UNIGIS Amsterdam

Postgraduate Certificate, Diploma & Master of Science Programme in Geographical Information Sciences

Study Guide

(2019-2020)

Educating GIS Professionals Worldwide

VU VRIJE UNIVERSITEIT AMSTERDAM | School of Business and Economics

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Colophon

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* This Master's programme is officially registered under the name Geographical Information Sciences (crohocode 75040) at the School of Business and Economics, Vrije Universiteit Amsterdam.

Contents

Welcome!

Welcome to the Master of Science in Geographical Information Sciences study programme at Vrije Universiteit Amsterdam (UNIGIS Amsterdam)! This Study Guide provides the information needed to successfully study at UNIGIS. Every student is advised to read this document carefully. The document is updated annually to ensure you are provided with the latest information. The Guide comprises three sections:

Part 1: General Information for Students;

Part 2: UNIGIS Programme;

Appendices: Assessment forms.

Part 1. General information for Students

1.1. Rationale of the Programme

Geographical Information Systems are finding increasing application in a broad range of organisations from utilities companies to environmental consultancies. Specialised undergraduate provision is still in its infancy and there are thus a large number of mid-career professionals who are being asked to take on GIS responsibilities but whose backgrounds include little formal GIS training. For many such professionals, taking a career break in order to obtain a GIS qualification is simply not possible. UNIGIS therefore offers a part-time, distance learning route to postgraduate qualifications in the GIS field suitable for those using GIS in the workplace.

The UNIGIS Programme is a three-year study programme with three regulated exit moments. It consists of distance learning modules, on-campus workshops and a thesis research project. The distance learning modules take full advantage of the latest developments in online learning tools including video conferences, discussion forum and structured group tasks. Students completing the first year only (four compulsory modules plus one on campus workshop) obtain the Postgraduate Certificate. Students who additionally complete the second year (three specialisation modules plus the capstone module and a second workshop) obtain the Postgraduate Diploma. Students who subsequently complete the third year (Thesis research project) obtain the Master of Science. Details of the study programme including specialisation pathways and schedule can be found in “part 2. UNIGIS Programme”.

The programme is intended to deliver GIS professionals who possess a strongly developed critical and analytical intellect, a profound understanding of state-of-the-art GIS concepts, methods and technologies and ability to apply these in a structured and reflective manner to complex societal issues. It aims to provide students with an understanding of the technical, geographical and organisational aspects of GIS. In doing so it provides hands-on experience. The need for this academic programme is reflected in the high demand and mobility of individuals with GIS skills, and the rapidly expanding nature of GIS as a professional skill.

1.2. UNIGIS Amsterdam Organisation

Programme Board

The Programme Board is responsible for content, organisation and quality assurance in that programme. The Programme Board is appointed by the Faculty Board of the School of Business and Economics and meets regularly with the faculty’s portfolio holder for teaching. The Programme Board consists of the following members:

- Programme Director - Prof. dr. Henk Scholten, Professor in Spatial Informatics/ Director Spatial Information Laboratory (SPINlab), School of Business and Economics, h.j.scholten@vu.nl;

- Programme Coordinator - Dr. Niels van Manen, Researcher, School of Business and Economics, n.van.manen@vu.nl.

Examination Board

The School of Business and Economics (SBE) has appointed a separate Examination Board for the MSc Geographical Information Science. The Examination Board is an independent body that safeguards the quality of the mid-term and final examinations, organises and coordinates examinations and completion of the final examinations. In addition, this board appoints the examiners. It reports its actions to the SBE Board through an annual report.

The Examination Board consists of the following members:

- Prof. dr. Gert-Jan Burgers, Professor, Faculty of Humanities (chairperson);
- Dr. Thomas de Graaff, Assistant Professor, School of Business and Economics;
- Dr. Eric Koomen, Associate Professor, School of Business and Economics.

Other members will be co-opted into the Examination Board as appropriate.

Programme Committee

The programme committee comprises an equal number of students and lecturers and is appointed by the SBE Board. Apart from monitoring the programme's quality and advising on the Academic and Examination Regulations as is their legal responsibility, the programme committee provides the programme board and the SBE Board with both solicited and unsolicited advice on course and examination design, content, schedules and changes in the programme. The committee meets at least four times a year, but usually more often, to discuss courses on the basis of written course reviews by the students on the committee and the results of the digital evaluations by students. Advice is passed on to the programme board, who takes any measures necessary and provides feedback to the programme committee. The programme committee reports formally to the SBE Board once a year through their annual report.

The Programme Committee can be contacted via unigisPC.sbe@vu.nl and consists of the following members:

- Prof. dr. Jaap Boter, Department of Marketing, School of Business and Economics, UNIGIS tutor 2nd-yr module Capstone and coordinator 3rd-yr Thesis (chairperson);
- Sanne Hettinga, MSc, UNIGIS tutor 2nd-year module GIS and Modelling;
- Dr. Maurice de Kleijn, UNIGIS tutor 1st-yr module Geodata Capture, Standards and Quality;
- Ferry Devilee, third-year student;
- Djoerd van Velzen, second-year student;
- *Vacancy*, first-year student.

Correspondence address UNIGIS Amsterdam Office[1]:

Vrije Universiteit Amsterdam

SBE-Spatial Economics

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Visiting address UNIGIS Amsterdam Office and the SPINlab:

Department of Spatial Economics

Main Building, room 9a89, please call the office telephone number above upon reaching the 9th floor.

For general information about Vrije Universiteit Amsterdam and its facilities, www.vu.nl.

1.3. Studying at UNIGIS & Student Facilities

1.3.1. Study material

A range of teaching and learning strategies is employed with an emphasis on collaborative learning, taking full advantage of the tools available in the virtual learning environment employed, Canvas. These include dedicated study materials written by UNIGIS staff, (online) scientific literature made available through the Vrije Universiteit university library, continuous and periodic self-assessed exercises, GIS tutorials and structured contact with the lecturer and fellow students through regular video meetings and a dedicated discussion forum. Students will be encouraged to research topics beyond the scope of the prescribed materials and to bring in case studies and data sets from the work environment to optimise the integration of academic and professional skills.

New students are introduced to the UNIGIS lecturers, fellow students, study materials and teaching platforms through a one-day kick off meeting at the start of the semester: 31 August 2019 (for September intake) and 1 February 2020 (for February intake). Existing students are invited for similar kick-off workshops on the same dates, to start their semester and to provide an opportunity for students from across the programme to meet with one another. The same is true for the compulsory one-week on-campus workshops in June, where all first, second and third-year students with student from their year take part in group assignments, lectures and seminars, as well as joint social activities for all participating students.

1.3.2. Books and Literature

UNIGIS Amsterdam recommends this textbook. Earlier editions are available free of charge as e-book through the University Library (www.ubvu.vu.nl).

Title: Geographic Information System and Science

Author: Longley, P.A, Goodchild, M.F., Maguire, D.J. and Rhind, D.W.
Paper back | John Wiley & Sons, Chichester, UK | 4th Edition, 2015

ISBN: 978-1-11-867695-0

Price: approximately € 50

N.B.: If your bookshop does not have a title, you can order it through Amazon.com (outside the Netherlands) or Bol.com (Netherlands), for instance.

