

Appendix

Table 1

Study programmes of the first, second, and third cycles of university studies related to artificial intelligence

No	Universities, faculty, study programmes, degree
1	University Rey Juan Carlos. Escuela Técnica Superior de Ingeniería Informática, Artificial Intelligence, first cycle, 1st cycle, 4 years, 240 ECTS, Spain; https://www.urjc.es/estudios/grado/7094-inteligencia-artificial
2	University Polytechnic of Madrid. Escuela Técnica Superior de Ingeniería Informática, Data Science and Artificial Intelligence, 1st cycle, 4 years, 240 ECTS, Spain; https://www.fi.upm.es/?id=gcdia
3	University Carlos III. Centro de Postgrado de la Universidad Carlos III de Madrid. Applied Artificial Intelligence, 2nd cycle, 1 year, 60 ECTS, Spain; https://www.uc3m.es/master/inteligencia-artificial-aplicada
4	University of Malaga. Escuela Técnica Superior de Ingeniería Informática, Software Engineering and Artificial Intelligence, 2nd cycle, 1 year, 60 ECTS, Spain; https://www.uma.es/etsi-informatica/info/129944/master-ing-del-sw-e-int-artific-plan-de-estudios-2021/
5	University Polytechnic of Madrid. Centro de I+D+i en Inteligencia Artificial de la UPM, Artificial Intelligence, 2nd cycle, 1 year, 60 ECTS, Spain; http://www.dia.fi.upm.es/masteria/
6	European University. Escuela de Arquitectura, Ingeniería y Diseño, Artificial Intelligence, 2nd cycle, 1 year, 30 ECTS, Spain; https://universidadeuropea.com/master-inteligencia-artificial-madrid/
7	International University of La Rioja. Escuela Superior de Ingeniería y Tecnología, Artificial Intelligence, 2nd cycle, 1 year, 60 ECTS, Spain; https://www.unir.net/ingenieria/master-inteligencia-artificial/claustro/
8	Euroinnova Business School. Master in Artificial Intelligence for developers, Artificial Intelligence for Programmers, 2nd cycle, 1 year, 60 ECTS, Spain; https://www.euroinnova.edu.es/master-inteligencia-artificial
9	University Rovira and Virgili. Escuela Técnica Superior de Ingeniería, Engineering on Computer Security and Artificial Intelligence, 2nd cycle, 1 year, 60 ECTS, Spain;

	https://www.urv.cat/es/estudios/masteres/oferta/ingenieria-seguridad-informatica/plan-estudios/
10	University Polytechnic of Catalonia. Facultad de Informática de Barcelona, Artificial Intelligence, 2nd cycle, 3 semesters, 90 ECTS, Spain; https://www.fib.upc.edu/es/estudios/masteres/master-en-inteligencia-artificial
11	University Polytechnic of Valencia. Master's Degree in Artificial Intelligence, Shape Recognition and Digital Image, 2nd cycle, 1 year, 60 ECTS, Spain; https://www.upv.es/titulaciones/MUIARFID/
12	National University of Education at Distance. Escuela Técnica Superior de Ingeniería Informática, Research Artificial Intelligence, 2nd cycle, 1 year, 60 ECTS, Spain; http://portal.uned.es/portal/page?_pageid=93,71542259&_dad=portal&_schema=PO_RTAL&idTitulacion=310801
13	Tartu University Faculty of Science and Technology. Study Programme: Computer Science, 2nd cycle, 2 years, 120 ECTS, Estonia; https://ut.ee/et/oppekavad/andmeteadus
14	Tartu University Faculty of Science and Technology. Study Programme: Software engineering, 2nd cycle, 2 years, 120 ECTS, Estonia; https://courses.cs.ttu.ee/pages/IVSM; https://ut.ee/en/curriculum/software-engineering
15	Tallinn University of Technology, School of IT. Study Programme: Computer Science, 2nd cycle, 2 years, 120 ECTS, Estonia; https://taltech.ee/infotehnoloogia-teaduskond/magistriope/informaatika
16	Tallinn University of Technology, School of IT. Study Programme: Computer and System Engineering, 2nd cycle, 2 years, 120 ECTS, Estonia; https://taltech.ee/en/computer-and-systems-engineering-0
17	Ss Cyril and Methodius University. Computer System Engineering Automation and Robotics, 1st cycle, 4 years, 240 ECTS, North Macedonia; https://feit.ukim.edu.mk/en/computer-system-engineering-automation-and-robotics/
18	Ss Cyril and Methodius University. Computer Science and Engineering, module: Intelligent information systems, 2nd cycle, 1 year, 60 ECTS, North Macedonia; https://www.finki.ukim.mk/en/studies/IIS-3-new

