MASTER'S PROGRAMME
COMPUTING SCIENCE

FACULTY OF SCIENCE

RADBOUD UNIVERSITY

QANU
Catharijnesingel 56
PO Box 8035
3503 RA Utrecht
The Netherlands

Phone: +31 (0) 30 230 3100
E-mail: support@qanu.nl
Internet: www.qanu.nl

Project number: Q0745

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This report was finalised on 30 March 2020.

REPORT ON THE MASTER'S PROGRAMME COMPUTING SCIENCE OF RADBOUD UNIVERSITY

This report takes the NVAO's Assessment Framework for the Higher Education Accreditation System of the Netherlands for limited programme assessments as a starting point (September 2018).

ADMINISTRATIVE DATA REGARDING THE PROGRAMME

Master's programme Computing Science

Name of the programme:	Computing Science
CROHO number:	60364
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	Data Science Software Science Mathematical Foundations of Computing Science (MFoCS) Cyber Security Science, Management and Innovation (SMI) Science in Society (SiS)
Location:	Nijmegen
Mode of study:	full time
Language of instruction:	English
Submission deadline NVAO:	01/05/2020

The visit of the assessment panel Computer Science to the Faculty of Science of Radboud University took place on 18 and 19 November 2019.

ADMINISTRATIVE DATA REGARDING THE INSTITUTION

Name of the institution:	Radboud University
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive

COMPOSITION OF THE ASSESSMENT PANEL

The NVAO has approved the composition of the panel on 15 April 2019. The panel that assessed the master's programme Computing Science consisted of:

- Em. prof. dr. T. (Theo) D'Hondt, emeritus professor in Software Languages and Software Engineering at the Faculty of Sciences and Bioengineering Sciences of Vrije Universiteit Brussel (Belgium) [chair];
- Prof. dr. ir. W.E.A. (Wim) van Petegem, professor and policy coordinator Learning Technologies at the Faculty of Industrial Engineering Technology of KU Leuven (Belgium);
- Prof. dr. S. (Sjouke) Mauw, professor in Security and Trust of Software Systems at the Department of Computer Science of the University of Luxembourg (Luxembourg);
- Ir. E.A.P. (Ewine) Smits, Senior Manager in Advanced Analytics & Big Data at KPMG Nederland;
- M. (Martijn) Brehm, third-year bachelor's student Computer Science at University of Amsterdam [student member].

The panel was supported by M. (Mark) Delmartino MA, who acted as secretary.

WORKING METHOD OF THE ASSESSMENT PANEL

The site visit to the master's programme Computing Science at the Faculty of Science of Radboud University was part of the cluster assessment Computer Science. Between June and December 2019 the panel assessed 29 programmes at 10 universities. The following universities participated in this cluster assessment: Leiden University, Delft University of Technology, University of Utrecht, Eindhoven University of Technology, Open University, University of Amsterdam, Vrije Universiteit Amsterdam, Radboud University, University of Groningen and University of Twente.

On behalf of the participating universities, quality assurance agency QANU was responsible for logistical support, panel guidance and the production of the reports. P.A. (Peter) Hildering MSc. was project coordinator for QANU. P.A. (Peter) Hildering MSc. and M. (Mark) Delmartino MA acted as secretary in the cluster assessment.

During the site visit at Radboud University the panel was supported by M. (Mark) Delmartino MA, a certified NVAO secretary.

Panel members of the cluster assessment Computer Science
The members of the assessment panel were selected based on their expertise, availability and independence. The panel consisted of the following members:

- Em. prof. dr. T. (Theo) D'Hondt, emeritus professor in Software Languages and Software Engineering at the Faculty of Sciences and Bioengineering Sciences of Vrije Universiteit Brussel (Belgium) [chair];
- Prof. dr. ir. W.E.A. (Wim) van Petegem, professor and policy coordinator Learning Technologies at the Faculty of Industrial Engineering Technology of KU Leuven (Belgium);
- Prof. dr. S. (Sjouke) Mauw, professor in Security and Trust of Software Systems at the Department of Computer Science of the University of Luxembourg (Luxembourg);
- Prof. dr. J.J. (John-Jules) Meyer, full professor Computer Science and Artificial Intelligence at the University of Utrecht;
- Drs. L. (Lennart) Herlaar, owner/director at Redbits.nl, a company specialized in software development and IT consultancy, and assistant professor Computer Science at the Faculty of Science of Utrecht University;
- T.A. (Tonny) Wildvank, owner/CEO at Wildvank, Management en Advies, specialized in IT-management and -consultancy;
- Prof. dr. J. (Jan) Aerts, full professor Visual Data Analysis at the University of Hasselt and associate professor Visual Data Analysis at the faculty of Engineering Science at KU Leuven (Belgium);
- Drs. H.C. (Jeroen) Borst, senior consultant Smart Cities at TNO;
- Prof. dr. P. (Petros) Koumoutsakos, full professor Computational Science at ETH Zürich (Switserland);
- Prof. dr. ir. J.M.W. (Joost) Visser Chief Product Officer at Software Improvement Group Nederland en bijzonder hoogleraar Large-scale Software Systems at the Radboud University Nijmegen;
- Ir. E.A.P. (Ewine) Smits, Senior Manager in Advanced Analytics & Big Data at KPMG Nederland;
- Prof. dr. D.P. (Danilo) Mandic, full professor Signal Processing at the department of Electrical and Electronic Engineering of Imperial College London (United Kingdom);
- Dr. ir. J.C. (Job) Oostveen, Research Manager at the Department Monitoring and Control Services at TNO;
- Prof. dr. B.A.M. (Ben) Schouten, full professor Playful Interactions at Eindhoven University of Technology;
- Dr. ir. N. (Nico) Plat, owner/CEO at Thanos IT-consultancy and architecture.
- N. (Nienke) Wessel BSc, master's student Computing Science and bachelor's student Mathematics and Linguistics at Radboud University [student member];
- E. (Evi) Sijben BSc, master's student Computing Science in the specialisation track Data Science at Radboud University [student member];

- B. (Baran) Erdogan, third-year bachelor's student Computer Science at University of Amsterdam [student member];
- M. (Martijn) Brehm, third-year bachelor's student Computer Science at University of Amsterdam [student member].

Preparation
On 21 March 2019, the panel chair was briefed by QANU on his role, the assessment framework, the working method, and the planning of site visits and reports. A preparatory panel meeting was organised on 9 May 2019. During this meeting, the panel members received instruction on the use of the assessment framework. The panel also discussed their working method and the planning of the site visits and reports.

The project coordinator and secretary composed a schedule for the site visit in consultation with the Faculty. Prior to the site visit, the Faculty selected representative partners for the various interviews. See Appendix 4 for the final schedule.