Please refer to Canvas page of the specific modules for recommended additional books and articles. Many of these are available as e-resources via the Vrije Universiteit Amsterdam library (see below).

1.3.3. Quality control of study material

For the programme to be successful, it is essential that the course materials are of a consistently high quality. If you have any comments on the study materials, please share them with the lecturer using the discussion platform on Canvas. Students complete module evaluations at the end of each module. Completed assessments, and other student responses, will be retained and used for module and programme review purposes. The UNIGIS teaching material undergoes regular quality checking within the UNIGIS International Network.

1.3.4. Support from the Tutor and Collaborative learning

Students have several possibilities to obtain help if they have a problem or do not understand something in a module.

Each module has a **module tutor**. The name and email address of the tutor can be found in the Study Guide and on the module's Canvas page. If you have any questions regarding the contents of the module, you can contact the tutor preferably via the discussion board on Canvas or by email. The module tutor will answer as soon as possible, depending on the urgency of the question, but usually in one or two days. For all the modules, we expect (and encourage) that students use the Discussion board in Canvas as an open discussion and collaboration platform in order to co-create knowledge with fellow students and the tutor. The tutor will also schedule **Online Video Meetings via Canvas** and participate in the discussions that the students initiate via the **Discussion board.**

Nowadays, knowledge is shared and created by groups using online platforms (e.g. Wikipedia, Quora, OpenStreetMap, gis.stackexchange.com). We expect that this Discussion Board can facilitate internal discussion within our UNIGIS community. In this way, we can share information resources and personal reflection on challenges and findings. You are encouraged to reflect on (and appropriate) the information and experiences shared: co-creation of knowledge. This is a very important 21st century skill: to share, filter and amalgamate online information with a critical and analytical perspective. Naturally, everyone should achieve the individual learning outcomes of each module and the assignment reports are the primary means to demonstrate your achievement and for us to evaluate you individually. Therefore, please be cautious with sharing assignment report drafts unless specifically instructed to do so by your module tutor (e.g. in the case of Module 1: Advanced GIS, TAA1).

1.3.5. VU Library

Every UNIGIS student is member of the extensive University Library of Vrije Universiteit Amsterdam. After registration at Vrije Universiteit Amsterdam, through registration at UNIGIS, each student will receive a VU Net ID, which provides access to numerous peer-reviewed journals and e-books. You can access the e-library through vunet.vu.nl. You can also obtain a library card for borrowing books at the library.

1.3.6. Hardware & Software

To complete the UNIGIS programme you must have:

- Unrestricted access to a PC with *Windows* operating system for the duration of the course. *Specifications vary according to the software adopted – see below*;
- Reliable (preferably Broadband) Internet access to e-mail and the World Wide Web.

An important part of the taught course is acquiring skills in using GIS software. All our modules have exercises and assignments, many of which require you to use GIS software.

UNIGIS currently supports three GIS software products. These products give you the opportunity to use software appropriate to your needs and to your educational objectives.

ArcGIS 10 (ESRI)

- Costs

  Students can obtain a *free* license of the latest version of ArcGIS Desktop or Professional plus extensions. You are entitled to a free license as long as you are registered as UNIGIS student. The license expires after one year; please contact the UNIGIS office, info@unigis.nl, to obtain a (new) user license code. ArcGIS is a dominant desktop GIS package in the market and with its many extensions it provides a powerful suite of GIS functions.

- Hardware specifications and more information

See: www.esri.com/software/arcgis

IDRISI (Clark labs)

- Costs

  IDRISI TerSett from Clark Laboratories is a leading raster GIS widely used in education and environmental applications. UNIGIS students who undertake remote sensing related tasks may wish to purchase IDRISI TerSett, which is available at a special educational discounted rate. Please email clarklabs@clarku.edu with UNIGIS office, info@unigis.nl in the cc: to confirm your student status. Once confirmed, you can obtain a license https://clarklabs.org/buy/; please put UNIGIS student status confirmed with Clark Labs in the comments box.

  There are extensive training materials and a wide network of educational users especially in the environmental field. IDRISI has a wide range of *raster* functionality for GIS and image processing and a unique set of functions for decision support. It is designed for small project and educational use and is a good entry level GIS.

  The costs for both a one-year license of IDRISI and an eternal license are adapted annually, the exact numbers for this academic year are not known yet, but they normally range from about $50 to $150.

- Hardware specifications and more information

  See: www.clarklabs.org

ERDAS

If you wish to obtain a free or discounted rate student copy of ERDAS, please email the UNIGIS office, info@unigis.nl, for a license code.

You can download ERDAS here:

· ERDAS Foundation 2014 (http://download.intergraph.com/downloads/erdas-foundation-2014)

· ERDAS IMAGINE / Photogrammetry 2014 (64-bit) (http://download.intergraph.com/downloads/erdas-imagine-2014-%2864-bit%29)

· ERDAS IMAGINE 2014 v.14.1 (64-bit) (http://downloada.erdas.com/software/2014/IMAGINE_2014_64bit/MR1/IMAGINE_x64_Patch.zip)

- Hardware specifications

  See http://www.hexagongeospatial.com/

What does the UNIGIS Programme Board recommend?

Since most of our tutors use ArcGIS themselves, we advise you to obtain the one-year licensed copy of ArcGIS. This way you can get the best support and you have a package that can handle both vector and raster data. Also, the SPINlab can give you access to ArcGIS on-line courses at ESRI Virtual Campus *for free*.

IDRISI, ERDAS and QGIS are other packages that are widely used in education and environmental applications. For some modules in the second year, one of these packages may be preferred.

1.3.7. Summer Schools, Winter Schools and UNIGIS Connect meetings

UNIGIS International organises Summer Schools and Winter Schools. These can take place at any of the UNIGIS sites. In past years, these workshops took place in among others Austria, Hungary and Spain. The Summer Schools and Winter Schools are organised around a theme, such as 'European Data Sets', 'Land Administration' or 'Location Based Services'. These workshops are optional in the UNIGIS course, though in some cases they can replace an elective module in your study programme. Details on each workshop will be announced separately on the UNIGIS website and by email.

UNIGIS Amsterdam organises UNIGIS Connect meetings three times a year. Generally, this includes one UNIGIS Connect meeting at the end of the annual workshop week in June at VU Campus; one meeting at a major GIS conference in the Netherlands (e.g. ESRI User conference in Rotterdam or Geobuzz in Den Bosch); one meeting in collaboration with a student, alumnus or GIS network organisation. Please contact the UNIGIS office, info@unigis.nl, if you wish to (help) organise an event!

1.3.8 Staying in touch with UNIGIS Amsterdam & UNIGIS Int. network

We have two **LinkedIn Groups** for all our students and alumni: "UNIGIS Amsterdam" and "UNIGIS Alumni & Students Worldwide". The purpose is more to share news within the network and to support each other in career progression. Please request permission to join the LinkedIn groups.

1.3. Course fees

For the postgraduate UNIGIS **Certificate** programme (one year - Modules 1 through 4 and Workshop Year 1). The fee is:

- **€ 3,600.-**.

