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B and M Cognitive Science and Artificial Intelligence

Tilburg University

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Project code P2303

Contents

Summary

Standard 1. Intended learning outcomes

The CSAI programmes at Tilburg University have a unique profile in the landscape of AI programmes, as interdisciplinary bachelor's and master's programmes that combines exact sciences and humanities through a focus on cognitive science and responsible AI. The BSc CSAI does this by providing a strong foundation in AI with a focus on cognitive science, and the MSc CSAI by focusing on the use of cognitive science and AI in developing solutions to societal problems. The panel appreciates this distinctive character and recommends further developing the branding to emphasize this unique profile. Given its growth ambitions, this is particularly true for the master's programme. The intended learning outcomes of the programmes are appropriate for academic bachelor's and master's programmes respectively, and reflect the requirements of the academic and professional fields through their alignment with the KION framework for academic AI programmes. The panel recommends expanding the current connections to the professional field to collect external input in a more structured way, for instance through the founding of an external advisory board or the organization of network meetings with external partners and more structural contact with alumni.

Standard 2. Teaching-learning environment

The panel found that both the BSc and MSc CSAI have translated their intended learning outcomes into well-structured and coherent curricula. The BSc curriculum builds up balanced knowledge and skills in cognitive science and AI through thematic clusters, and provides a solid interdisciplinary basis in both fields. The MSc curriculum is divided into a core in advanced cognitive science and AI topics, and a project part in which students apply what they learnt in open challenges in an internship and research project setting. Both programmes are well-connected to the research strengths of DCA, and provide students with ample opportunities to develop their skills as a researcher. The panel appreciates the educational vision of a strong connection between theory, practice and assignments, with interactive and engaging teaching methods. The choice for English as the language of instruction as well as the programme name is well-substantiated given the international character of the field in which students can be expected to work after graduation, and appropriate measures are taken to safeguard the quality of English-language education.

There are sufficient opportunities for students to shape the curriculum according to individual preferences, in the BSc through a substantial elective space, and in the master's through the possibility to select own topics for assignments and projects. The panel also concludes that students are well-supported and guided throughout the curriculum, including the research projects, and both programmes are feasible in the dedicated time. Staff and students describe the CSAI programmes as a close community, where they feel that student's voices are heard and taken seriously. The programmes have sufficient facilities to be able to organize all curriculum elements, including labs and computing facilities. The teaching staff of both programmes is well qualified, both in terms of substantive expertise as in didactic qualities.

To further improve the curricula, the panel recommends that the bachelor's investigate whether software development skills could be added to existing courses, such as one of the group projects. For the master's programme, the panel encourages the strengthening of deep learning in the curriculum without shifting the programme in a too technical direction. Additional facilities such as software development platforms for AI might be beneficial to this end. Furthermore, the master's programme should safeguard the embedding of communication skills in the curriculum now that the associated course is dropped from the curriculum. Another possible improvement is the inclusion of a quick scan for ethical review of research projects, which the panel thinks fits the programmes' focus on responsible AI.

Standard 3. Student assessment

Both programmes have a valid, reliable and transparent system of assessment, with appropriate checks and balances to safeguard the quality and validity of assessment in relation to the intended learning outcomes. The Board of Examiners functions well and safeguards the quality of assessment in a professional way. Assessment methods are varied and fit the intended learning outcomes of the programmes. The panel recommends the bachelor's programme to review whether the number of written exams can be reduced in favour of other individual assessment forms in the case of courses with group projects. The programmes have solid procedures for thesis assessment involving two examiners and a useful rubric. To further improve thesis assessment, the panel suggests to better differentiate higher grades (8 and up), and include research novelty as an element in the assessment of the master's theses. Finally, the panel recommends reducing the use of the thesis resit opportunity for extension of the thesis deadline and as a feedback opportunity, and restoring it as an exception rather than a rule. Modifying the thesis trajectory to include additional feedback opportunities and/or extending the trajectory with a preparatory phase could be a possible solution to address the issues that the resit is currently used for to resolve.

Standard 4. Achieved learning outcomes

The quality of the BSc and MSc theses show that students of both programmes realize the intended learning outcomes. Thesis quality is up to standard, and reflects the focus of the programme on societal impact and responsible AI, although the latter could be further strengthened according to the panel. Bachelor graduates are admitted to various relevant MSc programmes, and alumni of both programmes find relevant jobs within the field, further demonstrating that graduates from both programmes realize the intended learning outcomes.

Score table

The panel assesses the programmes as follows:

Bachelor's programme Cognitive Science and Artificial Intelligence	
Standard 1: Intended learning outcomes	meets the standard
Standard 2: Teaching-learning environment	meets the standard
Standard 3: Student assessment	meets the standard
Standard 4: Achieved learning outcomes	meets the standard
General conclusion	positive

Master's programme Cognitive Science and Artificial Intelligence	
Standard 1: Intended learning outcomes	meets the standard
Standard 2: Teaching-learning environment	meets the standard
Standard 3: Student assessment	meets the standard
Standard 4: Achieved learning outcomes	meets the standard
General conclusion	positive

Prof. dr. Walter Daelemans, panel chair

Peter Hildering MSc., panel secretary

Date: 10 September 2024

Introduction

Procedure

Assessment

On 10 and 11 June 2024, the bachelor and master's programmes Cognitive Science and Artificial Intelligence of the Tilburg University were assessed by an independent peer review panel. The assessment followed the procedure and standards of the NVAO Assessment Framework for the Higher Education Accreditation System of the Netherlands (September 2018).

Quality assurance agency Academion coordinated the assessment upon request of Tilburg University. Peter Hildering acted as coordinator and panel secretary. He has been certified and registered by the NVAO.

Preparation

Academion composed the peer review panel in cooperation with the institution and taking into account the expertise and independence of the members. On 20 February 2024, the NVAO approved the composition of the panel. The coordinator instructed the panel chair on his role in the site visit according to the Panel chair profile (NVAO 2016).

The programmes composed a site visit schedule in consultation with the coordinator (see appendix 3). The programmes selected representative partners for the various interviews. They also determined that the development dialogue would be made part of the site visit. A separate development report was made based on this dialogue.

The programmes provided the secretary with a list of graduates over the period 2022-2024. In consultation with the secretary, the panel chair selected 15 theses for the BSc programme, and all 10 available MSc theses. They took the diversity of final grades and examiners into account. Prior to the site visit, the programmes provided the panel with the theses and the accompanying assessment forms. They also provided the panel with the self evaluation reports and additional materials (see appendix 4).

The panel members studied the information and sent their findings to the secretary. The secretary collected the panel's questions and remarks in a document and shared this with the panel members. In a preliminary meeting, the panel discussed the initial findings on the self-evaluation reports and the theses, as well as the division of tasks during the site visit. The panel was also informed on the assessment framework, the working method and the planning of the site visits and reports.

Site visit

During the site visit, the panel interviewed various programme representatives (see appendix 3). The panel also offered students and staff members an opportunity for confidential discussion during a consultation hour. No consultation was requested. The panel used the final part of the site visit to discuss its findings in an internal meeting. Afterwards, the panel chair publicly presented the preliminary findings.