Before the site visit to Radboud University, QANU received the self-evaluation reports of the programmes and sent these to the panel. A thesis selection was made by the panel's chair and secretary. The selection consisted of bachelor theses, master theses and their respective assessment forms, based on a provided list of graduates in the academic years 2016-2017, 2017-2018 and 2018-2019. A variety of topics and tracks and a diversity of examiners were included in the selection. The secretary and panel chair assured that the distribution of grades in the selection matched the distribution of grades of all available projects and theses, and that all tracks were covered in the selection. After studying the self-evaluation report, theses and assessment forms, the panel members formulated their preliminary findings. The secretary collected all initial findings and questions and distributed these amongst all panel members.

At the start of the site visit, the panel discussed these initial findings, identified the key issues to be discussed during the sessions, and agreed on a division of tasks during the site visit.

Site visit
The site visit to Radboud University took place on 18 and 19 November 2019. Before and during the site visit, the panel studied the additional documents provided by the programmes. An overview of these materials can be found in Appendix 5. The panel had a tour across the campus visiting programme-specific learning facilities and the study association, and conducted interviews with representatives of the programmes: students and staff members, the programme's management, alumni and representatives of the Board of Examiners. It also offered students and staff members an opportunity for confidential discussion during a consultation hour. One person made use of this opportunity. 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 panel's preliminary findings and general observations.

The visit was concluded with a development conversation, in which the panel and the programmes discussed various development routes for the programmes. The result of this conversation is summarized in a separate report.

Consistency and calibration
In order to assure the consistency of assessment within the cluster, following measures were taken: the panel composition ensured regular attendance of (key) panel members, including the chair, and the project coordinator was present at the panel discussion leading to the preliminary findings of each programme at all site visits.

Report
After the site visit, the secretary wrote a draft report based on the panel's findings and submitted it to the project coordinator for peer assessment. Subsequently, the secretary sent the report to the

panel. After processing the panel members' feedback, the project coordinator sent the draft reports to the Faculty in order to have these checked for factual irregularities. The project coordinator discussed the ensuing comments with the panel's chair and changes were implemented accordingly. The report was then finalised and sent to the Faculty and University Board.

Definition of judgements standards
In accordance with the NVAO's Assessment framework for limited programme assessments, the panel used the following definitions for the assessment of the standards:

Generic quality
The quality that, from an international perspective, may reasonably be expected from a higher education Associate Degree, Bachelor's or Master's programme.

Meets the standard
The programme meets the generic quality standard.

Partially meets the standard
The programme meets the generic quality standard to a significant extent, but improvements are required in order to fully meet the standard.

Does not meet the standard
The programme does not meet the generic quality standard.

The panel used the following definitions for the assessment of the programme as a whole:

Positive
The programme meets all the standards.

Conditionally positive
The programme meets standard 1 and partially meets a maximum of two standards, with the imposition of conditions being recommended by the panel.

Negative
In the following situations:
- The programme fails to meet one or more standards;
- The programme partially meets standard 1;
- The programme partially meets one or two standards, without the imposition of conditions being recommended by the panel;
- The programme partially meets three or more standards.

SUMMARY JUDGEMENT

This evaluation concerns the master's programme Computing Science, a two-year full-time 120 EC programme offered by the Institute for Computing and Information Sciences at the Radboud University in Nijmegen.

The master's programme has an outspoken profile, which strongly reflects the research priorities of the institute. The panel thinks highly of the way in which the vision on computing science at the Radboud University interrelates with the priorities of the institute and the programme specialisations on Cyber Security, Data Science, Software Science and Mathematical Foundations of Computing Science. The intended learning outcomes of the master programme reflect adequately the discipline, level and orientation of the programme, do justice to the four research and two societal specialisations and the ambitions of the programme to prepare students for a career in industry or academia.

Overall, the teaching-learning environment of the master's programme is good, an appreciation that covers several components of the programme, the staff and the facilities: the curriculum is coherent and its contents are in full alignment with the programme profile and the intended learning outcomes; the didactic concept underlying the programme is both clear and appropriate; the admission criteria are clear and effective; the programme and its respective specialisations are feasible; teaching staff is highly qualified in terms of both disciplinary know-how and didactics; the explicit attention to female staff is attracting female students and researchers; in addition to the teaching locations of the Faculty of Science, the Mercator 1 building contributes to the small-scale approachable education environment; and the study association constitutes a value added for the students, the programme and the institute. However, the panel is concerned that in the near future the number of master students will grow to such a level that it affects some of the achievements and typical features of the Computing Science programmes in Nijmegen, such as the small scale of the programme, the variety of teaching methods, the availability of teaching staff and the homey atmosphere in and capacity of the Mercator 1 building. It therefore calls on the management to address these challenges, which are acute in the bachelor's programme but are also expected to impact the master programme in the near future.

Student assessment is well organized in the Computing Science programme. The policy and principles underlying course assessments are up to standard. The panel thinks highly of the extensive overall programme test matrix and considers that the course assessments are valid, reliable and transparent. Based on its own sample review, the panel agreed to almost all scores of the master's theses but considers that the current evaluation form is not inviting for assessors to provide qualitative feedback and motivate their appreciation. The panel therefore welcomes the plans to adjust the evaluation form in line with the rubrics-based evaluation format of the bachelor's thesis. The Examination Board has appropriate expertise and uses this to safeguard the control of both course and thesis assessments. Nonetheless, the panel thinks that the Examination Board can make better and more pro-active use of its expertise and independent position to insist that its findings and recommendations are implemented.

Master's students who graduate from the Computing Science programme are adequately prepared for a career in both industry and academia. Having established that all theses meet at least the minimum requirements of what can be expected of a final project at master's level – and are often of higher quality – it is fair to state that the intended learning outcomes of the programme are achieved at the end of the master curriculum. While the programme has good contacts with alumni individually and through the professional advisory board, the panel recommends the programme to follow-up more systematically the whereabouts of all graduates.

Throughout the visit, the panel has come to appreciate the unique selling points of each of the four master specialisations, which are different in their own right and worth offering and maintaining as separate tracks within one overarching programme. The two societal specialisations address a need

among students who wish to develop broader skills that will be useful in their professional career. As the research specialisations Software Science and Mathematical Foundations of Computing Science attract less students than the other research specialisations, the panel is concerned about their viability, hence the recommendation to the programme management to look for ways how both tracks can attract a sufficient number of students in order to continue offering the same level of choice in their curricula.

In sum, the panel concludes that the quality of the master's programme Computing Science is up to standard on all accounts, hence its overall positive conclusion.

