Research 5: Questionnaire for IT Students, Masters and Alumni in Information Systems and Technologies:
the state-of-the-art analysis for WP2

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Places of the development of the result
University of Bielsko-Biala, Bielsko-Biala, Poland
University of Library Studies and Information Technologies, Sofia, Bulgaria
University of Nis, Serbia
University of Ss. Cyril and Methodius in Trnava, Slovakia
University of Montenegro, Montenegro

Summary: This study is based on extensive survey conducted as a part of activities during the realization of the Erasmus+ project "Future is in Applied Artificial Intelligence". Survey aimed to research the needs and expectations of IT graduates Masters and IT Alumni in Information Systems and Technologies regarding various Applied Artificial Intelligence topics with the goal to examine knowledge and attitude of students toward AI contents, current state of AI education and future directions of the transformation of education system toward competency-based education.

1. Introduction

The fastest growing and most exciting scientific field today is Artificial Intelligence (AI) [1] with its real world applications. The current transformation of society and business needs for AI specialists with specific competencies and skills dictate the transformation of the educational system and its adjustment toward modern demands [2], [3]. The action plan for digital education [4] implies the transition of the education system towards the preparation of the workforce for the upcoming transformation of society under the influence of AI as well as the development of skills and competences needed to work with IT (competency-based education) [5].

This study presents some results and analysis of conducted survey in the scope of the Erasmus+ project 2022-1-PL01-KA220-HED-000088359 "Future is in Applied Artificial Intelligence" (FAAI) [6]. The coordinator of the project is the University of Bielsko-Biala from Poland and other project participants are: University of Library Studies and IT, Bulgaria; The University of Nis, Serbia; The University of Ss. Cyril and Methodius in Trnava, Slovakia; and University of Montenegro, Montenegro. The duration of the project is 24 months (September 2022 - August 2024). The main goal of the project is for students to get acquainted with the possibilities of AI systems for solving problems in management, industry, engineering, administration, and education; evaluations of existing AI systems and tools, emphasizing comparative studies and user experiences; and research on the economic, social, and cultural impacts of AI. The project aims to join together Universities and businesses and provide innovative solutions to develop Artificial Intelligence experts.

In the first phase (WP2) of the project "Future is in Applied Artificial Intelligence", a survey was conducted on the state of the subject area, namely Applied Artificial Intelligence in the project partner countries (Poland, Slovakia, Serbia, Bulgaria, Montenegro). The survey was performed online using AdminProject - European Project Management Software forms tools during a period from the 1st of February to the 31th of March 2023. The survey contained 8 online forms with both open and closed questions. The questionnaires considered different questions for job offerings, labor market in the field of Artificial Intelligence (AI), existing training programs, and good practices, and collecting IT specifications of good practices in AI. To obtain a wide range of data, multiple question fields, with an additional open-field option, were offered to mitigate the effect of narrowed answer suggestions. This particular analysis is based on Research 5: Questionnaire for IT students, masters and alumni in Information Systems and Technologies related to the

knowledge and attitude of students toward AI contents, current state of AI education and future directions of the transformation of education system in the sense of developing preferred competencies.

2. Collection and analysis of data

This study aim to research the needs and expectations of IT graduates Masters and IT Alumni in Information Systems and Technologies regarding Applied Artificial Intelligence topics. Analysis is performed on the basis of 1042 questionnaires carried out by five partner institutions in all the countries participating in the project: Poland, Slovakia, Bulgaria, Montenegro, and Serbia.

3. Results

3.1. What is your nationality?

The first group of three questions in the survey was of general purpose, with the aim to find out the basic information about questioners – their nationality, age and student status. The first question was about the nationality. Questioners were free to choose from partner countries (Poland, Serbia, Bulgaria, Montenegro, Slovakia) or to choose option *Other* for the countries outside the project consortium.

Data description:
Questioners were mostly residents of the participant countries of the project: Poland 14.01%, Serbia 15.26%, Bulgaria 35.22%, Montenegro 19.77%, Slovakia 9.88% as presented in the Chart below. There were also 61 questioners (5.85%) from other countries.

1. What is your nationality? *

1. ○ Polish	1.	146 / 1042 (14.01%)
2. ○ Serbian	2.	159 / 1042 (15.26%)
3. ○ Bulgarian	3.	367 / 1042 (35.22%)
4. ○ Montenegrian	4.	206 / 1042 (19.77%)
5. ○ Slovakian	5.	103 / 1042 (9.88%)
6. ○ Other	6.	61 / 1042 (5.85%)
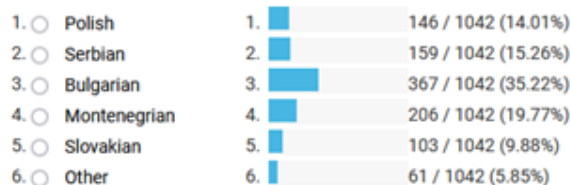
Discussion:
Great response of IT Students, Masters and Alumni in Information Systems and Technologies (over 1000 participants in the online survey), mostly from the partners' countries, demonstrates the interest of the target population in Applied Artificial Intelligence contents and a clear need for the corresponding courses.

3.2. What is your age?
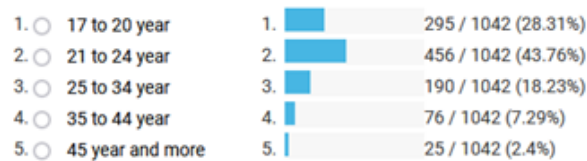
The second question was about the age of the questioners. Five ranges were offered: 17 to 20 year, 21 to 24 year, 25 to 34 year, 35 to 44 year, and 45 year and more.

Data description:
Questioners were mostly 21 to 24 year old (43.76%), 17 to 20 year old (28.31%) and 25 to 34 year old (18.23%) as presented in the Chart. Smaller percentage of them was 35 to 44 year old (7.29%) and 45 year and more (2.4%).

2. What is your age? *

1. ◯ 17 to 20 year	1. ▬	295 / 1042 (28.31%)
2. ◯ 21 to 24 year	2. ▬	456 / 1042 (43.76%)
3. ◯ 25 to 34 year	3. ▬	190 / 1042 (18.23%)
4. ◯ 35 to 44 year	4. ▮	76 / 1042 (7.29%)
5. ◯ 45 year and more	5. ▎	25 / 1042 (2.4%)

Discussion:
From the presented data, it can be concluded that younger people are more interested in new technologies, especially those who are still at their universities (over 70% of respondents are younger than 24).

3.3. Are you a student or graduates now?

The purpose of the third question was to establish whether questioners were students of first/second level of studies (BSc or MSc) or graduates, so they had only these three options to choose from. Their choice directly affected the following questions. For instance, questions 04-13 were exclusive for students (some of them could be also answered by graduates.

Data description:
Questioners were students in large majority - 931 (89.34%) while only 111 (10.65%) were graduates, as shown in the Figure below.

3. Are you a student or graduates now? *

1. ◯ Student (I level)	1. ▬	674 / 1042 (64.68%)
2. ◯ Student (II level)	2. ▬	257 / 1042 (24.66%)
3. ◯ Graduates	3. ▮	111 / 1042 (10.65%)
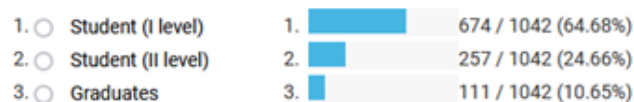
Discussion:
As already stated, younger people are more interested in new technologies. Students clearly think that Applied Artificial Intelligence contents could be important for their further careers.

3.4. In what education degree are you studying now?

Questioners which are students then had to answer to questions 4-13, but some questions could also be answered by the graduates. First, they were asked to state what education degree they are learning for. Offered answers were *Bachelor*, *Master*, *PhD*, and *I am not studying*.

Data description:
Most of questioners were from Bachelor Studies 758 (72.74%) and Master Studies 231 (22.17%) as shown in the Figure below. Fourteen (1.34%) questioners were from PhD Studies, and 39 questioners (3.74) declared that they did not have the student status.

4. In what education degree are you studying now? *

1. ○	Bachelor	1.	758 / 1042 (72.74%)
2. ○	Master	2.	231 / 1042 (22.17%)
3. ○	PhD	3.	14 / 1042 (1.34%)
4. ○	I am not studying	4.	39 / 1042 (3.74%)
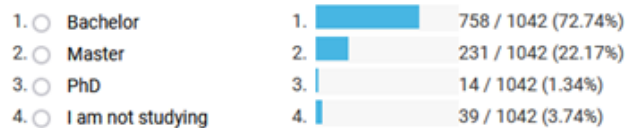
Discussion:
The big interest of students in Bachelor and Master programmes for the field of Applied Artificial Intelligence in comparison with other types of studies at the academy, reveals us the target population among the IT community.

3.5. What is your specialization?

The follow-up question was about the specialty of the students where they had to enter their answer in the free form.

Data description:
The answers were very heterogeneous, but mostly some variations in the field of IT. Most common answers were Information Technology with 28.69% and Computer Science 25.82%. The complete results are presented below in the form of graph and table.

What is your specialization?
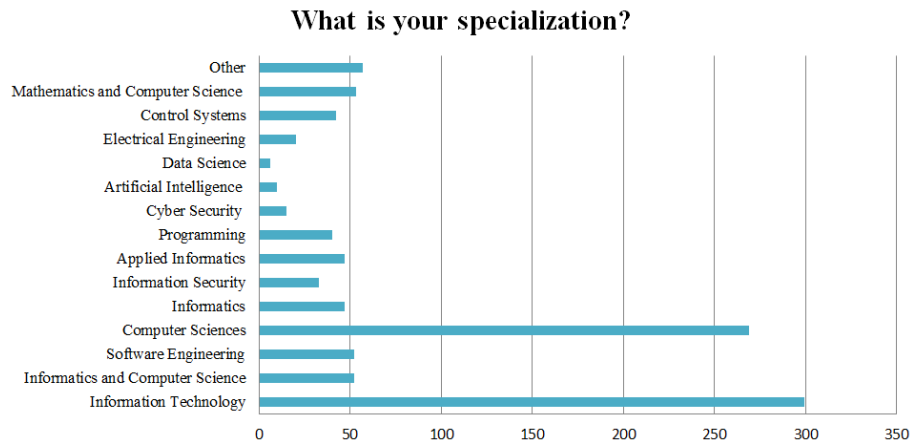
Specialty	Total	Percentage
Information Technology	299	28.69
Informatics and Computer Science	52	4.99
Software Engineering	52	4.99
Computer Sciences	269	25.82
Informatics	47	4.51
Information Security	33	3.17
Applied Informatics	47	4.51
Programming	40	3.84
Cyber Security	15	1.44
Artificial Intelligence	10	0.96
Data Science	6	0.58
Electrical Engineering	20	1.92
Control Systems	42	4.03
Mathematics and Computer Science	53	5.09
Other	57	5.47

Discussion:
Students of all kinds of IT studies showed interest in Applied Artificial Intelligence topics and courses, proving that the objectives of the project and target groups were set correctly.

