NVAO □ NETHERLANDS

ACADEMIC MASTER COGNITIVE SCIENCE AND ARTIFICIAL INTELLIGENCE

Tilburg University

PANEL REPORT

26 NOVEMBER 2019

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LIMITED INITIAL ACCREDITATION PANEL REPORT

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1 Executive summary

On April 8th the Accreditation Organisation of the Netherlands and Flanders (NVAO) received a request for an initial accreditation procedure regarding a proposed academic master's programme Cognitive Science and Artificial Intelligence at Tilburg University. NVAO convened an expert panel, which studied the information available and discussed the proposed programme with representatives of the institution and the programme during a site visit.

The following considerations have played an important role in the panel's assessment.

In September 2017 Tilburg University started offering a track Cognitive Science and Artificial Intelligence (CSAI) in the master's programme Communication and Information Sciences (CIS). In the academic year 2018/19 the track is in its second year. With the application for a new programme the University wants to turn this track into an independent programme. The programme will be offered by the Department of Cognitive Science and Artificial Intelligence in the Tilburg School of Humanities and Digital Sciences.

Standard 1
The programme adopted to a significant degree the learning outcomes proposed in the updated KION framework of domain-specific requirements (2015) and aligned the structure of the programme with the structure of other AI programs in the Netherlands. The developers of the programme also consulted some relevant international sources. Hence, the national as well as the international perspective were taken into account. Being situated in a School of Humanities and Digital Sciences gives the programme a specific flavour compared to most other existing programmes. The developers clearly aim for a programme which integrates the domains of Cognitive Science and Artificial Intelligence. The programme meets the requirements of Artificial Intelligence programmes in general (by using the KION framework), but by defining its own set of intended learning outcomes the programme has added its own specific focus.

The panel concludes the programme meets standard 1.

Standard 2
The programme offers a mixture of compulsory courses, electives, an internship and a thesis. At first glance the two domains Artificial Intelligence and Cognitive Science seem to be addressed by two separate pathways, but after talking to the developers and lecturers the panel was convinced that the programme fully integrates these two domains. Students work on many integrated projects and on cases in which they are asked to combine knowledge and experience in both domains. Giving examples relevant to Cognitive Science as well as Artificial Intelligence in many different courses and asking students to integrate their knowledge will enhance the coherence in the programme and will stimulate students to integrate the perspectives of both scientific areas. This will make the programme a true Cognitive Science and Artificial Intelligence programme. The panel noticed that the representation of the coherence of the programme - the way the two constituent domains are intertwined - by the curriculum committee differed from that by other staff members. It recommends the developers to make sure this aspect of the programme is communicated to all other staff involved.

The application file explains how the programme covers all intended learning outcomes. The course descriptions demonstrate how learning outcomes have been translated into learning objectives for each course. The panel concludes that the programme is internally coherent and covers the intended learning outcomes. One critical remark concerns the fact that students have limited space to design their own programme, for example through electives. The panel encourages the developers' plan to look for more possibilities for individual differentiation once the programme has started.

The admission requirements comply with the nature of the programme. In their bachelor's programme students can follow a minor CSAI which prepares them for the master's programme. Also, the elective in the first year provides students from bachelor programs other than Tilburg University's BSc CSAI with the opportunity to acquire enough relevant knowledge. The panel is positive about these provisions, but recommends to align the admission requirements with the content of the minor, as the minor did not provide enough EC's in some courses to qualify for admission. The admission requirements as

mentioned in the application file contained several subjects (like calculus, linear algebra and statistics, logic, data mining and machine learning, etc.) which are not covered by the content of the minor.

Two core characteristics of the programme are learning by doing and a strong research focus. The application file presents various examples of the way in which these principles are intertwined in the programme. The panel thinks the core characteristics are clearly visible in the way the programme was developed.

At the site visit some of the literature used in the programme was presented to the panel. The panel judges this literature to match the content and level of the programme.

The staff of the CSAI department consists of researchers who are active in the domains of artificial intelligence, cognitive science, and data science. The staff is enthusiastic and eager to participate in the programme and has state-of-the-art expertise in the field of Artificial Intelligence. They presented themselves as a real team. All staff members adequately master the English language. The expertise of the staff covers all mandatory courses of the programme and the lecturers are all in the process of getting the University Teaching Qualification (UTQ). Because of the popularity of Artificial Intelligence the university foresees a possible shortage of lecturers and is already looking for more staff. In view of the expected large interest of students for the CSAI master's programme, the panel recommends that the programme takes care to strengthen its internal organisation to function on a larger scale. Also in view of the pressure on facilities and other aspects of the learning environment, the panel recommends a controlled increase in the number of students and proactive hiring of new staff to make sure the quality of education remains guaranteed and the staff does not become overloaded.

The panel discussed the volume of the programme (120 EC) and concludes the volume of 120 EC is adequate for a programme like this. It is consistent with the volume of other AI programmes and actually offers the content of two different domains. The panel also agrees with the fact that the programme has an English name and will be offered in English. The university motivates its choices for the English language and name by referring to the highly international field of this domain, for which the programme should prepare its students.

A general concern of the panel relates to the fact that (as a result of the popularity of AI) the number of students could increase significantly. The panel is convinced of the institutional support and trusts this issue will be tackled in an adequate way. Yet, it advises a controlled increase of student numbers to make sure the quality of education remains guaranteed. Finally, the panel also recommends the developers to align all documents relating to the programme, as right now there are still many inconsistencies to be found.