19	<p>Ss Cyril and Methodius University. Informatics sciences and computer engineering, module: Intelligent Systems Engineering, 2nd cycle, 1 year, 60 ECTS, North Macedonia;</p> <p>https://www.finki.ukim.mk/en/studies/InIS-new</p>
20	<p>Ss Cyril and Methodius University. Automation, Robotics and System Engineering, 1 year, 60 ECTS, North Macedonia;</p> <p>https://feit.ukim.edu.mk/en/automation-robotics-and-system-engineering/</p>
21	<p>The University of Information Science and Technology "St. Paul The Apostle". Machine Intelligence and Robotics, 1st cycle 4 years, 240 ECTS, North Macedonia;</p> <p>https://uist.edu.mk/wp-content/uploads/2018/07/UIST-AITMIR-4-years-240-ECTS-from-2018-19.pdf</p>
22	<p>University American College. Robotics, Artificial Intelligence, and Signal Processing, 1st cycle, 3 years, 180 ECTS, North Macedonia; Retrieved July 20, 2022, from</p> <p>https://uacs.edu.mk/home/school-of-computer-science-and-information-technology/</p>
23	<p>University American College. Robotics and bio-informatics, 2nd cycle, 2 years, 120 ECTS, North Macedonia; Retrieved July 20, 2022, from</p> <p>https://uacs.edu.mk/home/school-of-computer-science-and-information-technology/</p>
24	<p>University of Rijeka. Faculty of Engineering, Study Programme: Graduate University Study of Computing, 2nd cycle, 2 years, 120 ECTS, Croatia;</p> <p>http://www.riteh.uniri.hr/en/education/masters-degree-university/graduate-university-study-computer-engineering/</p>
25	<p>Faculty of Electrical Engineering and Computing / University of Zagreb. Study Programme: Graduate University Study of Computing - Data Science, 2nd cycle, 2 years, 120 ECTS; Croatia;</p> <p>https://www.fer.unizg.hr/en/studies/master/computing</p>
26	<p>Algebra University College. Study Programme: Specialist Graduate Professional Study Programme in Computer Science – Internet of Things and Artificial Intelligence, 2nd cycle, 2 years, 120 ECTS, Croatia;</p> <p>https://www.algebra.hr/sveuciliste/en/graduate-professional-program/joint-graduate-study-programme-in-computer-science-internet-of-things-and-artificial-intelligence/</p>
27	<p>Offenburg University. Department of Electrical Engineering, Medical Engineering and Computer Science, Applied Artificial Intelligence, 1st cycle, 210 ECTS, Germany;</p>

	https://www.hs-offenburg.de/en/studium/studiengaenge/bachelor/angewandte-kuenstliche-intelligenz/studieninteressierte
28	Offenburg University. Department of Electrical Engineering, Medical Engineering and Computer Science, Computer Science, 2nd cycle, 90 ECTS, Germany; https://emi.hs-offenburg.de/en/department-of-electrical-engineering-medical-engineering-and-computer-science
29	Offenburg University. Department of Business and Industrial Engineering, Business Information Systems, 2nd cycle, 90 ECTS, Germany; https://bw.hs-offenburg.de/en/study-programs/masters-degree-programs
30	Aalen University. Machine Learning and Data Analytics, 2nd cycle, 90 ECTS, Germany https://www.hs-aalen.de/uploads/mediapool/media/file/42829/Master_Machine_Learning_and_Data_Analytics.pdf
31	University of Maribor. Faculty of Electrical Engineering and Computer Science (FERI), Computer science and information technologies, 1st cycle, 3 years, 180 ECTS, Slovenia; https://moja.um.si/studijski-programi/Strani/akreditacija.aspx?jezik=A&deli=N&program=0000312&fakulteta=FERI
32	University of Maribor. Faculty of electrical Engineering and Computer Science (FERI), Study Programme: Computer science and information technologies, 2nd cycle, 2 years, 120 ECTS, Slovenia; https://moja.um.si/studijski-programi/Strani/akreditacija.aspx?jezik=A&deli=N&program=0000319&fakulteta=FERI
33	University of Maribor. Faculty of Electrical Engineering and Computer Science (FERI), Study Programme: Computer science and informatics, 3rd cycle, 3 years, 180 ECTS, Slovenia; https://feri.um.si/en/study/programmes/third-cycle/dr/ri/
34	Jožef Stefan International Postgraduate School (IPS), Slovenia. Study Programme: Information and communication technologies, 2nd cycle, 2-year programmes, 2 nd cycle, 2 years, 120 ECTS, Slovenia;