Report

The secretary wrote a draft report based on the panel's findings and submitted it to an Academion colleague for peer assessment. Subsequently, the secretary sent the report to the panel for feedback. After processing this feedback, the secretary sent the draft report to the programme in order to have it checked for factual irregularities. The secretary discussed the ensuing comments with the panel chair and changes were

implemented accordingly. The panel then finalised the report, and the coordinator sent it to the Tilburg School of Humanities and Digital Sciences and Tilburg University.

Panel

The panel assessing the bachelor and master's programmes Cognitive Science and Artificial Intelligence at Tilburg University consisted of the following members:

- Prof. dr. W. (Walter) Daelemans, professor of Computational Linguistics at the University of Antwerp (Belgium) [chair];
- Prof. dr. A.A. (Albert Ali) Salah, professor of Social and Affective Computing in the Department of Information and Computing Sciences of Utrecht University;
- Dr C. (Cynthia) C.S. Liem MMus, associate professor in the Multimedia Computing Group of Delft University of Technology;
- N. (Nienke) Wessel BSc., master student Data Science at Radboud University [student member].

Information on the programmes

Name of the institution:	Tilburg University
Status of the institution:	Publicly funded institution
Result institutional quality assurance assessment:	Positive

Programme name:	Cognitive Science and Artificial Intelligence
CROHO number:	59338
Level:	Bachelor
Orientation:	Academic
Number of credits:	180 EC
Educational minor:	Applicable (Computer Science)
Location:	Tilburg
Mode(s) of study:	Fulltime
Language of instruction:	English
Submission date NVAO:	1 November 2024

Programme name:	Cognitive Science and Artificial Intelligence
CROHO number:	60969
Level:	Master
Orientation:	Academic
Number of credits:	120 EC
Location:	Tilburg
Mode(s) of study:	Fulltime
Language of instruction:	English
Submission date NVAO:	1 November 2024

Description of the assessment

Organization

The BSc and MSc Cognitive Science & Artificial Intelligence (CSAI) are organized by the Department of Cognitive Science and Artificial Intelligence (DCA) in the Tilburg School of Humanities and Digital Sciences (TSHD) of Tilburg University (TiU). Together with the MSc Data Science and Society (accredited separately in 2023), the programmes share a curriculum team that discusses the daily management of the programme, including staff allocation, quality assurance and planning. This curriculum team consists of the academic director, the thesis coordinators and the coordinator for the minor programme offered by DCA. Educational and administrative support is provided on the level of TSHD. The Examination Board operates on a School level, and the Programme Committees on a programme level, although the Programme Committees for the BSc and MSc CSAI meet jointly.

Recommendations previous accreditation

The accreditation panels that reviewed the programmes for initial accreditation made several recommendations to the programmes, most notably advising them to focus on balance and coherence between Cognitive Science and AI in the curricula, to ensure adequate representation of the programme on the Board of Examiners, and to prepare for potentially large numbers of students in terms of staff and facilities. The panel found that the programmes have taken these recommendations to heart and used them to improve the quality of the new programmes.

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.

Findings

Profile

The CSAI programmes at Tilburg University are interdisciplinary Artificial Intelligence (AI) programmes that connect AI with the field of Cognitive Science. The programmes focus on the relation between human intelligence and artificial intelligence, and the computational modelling of mental processes such as decision-making, learning, cooperation and communication. Students also explore the interaction between humans and technology, focusing on technological innovations that benefit society. This includes attention to the ethics of responsible AI, which permeates both programmes. This profile aligns with the research expertise of DCA in hybrid intelligence, i.e. applying knowledge of human cognition in AI and vice versa, as well as with the mission of Tilburg University, which underlines the importance of self-aware and engaged academics with a strong sense of responsibility and empathy. As AI is a fast-evolving field, students are also made aware of the importance of staying abreast of new developments, and provided with the learning skills to keep their knowledge and abilities up to date. The BSc attracts approximately 160 students per year. The MSc attracted 28 students in 2023-24, growing steadily from the cohorts of around 10 students in its early years. The MSc hopes to attract more students as more students are graduated and enter successful career paths to serve as positive examples.

The *bachelor's programme* aims to provide students with broad knowledge of the core concepts of AI as well as with modelling and computational skills. This should enable them to apply AI in a specific context,

conduct AI research under supervision and be aware of the possibilities and limitations of AI, including ethical aspects. While AI is at its core, the programme adds a strong focus on cognitive science, particularly in the second half of the curriculum. Students learn to connect AI to human cognition, for instance in topics related to human-computer interaction and the connection between machines and natural language. After completion of the BSc, students are able to follow any AI master at a Dutch university that adheres to the national AI framework (see below).

The *master's programme* teaches students advanced understanding of the core concepts of AI, as well as in-depth knowledge in cognitive science and/or AI in an area of choice. After completion of the programme, graduates should be able to apply their knowledge to complex problems related to AI in connection to cognitive science. The academic and applied problems that graduates can expect to face in their careers are often open-ended problems that require interdisciplinary teamwork to solve. In future, the programme aims to include content related to cyber security. CSAI could provide insight into designing security systems that align with human cognitive capabilities and decision-making under stress, thus countering phishing and social engineering attacks.

According to the panel, the CSAI programmes at Tilburg University have a well-developed profile. The focus on cognitive science as well as responsible AI gives the programmes a unique flavour in the field of AI programmes in the Netherlands. The interdisciplinary character of CSAI connecting the exact sciences and humanities fits the research focus of DCA, as well as TiU's strategic focus on societal impact and responsibility. Building on this notion, the panel sees developmental opportunities to expand the interdisciplinary nature of CSAI by linking it to other strong disciplines within the university, such as economic psychology and decision making. It suggests that the department explores whether this might be a viable direction for future development.

The panel noted that although the bachelor's and master's programme share the same name, there is a distinctive difference between the focus of the programmes. Whereas the BSc is in its core an AI programme that uses cognitive science as a connected focus area, the MSc focuses equally on both fields and their interconnection, as well as working on solutions for societally relevant open problems. The panel appreciates the distinctive character of both programmes, which fits well with the broad nature of the bachelor's and the more specialized nature of the master's. Students that followed both programmes mentioned to the panel that they were pleasantly surprised by this distinctive character, as the expectation among part of the bachelor student population was that the MSc is a more direct continuation of the BSc. The panel believes that the MSc CSAI could further develop its branding to highlight its unique character. This could increase the attractiveness of the programme, in line with the growth ambition mentioned by the programme management, for instance by increasing outflow from the BSc to the MSc CSAI. The abovementioned addition of cyber security as a new topic to the curriculum might provide further opportunities for this.

Intended learning outcomes

Both programmes have formulated their intended learning outcomes relative to the KION (Kunstmatige Intelligentie Opleidingen Nederland) framework, the national framework that describes the relevant core topics for AI and the expected learning outcomes of academic AI programmes. The focus on Cognitive Science comes on top of the KION framework, distinguishing CSAI from other academic AI programmes. The learning outcomes for both the BSc and MSc are listed in Appendix 1. They are grouped according to the Dublin descriptors to demonstrate their level and academic orientation.