The programme meets standard 2

Standard 3
The panel is convinced that there is a thorough system in place to ensure the quality (validity, reliability and transparency) of the assessments. The quality of assessments is safeguarded by a very capable group of people: lecturers and members of the examination board are all trained for their job. The Examination Board is now made up of members from the Humanities programmes and one member of the Cognitive Science & Artificial Intelligence Department. The panel supports the idea of installing a separate examination board or a separate chamber in the existing board once the programme has started.

The assessment plan shows there is a diversity in assessments, which cover the intended learning outcomes. Examples of assessments which are contained in the course descriptions show that they are developed at master's level, not only assessing knowledge comprehension, but also application, analysis, evaluation and synthesis which matches with the level of the programme

The Master's Thesis Syllabus gives a clear description of and requirements for the research process. The rubrics which are used match the course objectives which are in turn related to the intended learning outcomes of the programme. They are a useful instrument for the assessors. The panel thinks it's a good thing that there are always two assessors involved in grading the thesis.

The programme meets standard 3

The panel concludes that the programme meets all assessment standards. Given these considerations, the panel advises NVAO to take a positive decision regarding the quality of the proposed academic Master's programme Cognitive Science and Artificial Intelligence of Tilburg University

The panel advises to award the degree Master of Science (MSc) to the Academic Master's programme Cognitive Science and Artificial Intelligence. The panel supports the programme's preference for the CROHO field of study 'Natuur', in alignment with the other AI programmes in the Netherlands.

The Hague, 14 November 2019

On behalf of the assessment panel convened for the initial limited accreditation assessment of the programme academic bachelor's Cognitive Science and Artificial Intelligence at Tilburg University.

Prof.dr. Dirk Heylen
(Chair)

Drs. T. Kleene
(Secretary)

2 Introduction

2.1 The procedure

NVAO received a request for an initial accreditation procedure including programme documents regarding a proposed academic master's programme Cognitive Science and Artificial Intelligence at Tilburg University. The request was received on 8th April 2019 from Tilburg University. On 20th September the panel received additional documentation which was made available on a SURF website.

An initial accreditation procedure is required when a recognised institution wants to award a recognised bachelor's or master's degree after the successful completion of a study programme. The procedure for initial accreditation is slightly different as compared to the approach for programmes that have already been accredited. Initial accreditation is in fact an ex ante assessment of a programme. The programme becomes subject to the normal accreditation procedures once initial accreditation has been granted.

To assess the program, the NVAO convened an international panel of experts. The panel consisted of:

- Prof.dr. Dirk Heylen (chair), Professor of Socially Intelligent Computing, Department Computer Science, University of Twente
- Prof.dr. Bart de Boer (member), Professor/researcher, Artificial Intelligence-lab, Vrije Universiteit Brussel;
- Dr. Evert Haasdijk (member), Senior Manager, Deloitte;
- Dr. Iris van Rooij (member), Senior lecturer Artificial Intelligence at the Radboud University Nijmegen, Principal Investigator of the Computational Cognitive Science group of the Donders Instituut;
- Stijntje Dijk (student-member), Medical student and student of Health Economics, Policy & Law, Erasmus University Rotterdam.

This composition reflects the expertise deemed necessary by NVAO. All panel members signed a statement of independence and confidentiality.

On behalf of the NVAO, Thomas de Bruijn and drs. Tineke Kleene were resp. responsible for the process-coordination and the drafting of the experts' report.

The panel has based its assessment on the standards and criteria described in the NVAO Assessment framework for the higher education accreditation system of the Netherlands (Stcrt. 2019, nr 3198).

The following procedure was undertaken. The panel members prepared the assessment by analysing the documents provided by the institution (Annex 3: Documents reviewed).

The panel organised a preparatory meeting on 30th September 2019, i.e. the day before the site visit. During this meeting, the panel members shared their first impressions and formulated questions for the site visit.

The site visit took place on 1st October 2019 at Tilburg University. During this visit, the panel was able to discuss the formulated questions and to gather additional information during several sessions (Annex 2: Schedule of the site visit). Afterwards, the panel discussed the findings and considerations and pronounced its preliminary assessments per theme and standard. At the end of the site visit, the initial findings were presented to the institution.

Based on the findings, considerations and conclusions the secretary wrote a draft advisory report that was first presented to the panel members. After the panel members had commented on the draft report, the chair endorsed the report. On 15 November 2019 the advisory report was sent to the institution, which was given the opportunity to respond to any factual inaccuracies in the report. The institution replied on 26 November. Most of the suggested corrections were adopted. Subsequently the final report was endorsed by the panel chair. The panel composed its advice fully independently and offered it to NVAO on 27 November 2019.

2.2 Panel report

The first chapter of this report is the executive summary of the report, while the current chapter is the introduction.

The third chapter gives a description of the programme including its position within the institution, Tilburg University and within the higher education system of the Netherlands.

The panel presents its assessments in the fourth chapter. The programme is assessed by using the standards of the Initial Accreditation Framework. For each standard the panel presents an outline of its findings, considerations and a conclusion.

The outline of the findings presents the objective facts as found by the panel in the programme documents, in the additional documents and during the site visit. The panel's considerations consist of the panel's judgments and subjective evaluations regarding these findings and their relative importance. The considerations presented by the panel are at the basis of a concluding overall assessment.

The panel concludes the report with a table containing an overview of its assessments per standard.

