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FAAI:

The Future is in Applied Artificial Intelligence  
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01.09.2022 – 31.08.2024

# Research 1: Existing Training Courses in the Field of Applied AI: the state-of-the-art analysis for WP2





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15.09.2021

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**Summary:** This questionnaire that is subject of this document is a part of the research in connection with the objectives of project 2022-1-PL01-KA220-HED-000088359 "The Future is in Applied Artificial Intelligence" (FAAI) under the Erasmus + program. This project aims to join together Universities, and businesses and provide innovative solutions to develop AI experts. The questions in this study aimed to research the needs and expectations of business organizations to propose training specialists in the field of Applied AI. This paper presents a short review of the offered training courses in Applied AI and describes them. Despite existing training courses offered, there is a need of aggregating and inferring information on topics required and covered within the training courses in the field of AI. DataProject site: <http://faai.ath.edu.pl/0>.

**Keywords:** applied AI, training courses

### 1. Introduction

Artificial intelligence and automation are likely to be adopted by even more companies to improve efficiency and productivity. These technologies can be used to automate repetitive tasks, process large amounts of data, and make more accurate predictions. This will have the added benefit of freeing up employees to focus on more complex and creative tasks.

In particular, we expect to see an increase in use of AI in the hiring process such as finding candidates and screening CVs. AI also shows success in removing bias from the hiring process and improving the decision-making of HR professionals and hiring managers. AI can be used to analyze data and identify patterns, helping managers and employees make more informed decisions.

This survey was carried out in the context of project no. 2022-1-PL01-KA220-HED-000088359 entitled "The Future is in Applied Artificial Intelligence". Answers were obtained by searching and analyzing the job offers in the field of artificial intelligence. The questionnaire was performed on-line, using google forms tools.

Due to various formats and specification of advertising information in each case the data was collected by scientists based on phrase search.

To obtain a wide range of data, multiple choice question fields, with additional open question fields were offered to overcome the shortcomings of narrowed answers suggestions. The survey contains both open and closed questions. To make a process of data collection unbiased no additional recommendation was added. No events were reported during that time that could influence the result.

The job offers were selected randomly from the advertising sites. The web sites were selected based on popularity and number of references.

The survey data were presented in a quantitative form. The data was aggregated to the category based on syntactic analysis i.e., the difference in form and not meaning. The open descriptions were analyzed with the help of bar charts of word frequencies, word clouds, and word associates.

The questions in this study aim to research the needs and expectations of business organizations and to create a profile of a specialist in the field of artificial intelligence. Despite direct Employers survey this survey allows to obtain additional information on specific skills for AI experts profile and specific job opportunities.

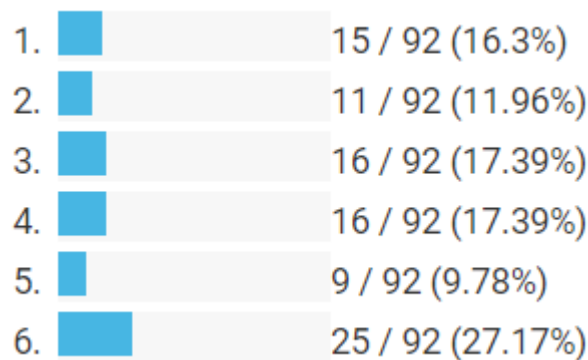
## 2. Collection and analysis of data

The data was acquired by five partner institutions scientists. In total 92 questionnaires were collected by 10 researchers. More precisely, 16 questionnaires were obtained from the Poland market, 29 questionnaires from the Bulgarian market, 16 from the Serbian market, 16 from the Slovak market and 15 from the Montenegrin market.

## 3. Results

### 3.1. Country in which the training takes place

The first question is what is the country in which the training course is organized. Possible answers were as follows: 1 - Poland, 2 - Bulgaria, 3 - Serbia, 4 - Slovakia, 5 - Montenegro, 6 - Other under which it was possible to explicitly name the country not previously enumerated. Histogram obtained from the raw data is presented in Figure 1.



#### Data description:

According to the research data, the training courses are offered in Poland, Bulgaria, Serbia, Slovakia, Montenegro, but also in other countries. These are as follows: England, Germany, Romania, Macedonia, Hungary, Scotland and Slovenia. Nevertheless, all the offers take place in the EU area and UK.

#### Discussion:

The survey shows that in many countries there are a wide variety of courses referred to artificial intelligence and related fields. This situation is expected having in mind that artificial intelligence occupies a very big research and practitioners community for a long period of time.