3.6. What is your year of study?

The aim of this question was to determine more closely the years of study of the questioners. Proposed answers were *1*, *2*, *3*, *4*, *I am not studying* and *Other*.
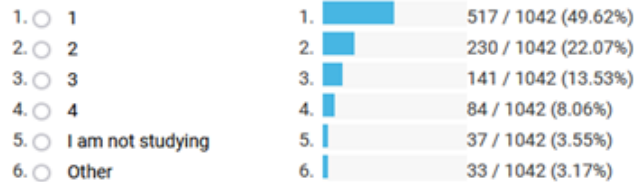
Data description:

Most of the students chose option 1 (49.62%), 2 (22.07%), 3 (13.53%), and 4 (8.06%). Only 37 (3.55%) questioners declared that they were not a student, while 33 questioners (3.17) chose option *Other*.

6. What is your year of study? *

1. ○	1	1.	517 / 1042 (49.62%)
2. ○	2	2.	230 / 1042 (22.07%)
3. ○	3	3.	141 / 1042 (13.53%)
4. ○	4	4.	84 / 1042 (8.06%)
5. ○	I am not studying	5.	37 / 1042 (3.55%)
6. ○	Other	6.	33 / 1042 (3.17%)

Discussion:
The results of the survey show us that interest in Applied Artificial Intelligence is present already at the very beginning of studies.

3.7. Do you know any Applied Artificial Intelligence courses offered at your university?

Students were asked whether they know any Applied Artificial Intelligence courses offered at their university. There were 3 proposed answers: *Yes, I know a lot of them*; *Yes, I know only a few*; and No.

Data description:
Students in large majority chose answers *No* (54.03%) and *Yes, I know only a few* (39.25%) while only 6.72% chose the answer *Yes, I know a lot of them*.

7. Do you know any Applied Artificial Intelligence courses offered at your university? *

1. ○	Yes, I know a lot of them	1.	70 / 1042 (6.72%)
2. ○	Yes, I know only a few.	2.	409 / 1042 (39.25%)
3. ○	No	3.	563 / 1042 (54.03%)
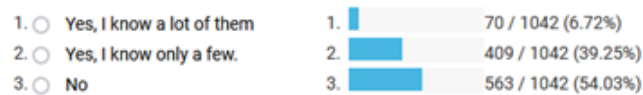
Discussion:
The majority of students interested in the survey on the Applied Artificial Intelligence, but not knowing about any relevant course at their university, demonstrates the good foundation of FAAI project and the growing need for courses dealing with Applied Artificial Intelligence.

3.8. What activities do you prefer to extend your knowledge in Applied Artificial Intelligence?

The next question was what activities do students prefer to extend their knowledge in Applied Artificial Intelligence with offered answers: *Lectures, Classes, Laboratories, Projects, Question and answer session, Student internships,*

Participation in the activity of students' scientific groups, Getting to know the results of research conducted at the University, Thematic courses/seminars/webinars, Solving use cases, and *Other*. Students had an opportunity to choose multiple answers for this question.

Data description:
The answers the students chose were the following: Lectures 466 (44.72%), Classes 376 (36.08%), Laboratories 399 (38.29%), Projects 312 (59.21%), Questio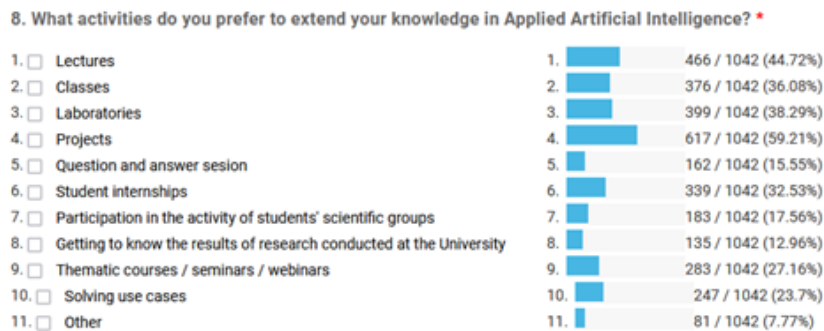n and answer session 162 (15.55%), Student internships 339 (32.53%), Participation in the activity of students' scientific groups 183 (17.56%), Getting to know the results of research conducted at the University 135 (12.96%), Thematic courses/seminars/webinars 283 (27.16%), Solving use cases 247 (23.7%), and Other 81 (7.77%).

8. What activities do you prefer to extend your knowledge in Applied Artificial Intelligence? *

1. ☐	Lectures	1.	466 / 1042 (44.72%)
2. ☐	Classes	2.	376 / 1042 (36.08%)
3. ☐	Laboratories	3.	399 / 1042 (38.29%)
4. ☐	Projects	4.	617 / 1042 (59.21%)
5. ☐	Question and answer sesion	5.	162 / 1042 (15.55%)
6. ☐	Student internships	6.	339 / 1042 (32.53%)
7. ☐	Participation in the activity of students' scientific groups	7.	183 / 1042 (17.56%)
8. ☐	Getting to know the results of research conducted at the University	8.	135 / 1042 (12.96%)
9. ☐	Thematic courses / seminars / webinars	9.	283 / 1042 (27.16%)
10. ☐	Solving use cases	10.	247 / 1042 (23.7%)
11. ☐	Other	11.	81 / 1042 (7.77%)

Discussion:
Students showed interest in Applied Artificial Intelligence content and course. It is clearly stated that the developing course should lean heavily on practical implementation with laboratory work, students' projects and internships.

3.9. How would you like to use your Applied Artificial Intelligence research and skills for the aims of your future diploma thesis?

The aim of this question was to find out how would the students like to use their Applied Artificial Intelligence research and skills for the aims of their future diploma thesis, with proposed answers: *I would like to write a scientific paper*, *I would like to present my Applied Artificial Intelligence research and skills during seminar*, *I am not interested in Applied Artificial Intelligence activities*, *I am not working at the diploma thesis* and *Other*.

Data description:
The majority of the students 394 (37.81%) answered that they are not working on the diploma thesis, which is logical if we take into account that the largest number of questioners are students from the initial years of study. Another significant number of students declare that they would like to present their Applied Artificial Intelligence research and skills during seminar – 294 (28.21%) or that they would

like to write a scientific paper – 241 (23.13%). The rest of the questioners 204 (19.58%) mostly chose that they are not interested in this subject, or chose option Other 29 (2.78%).

9. How would you like to use your Applied Artificial Intelligence research and skills for the aims of your future diploma thesis? *
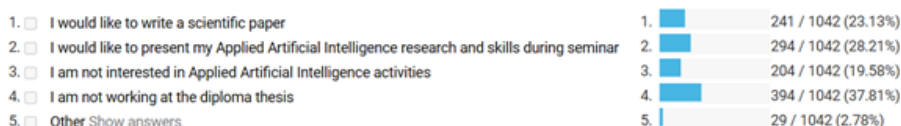
1.	I would like to write a scientific paper	1.	241 / 1042 (23.13%)
2.	I would like to present my Applied Artificial Intelligence research and skills during seminar	2.	294 / 1042 (28.21%)
3.	I am not interested in Applied Artificial Intelligence activities	3.	204 / 1042 (19.58%)
4.	I am not working at the diploma thesis	4.	394 / 1042 (37.81%)
5.	Other Show answers	5.	29 / 1042 (2.78%)

Discussion:
Although the largest number of questioners answered that they are not working on the diploma thesis yet, majority (more than 50%) responded positively, proving the necessity of introducing Applied Artificial Intelligence contents and courses through FAAI project.

3.10. What obstacles/issues do you see in implementing Applied Artificial Intelligence subject into a teaching programme?

The next question was what obstacles/issues students see in implementing Applied Artificial Intelligence subject into a teaching programme. Proposed answers were: *Limitations resulting from the study program*, *Formal barriers in submitting a new form of classes*, *Inadequate or maladjusted laboratory/lecture room equipment*, and *Other*, whereby students had the opportunity to choose multiple answers.

Data description:
394 students (37.81%) answered that they see Limitations resulting from the study program as an obstacle in implementing Applied Artificial Intelligence subject into a teaching programme, 360 (34.55%) gave the answer Formal barriers in submitting a new form of classes, while 246 (23.61%) stated Inadequate or maladjusted laboratory/lecture room equipment. Rest of questioners 223 (21.4%) chose option Other.

10. What obstacles/issues do you see in implementing Applied Artificial Intelligence subject into a teaching programme *

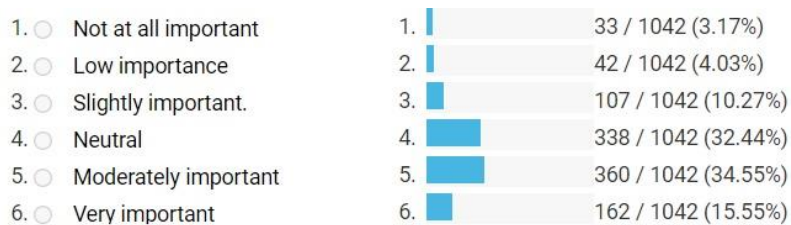|			
1.	Limitations resulting from the study program	1.	394 / 1042 (37.81%)
2.	Formal barriers in submitting a new form of classes	2.	360 / 1042 (34.55%)
3.	Inadequate or maladjusted laboratory/lecture room equipment	3.	246 / 1042 (23.61%)
4.	Other	4.	223 / 1042 (21.4%)
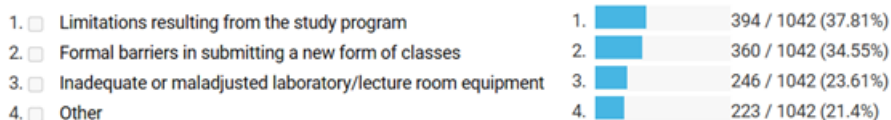
Discussion:
Partner countries of FAAI project should focus on implementing Applied Artificial Intelligence content into study programs by either innovating existing courses or by introducing completely new courses. Improving material component (equipment, laboratories) is secondary, but also important factor.

3.11. How do you rate the idea of building a website which will present results Applied Artificial Intelligence research carried out by local University employees?

The students were asked to share their thoughts on creating a website to showcase the findings of Applied Artificial Intelligence research conducted by the local university staff. They were given six options to rate the importance of the idea, ranging from "Not at all important" to "Very important."

Data description:
Most respondents (360 - 34.55%) expressed a particular viewpoint on this matter as moderately important, while a similar number (32.44%) stayed neutral. Of those who expressed an opinion, 15.55% rated it as very important and 10.27% as slightly important. Only 4.03% of respondents felt that creating a website was of low importance, and 3.17% was not at all important.

1. ○ Not at all important	1.	▌	33 / 1042 (3.17%)
2. ○ Low importance	2.	▌	42 / 1042 (4.03%)
3. ○ Slightly important.	3.	▌	107 / 1042 (10.27%)
4. ○ Neutral	4.	▬	338 / 1042 (32.44%)
5. ○ Moderately important	5.	▬	360 / 1042 (34.55%)
6. ○ Very important	6.	▬	162 / 1042 (15.55%)

Discussion:
Creating a website to present research in the scope of Applied Artificial Intelligence should be a priority for partner universities. It is an efficient way to disseminate findings and engage students and other target audiences in Applied Artificial Intelligence topics. This method of information dissemination is easy to access and can increase awareness and interest in Applied Artificial Intelligence research among the wider community.

3.12. Are you familiar with Applied Artificial Intelligence issues?

One other significant inquiry was whether the students were acquainted with Applied Artificial Intelligence matters, with four possible responses: "Yes, I know about it and I know how to use it", "Yes, I have heard about the access but I have never used it," "No, I have not heard about it and I would like to know how to use it," and "No, I have not heard about it and I am not interested in such access."

