educational services system upgrade

The RAISE Educational services platform started operation in June 2021, and a number of updates were done on regular basis. In the previous Deliverable D6.2 (Educational portfolio document), updates to the course filtering criteria were described. The Educational services system has moved from the cloud to the RTU HPC server this year 2022, and some changes have been made to the functionality as well as to the visual design based on user experiences.

During the Mid-Term Project Review advice was received from the reviewers to look for opportunities to use other, more popular platforms for the RAISE education and training needs. An analysis of other existing portals was conducted during the development of the Educational service platform and the main results were presented in D6.1 (Educational service platform) in 2021. Now, some new portals (EuroHPC and EuroCC Access) are operational and it was decided to review the current situation.

Subsequently, a review of the portals with course offerings is presented Sec. 2.1, upgrades introduced in the Educational service platform are described in Sec. 2.2, and the course representation upgrade is presented in Sec. 2.3.

2.1 Review of the existing portals

The RAISE Educational service platform was created to present to potential users:

- forthcoming educational and training events (webinars, workshops etc.);
- long term existing learning resources such as e-learning, Massive Open Online Courses (MOOCs), podcasts etc.;
- collected portfolio of courses and training material from AI, HPC, and related topics not only from the project partners, but on a wider scope.

There are several education and training web portals that belong to organizations, enterprises, or projects offering courses. All these portals contain a portfolio of educational and training resources combined with a search option. Another typical component is a list of forthcoming training events. A review of existing solution was performed and presented in D6.1 (Educational service platform). From this review, a kind of “minimalistic” approach was taken to create the Educational service platform – just limited information on the featured course, but with a link to complete information and a limited number of search criteria to make this procedure easy for the user.

From the reviewers the advice to consider usability and visibility of the platform was provided:

> *“The deliverable provides a good overview on technological aspects of such a platform, its current form and usability. Still, the effort requires better justification in the next period, as there are already platforms available with potentially higher visibility. In addition, the effort of maintaining and marketing RAISE’s platform beyond the project lifetime and in competition with larger and more established ones is unclear.”*
>
> *“In the frame of WP6, the publication strategy of training offers should be revised. As there are already training portals in the HPC context (as e.g. from EuroCC within the eurocc-access.eu portal or from PRACE) their potential to serve RAISE should be explored. For the current placement on the RAISE website the number of offered training courses is small, the dates are unclear and the visibility is likely to be behind the one that could be reached by more established portals.”*

Based on this advice and the need for a regular update of the platform, a review of the few existing education and training portals mentioned is provided in the following. In more detail, Sec. 2.1.1 reviews the EuroHPC portal, Sec. 2.1.2 the portal of the Partner for Advanced Computing in Europe (PRACE)[6], and Sec. 2.1.3 the EuroCC Access portal. Finally, some conclusions on these portals are drawn in Sec. 2.1.4.

2.1.1 EuroHPC portal

The EuroHPC portal is one of the newest and therefore it is analzed first with respect to its functionality. A screenshot from the EuroHPC portal website[7] is presented in Figure 1.

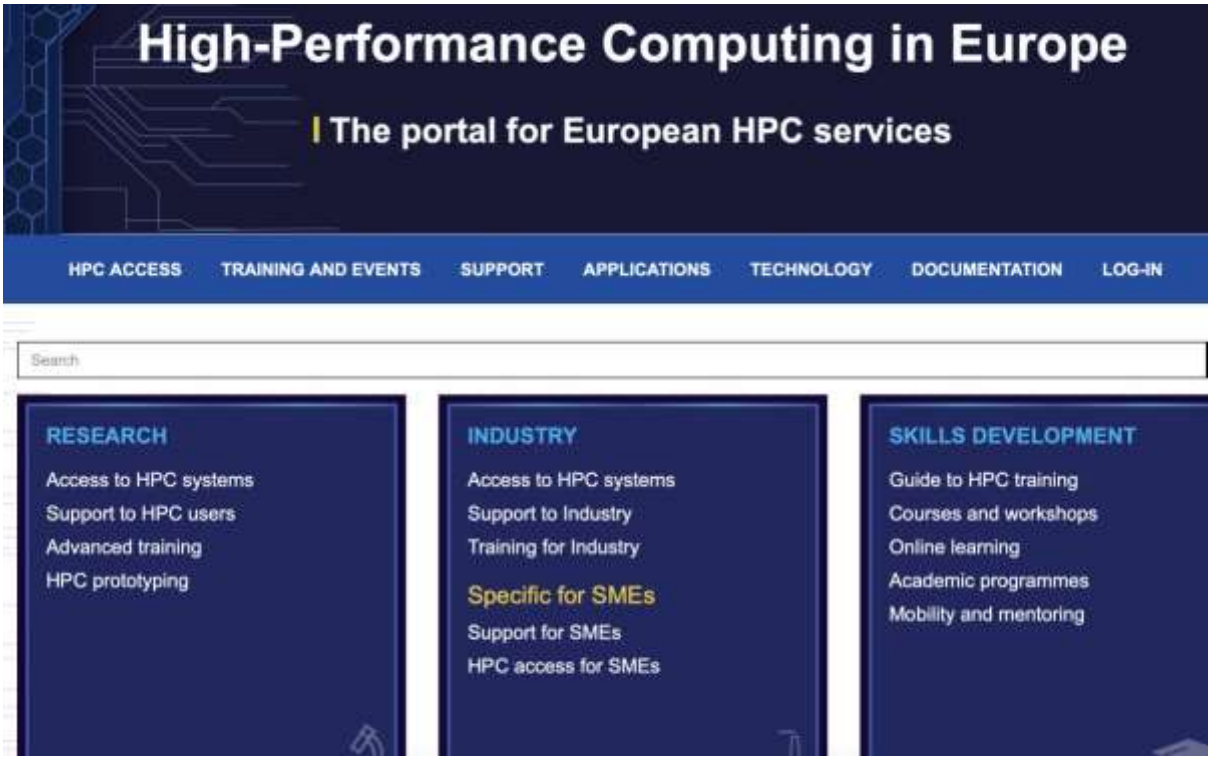

Figure 1: EuroHPC portal view.

The structure of the portal is quite complicated, and there are several choices to search for training resources:

- Training and Events,
- Advanced training (under Research),
- Training for Industry (under Industry),
- Guide to HPC training (under Skills development),
- Courses and workshops (under Skills development),
- Online learning (under Skills development),
- Academic programmes (under Skills development).

When choosing “Training and Events“ even more choices, as shown in Figure 2, appear.

[6] PRACE https://prace-ri.eu
[7] EuroHPC portal https://hpc-portal.eu

Figure 2: Training and Events from EuroHPC portal.

When opening the link to „All training events“, we a new list of choices is provided – “Short courses“, “University courses“, “Providers and organisers“. When selecting the link to “All short courses (calendar)“ from “Short courses“, search options to find the appropriate course become available, see Figure 3.