The panel assesses the standards from the *Assessment framework for limited programme assessments* in the following way:

Master's programme Computing Science	
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

The chair, em. prof. dr. T. (Theo) D'Hondt, and the secretary, M. (Mark) Delmartino MA, of the panel hereby declare that all panel members have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 30 March 2020

DESCRIPTION OF THE STANDARDS FROM THE ASSESSMENT FRAMEWORK FOR LIMITED FRAMEWORK ASSESSMENTS

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 master's programme Computing Science is offered by the Institute for Computing and Information Sciences (ICIS). In the Faculty of Science of Radboud University (RU), ICIS is both an interdisciplinary thematic research institute and an educational institute: the educational institute is responsible for the bachelor's and master's programmes Computing Science and the master's programme Information Sciences and the bulk of its teaching staff are members of the research institute.

The master's programme aims to equip graduates with knowledge and skills in computing science and general academic competences to independently tackle unresolved problems and develop new solutions and methodologies. It offers students a very focused research-based education. Students enrolling in the master's programme Computing Science choose one of four research specialisations, which align with the main research areas at ICIS:

- Cyber Security (CS) covers the full width of core knowledge areas in cyber security, is taught in collaboration with TU Eindhoven and is linked to the research group Digital Security;
- Data Science (DS) focuses on artificial intelligence and information retrieval, is related to the research group Data Science and benefits from expertise in the faculty of social sciences and the interfaculty Institute for Brain, Cognition and Behaviour;
- Mathematical Foundations of Computing Science (MFoCS) follows a long-standing research tradition at RU in logical and mathematical foundations of computing science and is linked to the research group Software Science;
- Software Science (SS) relates to the Software Science research group and their interest in functional programming and model-based system development and analysis.

Moreover, students in the Data Science and Software Science specialisations can opt for one of two additional so-called societal specialisations which are offered faculty-wide:

- Science, Management and Innovation (SMI) provides tools to address the world's sustainable development goals, as well as skills in science, policy making and business;
- Science in Society (SiS) offers competences to become a professional intermediary between science and society.

The panel gathered from the self-evaluation report and the discussions on site that the computing science programmes at RU have a clear profile within the Dutch higher education landscape: they focus on software products and emphasize the role of theory and formal methods in its analysis, design, and manufacturing. Moreover, computing science is viewed as a constructive science: researchers and students design, build and analyse products according to academic standards, using and developing knowledge about these products and the production process. Furthermore, the panel understood that Nijmegen is well known – also among potential students - for its attention to Cyber Security, one of the ten leading research areas of RU and a prominent specialism in its computing science programmes.

The panel noticed that this distinctive profile and this vision on computing science reflect the research priorities of the institute and the master programme. In this regard, the panel has come to appreciate the unique selling points of each of the four master specialisations, which are different in their own

right and worth offering and maintaining as separate tracks within one overarching programme. The discussions furthermore revealed that the two societal specialisations are relevant for computing science students who wish to develop broader skills that will be useful in a professional career that combines computing science with communication, policy making or business.

Intended learning outcomes
The programme aims for graduates to have thorough academic knowledge and insight in their specialisation, apply their knowledge and skills to research and system development issues, be aware of the societal aspects of IT and capable of communicating at a professional level. These ambitions are reflected in the intended learning outcomes (ILOs), which are listed in Appendix 2 to this report. According to the panel, the programme's end terms are formulated adequately for a programme at master's level and their description is detailed and sufficiently specific per specialisation. The panel noticed furthermore that the ILOs cover all Dublin descriptors at master's level.

There is a common understanding among Dutch universities offering computer science programmes that the so-called ACM Computer Science Curricula 2013 serve as domain-specific framework of reference for bachelor programmes. As the ACM framework was formulated for undergraduate programmes, it only forms a source of inspiration for master's programmes; this also applies for the master's programme in Computing Science. Furthermore, the Cyber Security specialisation has its own domain-specific reference framework: the curriculum Guidelines for Post-Secondary Degree Programmes in Cybersecurity by ACM & IEEE. The panel noticed in the materials that the mandatory courses for the Cyber Security specialisation cover all knowledge areas of the ACM & IEEE curriculum guidelines. A link to both reference frameworks is provided in Appendix 1 to this report.

Professional field
There are various ways in which the learning outcomes and the curriculum match the needs and expectations of the professional field: research collaborations with external parties, external master's thesis and research internship projects, part-time appointments of teaching staff who work in industry, guest lectures, etc. The panel noticed that the relevance of the programme objectives and the curriculum contents are checked and discussed regularly with the professional advisory committee (*Commissie Afnemend Veld*). This was confirmed during the visit by members of the advisory committee, which has been around for quite some time.

Considerations
The panel considers that the master's programme Computing Science has an outspoken profile, which reflects the research priorities of the institute, the faculty and the university. The panel thinks highly of the way in which the vision on computing science interrelates with the priorities of the Institute and the programme specialisations. Given this well-grounded profile, Computing Science in Nijmegen takes up a position of its own within the Dutch higher education landscape of computer science programmes.

The panel appreciates the way in which the programme ambitions are covered in the intended learning outcomes. These end terms are formulated adequately and reflect properly the domain (computing science), the level (master) and the orientation (academic) of the programme. The ILOs also do justice to the four research and two societal specialisations. According to the panel, the learning outcomes cover comprehensively both the European-wide Dublin Descriptors and in the case of the Cyber Security track the international domain-specific ACM & IEEE curriculum.

The academic orientation of the programme does not prevent students from acquiring relevant competences to enter the labour market as academically trained professionals. In this regard, the panel welcomes the role of the professional advisory committee in ensuring that the programme objectives and the curriculum contents remain up-to-date in the rapidly evolving field of computing science.

Conclusion
Master's programme Computing Science: the panel assesses Standard 1 as meets the standard..

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
The master's programme Computing Science amounts to 120 EC, which are spread equally over two years of four quarters each. The curriculum for each master specialisation consists of mandatory courses (18-30 EC), specialisation electives (15 – 24 EC), a research seminar (6EC), electives (12 – 32 EC), free choice (6 EC), a research internship (15 EC) and a master's thesis (30 EC). Moreover, there is one mandatory course for all students: Philosophy and Ethics for Computing and Information Science (3 EC). The mandatory courses and specialisation electives are different sets of courses which provide students with the necessary depth and focus for their respective specialisation; the research internship allows students to obtain practical experience with planning, carrying out, discussing, reporting and presenting research before embarking on the master's thesis. Electives allow for some breadth outside the specialisation. The societal specialisations that students can combine with the Data Science and Software Science consist of a set of courses amounting to 27 and 30 EC, which replace the internship, the free choice and part of the electives. Appendix 3 to this report provides an overview of the curricula offered by the respective master specialisations.