#### Main conclusions:

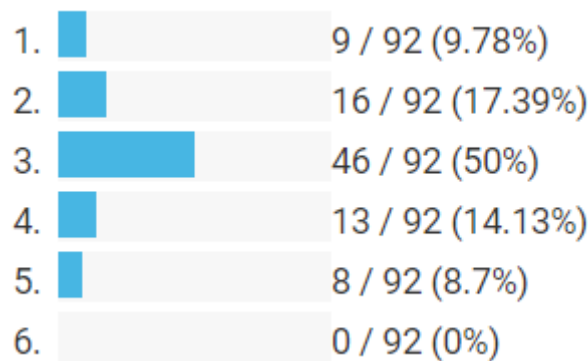
- Despite the existence of other courses there is an essential need for unique courses that will allow competency based education in the field of artificial intelligence.

- Unique course design according to a competency based framework will define clear standards that must be achieved by artificial intelligence training courses.

### 3.2. Type of the course

#### Data description:

The second question is related to the specific type of the course. Possible answers were as follows: 1 - course at the academy, 2 - bachelor degree program, 3 - master degree program, 4 - training course, 5 - short course, 6 - exchange program. Histogram obtained from the raw data is presented in Figure 2.



#### Discussion:

The previous results clearly indicate that the majority of courses related to artificial intelligence are situated in master studies. Together with bachelor studies and academic courses these three types occupy more than 3/4 of all courses. There are about 14% of courses that can be considered as training courses.

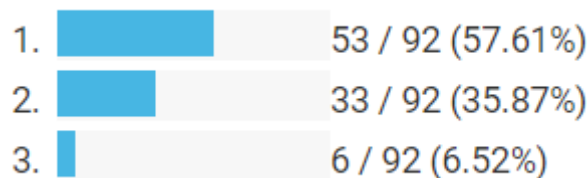
#### Main conclusions:

- The majority of courses related to artificial intelligence are connected to university and academic community, indicating huge space for designing and implementing training courses that will be dominantly oriented to the applied artificial intelligence.
- Unique course design according to a competency based framework will define clear standards that must be achieved by artificial intelligence training courses, especially in real case applications.

### 3.3. Level of the course

#### Data description:

The third question is related to the level of the proposed course. Possible answers were as follows: 1 - Advanced, 2 - Beginner, 3 - Other under which it was possible to explicitly specify the level not previously enumerated. Histogram obtained from the raw data is presented in Figure 3.

**Discussion:**

The previous results show that the unambiguous majority is advanced courses. About  $\frac{1}{3}$  are courses for beginners. Some categories under Other that appeared in the answers are: intermediate, online short courses, 5th year of Computer science studies, 4th year of computer science studies, for professionals in management and beginners with knowledge of programming.

**Main conclusions:**

- Previous figures prove that space for training courses devoted to applied artificial intelligence exists.
- Unique course design according to a competency based framework will define clear standards that must be achieved by any artificial intelligence training course.

**3.4. Name of the training course/discipline****Data description:**

This question is related to the name of the training course. Answers are found in the questionnaire are as follow: AI ENGINEER MASTER'S PROGRAM In collaboration with IBM, Applied Artificial Intelligence and User Experience, Artificial intelligence, Artificial intelligence - contemporary approach, Artificial Intelligence and Computing Intelligence, Artificial Intelligence and Data Analysis, Artificial Intelligence and Distributed Computing, ARTIFICIAL INTELLIGENCE AND ROBOTICS, Artificial Intelligence Code: 17840, Artificial intelligence methods, Bachelor's degree Applied Artificial Intelligence, Basics of artificial intelligence, Big Data and Artificial Intelligence, Computer Science MSc course – Artificial Intelligence specialization, CS 181: Machine Learning (2023), CS 182, Harvard, Data Science, AI & Digital Business, Eastern European Machine Learning Summer School, EITCA/AI Sztuczna Inteligencja, Elements of AI Embedded machine learning, Group Artificial Intelligence, IBM Master's in Artificial Intelligence, Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization, Industrial system software, Introduction to Artificial Intelligence / Data Science, Kurs online - Akademia Sztucznej Inteligencji Machine Intelligence and Robotics, Machine learning, Mathematical Methods of Artificial Intelligence, MSc APPLIED ARTIFICIAL INTELLIGENCE, Postgraduate Diploma in Artificial Intelligence, Processing of multimedia content, Unsupervised Learning, Recommenders, Reinforcement Learning, Системи машинного навчання, Системи штучного інтелекту.

**Discussion:**

The previous list contains 92 names of courses related to artificial intelligence and related fields. By analyzing the list it became obvious that only several of them are actually related to applied artificial intelligence and/or implemented in consortium with some respectable company. Good example is the course AI ENGINEER MASTER'S PROGRAM that is implemented in collaboration with IBM.