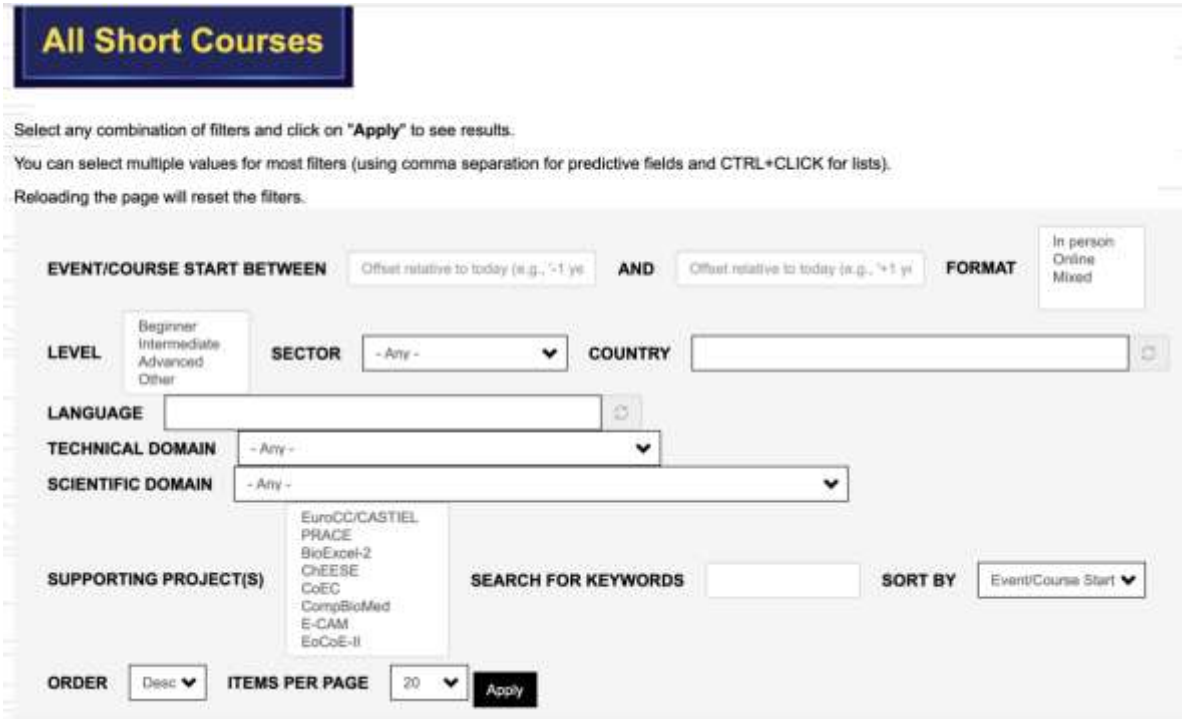

Figure 3: Search options for the short courses in the EuroHPC portal.

From this figure it becomes obvious that courses available in the portal are related to particular projects and countries. In contrast, CoE RAISE’s Educational service platform does not have such limitations. Under “Technical domain“ a search option „Artificial intelligence (AI), machine and deep learning“ can be found among other choices, such as Accelerators, Parallel computing, Quantum computing etc. In RAISE’s platform, these are devided as three separate options under “Topic” and there are more options related to AI, e.g., neural networks, robotics, computer vision, etc. In the section “Scientific domain” of the EuroHPC portal, it is possible to search for courses in the particular science fields, such as engineering, mathematics, etc. The RAISE platform offers those under the name “Field”.

2.1.2 PRACE portal

One of the popular projects offering a wide range of training events and resources is PRACE. Education and training resources are available from the PRACE training portal[8]. The portal consists of several sections, cf. Figure 4:

- Upcoming training events;
- Materials;
- PRACE Tutorials;
- PRACE Code Vault;
- PRACE MOOCs.

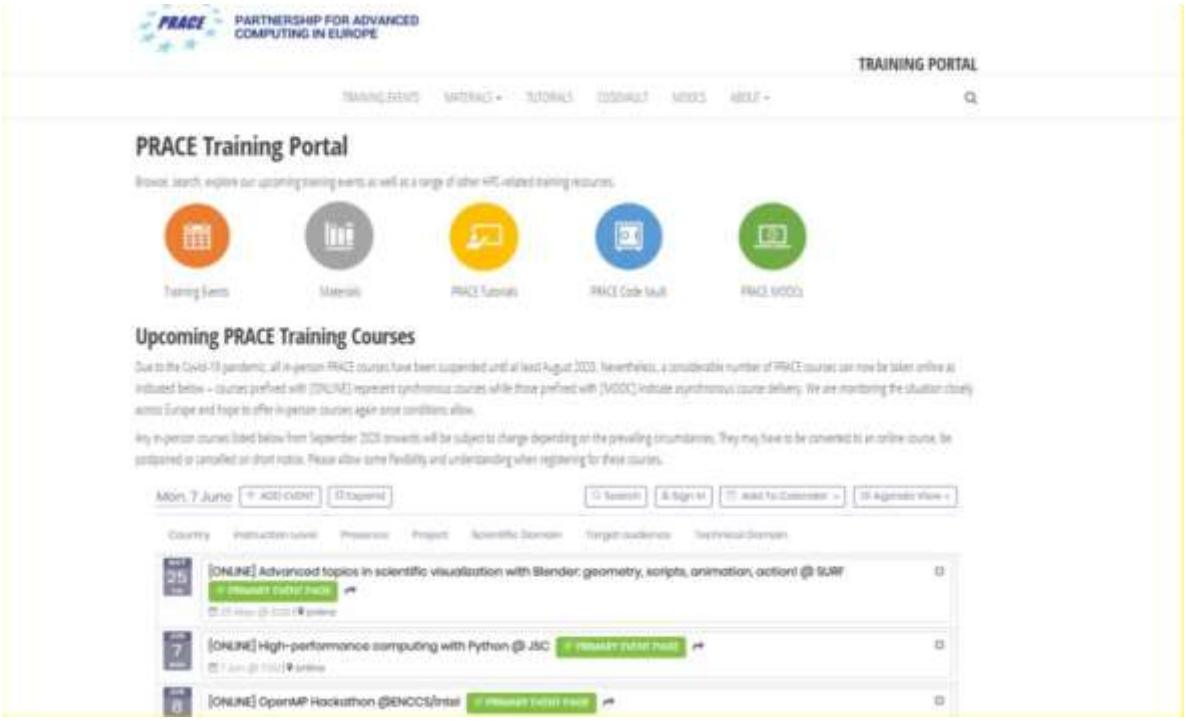

Figure 4: PRACE project training portal.

Upcoming training events (courses) are listed indicating the date and start time, as well as the format, for example “[Online]”. A link to full a description of the event is also provided. Materials, Tutorials, Code Vault and MOOCs can be interpreted as collections of training resources in various formats.

There is also an upgraded PRACE training portal[9] providing links to 14 PRACE training centers, a Summer School, and some additional features. However, the presentation format of the upcoming training events and training resources repositories is quite similar to the old PRACE portal.

The structure and functionality of the portal has already been analyzed in Deliverable D6.1. Unfortunately, registration for most of the training events is only possible for participants from PRACE member states.

[8] PRACE training portal https://training.prace-ri.eu/
[9] Upgraded PRACE training portal https://prace-ri.eu/training-support/training/

2.1.3 EuroCC Access portal

The EuroCC Access portal[10] collects information from 33 countries participating in the EuroCC project. Information about training events can be found under “Services”, which include upcoming training offers by the National Competence Centres (NCCs). Search options contain the Difficulty Level (Beginner, Intermediate, Advanced, Other), the Language, Country/NCC, the Audience (Research and Academia, Industry, Public Sector, Other (general public …)), and the Format (In Person, Mixed, Online). To see all training offers, including past courses, it is advised to go to the EuroHPC portal. A screenshot of the portal is shown in Figure 5.