The panel concludes that the intended learning outcomes are appropriate and reflect the academic orientation and the respective bachelor's and master's level of the programmes, as demonstrated in their alignment with the Dublin descriptors. The panel appreciates that the programmes focus on general skillsets in its intended learning outcomes rather than trying to capture all developments in AI, which the panel thinks is the appropriate position in such a rapidly changing field.

The programmes are well-aligned with the requirements of both the academic and professional AI field through the KION framework. During the site visit, the panel discussed the intended learning outcomes and their relation to the KION framework with the programme management. The panel noted that the KION framework is currently rather extensive and poses detailed requirements for particularly the bachelor's programme based on a more traditional view of AI. The panel understood that the KION framework is currently being updated by the associated partners, and will be renewed in the upcoming years. The panel hopes that the new framework will have more concrete recommendations and guidance with respect to the newer developments in AI.

Further alignment with the requirements of the professional field is ensured by the many connections between the department and external stakeholders. These allow the programmes to keep track of the fast-changing field and the associated expectations. The panel appreciates the ties of the programmes to the professional field. It suggests building upon these connections to collect external input in a more structured way. This could for instance take the shape of an external advisory board or network meetings with external partners. This approach might also be useful in allowing the programmes to build a broader network for students wanting to pursue an external internship (see standard 2). The panel heard during the site visit that DCA is currently working on an alumni policy to keep in touch with its alumni in a more structured way. To this end, an alumni officer has recently been appointed. The panel suggests that these efforts should be combined in a joint approach to developing structural links with the professional field.

Considerations

The CSAI programmes at Tilburg University have a unique profile in the landscape of AI programmes, as interdisciplinary bachelor's and master's programmes that combine exact sciences and humanities through a focus on cognitive science and responsible AI. The BSc CSAI does this by providing a strong foundation in AI with a focus on cognitive science, and the MSc CSAI by focusing on the use of cognitive science and AI in developing solutions to societal problems. The panel appreciates this distinctive character and recommends further developing the branding to emphasize this unique profile. Given its growth ambitions, this is particularly true for the master's programme. The intended learning outcomes of the programmes are appropriate for academic bachelor's and master's programmes respectively, and reflect the requirements of the academic and professional fields through their alignment with the KION framework for academic AI programmes. The panel recommends expanding the current connections to the professional field to collect external input in a more structured way, for instance through the founding of an external advisory board or the organization of network meetings with external partners and more structural contact with alumni.

Conclusion

The panel concludes that the bachelor's and master's programme Cognitive Science and Artificial Intelligence meet standard 1.

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.

Findings

Curriculum BSc CSAI

The curriculum of the BSc CSAI is organized in six semesters of 30 EC each, with typically five 6 EC-courses running in parallel. Courses are organized in thematic clusters: groups of successive courses that progressively build up knowledge and skills. The clusters are Cognitive Science, AI 1 and 2 (agent-based systems and learning, respectively), Programming, and Statistics and Methodology (see Appendix 2). The responsible lecturers for the associated courses meet annually in cluster meetings to discuss coherence, possible overlap and new developments in the field that should be included in the courses. Furthermore, the teaching staff of each semester meets before the semester start to align scheduling, teaching load and assessment deadlines.

The first year mostly consists of broad introductory courses for each of the clusters that lay the foundation for future courses, as well as a number of core AI courses. The second year deepens students' knowledge and understanding in the various clusters. Students develop their research skills in a Research Workshop (6 EC), where they practice the full research cycle in a group project offered by a DCA staff member. The first two years are made up of compulsory courses; electives start in the third year. The first semester of the third year has a 30 EC mobility window, that students can use for either exchange programmes with associated universities abroad, a research internship, one of the three CSAI elective packages, deepening or broadening electives offered elsewhere, or an educational minor for secondary school teacher in computer science. The final semester includes the 12 EC bachelor's thesis, which is written in a fixed time period in the curriculum. Students select three preferred topics from a list of BSc research projects offered within DCA, based on which the thesis coordinator assigns students to topics and supervisors. Students can also propose their own topic and find a teaching staff member willing to supervise this. Thesis supervision typically takes place in groups of students working on similar topics with the same supervisor. The project results in a written thesis, supplemented with the created code, a short video and a self-reflection essay focused on personal development.

The panel studied the curriculum of the BSc CSAI and concludes that it is well-structured and contains all relevant elements that are described in the programme's intended learning outcomes. The curriculum is also coherent, with knowledge and skills building upon each other through the thematic clusters. Whereas the panel executing the initial accreditation found that the curriculum tilted too much in the direction of cognitive science rather than AI, the current panel found that the programme has restored this balance and offers a good balance between both fields. The curriculum covers a broad range of up-to-date knowledge and skills, and the panel understood from discussions during the site visit that the courses are regularly updated to incorporate developments in the field. Attention to ethics and responsible AI is clearly visible throughout several courses, which the panel appreciates. The panel also appreciated the flexibility of the curriculum, with a 30 EC mobility window that allows students to pursue a wide range of deepening or broadening activities. The programme has a strong connection to DCA research. This is most prominently visible in the Research Workshop and the bachelor's thesis, which both allow students to directly interact with DCA research. The panel appreciates the close interaction between teaching staff and students during both research projects, and understood from students that they feel well supported and guided by their supervisors.

One element that some students found missing in the curriculum is attention to software development skills. Many students expect to be working in software development in their future career, and would appreciate to learn skills related to this. The programme management explained that this is not included as a compulsory course, as it feels that this does not align with the academic character of the programme. Moreover, there are elective opportunities for students that want to further develop their skills in this direction. The panel understands this reasoning, but at the same time thinks that there are opportunities to include software development elements in existing courses, for instance as part of one of the projects. It advises investigating whether this could be realized.

Curriculum MSc CSAI
The curriculum of the MSc CSAI consists of 120 EC. These are divided into core courses (69 EC), an elective (6 EC), an internship (15 EC) and a research project and thesis (30 EC). The curriculum is divided into a classroom-oriented first year, and a project-oriented second year.

In the first year, courses are organized in semesters, with five or six courses running in parallel. Core courses are grouped into three categories: AI, Cognitive Science (CS) or Research Skills. The first semester is mostly theoretical, and makes students familiar with current advanced topics in CS and AI, laying the foundation for application and deepening in later courses. The courses also aim to ensure that students with different backgrounds share a common ground. The first semester also includes the elective space, where students choose one out of four CS/AI-related courses. Students without previous training in deep learning are required to take the Deep Learning elective to prepare for the more advanced deep learning courses later in the curriculum. The second semester has a more practical orientation, and challenges students to combine theory and practice in projects and assignments.