3 Description of the programme

3.1 General

Country	Netherlands
Institution	Tilburg University
Programme	Cognitive Science and Artificial Intelligence
Level	Master
Orientation	Academic
Specialisation	n.a.
Degree	Master of Science
Location(s)	Tilburg
Study Load (EC)	120 EC
Field of Study	Natuur

3.2 Profile of the institution

Tilburg University (TiU) is a public research university, founded in 1927 as a Roman Catholic University. It is centered in the heart of the region Noord Brabant in the south of The Netherlands, rooted in the city of Tilburg. TiU hosts 15.761 students, 2,000 employees and employs 331 PhD students. The university hosts over a hundred different nationalities.

Tilburg University consists of 5 Schools:

1. Tilburg School of Economics and Management
2. Tilburg Law School
3. Tilburg School of Social and Behavioral Sciences
4. Tilburg School of Humanities and Digital Sciences
5. Tilburg School of Catholic Theology

School of Humanities and Digital Sciences has four departments:

- Communication and Cognition
- Cognitive Science and Artificial Intelligence
- Culture studies
- Philosophy

Tilburg University also has a University College, various Graduate Schools and a large number of institutes and research groups.

The new programme will be part of the Department of Cognitive Science and Artificial Intelligence. The Department of Cognitive Science and Artificial Intelligence already participates in four other Digital Sciences programs:

- BSc Cognitive Science & Artificial Intelligence (CS&AI)
- BSc Data Science, a joint degree with TU Eindhoven;
- MSc Data Science and Entrepreneurship, a joint degree with TU Eindhoven;
- MSc Data Science and Society (DSS), an inter-faculty programme-at Tilburg University which recently passed the initial accreditation procedure and is now conditionally approved. This programme-has already been offered for several years in the form of the track Data Science: Business and Governance within the CIS program.

At TiU students can choose from a wide range of educational programmes in economics & management, law & governance, communication, culture, and behavior & society. TU offers 70 bachelor's and master's programmes. More than half of them are English-taught. Together with Eindhoven Technical University, TiU offers educational programmes in data science.

According to the university website the mission of Tilburg University is “to understand society and to inspire and challenge students”. The educational programmes focus on students acquiring in-depth knowledge, on training their professional skills, and developing themselves as a person.

TiU values its contact between students, teachers and the teams. Classes are taught in small groups whenever possible or feasible. Students and teachers constitute a learning community in which active participation and strong commitment to and in classes are of paramount importance.

3.3 Profile of the programme

In September 2017 Tilburg University started offering a track Cognitive Science and Artificial Intelligence (CSAI) in the master’s programme Communication and Information Sciences (CIS). In the academic year 2018/19 the track is in its second year. With the application for a new programme the University wants to change this track into a separate programme. The programme will be offered by the Department of Cognitive Science and Artificial Intelligence in the Tilburg School of Humanities and Digital Sciences.

The CSAI programme derives from a CIS specialization with a focus on Artificial Intelligence and was developed into an autonomous Artificial Intelligence program. Prior to offering the CSAI track, the CIS programme offered the Human Aspects of Information Technology (HAIT) master’s track. The HAIT track included several technology-oriented courses but its content was substantially different from the CSAI track in terms of scope, depth and scientific methodology. The HAIT track attracted a limited number of students (ca. 10-15 each year). In contrast, the CSAI master’s track attracted 44 students in 2017-2018, and 79 students in 2018/19. Since the CIS programme only offers one-year master’s tracks, the CSAI track currently consists of 60 EC. In contrast, the proposed CSAI program, which will be substantially different from the present CSAI track, consists of 120 EC, in line with all other Dutch AI programs. In this way, the proposed programme will be able to meet the standards for the intended learning outcomes and offer graduates a level of education that is comparable with other programmes in the Netherlands.

The master's programme CSAI aims to attract both Dutch and international students with a relevant bachelor's degree who are interested in artificial intelligence, human cognition, and computer modelling of intelligent behaviour. Since artificial intelligence is an interdisciplinary field, students need to be prepared not just to contribute to the development of technological applications but also to reflect on their implementation from the cognitive, neuroscientific, and ethical perspectives. The proposed name of the programme – Cognitive Science and Artificial Intelligence – expresses the intention to study artificial intelligence in relation to human cognition rather than from a purely engineering perspective.

New programme in the Netherlands
There are various Master’s programmes Artificial Intelligence in the Netherlands. While the combination of Cognitive Science and Artificial Intelligence is also present in existing programmes, the programme aims to distinguish itself by focusing on computational cognition, hybrid (human-machine) intelligence and human-AI interfacing using both cognitive science and AI methodologies.

New programme for the institution
At the moment a programme is offered as a track Cognitive Science and Artificial Intelligence (CSAI) of the 60 EC master’s programme Communication and Information Sciences (CIS). The existing programme has a much more limited scope than the proposed master's programme which will have a more technical orientation including a firm basis in Machine Learning and Computational modeling on the one hand and a more extensive set of courses in Cognitive Science on the other hand.

Credits
The master’s CSAI will be a 2-year programme of 120 EC

4 Assessment per standard

This chapter presents the evaluation of the standards by the assessment panel. The panel has reproduced the criteria for each standard. For each standard the panel presents (1) a brief outline of its findings based on the programme documents and on documents provided by the institution and the site visit, (2) the considerations the panel has taken into account and (3) the panel's conclusion. The panel presents a conclusion for each of the standards, as well as a final conclusion.

The assessment is based on the standards and criteria described in the NVAO Assessment framework for the higher education accreditation system of the Netherlands (Stcrt. 2019, nr 3198). Fundamental to the assessment is a discussion with peers regarding the content and quality of the new programme.