For the postgraduate UNIGIS **Diploma** programme (two years - Modules 1 through 4, three specialization modules plus the capstone module plus Workshops Year 1 and Year 2), the fee is:

- **€ 6,200.-** for people who have *not* obtained the UNIGIS Certificate yet, and
- € 2,600.- for people who have already obtained the UNIGIS Certificate.

The **Master of Science in GIS** programme takes three years and involves the entire Diploma programme plus an additional third year in which you carry out a Master's research project and you write a thesis. The fee is:

- **€ 8,800.-** for people who have not obtained the UNIGIS Diploma yet, and
- € 2,600.- for people who have already obtained the UNIGIS Diploma.

Premaster programme

In some cases, you may need to take additional course to bring you up to entry level. The costs for bringing you up to entry level depend on whether or not you have to follow the *complete* Premaster programme *or only part of it*. The complete Premaster programme, consisting of two 6ec courses, costs **€ 1,000.-**. If you only need to take one course, this costs € 500,-.

Write-up fee related to maximum length and registration for the UNIGIS course

The table below shows the minimum and maximum length of the PgC, PgD, and MSc courses in years. If the maximum lengths are not met, an additional write-up fee must be paid. The write- up fee is **€ 350.-** and will increase with a second and third prolongation: a second write-up fee is € 425.-, a third write-up fee is € 500.-. After three prolongations, the write-up fee remains at an annual € 500.-.

	Norm	*Maximum*
PgC	1	2
PgD (incl. PgC)	2	3
MSc (incl. PgD)	3	4

To give an example: Suppose you started your PgC-studies on 1-9-2018. You then normally finish your Certificate studies by 31-8-2019, but you may take until 31-8-2020 to complete it without paying a write-up fee. If you have not finished the PgC programme by then, you have to pay the write-up fee.

Fees include payment for:

- Most learning materials (with the exception of additional reading material and some additional software), course notes, selected texts and readings (e-books), computer based learning software, data, help line support, assessment, feedback and certificates;
- ArcGIS Desktop and Professional;
- Student facilities provided by Vrije Universiteit Amsterdam;
- Free access to the ESRI Virtual Campus;
- Discount when buying IDRISI software;
- Free subscription to Geo-Informatics; GIS Magazine with discount;
- Workshops and selected events.

Not included are: Hardware, Internet connection (preferably broadband), workshop expenses (such as travel and accommodation), and other study-related travel expenses (such as meetings with UNIGIS staff at Vrije Universiteit Amsterdam).

1.3.1. Payment & refunds

Premaster

The total fee is paid after confirmation of acceptance, before commencement of the programme.

PgC, PgD and MSc

You can either pay the required fee at once, or in instalments. Information about instalments can be found on the applications forms for the different programmes, see https://spinlab.vu.nl/websites/unigis/.

Applicants will receive an invoice with the exact information on how to transfer the money. The applicant has the responsibility to ensure the payment(s) is (are) made; this responsibility will remain at all times. Access to modules can be restricted if fees have not been paid. In these cases, UNIGIS cannot be held liable for any study delays.

If you are delayed in making the payment(s) due to unexpected events, contact the UNIGIS Amsterdam office. Please check all details (correct registration and corresponding fee) before making the actual payment.

Refunds

If a student decides to withdraw from the programme, he or she will remain responsible for the fee for the running year of registration. A year runs from February to February or September to September, depending on the intake you are in. No refunds are made for part of a course (PgC, PgD, or MSc).

Additionally, if a student who has enrolled in the Diploma course decides to withdraw from the programme and the student has not yet passed any modules from the Diploma part of the programme (= second year), he or she will at least remain responsible for the entire fee for the Certificate part (= first year).

1.4. Assessment & Rules and Regulations

All formal rules pertaining to teaching and examinations are laid down in the **Classes and Examination Regulations and the Examination Board's Rules and Guidelines**. A short overview of the most important elements is given below.

1.4.1. Assessment in the UNIGIS programme

Assessment in the PgC and PgD modules takes place primarily through formally assessed assignments and workshop tasks. There are no conventional written examinations. Assessment

takes place in each module. To complete a module, Assignments need to be submitted for assessment by the module tutor. Most assignments involve writing an essay or a project report, though other kinds of assignments are also possible. The assignments are often of an 'open' type, which means that the answer is not a matter of yes/no or right/wrong, but requires the presentation of arguments, with the possibility of different correct results. Therefore, the grade is supported by a grading rubric, which indicates the strengths and weaknesses of your assignment.

The assignments for the PgC and PgD courses are evaluated by the module tutor and workshops are evaluated by the workshop tutors. The MSc thesis will be assessed by a board of examiners, which includes the thesis supervisor, one external examiner and the Programme Director. Each member independently assesses the thesis and complete a separate evaluation form. They will then reach a consensus about the final grade and complete one joint evaluation form that is communicated to the student. Students are also expected to give a presentation on their thesis in front of the examiners (private defence) and others (public defence).

1.4.2. Module assessment

Modules are assessed based on grading rubrics, specifying the grading criteria, the weight allocated to each criteria and performance descriptors that indicate what is expected for each criteria to score a certain grade. Each assignment has its own unique rubric; please carefully study the assignment guidelines and the rubric before completing the assignment. An example rubric is included in Appendix I.

Your grade for a module is the weighted sum of the grades for all assessments. Most courses have two assignments that each count for 50% towards your module grade, but sometimes the weights vary. For grading, the Dutch 10 to 1 system is used, where 10 means excellent and 1 means poor. Grades are aggregated at 0.5.

You should obtain at least a 5.0 for all exam components, i.e. assignments. **To pass, an average of 5.5 or higher should be obtained for a module**.

The assignments aim to test if you have mastered the material that has been presented in the module. In general, several types of understanding are tested: 'knowledge' (reproducing course material), 'insight' (linking, associating, and building arguments based on the course material),

'application' (applying the course material to external topics, usually with a fixed answer), and

'thinking' (creative and productive application, often more answers are possible and require argumentation). The term 'course material' includes not only the basic material of the course, but also any relevant reference and further reading appropriate for the topic.

1.4.3. Link with the ECTS grading scheme

The European Credit Transfer System is used among others to convert credits and grades between the different national systems of EU member states. The table below gives the conversion for the Dutch system to ECTS. See also:

http://europa.eu.int/comm/education/socrates/ects.html

European Credit Transfer System		
Grade according to the Dutch system	ECTS grade	Description
8.1-10.0	A	EXCELLENT - outstanding performance with only minor errors
7.5-8.0	B	VERY GOOD -above the average standard but with some errors

7.0-7.4	C	GOOD -generally sound work with a number of notable errors
6.1-6.9	D	SATISFACTORY- fair but with significant shortcomings
5.5-6.0	E	SUFFICIENT - performance meets the minimum criteria
5.0-5.4	FX	FAIL- some more work required before the credit can be awarded
>5.0	F	FAIL- considerable further work is required

Table 1: ECTS system

1.4.4. Reassessment

Students are allowed two resubmissions if they fail a module. At the second resubmission, the max. grade is 6.0. See Article 15.3.d of the Classes and Examination Regulations for more information.