In the second year, students take three additional core courses and the internship in the first semester. The courses in the first semester are all scheduled on the same day of the week to optimize alignment with the internship. The internship is research-based, and is focused on getting familiar with research and working on personal development. It is often conducted internally in a DCA research group, but an external project at a company or a research institution is also possible after the topic and organizational supervisor are approved by the internship coordinator. The second semester focuses on the research project and thesis. The research project and thesis form the final product of the programme, and cannot be combined with the internship. It is organized during a fixed timeframe during the second semester of the second year. Students choose a topic from a list of possible projects offered by DCA research groups or propose their own topic, and will be assigned a supervisor by the thesis coordinator. Students usually work within the research group and have weekly meetings with their supervisor. All research projects at least involve the analysis of a dataset. These datasets are often provided by external partners. In some cases, students also actually work with the external partners. In that case, the student writes a supervision plan with the external supervisor. The thesis coordinator will be the formal supervisor on behalf of the programme, and will meet at least three times with the student during the project. Before students can start on their thesis, a written research proposal needs to be approved by the supervisor. The research project is concluded with a thesis and a poster presentation to peers.

The panel concludes that the MSc CSAI has a solid and coherent curriculum that covers all elements mentioned in the programme's intended learning outcomes. Students obtain in-depth knowledge in AI and cognitive science, as well as their interconnectedness, in a balanced way. Responsible AI and ethics are clearly integrated into the courses and, as the panel understood, will be further strengthened with the inclusion of a dedicated core course Responsible AI in the next academic year. The core courses in the first

year allow students to obtain a solid basis in advanced CS and AI topics, preparing them for applying this knowledge in the internship project and research projects. The panel learnt from students that they appreciate the two opportunities to focus on a specific topic and work on an open challenge in the projects. Students experience a clear distinction between the internship and thesis: the internship is more practical and applied, whereas the thesis has a research focus. Some students choose to continue working on the same topic for both projects, but told the panel that they are always required to demarcate the two projects as separate and with a different focus. Students in both internal and external projects feel well supported and guided during the project-oriented second year.

Whereas the curriculum has a relatively large mandatory core, it is still flexible in the sense that students can often choose their own assignment topics in courses, and have considerable freedom in selecting a topic and location for their internship and thesis project. Furthermore, the programme differentiates in the first semester depending on the background of students. Students can get extra help or extra challenges in topics such as programming or deep learning based on their bachelor's background. Students appreciate this freedom, even though some would welcome more room for electives. The panel understands that the set-up of the programme currently has limited room for this, and approves of the programme's choice not to include further elective space.

A point of improvement mentioned by students is attention to advanced deep learning, which they feel could be further strengthened in the curriculum. The programme management acknowledges that this is an important development within AI, but at the same time recognizes that this is a technical and challenging topic that is difficult to grasp for the diverse student population that CSAI aims for. The programme is currently investigating opportunities to strengthen this component in the curriculum. The panel recognizes that this is a challenge, and applauds the fact that the programme is invested in keeping the programme up-to-date. The panel encourages the programme management to look for solutions to strengthen advanced deep learning in the curriculum.

The panel noted that skills education is appropriately integrated into the courses, but is less prominently visible compared to the BSc curriculum as skills are more embedded within courses. The panel recommends ensuring that the inclusion of skills education in the curriculum is safeguarded during future curriculum changes. This is particularly relevant for communication skills, as the panel understood that the dedicated core course on this topic (Risk Communication and Uncertainty) will be replaced with the new course Responsible AI in the next academic year. It recommends ensuring that the associated learning goals are sufficiently integrated into other courses, given the relatively large emphasis on communication skills in the intended learning outcomes. At the same time, the panel thinks that the Responsible AI course is a valuable addition to the curriculum, further emphasizing this as one of the defining characteristics of the programme.

Teaching methods and guidance

The educational vision of the BSc CSAI is based on the principles of *learning by doing*, providing a strong *research focus* and encouraging *continuous study behaviour*. Learning by doing is demonstrated in courses that complement lectures with practical seminars, on such topics as programming or working with hardware in the Robotics Lab. The research focus is reflected in the fact that the teaching staff is encouraged to integrate their research into their courses, and that students conduct several small (Research Workshop) and one large (BSc thesis) research projects in the curriculum. Furthermore, BSc students have the opportunity to do a research internship in their elective space. *Continuous study behaviour* is stimulated through providing assignments throughout most of the courses. These assignments usually contribute a small percentage to the total grade of the course. Students also participate in PASS (Program for Academic Study Success), a programme that runs throughout the semester and is focused on knowledge, skills and

character. PASS includes a mentorship programme, where senior students help new students find their way in the programme, plan their study and prepare for their first exams. Other elements of PASS are the annual Career Days and information sessions on the curriculum, which provide students with information on the elective options.

The educational vision of the MSc CSAI is to apply theory to practical problems and to connect teaching to research. Students apply theory learnt in the lectures in individual or group assignments. Some courses are fully-project based and require students to work on a larger and coherent problem. Furthermore, students are stimulated to become active researchers and contribute to current research during their studies, both in courses and in the MSc research project. Due to the small number of students in the programme, courses are typically small-scale and interactive with plenty of room for questions and discussion.

The panel appreciates the educational vision of both programmes. They provide a good combination of theory, practice and assignments, allowing students to apply knowledge to practical problems and assignments. The programmes are strongly connected to DCA research, providing students with multiple opportunities to interact with researchers and engage in projects directly related to ongoing research. Students and staff confirmed to the panel that teaching methods used in the courses are engaging and interactive, with lots of room for discussion and dialogue. The panel also commends the guidance and support provided by the programmes, such as the PASS mentorship programme in the bachelor's. The small scale of particularly the master's programme allows for close interaction, but the bachelor students also mention that they experience the programme as a close community. Students feel that they can easily share feedback on their programme through the formal structures, including the programme committee and the student panels that the programmes organize halfway through each semester. Furthermore, an important informal role in the CSAI community is taken up by student association Enigma which organizes community-forming social activities, provides student support and helps students bring suggestions for improvement to the attention of the programme. Students feel that they can voice any concern they have and that this is taken up seriously by both the teaching staff and programme management.

Admission and feasibility
The BSc CSAI is open to all students with a Dutch vwo or hbo foundation diploma (or an international equivalent), provided that they can demonstrate a sufficient level of mathematics as reflected in their choice of subjects. The programme has a relatively stable inflow of approximately 160 students per year. As the first cohort of students started in 2019/20, data on success rates is limited. The first indications are that over half of the students (59% for the first cohort) graduate within 4 years.

Over the past period, the MSc CSAI attracted approximately 10 students per year, but student numbers are rising (28 students for 2023/24). The first cohorts entered the programme after graduating from the BSc CSAI in Tilburg. Students with a Dutch bachelor's degree in AI that adheres to the KION framework are directly admitted to the programme. Other students need to demonstrate that their degree contained sufficient AI and mathematics. Even though only a small number of students has graduated yet, the first results indicate that most students take longer than two years to complete the programme. Students mention in the student chapter that they feel the programme is in principle doable in two years, and that delays are often the result of other activities pursued on the side. Students with a study delay are monitored by the study advisor and invited to meet for further discussion.