Regarding each of the standards, the assessment panel gives a substantiated judgement on a three-point scale: meets, does not meet or partially meets the standard. The panel subsequently gives a substantiated final conclusion regarding the quality of the programme, also on a three-point scale: positive, conditionally positive or negative.

4.1 Standard 1: Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Outline of findings
The CSAI programme defined the intended learning outcomes with reference to the KION framework (revision of 2015), and according to the five Dublin descriptors. Appendix A of the application file contains an overview of the intended learning outcomes. The KION framework[1] was initially developed in 2006 by all Dutch universities offering Artificial Intelligence programmes at that time and updated in 2015 as a result of the recommendations given by the panel of the cluster visitation. The panel observed that AI master's programs in the Netherlands varied widely, and recommended to create either more uniform programs or to allow for differentiation based on a minimal definition of their AI-nature. Since AI master programs still vary widely in 2018, the programme operationalised this recommendation by adopting the learning outcomes proposed in the updated frame of reference to a significant degree and by aligning the structure of the programme to the structure in other AI programs in the Netherlands (120 EC, consisting of 75 EC for courses, 15 EC for the research internship and 30 EC for a research project and thesis). Other relevant sources of information consulted during the development of the programme included a Stanford report on Artificial Intelligence from 2016, and the annual Artificial Intelligence Index.

The KION framework is based on information from international AI journals, conferences and textbooks on AI and incorporates changes and trends relevant for the AI master curricula in the Netherlands. Adherence to the KION framework, therefore, integrates the international perspective into the program. A comparison of the content of the proposed programme with several international programs in Cognitive Science, Artificial Intelligence and related disciplines, listed in the application file, shows a high degree of overlap.

During the site visit the panel interviewed different groups (dean, lecturers, students and alumni) about the focus of the programme: Is it primarily an Artificial Intelligence programme? Is it primarily a Cognitive Science programme? Or is it a combination of both? All stakeholders agreed that the programme is supposed to and does integrate the two fields.

Considerations
By using the KION framework the programme meets the requirements of the field in Artificial Intelligence. The KION framework was used by the university to define a specific set of intended learning outcomes which contains aspects of cognitive science (appendix A of the application file). The intended learning outcomes are verifiably formulated at master's level. The panel appreciates the programme's

[1] https://www.qanu.nl/sites/default/files/bestanden/files/SOTA_AI_final.pdf

intention to integrate AI and CS. It can also see it expressed in the learning outcomes. It did notice, however, that the integration was expressed more clearly during the interviews by the programme's stakeholders than the panel could find it explained in the learning outcomes. The panel therefore recommends to reformulate parts of the learning outcomes to better emphasise the integration of the two constituent domains.

The international perspective is guaranteed by benchmarking the programme with a number of relevant foreign programmes. The university has intensive contacts with the professional field (e.g. via the regional centre for digital technology Mindlabs) and the academic field. Therefore, the panel is convinced that the intended learning outcomes meet the requirements of the professional field.

Conclusion
*The programme **meets** standard 1.*

4.2 Standard 2: Teaching-learning environment

The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Outline of findings
An overview of the programme is presented in the table below. The numbers indicate the number of ECs for each course.

Yr	Sem.						
MA1	S1	Core Topics AI	Agent Based Modeling	Core Topics CS	Cogn Models of Language Learning	Eye Tracking	Spatiotemp. Data Analysis
		6	6	6	6	3	3
	S2	Deep Reinforcement Learning	Computer Games	Risk Communication and Uncertainty	Brain Computer Interfacing	Elective	
		6	6	6	6	6	
MA2	S1	Advanced Deep Learning	Image Analysis	Bayesian Models of Cognitive Processes	Internship		
		6	3	6			15
	S2	Research Project and Thesis					
							30
		Artif Intell	Cogn Science	Research Skills	Keuzevakken	Stage en scriptie	

The programme offers a mixture of compulsory courses (69 EC), electives (6 EC), an internship (15 EC) and a thesis (30 EC). The compulsory courses concern five courses in Artificial Intelligence (30 EC), five courses in Cognitive Science (30 EC) and three courses in Research Skills (9 EC).

This table (copied from application file appendix B) shows that courses are partly structured into several learning pathways (Artificial Intelligence, Cognitive Science, Research Skills), electives and an internship and research project. During the site visit the panel talked to the developers of the programme about the fact that it looks as if the domains Cognitive Science and Artificial Intelligence are regarded as separate paths and are therefore not integrated. This would not match the integrated vision as described at the previous standard. All stakeholders emphasised the fact that in all courses integration is realised by consequently using integral cases, examples, etc. In everything the students are asked to do in the programme they are asked to integrate both fields.

The coherence of the programme is ultimately the responsibility of the programme director. During the development of the programme, regular staff meetings were held focusing on the coherence of the programme (overlap, gaps, etc.). These meetings, albeit with a lower frequency (twice a year), will be held also once the programme has been fully established. The student focus groups, which already exist in the present track, also provide important input about (among other things) the coherence of the programme. At the end of each semester, student focus groups discuss the quality of the programme with the programme director, supported by the academic coordinator and, occasionally, representatives of the TSHD Faculty Board.

Appendix B of the application file shows the relationship between the courses and the intended learning outcomes presented in Appendix A. Also, one of the additional documents (the assessment plan) shows the relationship between the courses and intended learning outcomes in appendix A of the application file.