Data description:
A majority of students responded that they have not heard about the Applied Artificial Intelligence issues but would like to know how to use it in such circumstances (434 - 41.65%) while 38.29% have heard about it but have never used it. A smaller proportion of students answered that they know about it and know how to use it (10.75%), and even smaller percentage indicated no interest in accessing it (9.31%).

1. ○ Yes, I know about it and I know how to use it.
2. ○ Yes, I have heard about the access but I have never used it.
3. ○ No, I have not heard about it and I would like to know how to use it.
4. ○ No, I have not heard about it and I am not interested in such access

1. ▮ 112 / 1042 (10.75%)
2. ▮ 399 / 1042 (38.29%)
3. ▮ 434 / 1042 (41.65%)
4. ▮ 97 / 1042 (9.31%)
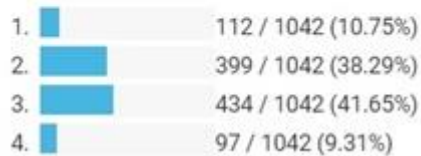
Discussion:
The results indicate that a significant number of students have not been exposed to Applied Artificial Intelligence, which suggests that there may be a need for more education and training in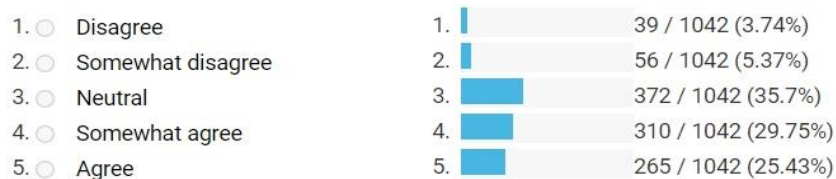 this area. The fact that a majority of students who were not familiar with the concept still expressed interest in learning about it is encouraging, as it suggests that there is a potential demand for courses related to Applied Artificial Intelligence. These results suggest that there is a need to increase awareness and education about Applied Artificial Intelligence, as well as provide more comprehensive training opportunities for those who are interested in this field.

3.13. Do you agree to take part in Applied Artificial Intelligence courses?

The final and crucial query in this series of questions asked whether students were willing to participate in Applied Artificial Intelligence courses. The possible responses were "Disagree" or "Somewhat disagree". Alternatively, if the responses to this question could be "Neutral," "Somewhat agree," or "Agree,".

Data description:
Students were mostly Neutral regarding the option to take part in Applied Artificial Intelligence courses (372 – 35.7%), Somewhat agree (310 – 29.75%) or Agree (265 – 25.43%). Minority of the students were Somewhat disagree (56 – 5.37%) and Disagree (39 – 3.74%).

1. ○ Disagree
2. ○ Somewhat disagree
3. ○ Neutral
4. ○ Somewhat agree
5. ○ Agree

1. ▮ 39 / 1042 (3.74%)
2. ▮ 56 / 1042 (5.37%)
3. ▮ 372 / 1042 (35.7%)
4. ▮ 310 / 1042 (29.75%)
5. ▮ 265 / 1042 (25.43%)

Discussion:
The fact that nearly all IT students expressed interest or were neutral towards studying an Applied Artificial Intelligence course aligns with the project's assumption that there is a deficiency in Applied Artificial Intelligence and other digital skills in Southern Europe. Therefore, it emphasizes the need for new

initiatives to adequately incorporate these skills into the curriculum, teacher development, assessment practices, and learning content.

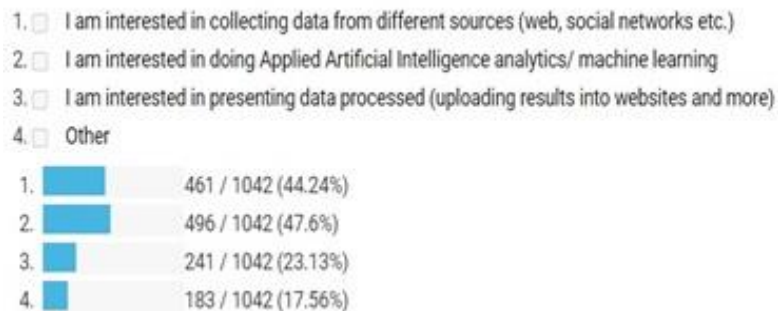## Participation in Applied Artificial Intelligence training

Students had the opportunity to answer the third group of questions Participation in Applied Artificial Intelligence training consisting of only two questions (14 and 15) related to the AAI context and the previous courses in Applied Artificial intelligence area.

3.14. What would you like to do, in the context of AI, within your classes as a part of Applied Artificial Intelligence programme?

First of those two questions was what would they like to do, in the context of AI, within their classes as a part of Applied Artificial Intelligence programme. Offered answers were: "I am interested in collecting data from different sources (web, social networks etc.) ", "I am interested in doing Applied Artificial Intelligence analytics/ machine learning", "I am interested in presenting data processed (uploading results into websites and more) ", and "Other".

Data description:
The students were asked about their level of interest within the classes as a part of the Artificial Applied Intelligence aspects in the context of AI. The results showed that 47.6% of the participants were interested in Applied Artificial Intelligence analytics/machine learning, while 44.24% indicated their interest in collecting data from different sources. In contrast, only 23.13% of the students expressed interest in presenting processed data, such as uploading results to websites or other platforms. Lastly, 17.56% of the students selected "Other" as their response.

1. ☐ I am interested in collecting data from different sources (web, social networks etc.)
2. ☐ I am interested in doing Applied Artificial Intelligence analytics/ machine learning
3. ☐ I am interested in presenting data processed (uploading results into websites and more)
4. ☐ Other

1.	▇	461 / 1042 (44.24%)
2.	▇	496 / 1042 (47.6%)
3.	▇	241 / 1042 (23.13%)
4.	▇	183 / 1042 (17.56%)

Discussion:
The results obtained from the survey can be used to design an Applied Artificial Intelligence course focusing on techniques for Applied Artificial Intelligence analytics, particularly machine learning and collecting data from different sources related to this area. This approach could make the course more appealing to students based on their interests.

3.15. Have you participated in classes which were based on Applied Artificial Intelligence?

The second question was related to the previous participation in Applied Artificial Intelligence based courses.

Data description:
The responses to the question were the following: 696 students (66.79%) indicated that they had not taken any classes related to Applied Artificial Intelligence courses, 212 (20.35%) reported that they had, and 134 (12.86%) were unsure.

1. ○ Yes	1.	▇	212 / 1042 (20.35%)
2. ○ No	2.	▇▇▇	696 / 1042 (66.79%)
3. ○ I don't know	3.	▇	134 / 1042 (12.86%)

Discussion:
The fact that only one-fifth of the students who had previously taken classes related to Applied Artificial Intelligence responded positively highlights the significant gap and necessity for providing appropriate courses at partner universities. It should be noted that this question was answered only by students interested in Applied Artificial Intelligence content.

Next two groups of questions are related to the employment, working experience and positions of the participants.

3.16. Are you working now?

In the online survey, question 16 was crucial in determining the subsequent questions for the participants. The question asked whether the respondents had a paid job. Those who answered in the affirmative were directed to answer questions from sections 5 and 6, which were focused on work experience and workers in the IT industry, respectively. On the other hand, those who answered negatively skipped all the following questions until section 7, which started with questions about important competencies.

Data description:
The survey participants were almost evenly divided when asked about their current employment status in question 16. Specifically, 510 respondents (48.94%) indicated that they have a paid job, while 532 respondents (51.06%) reported that they do not have a paid job at the moment.

1. ○ Yes	1.	▇▇▇	510 / 1042 (48.94%)
2. ○ No	2.	▇▇▇	532 / 1042 (51.06%)

Discussion:
Although this question was only used to determine which set of questions the participants would answer, it is noteworthy that the survey captured responses from almost an equal number of participants who are currently employed and those who are not.
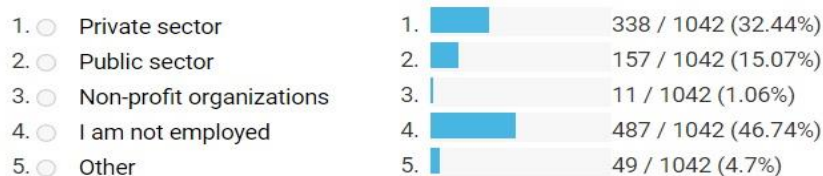
Work experience

Section 5 pertains to work experience and comprises a total of three questions (17-19), which aim to gather information on the duration and nature of the respondents' previous employment. This section provides valuable insight into the work background of the survey participants. It can assist in identifying potential correlations between prior work experience and an interest in Applied Artificial Intelligence education.

3.17. In which sector are you working?

The initial inquiry in Section 5 of the survey pertained to the sector of the respondents' current employment. The question provided multiple response options, including "Private sector", "Public sector", "Non-profit organizations", "Not employed", and "Other". This information will aid in identifying the current work context of the participants and analyzing the survey results accordingly.

Data description:
Among the participants who responded to this question, 32.44% reported being employed in the private sector, while 15.07% were employed in the public sector. A mere 1.06% reported being employed in non-profit organizations, while 46.74% of respondents reported not being employed. Finally, 4.7% of respondents selected "Other" as their employment sector.

1. ○	Private sector	1. ▬	338 / 1042 (32.44%)
2. ○	Public sector	2. ▬	157 / 1042 (15.07%)
3. ○	Non-profit organizations	3. ▎	11 / 1042 (1.06%)
4. ○	I am not employed	4. ▬	487 / 1042 (46.74%)
5. ○	Other	5. ▎	49 / 1042 (4.7%)

Discussion:
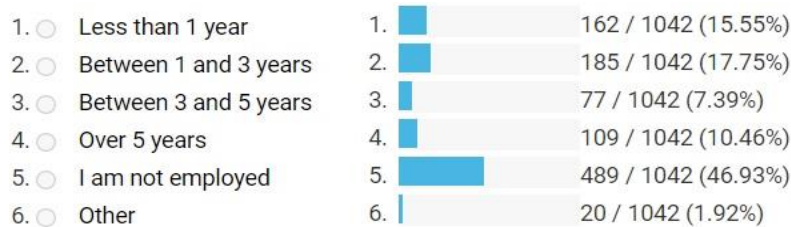The data suggests that a significant proportion of the surveyed population is unemployed. However, among those who are employed, the private sector is the most common employment sector, with almost one-third of respondents reporting being employed in this sector. The relatively low percentage of respondents employed in the public sector and non-profit organizations may indicate a need for more career opportunities in these sectors.

3.18. How long have you been working in this position?

The purpose of the subsequent inquiry was to determine the duration of employment of the respondents in their current workplaces. The query provided four options to choose from, including "Less than 1 year", "Between 1 and 3 years", "Between 3 and 5 years", and "Over 5 years", as well as two additional responses: " I am not employed" and "Other".

Data description:
The results showed that the majority of respondents, 46.93%, were not employed at the time of the survey. Among those who were employed, 15.55% reported working in their current position for less than a year, while 17.75% had been working for between one and three years. A smaller proportion of respondents, 7.39%, reported working in their current position for three to five years, while 10.46% had been working there for over five years. Finally, 1.92% of respondents reported being in the "Other" category.