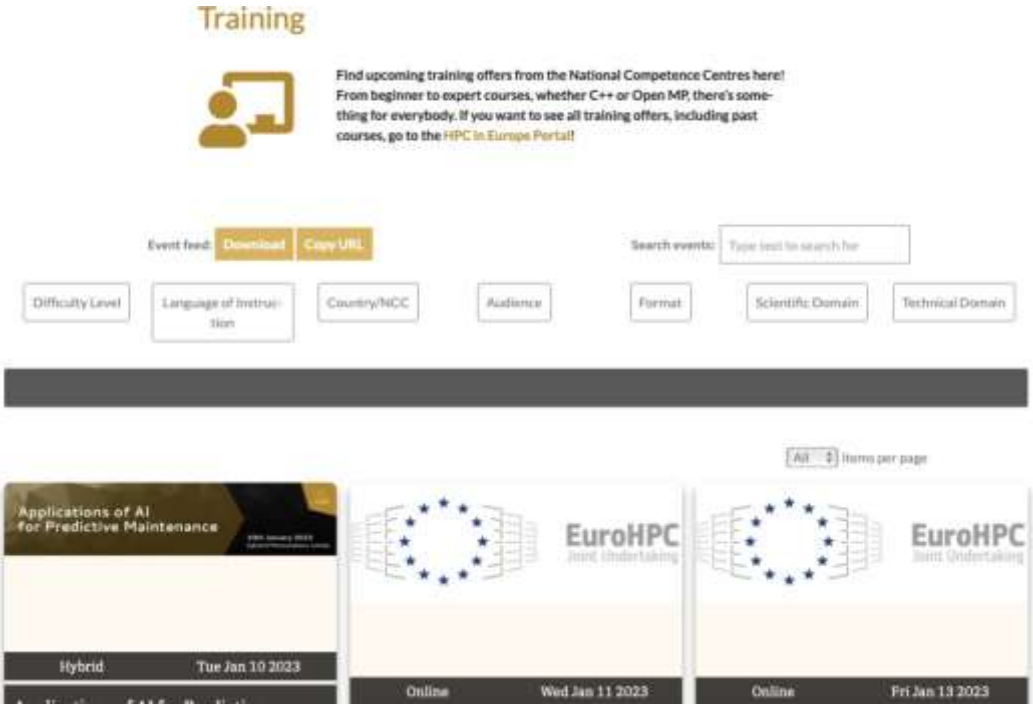

Figure 5: EuroCC training platform.

2.1.4 Conclusion on the analysis of the portals

After reviewing these three advised popular portals, it can be conclude that searching for a special course format in the EuroCC Access and Euro HPC portals is quite limited – In person, Online and Mixed. The meaning of the term “Online” is not explained, but it looks like representing **synchronous online teaching**, because in the course description is given an event timing (start – end) and also location on a map. This means that this portal does not contain **asynchronous online learning** resources such as e-learning courses, MOOCs, Open Education Resources (OER), and other self-learning materials. RAISE’s Educational service platform offers such courses in these formats.

The PRACE portal also contains MOOCs and other kind of training resources. One more feature is that PRACE training events are in most cases open just for persons from partner countries.

The portals reviewed contain a wide spectrum of courses from the project partners, mainly related to HPC applications, with AI being just one of the topics under “Technical domain”. In

[10] EuroCC Access portal https://www.eurocc-access.eu

contrast, RAISE's Educational service platform focuses on AI courses from all over the world and in all possible formats.

2.2 Upgrade of the Educational service platform

During the implementation of the project, it was realized that IT technology is an essential part of the whole Educational service platform (or just platform in the following). Without following the state-of-the-art in the Information Technology (IT) industry, the platform, as it was built a year ago, would quickly fall apart.

Like many other Content Delivery Networks (CDN) and platforms built on CDNs, the project faces the age-old need for IT updates to drive success in helping to maximize the value of the data on the platform.

In the following, reasons to upgrade the system and the results obtained are provided. In more detail, Sec. 2.2.1 reports on reasons for upgrading the platform, Sec. 2.2.2 on the technologies involved in the upgrade process, Sec. 2.2.3 on the achieved results for the given moment.

2.2.1 Reasons for upgrading the platform

Initially, the Educational service platform was developed and deployed on the Amazon Web Services (AWS)[11] cloud resources utilizing all the benefits that cloud-based infrastructure can offer. However, over time, the team concluded that partial or complete migration to local services would give some specific value to the project rather than just following the industry trends and moving everything from lambda functions to the whole Infrastructure as a Service (IaaS) on third-party cloud services.

The main goal for the platform upgrade was to partly or entirely migrate to an IT product independent of global cloud service providers such as AWS, IBM, or Google. In addition, an additional benefit could be to offer the Educational service platform code to project IT teams for further improvement and long-term deployment in partners' local IT infrastructures.

Also, the reasons for the migration stem from the negative experience with the AWS DynamoDB service[12]. Although the DynamoDB database service is excellent for mockups and small-scale setups, it was estimated that unexpected expense-related problems could be faced in the long term. For example, one of the pitfalls would be unexpected gaining costs at possible service scaling. Another possibility is principal migration difficulties (which were faced during experiments) moving to other database schemes preferred for further platform development.

2.2.2 Upgrade process technologies

Before the platform upgrade, a vision was crafted to identify goals to achieve and to clear a path to get to the new level. More specifically, the developers had the vision to use a modern, microservices-based Java framework for the platform's backend. The Quarkus framework[13] was the first choice since the only acceptable option being relevant for the user-side application is the web browser. VAADIN[14] was walso considered for the front-end development.

[11] AWS https://aws.amazon.com
[12] AWS DynamoDB https://aws.amazon.com/de/dynamodb/
[13] Quarkus framework https://quarkus.io
[14] VAADIN https://vaadin.com

The last architectural element of the platform is the database. Here, PostgreSQL[15] (Postgres DB in Figure 6) was chosen; another option can be one of the NoSQL flavors, eg., MongoDB[16].

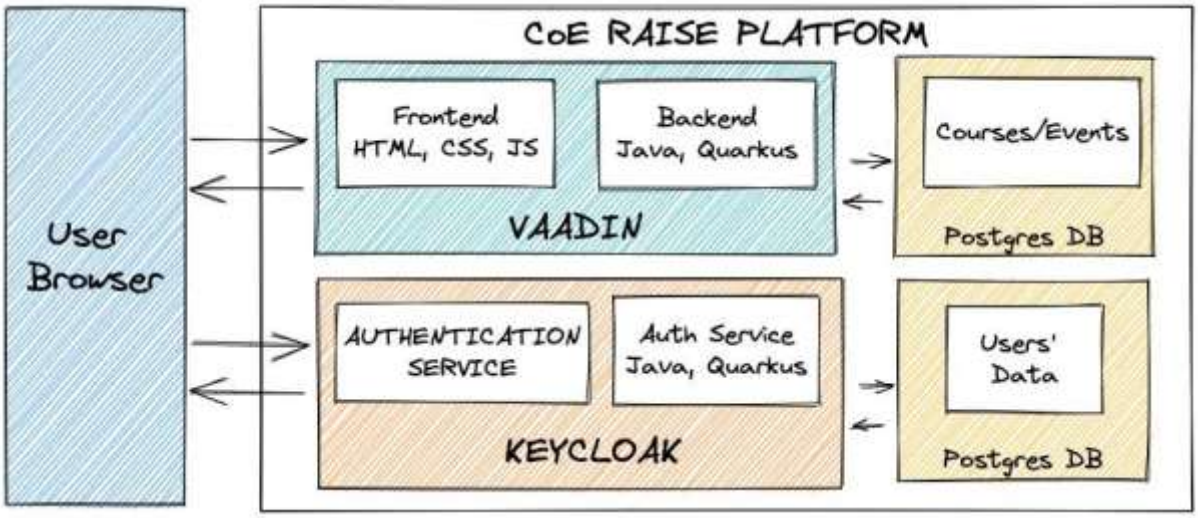

Figure 6: Towards updated Educational service platform architecture.