1.4.5. Submitting assignments

If not specified otherwise, assignments must be submitted via the upload link provided on Canvas.

Please observe the following when submitting your assignments:

- Observe the deadline for submission for the assignment specified on Canvas. In case you are unable to meet the deadline, contact the tutor to agree an alternative date for submission;
- Ensure your assignment follows the general *Assignment Requirements* and *Referencing Instructions* applicable to all assignments (included in the "Getting started" folder on Canvas).
- Check your assignment meets the Assignment guidelines and Grading rubric provided for this specific assignment on Canvas.
- Carefully proof-read and spell & grammar check your assignment before submitting.
- Name your file according to this format: Surname_First Name_Module Title_Assignment Number.

1.4.6. Exemptions

The regulations allow students to apply for exemptions for modules (or parts of modules) where they believe they have already covered the material. We can allow credit for prior learning on two grounds:

1. If you have already taken a course that duplicates the material in a module, you are invited to submit the curriculum of the course together with evidence of successful completion. We will then take a decision about whether there is a sufficient comparability between the previous course and the module to allow exemption.
2. If you believe that through your employment you are already entirely familiar with the material contained in a module you might consider asking for exemption on the grounds of prior experience. In these circumstances, we would need to be provided with detailed evidence of the extent and currency of your prior experience so that we can take a judgement about whether an exemption is acceptable.

When you have read through a module and you feel you wish to apply for an exemption, please send an email to the UNIGIS office, info@unigis.nl, but addressed to the Examination Board. Specify for each learning outcome of the module (see: module descriptions in the Study Guide) why you already meet this outcome and present evidence in support.

There is a maximum number of credits that can be granted as exemption, see the Classes and Examination Regulations. Further, it is not possible to obtain an exemption for a Workshop, for

Module 1 or for the MSc Thesis.

1.4.7. Assessment period

Assignments will be assessed and returned to students within two weeks of receipt, provided that the student has submitted the work by the deadline. This assessment period will be extended to one month in case students submits the assignment late or when the assignment is submitted during a recess period (i.e. between 15 July and 31 August, or between 15 December and 1 January). See also the Classes and Examination Regulations.

1.4.8. Other regulations

Workload and credits

You are expected to complete around 1,680 hours of study for the complete UNIGIS course. For example, to complete the PgD in two years you will need to study approximately 10 to 14 hours per week. Distance learning means that you manage your own time so you can allocate study times to suit yourself. However, you receive weekly announcements by the tutor indicating the expected work to be completed. Furthermore, the tutor organises regular video meetings (approximately every other week) to provide another opportunity to discuss your progress and ensure you stay on track.

The assessment schemes are designed to conform as far as possible to the European Credit Transfer Schemes (ECTS), which universities have in operation. One unit of credit reflects (according to the Dutch Law on Higher Education) approximately 28 hours of learning experience. The overall number of hours required for completion of the course is 1,064 for the Postgraduate Diploma course alone and 1,680 for the entire MSc. programme. The overall length needed to complete the MSc programme is three years. Note, however, that these numbers can vary substantially from student to student.

Study progression

Students and tutors will be expected to maintain regular contacts to ensure sufficient progress within each module. In addition, the UNIGIS office monitors the progress of students through the programme and will be in touch with students who are not completed the expected credits. Students have, however, also the obligation to inform the UNIGIS office of any delay in their study. If you are unable to meet an Assignment deadline, you send a message to the tutor with the UNIGIS office in cc: stating the reason of the delay and the expected date of submission. Delays should be kept to a minimum to ensure you stay on track.

Modules and workshops should be taken in the order described in Chapter 2. Students will get access to the next module when the assignments of the current module have been submitted. Some elective modules have prerequisites regarding other modules, see the module description in Section 2.7 of the Study Guide. The first-year workshop (Workshop II), for example, requires the completion of modules 1 and 2, while the second-year workshop (Workshop III) requires the completion of the PgC programme and an additional two 5 ECTS modules of the PgD programme.

Interruption of study and delay

In a distance-learning course designed to attract primarily working, mature students, it is likely that some students will find it necessary to temporarily interrupt their studies due to professional or personal circumstances. Accordingly, students will, with the agreement of the Amsterdam UNIGIS Organisation, be allowed to suspend their studies with the limitation that the minimum period of suspension of study will be half a year. It is required to send a written request to the UNIGIS office to apply for suspension. The student will subsequently join the course calendar of a later intake.

Extenuating circumstances – Flexibility in the UNIGIS programme

The UNIGIS programme offers flexibility in case of extenuating circumstances (illness, family or work-related circumstances, et cetera). In these cases, try to contact the UNGIS office as early as possible. In consultation with the Programme Director or a representative the effects on your

study progress will be discussed and a solution will be implemented.

Study in excess of the programme

It is not allowed to study more modules or participate in more workshops than required for the PgC or PgD course. If a student wants to do more modules or participate in more workshops, he or she can only do this after approval of the Programme Director and after payment of additional fees.

Language

In principle, the UNIGIS course is an international course taught in English. This means that all study materials are provided in English, that Workshops are held in English, and that the student's work (assignments and thesis) needs to be submitted in English. However, students may decide to submit their work in Dutch and do their thesis in Dutch if they feel more confident in doing so. An exception are the modules taught by foreign tutors, for which the assignments must be submitted in English (tutors announce themselves at the start of a module; if you would like to know if a specific module can be submitted in Dutch please contact the UNIGIS office). Also, workshops will always be fully taught in English if any one of the students or tutors does not speak Dutch.

If a student decides to do his assignments and thesis in Dutch, he must consider the fact that his work will not have international exposure and that international interaction is reduced. Regarding the MSc, some topics can only be chosen if the thesis will be written in English. Note also that a student will not be eligible for qualification 'European Masters in GIS' if the work is carried out in Dutch.

Fraud

See Article 3 of the Examination Board's Rules and Guidelines.

Appeal

If a student does not agree with a decision of the tutor, (s)he can appeal at the Programme Committee.

The first step, however, is for the student to state the complaint to the tutor with the unigis office in cc:. If the tutor and the student cannot come to an agreement, the Programme Director or Programme Coordinator will act as a second supervisor or mediate between the student and the tutor.

If the student is not satisfied with the outcome, (s)he can send an email to the Programme Committee explaining his/her case, unigisPC.sbe@vu.nl. The Programme Committee can then give a (non-binding) advice to the Programme Board whether or not anything should be changed in the programme based upon this case.

Also, if the student is not satisfied with the outcome, the student can contact a student advisor of the School of Business and Economics who can give advice on possibilities of appeal within the legal framework of Vrije Universiteit Amsterdam.

Finally

- Please inform the UNIGIS office in case of a change of your contact information (e-mail, home address, new employer, work address, job function, et cetera);
- For questions relating only to the modules you can contact the module tutors. For all other matters, please contact the UNIGIS office, info@unigis.nl;
- For each student, a digital file is kept at the UNIGIS office which holds the registration forms, (copies of) messages, submitted modules, and other information relevant for the course.