1. ○	Less than 1 year	1.	▮	162 / 1042 (15.55%)
2. ○	Between 1 and 3 years	2.	▮	185 / 1042 (17.75%)
3. ○	Between 3 and 5 years	3.	▮	77 / 1042 (7.39%)
4. ○	Over 5 years	4.	▮	109 / 1042 (10.46%)
5. ○	I am not employed	5.	▬▬▬	489 / 1042 (46.93%)
6. ○	Other	6.	▮	20 / 1042 (1.92%)

Discussion:
The results suggest that a significant proportion of the respondents are not currently employed, which could potentially affect their perception of the importance of specific skills and competencies in the workplace. Most of those employed have been working in their current position for less than three years. This could imply that they are still early in their career development and may have a different perspective on the skills and competencies necessary for career success compared to those working longer.

3.19. What field are you working in?

The ultimate objective of the final question in this section is to uncover the occupational field of the respondents. The options they presented include the "IT industry", "Manufacture", "Economics (accounting, own business) ", "Administration", "Marketing", "Banking", "Security and defence activities", "I am not employed", and "Other". Those who select "IT industry", "Banking" or "Security and defence activities" proceed with the subsequent section (Section 6, with questions 20-23), whereas the remainder advance to Section 7 (commencing with question 24).

Data description:

The question regarding the field of work of the respondents revealed that the majority of the participants (29.37%) work in the IT industry. Other fields of work selected by the participants were: Manufacture (2.3%), Economics (accounting, own business) (1.73%), Administration (3.55%), Marketing (2.5%), Banking (0.67%), Security and defence activities (1.54%), and Other (12.67%). A significant proportion of respondents (45.68%) reported not being employed. It is interesting to note that the IT industry is the most popular field among the participants.

1. ○ IT industry	1.	306 / 1042 (29.37%)
2. ○ Manufacture	2.	24 / 1042 (2.3%)
3. ○ Economics (accounting, own business)	3.	18 / 1042 (1.73%)
4. ○ Administration	4.	37 / 1042 (3.55%)
5. ○ Marketing	5.	26 / 1042 (2.5%)
6. ○ Banking	6.	7 / 1042 (0.67%)
7. ○ Security and defense activities	7.	16 / 1042 (1.54%)
8. ○ I am not employed	8.	476 / 1042 (45.68%)
9. ○ Other	9.	132 / 1042 (12.67%)
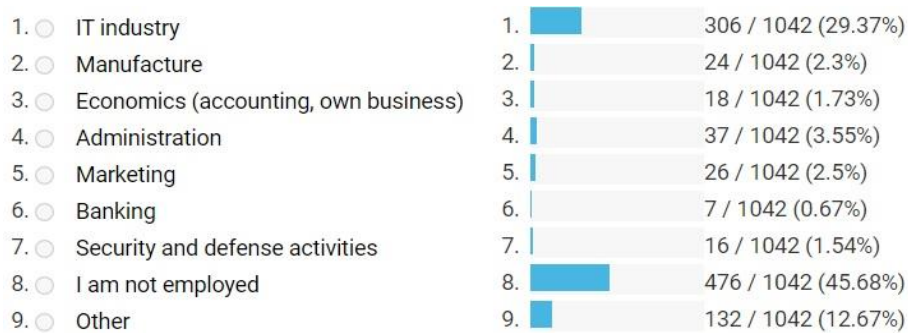
Discussion:

Again, the high number of respondents who are not employed could be due to the fact that the survey was conducted among university students, who may not have entered the job market yet. The popularity of the IT industry as a field of work among employed respondents is not surprising given the increasing demand for technology-related jobs in the modern workforce. The low number of responses in the fields of economics, banking, and security and defence activities may indicate a lack of interest in these fields among the respondents or that there are fewer job opportunities in these fields in the current job market.

Workers in IT industry

Group of questions (20-23) named Workers in IT industry was intended for examinees who work in IT industry. Questions are formulated in such a way to better describe the job position, requirements and experience of the IT workers.

3.20. What is your job in the IT industry?

First question in the group of questions Workers in IT industry was to state concrete job inside industry, and the offered answers were: Network construction and service, Software developer, Graphic design, Telecommunications, Data Analytics, Data Science, Support, Administrator, Applied Artificial Intelligence Developers, Database Administration, I am not employed in IT.

Data description:

It can be seen from the Figure below that most of the surveyed students do not work (or do not work in IT sector) 65.36%. Most of IT workers work as Software

developers (17.47%), in Support (4.7%), as Administrators (3.55%) and in Network construction and service (3.26%).

20. What is your job in the IT industry?

1.	Network construction and service	34 / 1042 (3.26%)
2.	Software developer	182 / 1042 (17.47%)
3.	Graphic design	12 / 1042 (1.15%)
4.	Telecommunications	11 / 1042 (1.06%)
5.	Data Analitics	14 / 1042 (1.34%)
6.	Data Sciense	13 / 1042 (1.25%)
7.	Support	49 / 1042 (4.7%)
8.	Administrator	37 / 1042 (3.55%)
9.	Big Data Developers	6 / 1042 (0.58%)
10.	Database Administration	3 / 1042 (0.29%)
11.	I am not employed in IT	681 / 1042 (65.36%)
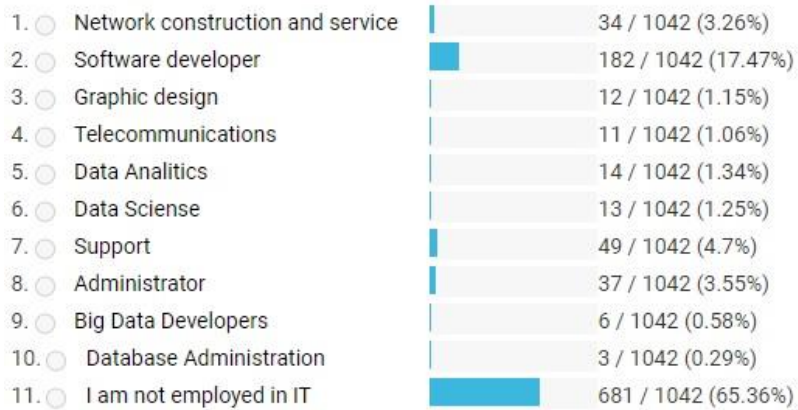
Discussion:
Designed Applied Artificial Intelligence courses must be heavily oriented toward Software developers because they are making the vast majority of the target group for developing digital competencies and skills in the area of Applied Artificial Intelligence.

3.21. What education is required for an appointment to your position?

The follow-up question for workers in IT industry was what kind of education is required for an appointment to their position: Bachelor, Vocational high school, Professional specialized course, No requirements, or I am not employed in IT.

Data description:
Out of 437 workers in IT industry, 222 stated that for their position Bachelor degree is required. 99 works at positions where there is No requirements, while 74 needed to finish Professional specialized course. 42 employees work with Vocational high school.

21. What education is required for an appointment to your position?

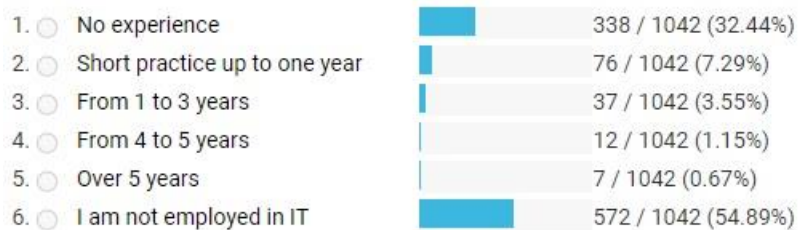|		
1.	Bachelor	222 / 1042 (21.31%)
2.	Vocational high school	42 / 1042 (4.03%)
3.	Professional specialized course	74 / 1042 (7.1%)
4.	No requirements	99 / 1042 (9.5%)
5.	I am not employed in IT	605 / 1042 (58.06%)

Discussion:
During designing Applied Artificial Intelligence trainings, project partners must have in mind that workers in IT sector mostly work at positions where bachelor diploma is needed (more than half of surveyed workers). There are almost no workers who must have master degree. So, the most logical choice to place Applied Artificial Intelligence courses would be at Bachelor studies or as part of some specialization programs.

3.22. What is your experience in Applied Artificial Intelligence field?

Next question aimed to find out whether IT workers have experience in Applied Artificial Intelligence field and for how long. Offered answers were: No experience, Short practice up to one year, From 1 to 3 years, From 4 to 5 years, Over 5 years, I am not employed in IT.

Data description:
Surveyed IT workers mostly (32.44%) have no experience in Applied Artificial Intelligence field or have Short practice up to one year (7.29%). Only 3.55% have experience From 1 to 3 years, 1.15% From 4 to 5 years and 0.67% Over 5 years.

22. What is Your experience in Applied Artificial Intelligence field?

1.	No experience	338 / 1042 (32.44%)
2.	Short practice up to one year	76 / 1042 (7.29%)
3.	From 1 to 3 years	37 / 1042 (3.55%)
4.	From 4 to 5 years	12 / 1042 (1.15%)
5.	Over 5 years	7 / 1042 (0.67%)
6.	I am not employed in IT	572 / 1042 (54.89%)

Discussion:
Large majority of workers in IT sector either have no experience (almost 72% of all surveyed workers) or very limited experience (16%) in Applied Artificial Intelligence field, meaning that designed courses have to be at more basic level, providing all the necessary knowledge for dealing with Artificial Intelligence.

3.23. Do you use Applied Artificial Intelligence at your work?

Last question in section dedicated for IT workers was whether they use Applied Artificial Intelligence at their work with five options: Yes, to a small extent, Yes, to a large extent, No, I did not search such tools, and I am not employed in IT.

Data description:
Vast majority of IT workers do not use Applied Artificial Intelligence at their work (302). 89 of them use it, but only to a small extent. Only 37 use Applied Artificial Intelligence to a large extent.

23. Do you use Applied Artificial Intelligence at your work?

1.	Yes, to a small extent		89 / 1042 (8.54%)
2.	Yes, to a large extent.		37 / 1042 (3.55%)
3.	No		302 / 1042 (28.98%)
4.	I did not search such tools		28 / 1042 (2.69%)
5.	I am not employed in IT		586 / 1042 (56.24%)
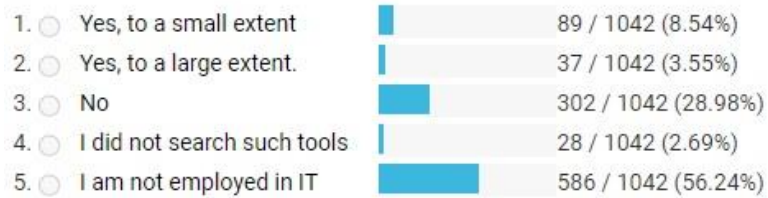
Discussion:

Almost two thirds of the respondents (66.2%) do not use Applied Artificial Intelligence at their work, meaning that they either do not need it, or they are not aware that these tools could ease their everyday work. Both to them and to those IT workers which use Applied Artificial Intelligence tools to some extent, Applied Artificial Intelligence contents would be valuable for their future career development.

Important competencies

Question 24 starts a next set of questions consisting of 6 questions (24-29) related to Important competencies necessary for Applied Artificial Intelligence.

3.24. Do you think Applied Artificial Intelligence issues are important for your future career?

Regarding the important competencies, surveyed students first had to answer whether they think that Applied Artificial Intelligence issues are important for their future career. Offered answers were: Not at all important, Low importance, Slightly important, Neutral, Moderately important, and Very important.

Data description:

The same number of surveyed students took either Neutral stance or think that Applied Artificial Intelligence competencies are Moderately important for their future career (313 or 30.04%), 19.58% consider them Very important, while 10.08% think that Applied Artificial Intelligence competencies are Slightly important. Only 6.43% consider them of Low importance and 3.84% Not important at all.