The panel concludes that the curricula of both programmes are feasible. The admission criteria are appropriate in the light of the programme goals, safeguarding that students have sufficient affinity with technical subjects without limiting intake too much in the light of the interdisciplinary nature of the

programmes. Students and staff confirm that study delays are usually the result of side activities pursued by students. Several students have jobs on the side, sometimes already within their field of study, and choose to study at a lower pace. In the event of workload issues within the curriculum, students have found that the programmes are highly responsive and typically identify and implement solutions promptly, such as adjusting project deadlines when an unanticipated peak workload arises. The panel also found that the strict thesis deadlines help to keep students on track with their project planning and graduate on time. At the same time, the panel also saw in the theses that this sometimes hampers the successful execution of promising research projects when delays or set-backs in data collection leaves students with a limited dataset to work with. It understands that this is a consequence of the choice for strict thesis deadlines, but wonders whether some leeway can be introduced (see standard 3 for further discussion).

Programme-specific facilities
Students in the programmes work in the DCA labs for their research internship and/or thesis. During the site visit, the panel had the opportunity to visit the MindLabs research institute facilities, where DCA researchers work on collaborative projects with other researchers, companies and societal organizations on topics related to for instance Robotics, VR, and Serious Gaming.

Based on the interviews with students and the visit to MindLabs, the panel concludes that the facilities for research and project work in both programmes are appropriate. The panel particularly appreciated that students have the opportunity to use GPU clusters for projects, which it considers to be very helpful for data-driven projects. Based on the discussions during the site visit, the panel has two suggestions for additional facilities and services that it thinks would benefit both programmes. First, following the abovementioned discussion on deep learning, the panel suggests to consider software platforms such as HuggingFace for deep learning projects, as such user-friendly software could remove some of the technical barriers that students face when working on advanced deep learning topics. Second, the panel thinks that the programme would benefit from introducing a more explicit and pro-active ethics review procedure for each thesis project. It understood from the programme management that this is currently not used due to the cumbersome and lengthy procedures that do not fit the timeline of student projects. The panel understands this well, but also thinks this a missed opportunity due to the emphasis on responsible AI in the programmes. It suggests setting up an ethical quick scan procedure for evaluating student projects in a shorter time frame. This does not necessarily have to be a programme-specific service, but could also be introduced on a faculty- or even university-wide level.

Language of instruction
The language of instruction as well as the name of both programmes is English. The reason behind this choice is that the programme expects that most students will work in an international context upon graduation, either in academia or in a commercial organization. Furthermore, the programmes hope to attract international talent to the Netherlands, as there a labour market shortage in AI-related jobs. To promote the quality of English-language education, staff is required to be proficient in English on C2 level. Furthermore, international students need to demonstrate that they have sufficient command of English before being admitted to the programmes.

The panel discussed the choice of English with programme representatives, and concludes that the programmes have made a well-substantiated choice in using English as the language of instruction and programme name. The professional field in which students are expected to work is undoubtedly international, and often uses English on a daily basis. The attraction of international talent to the Netherlands for the highly competitive market of AI-related jobs is considered to be an additional benefit by

the panel. The programmes have taken appropriate measures to safeguard the quality of English-language education through language requirements for both staff and (international) students.

Teaching staff
The large majority of the teaching staff of the programmes is associated with DCA, with additional teachers from the Department of Philosophy and Tilburg Law School for ethics and privacy-related courses. All lecturers are active researchers that teach in areas related to their research specialization. The core teaching staff (course coordinators) hold a PhD. The bachelor's programme also employs several teaching PhDs: PhD students with an extended contract who dedicate a substantial part of their time to teaching next to their PhD research. The majority of the teaching staff (including the teaching PhDs) holds a University Teaching Qualification (40%) or is working towards this (another 45%). The large size of the latter group is due to the rapid increase of the teaching staff in recent years. The remaining 15% is mostly comprised of staff with an exemption because of previously obtained didactic qualifications.

The panel commends the quality of the teaching staff, both in terms of relevant substantive expertise and in didactic quality. There is a clear connection between research and teaching, with staff members being involved in courses and project supervision on topics related to their own research expertise. A balanced mix of full, associate, and assistant professors is involved in the programme. The panel approves of the use of teaching PhDs in the bachelor's programme, and appreciate that they get a thorough teaching professionalization through the UTQ programme. The panel understood from the teaching staff members that the general workload, which also includes other academic activities, can be high, but that the programmes try to mitigate this where possible. For instance, teaching staff members new to a course get additional hours dedicated to teaching so that they can make themselves familiar with its content and teaching methods. The high student numbers that the initial accreditation panel predicted have not fully become a reality, but nevertheless the panel concludes that the programmes have responded appropriately to the recommendation of the initial accreditation and pay sufficient attention to workload issues among staff members.

Considerations
The panel found that both the BSc and MSc CSAI have translated their intended learning outcomes into well-structured and coherent curricula. The BSc curriculum builds up balanced knowledge and skills in cognitive science and AI through thematic clusters, and provides a solid interdisciplinary basis in both fields. The MSc curriculum is divided into a core in advanced cognitive science and AI topics, and a project part in which students apply what they learnt in open challenges in an internship and research project setting. Both programmes are well-connected to the research strengths of DCA, and provide students with ample opportunities to develop their skills as a researcher. The panel appreciates the educational vision of a strong connection between theory, practice and assignments, with interactive and engaging teaching methods. The choice for English as the language of instruction as well as the programme name is well-substantiated given the international character of the field in which students can be expected to work after graduation, and appropriate measures are taken to safeguard the quality of English-language education.

There are sufficient opportunities for students to shape the curriculum according to individual preferences, in the BSc through a substantial elective space, and in the master's through the possibility to select own topics for assignments and projects. The panel also concludes that students are well-supported and guided throughout the curriculum, including the research projects, and both programmes are feasible in the dedicated time. Staff and students describe the CSAI programmes as a close community, where they feel that student's voices are heard and taken seriously. The programmes have sufficient facilities to be able to

organize all curriculum elements, including labs and computing facilities. The teaching staff of both programmes is well qualified, both in terms of substantive expertise as in didactic qualities.

To further improve the curricula, the panel recommends that the bachelor's investigate whether software development skills could be added to existing courses, such as one of the group projects. For the master's programme, the panel encourages the strengthening of deep learning in the curriculum without shifting the programme in a too technical direction. Additional facilities such as software development platforms for AI might be beneficial to this end. Furthermore, the master's programme should safeguard the embedding of communication skills in the curriculum now that the associated course is dropped from the curriculum. Another possible improvement is the inclusion of a quick scan for ethical review of research projects, which the panel thinks fits the programmes' focus on responsible AI.

Conclusion

The panel concludes that the bachelor's and master's programme Cognitive Science and Artificial Intelligence meet standard 2.

Standard 3. Student assessment

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

Findings

System of assessment

The system of assessment in the CSAI programmes is based on the TSHD Assessment Policy, which describes the principles of assessment on the level of TSHD, programme, course and thesis. For each level, an assessment handbook for teaching staff members describes the relevant steps in the quality assurance system. The academic director of each programme, supported by the TSHD assessment specialists, drafts an assessment plan that relates the programme's ILOs to course assessment. Attention is paid to the alignment of assessment with the learning outcomes. The grading rules and rubrics are communicated beforehand to students, and examiners use pre-defined answer models.