2. The UNIGIS Programme

2.1. Structure of the Programme

The part-time Master's in GIS is a three-year programme taught in English. The programme curriculum is depicted in Table 1.

Period	Courses (ec)	
Year 1 – Foundation		
Period 0 (Sep)	Introduction Workshop (0)	Tutorial support
Period 1 (Sep-Nov)	Advanced GIS (5) & Introduction Workshop (0)	
Period 2 (Nov-Jan)	Database Theory (4)	
Period 3 (Feb-Apr)	Geodata Capture, Standards and Quality (5)	
Period 4 (Apr-Jun)	Research Methods (4)	
Period 5 (Jun)	Workshop Spatial Analysis (1)	
Year 2 – Specialisation	***GIScience***	***GIS and Environment***
Period 1 (Sep-Nov)	GIS and Modelling	Geodesign
Period 2 (Nov-Jan)	Internet GIS	Remote Sensing for GIS Appl.
Period 3 (Feb-Apr)	Databases for Enterprise GIS	Geovisualization
Period 4 (Apr-Jun)	Capstone	
Period 5 (Jun)	Workshop Decision Support (1)	
Year 3 – Thesis		
Period 0 (Sep)	Thesis workshop (0)	
Period 1 (Sep-Jun)	Research Proposal and Thesis (22)	

Table 1: Curriculum of the Master's programme GIS (part-time), September 2019 intake

As depicted, the programme consists of three study phases, to which a self-study programme of additional tutorials is added when students require additional practical GIS training:

- *Year 1 – Foundation* Introductory one-day workshop, four compulsory core courses and one compulsory week-long workshop on campus in the first year, which provides a foundation for the MSc and is known as the UNIGIS Certificate programme (19 ec)
- *Year 2 – Specialisation* Three specialisation courses in either GIScience or GIS and Environment, concluding with a capstone and one compulsory week-long workshop in the second year (19 ec). Elective courses can be chosen from the optional courses offered (see 2.2.2. for current offer) or from core courses offered in other specialisation pathways. Together with the first year, these in total eight courses and three workshops are also known as the UNIGIS Diploma programme;
- *Year 3 – Thesis* MSc Workshop, Research proposal and Thesis (22 ec).

The PgC, PgD and MSc are designed to be free standing, but complementary, courses presented

to professional standards. They will satisfy the requirements of a wide range of employers for the training and development of information technology personnel and middle management. They will satisfy also the needs of individuals for professional development to increase job mobility and to enhance career prospects.

The materials have been adopted by the international UNIGIS network of universities as the core materials in their programme for advanced GIS education.

2.2.1 Year 1-Foundation - Postgraduate Certificate Programme

The purpose of the first-year courses and workshops is to provide the students with a solid foundation in all the learning objectives of the programme. This includes the mastering of state of the art GIScience concepts and technologies and applying these in solutions to complex geospatial problems (in all practical course assignments and the workshop); developing advanced academic and research skills (principally in the Research methods course); further their professional reporting and oral presentation skills (assignment reports and essays and workshop presentation); and reflecting on the relevance of GIScience to international and interdisciplinary developments (in essay assignments). Furthermore, they learn to take responsibility for their own learning and identify their individual learning needs and strategies.

The introductory one-day workshop is held on campus but with facilities for overseas students to join via video link. It aims to set the students on the right track for a successful study experience. This includes introducing them to our way of looking at the field of geo-information science, through a lecture by Professor Scholten on GIS concepts and spatial thinking, but also reactivating their academic and research skills – for many it has been some time since they last wrote an academic paper – by discussing how to identify and judge literature, referencing methods and scientific report writing (learning outcome 1) and introducing them to the blended learning methods and tools of the Master's programme.

In modules 1 (Advanced GIS), 2 (Database Theory) and 3 (Geodata Capture, Standards & Quality) students acquire knowledge of the major building blocks of GIS, the spatial thinking framework, the theoretical concepts of relational databases and of the whole process from collecting data up to providing information for decision-support. In all courses applying this knowledge is an essential part through essay and practical assignments.

The fourth course, Research Methods, strengthens the students' academic and research skills. They critically review the research design of a recent UNIGIS MSc Thesis and design a questionnaire or interview schedule as part of their own GIScience research proposal including methodological, ethical and practical considerations. They can very well apply the skills they acquire here in their specialisation pathway – in which they are increasingly confronted with peer-review articles as core reading and assignment tasks that require advanced academic skills – as well as during the writing of their Master's thesis.

The first year is concluded with an on-campus workshop lasting five days on Spatial Analysis, where they have to apply relevant theoretical and methodological knowledge acquired in the first courses of the programme. The students prepare through homework tasks and during the workshop attend lectures, present their work and write a report on the spatial analysis they carry out. The students work together in groups to elaborate actual cases and have limited time for solving the complex spatial case presented, forcing them to co-operate efficiently and productively.

Awarding of the PgC

Although the majority of students will wish to pursue their studies at least to the Diploma level, some students may decide to terminate their studies at an earlier stage. Students who successfully complete four Modules and Workshop II will be eligible for the award of Postgraduate Certificate in GIS. The Postgraduate Certificate is awarded by the Examination Board.

2.2.2. Year 2-Specialisation - Postgraduate Diploma Programme

To obtain the award for the PgD course, a student must study eight modules and successfully

complete workshops II and II. When entering the PgD course, a student needs to select one of the two pathways. Both pathways contain a number of core (compulsory) modules and a compulsory on-campus workshop lasting five days.

Pathway 1: Geographical Information Science

Philosophy: This programme is aimed at people who want to develop careers in the technical and scientific areas of GIS or applications developers who want to specialise in GIS. Emphasis is placed upon design and organisational issues in the context of applications development. Experience in the use of software products and of applications development forms an important part of the course.

Aims: a) provide a consolidated view of the linkage between technology, data, methods and organisations in GIS;

b) focus on computing methods and computing algorithms;

c) focus on databases and architecture of GIS systems;

d) provide experience in the use of different software products and of applications development;

e) emphasise applications development in the contexts of design and organisational issues.

Pathway 2: Geographical Information Systems and Environment

Philosophy: This programme is aimed at specialists in the area of environmental applications or project management who wish to enter the GIS field or GIS developers and managers who wish to enter the environment field

Aims: a) provide a consolidated view of the linkage between technology, data, methods and organisations;

b) cover the technical and systems background for developing environmental applications;

c) focus on the procedural and methodological requirements for environmental analysis;

d) emphasise environmental applications and the theory and methods of environmental modelling;

e) provide experience in the use of different software products and of applications development.

Award of the PgD

The PgD will be awarded if the student has passed eight modules with a sufficient grade and if he or she has successfully passed workshops Year 1 and Year 2.

2.2.3. Year 3 – Thesis - Master of Science programme

When you have decided that you would like to continue in the Unigis programme to complete an MSc, contact our administration to make an appointment to discuss your plans with the Programme Coordinator. Perhaps you already have a research topic in mind, perhaps you have several possibilities, or maybe you are in need of some inspiration, but you need to talk about your future topic and what the MSc entails. You must also be sure that you qualify to start on the MSc programme.