24. Do you think Applied Artificial Intelligence issues are important for your future career?

1.	Not at all important		40 / 1042 (3.84%)
2.	Low importance		67 / 1042 (6.43%)
3.	Slightly important		105 / 1042 (10.08%)
4.	Neutral		313 / 1042 (30.04%)
5.	Moderately important		313 / 1042 (30.04%)
6.	Very important		204 / 1042 (19.58%)
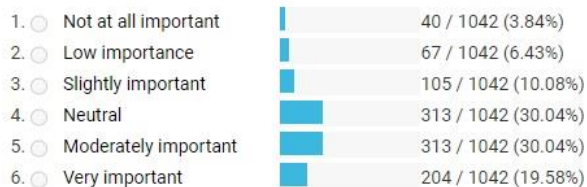
Discussion:
Only 10.27% of respondents answering that Applied Artificial Intelligence issues are either Not at all important or is of Low importance to their future career prove the foundation of FAAI project and importance of introducing structured trainings in Applied Artificial Intelligence topics.

25. Please select 10 soft skills from the list, which is most important for employment in the organization in which you are working

This question was different from the rest because surveyed students had to select 10 competencies from the broader list (31 competencies in total), which they consider most important for the employment in the organization in which they work.

Data description:
Results of the survey are given in the table below. Few competences stand out in the sense that large majority of the workers find them more important than others: Ability to work in a team (66.7%), Ability to plan and manage time (62.67%), Ability to communicate in a second (foreign) language (60.56%). The following competences were also popular: Ability to identify, propose and resolve problems (55.76%), Capacity to learn and stay up-to-date with learning (51.63%), Ability to apply knowledge in practical situations (50.58%), Capacity to generate new ideas (creativity) (48.94%). Other competences were chosen less frequently and the following competences were the least important for our students: Commitment to conservation of the environment (11.8%), Ability to show awareness of equal opportunities and gender issues (12.28%), Ability to take the initiative and to foster the spirit of entrepreneurship and intellectual curiosity (13.44%).

25. Please select 10 soft skills from the list, which is most important for employment in the organization in which you are working

1. ☐ Ability to communicate in a second (foreign) language
2. ☐ Capacity to learn and stay up-to-date with learning
3. ☐ Ability to communicate both orally and through the written word in first language
4. ☐ Ability to be critical and self-critical
5. ☐ Ability to plan and manage time
6. ☐ Ability to act on the basis of ethical reasoning
7. ☐ Capacity to generate new ideas (creativity)
8. ☐ Ability to search, process and analyze information from a variety of sources
9. ☐ Ability to work autonomously
10. ☐ Ability to identify, propose and resolve problems
11. ☐ Ability to apply knowledge in practical situations
12. ☐ Ability to make reasoned decisions
13. ☐ Ability to undertake research at an appropriate level
14. ☐ Ability to work in a team
15. ☐ Knowledge and understanding of the subject area and understanding of the profession
16. ☐ Ability to motivate people and move toward common goals
17. ☐ Commitment to conservation of the environment
18. ☐ Ability to communicate with people who are not experts in the subject area
19. ☐ Ability for abstract and analytical thinking, and synthesis of ideas
20. ☐ Ability to interact constructively with others regardless of background and culture and respecting diversity
21. ☐ Ability to design and manage projects
22. ☐ Ability to interact with others in a constructive manner, even when dealing with difficult issues
23. ☐ Ability to show awareness of equal opportunities and gender issues
24. ☐ Commitment to health, well-being and safety
25. ☐ Ability to take the initiative and to foster the spirit of entrepreneurship and intellectual curiosity
26. ☐ Ability to evaluate and maintain the quality of work produced
27. ☐ Ability to use information and communication technologies
28. ☐ Commitment to tasks and responsibilities
29. ☐ Ability to adapt to and act in new situations and cope under pressure
30. ☐ Ability to act with social responsibility and civic awareness
31. ☐ Ability to work in an international context

1.		631 / 1042 (60.56%)	16.	252 / 1042 (24.18%)
2.		538 / 1042 (51.63%)	17.	123 / 1042 (11.8%)
3.		347 / 1042 (33.3%)	18.	346 / 1042 (33.21%)
4.		415 / 1042 (39.83%)	19.	325 / 1042 (31.19%)
5.		653 / 1042 (62.67%)	20.	194 / 1042 (18.62%)
6.		192 / 1042 (18.43%)	21.	379 / 1042 (36.37%)
7.		510 / 1042 (48.94%)	22.	275 / 1042 (26.39%)
8.		425 / 1042 (40.79%)	23.	128 / 1042 (12.28%)
9.		365 / 1042 (35.03%)	24.	186 / 1042 (17.85%)
10.		581 / 1042 (55.76%)	25.	140 / 1042 (13.44%)
11.		527 / 1042 (50.58%)	26.	263 / 1042 (25.24%)
12.		343 / 1042 (32.92%)	27.	338 / 1042 (32.44%)
13.		169 / 1042 (16.22%)	28.	385 / 1042 (36.95%)
14.		695 / 1042 (66.7%)	29.	359 / 1042 (34.45%)
15.		311 / 1042 (29.85%)	30.	179 / 1042 (17.18%)
			31.	279 / 1042 (26.78%)

Discussion:

Developing of digital and soft skill becomes more and more important in today's job market. Young people recognize their importance as well as their employers. Any designed training should also focus on developing soft skills, especially those related to Teamwork, Communication and Time management. Creativity, Resolving problems, Capacity to learn and apply obtained knowledge should also be highly valued during course creation.

3.26. What competencies (in terms of their importance) should have a specialist in Applied Artificial Intelligence? Put a point from 1 to 5

Question 26 was first in a group of several questions where the task was to rate certain competencies with 1 to 5 rates. This question had the aim to graduate competencies (in terms of their importance) which the specialist in Applied Artificial Intelligence should have. Total of 12 competencies were offered:

1.   Describe major areas of AI as well as contexts in which AI methods may be applied.
2.   Represent information in a logic formalism and apply relevant reasoning methods.
3.   Represent information in a probabilistic formalism and apply relevant reasoning methods.
4.   Be aware of the wide range of ethical considerations around AI systems, as well as mechanisms to mitigate problems.
5.   Recognize the breadth and utility of machine learning methods
6.   Compare and contrast machine learning methods
7.   Select appropriate (classes of) machine learning methods for specific problems.
8.   Use appropriate training and testing methodologies when deploying machine learning algorithms.

9. Explain methods to mitigate the effects of overfitting and curse of dimensionality in the context of machine learning algorithms.

10. Identify an appropriate performance metric for evaluating machine learning algorithms/tools for a given problem.

11. Recognize problems related to algorithmic and data bias, as well as privacy and integrity of data.

12. Debate the possible effects -- both positive and negative -- of decisions arising from machine learning conclusions

Data description:

As can be seen from the Table below, surveyed students rate all twelve competencies related to Applied Artificial Intelligence relatively high, giving them mostly high rates 3-5.

	1	2	3	4	5
1	65/1042 (6.2%)	64/1042 (6.1%)	348/1042 (33.4%)	267/1042 (25.6%)	298/1042 (28.6%)
2	32/1042 (3.1%)	102/1042 (9.8%)	360/1042 (34.5%)	309/1042 (29.7%)	239/1042 (22.9%)
3	30/1042 (2.9%)	94/1042 (9%)	382/1042 (36.7%)	334/1042 (32.1%)	202/1042 (19.4%)
4	37/1042 (3.6%)	107/1042 (10.3%)	329/1042 (31.6%)	303/1042 (29.1%)	266/1042 (25.5%)
5	30/1042 (2.9%)	79/1042 (7.6%)	285/1042 (27.4%)	332/1042 (31.9%)	316/1042 (30.3%)
6	25/1042 (2.4%)	76/1042 (7.3%)	337/1042 (32.3%)	319/1042 (30.6%)	285/1042 (27.4%)
7	23/1042 (2.2%)	84/1042 (8.1%)	308/1042 (29.6%)	306/1042 (29.4%)	321/1042 (30.8%)
8	26/1042 (2.5%)	78/1042 (7.5%)	277/1042 (26.6%)	300/1042 (28.8%)	361/1042 (34.6%)
9	47/1042 (4.5%)	106/1042 (10.2%)	340/1042 (32.6%)	317/1042 (30.4%)	232/1042 (22.3%)
10	28/1042 (2.7%)	88/1042 (8.4%)	316/1042 (30.3%)	332/1042 (31.9%)	278/1042 (26.7%)
11	22/1042 (2.1%)	73/1042 (7%)	312/1042 (29.9%)	294/1042 (28.2%)	341/1042 (32.7%)
12	41/1042 (3.9%)	83/1042 (8%)	336/1042 (32.2%)	277/1042 (26.6%)	305/1042 (29.3%)

Discussion:

Any designed course in Applied Artificial Intelligence has to take into account the main topics related to this area, recognized by surveyed students, like: Using appropriate training and testing methodologies when deploying machine learning algorithms, Recognizing the breadth and utility of machine learning methods, Selecting appropriate (classes of) machine learning methods for specific problems, Comparing and contrasting machine learning methods.

3.27. What related competences (in terms of their importance) should have a specialist in Applied Artificial Intelligence? Put a point from 1 to 5

The follow-up question was What related competences (in terms of their importance) should have a specialist in Applied Artificial Intelligence? Surveyed students also had to put their rates from 1 to 5 next to each of 12 related competencies:

1. Obtain information from existing sources (streaming data/ historical ones/ applications logs/ open-source databases)

2. Effectively use variety of data analytics techniques (Machine Learning, Data Mining, Prescriptive and Predictive Analytics).

3.   Apply quantitative techniques (statistics, time series analysis, optimization, and prediction)
4.   Process heterogeneous data (natural language, visual objects, data, text and other).
5.   Visualize results of analysis of Applied Artificial Intelligence
6.   Deploy solution (merging data collection, storage, analysis and visualization)
7.   Using wide range of Applied Artificial Intelligence analytics platforms
8.   Develop and operate large scale data storage (e.g., Data Lakes, Hadoop and others)
9.   Apply data security mechanisms and controls at each stage of the data processing
10. Design, build, operate relational and nonrelational databases (SQL and NoSQL)
11. Process large dataset (i.e., ETL, OLTP, OLAP)
12. Ensure data quality, accessibility, interoperability, compliance to standards, and publication (data curation)

Data description:
Ratings distribution for all 12 competencies can be seen in Table below. We can see similar trends as in the previous question where surveyed students rated all the competencies relatively high (mostly with rates 3-5).