Appendix C of the application file gives a short description of each course. It shows that for each individual course learning objectives have been formulated. It also contains information about the literature used in each course. Additional documentation contained many course manuals showing the contribution to the intended programme learning outcomes. In addition, several of the books mentioned in the syllabi and some articles were presented at the site visit.

During the site visit the panel talked about the place of ethics in the programme and received a document called “ethics in the MSc CSAI curriculum”. This document states that Tilburg University is currently implementing the Tilburg Educational Profile (TEP) in its master’s, the implementation of the Tilburg University Educational Vision in which there is (a.o.) a focus on ethical problems . The document shows that in the master CSAI ethics is addressed in two electives and in four compulsory components.

The application file contains the admission requirements for Dutch as well as international students. A 30 EC minor CSAI is offered to bachelor students from programmes such as Psychology who wish to enrol in the master CSAI. The minor consists of courses in mathematics and advanced statistics (12 EC), programming (12 EC), and AI techniques (6 EC). At the site visit the panel received a paper containing information regarding direct admissions and other admissions.

The elective in the first year provides students from bachelor programs other than Tilburg University’s BSc CSAI with the opportunity to acquire knowledge in the field of Deep Learning, since Deep Learning techniques are not a standard feature of all AI bachelors. Knowledge of Deep Learning is necessary for the 2nd year course Advanced Deep Learning

According to the application file the programme is built on a balanced mix of theory and practice. Two core characteristics of the programme are **learning by doing** and a **strong research focus**. Examples of the way this is visible in the programme are:

- Practical seminars
- Breakout sessions
- Close relation to existing research facilities
- Participation in existing research projects
- State-of-the-art content

All examples are explained and illustrated in detail in the application file.

The programme does not offer students a lot of choice. Most courses are compulsory; only in the internship students can formulate their own learning goals. There is little room for electives, but the programme is planning to make this more flexible in the future.

The staff of the CSAI department consists of researchers who are active in the domains of artificial intelligence, cognitive science, and data science. Members of the department chair the 2018 Benelearn and Belgium-Netherlands AI Conferences, participate in the Dutch Special Interest Group Artificial Intelligence, participate in the School for Information and Knowledge Systems (SIKS), participate in the VSNU Digital Society program, and have national and international research collaborations in the field of Cognitive Science and Artificial Intelligence. Appendix F of the application file contains an overview of the teaching staff. CV’s of the staff members were provided to the panel.

According to the application file the CSAI Department teaching staff currently consists of 28 staff members (26.5 f.t.e.). The teaching duties of the CSAI teaching staff also include courses in several master’s programmes and the Data Science Bachelor’s programme jointly offered by Tilburg University and Technical University Eindhoven. The number of lecturers involved in the programme increased from 16 in the Fall of 2017 to 28 in the Spring of 2019, with several additional positions presumably to be filled in 2019/2020. Since the programme is new, the staff consists of enthusiastic scholars with state-of-the-art expertise in the field of AI. All members of staff have teaching as well as research responsibilities, thus guaranteeing the scientific character of the program.

Since 2010, the UTQ is compulsory for all teaching staff with a teaching load of 0,4 fte or more. At the moment, 7 members of staff (25%) have passed the UTQ and 6 are in the process of passing the qualification, which will raise the percentage to 46%. The other lecturers will do the UTQ training in the near future. According to the application file the relatively low UTQ percentage is mainly due to the fact that the staff is growing fast and that quite a few lecturers have been appointed recently. This was confirmed at the site visit. The university expects the percentage to rise sharply when the staff has stabilised.

All non-native speakers have to pass an assessment of their proficiency in English. Teachers who do not meet the minimum requirement of level C1 are offered English language courses.

All expertise is currently high in demand and there is a danger of an AI "brain drain" to large tech companies in the Netherlands, as well as elsewhere in Europe. The Faculty Board recently agreed to announce several competitive vacancies. At the site visit the panel was told that there was a good response of promising candidates.

The most important facilities needed to offer the programme are lab facilities and computer facilities. A number of services are offered to support the computational expense and complexity that CSAI education requires. At the site visit the panel had a guided tour at the university during which they had a presentation about Mindlabs, a collaborative initiative between Fontys University of Applied Sciences (Journalism), intermediate vocational education (ROC Tilburg), media and publishing company De Persgroep, the city of Tilburg, the Province of Noord-Brabant, and Tilburg University (Cognitive Science & Artificial Intelligence). Mind Labs operates in the domain of interactive technologies and behavior. It investigates human minds, artificial minds, and pushes an innovative mindset. Many lectures of the new programme will be held in the Deprez building where Mindlabs is situated.

The programme will be taught in English. Therefore, the name of the programme is English as well. There are a number of reasons for not offering the programme in Dutch:

- A considerable part of the graduates will eventually work in an international environment, either in an international firm or in a Dutch firm with international colleagues.
- To prepare students for their future work environment, Tilburg University wishes to offer future graduates an international classroom. Therefore, the programme is open to international students, which is only feasible when the programme is offered in English.
- It is difficult to hire competent academic staff in the field of Cognitive Science and Artificial Intelligence. Therefore, in the case of vacancies, Tilburg University tries to find suitable candidates on both the Dutch and the international labour market. Consequently, the staff is now a mix of Dutch and international academics. Most of the international staff do not speak Dutch at a level that enables them to lecture in Dutch. Hence, offering the programme in Dutch is not an option.

Tilburg University offers special courses to non-native speakers to improve their proficiency in English.