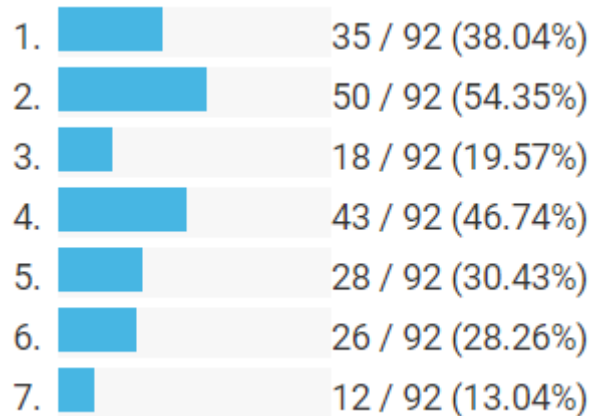
**Main conclusions:**

- There are a wide variety of courses related to artificial intelligence and related fields, but analyzing these we can conclude that only some of them are strongly connected to the possible application areas and domains.
- There are less than 1% courses that are organized in collaboration with respectable companies recognized to implement artificial intelligence or similar concepts into real use cases.
- There is no training course based on a competency based learning paradigm.

**3.5. Entry-level for the course - requirements for enrolling**

**Data description:**

This question considers an important aspect of any course, namely what is the required level of candidates to attend and successfully complete the course program. Possible answers were as follows: 1 - basic knowledge of statistics, 2 - basic knowledge of programming (Python, R), 3 - basic knowledge of data mining, 4 - basic knowledge of algorithms, 5 - mathematical modeling, 6 - No prior experience is required, 7 - Other under which it was possible to explicitly specify the level not previously enumerated. Histogram obtained from the raw data is presented in Figure 5.



**Discussion:**

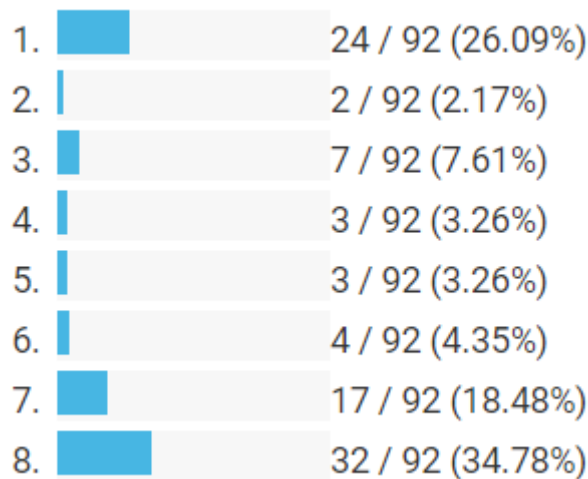
It is interesting to notice that more than a clear majority of courses propose a requirement to attend to have knowledge in programming in Python or R and knowledge in algorithms. Other categories such as knowledge in statistics and mathematical modeling, are also present in a significant number of courses. Finally, it is worth saying that about ¼ of all courses can be attended without any experience and/or knowledge.

**Main conclusions:**

- It is obvious that one can expect to be required to have specific knowledge in order to attend training courses in the field of applied artificial intelligence.
- Requirements for enrolling should be defined with respect to competency based learning methodology.

**3.6. Topics covered in the course****Data description:**

This question considers a very important question in designing artificial intelligence courses, especially in applied domain and with competency based learning paradigm. According to the questionnaire topics can be classified as follow: 1 - General, 2 - Knowledge representation and reasoning – logic based, 3 - Knowledge representation and reasoning – probability based, 4 - nPlanning and search strategies, 5 - Supervised learning, 6 - Unsupervised learning, 7 - Mixed methods, 8 - Deep learning. Histogram obtained from the raw data is presented in Figure 6.

**Discussion:**

The previous results indicate that the most topics are classified into deep learning (35%) and mixed methods (18%). General topics are also significantly present, around 26%. It is worth mentioning probabilistic based reasoning among rest topics.