The MSc is thus seen as a continuation of the PgD course, which permits good students to pursue a research topic of their choosing. The student in conjunction with the Thesis coordinator,

Prof. Dr. Jaap Boter, jaap.boter@vu.nl, will select the research topic. The student will conduct her/his research independently; with distance coaching from the supervisors when needed. The resulting thesis will subsequently be submitted for assessment. The Programme Board will encourage students to begin to prepare thesis proposals during the later stages of their PgD.

Planning and Duration

Formal registration for the MSc will normally take place once a year, although students who wish to do so will be encouraged to begin to work on their theses immediately after their PgD results are published. At an early stage, students will be required to submit MSc Proposal following the UNGIIS MSc template instructions. This proposal will be assessed by either the Programme Coordinator or the appointed thesis supervisor and will account for 10% of the MSc mark. If a sufficient number of students are starting with their thesis simultaneously, the proposals are discussed during an MSc workshop at Vrije Universiteit Amsterdam. The proposal will provide a clear basis for the remainder of the MSc project and should include: a summary of the main purposes of the thesis; chapter structures; draft introductory chapters; an assessment of data sources; draft questionnaires; annotated bibliographies; program specifications; and action plans. The UNIGIS office will place a copy of each student's project outline, and the supervisors' comments, on file for later inspection.

The normal period in which a student will be allowed to complete a thesis will be one year. Students will therefore be able to complete their MSc studies in three years (two years for the PgD plus one for the thesis). It is expected that most students will progress immediately to the MSc upon completion of their PgD. Students who receive their PgD will be permitted to register as MSc students provided they do so within four years of the date of their initial PgD registration. Students who elect to study for an MSc but who do not complete within the registration period will retain their entitlement for a PgD award. The Examination Board will have the right to extend the registration periods of students where it believes this to be appropriate. Except where the Examination Board deems an extension to be appropriate, the maximum period of registration for the MSc will be five years from the date of initial registration.

Student Workload Requirements

According to the Dutch Law on Higher Education, an MSc degree is expected to be a minimum of 60 credits (ECTS) of 28 hours, which equates 1680 hours of study, though normally it is about 1800 hours or 65 credits. Students will already have accumulated 38 credits from their PgD studies and will be expected to devote a minimum of 616 hours or 22 credits to producing their MSc theses.

Topics

Dissertation topics will be drawn from within the broad area of GIS research. The Programme Board will advise students about the acceptability of topics and will help them to develop thesis proposals. Students will be allowed, indeed, encouraged to develop MSc theses from work-based projects. Where this is the case, however, the Thesis coordinator will need to be persuaded that the additional work which the student proposes is of appropriate academic level to merit the award of an MSc. Staff will give advice about the conversion and extension of work- based materials into MSc theses. Material that has previously been submitted for an academic award will not be accepted. Students will be required to provide evidence that they have access to appropriate resources.

Length

Dissertations will not normally exceed 20,000 words in length. Where a thesis contains a substantial technical element, such as the development of a computer application, theses substantially shorter than 20,000 will be accepted.

Supervision

Each student will be allocated one supervisor. The supervisor will be allocated on the basis of topic supervision. Supervisors who do not teach on the UNIGIS course may be appointed to supervise MSc topics where appropriate. Supervision will be primarily by distance methods, although students

will be encouraged to make visits to Vrije Universiteit Amsterdam and, if needed, to make use of the facilities of the SPINlab. The Programme coordinator oversees the MSc programme and organises the MSc Workshop.

Dissertation Assessment

The first step in the dissertation assessment is the independent assessment of two supervisors: the thesis supervisor and a second Unigis tutor. After they agree that the thesis is of sufficient quality, they will each report their findings and propose a grade. The two reports will be submitted to the Programme Director. He will assess the thesis and, together with the two supervisors, determine the grade.

The student is required to defend his/her thesis before an audience (public defence) and before the Board of Examiners (private defence).

More information on the MSc course can be found in the MSc handbook, available on Canvas.

Award of the MSc

For more information about specific award classifications that may be granted to the degree, see Article 9 of the Examination Board's Rules and Guidelines.

2.3. Teaching

The UNIGIS curriculum is a distance learning course. The study materials are delivered through the Internet and evaluation takes place by assignments and not by exams. Communication between students and tutors mainly takes place using the discussion forum and video conferencing via Canvas. However, we recognise that face-to-face contact is also needed for a successful course. Therefore, workshops and seminars will be organised, and it is always possible to make an appointment for a personal interview or a chat with tutors at the UNIGIS office at Vrije Universiteit Amsterdam.

To actively engage the students and the tutor in the learning process, we have designed and implemented a consistent workflow across the curriculum. Students are notified one week before the start of each course that they have been enrolled and encouraged to familiarize themselves with the course manual and assessments. The tutor contacts the students to schedule the first video conference in week 1 at a date and time suitable to all, and creates a topic on the discussion forum to collect questions for the first conference. During the conference, the aims, structure and assessments (including the grading rubrics) of the course are discussed and the tutor agrees with the students upon dates for additional video conferences. The conferences are scheduled regularly, approximately every two weeks, such that they support the students in the work they do for the two assessed assignments. Often students present their progress during these conferences and the tutor moderates the discussion, encouraging students to give feedback on each other's work. Conferences are also a good opportunity to check whether everyone is still on track, with the upcoming assignment deadline in sight. In the meantime, the students use the discussion forum to share learning resources, post questions and for trouble shooting on the practical assignments. The tutor monitors these discussions closely and provides input where desirable. The tutor also notifies the students of upcoming conferences or deadlines and reports when the grades and feedback are available using the announcements function embedded in the virtual learning environment.

2.4.1. MSc Seminar

If we have a group of students starting on the MSc programme at around the same time, we shall try to organize an MSc Seminar. This will bring students and some staff together, and each student will make a short presentation of the research work he/she plans to undertake. On the staff side, we shall explain as much as possible about the MSc programme and we shall try to draw attention to the important issues involved in doing research and writing a dissertation. Questions and discussions will be encouraged, so that everyone should go home with a clearer idea of what is involved, and how different people are tackling their own project. Within the Canvas environment there is a protected area for part-time MSc students, where each student links

his/her own web page with information about his/her own research project and how it is progressing.

2.4.2. Study load and planning

The UNIGIS part-time distance learning course (PgC, PgD, and MSc) totals 1,680 hours of study: The first two years require 1,064 hours (38 ECTS) while the MSc requires approximately 616 hours (22 ECTS). The PgC & PgD course will run for two years beginning February and September each year. The course calendar provides module dispatch and assessment completion dates (see timetable below). This calendar allows some flexibility, which is required for a distance-learning course that is designed for postgraduate, working students, though it also retains the necessary degree of control to ensure efficient course management. Modules each take two or two-and-a-half months to complete depending whether they are worth 4 or 5 ECTS. Upon delivery of the tutor-assessed assignments the student will get access to the next module through the personalised study centre on the Internet.