2.2.3 Upgrade results

Users' authentication. By migrating from on-the-cloud authentication (AWS Cognito) to a self-served platform, the open-source solution Keycloak[17] was included. This growing product opens a broad perspective for authentication integration in any modern but self-hosted infrastructure.

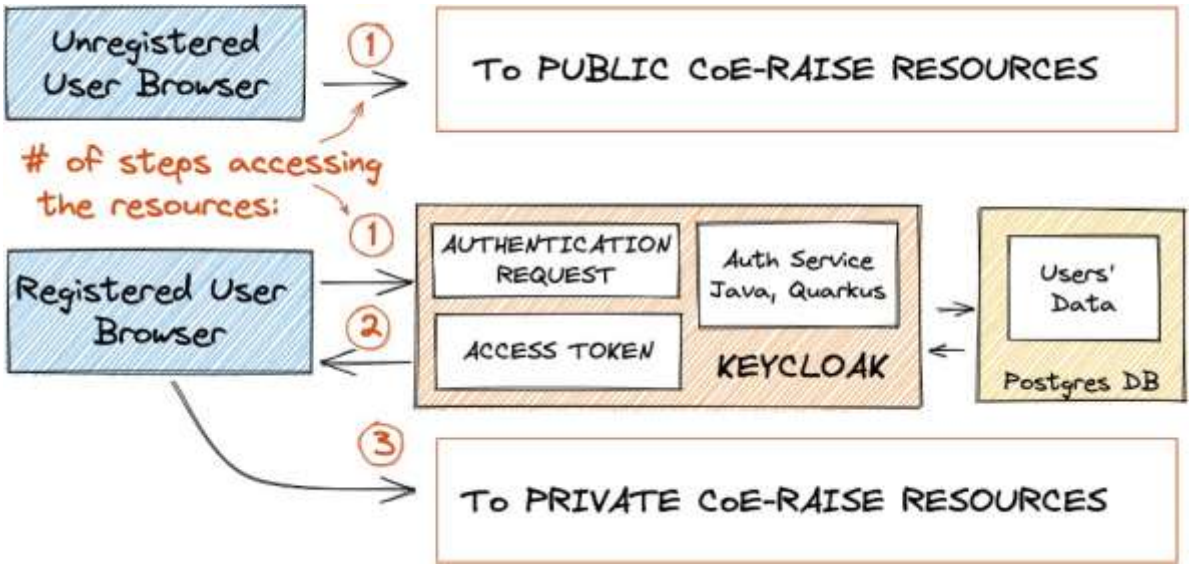

Figure 7: The Educational service platform authentication architecture.

Figure 7 demonstrates two distinct user categories - unregistered and registered users. Public resources are easily accessible in one step. In contrast, private resources are those that are under construction, outdated, or just hidden and are therefore not visible to the public. The database with platform users is stored on the platform's resource computer using the Keycloak

[15] PostgreSQL https://www.postgresql.org
[16] MongoDB https://www.mongodb.com
[17] Keycloak https://www.keycloak.org

service and the Postgres DB. Surprisingly, the latest Keycloak versions have migrated from the old Java 8 backend to the modern Quarkus framework.

On the Educational service platform, as in the initial version, there is still some hierarchy allowing control access to the platform resources. Currently, the platform authentication is almost completely moved to the local service; the email service is transferred from the AWS to the Google service, which is still free for the current platform utilization level.

Email sending/receiving. On the platform exist two-way communication services, see Figure 8. To send messages to registered users or to enable communication with potential users keen to register themselves on the platform, the Gmail Application Programming Interface (API)[18] is utlized. To receive email messages, a Gmail account is used. These services are evaluaed as affordable for everyday use.

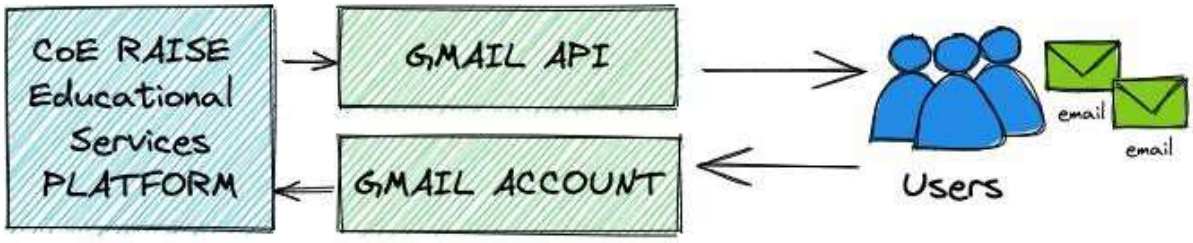

Figure 8: Google Mailing services implementation into the platform.

Platform Analytics. Initially, platform users accessing the web elements invoke events that produce data stored in local log files, which is quite a regular practice. After a while, the development team decided to store event data in a database towards more advanced auditing scenarios.

Finally, RAISE subscribed to the Google Analytics service[19], which is a common practice for web service providers nowadays. Figure 9 shows the integration of this service in the platform. The service allows to access various forms of access data - log files, local DB records, and records on the Google Analytics platform. And yet, the set of observable objects and optimal documents granularity is still subject to debate and can vary depending on the team's needs at any given time.

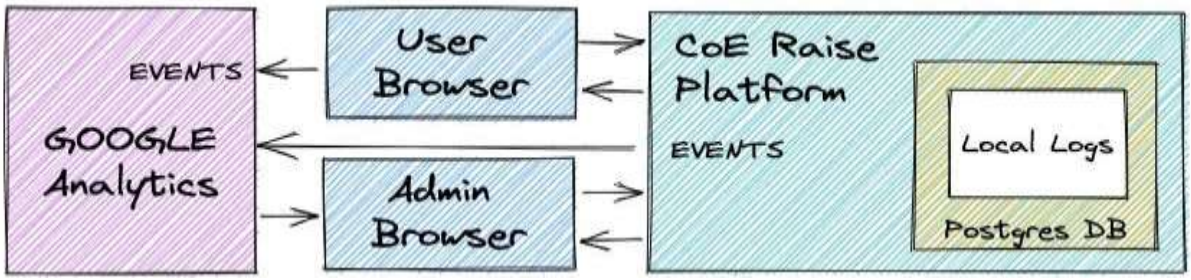

Figure 9: Google Analytics integration into the platform.

Conclusion. Overall, the partial migration of the Educational service platform provided great insight into cost models, technology analysis ,and service optimization based on hands-on experience. Simply put, cloud-based mature services like the Gmail API are handy for quick and reliable service scaffolding. Custom system functionality with database schema design

[18] Gmail API https://developers.google.com/gmail/api/guides
[19] Google Analytics https://analytics.google.com/analytics

and complex integration should always be treated as a multi-dimensional optimization problem. There is no one magic pill – the best ammunition and armor should be leveraged: skills and experience.

2.3 Upgrade of the course representation

The course criteria have been upgraded due to the growing diversity of education and training resources.

The previous upgrade added Degree programmes, ExpertTracks, Micro-Credentials, and Guided projects. Now reviewing available resources it was found that there is an offer of the Short Courses (~ one hour) which does not fit to other categories. Therefore, Short Courses were added to Online and e-learning formats, and Video and Articles were added to the Self-learning category. The changes are presented in Table 1 of Annex A1.