	https://www.mps.si/en/studij/bolonjski-studij-druge-stopnje/informacijske-komunikacijske-tehnologije/
35	Jožef Stefan International Postgraduate School (IPS), Slovenia. Study Programme: Information and communication technologies, 3rd cycle, 3 year programmes, 180 ECTS, Slovenia; https://www.mps.si/en/studij/bolonjski-studij-tretje-stopnje/informacijske-komunikacijske-tehnologije/
36	University of Ljubljana. Faculty of Computer and Information Science (FRI), Computer science and informatics, 1st cycle, 3 years, 180 ECTS, Slovenia; https://www.fri.uni-lj.si/upload/Slike/predmetniki/2020EN_BUN_RI.pdf
37	University of Ljubljana. Faculty of Computer and Information Science (FRI), Study Programme: Computer science and informatics, Data science, 2 years, 2nd cycle, 120 ECTS, Slovenia; https://fri.uni-lj.si/en/study-programme/data-science
38	University of Ljubljana. Faculty of Computer and Information Science (FRI), Study Programme: Computer science and mathematics, 2 years, 2nd cycle, 120 ECTS, Slovenia; https://fri.uni-lj.si/en/study-programme/racunalninstvo-matematika-mag-ii-st
39	University of Ljubljana. Faculty of Computer and Information Science (FRI), Study Programme: Computer science and informatics, 4 years, 3rd cycle, 240 ECTS, Slovenia; https://fri.uni-lj.si/en/study-programme/computer-and-information-science-1

Source: authors' own work.

Table 2

Number of economically active ICT companies for consortium countries of the TSAAI project

Country	Number of economically active companies			Share of companies in the ICT industry in the total number of companies (%)		
	2020	2021	Growth rate (%)	2020	2021	Growth rate (%)
Spain	35 884	67 998	89.5	1.05	2.02	92.3
Germany	95 048	/	/	/	/	/

North Macedonia	2 069	2 199	6.3	2.8	3	7.1
Croatia	7 032	7 523	6.98	4.24	4.47	5.42
Slovenia	3 000 (est.)	3 000 (est.)	5.0 (est.)	3.0 (est.)	3.0 (est.)	5.0 (est.)
Estonia	9 761	11 331	16.0	7.1	7.8	9.9

Source: authors' own work.

Table 3

Total number of employees in the economically active ICT companies for consortium countries of the TSAAI project

Country	Total number of employees in the labour market		Number of ICT employees solely		Share (%) ICT employees in the total number of employees	
	2020	2021	2020	2021	2020	2021
Spain	20 184 900	/	806 300	/	4.0	/
Germany	33 700 284	34 322 787	1 206 800	1 258 000	3.58	3.67
North Macedonia	794 909	795 087	18 481	20 659	2.32	2.6
Croatia	1 525 054	1 573 652	45 430	50 720	2.98	3.22
Slovenia	800 000	791 667	32 000	38 000	4.0	4.8

Source: authors' own work.

Table 4

Distribution of persons employed as ICT specialists by gender, education attainment level, and age for consortium countries of the TSAAI project, years 2012 and 2021

			North Macedonia	Spain	Germany	Croatia	Slovenia	Estonia
Distribution by gender (%)	Female	2012	23.90	18.70	15.20	15.50	14.20	26.20
		2021	23.30	19.40	19.00	20.90	16.60	22.60
	Male	2012	76.10	81.30	84.80	84.50	85.50	73.80
		2021	76.70	80.60	81.00	79.10	83.40	77.40
Education level (%)	Tertiary	2012	49.00	78.90	46.41	50.50	50.30	56.90
		2021	60.00	82.20	51.84	61.20	64.70	59.60
	Non-tertiary	2012	51.00	21.10	53.59	48.50	49.70	43.10
		2021	40.00	17.80	48.16	38.80	35.30	40.40
Distribution by age (%)	15-34	2012	57.20	41.20	36.25	45.00	40.30	48.70
		2021	54.80	32.70	37.46	49.20	34.70	47.40
	35-74	2012	42.80	58.80	63.75	55.00	59.70	51.30
		2021	45.20	67.30	62.54	50.80	65.30	52.60

Source: authors' own work.

Table 5

Share of the training providers in the ICT industry for countries part of the consortium of the TSAAI project, years 2012 and 2021

Education/training provider	North Macedonia	Spain	Croatia
Higher Education institutions (universities) (%)	5.50	7.00	7.00
Vocational education training centres (%)	19.00	6.00	18.00
Business association / Chambers (%)	5.50	45.00	/
Governmental institutions (%)	/	11.00	/
Private consulting companies (%)	43.00	24.00	11.00
Other projects	27.00	7.00	/

Source: authors' own work.