Although it is strongly advised to follow the course schedule, it is possible to have some flexibility in the schedule. This flexibility must be agreed between the student and the supervisor. Late submission of assignments can be allowed if external circumstances, such as pressures of work or personal life, mean that the strict assignment deadlines cannot be met. It is also possible to agree on a 'faster' schedule if the student has more time to spend on the study. The timetable below gives the deadlines at which all assignments of a module have to be submitted. Students will only be allowed to carry assignments across a deadline with specific permission of the Amsterdam UNIGIS Organisation. Workshop dates are fixed, so please include them in your year planning.

The timetable supposes that you study 14 hours per week during the academic year (which is 10 months long). Distance learning means, however, that you manage your own time so you can allocate study times to suit yourself, depending on your workload and other activities, as long as you comply with the deadlines.

The MSc part of the programme covers one year. The student and the tutor will make a planning at the beginning of the programme.

2.5. Examination Components part-time Programme

The learning outcomes are made specific in the following six Learning Objectives of this programme:

The Academic Role

1. Graduates can demonstrate a command of all the academic research skills necessary to make (academic, managerial and societal) relevant and original contributions to the GIS profession.

The Academic Professional Role

2. a. Graduates can demonstrate their mastering of state-of-the-art theory and technology skills in the domain of GI Science and Technology.
   b. Graduates can develop solutions from different theoretical perspectives and technological approaches for complex real-life geospatial problems.
3. Graduates can present the geospatial insights they have obtained regarding complex multidisciplinary problems to professionals and non-experts convincingly.

The Academic Professional as Citizen Role

4. Graduates can explain the relevance of GI science to (inter)national and interdisciplinary developments.
5. Graduates can take responsibility for their own learning, knowledge and actions.

Our understanding of how these intended learning outcomes relate to the Dublin descriptors is

summarised in Table 3. Bullets indicate areas where the relationship is most pronounced, without implying that in other cases the learning outcomes do not contribute to achieving the aspiration expressed by the Dublin descriptors.

D1 Knowledge and understanding	D2 Applying knowledge and understanding	D3 Making judgements	D4 Communication	D5 Learning Skills	Learning Objective (that which a graduate can do or make)
Dublin Descriptors					Programme learning objectives
●	●	●			**Graduates can demonstrate a command of all the academic research skills necessary to make (academic, managerial and societal) relevant and original contributions to the GIS profession.**
●	●	●			**a. Graduates can demonstrate their mastering of state-of-the-art theory and technology skills in the domain of GI Science and Technology. b. Graduates can develop solutions from different theoretical perspectives and technological approaches for complex real-life geospatial problems.**
			●		**Graduates can present the geospatial insights they have obtained regarding complex multidisciplinary problems to professionals and non-experts convincingly.**
	●	●			**Graduates can explain the relevance of GI science to (inter)national and interdisciplinary developments.**
				●	**Graduates can take responsibility for their own learning, knowledge and actions.**

Table 3: Learning outcomes in relation to Dublin descriptors

The assessment and learning outcomes have been specified for each course. The programme has an assessment plan (see Appendix), which relates the learning outcomes to course-level learning objectives and also indicates the assessment format in each course in relation to these course-level learning objectives. The assessment plan shows how the programme ensures that the individual learning outcomes are covered in the compulsory curriculum.

The relationship between course-level objectives and programme-level intended learning outcomes is made clear to the students in the course descriptions included below. For each course, a Course Manual is made available in a standard format which elaborates on the course description and provides details on the organisation of the course and the assessments. The curriculum map included in the assessment plan (Appendix) shows that the assessment of the intended learning outcomes is increasing during the programme with the thesis as final assessment.

2.5.1 Postgraduate Certificate (PgC)

UNIT CODE NUMBER AND TITLE	**P1-01 Advanced GI Science and Systems**		
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network		
HOME DEPARTMENT	Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU		
UNIT LEADER(S)	Niels van Manen (Assignment 1), Eduardo Dias (Assignment 2)		
CREDIT VALUE (ECTS)	5	STUDENT EFFORT (HOURS)	140
UNIT STATUS	MANDATORY CORE: PgC/PgD/MSc GIS; PgD/MSc GIS and Management; PgD/MSc GIS and Environment; PgD/MSc GIScience.		
PRE-REQUISITES	None		

UNIT LEARNING OUTCOMES

On completion of this unit students should be able to:

ACADEMIC & RESEARCH SKILLS/ SOCIAL AND PROFESSIONAL SKILLS

i. Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text. TAA1 and TAA2

BRIDGING THEORY AND PRACTISE: THEORY

ii. Analyse the changing definitions of GIS/GIScience since the 1960s and what these signify or the development of GIS/GIScience as a field of engineering and science. TAA1
iii. Identify the different components of GIS/GIScience and discussing their linkages. TAA1
iv. Analyse how GIS components have transformed from the early stages when GIS was used as an automated map making technology (1960s) to a widely used spatial decision-making tool (21st century). TAA1
v. Evaluate how spatial data models are used in the representation of geographical phenomena. TAA2
vi. Explain the purpose, techniques and algorithms of basic spatial operations used in GIS. TAA2

BRIDGING THEORY AND PRACTISE: APPLICATION

vii. Select the appropriate data and data models for particular applications. TAA2
viii. Evaluate the constraints placed on the use of data by particular data types and models. TAA2
ix. Use GIS software effectively and be able to design and implement appropriate analysis procedures for any given application. TAA2

BROADENING YOUR HORIZON

x. Appraise for a case study the effectiveness of GIS in supporting decision making, including the impact of the absence/underdevelopment of GIS/GIScience components in the case study. TAA1 and TAA2

CURRICULUM OUTLINE

This unit aims to provide students with a deep understanding of the concepts and principles of GIS and be able to effectively employ GIS techniques in a real-world context.
GIS as a field of study - History and continuing evolution of concepts, issues and technologies in GIS. The components of GIS*:* Technology, Data, Method, Organisation and Bodies of knowledge.
Spatial data modelling - Spatial entities and geographical representation, ontology and semantic modelling, raster and vector encoding, object-oriented modelling, multi-dimensionality and representation in GIS.
Spatial operations - Single and multiple layer operations and their algorithms, spatial interpolation and generation of continuous surfaces, applications and methods of network analysis, cartographic modelling.

Practical experience with GIS - Introduction to desktop GIS software ArcGIS, or open-source alternative of the student's choice, using problem based learning. Raster and vector application exercises. Implementation of different spatial operations and analytical procedures.

TEACHING AND LEARNING STRATEGIES

The learning and teaching strategies are student centred. They aim to encourage a deep- learning approach by using reflection and self-evaluation. A written Directed Reader will be provided on-line, which will provide the essential background, the framework for study and essential detail. It will include self- assessment exercises. Each section of this Reader will be framed with a context setting introduction, clearly identified learning outcomes and additional reading within the academic and professional literature. Students will be required to reflect on
their learning as part of the self -assessment exercises and the summative assignments.

Opportunities for students to discuss issues with staff and fellow students will be provided via an online discussion form.
Next to the Directed Reader, students will meet online with their tutor to discuss some module components and to monitor the progress on the individual assignments.

ASSESSMENT STRATEGIES
Assessment is by coursework. There will be two assignments of equal weighting, the first assesses their defining of the field GIS by essay and the second assess the use of GIS by practical exercises.