3 Courses, degree programs, and training resources from professional and academic organizations

Educational resources were collected from CoE RAISE's project partners, IT companies, and OER providers described in the previous Deliverable. The search for training courses and other resources from professional and academic organizations is ongoing and this section reports on the major findings. More speficially, Sec. 3.1 presents activites of IEEE and Sec. 3.2 of the ITCI Instiute. This is followed by activites of the MIT and the Harvard University in Sec. 3.3 and Sec. 3.4. Finally, other activities are reported in Sec. 3.5.

3.1 The Institute of Electrical and Electronics Engineers

IEEE is a global organization with members in all regions and is the world's largest technical professional organization with the mission to foster technological innovation and excellence for the benefit of humanity.

The IEEE Strategic Plan (2020 – 2025) among other goals are:

- Drive global innovation through broad collaboration and the sharing of knowledge;
- Be a trusted source of educational services and resources to support life-long learning.

There is the IEEE Learning Network[20] providing a catalog of educational resources[21] for IEEE members as well as for the general public.

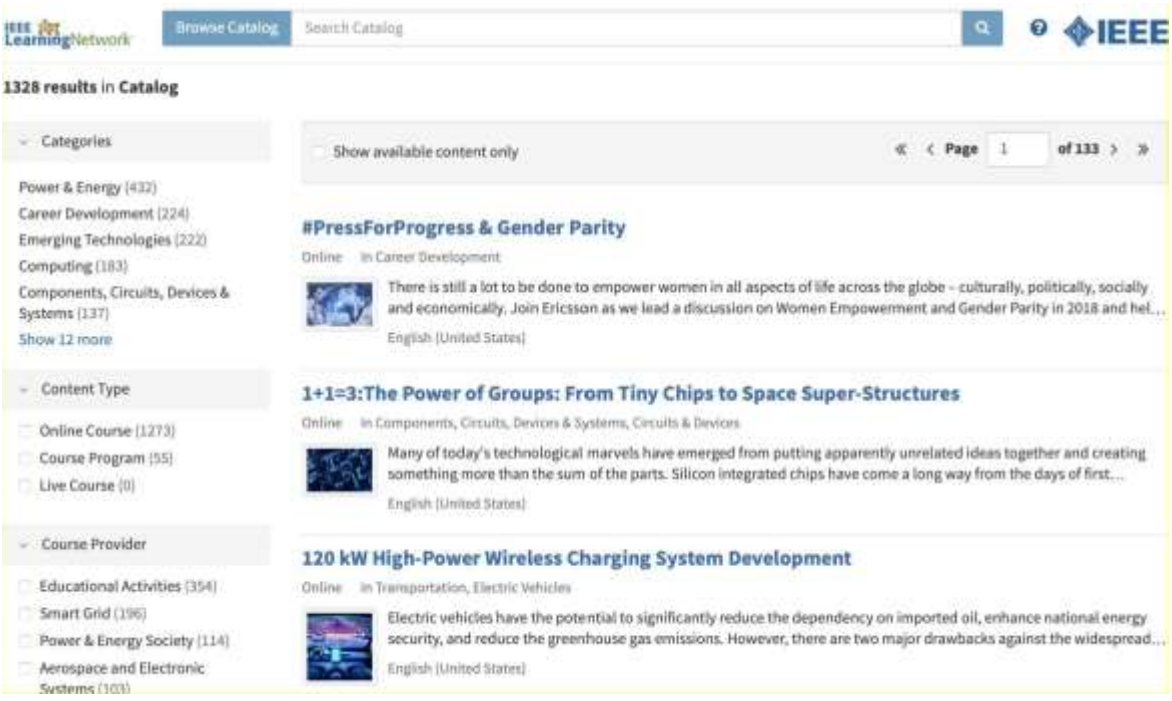

Figure 10: IEEE Learnig Network catalog.

[20] IEEE Learning Network https://www.ieee.org/education/iln.html
[21] IEEE Learning Network catalog
https://iln.ieee.org/public/searchresults?q=&at=T&ty=ML.BASE.DV.SearchAnyWords&ln=

There are 17 different categories ("Fields" in CoE RAISE's platform) such as computing, aerospace, robotics, etc., and 37 kinds of course providers. There are now 1,328 resourses and after searching, it is found that 105 of them are related to AI. Figure 10 shows a screenshot of the catalog.

There are different communities in IEEE related to specific science and technology fields. IEEE engineering resources are published through topic-specific Resource Centers[22] and hosted by specific IEEE societies and technical communities. IEEE members get discounts on many resources, and IEEE society members receive almost all resources from their Resource Center for free.

3.2 The European Information Technologies Certification Institute

One of professional organizations offering courses in AI is EITCI Institute, which is an international non-profit organization providing certification and accreditation. In collaboration with academic and industrial experts, they organize high-quality IT training and education that conclude with the issuance of a certificate. EITC provides skills certification with international recognition, secure digital validation and permanent validity — no recertification required. The entire training and certification process is carried out by the European IT Certification Academy (EITCA)[23].

EITCA provides online open-access to all materials, and the courses are based on the asynchronous distance learning methodology. There are no specifically organized classes and everybody studys to prepare for the exam when they can. A typical course is designed for approximately 15 hours of individual study and could can be completed in two days or in a month, depending on the learner. Online consultations are also available. Courses end with an exam that tests theoretical knowledge and practical skills acquired. The exam can be repeated and upon successful completion the certificate is issued.

The course enrolment fee is 110 EUR for 15 hours of an online learning curriculum. Enrolment provides lifetime and full access to all of the e-platforms covering all services: Access to course materials, online consultations with experts, learning and exam (fully online), individual schedule with no time limit, and unlimited exam retakes.

EITCA also offers a certification program specialized in AI, i.e., the "EITCA/AI Artificial Intelligence Academy[24]" consists of 12 relevant European IT certification courses. This 180-hour curriculum is well suited for both beginners and experts. Thw following list provides an overview of the AI-realted courses:

1. EITC/AI/GCML: Google Cloud Machine Learning
2. EITC/AI/GVAPI: Google Vision API
3. EITC/AI/TFF: TensorFlow Fundamentals
4. EITC/AI/MLP: Machine Learning with Python
5. EITC/AI/DLTF: Deep Learning with TensorFlow
6. EITC/AI/DLPTFK: Deep Learning with Python, TensorFlow and Keras
7. EITC/AI/DLPP: Deep Learning with Python and PyTorch

[22] IEEE Resource Centres https://www.ieee.org/communities/ieee-resource-centers/find-your-ieee-resource-center.html
[23] European IT Certification Academy https://eitca.org
[24] EITCA/AI Artificial Intelligence Academy programme https://eitca.org/certification/eitca-ai-artificial-intelligence-academy/

8. EITC/AI/TFQML: TensorFlow Quantum Machine Learning
9. EITC/AI/ADL: Advanced Deep Learning
10. EITC/AI/ARL: Advanced Reinforced Learning
11. EITC/CP/PPF: Python Programming Fundamentals
12. EITC/CL/GCP: Google Cloud Platform

3.3 Massachusetts Institute of Technology

The Massachusetts Institute of Technology offers the website Open Course Ware[25], where it is possible to search for courses, materials, and teaching resources. Any keyword phrase can be entered into the search window. In general, two separate filters are used for courses and resources.

Resources can be searched by only two categories – 17 Resource Types, and 22 Topics. Courses can be searched by four different categories. First of all, courses can be found by 16 Departments, and all courses provided by each of them are provided. In addition to this, the Levels are divided into undergraduate and graduate categories. The next filter is Topics, which categorizes by the number of items containing the topic. Overall, there are 102 Topics, Engineering having 55 courses, and Urban Studies only containing one course. Another feature that has not been found anywhere else, is Features, indicating several types of videos, audios, notes, and many more. Out of 39 Features, the most common one is Lecture notes with 663 records.