	1	2	3	4	5
1	52/1042 (5%)	75/1042 (7.2%)	314/1042 (30.1%)	263/1042 (25.2%)	338/1042 (32.4%)
2	22/1042 (2.1%)	82/1042 (7.9%)	236/1042 (22.6%)	329/1042 (31.6%)	373/1042 (35.8%)
3	24/1042 (2.3%)	75/1042 (7.2%)	334/1042 (32.1%)	351/1042 (33.7%)	258/1042 (24.8%)
4	23/1042 (2.2%)	84/1042 (8.1%)	333/1042 (32%)	354/1042 (34%)	248/1042 (23.8%)
5	30/1042 (2.9%)	79/1042 (7.6%)	363/1042 (34.8%)	311/1042 (29.8%)	259/1042 (24.9%)
6	25/1042 (2.4%)	69/1042 (6.6%)	347/1042 (33.3%)	331/1042 (31.8%)	270/1042 (25.9%)
7	29/1042 (2.8%)	80/1042 (7.7%)	388/1042 (37.2%)	312/1042 (29.9%)	233/1042 (22.4%)
8	32/1042 (3.1%)	92/1042 (8.8%)	355/1042 (34.1%)	324/1042 (31.1%)	239/1042 (22.9%)
9	36/1042 (3.5%)	84/1042 (8.1%)	310/1042 (29.8%)	324/1042 (31.1%)	288/1042 (27.6%)
10	32/1042 (3.1%)	99/1042 (9.5%)	318/1042 (30.5%)	301/1042 (28.9%)	292/1042 (28%)
11	35/1042 (3.4%)	98/1042 (9.4%)	317/1042 (30.4%)	335/1042 (32.1%)	257/1042 (24.7%)
12	33/1042 (3.2%)	66/1042 (6.3%)	326/1042 (31.3%)	292/1042 (28%)	325/1042 (31.2%)

Discussion:
Most valued related competence which a specialist in Applied Artificial Intelligence should have and which should be taught during Applied Artificial Intelligence trainings is Effectively use variety of data analytics techniques (Machine Learning, Data Mining, Prescriptive and Predictive Analytics). Analysis of other survey questions also demonstrate importance of Ensuring data quality, accessibility, interoperability, compliance to standards, and publication (data curation), as well as Applying quantitative techniques (statistics, time series analysis, optimization, and prediction)

3.28. Please rate the Applied Artificial Intelligence tools which are required to know?

Aim of this question was to find out how the surveyed students rate the need of possessing knowledge on certain Applied Artificial Intelligence tools. Offered ratings ranged from 1 (low importance) to 5 (high importance).

1. Applied Artificial Intelligence and distributed computing tools (Spark, MapReduce, Hadoop, Mahout, Lucene, NLTK, Pregel, etc.)
2. Applied Artificial Intelligence Analytics platforms (Hadoop, Spark, Data Lakes, others)
3. Real time and streaming analytics systems (Flume, Kafka, Storm)
4. Hadoop Ecosystem/platform
5. Azure Data Analytics platforms (HDInsight, APS and PDW, etc)
6. Amazon Data Analytics platform (Kinesis, EMR, etc)
7. Other cloud-based Data Analytics platforms (HortonWorks, Vertica LexisNexis HPCC System, etc)
8. Cognitive platforms (such as IBM Watson, Microsoft Cortana, others)
9. Kaggle competition, resources and community platform
10. Anaconda ecosystem
11. Google Colab
12. R Studio
13. Mathcad

Data description:
Ratings distribution for all 13 Applied Artificial Intelligence tools can be seen in Table below. Once again, all the tools are highly rated (rates 3-5).

	1	2	3	4	5
1	56/1042 (5.4%)	76/1042 (7.3%)	318/1042 (30.5%)	288/1042 (27.6%)	304/1042 (29.2%)
2	30/1042 (2.9%)	72/1042 (6.9%)	323/1042 (31%)	324/1042 (31.1%)	293/1042 (28.1%)
3	27/1042 (2.6%)	61/1042 (5.9%)	395/1042 (37.9%)	324/1042 (31.1%)	235/1042 (22.6%)
4	34/1042 (3.3%)	101/1042 (9.7%)	386/1042 (37%)	317/1042 (30.4%)	204/1042 (19.6%)
5	32/1042 (3.1%)	71/1042 (6.8%)	382/1042 (36.7%)	301/1042 (28.9%)	256/1042 (24.6%)
6	37/1042 (3.6%)	71/1042 (6.8%)	389/1042 (37.3%)	310/1042 (29.8%)	235/1042 (22.6%)
7	37/1042 (3.6%)	109/1042 (10.5%)	406/1042 (39%)	300/1042 (28.8%)	190/1042 (18.2%)
8	35/1042 (3.4%)	84/1042 (8.1%)	353/1042 (33.9%)	308/1042 (29.6%)	262/1042 (25.1%)
9	40/1042 (3.8%)	91/1042 (8.7%)	391/1042 (37.5%)	301/1042 (28.9%)	219/1042 (21%)
10	46/1042 (4.4%)	112/1042 (10.7%)	408/1042 (39.2%)	266/1042 (25.5%)	210/1042 (20.2%)
11	35/1042 (3.4%)	83/1042 (8%)	356/1042 (34.2%)	276/1042 (26.5%)	292/1042 (28%)
12	48/1042 (4.6%)	108/1042 (10.4%)	407/1042 (39.1%)	284/1042 (27.3%)	195/1042 (18.7%)
13	49/1042 (4.7%)	91/1042 (8.7%)	427/1042 (41%)	258/1042 (24.8%)	217/1042 (20.8%)

Discussion:
Answers to this question can help us design popular Applied Artificial Intelligence courses in regard of practical Applied Artificial Intelligence tools to be used to assist theoretical lectures. Surveyed students identified as most popular tools: Applied Artificial Intelligence Analytics platforms (Hadoop, Spark, Data Lakes, others), Applied Artificial Intelligence and distributed computing tools (Spark, MapReduce,

Hadoop, Mahout, Lucene, NLTK, Pregel, etc.), and Google Colab. Least popular were: Anaconda ecosystem, R Studio, and Mathcad.

3.29. Please rate the competencies which academic/analytical Applied Artificial Intelligence employee should have?

The last question in this group (Important competencies) was to rate the competencies which academic/analytical Applied Artificial Intelligence employee should have (offered ratings were the same, ranging from 1 (low importance) to 5 (high importance)):

1. Ability to perform simulations and experiments
2. Ability to verify results with statistical tools
3. Ability to carry out feasibility studies on new technologies, methods, and standards that could be of use to the organization
4. Ability to innovate and modify methods and approaches used in the organization
5. Ability to write research or technical papers on the results of work
6. Ability to apply modern methods of psychology and pedagogy in everyday work
7. Ability to patent inventions and technical innovations, to perform standardization of developed systems and processes
8. Ability to ensure and manage copyright protection of software products and to carry out their price evaluation

Data description:
Ratings distribution for all 8 competencies can be seen in Table below, with the similar distribution as before.

	1	2	3	4	5
1	38/1042 (3.6%)	64/1042 (6.1%)	241/1042 (23.1%)	304/1042 (29.2%)	395/1042 (37.9%)
2	21/1042 (2%)	68/1042 (6.5%)	257/1042 (24.7%)	342/1042 (32.8%)	354/1042 (34%)
3	23/1042 (2.2%)	54/1042 (5.2%)	320/1042 (30.7%)	347/1042 (33.3%)	298/1042 (28.6%)
4	28/1042 (2.7%)	56/1042 (5.4%)	292/1042 (28%)	337/1042 (32.3%)	329/1042 (31.6%)
5	32/1042 (3.1%)	118/1042 (11.3%)	313/1042 (30%)	318/1042 (30.5%)	261/1042 (25%)
6	49/1042 (4.7%)	135/1042 (13%)	351/1042 (33.7%)	272/1042 (26.1%)	235/1042 (22.6%)
7	36/1042 (3.5%)	80/1042 (7.7%)	346/1042 (33.2%)	325/1042 (31.2%)	255/1042 (24.5%)
8	54/1042 (5.2%)	98/1042 (9.4%)	336/1042 (32.2%)	285/1042 (27.4%)	269/1042 (25.8%)

Discussion:
This question gives us the clear direction which future Applied Artificial Intelligence trainings should take. Workers in IT sector find the following competencies most important for academic/analytical Applied Artificial Intelligence employees: Ability to perform simulations and experiments and Ability to verify results with statistical tools. Least important were: Ability to apply modern methods of psychology and pedagogy in everyday work and Ability to ensure and manage copyright protection of software products and to carry out their price evaluation.

3.30. Please evaluate your completed competency training. Put a point from 1 to 5 *

The follow-up question aims to answer what the quality of the conducted competency level is from the perspective of individuals. Thirteen evaluation metrics are included, ranging from mastering the techniques of scientific work and writing to developing logical thinking capabilities. All competencies are graded on a scale of 1 to 5.

Data description:
Based on the list of questions and the corresponding results, it is evident that the students exhibited the poorest performance in mastering the techniques of scientific work (11.6%) and in mastering the ability to use industrial architectures in the development of IS (12.9%). On the other hand, the students demonstrated the best performances in mastering their ability to adapt to changes in the IT market (25.9%) and in significantly improving their logical thinking skills (24.8%).

1	Mastering the techniques of scientific work
2	Mastering the ability to write scientific texts
3	Individual professional and educational consulting
4	Mastering Business Analysis methods
5	Acquiring skills in managing IT projects
6	Professional knowledge and skills in software development
7	Professional knowledge and skills in the development of IS
8	Acquiring the skills of system administration
9	Mastering the ability to use industrial architecture in the development of IS
10	Mastering software testing technology and IS
11	Acquiring skills systems analyst
12	Development of logical, algorithmic, systems thinking
13	Ability to adapt to changes in the IT market

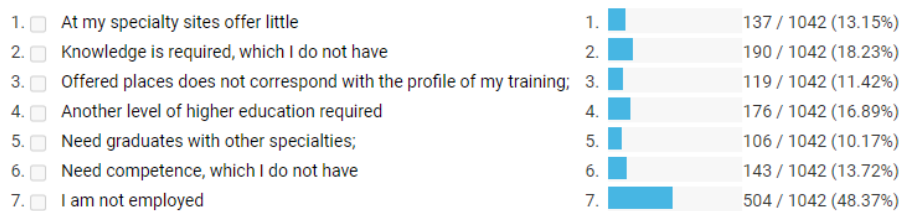|	1	2	3	4	5
1	121/1042 (11.6%)	140/1042 (13.4%)	352/1042 (33.8%)	249/1042 (23.9%)	180/1042 (17.3%)
2	108/1042 (10.4%)	183/1042 (17.6%)	362/1042 (34.7%)	244/1042 (23.4%)	145/1042 (13.9%)
3	77/1042 (7.4%)	148/1042 (14.2%)	379/1042 (36.4%)	271/1042 (26%)	167/1042 (16%)
4	136/1042 (13.1%)	169/1042 (16.2%)	351/1042 (33.7%)	242/1042 (23.2%)	144/1042 (13.8%)
5	89/1042 (8.5%)	118/1042 (11.3%)	323/1042 (31%)	296/1042 (28.4%)	216/1042 (20.7%)
6	79/1042 (7.6%)	120/1042 (11.5%)	313/1042 (30%)	287/1042 (27.5%)	243/1042 (23.3%)
7	106/1042 (10.2%)	137/1042 (13.1%)	365/1042 (35%)	258/1042 (24.8%)	176/1042 (16.9%)
8	109/1042 (10.5%)	163/1042 (15.6%)	352/1042 (33.8%)	261/1042 (25%)	157/1042 (15.1%)
9	134/1042 (12.9%)	171/1042 (16.4%)	347/1042 (33.3%)	239/1042 (22.9%)	151/1042 (14.5%)
10	114/1042 (10.9%)	152/1042 (14.6%)	367/1042 (35.2%)	242/1042 (23.2%)	167/1042 (16%)
11	115/1042 (11%)	161/1042 (15.5%)	345/1042 (33.1%)	252/1042 (24.2%)	169/1042 (16.2%)
12	66/1042 (6.3%)	111/1042 (10.7%)	323/1042 (31%)	284/1042 (27.3%)	258/1042 (24.8%)
13	84/1042 (8.1%)	107/1042 (10.3%)	305/1042 (29.3%)	276/1042 (26.5%)	270/1042 (25.9%)

Discussion:

Evaluating competency training demonstrated that IT workers highly value both soft competencies like Development of logical, algorithmic, systems thinking and Ability to adapt to changes in the IT market, as well as professional skills like Professional knowledge and skills in software development and Acquiring skills in managing IT projects. Least valued are Mastering business analysis methods and Mastering the ability to use industrial architecture in the development of IS.