Most courses in both programmes combine an exam and some type of assignment, either individual or in a small group. In the case of group work, the programme ensures that at least 60% of the grade of the total course is based on individual work to prevent freeriding. Furthermore, students are asked to account for their individual contributions to collective group products. The bachelor's programme frequently uses formative assessment in the shape of assignments throughout the courses that help students assess their progress. These account either for a small percentage of the final grade, or are fully formative. In the master's programme, formative assessment usually consists of mid-term feedback sessions with the teacher while working on an assignment or project. The internship in the master's programme is assessed through an internship proposal (pass/fail), oral presentation (pass/fail), and internship portfolio (grade 1-10). In the internship portfolio, students reflect on their personal learning goals as described in the internship proposal, which include elements related to both process and products. The internship is assessed by the (internal) supervisor of the student. In the case of an external internship, the daily supervisor at the internship organization acts as advisor to the assessor.

The panel studied the system of assessment of the programmes, and concludes that this is designed in a valid and insightful way. The assessment plans make the relation between intended learning outcomes and course assessment insightful, and there is sufficient attention for the balance between individual and group

assessment. Assessment methods are varied and fit the learning goals of the various courses. Regarding the balance between exams and assignments, some bachelor's students expressed the view that several of the exams were of limited value. Their primary purpose seemed to be to meet the assessment policies regarding individual versus group assessment, and that the course learning outcomes could also have been assessed without these written exams. The panel advises the bachelor's programme to review this feedback and determine whether it would be appropriate to replace some of the exams with other individual assessment methods, for instance individual assignments within group projects and/or discussion with individual students about the content of the project.

During the site visit, the panel discussed the potential use and pitfalls of student use of generative AI in assessment with various representatives. The faculty has guidelines in place that are based on transparency. Generative AI can be used as a tool, as long as students are transparent about how it is used and for what purpose, and do not claim AI-generated content as their own work. General use such as researching information, code checking and text rewriting or editing is usually permitted. Furthermore, the programmes sometimes also deliberately use types of assessment that are harder to realize with generative AI, such as presentations or videos. The panel concludes that the programmes pay adequate attention to the use of generative AI in assessment.

Thesis assessment
The bachelor's thesis consists of four deliverables: a written thesis report, the programming code created during the project, a short video describing the results, and a self-reflection essay. The last three deliverables are assessed by the thesis supervisor on a pass/fail basis, whereas the thesis report is graded on a scale of 1-10 by two examiners according to a standardized grading form.

For the master's thesis, students produce four deliverables: a research proposal, an oral presentation of the proposal, a poster presentation of the thesis, and the thesis with annotated code and a demo. A pass for the first two deliverables is conditional for the start of the actual research project. The poster presentation is held before staff members and fellow students during an exhibition-like session. The feedback given by the supervisor at this presentation should be included in the final deliverables. These final deliverables (thesis, code, and demo) are assessed by two examiners: the code and demo on a pass/fail basis, and the thesis on a scale of 1-10.

For both the bachelor's and master's programme, the written thesis report is considered to be the final product and determines the grade of the student. The two examiners involved in thesis grading are the supervisor and an independent assessor not involved in supervision. The assessors use a standardized assessment form with grading criteria and a rubric. The grading criteria are the same for bachelor's and master's theses but differ in the rubric, reflecting the different ILOs of the individual programmes. The grading criteria are 1) formulation of the goals and framework of the project, 2) the theoretical underpinnings and the use of literature, 3) the methods used and the quality of the data analysis, 4) the reflection on the results, 5) the quality of the conclusion and discussion and 6) the language and writing skills. All criteria must be at least a 6, and have an equal weight in calculating the final grade. Differences of one point or less on grading criteria are averaged, differences of more than one point are discussed among both assessors and consensus is sought. If there is disagreement after this discussion, a third assessor is appointed that gives a third grade, with the final score being the average of the three grades. Students can submit their thesis twice: if they fail their first attempt they can have a resit two weeks after receiving their first grade, in which they can try to remedy identified shortcomings. If the second attempt also fails, they have to start over the next year with a new topic.

Based on the thesis assessment procedures and the completed assessment forms that the panel studied before the site visit, the panel concludes that thesis assessment is organized in a valid, reliable and transparent way. The inclusion of an independent second examiner as well as a standardized assessment forms with rubrics adds to the validity of the assessment. The thesis assessment forms and rubrics are well-designed and used in an insightful way, with a clear explanation of the grades and useful feedback for students. For the higher grades in the rubrics, the panel would have welcomed more substantiation. It feels that the current differentiation between high (8-8.5) and very high (9-10) grades could be described better in the rubric.

To further develop thesis assessment, the panel suggests to include research novelty, either as a grading criterion or as part of the rubric, in the master's programme. According to the panel, the focus of the programme on developing solutions for open problems would suggest that creative and novel use of insights from AI and/or cognitive science is important in student work. Including this as element in thesis assessment would further highlight this.

The panel noted that the majority of projects for both programmes in the thesis sample consisted of resits, which it deemed unusual. When discussing this during the site visit, the panel found out that most students and staff view the first thesis deadline as an opportunity to extend the thesis trajectory as well as a means to collect additional feedback. Students hand in what they consider to be their final product at the resit opportunity. At the same time, the Board of Examiners stressed that they consider the first submission a graded formal attempt rather than a feedback round. The panel recommends clarifying this situation and repairing the mismatch between the administrative and experienced reality by restoring the resit as an exception rather than a rule, also in communication to students. The panel is of the opinion that the administrative burden of two fully graded attempts per student with the involvement of multiple examiners is superfluous. If students need additional feedback on their thesis, the panel believes this should be incorporated into the thesis track, without using the formal assessment process for this purpose. Since students use the resit to give themselves more time to work on the thesis, a possible solution according to the panel could be to extend the thesis trajectory for all students by introducing a preparatory course, allowing students to work on a thesis proposal and receive feedback on it before they begin their research. It would also allow students to dedicate more time to data collection, as previously discussed under standard 2. The panel recognizes the challenges associated with incorporating additional elements into the curriculum. It therefore suggests that this preparatory phase could be incorporated into the existing EC dedicated to the thesis.

Examination Board

The Examination Board oversees the quality of assessment within the programme. The Board is shared by all TSHD bachelor's and master's programmes, and has separate chambers per cluster of programmes that are mandated to make decisions at the operational level. The CSAI chamber is responsible for the BSc and MSc CSAI. The chairs of all chambers jointly form the central Examination Board. The Board advises the programme management and teaching staff on assessment, including annual advice on the programme assessment plan, enforces fraud and plagiarism regulations and evaluates the quality of courses and theses. To evaluate the quality of courses, the Board has appointed an Assessment Committee that selects two courses per semester to check the validity, reliability and transparency of assessment. To evaluate the quality of theses, the Board issues a thesis calibration session every semester. This session is organized by the thesis coordinator and consists of the re-evaluation of a number of theses by examiners to see whether the theses have been assessed in a transparent, reliable and objective way. The resulting report is discussed by the Examination Board and if necessary, leads to recommendations by the Board to the programme director.