Although AI isn't one of topics to choose from, it appears in 862 course topics and in 2,644 resources. For each item found, the Level, name of the course, names of the teachers, as well as topics included according to the filters are provided. When opening a specific course (see Figure 11), the course description, course information with instructors, departments, and topics as well as learning resource types are visible in the center of the screen. On the left side, syllabus, calendar, readings, lecture notes, exams, projects, study materials, and related resources are available. On the right side, an example of lecture notes is seen as well as a button Download Course.

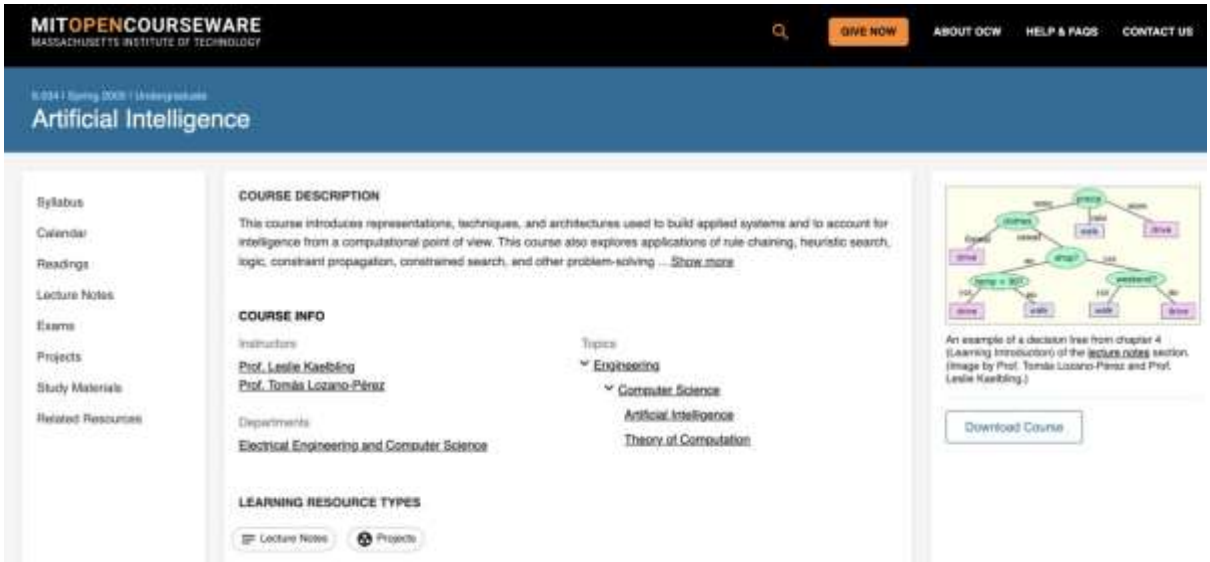

Figure 11: MIT course "Artificial Intelligence".

[25] MIT Open Course Ware https://ocw.mit.edu/

3.4 Harvard University

Digital Access to Scholarship at Harvard (DASH)[26] is a central, open-access repository of research by members of the Harvard community, according to its website. It is possible to browse by communities and collections, issue date, author, title, keyword, or department. When entering the keyword AI, 1,652 instances are found, and displayed at the center of the screen. On the right side of the screen, items can be further filtered by author, keyword, department, or date issued.

Opening a specific item from the search results displays information about the title, pdf, author, metadata, collections, citation, abstract, terms of use, and citable link to the page, see Figure 12. A large number of items are available. However, it is not possible to find courses and course materials, but mostly theses or dissertations. Since the number of pages per search are not displayed, it is not easy to navigate between the pages.

Figure 12: Course search in the Harvard University Library.

3.5 Other websites with course offers

There are several further websites offering trainings, having, however, certain limitations. One of such websites is UpGrad[27], which states to offer courses, for example, five courses in Machine Learning (ML) and AI. However, after selecting the filter, five featured programs from five different universities appear and no courses. When choosing an item from the selection, only a brochure or a brief overview is provided. In case a student is interested in one of the courses and wants to apply, an e-mail should be written.

Another website offering courses is DataCamp[28], which uses filters by readiness to learn courses, tracks, or technologies. For courses, three levels (beginner, intermediate, advanced)

[26] DASH https://dash.harvard.edu
[27] UpGrad https://www.upgrad.com
[28] Data Camp https://www.datacamp.com

and 10 topics are used. For tracks, skill and career tracks can be chosen from and for technologies, seven different criteria. Amongst many criteria, this website offers certification and resources. Resources can be filtered according to 10 topics, 10 industry spheres, six roles, nine resource types, and seven technology selections. Overall, it offers 158 webinars, 22 podcasts, 20 white papers, 20 cheatsheets, 16 case studies, 7 data sheets, one e-book, and one tool. Figure 13 shows the DataCamp website.

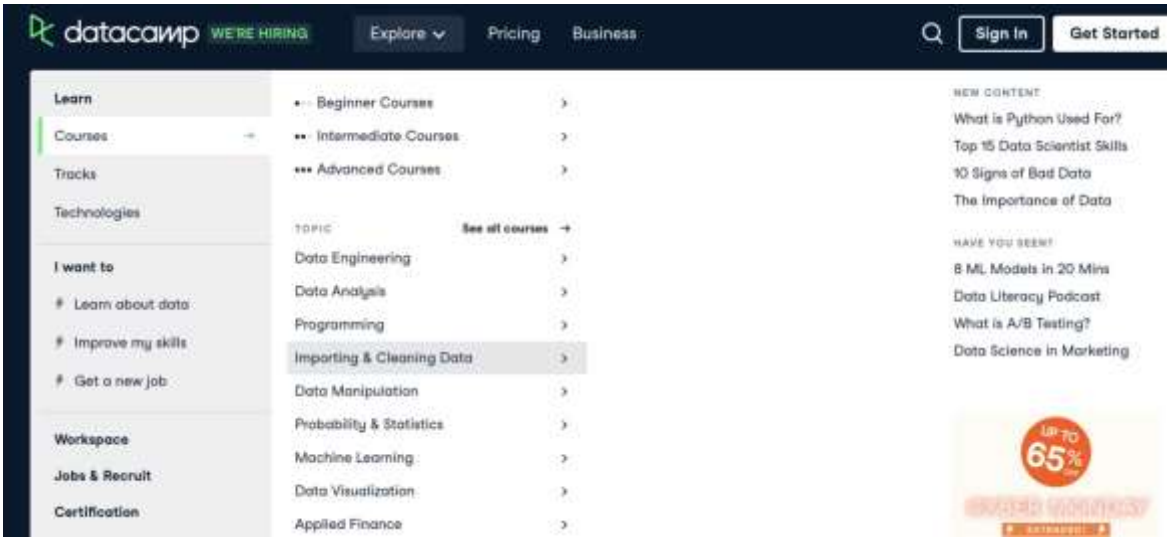

Figure 13: DataCamp website with course filter.

Free access is limited to every first chapter being free of charge as well as six free courses. Other types of access are chargeable.

This section presented several websites from professional organizations, universities, and other providers offering educational and training resources in AI related topics. The search for more resources will be continued.

4 Conclusions

There are a lot of platforms dedicated to training and education events. A review of the popular EuroHPC, PRACE, and EuroCC Access portals shows that they contain a wide spectrum of mainly HPC-application-related courses from the project partners, with AI being only one of the topics. The CoE RAISE Educational service platform is offering courses in the wider scope with the focus on AI topics, not only from the RAISE partners, but also from resources all over the world and in all possible formats.