3.31. What difficulties have you encountered in employment?

The questions aim to answer the difficulties that students encountered in employment by analysing the required knowledge, special competencies, and study profiles necessary for the job.

Data description:

The results indicate that nearly 50% of students are unemployed and that employment requires knowledge that students do not possess (18.23%). The least significant issue is the requirement for graduates with other specialties (10.17%).

31. What difficulties have you encountered in employment? *

1. ☐ At my specialty sites offer little	1.	137 / 1042 (13.15%)
2. ☐ Knowledge is required, which I do not have	2.	190 / 1042 (18.23%)
3. ☐ Offered places does not correspond with the profile of my training;	3.	119 / 1042 (11.42%)
4. ☐ Another level of higher education required	4.	176 / 1042 (16.89%)
5. ☐ Need graduates with other specialties;	5.	106 / 1042 (10.17%)
6. ☐ Need competence, which I do not have	6.	143 / 1042 (13.72%)
7. ☐ I am not employed	7.	504 / 1042 (48.37%)

Discussion:

Difficulties that IT workers encountered during their career once again confirm the proclaimed goals of FAAI project. Namely, IT workers answered in large majority that they encountered situations where Knowledge was required, which they did not possess or Competence was needed, which they did not have. Both problems should be tackled by designing adequate FAAI trainings in cooperation with business sector. Workers also had problems where Another level of higher education was required.

3.32. Evaluate your professional prospects in the future? Put a point from 1 to 5

The question aims to answer the future professional prospects regarding reliable employment and the possibility of professional conversion.

Data description:

The results are affirmative regarding both statements. 35.2% of students believe that reliable employment is of the utmost importance (given a grade of 5 points), and the prospect of professional conversion also received high grades (31.1%).

32. Evaluate your professional prospects in the future? Put a point from 1 to 5 *

	1	2	3	4	5
Reliable employment	37/1042 (3.6%)	49/1042 (4.7%)	253/1042 (24.3%)	336/1042 (32.2%)	367/1042 (35.2%)
Possibility of professional conversion	42/1042 (4%)	79/1042 (7.6%)	281/1042 (27%)	316/1042 (30.3%)	324/1042 (31.1%)

Discussion:
Based on the answers, it is important for the course to enable students to refine competencies that will allow them to undergo professional conversion if required and to secure reliable employment.

3.33. Select a profession for which you are working or want to work (in accordance with the list of the European framework of IT competences)

The following question provides information about the professions that students are interested in or their current job profile if they are employed. The question includes 24 different job profiles, ranging from developers, analysts, and specialists to administrators and managers.

Data description:
The results clearly demonstrate that the majority of students either work or plan to work as software developers (57.97%). Systems administrators come in second place with 21.31%, while there is the least interest in ICT Operations Managers (3.84%).

1. ☐ Service Desk Agent	1.		63 / 1042 (6.05%)
2. ☐ Technical Specialist	2.		195 / 1042 (18.71%)
3. ☐ ICT Trainer	3.		65 / 1042 (6.24%)
4. ☐ Business Analyst	4.		111 / 1042 (10.65%)
5. ☐ Business Information Manager	5.		105 / 1042 (10.08%)
6. ☐ Project Manager	6.		269 / 1042 (25.82%)
7. ☐ ICT Consultant	7.		62 / 1042 (5.95%)
8. ☐ Digital Media Specialist	8.		108 / 1042 (10.36%)
9. ☐ Test Specialist	9.		176 / 1042 (16.89%)
10. ☐ Software Developer	10.		604 / 1042 (57.97%)
11. ☐ Systems Architect	11.		176 / 1042 (16.89%)
12. ☐ Systems Administrator	12.		222 / 1042 (21.31%)
13. ☐ Information System Developer	13.		125 / 1042 (12%)
14. ☐ ICT Operations Manager	14.		40 / 1042 (3.84%)
15. ☐ ICT Security Specialist	15.		76 / 1042 (7.29%)
16. ☐ Enterprise Architect	16.		62 / 1042 (5.95%)
17. ☐ Quality Assurance Manager	17.		70 / 1042 (6.72%)
18. ☐ Chief Information Officer (CIO)	18.		58 / 1042 (5.57%)
19. ☐ Network Specialist	19.		183 / 1042 (17.56%)
20. ☐ Database Administrator	20.		211 / 1042 (20.25%)
21. ☐ Systems Analyst	21.		144 / 1042 (13.82%)
22. ☐ Service Manager	22.		84 / 1042 (8.06%)
23. ☐ Ict Security Manager	23.		73 / 1042 (7.01%)
24. ☐ Account Manager	24.		117 / 1042 (11.23%)

Discussion:

FAAI trainings and courses and guidelines for their design have to take into account desirable professions for which the respondents are working or want to work (in accordance with the list of the European framework of IT competences) and to be tailored specifically around them: Software Development, Project Manager, Systems Administrator, and Database Administrator.

3.34. How did you describe the place of labor activity and your work environment (if you are employed)?

This question analyses the work environment of employed students, with a focus on their work activities. The question provides students with 20 different options, ranging from acknowledging success to analysing the cooperative atmosphere.

Data description:

The problem with this question is that almost half of the students (47.33%) are not employed, and the options are not applicable to them. Among the second half of the students, most of them (24% of all students) stated that their work is related to projects, and their success is acknowledged. In contrast, only 3.83% stated that their suggestions for improvement are taken into consideration.

34. How did you describe the place of labor activity and your work environment (if you are employed)?

1. ☐	The work is related with the projects	1.	238 / 991 (24.02%)
2. ☐	Specialists of different profiles are in collective, which I work in	2.	123 / 991 (12.41%)
3. ☐	I regularly co-operate with colleagues which have other profile of preparation	3.	159 / 991 (16.04%)
4. ☐	My work is often estimated	4.	122 / 991 (12.31%)
5. ☐	Success is acknowledged	5.	191 / 991 (19.27%)
6. ☐	I count on own forces at the decision of problem	6.	88 / 991 (8.88%)
7. ☐	An innovative climate dominates	7.	53 / 991 (5.35%)
8. ☐	I must think wider than scopes of my specialty often	8.	139 / 991 (14.03%)
9. ☐	My initiative is valued	9.	162 / 991 (16.35%)
10. ☐	My tasks change often	10.	174 / 991 (17.56%)
11. ☐	I have possibility to make decision in my sphere of activity	11.	133 / 991 (13.42%)
12. ☐	My work requires loneliness	12.	52 / 991 (5.25%)
13. ☐	My work is good time certain	13.	101 / 991 (10.19%)
14. ☐	I organize my work Independently	14.	134 / 991 (13.52%)
15. ☐	My work is related to international cooperation	15.	128 / 991 (12.92%)
16. ☐	My suggestions on perfection in earnest are checked up	16.	38 / 991 (3.83%)
17. ☐	I need a foreign language in everyday work	17.	167 / 991 (16.85%)
18. ☐	A large value gets to further preparation and in-plant training	18.	42 / 991 (4.24%)
19. ☐	A co-operative atmosphere dominates	19.	113 / 991 (11.4%)
20. ☐	I am not employed	20.	469 / 991 (47.33%)

Discussion:
Answers were very various, but several options stand out: The work is related with the projects (238 – 24.02%), Success is acknowledged (191 – 19.27%), My tasks change often (174 – 17.56%), I need a foreign language in everyday work (167 – 16.85%). Statements which least describe the place of labour activity and work environment are: A large value gets to further preparation and in-plant training (42 – 4.24%), My work requires loneliness (52 – 5.25%), and An innovative climate dominates (53 – 5.35%).

mini Quiz on AI

The following questions are part of the mini quiz conducted among participating students for statistical purposes of the project only. The personal results will not be published or made available for publicity.
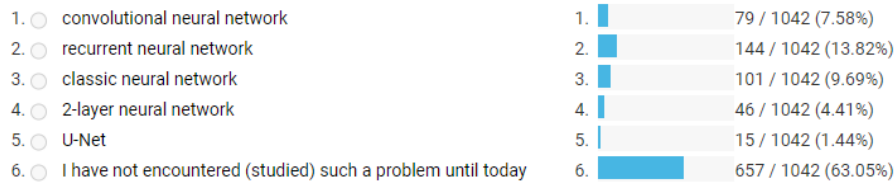
3.35. What neural networks are used for coping with sequences?

This question is followed by six different answer options, including one that indicates a lack of knowledge about the topic of the question

Data description:
The results showed that 63% of students did not know the answer to the question. Among those who provided an answer, 13.82% selected recurrent neural networks, while only 1.44% selected U-net.

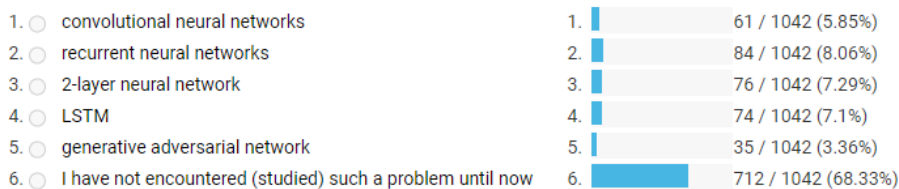**35. What neural networks are used for coping with sequences? ***

1. ○ convolutional neural network	1.	79 / 1042 (7.58%)
2. ○ recurrent neural network	2.	144 / 1042 (13.82%)
3. ○ classic neural network	3.	101 / 1042 (9.69%)
4. ○ 2-layer neural network	4.	46 / 1042 (4.41%)
5. ○ U-Net	5.	15 / 1042 (1.44%)
6. ○ I have not encountered (studied) such a problem until today	6.	657 / 1042 (63.05%)

Discussion:
Since the correct answer to the question is 'recurrent neural network', it can be concluded that only 13.82% of students were able to answer the question correctly.

3.36. What kind of neural network does allow us to avoid vanishing gradient problem?

This question also has six possible answers, with five offering specific network solutions.

Data description:
Once again, it is shown that the majority of students do not know the answer to the question (68.33%). The differences between other selections are small, ranging from 8.06% for recurrent neural networks to generative adversarial network selected by 3.36% of students.

36. What kind of neural network does allow us to avoid vanishing gradient problem? *

1. ○ convolutional neural networks	1.	61 / 1042 (5.85%)
2. ○ recurrent neural networks	2.	84 / 1042 (8.06%)
3. ○ 2-layer neural network	3.	76 / 1042 (7.29%)
4. ○ LSTM	4.	74 / 1042 (7.1%)
5. ○ generative adversarial network	5.	35 / 1042 (3.36%)
6. ○ I have not encountered (studied) such a problem until now	6.	712 / 1042 (68.33%)

Discussion:
LSTM is a solution for the vanishing gradient problem, which was recognized by only 7.1% of students. The overall conclusion is that students are not familiar with this specific problem and its applicable solution.
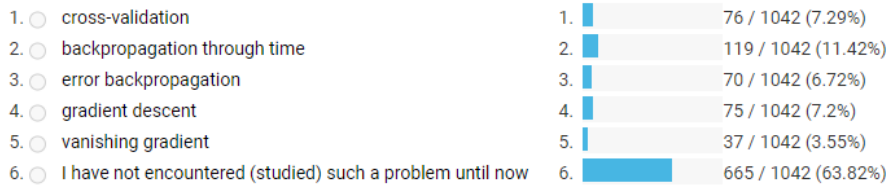
3.37. What procedure is used for tuning the parameters of recurrent neural network?