The panel obtained extensive information on the master's programme and its specialisation curricula in the self-evaluation report and the annexes. Studying the materials, the panel found that each curriculum is well-thought through and coherent. During the visit, the panel looked into several course materials and found these to be of good quality and at the proper level for an academic master's programme. It gathered from the detailed master assessment matrix, which relates the learning goals per course to the overall end terms of the programme, that altogether the courses cover the intended learning outcomes of the master's programme Computing Science.

During the visit, the panel discussed the set-up and the respective components of each specialization. Students indicated that overall they are satisfied with the respective tracks, which meet the initial expectations. If anything, they would appreciate a wider offer of (elective) courses that cover the full breadth of the domain of computer science, beyond the focus areas of the departments. The panel is sympathetic towards this request and encourages the programme to look into the possibilities. Furthermore, the panel gathered from the materials and the discussions that the research internship is much appreciated by all stakeholders; its rationale and position within the curriculum structure as preparation for the master's thesis is quite unique. Students on the Cyber Security track reported some administrative and logistic issues given that they attend courses in both Nijmegen and Eindhoven; however, they do appreciate the breadth of the curriculum and emphasized that the combined know-how of the teaching staff far outweighs the organizational weaknesses. The Data Science students welcome the broad choice of electives as they are allowed to take courses from the Artificial Intelligence master's programme. While students reported that the Software Science specialization did not innovate to the same extent as other tracks, staff and management indicated that new content and courses will be delivered soon by newly hired staff. Finally, the panel learned that the MFoCS specialization is quite unique and attracts a small group of students in computing science and mathematics with strong theoretical interests. Further to its considerations on the programme's end terms, the panel found that the Computing Science curricula are in full alignment with the programme profile, the ILOs and in the case of the Cyber Security specialisation, the international domain-specific requirements.

Language of instruction
For more than ten years, the master's programme Computing Science has been offered in English. The panel noticed that the choice for an English language programme is properly motivated in the materials: on the one hand, English is the language of discourse for computing science and will be the working language for many students in their future career; on the other hand, it allows international tenured staff, postdocs and PhD students to be involved in teaching and supervising students.

Educational concept
ICIS adopts a didactic concept emphasizing a constructive approach in which students gain understanding (knowledge and skills) by using a solution-driven approach: based on existing understanding, new understanding is acquired and integrated, strengthening the existing understanding. In the master's programme this approach to teaching and learning pays particular attention to the construction of (tangible) products: engagement in the construction and justification of processes and methods, as well as the tangible results, is very effective for stimulating learning processes and for providing links between theory and practice. According to the panel, the educational concept is well conceived, implemented in similar ways across the specialisations, and particularly suitable for the programme given Nijmegen's vision on computing science as a constructive science.

While the bachelor's programme featured a mixture of quarter and semester courses, most courses in the master's programme take 5 or 6 EC and are offered for a full semester. The panel agrees with staff and students that courses of this size are well suited at master's level as they allow to digest knowledge, develop insights and offer students the opportunity to work on larger projects. It observed furthermore that the programme courses feature a wide variety of teaching methods ranging from plenary lectures and lab sessions to self-study, team projects and discussions. Many courses include practical exercises and individual or group projects to train students in applying technical knowledge and developing technical skills, while it also helps developing a broader range of soft skills. Compared to the bachelor's programme, the panel noticed that master's students are treated as independent junior researchers and colleagues of the research staff. They get to read scientific literature rather than text books and have to show more independence in planning and organisation of projects. Students indicated to the panel that they appreciate the variety of teaching methods and think the emphasis on self-organisation is appropriate for a study at master's level.

Notwithstanding the focus on self-organisation in the master's programme, the panel noticed that the institute also offers master's students an approachable education environment featuring plenty of teacher and peer contact. Students indicated both in the self-evaluation report and during the visit that the small scale of the study is particularly valuable: teachers know their students personally, know what they are up to and take time to help.

Student intake
Since the previous accreditation visit, the number of master's students in the Computing Science programme has increased from 53 (in 2014) to 91 (in 2018). In the current academic year 2019-2020, 83 students enrolled in one of the master specialisations. The panel studied the detailed intake figures on site and noticed that compared to the previous years, the most recent 2019 cohort has a (significantly) higher share of international students (25%), female students (22%) and students who obtained their bachelor degree outside RU (52%) or in a University of Applied Sciences (17%).

The panel gathered from the information materials and the discussions that ICIS is actively promoting computing science as an interesting study for both male and female students. It is supported in this endeavour by the Radboud Women of Computing Science, a committee founded in 2014-2015 by female staff and students who aim to attract female students into computing science and stimulate them to continue their career in this domain. The detailed breakdown of the respective student cohorts indicates that the share of female students has been around 10% with a sudden increase from 11% in 2018 to 22% in 2019. The site visit was held too early in the academic year to establish

the reasons for this increase or to ascertain that there was a link with the increasing number of international students. In any case, the panel noticed that the intake is becoming increasingly international and diverse and welcomes this trend.

Over the years the distribution of students across the four research specialisations has been relatively stable: Data Science attracts the largest number of students (around 40%), followed by Cyber Security (around 30%). Software Science (between 10% and 20%) and MFoCS (just under 10%) attract less students. The panel understood from the discussions that Data Science and Cyber Security are quite successful specialisations because RU has a good reputation in these domains, which are considered 'hot topics' in computing science. The distinctiveness of the Software Science track compared to other programmes in the Netherlands is smaller. MFoCS has a distinctive profile but is more of a niche area that appeals to a select group of theoretically minded students. According to the programme management, the viability of both Software Science and MFoCS is a point of attention: the current intake is still fine, but should not decrease further. The panel encourages the programme management to consider how both tracks can attract a sufficient number of students to remain viable and to continue offering the same level of choice in their curricula. While traditionally only a handful of students add one of the faculty-wide societal specialisations to their master's programme Computing Science, the panel was informed that there is more interest for these specialisations from students in other master's programmes offered by the Science Faculty.

The panel obtained detailed information on the admission criteria for each of the master specialisations. Bachelor's graduates in computer science from a Dutch university have direct access to the master's programme. This specifically applies to bachelor's students Computing Science from RU: the bachelor specialisations Cyber Security and Software & Data Science often constitute a first step to choosing a master specialisation, but bachelor graduates can still enrol for a master specialisation in a different field. Furthermore, Data Science is also open to bachelor's graduates Artificial Intelligence, while students with a bachelor's degree in Mathematics can also enter MFoCS directly.