The extension of the course portfolio and the upgrade of the Educational service platform will be continued. In Deliverable D6.2 (Educational portfolio document) pulished a year ago there were 78 AI related educational and training resourses on the platform. Since then, the number of resourses in the platform increased to 152. Further courses created during the CoE RAISE project will be added to the Educational portfolio as soon as they are ready.

The Educational service platform has been moved from the cloud to RTU's HPC servers and its functionality upgraded, i.e., new functions were added and new course filter criteria were added. The upgrade and extension of the Educational service platform is ongoing.

Annex A

A.1 Upgraded course filter criteria

Certain criteria have been developed to search for courses on the Educational services platform. These criteria were described in Sec. 2.2 of Deliverable D6.1. The first upgrade took place a year ago and was described in the Deliverable D6.2. Here, some new upgraded criteria (in red) are presented in Table 1. The upgrade of the criteria was necessary to better categorize the courses in the appropriate group when information is uploaded.

	First level choice	Second level choice	Comment
Topic:	• Artificial Intelligence – general • Machine Learning • Deep Learning • Reinforcement Learning • Neural Networks • Robotics • Computer Vision • Natural Language Processing • Recommender Systems • Algorithmic Game Theory • Computational Mechanism Design • Other	-	-
Level:	• Potential users • Beginners • Intermediate • Advanced	-	For the potential users, there could be organized attractive lectures and introductory courses with no demand of any previous knowledge in the field. For higher levels, some prerequisites are demanded.
Field:	• Fundamental Science • Engineering and Mathematics	-	-

	• IT and Computer science • Industry applications • Nature and Environment • Healthcare and Medicine • Education • Business and Management • Other		
Format:	Face-to-Face	• Lecture • Lecture with hands-on (practice) • Workshop/Tutorial • Hands-on/Guided project • Project/Teamwork/Hackathon • Summer School • Micro-credential/Expert Track • Degree programme	Traditional training format
	Online teaching/training	• Lecture • Lecture with hands-on (practice) • Workshop/Tutorial • Hands-on/Guided project • Short course • Micro-credential/Expert Track • Degree programme	Remote synchronous online lectures and training events using appropriate technologies
	Distance learning	• e-learning course • MOOC • Guided project • Short course • Micro-credential/Expert Track • Degree programme	Traditional distance education technology and methodology with mainly asynchronous learning with tutor support
	Self-learning	• Video recording of training event • Tutorials • Podcast • Video • Course material • Article • Book • Open Educational Resource	Self-learning without tutor support
Language:	• English • German • Spanish • Dutch • French	-	-

	• Icelandic • Italian • Latvian		

Table 1: Course filter criteria.

A.2 List of courses

The list of courses and other educational and training resources collected within the project at M12 is presented in in the following Table 2 to Table 8. Detailed information on each resource can be found at the Educational service platform[29].

POTENTIAL USERS

PUBLISHED ONLY RESOURCES

Page 1/1

	FORMAT	RESOURCE TITLE
1	Online teaching/training	A.I. as a Tool for Change
2	Distance learning	AI For Everyone
3	Distance learning	AI Foundations for Everyone Specialization
4	Self-learning	ARTIFICIAL INTELLIGENCE: RESEARCH, TECHNOLOGY AND BUSINESS IN OER
5	Online teaching/training	Business Implications of AI
6	Online teaching/training	Data Analysis and Plotting in Python with Pandas
7	Distance learning	Elements of AI
8	Distance learning	Ethics of AI
9	Online teaching/training	IEVADS AUGSTAS VEIKTSPĒJAS SKAITĻOŠANAS TEHNOLOĢIJĀ CUDA
10	Online teaching/training	Interactive High-Performance Computing with Jupyter
11	Face-to-Face	Introduction to High Performance Computing Technology CUDA
12	Self-learning	Life 3.0: Being Human in the Age of Artificial Intelligence
13	Online teaching/training	ON-DEMAND WEBINAR: Bootcamp Warm-Up: AI Literacy
14	Online teaching/training	Sense & Sensibility of AI
15	Self-learning	The Future of AI, Security, and the Edge
16	Distance learning	Understanding Machine Learning
17	Self-learning	What Is the Algorithmic Game Theory? Explained With Examples
18	Self-learning	What is Artificial Intelligence?

In total (for POTENTIAL USERS) on the platform, 18 / 157 resources published

Table 2: Course filter criteria 1/7.

[29] Educational service platform https://raise.learning.lv/courses

BEGINNERS

PUBLISHED ONLY RESOURCES

Page 1/2

	FORMAT	RESOURCE TITLE
1	Self-learning	Interactive HPC with JupyterLab
2	Online teaching/training	Interactive HPC with JupyterLab
3	Face-to-Face	A.I. DEVELOPER - DATA OPERATOR
4	Face-to-Face	ACM Europe Summer School on HPC Computer Architectures for AI and Dedicated Applications
5	Face-to-Face	AI Academy
6	Online teaching/training	AI Training
7	Online teaching/training	AI and Segmentation in Radiotherapy
8	Distance learning	AI for Materials Industry
9	Distance learning	AI&Predictive Analytics in Data Center Environments
10	Online teaching/training	AUGSTAS VEIKTSPĒJAS SKAITĻOŠANAS TEHNOLOĢIJAS CUDA LIETIŠĶAIS LIETOJUMS
11	Self-learning	Accelerating Machine Learning with GraphCore
12	Online teaching/training	Accelerating Machine Learning with GraphCore
13	Distance learning	Artificial Intelligence (AI) for Earth Monitoring
14	Distance learning	Artificial Intelligence in Bioinformatics
15	Online teaching/training	BSC GPU Hackathon - HPC+AI
16	Online teaching/training	BSC-NVIDIA GPU Hackathon for HPC and AI
17	Online teaching/training	Bioinformatics and AI
18	Face-to-Face	Cybersecurity Solutions in High Performance Computing Environment
19	Self-learning	EUROCC TRAINING EVENT (IT2021): DAY 1

Table 3: Course filter criteria 2/7.

BEGINNERS

PUBLISHED ONLY RESOURCES

Page 2/2

	FORMAT	RESOURCE TITLE
20	Self-learning	EUROCC TRAINING EVENT (IT2021): DAY 2
21	Face-to-Face	HDCRS Summer School: Summer School on High-Performance and Disruptive Computing in Remote Sensir
22	Self-learning	HDCRS Summer School: Summer School on High-Performance and Disruptive Computing in Remote Sensir
23	Self-learning	HPC Beginner Training Event
24	Online teaching/training	HPC Systems Engineering in the Interaction Room
25	Self-learning	HPC Systems Engineering in the Interaction Room
26	Face-to-Face	High Performance Computing Technology CUDA
27	Face-to-Face	Introduction to HPC Applications, Systems, Programming Models and Machine Learning and Data Analytics
28	Face-to-Face	Introduction to genetic algorithms
29	Distance learning	Learn To Create AI Assistant (JARVIS) With Python
30	Self-learning	MLOps with ClearML
31	Online teaching/training	MLOps with ClearML
32	Distance learning	Machine Learning
33	Distance learning	Machine Learning in Weather & Climate
34	Online teaching/training	Massively Parallel GPU Computing with CUDA: Introduction
35	Online teaching/training	Nature Reviews Physics – AI for science and government (ASG) series
36	Distance learning	Professional Certificate in AI and Cloud Computing: Implementation Strategies for Business
37	Distance learning	Professional Certificate in Data Engineering Fundamentals
38	Distance learning	Professional Certificate in Essential Technologies for Business
39	Distance learning	Professional Certificate in Fundamentos de Inteligencia Artificial
40	Distance learning	Professional Certificate in Introduction to Python Programming
41	Self-learning	Quantum Support Vector Machine Algorithms
42	Online teaching/training	Quantum Support Vector Machine Algorithms
43	Distance learning	TensorFlow Fundamentals
44	Online teaching/training	Tutorial at Information Technology Conference: Parallel & Scalable Machine & Deep Learning with Applicatic

In total (for BEGINNERS) on the platform, 44 / 157 resources published

Table 4: Course filter criteria 3/7.