During the site visit, the panel had the opportunity to speak with the Board of Examiners. Based upon this interview as well as the supporting documentation, the panel concludes that the Board functions well. The dedicated chamber for CSAI guarantees adequate representation of the programme in the Board of Examiners, remedying concerns expressed by the panel during the initial accreditation. Through the chamber, the Board has good insight into assessment practices in both programmes. The Board has appropriate measures and procedures in place to safeguard the quality of assessment. Particularly the thesis calibration sessions were viewed by the panel to be a very useful tool for both thesis quality assurance and alignment and professionalization among thesis examiners. The panel also appreciates that the central Examination Board can make use of the services of an assessment expert, allowing the Board to provide professional quality advice and insights to the programme management and teaching staff regarding assessment issues.

Considerations

Both programmes have a valid, reliable and transparent system of assessment, with appropriate checks and balances to safeguard the quality and validity of assessment in relation to the intended learning outcomes. The Board of Examiners functions well and safeguards the quality of assessment in a professional way. Assessment methods are varied and fit the intended learning outcomes of the programmes. The panel recommends the bachelor's programme to review whether the number of written exams can be reduced in favour of other individual assessment forms in the case of courses with group projects. The programmes have solid procedures for thesis assessment involving two examiners and a useful rubric. To further improve thesis assessment, the panel suggests to better differentiate higher grades (8 and up), and include research novelty as an element in the assessment of the master's theses. Finally, the panel recommends reducing the use of the thesis resit opportunity for extension of the thesis deadline and as a feedback opportunity, and restoring it as an exception rather than a rule. Modifying the thesis trajectory to include additional feedback opportunities and/or extending the trajectory with a preparatory phase could be a possible solution to address the issues that the resit is currently used for to resolve.

Conclusion

The panel concludes that the bachelor's and master's programme Cognitive Science and Artificial Intelligence meets standard 3.

Standard 4. Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

Findings

Thesis quality

To determine the exit level of students, the panel studied 15 recent theses of the bachelor's programme, and all available 10 theses of the master's programme. It concludes that the theses demonstrate that graduates of both programmes meet the exit level as described in the intended learning outcomes. According to the panel, the theses show a diversity of topics in line with the foci of the programmes. For the bachelor's programme, this is usually the analysis of a real-life dataset, whereas the master's programme features more open-ended challenges. All theses pay attention to the impact of the results as well as to ethical reflection. Notwithstanding this positive assessment, the panel was expecting more emphasis on this part in some of the theses, given the strong focus of both programmes on responsible AI. It advises both programmes to investigate whether strengthening this part of the thesis requirements is necessary.

Alumni

Data on the first two cohorts of bachelor graduates shows that the majority continues in a master's programme, and that there is also a significant fraction (around one-third of graduates) directly entering the job market. The master's programmes that graduates choose are generally within the realm of data science, AI and cognitive science. Around 10% continues with the MSc CSAI at TiU. The limited data that the programmes have on the job market perspective of graduates shows that most find a relevant CSAI-related job, such as software or machine learning engineer, or IT trainee. Many of the students already have a CSAI-related job during their studies, and mention that they are regularly approached by recruiters before completing the programme. In addition, the panel understood that several students and graduates aspire a PhD after completion of the master's programme, and that a growing number of graduates is in the process of obtaining a position.

The panel concludes that the performance of graduates shows that the programmes prepare students well for an academic or professional career. Bachelor graduates are admitted to a wide variety of relevant master's programmes, and graduates of both programmes find relevant jobs. The department's ambition of throughput from bachelor's to master's CSAI is not fully realized, with only a limited number of students continuing from the BSc to the MSc CSAI. As discussed in standard 1, the panel thinks that a better branding of the master's programme could help in this regard.

Considerations

The quality of the BSc and MSc theses show that students of both programmes realize the intended learning outcomes. Thesis quality is up to standard, and reflects the focus of the programme on societal impact and responsible AI, although the latter could be further strengthened according to the panel. Bachelor graduates are admitted to various relevant MSc programmes, and alumni of both programmes find relevant jobs within the field, further demonstrating that graduates from both programmes realize the intended learning outcomes.

Conclusion

The panel concludes that the bachelor's and master's programme Cognitive Science and Artificial Intelligence meet standard 4.

General conclusion

The panel's assessment of the bachelor's and master's programme Cognitive Science and Artificial Intelligence is positive.

Development points

Both programmes:

1. Expand current connections to the professional field to collect external input in a more structured way, for instance through the founding of an external advisory board or the organization of network meetings with external partners and more structural contact with alumni.
2. Consider the inclusion of a quick scan for ethical review of research projects.
3. Adapt the thesis assessment rubric to better differentiate between higher grades (8 and up).
4. Reduce the use of the thesis resit opportunity for extension of the thesis deadline and as a feedback opportunity. Find other solutions to these issues through adaptation of the thesis trajectory.
5. Further strengthen the attention to ethical reflection in the theses.

Bachelor's programme:

6. Investigate whether software development skills can be added to existing courses.

Master's programme:

7. Include research novelty as a criterion in the assessment of the master's theses.
8. Strengthen deep learning in the curriculum without shifting the programme in a too technical direction, possibly through the use of software development platforms for AI.
9. Safeguard the embedding of communication skills in the curriculum now that the associated course is dropped from the curriculum.

Appendix 1. Intended learning outcomes

Bachelor's programme Cognitive Science and Artificial Intelligence

A. Knowledge and understanding
1. Basic understanding of key areas in Artificial Intelligence.
2. Advanced knowledge of at least one of the key areas in Artificial Intelligence, up to a level that without further requirements grants access to a master program in this area.
3. Knowledge of the symbolic approach to Artificial Intelligence
4. Knowledge of the numerical, non-symbolic, approach to Artificial Intelligence.
5. Knowledge of the most important philosophical theories in the area of knowledge and cognition.
6. Knowledge of the most important theories developed in the area of empirical sciences, particularly psychology.
7. Expertise in constructing and evaluating computational models of cognitive processes.

B. Applying knowledge and understanding
1. The ability to understand, apply, formulate, and validate models from the domains of Artificial Intelligence.
2. The ability to apply the symbolic approach to Artificial Intelligence.
3. The ability to apply non-symbolic approaches to Artificial Intelligence.
4. The ability to design, implement, and evaluate knowledge systems.
5. The ability to apply tools from mathematics and logic.
6. The ability to apply important programming languages used in Artificial Intelligence.
7. Analytical approach to problem solving and design:
7a. Ability to comprehend problems and abstract their essentials.
7b. Ability to construct and develop logical arguments with clear identification of assumptions and conclusions.
8. The ability to submit an argument in the exact sciences or humanities to critical appraisal.
9. Analytical and critical way of thought and ability to apply logical reasoning.
10. The ability to create an effective project plan for solving a prototypical Artificial Intelligence problem in a supervised context.

C. Making judgments
1. Ability to critically review results, arguments and problem statements from accepted perspectives in the field of Artificial Intelligence.
2. Initial competence in search and critical processing of professional literature in Artificial Intelligence.
3. Acquaintance with the standards of academic criticism.
4. Awareness of, and responsibility concerning the ethical, normative, and social consequences of developments in science and technology, particularly resulting from Artificial Intelligence.