Students who obtained a bachelor's degree abroad submit their diploma for review. In case of deficiencies, students are advised to take one or more (online) courses from the bachelor's programme. Both students and staff indicated to the panel that deficiencies are spotted quickly and remedied accordingly: after a few weeks in the programme all students are up to speed. Students with a bachelor's degree from a University of Applied Sciences follow a pre-master programme which is tailored to both the prior knowledge and the envisaged master specialisation. Given the level of mathematics and theoretical computer science required, it is not possible for students with a professional bachelor degree to enrol for the MFoCS specialisation. According to the panel, the admission requirements for the programme specialisations are clear and prove to be effective.

Feasibility
The panel gathered from the information materials and the discussions that the master's programme and its specialisations are feasible. Students indicated to the panel that the workload is high but corresponds to what can be expected of a programme with a full-time study load. Moreover, students confirmed that any deficiency in prior knowledge is repaired smoothly; the pre-master programme is considered quite tough but those students who are successful in enrolling on the master's programme, find it a very good preparation that allows them to start at the same level as their academically educated colleagues. Students reported furthermore that there are no specific courses that systematically hinder a smooth and timely realisation of the curriculum. The panel learned that following a recent survey which showed that students encounter problems with a handful of individual courses across the specialisations, the programme is now investigating how to improve their feasibility.

According to figures in the evaluation report, around 30% of the students finish the master's programme within the nominal period of two years, while another 40% does so within three years. The panel was informed that very often international students and students who enrolled after a pre-

master manage to graduate in time, while students who incur a considerable delay are often not studying full-time. The programme recently surveyed master's students about their study investment and the potential hurdles in the curriculum: 38% of the respondents indicated they have a structural job next to their study and 24% deliberately choose not to study full-time. The panel appreciates the efforts of the programme to monitor the feasibility of the programme and to undertake action whenever this is required. It is aware that very often reasons for completing the study with a considerable delay are outside the scope of the programme.

Staff
The self-evaluation report provides an overview of the teaching personnel at ICIS. The education institute deploys education formation from the research institute, which means that teaching staff belong to one of the three research sections of ICIS: Software Science, Data Science or Digital Security. The panel learned that there is a strong link between the master specialisations and the research specialisms of ICIS. Courses are always coordinated by teaching staff with a research position. Moreover, the different tracks benefit from collaboration with other academic institutes within RU (e.g. the Donders Institute) or outside (e.g. TU Eindhoven). Several part-time lecturers and professors by special appointment bring in expertise and experience from outside academia. Over the years staff has been appointed to cover very specific fields of expertise such as network security or the legal and organizational aspects of cyber security. The panel highly appreciates the emphasis of the programme on the substantive expertise of the teaching staff.

The panel was informed that the institute, faculty and university are paying attention to attracting female staff who in turn serve as role models for attracting new students and PhD researchers. Currently, 20% of the ICIS teaching staff – five full professors and three assistant professors - is female. The panel welcomes this consistent effort, which seems to bear fruit.

Almost all lecturers have a basic or senior teaching qualification or are in the process of obtaining such educational qualification. The panel learned that teaching skills are considered important at RU and ICIS: the central Educational Support department offers several training schemes for lecturers, while the Education Board of the Institute organizes teacher days, issues teacher guidelines and informs staff during bi-monthly staff lunches. Students indicated in the student chapter and during the visit that they think highly of the domain-specific know-how and the didactic qualities of the staff; the teachers' level of English in the master's programme is good.

The panel noticed in the information materials that staff numbers relate to the entire institute and the three programmes it is responsible for. During the academic year 2018-2019, 39 scientific staff members – full/associate/assistant professors and appointed lecturers - were involved in teaching. The panel observed that over the past few years the number of students in the three programmes has increased significantly while there was hardly any increase in the institute's teaching staff: the staff-student ratio went up from 1:36 in 2015 to 1:53 in 2018. According to the programme management, this increase has been mitigated by hiring teaching assistants and will be further reduced when several vacancies are eventually filled. Students from their side indicated that the level of individual support they were used to receive from teachers is going down. The teachers are still very much willing to help but are reaching their limits in supporting an ever growing number of students. The growing staff-student ratio has important consequences for the supervision of individual student projects such as the research internship and the master's thesis. With the current inflow staff has to supervise on average less than three master's theses and three research internships per year. The panel understands that while this is still manageable now, there will be a need for more capacity and coordination among staff when in a few years' time, the international bachelor cohorts graduate and proceed to the master's programme.

Facilities
The computing science programmes are housed in the Mercator 1 building. While teaching locations are also located in other buildings of the Science faculty, the panel noticed during a guided tour that this building is really the home base of both staff and students: spread over three floors, there are

offices for lecturers, study places for students and the board room of the study association Thalia. It also hosts the New Devices Lab and the student company GiPHouse. The panel acknowledges that the building contributes to creating a homey atmosphere and allows for frequent contacts between and among students and staff. However, its capacity is hardly sufficient for the current 'inhabitants', let alone for any further growth in staff and student numbers. After visiting the side channel lab as one example of the lab facilities, the panel voiced its concern to the management about the limited space in the lab and the number of students and researchers it was expected to accommodate.

The panel noticed that Thalia, the study association of Computing Science in Nijmegen, plays an important role in building a community among and providing services to students: it is involved in the introduction week and organizes several activities throughout the year involving alumni and industry. The institute considers the study association as a reliable partner and provides good support for their activities. According to the panel, the study association constitutes a value added for the programme and the institute.

Furthermore, the panel thinks it is a nice and useful initiative that each master specialisation uses a mailing list or Slack group to inform students of research talks, opportunities for thesis topics and relevant events.

Students play an important role in the quality system of the programme. They fill in course evaluations, are an active part of the programme committee and are represented on the education board meetings through a so-called institute assessor. Furthermore, they feel safe to share constructive criticism with the teaching staff. Students indicated to the panel that they appreciate the good contact with the programme management and that course evaluations are followed-up through the programme committee and by the teaching staff concerned.

Considerations
The panel considers that the teaching-learning environment of the master's programme Computing Science is good, an appreciation that covers the programme, the staff and the facilities: the curriculum is coherent and its contents are in full alignment with the programme profile and the intended learning outcomes; the didactic concept underlying the programme is both clear and appropriate; the admission criteria are clear and effective; the programme and its respective specialisations are feasible; teaching staff is highly qualified in terms of both disciplinary know-how and didactics; the explicit attention to female staff is attracting female students and researchers; the Mercator building contributes to the small scale approachable education environment; and the study association constitutes a value added for the students, the programme and the institute.