**Main conclusions:**

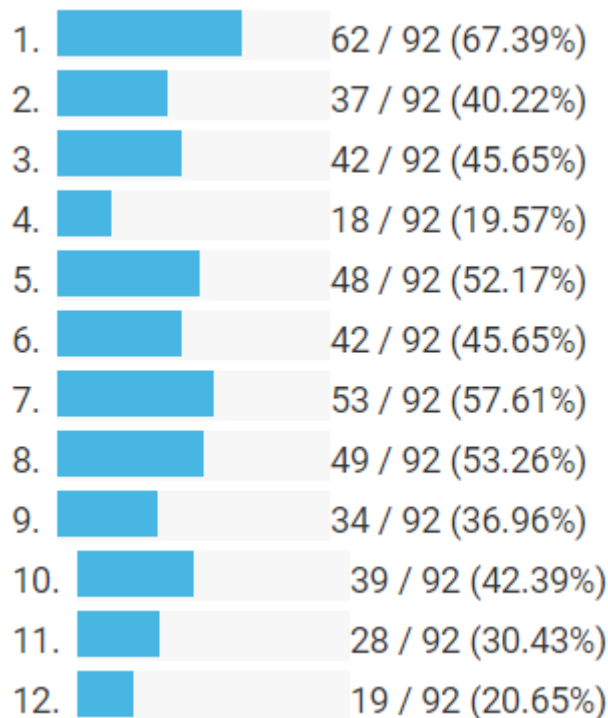
- Proposed topics in analyzed courses are with strong unbalanced distribution. Despite the fact that this can be in some way expectable or/and explainable, the training courses in the field of applied artificial intelligence should be prepared and implemented in a very careful way in order to equally include all proposed topics, especially in context of competency based learning methodology.
- Unique course design according to a competency based framework will define a set of topics that must be covered by any artificial intelligence training course.



### 3.7. What competencies should will be covered by the course

#### Data description:

This question is related to one of the most important concepts in competency based learning framework. The list of competencies specified are as follows: 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. Histogram obtained from the raw data is presented in Figure 7.



#### Discussion:

The previous results show that, according to this questionnaire, the most important competencies are: Describe major areas of AI as well as contexts in which AI methods may be applied, Select appropriate (classes of) machine learning methods for specific problems, Use appropriate training and testing methodologies when deploying machine learning algorithms, Recognize the breadth and utility of machine learning methods, Compare and contrast machine learning methods. It is worth mentioning the following competencies: Identify an appropriate performance metric for evaluating machine learning algorithms/tools for a given problem, Represent information in a logic formalism and apply relevant reasoning methods, Explain methods to mitigate the effects of overfitting and curse of dimensionality in the context of machine learning algorithms.

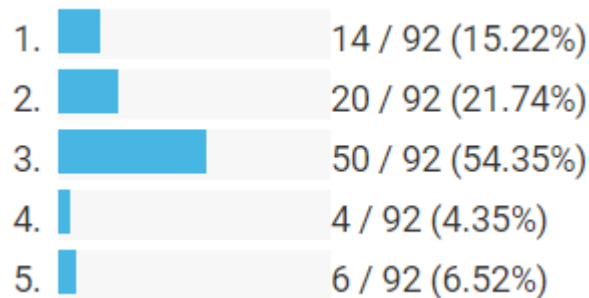
**Main conclusions:**

- Unique course design according to a competency based framework will define a set of main competencies and skills that must be achieved by finishing any artificial intelligence training course.
- It is very important to clearly indicate the set of competencies and skills that participants must achieve in training courses related to the applied artificial intelligence field. These results can be useful indicators.

**3.8. Expected results**

**Data description:**

Expected results of the course are considered in this question. Possible answers are as follows: 1 - Professional Certificate, 2 - Bachelor Degree, 3 - Master Degree, 4 - No certificate, 5 - Other under which it was possible to explicitly specify the level not previously enumerated. Histogram obtained from the raw data is presented in Figure 8.



**Discussion:**

The most expected results are master and bachelor degrees. These two categories occupy above  $\frac{3}{4}$  all answers. Of course, with a respectable percentage Professional Certificate as expected result from the course is present. Among category Other there are also interesting proposals: online course certificate, part of master/bachelor degree.

**Main conclusions:**

- It is of very importance to clearly define what a participant can expect when he eventually finishes a training course related to the applied artificial intelligence field. The previous results can be used as significant indicators.
- Unique course design according to a competency based framework will precisely define expected results not just in terms of diploma degree, but also in defining a list of competencies and corresponding skills.

### 3.9. Form of knowledge assessment

#### Data description:

This question considers knowledge assessments procedures during the training course related to the applied artificial intelligence field. This field was free to fill. The most frequent answers are as follows: Combination of exams, coursework and practicals, written and/or oral exam, practical project.

#### Discussion:

The results from this part of analysis should indicate what are the most appropriate knowledge assessment procedures or combination of such procedures for assessment in the training courses related to the applied artificial intelligence field.