Considerations

In general the panel thinks there is a well-balanced programme which covers all intended learning outcomes. The relationship between the intended learning outcomes and the programme can be verified in several documents.

The entry requirements are clear and comply with the nature of the programme. The panel is positive about the fact that students get the opportunity to follow a minor in order to be admissible. Looking at the entry requirements and the content of the minor however, the panel has noticed some differences and recommends that the developers align the entry requirements with the content of the minor. The entry requirements ask for more EC for specific subjects than the number of EC's offered in the minor (and more than could possibly fit in the minor).

Based on the information provided in the application file and on the additional information provided before the site visit the pathways in the programme did not seem to enhance the integration between Artificial Intelligence and Cognitive Science but, rather, set them apart as two distinctive domains. Also the learning objectives in the course descriptions looked as if both domains had their own pathways. However, during the site visit the developers and lecturers of the programme convinced the panel of the fact that the programme actually offers a fully integrated programme in which virtually all courses use cases that stimulate the integration of both fields. This was confirmed by documentation which was handed over to the panel during the site visit and explained by the programme director. The panel was surprised to hear about the diversity of the projects which students participate in and which continually stimulate an integral approach of different problems by the students. The panel encourages the developers to make the integration more visible in the titles of the courses and in the learning objectives in order to comply with the vision on integration as presented in the previous chapter an to reflect the actual situation. The panel also advises the developers to reconsider some of the course titles as they do not always cover the content.

During the site visit the panel talked to the stakeholders about the fact that students do not have a lot of opportunity to adapt their study trajectory to their own wishes. Only 6 out of 120 EC is available for electives. However, if students have not covered the topic of deep learning in their bachelor's, they have to take a mandatory course on deep learning. These students will therefore have no elective space. The panel was told that the programme as it is presented now is a starting point and that the developers intend to investigate how much room there is for personalisation of individual study trajectories after the programme has started. The panel encourages this intention as it thinks more choice would be welcome.

The panel is positive about the fact that the programme has its own curriculum committee, but noticed that the representation of the coherence of the programme - the way the two constituent domains are intertwined - by the curriculum committee differed from that by other staff members. It recommends the developers to make sure this aspect of the programme is communicated to all other staff involved.

During the site visit the panel noticed that the members of the team are all very enthusiastic and eager to participate in the new programme. They also presented themselves as a real team. Based on the CV's of the staff and the additional course overview of the lecturers which was provided during the site visit (showing which courses will be given by which lecturers) the panel is convinced the proposed staff members meet the requirements of the programme, content wise as well as didactically. Together they cover all subjects in the programme and many of them are very experienced in the field. They all have adequate command of the English language and can therefore be expected to teach in English.

A general concern of the panel relates to the fact that (as a result of the popularity of AI) the number of students could increase significantly. Under the present circumstances the panel does not anticipate any major problems regarding facilities, personnel, etc. but if the student population increases too much the panel foresees problems with recruiting enough staff. The university is aware of this, but the panel wants to emphasise the importance of taking this issue very seriously, particularly in light of the intensity of supervision required by the learning-by-doing focus in the programme. The panel is convinced of the institutional support and trusts this issue will be tackled in an adequate manner. Yet, it advises a controlled increase of student numbers and proactive hiring of new staff to make sure the quality of education remains guaranteed and the staff does not become overloaded.

The panel discussed the volume of the programme (120 EC). While master programmes in general contain 60 EC, the other Artificial Intelligence master programmes in the Netherlands also contain 120 EC. As the proposed programme not only contains subjects on Artificial Intelligence but also on Cognitive Science, it would, in the panel's opinion, be impossible to offer this programme in less than 2 years. Therefore the panel concludes the volume of 120 EC is adequate.

The panel agrees with the fact that the programme has an English title and it is offered in English. It agrees with the motivation provided by the institution: Many lecturers as well as many of the students have a non-Dutch background. The field is very international, so many students can be expected to end up in a different country after graduation. The fact that the programme is offered in English also enhances the opportunities to find good lecturers.

In general the panel has noticed some inconsistencies in the documentation of the programme. The panel is aware of the fact that it is "work in progress" and new versions of course descriptions and other documents are still being developed, but it stresses the importance of aligning all documents in due course. The curriculum committee could play an important role in this.

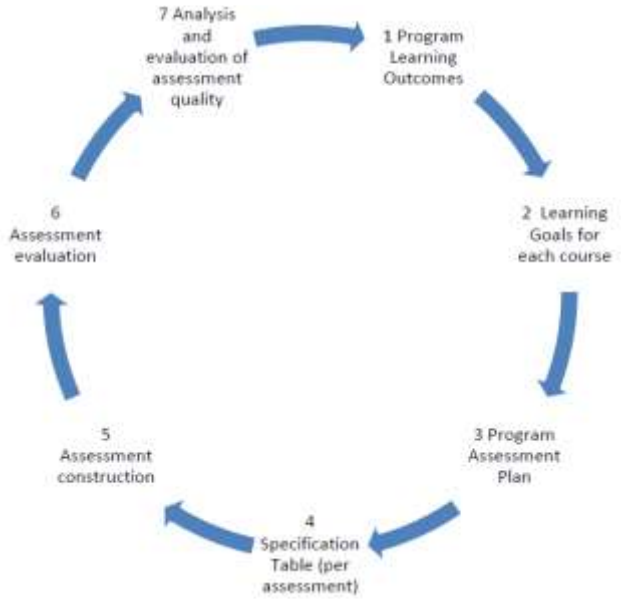
Taking everything into account the panel thinks there is a good, coherent and state-of-the-art programme which will enable students to reach the intended learning outcomes.