Throughout the visit, the panel has come to appreciate the unique selling points of each of the four master specialisations, which are different in their own right and worth offering and maintaining as separate tracks within one overarching programme. The panel did notice that the Software Science and MFoCS specialisations attract less students. The panel encourages the programme management to consider how both tracks can attract a sufficient number of students to remain viable and to continue offering the same level of choice in their curricula.

Furthermore, the panel draws attention to the growing staff-student ratio. While the student growth in the master's programme is less considerable than in the bachelor programme, both student groups are served by the same staff and use the same facilities. The panel is concerned that the growing number of students is starting to affect some of the achievements and typical features of the Computing Science programmes in Nijmegen, such as the small scale of the programme, the variety of teaching methods, the availability of teaching staff and the homey atmosphere in and capacity of the building. It therefore calls on the management to actively address these challenges which are likely to become bigger rather than smaller in the near future.

Conclusion
Master's programme Computing Science: the panel assesses Standard 2 as meets the standard. .

Standard 3: Student assessment
The programme has an adequate system of student assessment in place.

Findings

Assessment system
The panel noticed that the assessment system of the master's programme Computing Science is based on the policy and procedures of the Science Faculty. Within the programme, there is a clear relation between the programme learning outcomes, the learning goals at course level and the test form to assess whether all learning goals have been achieved. Every course file consists of a course description, the learning goals and the exam(s) together with the correction prescription and a test matrix. By completing a test matrix, every course coordinator ensures that the different learning goals are tested and covered by the examination. Prior to the site visit, the panel studied the overall test matrix for the master's programme, which lists the learning goals and test forms associated with each course.

The panel noticed in the overall test matrix that throughout the master's programme, students are confronted with various test formats such as written exams, project exams, oral presentations, assignments, essays, (research) reports, peer review and seminar participation. Furthermore, every exam is created according to the four eyes principle: the course coordinator consults with a colleague to check that the exam tests what is required and whether the size, the formulation and the level of the exam are adequate.

The Computing Science programmes have a fraud policy, which is described in the Teaching and Exam Regulations and discussed extensively with students and among staff. Students confirmed to the panel that they are informed at several occasions about fraud and are well aware of the sanctions.

Course and thesis assessments
The panel noticed that the assessment principles underlying the master's programme are sound and have been rigorously implemented in all courses. On site the panel looked into course files and their respective assessment forms and found these to be appropriate: the questions were valid and reliable. Students indicated during the visit that assessment is transparent: they know well in advance what they need to know for the exam and how they will be assessed.

As part of its thesis review, the panel studied a sample of 15 master's theses and their respective assessment forms. Every thesis is assessed by two staff members who each complete an evaluation form and decide on a final grade after the student's presentation. If the thesis is produced as an external project, the external supervisor is asked for feedback but the grading is ensured by ICIS staff members. Each master's thesis is assessed on seventeen criteria clustered around five domains: content and results, thesis, other products, oral presentation and effort. The section on oral presentation is broken down in a separate section of the evaluation form where assessors reflect on the content, form and execution of the presentation.

While in almost all cases it agreed to the final score, the panel found that the evaluation form does not induce assessors to provide qualitative feedback and motivate their appreciation. Those who do motivate their scores systematically, provide useful comments that help understand the final score. However, many assessors do not complete the optional comments boxes or provide minimalistic comments of limited informative value. The panel therefore welcomes the plans of the programme to adjust the evaluation form bringing it in line with the bachelor thesis evaluation form, among others by adding rubrics. Having reviewed the evaluations of the bachelor's thesis, the panel encourages the programme to monitor in the new master's thesis evaluation forms that all assessors add qualitative feedback to motivate the dimensions that contribute to the final grade.

The thesis evaluation is processed online through a faculty-wide system SPIB. Since the introduction of this system, which required an adaptation of the evaluation form for online handling, there has

been a problem with the retrieval / printed version of the evaluation form. The panel experienced that it was indeed very hard to read and review the thesis assessment form. According to the management and the Examination Board, the system is under review and should be optimized in the course of 2019-2020.

Examination Board
The Examination Board is responsible for safeguarding the quality of assessment and the realization of the intended learning outcomes in the Computing Science programmes. The panel gathered from the discussion with the Examination Board that the individual members have adequate expertise to fulfil their quality assurance tasks. It welcomes the random checks the Examination board performs of the course files and the respective exams and test matrices. The panel learned that the Examination Board also checks that the master's theses meet the requirements in terms of content, level and form. The panel subscribes to the statement of the Examination Board that the sample check did not raise concerns with regard to the quality of the theses and the allocated score. The Examination Board agreed with the panel that the online evaluation form is not inviting for assessors to provide additional qualitative feedback and is working towards a new master's thesis evaluation form.

The panel understood from the discussion with the Examination Board there are many ideas for change and improvement in the Computing Science programmes, but that their implementation process is slowed down because the Education Centre reportedly has to serve several programmes and because there is a tendency at faculty level to harmonise processes as much as possible across all programmes. While the panel acknowledges these circumstances, it also found the Examination Board to be rather reactive in its approach and therefore recommends the Board to take a more proactive stance and use its expertise and independent position to insist that its findings and recommendations are implemented.

Considerations
The panel considers that student assessment is well organized in the Computing Science programme. The policy and principles underlying course assessments are up to standard. The panel thinks highly of the extensive overall programme test matrix. Based on the discussions on site and the limited sample of individual assessments it reviewed, the panel considers that the course assessments are valid, reliable and transparent. Moreover, the panel appreciates that the programme is taking fraud seriously.

Based on its own sample review, the panel agreed to almost all scores of the master's theses. However, it thought the evaluation form was not inviting for assessors to provide qualitative feedback and motivate their appreciation. The panel therefore welcomes the plans to adjust the evaluation form in line with the rubrics-based evaluation format of the bachelor's thesis. It encourages the programme, when using the new form, to monitor that all assessors add qualitative feedback to motivate each dimension that contributes to the final grade.

According to the panel, the Examination Board has appropriate expertise and uses this to quality control the course and thesis assessments. Nonetheless, the panel thinks that the Examination Board can make better and more pro-active use of its expertise and independent position to insist that its findings and recommendations are implemented.

Conclusion
Master's programme Computing Science: the panel assesses Standard 3 as meets the standard. .

Standard 4: Achieved learning outcomes
The programme demonstrates that the intended learning outcomes are achieved.

Findings

Thesis quality
In order to establish whether students achieve the intended learning outcomes, the panel has reviewed a sample of 15 master's theses that were accepted in the academic years 2016-2017, 2017-2018 and 2018-2019. In the master's thesis, which amounts to 30 EC, students demonstrate the ability to independently tackle a research question and document and present the process and the results. Students can combine the thesis with the mandatory research internship (15 EC) but both projects have their own specific aim, i.e. to experience working in an academic and in an industry environment during their studies. Master's students indicated to the panel that they appreciate the freedom to choose a thesis topic and highly value the expertise and availability of their thesis supervisor.