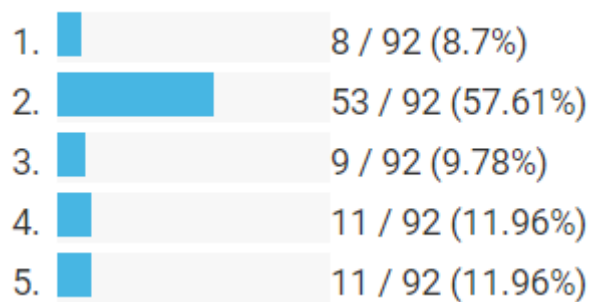
#### Main conclusions:

- Training course design according to a competency based framework should precisely define assessments procedures with respect to a list of competencies and corresponding skills expected to achieve by the course.
- Knowledge assessment procedures should be a compromise between competency based learning paradigm and traditional approaches.

### 3.10. Duration of training

#### Data description:

Training duration is considered in this question. Possible answers are as follows: 1 - less than 1 month, 2 - 1-6 months, 3 - 6-12 months, 4 - 12-24 months, 5 - more than 24 months. Histogram obtained from the raw data is presented in Figure 9.



#### Discussion:

The distribution of answers from the previous question should indicate the duration of a training course in the field of applied artificial intelligence. It is obvious that the final decision can be found between duration between 1 and 6 months.

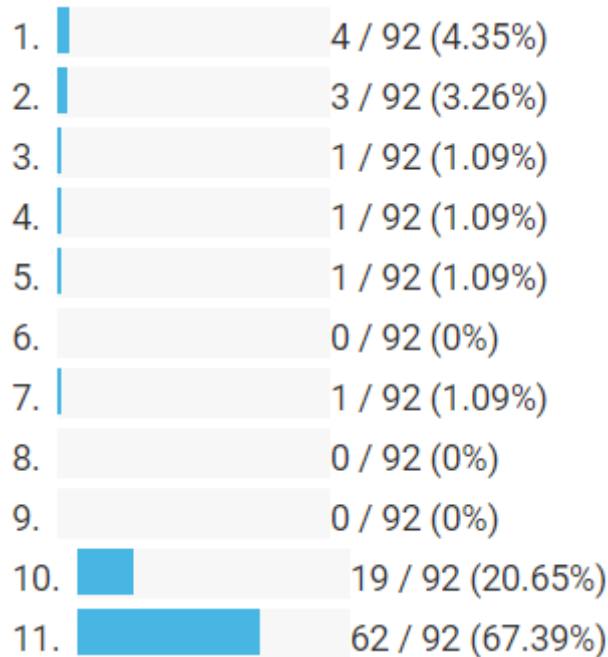
**Main conclusions:**

- Duration of a training course should be carefully considered and defined with respect to expected results and competencies that must be achieved during the course. The previous results can serve as useful indicators.

**3. 11. Price (in euro)**

**Data description:**

The last question is what is the price of the proposed training course. Possible answers were as follows: 1 - < 100, 2 - 100-250, 3 - 250-500, 4 - 500-750, 5 - 750-1000, 6 - 1000-1250, 7 - 1250-1500, 8 - 1500-1750, 9 - 1750-2000, 10 - > 2000, 11 - Not available. Histogram obtained from the raw data is presented in Figure 10.



**Discussion:**

The survey shows that the price greater than 2000 euros occupy about 20% of all answers. It is worth mentioning that the answer Not available obtains more than  $\frac{2}{3}$  all answers. It can be due to absence of enough information and novelty of the training course in the field of applied artificial intelligence.

**Main conclusions:**

- Despite the existence of other courses there is an essential need for unique courses that will allow competency based education in the field of artificial intelligence.
- Unique course design according to a competency based framework will define clearer standards regarding price estimation of such courses.

### 4. Conclusions

Based on the state-of-the-art analysis, it is evident that there are numerous training courses available in the field of Applied AI, each with its own strengths and weaknesses. However, competency-based learning paradigms appear to be particularly effective in developing practical skills and preparing individuals for real-world applications of AI. These courses focus on the acquisition of specific competencies and offer hands-on training with real-world problems, enabling learners to develop the necessary skills and knowledge to become successful AI practitioners.

Overall, it is essential to choose training courses that align with one's specific needs and goals, and also take into account the latest advancements in the field. By selecting a competency-based training course, learners can ensure that they are equipped with the practical skills and knowledge necessary to excel in the field of Applied AI.

It is important for training courses to keep up with the latest advancements in the field to remain relevant and effective.

Learners should also seek out training courses that offer opportunities for networking and collaboration with other professionals in the field.

Employers can benefit from investing in the training and development of their employees in Applied AI, as it can lead to improved performance and innovation.

Overall, selecting a competency-based training course is a worthwhile investment for individuals looking to develop their skills and knowledge in the field of Applied AI.

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