Conclusion
*The programme **meets** standard 2*

4.3 Standard 3: Assessment

The programme has an adequate system of student assessment in place.

Outline of findings
Assessments are developed according to the assessment cycle below (application file, p.15):



In the Summer and Fall of 2018, workshops were organised in which lecturers of the programme have translated the course objectives into specification tables. These tables link the course objectives to the various components of the assessment to ensure that course objectives and assessment are aligned. Appendix C of the application file (short description of the courses) shows per course which type of assessments will be used and what the weight of each assessment will be.

To assure enough variation in the assessment methods used, an assessment matrix has been made that will be updated on an annual basis. In most courses, there is a mixture of formative and summative assessments. The assessment matrix (which only shows the summative assessments) was made available to the panel before the site visit. It shows that the programme uses a multitude of assessment methods. It also shows that each competence is assessed in several modules. The coordinating lecturer of a course, in consultation with the programme director, determines the assessment method given the nature of the course objectives. Generally, knowledge is assessed through written exams and skills through practical assignments. Using the assessment plan, the programme director monitors the assessment of the programme and the course objectives. The TSHD Board of Examiners supervises the entire assessment process.

In 2018/19, intermediary exams for some courses were introduced to encourage attendance of plenary meetings from the very start of the course and to motivate students to complete formative assessments on time. Students appreciate this change, as it also helps to spread the study load.

According to the application file students confirm that the exams are a good reflection of the course and that the formative assignments of courses are a good preparation for the actual exam.

<u>Group assessments</u>
To prevent free-rider behaviour in group assignments, the number of students in a group is limited to 3 to 5 students. A group assignment is never the only form of assessment of a course and in cases of component grades, it does not account for more than 40% of the overall grade. Consequently, a student will not be able to pass a course, let alone the whole programme, through free riding.

<u>E-assessment</u>

At Tilburg University, E-assessment will be intensified using the programme TestVision Online. The new Cube building and the Goossens building have been equipped with special exam rooms. E-assessment will be used parallel to assessment on paper, but a gradual increase of E-assessment is expected. Students are given the opportunity to familiarize themselves with TestVision through an online practice test.

Thesis

The thesis (30 EC), in which students demonstrate that they master the program's intended learning outcomes, is the most comprehensive assignment of the programme. The Master Thesis Syllabus and the Thesis Proposal Guidelines were provided to the panel before the site visit. The syllabus shows the connection between the intended learning outcomes (standard 1) and the course learning outcomes. The assessment criteria are derived from the course learning outcomes. The syllabus also contains a grading rubric which helps the examiners to grade the thesis. The thesis is supervised by a member of staff, who has obtained his or her PhD. The supervisor assists the student during the research and writing process and is the first assessor. In addition, there is a second reader. Both assessors score all criteria independently. Criteria 1 to 7 must be scored at least 'sufficient' to pass. The overall grade is determined from the grading of the individual criteria as well as the cohesion of the various parts.

Board of examiners and assessment committee

The institution that is primarily responsible for the quality assurance of the assessment is the Board of Examiners Board (BoE). There are two BoE's at TSHD: one for all regular TSHD bachelor and master programs and one for the Research Master program. The BoE has nine members, including an independent Chair, an external member, a secretary, and a consultant with educational and assessment expertise. The BoE is assisted by five assessment committees, one for each group of programmes. Each committee consists of an assessment expert and two experienced members of staff who have passed the UTQ and are specially trained for this role. The assessment committee works by way of peer review and gives practical support in constructing assessments. Another task of the assessment committees is the ex post course assessment. The committee reports its findings to the BoE, which discusses the findings with the Academic Director.

During the site visit the panel talked to members of the board. They told the panel that currently there is one board for the whole school with one member assigned for the new programme. Depending on the number of students it might be a good idea to install a separate board for the new programme or a special chamber within the existing board. This will become clear after the programme has started and the performance of the existing board has been evaluated.

When CSAI is a separate programme, it will have its own assessment committee as the number of courses to be evaluated will increase.

Considerations

The panel thinks there is a thorough system in place to ensure the quality (validity, reliability and transparency) of the assessments. The examination board consists of people who are trained for this job and the staff are all in the process of getting the UTQ. The panel is also positive about the fact that the programme will have its own assessment committee for which a special handbook is available. The panel thinks the quality of assessments is safeguarded by a very capable group of people. The panel nevertheless encourages the installation of a separate examination board or chamber within the existing board once the programme has started, as content wise this programme requires different expertise than the other programmes of the School.

The assessment programme shows that there are many different forms of (summative) assessment. The programme not only contains summative assessments, but many formative assessments as well. The panel thinks this matches the digital concept of "learning by doing" in which feedback plays an important role.

The course descriptions provided to the panel not only contain specification tables for the construction of the assessments, but also examples of assessments. These assessments not only assess knowledge comprehension, but also application, analysis, evaluation and synthesis. The panel thinks the assessments all clearly require cognitive skills a master's level.

The Master's Thesis Syllabus gives a clear description as to how the research should be carried out, what the process looks like and which are the requirements of the report. The rubrics which are used to assess the thesis match the course objectives which are in turn related to the intended learning outcomes of the programme. They are a useful instrument for the assessors. The panel thinks it's a good thing that there are always two assessors involved in grading the thesis.