The panel found that each of the fifteen theses were of a quality that can be expected of a final project at master's level. In almost all cases the panel agreed to the final score. Having reviewed a representative sample in terms of scoring, the panel found that the theses with a (near) perfect score were indeed of very high quality and deserved this grade.

In a previous section, the panel considered that through the individual courses, the curriculum allows students to acquire the programme's intended learning outcomes. Having reviewed a selection of master's theses, the panel considers that students who successfully pass the thesis have indeed achieved all intended learning outcomes.

Alumni
In addition to verifying the quality of the final deliverables, the academic and/or labour market performance of master graduates is another way to establish whether students achieve the intended learning outcomes upon completion of the programme. Both the information materials and the discussions indicated that the master graduates are effective in pursuing a career in industry or academia. Alumni and employers indicated during the site visit that upon entering the labour market they benefited mostly from the theoretical foundations and the very broad background of the study. The training in academic writing is also an important asset which graduates are still using on a daily basis. If anything, the professional advisory board would like the programme to expose students more to interdisciplinary work and to give them a life-long learning attitude.

The panel understood from the discussions that the market pull for computer scientists is very strong, which results in students working part-time in the ICT domain during their studies and finding a proper job right after graduation. Nonetheless, the panel also noted with satisfaction that the programme manages to motivate students for a scientific career in academia.

While the programme has good contacts with alumni individually and through the professional advisory board, the panel noticed that there was no systematic follow-up of the graduates. In fact, the programme could only provide data which were based on the annual national alumni survey. The panel thinks the programme would benefit from following-up more systematically the whereabouts of all graduates. This may be incorporated in the context of the alumni policy of the faculty. The panel welcomes the initiative and recommends gathering and processing data on an individual programme level.

Considerations
Based on its review of the final thesis projects and the discussions with alumni and employers, the panel considers that master's students who graduate from the Computing Science programme are adequately prepared for a career in both industry and academia. Having established that each thesis in the sample meets at least the minimum requirements of what can be expected of a final project

at master's level – and often is of higher quality – it is fair to state that the intended learning outcomes of the programme are eventually achieved at the end of the master's curriculum.

While the programme has good contacts with individual alumni and through the professional advisory board, there is no systematic information available on all graduates. The panel therefore recommends the programme to follow-up more systematically the whereabouts of its graduates.

Conclusion
Master's programme Computing Science: the panel assesses Standard 4 as meets the standard. .

GENERAL CONCLUSION

In the previous sections, the panel has come to the conclusion that the MCS programme fulfils the quality requirements with regard to each of the four standards set by the NVAO's Assessment Framework for the higher Education Accreditation System of The Netherlands for limited programme assessments: intended learning outcomes, teaching-learning environment, student assessment, and achieved learning outcomes. Hence, the panel's overall assessment of the *master's programme Computing Science* is positive.

APPENDICES

APPENDIX 1: DOMAIN-SPECIFIC FRAMEWORK OF REFERENCE

Unlike for the Bachelor programme, where we can refer to the ACM/IEEE guidelines for undergraduate curriculums in computing science [ACM 2013], for the Master programme and its specialisations there is no domain-specific reference framework that we can refer to.

The one exception here is the specialisation Cyber Security, for which the ACM/IEEE guidelines for Cyber Security curriculums [ACM 2017] provide a reference framework to validate our programme against (see Section 2). This extensive document is available at:
https://www.acm.org/binaries/content/assets/education/curricula-recommendations/csec2017.pdf

APPENDIX 2: INTENDED LEARNING OUTCOMES

Master's programme Computing Science

The Computing Science degree programme aims to enable students to work and think at an academic level and to ensure that graduates of the programme:

a. have thorough academic knowledge and insight in the area of their specialisation (discussed in more detail below per specialisation in points e to h), are experts in a sub-area within their specialisation and can contribute to the further academic development within this sub-area, and are able to acquire knowledge, insight and skills in other sub-areas of Computing Science.
b. can apply their knowledge and skills to research (b1) and system development (b2) issues, both independently and in small teams. Depending on the chosen specialisation and expertise, the emphasis here may be on research or system development.
c. are aware of the social aspects of IT.
d. are capable of communicating at a professional level and providing a clear oral (d1) and written (d2) presentation of completed work.
e. for the specialisation **Software Science**, graduates (e1) possess broad knowledge of state-of-the-art techniques for the development and analysis of software (including software technology, domain-specific languages, computer-aided analysis, and the use of mathematic models and modelling techniques) and (e2) are able to apply these techniques.
f. for the specialisation **Data Science**, graduates have (f1) a broad overview of the data science discipline (incl. algorithmic, organisational, software, hardware and ethical aspects), (f2) are able to use appropriate data science techniques to extract data from databases, (f3) are experienced with specifying, designing and creating applications in which data science plays an important role, and (f4) can contribute to discussions about the role of data science in society.
g. for the specialisation **Cyber Security**, graduates (g1) possess broad knowledge of information and computer security (including organisational, software, hardware, network, cryptographic, legal and privacy aspects), (g2) can evaluate the security aspects of existing systems and systems yet to be developed and to this end are able to formulate and prioritise security requirements, (g3) are experienced in specifying, designing or developing applications in which security plays an important role, and (g4) can contribute to discussions on the role of cyber security and privacy in society.
h. for the specialisation **Mathematical Foundations of Computer Science**, graduates (h1) have a broad knowledge of theoretical computing science and the mathematics that serve as its foundation and (h2) can apply mathematical techniques (such as logic and algebra) in modelling and analysing computing science concepts.

Students who choose the specialisation **Science, Management and Innovation** also have the following learning outcomes:

m1. Capable of bridging between their own science discipline and other disciplines, based on profound understanding of the chosen core theme and how this relates to societal, political, economic, and environmental requirements of today's world.

m2. Familiar with and capable of analysing specific problems within their theme, and able to apply a range of approaches to address these, argue for, select, and implement feasible options, taking into account the full width of technological, societal, political and economic perspectives.

m3. Proficient in using research methods and techniques, including basic finance and economics, to verify, justify and substantiate strategies and plans, and capable of effectively using a wide variety of information and communication channels.

m4. Capable of balancing perspectives and interests in specific contexts within a company or (non)governmental organisation in order to formulate appropriate strategies and plan towards implementation of the Sustainable Development Goals (SDGs).

m5. Capable of communicating insights, views and analyses of complex issues to others in a clear, concise and understandable manner, both in written and spoken form.

m6. Capable of working in multidisciplinary and multicultural high-performance teams based on sound division of tasks, knowledge, competencies, and responsibilities, whilst respecting diverging views and opinions.