This question tries to test students' knowledge on tuning parameters of recurrent neural networks.

Data description:

The trend of students lacking deep learning knowledge continues with 63.82% of students not knowing the answer. Out of the remaining students, 11.42% selected backpropagation through time as the answer, while only 3.55% chose to use vanishing gradient to solve the problem.

37. What procedure is used for tuning the parameters of recurrent neural network? *

1. ○ cross-validation	1.	76 / 1042 (7.29%)
2. ○ backpropagation through time	2.	119 / 1042 (11.42%)
3. ○ error backpropagation	3.	70 / 1042 (6.72%)
4. ○ gradient descent	4.	75 / 1042 (7.2%)
5. ○ vanishing gradient	5.	37 / 1042 (3.55%)
6. ○ I have not encountered (studied) such a problem until now	6.	665 / 1042 (63.82%)

Discussion:
Backpropagation through time is the correct answer for the given question, implying that the students who selected one specific parameter had the highest percentage of correct answers.

3.38. What is the purpose of the usage of the activation functions inside the neural networks?

The following question aims to test students' knowledge about the basic element of neural networks: activation functions. The results are similar to the previous cases.

Data description:
The results show that 64.3% of students do not possess knowledge in the required field. 14.11% of them believe that the role of activation functions is to add nonlinearity to the network, while only 2.69% think that these functions have no effect on the network.

38. What is the purpose of the usage of the activation functions inside the neural networks? *

1. ○ to preserve the linear behavior of the network	1.	60 / 1042 (5.76%)
2. ○ to add the nonlinearity to the network	2.	147 / 1042 (14.11%)
3. ○ to add the convexity to the network	3.	85 / 1042 (8.16%)
4. ○ to add the concavity to the network	4.	52 / 1042 (4.99%)
5. ○ none effect	5.	28 / 1042 (2.69%)
6. ○ I have not encountered (studied) such a problem until now	6.	670 / 1042 (64.3%)
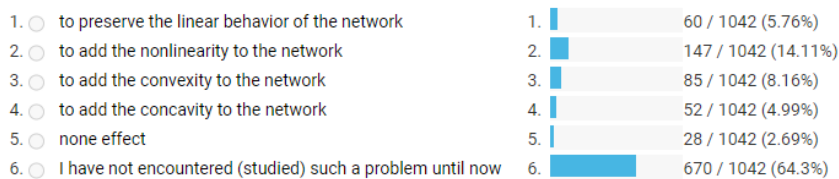
Discussion:
Assuming that adding nonlinearity is the correct answer, it can be concluded that only 14% of students who attempted to select a specific solution were correct. However, it is evident that almost 86% of students selected the wrong answer or stated that they didn't know the answer, highlighting a significant knowledge gap in this area.
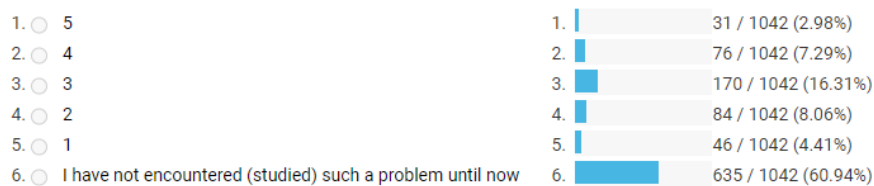
3.39. How many layers are required for the neural network to model any continuous function?

In this question, the students' knowledge regarding the importance of network layers is tested.

Data description:
Once again, more than 60% of students stated that they don't know the answer. 16% of them selected 3 layers as the answer, while only 2.98% think it is required to use 5 layers to model a continuous function.

39. How many layers are required for the neural network to model any continuous function? *

1.	5	1.	31 / 1042 (2.98%)
2.	4	2.	76 / 1042 (7.29%)
3.	3	3.	170 / 1042 (16.31%)
4.	2	4.	84 / 1042 (8.06%)
5.	1	5.	46 / 1042 (4.41%)
6.	I have not encountered (studied) such a problem until now	6.	635 / 1042 (60.94%)

Discussion:
16,31% of students was correct stating that 3 layers are required for modelling the functions. If we assume that this question was the easiest one, we can see that almost 84% of the students do not possess elemental knowledge on Artificial Intelligence.
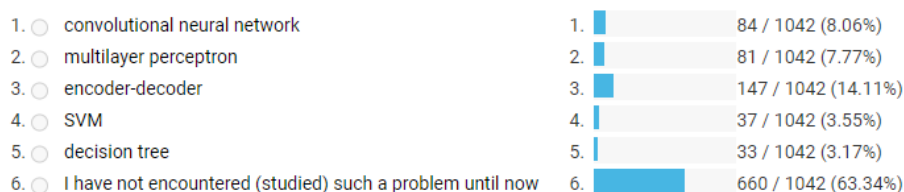
3.40. What model is used for the language translation?

The final question is about language translation models. Five different models are provided, ranging from Convolutional Neural Networks to Decision Trees.

Data description:
After this final question, it can be definitively concluded that 6 out of ten participants don't have any experience or knowledge with artificial neural networks. As for the answer to this specific question, 14.11% of students selected the encoder-decoder option, while only 3.17% think that the problem could be solved with decision trees.

40. What model is used for the language translation? *

1.	convolutional neural network	1.	84 / 1042 (8.06%)
2.	multilayer perceptron	2.	81 / 1042 (7.77%)
3.	encoder-decoder	3.	147 / 1042 (14.11%)
4.	SVM	4.	37 / 1042 (3.55%)
5.	decision tree	5.	33 / 1042 (3.17%)
6.	I have not encountered (studied) such a problem until now	6.	660 / 1042 (63.34%)

Discussion:

The combination of encoder-decoder networks is the correct selection for this question, implying that the highest percentage of students who tried to answer the question (14.11%) was correct. Still, analysing the results from the whole group of students, the overall performance is poor, depicted with more than 85% of students who do not know the correct answer.

4. Conclusions

The interest of IT graduates Masters and IT Alumni in Information Systems and Technologies for the online survey, in the scope of the Erasmus+ "Future is in Applied Artificial Intelligence" (FAAI) project, was impressive, with 1042 participants, mostly from the partners' countries. That interest demonstrates the clear need of the target population for Applied Artificial Intelligence (AAI) contents as well as Applied Artificial Intelligence trainings and courses. Respondents were mostly young people (72% younger than 24 years) still at universities or working for a short period of time.

Survey respondents were mostly student population engaged in Bachelor and Master programmes of different kinds of IT studies, proving that the objectives of the project and target groups were set correctly. Good foundation of the FAAI project and the growing need for courses dealing with AAI are also confirmed by the fact that the majority of students interested in the survey on the AAI, do not possess the knowledge about any relevant course at their university. Surveyed students demonstrated large interest in AAI content and new courses whereby their opinion is that the developing course should lean heavily on practical implementation with laboratory work, students' projects and internships. Having almost all of the IT students interested or neutral regarding studying AAI course, is in line with assumption of the project that there is a gap regarding the AAI and other digital skills and a need for new initiatives to ensure that these skills are adequately promoted in the curriculum, in teacher development, in assessment practices and in learning content.

Survey showed that partner countries of FAAI project should focus on implementing AAI content into study programs by either introducing completely new courses or by innovating existing courses. Improving material component (equipment, laboratories) is secondary, but also important factor. Presenting AAI research in a form of website should be one of the most important goals for partner universities, because that kind of informing is the easiest way to motivate and include students and other target groups in AAI topics. Large interest of the students in AAI issues, despite their low level of insight adds to the project goal to identify the underrepresented skills, the rationale behind the phenomenon of talented people who lack the traditional credentials to land a good job and the AAI with the most pressing needs. Answers obtained by the students interested in taking part in AAI Courses showed that designed AAI courses and trainings should be attractive if they are heavily based on techniques of collecting data from different sources as well as on analytics of those data, i.e., machine learning and data mining techniques.

Almost the same number of surveyed persons was currently working or was without a paid job. This proportion allows needed diversity for the survey analysis and

enabled analysis of the needs of working people also, not only the students. Answers provided by working population showed that designed AAI trainings should be tailored particularly toward people working in the private sector (by content, time of lectures...). These people are mostly motivated to improve their competencies and to learn more about AAI. Proposed AAI courses should target younger people with less working experience because they are more motivated and still interested in learning new topics, for which they feel that could help them improve their careers.

Specific attention in the survey was paid to the workers in the IT industry. Results showed that designed AAI trainings should be heavily oriented toward Software developers because they are making the majority of the target group for developing digital competencies and skills in the area of AAI. During designing AAI trainings, project partners must have in mind that workers in IT sector mostly work at positions where bachelor diploma is needed (more than half of surveyed persons). These data are consistent with the lack of IT experts in the market. So, the most logical choice to place AAI courses would be at Bachelor studies or as part some specialization programmes. Large majority of workers in IT sector either have no experience or very limited experience (up to one year) in AAI field, meaning that designed courses have to be at the basic level providing all the necessary knowledge for dealing with AAI.

Large majority of working respondents answered that AAI issues are important or somewhat important to their job and that AAI contents would be valuable for their future career development, proving the foundation of FAAI project and importance of introducing structured trainings in AAI topics. Developing of digital and soft skill becomes more and more important in today's job market. Young people recognize their importance as well as their employers. Any designed training should also focus on developing soft skills, especially those related to Teamwork, Communication and Time management. Creativity, Resolving problems and Capacity to learn and apply knowledge are also highly valued.

Most valued professional competences which a specialist in AAI should have and which should be taught during AAI trainings are Using appropriate training and testing methodologies when deploying machine learning algorithms, Recognizing the breadth and utility of machine learning methods, Selecting appropriate (classes of) machine learning methods for specific problems, Comparing and contrasting machine learning methods. Most valued related competence for specialists in AAI is Effectively use variety of data analytics techniques (Machine Learning, Data Mining, Prescriptive and Predictive Analytics). Workers in IT sector find the following competencies most important for academic/analytical Applied Artificial Intelligence employees: Ability to perform simulations and experiments and Ability to verify results with statistical tools. Surveyed students identified as most popular AAI tools: Applied Artificial Intelligence Analytics platforms (Hadoop, Spark, Data Lakes, others), Applied Artificial Intelligence and distributed computing tools (Spark, MapReduce, Hadoop, Mahout, Lucene, NLTK, Pregel, etc.), and Google Colab.

Difficulties which IT workers encountered during their career once again confirm the proclaimed goals of FAAI project. Namely, IT workers answered in large majority that they encountered situations where Knowledge was required, which they did not possess or Competence was needed, which they did not have. Both problems should be tackled by designing adequate AAI trainings in cooperation with

business sector. AAI trainings and courses and guidelines for their design have to take into account desirable professions for which the respondents are working or want to work (in accordance with the list of the European framework of IT competences) and to be tailored specifically around them, especially professions like Software Development, Project Manager, and Systems Administrator.

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