INTERMEDIATE USERS

PUBLISHED ONLY RESOURCES

Page 1/4

	FORMAT	RESOURCE TITLE
1	Online teaching/training	ACM Europe Summer School on HPC Computer Architectures for AI and Dedicated Applications
2	Distance learning	AI for healthcare
3	Self-learning	AI in Business
4	Self-learning	Accelerating Machine Learning with CUDA
5	Online teaching/training	Accelerating Machine Learning with CUDA
6	Face-to-Face	Advanced Multiscale CFD and Turbulence Modelling targeting HPC
7	Face-to-Face	Artificial neural systems in information processing
8	Face-to-Face	Artificial neuron and neural networks
9	Face-to-Face	Basics of data processing and data mining
10	Self-learning	Brief Introduction to Autoencoders
11	Online teaching/training	Brief Introduction to Autoencoders
12	Distance learning	Building Recommender Systems with Machine Learning and AI
13	Face-to-Face	Business Optimizer Bootcamp (OptaPlanner)
14	Distance learning	Concepts of Machine Learning
15	Self-learning	Data Skeptic - Podcasts
16	Self-learning	Data Stories
17	Face-to-Face	Data mining and knowledge discovery
18	Distance learning	Deep Learning Specialization
19	Online teaching/training	Directive-based GPU programming with OpenACC
20	Self-learning	Distributed Deep Learning

Table 5: Course filter criteria 4/7.

INTERMEDIATE USERS

PUBLISHED ONLY RESOURCES

Page 2/4

	FORMAT	RESOURCE TITLE
21	Online teaching/training	Distributed Deep Learning
22	Online teaching/training	Energy reduction for AI workloads
23	Self-learning	Energy reduction for AI workloads
24	Face-to-Face	Evolutionary and genetic algorithms
25	Online teaching/training	Git based CI/CD for ML
26	Online teaching/training	High-performance computing with Python
27	Online teaching/training	Hybrid BSC RS: European Strategies and Regulations on AI
28	Self-learning	Hyperparameter Tuning with Ray Tune
29	Online teaching/training	Hyperparameter Tuning with Ray Tune
30	Face-to-Face	Intelligent computer technologies
31	Face-to-Face	Intelligent computer technologies and systems
32	Online teaching/training	Introduction to Scalable Deep Learning
33	Face-to-Face	Introduction to artificial neural networks
34	Online teaching/training	Introduction to machine learning in the application area of fluid mechanics and combustion using HPC
35	Self-learning	Lex Fridman Podcast
36	Self-learning	Linear Digressions
37	Self-learning	Machine Learning Guide
38	Distance learning	Machine Learning Specialization
39	Self-learning	Machine Learning on AWS
40	Self-learning	Machine Learning: a Probabilistic Perspective
41	Distance learning	Master in Artificial Intelligence
42	Distance learning	Master's Degree in Electrical and Computer Engineering
43	Distance learning	Master's Degree in Mechanical Engineering
44	Distance learning	MicroMasters Program in Quantum Technology: Computing
45	Self-learning	Modelling/Simulations of Molecular Systems

Table 6: Course filter criteria 5/7.

INTERMEDIATE USERS

PUBLISHED ONLY RESOURCES

Page 3/4

	FORMAT	RESOURCE TITLE
46	Self-learning	Nature Reviews Physics: Machine learning in astrophysics and cosmology
47	Online teaching/training	Nature Reviews Physics: Machine learning in astrophysics and cosmology
48	Online teaching/training	Nature Reviews Physics: Machine learning in condensed matter and materials physics
49	Online teaching/training	Nature Reviews Physics: Machine learning in condensed matter and materials physics
50	Online teaching/training	Nature Reviews Physics: Machine learning in fluid dynamics and climate physics
51	Self-learning	Nature Reviews Physics: Machine learning in fluid dynamics and climate physics
52	Online teaching/training	Nature Reviews Physics: Machine learning in theoretical and experimental high energy physics
53	Self-learning	Nature Reviews Physics: Machine learning in theoretical and experimental high energy physics
54	Online teaching/training	Nature Reviews Physics: Machine learning research in industry
55	Self-learning	Nature Reviews Physics: Machine learning research in industry
56	Distance learning	Neural Networks and Deep Learning
57	Face-to-Face	Ontology in data retrieval
58	Online teaching/training	PATC: Introduction into the Big Data Analytics @ BSC
59	Face-to-Face	POSGRADO EN ARTIFICIAL INTELLIGENCE WITH DEEP LEARNING
60	Face-to-Face	POSGRADO EN ARTIFICIAL INTELLIGENCE WITH DEEP LEARNING
61	Online teaching/training	PUMPS+AI Summer School 2021
62	Distance learning	Professional Certificate in AI in Practice
63	Distance learning	Professional Certificate in Applied AI
64	Distance learning	Professional Certificate in Buildings as Sustainable Energy Systems
65	Distance learning	Professional Certificate in Computer Science for Artificial Intelligence
66	Distance learning	Professional Certificate in Deep Learning
67	Distance learning	Professional Certificate in Foundations of AI
68	Distance learning	Professional Certificate in Fundamentals of Google AI for Web Based Machine Learning
69	Distance learning	Professional Certificate in Inteligencia artificial aplicada
70	Distance learning	Professional Certificate in Python Data Science

Table 7: Course filter criteria 6/7.

INTERMEDIATE USERS

PUBLISHED ONLY RESOURCES

Page 4/4

	FORMAT	RESOURCE TITLE
71	Distance learning	Professional Certificate in Tiny Machine Learning (TinyML)
72	Online teaching/training	SciML GPU Bootcamp
73	Self-learning	SuperDataScience
74	Self-learning	Talking Machines
75	Self-learning	The TWIML AI Podcast (formerly This Week in Machine Learning & Artificial Intelligence)

In total (for INTERMEDIATE USERS) on the platform, 75 / 157 resources published

Table 8: Course filter criteria 7/7.

List of Acronyms and Abbreviations

AI	Artificial intelligence
API	Application Programming Interface
AWS	Amazon Web Services
DASH	Digital Access to Scholarship at Harvard
CDN	Content Delivery Network
CoE RAISE	Center of Excellence "Research on AI- and Simulation-Based Engineering at Exascale"
EITCA	European IT Certification Academy
EITCI	European Information Technologies Certification Institute
FocusCoE	Network of the Centres of Excellence in HPC
FZJ	Forschungszentrum Jülich GmbH
HPC	High-Performance Computing
IEEE	Institute of Electrical and Electronics Engineers
IaaS	Infrastructure as a Service
IT	Information Technology
MIT	Massachusetts Institute of Technology
ML	Machine Learning
MOOC	Massive Open Online Course
NCC	National Competence Centre
OER	Open Educational Resource
PMT	Project management team
PRACE	Partnership for Advanced Computing in Europe
RAISE	see CoE RAISE
RTU	Riga Technical University
SAFRAN	Safran Helicopter Engines
SME	Small- and Medium-Sized Enterprise
WP	Work Package