Students who choose the specialisation **Science in Society** also have the following learning outcomes:
s1. Capable of analyzing the role of scientific expertise in societal and political decision making with regard to socio-scientific issues
s2. Capable of designing and conducting independent and methodologically sound social research at the interface of science and society and capable of contributing to academic research
s3. Capable of understanding and designing public and stakeholder participation processes in research and innovation
s4. Capable of analyzing, improving and evaluating interdisciplinary collaborations with multiple stakeholders, integrating different perceptions, interests and types of knowledge (experiential, professional and scientific)
s5. Capable of substantiating and communicating the relevance of one's scientific discipline in society.

APPENDIX 3: OVERVIEW OF THE CURRICULUM

Master's programme Computing Science

The overall structure of the specialisations in the Master programme is as follows:

- mandatory courses (18-30 EC): each research specialisation has its own set of mandatory courses that provides core concepts and knowledge for that specialisation;
- specialisation elective (15-24 EC): a set of courses closely related to the specialisation from which the students can choose; these typically zoom in on the specific areas of expertise at ICIS within the specialisation;
- Philosophy and Ethics for Computing and Information Science (3 EC): a mandatory course for all specialisations;
- a seminar course (6 EC): the students learn general academic skills of presenting, discussing, and evaluating scientific research in a seminar setting with fellow students from their specialisation;
- electives (12-32 EC): these can be chosen from all Computing Science master courses, also of the other research specialisations;
- free choice (6 EC): that can be completely freely chosen;
- research internship (15 EC);
- master thesis (30 EC).

Master specialisation	**Cyber Security**	**Data Science**	**Software Science**	**Mathematical Foundations**	**SMI***	**SIS***
Mandatory courses	30	18	18	18	18	18
Seminar and Philosophy courses (mandatory)	9 or 8 **	9	9	9	9	9
Specialisation electives	15	24	24	24	24	24
Master electives	12	18	18	18		
Research Internship	15	15	15	15		
Master Thesis	30	30	30	30	30	30
Free electives	9 or 10 **	6	6	6	12	12
SMI-courses mandatory					15	
SMI-theme courses					12	
SIS-courses mandatory						24
SIS-restricted choice						3
Total number of ec	**120**	**120**	**120**	**120**	**120**	**120**

**Students choose the SMI or SIS specialisation in combination with Data Science or Software Science, and take 51 ec of Computing Science courses (mandatory courses, Seminar and Philosophy courses and specialisation electives).*
*** Depending on choice of Seminar*

APPENDIX 4: PROGRAMME OF THE SITE VISIT

Venue: RU Nijmegen, campus Toernooiveld, Huygens building, room 01.060

Programme site visit Computing Science, Radboud University		
Date: 18-11-2019	**Activity**	**Language**
10.30 h. - 10.45 h.	Arrival of panel	
10.45 h. - 13.00 h.	Preparation panel (closed session), including lunch	
13.00 h. - 14.00 h.	**Round 1:** Programme management	Dutch
14.15 h. -15.15 h.	**Round 2:** Examination board (and admissions officer)	Dutch
15.15 h. - 16.15 h.	Guided tour panel - visit Mercator, GiPHouse/LEGO/New Devices Lab etc.	
16.15 h. - 17.00 h.	**Round 3:** Alumni, employers and professional advisory board	Dutch
17.00 h. - 18.00 h.	Walk-in session	
18.00 h. - 18.30 h.	Deliberations panel (closed session)	
Date: 19-11-2019	**Activity**	**Language**
08.45 h. - 09.00 h.	Arrival of panel	
09.00 h. - 09.45 h.	**Round 4:** Students (Bachelor)	English
10.00 h. - 10.45 h.	**Round 5:** Students (Master)	English
11.00 h. - 12.00 h.	**Round 6:** Lecturers (Bachelor and Master)	English
12.00 h. - 13.15 h.	Lunch and preparation final feedback (closed session)	
13.15 h. - 14.00 h.	**Round 7:** Programme management (final consultation)	Dutch
14.00 h. - 16.15 h.	Panel deliberations (closed session)	
16.15 h. - 16.30 h.	**Plenary feedback of main findings by panel chair in HG 00.071**	English
16.45 h. - 17.30 h.	**Development dialogue (closed session)**	Dutch
17.30 h.	Drinks and snacks in Mercator 1 (ground floor)	

APPENDIX 5: THESES AND DOCUMENTS STUDIED BY THE PANEL

Master's Programme Computing Science, Self-evaluation report, September 2019.

Prior to the site visit, the panel studied 15 theses of the master's programme Computing Science. Information on the selected theses is available from QANU upon request.

Following materials were made available by the Educational Institute for Computing and Information Sciences before or during the site visit, either as hard copy or in digital format through the QANU document site or the faculty's electronic learning environment Brightspace:

Overview of student intake

Toetsmatrix master programme

Annual Reports: Jaarverslagen van het Onderwijsinstituut Informatica en Informatiekunde (jaren 2013-2014 t/m 2017-2018)
Verslagen van vergadergremia

a. Verslagen en rapportages van de Examencommissie
b. Verslagen van de Opleidingscommissie
c. Verslagen van de Onderwijsdirectie

Course materials: Cursusmateriaal, bestaande uit literatuur (indien als hard-copy aanwezig) en samenvatting van cursusdossiers. Hierbij was opgenomen de cursusbeschrijving, practicumopdrachten (voor zover aanwezig), (deel)tentamen(s) en correctievoorschrift(en), toetsmatrix, student-evaluaties, docentevaluatie en oordeel van de opleidingscommissie.
Tevens is digitaal cursusmateriaal beschikbaar gemaakt via Brightspace.

- NWI-IPC023 Requirements Engineering
- NWI-IPC026 Web Security
- NWI-IPC031 Imperative Programming
- NWI-IBC022 Network Security
- NWI-IBC027 Algorithms and Data Structures
- NWI-IBI008 Data Mining
- NWI-I00041 Information Retrieval
- NWI-IMC039 Cryptographic Engineering

Het materiaal van de cursus NWI-IBI010 Reflection and Vocational Orientation is digitaal beschikbaar gesteld via Brightspace, en tevens is een overzicht van requirements beschikbaar gesteld.

Enkele *Thabloid*s – blaadje van studievereniging Thalia

Keuzegids Hoger Onderwijs (Universiteiten + Masteropleidingen)

Strategisch plan 2016-2020 van de faculteit Science