Conclusion
*The programme **meets** standard 3.*

4.4 Qualification and field of study (CROHO)

The panel advises to award the degree Master of Science (BSc) to the Academic Master's programme Cognitive Science and Artificial Intelligence. The panel supports the programme's preference for the CROHO field of study 'Natuur', as all other Artificial Intelligence programmes are classified in the same field and the programme was set up according to the KION framework which is leading for all Artificial Intelligence programmes. The panel describes the character of the programme as "a cognitive science flavoured Artificial Intelligence programme". This justifies the proposed 'Natuur' classification.

4.5 Conclusion

All in all, the panel assesses the quality of the programme as positive.

4.6 Recommendations

The panel recommends :

1. to reformulate the intended learning outcomes in a way that they match the programme's vision on the integration of the two domains (AI and CS);
2. to align the content of the minor with the entry requirements;
3. to make the integration of AI and CS more explicit in the titles and learning objectives of the courses in order to comply with the vision on integration and to reflect the actual situation;
4. to reconsider some of the course titles as they do not always cover the content optimally;
5. to align all documents relating to the programme and remove the inconsistencies in due course;
6. that the curriculum committee ensures that all teaching staff share a consistent vision on the coherence within the programme.
7. a controlled increase of student numbers to make sure the quality of education remains guaranteed.

5 Overview of the assessments

Standard	Assessment
Intended Learning outcomes *Standard 1 : The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements*	**Meets the standard**
Teaching-learning environment *Standard 2 : The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.*	**Meets the standard**
Student assessment *Standard 3: The programme has an adequate system of student assessment in place.*	**Meets the standard**
Conclusion	**Positive**

Appendix 1: Schedule of the site visit

The panel visited Tilburg University on 1st October 2019 as part of the external assessment procedure regarding the academic master's programme Cognitive Science and Artificial Intelligence.

In compliance with the General Data Protection Regulation (GDPR) the names of the persons interviewed by the panel are not included in the report, only their function or status.
Further information on this can be obtained from the NVAO.

Location
Portrettenzaal, Cobbenhagen Building, Tilburg University Cube 220, Cube, Tilburg University (Presentation Mindlabs)

9.00 – 9.30	Arrival and welcome
9.30 – 10.00	Session 1: Meeting with TSHD Board
10.00 – 10.45	Session 2: Programme Management
10.45 – 11.00	Break
11.00 – 11.45	Session 3: Teaching Staff
11.45 – 12.00	Break
12.00 – 12.30	Session 4: Lunch panel and meeting students
12.30 – 12.45	Break
12.45 – 13.30	Session 5: Presentation Mindlabs
13.30 – 14.00	Break
14.00 – 14.30	Session 6: Examination Board and Programme Committee
14.30 – 15.00	Session 7: Alumni and representatives from the working field
15.00 – 15.15	Break
15.15 – 15.30	Session 8: Second meeting with Programme Management
15.30 – 17.15	Committee deliberations
17.15	Brief feedback by the chair of the committee

Appendix 2: Documents reviewed

Documents presented by Tilburg University (accessible via SURF website before the site visit):

1. Tilburg School of Humanities and Digital Sciences –Organisational structure 2018-2019
2. School Regulations Tilburg School of Humanities and Digital Sciences (in force as of 1st January 2018)
3. 12 course syllabi
4. List of Electives
5. Procedures Toets-en Examenbeleid Bachelor-/Masteropleidingen Tilburg School of Humanities (TSH) (Ingaande 1 september 2014)
6. Syllabus master thesis
7. Excel met Competentiematrix/ toetsplan (vakken vs. competenties), toetsprogramma (hoe wordt elk vak getoetst), overzicht van werkvormen (welke werkvormen worden bij elk vak gebruikt)
8. Bachelor's and Master's programme Cognitive Science and Artificial Intelligence Handbook for Constructing and Grading Course Assessments
9. Internship manual-MSc Cognitive Science and Artificial Intelligence -Department of Cognitive Science and Artificial Intelligence, TSHD2021-2022
10. Onderwijs-en Examenregeling 2020-2021 MASTER-opleidingen School of Humanities and Digital Science
11. Guidelines Programme Committees TSHD2019-2020TSHD Education Support Team August 2019
12. Building blocks for quality assurance within the master's programme Cognitive Science and Artificial Intelligence
13. Jaarverslag Examencommissie Bachelor/Master Tilburg School of Humanities and Digital Sciences Academisch jaar 2017-2018
14. Humanities for a Digital Society, 2018-2021Towards The Tilburg School of Humanities and Digital Sciences Version 4.0, dd 23 November 2017
15. Curricula vitae teaching staff

Documents provided during and after the site visit:

16. Addendum to the initial accreditation containing an updated overview of the curriculum
17. Ethics in the MSc CSAI curriculum
18. MSc CSAI Course overview with lecturers
19. Presentation Mindlabs
20. Thesis Proposal Guidelines

Appendix 3: List of abbreviations

Ba	bachelor's degree
CSAI	Cognitive Science and Artificial Intelligence
EC	European credit point
Ma	master's degree
MSc	Master of Science
NVAO	Accreditation Organisation of the Netherlands and Flanders
wo	Academic orientation

The panel report was ordered by NVAO for the initial accreditation of the programme wo master Cognitive Science & Artificial Intelligence of Tilburg University

Application no.: 008208

NVAO

Nederlands-Vlaamse Accreditatieorganisatie
Accreditation Organisation of the Netherlands and Flanders

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