D. Communication
1. The bachelor can communicate ideas effectively in written form.
2. The bachelor can make effective oral presentations.
3.The bachelor can understand and offer constructive critiques of the presentations of others in the domain.

E. Learning skills
1. Students take initiative and take responsibility for their learning process and are able to manage their own learning process, in order to continue to learn independently, to develop professionally and to develop the ability of self-reflection.
2. Students have the learning skills necessary to continue their study successfully at the level of a master's program in Cognitive Science, Artificial Intelligence, Data Science, Digital Humanities and related areas.
3. Students have the ability to transpose academic knowledge and expertise into social, professional and economic contexts.
4. Students are able to work in teams in order to collaboratively identify problems, come to desired outcomes and negotiate mutually acceptable conclusions.

Master's programme Cognitive Science and Artificial Intelligence
A. On successful completion of the program, the student has demonstrated extended knowledge and understanding of:
A1 Scientific and technological principles underlying research in Cognitive Science (A1a) and Artificial Intelligence (A1b).
A2 Specialist tools and techniques used to design, analyze, implement, and verify Cognitive Science systems (A2a) and Artificial Intelligence systems (A2b).
A3 Advanced research issues relevant to key areas in Cognitive Science (A3a) and Artificial Intelligence (A3b).

B. On successful completion of the program, the student will be able to:
B1 Formulate a project plan for specific open problems in Cognitive Science (B1a) and Artificial Intelligence (B1b).
B2 Contribute autonomously and with minimal supervision to an interdisciplinary project team.
B3 Choose, formulate and validate models, theories, hypotheses, and ideas from the domains of Cognitive Science (B3a) and Artificial Intelligence (B3b).

C. On successful completion of the program, the student has the ability to:
C1 Integrate results, arguments, and problem statements from accepted perspectives in the field of Cognitive Science (C1a) and Artificial Intelligence (C1b), in line with the standards of academic criticism.
C2 Formulate an opinion and make judgments related to the application of one's own contributions in the domain of Cognitive Science (C2a) and Artificial Intelligence (C2b).
C3 Translate academic knowledge and expertise into social, professional, economic, and ethical contexts using incomplete or limited information.

D. On successful completion of the program, the student is able to communicate:
D1 The findings, opinions and rationale behind Cognitive Science (D1a) and Artificial Intelligence (D1b) solutions in oral presentations to specialist and non-specialist audiences clearly and unambiguously.
D2 The findings, opinions and rationale in Cognitive Science (D2a) and Artificial Intelligence (D2b) research in written presentations.
D3 Understand and offer constructive criticism of the written reports or oral presentations of others.

E. On successful completion of the program, the student has the learning skills to:
E1 Study the research developments in the field of Cognitive Science (E1a) and Artificial Intelligence (E1b) in a manner that is largely self-directed and autonomous.
E2 Further extend the technical skills necessary for keeping up with the advances in the field of Cognitive Science (E2a) and Artificial Intelligence (E2b).

Appendix 2. Programme curriculum

Bachelor's programme Cognitive Science and Artificial Intelligence

Sem 1	Introduction to AI 1	Introduction to Cognitive Science	Introduction to Logic	Introduction to Programming	Critical and Scientific Thinking	PASS CSAI 1
	6	6	6	6	6	
Sem 2	Introduction to AI 2	Language, Cognition & Computation	Knowledge Representation	Statistics for CSAI 1	Calculus	
	6	6	6	6	6	
Sem 3	Data Structures and Algorithms	Human-Computer Interaction for CSAI	Multi-Agent Systems	Statistics for CSAI 2	Linear Algebra	PASS CSAI 2
	6	6	6	6	6	
Sem 4	Introduction to Machine Learning	Cognitive Neuroscience	Autonomous Systems	Research Workshop	Ethics of AI	
	6	6	6	6	6	
Sem 5	Minor / Electives / Mobility Window					PASS CSAI 3
	30					
Sem 6	Introduction to Deep Learning	Computational Linguistics	Advanced Programming	Thesis		
	6	6	6	12		

Cluster CS	Cluster AI 1	Cluster AI2	Cluster Progr.	Cluster ST. & Meth.

Master's programme Cognitive Science and Artificial Intelligence

Year 1

Sem 1	Core Topics AI	Computer Games	Core Topics CS	Cogn Models of Language Learning	Elective	
	6	6	6	6	6	
Sem 2	Deep Reinforcement Learning	Complex Systems	Risk Communication and Uncertainty	Brain Computer Interfacing	Image Analysis	Spatio-temporal Data Analysis
	6	6	6	6	3	3

Year 2

Sem 1	Advanced Deep Learning	Bayesian Models of Cognitive Processes	Big Data	Internship
	6	6	3	15
Sem 2	Research Project and Thesis			
	30			

Artif Intell	Cogn Science	Research Skills	Electives	Internship / thesis

Appendix 3. Programme of the site visit

Monday 10 June 2024

Time	*Schedule*
12.00 - 12.15	Welcome
12.15 - 14.00	Panel preparation (incl. lunch)
14.00 - 15.00	Interview programme management
15.15 - 16.00	Interview BSc students and recent BSc alumni
16.00 - 16.30	Break
16.30 - 17.15	Interview BSc teaching staff
17.15 - 17.30	Internal panel meeting

Tuesday 11 June 2024

Time	*Schedule*
08.45 - 09.15	Panel preparation
09.15 - 10.00	Interview MSc students and recent alumni
10.15 - 11.00	Interview MSc teaching staff
11.00 - 11.30	Break
11.30 - 12.00	MindLabs tour
12.00 - 12.30	Interview Board of Examiners
12.30 - 13.30	Internal panel session (incl. lunch)
13.30 - 14.00	Concluding session programme management
14.00 - 15.30	Concluding session panel
15.30 - 16.15	Development dialogue
16.15 - 16.30	Oral feedback panel

Appendix 4. Materials

Prior to the site visit, the panel studied 15 theses of the bachelor's programme Cognitive Science and Artificial Intelligence and 15 theses of the master's programme Cognitive Science and Artificial Intelligence. Information on the theses is available from Academion upon request.

The panel also studied other materials, which included:

- Reports initial accreditation BSc CSAI and MSc CSAI
- Measures after recommendations of the previous panel
- Staff overview
- SWOT analysis
- TSHD Strategic Plan
- TSHD School Regulations
- TSHD Assessment Policy
- TSHD Quality Assurance Education
- TSHD Assessment Handbook
- Manual Examination Boards TSHD
- Annual Report Examination Board TSHD
- Guidelines Program Committees TSHD
- Education and Examination Regulations and Rules and Guidelines
- Ba and Ma SCAI – Program Information Year Study Guide
- B and M CSAI 2023-2024 Assessment Plan
- B and M CSAI 2022-2023 Example Assessment Committee reports
- An example of a Calibration Session Report
- Thesis Guidelines
- Annual Report Program Committee
- Ethical Standards Compliance document: DSECT statement
- Study materials selected BSc and MSc courses