ASSESSMENT CRITERIA FOR UNIT/ELEMENTS OF ASSESSMENT

Assessment 1 – Essay (50%)
The essay will concern a fundamental issue in the field of GIS related to its development, use and components. This assignment will allow students to demonstrate learning outcomes related to topic knowledge and the use of skills such as literature searching, development of a coherent argument, academic writing, and citation/referencing.
Learning outcomes i-iv and viii are evaluated in Assessment 1.

Assessment 2 – Practical GIS assignment (50%)
A software exercise concerning spatial modelling and spatial operations. The exercise will test software competency, and will be accompanied by critical commentary which will demonstrate. Learning outcomes v-vii and viii are evaluated in Assessment 2.

INDICATIVE STUDENT LEARNING RESOURCES

The primary resource will be the Directed Reader supplemented by a mixture of academic journal and professional references.
See the online module for more information on the recommended reading material.

UNIT CODE NUMBER AND TITLE	**P1-02 Database Theory**		
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network		
HOME DEPARTMENT	Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU.		
UNIT LEADER(S)	Xander Wilcke		
CREDIT VALUE	4	STUDENT EFFORT (HOURS)	112
UNIT STATUS	MANDATORY CORE: PgC/PgD/MSc GIS; PgD/MSc GIS and Management; PgD/MSc GIS and Environment; PgD/MSc GI Science.		
	PRE-REQUISITES	None	

UNIT LEARNING OUTCOMES

On completion of this unit, students should be able to:

ACADEMIC & RESEARCH SKILLS/ SOCIAL AND PROFESSIONAL SKILLS

1. Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text. TAA1 and TAA2

BRIDGING THEORY AND PRACTISE: THEORY

2. Critically assess the limitations of conventional database structures as a means of storing spatial data. TAA1
3. Decide when relational database management systems are not fit for a purpose (e.g. Big Data) and which other DBM systems should be used (e.g. NoSQL). TAA1

BRIDGING THEORY AND PRACTISE: APPLICATION

4. Design well-formed database models, using appropriate design techniques. TAA2
5. Implement such designs using relational database software. TAA2
6. Provide high-quality documentation of the database design (process) and its implementation. TAA2
7. Use high-quality and well-formatted SQL to establish and interrogate databases. TAA2

CURRICULUM OUTLINE

This unit aims to provide students with the practical skills to design, implement and interrogate relational databases together with the requisite knowledge to critically assess both current database models and developments of those models for geospatial data.

The Database Approach - What is an information system? What is a database? Why are they necessary – generally and specifically for GIS? Database models; Reference architectures; Attribute data and spatial data.

The Relational Model - Origins of the Relational model; Requirements of the Relational Model; Normalisation; EAR modelling; EEAR/UML modelling (introduction only); SQL.

Implementing a database - Designing and implementing a database; tutorial exercises.

GIS and DBMS - Current issues: A typology of GIS database architectures; limitations of the relational model for spatial data; the impact of OODBMS and ORDBMS; Universal servers; impact of web/web services; XML/GML; NoSQL and Big Data. The ambition here is to provide a 'management' overview of current technology developments.

Big Data and NoSQL – RDBM systems are ill equipped to handle extremely large datasets; what are the problems, how are they solved by NoSQL databases and what are the tradeoffs?

TEACHING AND LEARNING STRATEGIES

The learning and teaching strategies are student centered. They aim to encourage a deep- learning approach by using reflection and self-evaluation. A written Directed Reader will be provided on-line, which will provide the essential background, the framework for study and essential detail. It will include self-assessment exercises. Each section of this Reader will be framed with a context setting introduction, clearly identified learning outcomes and additional reading within the academic and professional literature. Students will be required to reflect on their learning as part of the self-assessment exercises and the summative assignments.

Opportunities for students to discuss issues with staff and fellow students will be provided via an online bulletin board. Finally, the course tutor will give one or more online lectures to explain the course material in more detail and to offer students the opportunity to ask questions and to discuss the material with each other.

Opportunities for students to discuss issues with staff and fellow students will be provided via an online discussion form.

Next to the Directed Reader, students will meet online with their tutor to discuss some module components and to monitor the progress on the individual assignments.

ASSESSMENT STRATEGIES

Assessment is by coursework. There will be two assignments of equal weighting, the first assesses their defining of the field GIS by essay and the second assess the use of GIS by practical exercises.

ASSESSMENT CRITERIA FOR UNIT/ELEMENTS OF ASSESSMENT

Assessment 1 – Big Data and NoSQL databases (50%)
The student is asked to research NoSQL databases and compare these to Relational Databases in the context of Big Data.

Assessment 2 – Urban planning department development database (50%)

The student is asked to design and implement a Relational Database for a local planning department to help it keep track of the residential development sites within its area.

GRADING CRITERIA

<u>Assignment 1</u>

- thorough description of Big Data and the challenges it poses to “conventional” relational database systems (Learning outcome 1.)
- thorough and complete description of a number of NoSQL databases and a discussion about their advantages/disadvantages over the relational model in the context of Big Data (Learning outcome 2.)

<u>Assignment 2</u>

- A high-quality database design and a robust and functioning implementation (Learning Outcome 3.)
- Concise and clear yet thorough description of the database design process and its implementation (Learning Outcome 5.)
- Well-formulated and well-formatted SQL queries (Learning Outcome 6.)

<u>Overall – Content and Argument</u>

- Analytical approach: An analytical approach (as opposed to a descriptive approach) is expected. An analytical approach shows good understanding of the topics discussed, the problem is well-analysed.
- Critical and balanced treatment of subject: These criteria refer to the argumentation and reasoning used in the assignment.

- Originality: Original answers require creative thinking; original answers may connect to the current state of affairs and possible future developments.
- Coherent conclusion: The conclusion is a very important part of your assignment, in which you give an answer to the problem, based on your argumentation and/or findings.
- Adequate use of sources: Relevant, up-to-date, and representative material from books, Internet, or other sources can improve the quality of the assignment but you should cite all references in your work, and list the references in full at the end.

Overall - Structure and Form

- Structure and organisation: A good assignment contains an introduction, middle part, and conclusion. The text is structured in sections and paragraphs that correspond with the structure of the arguments. Think further about correct titles, logical order of items, and relevance of items.
- Style and grammar: For good style and grammar it is not necessary to be an English novel writer, but your assignments should be clear, readable, and neat. Remember to use your computer spell check (and grammar check if available) whenever possible; it will remove some errors.
- Visual presentation: This refers to the appropriate use of tables, graphs, figures, and a good lay-out (of SQL queries). It also includes other form aspects, such as a correct title page.
- Referencing: Please adhere to the Harvard referencing style.

INDICATIVE STUDENT LEARNING RESOURCES

The primary resource will be the Directed Reader supplemented by a mixture of academic journal and professional references.
See the online module for more information on the recommended reading material.

UNIT CODE NUMBER AND TITLE	**P1-03 Geodata Capture, Standards and Quality**		
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network		
HOME DEPARTMENT	Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU		
UNIT LEADER(S)	Maurice de Kleijn		
CREDIT VALUE (ECTS)	5	STUDENT EFFORT (HOURS)	140
UNIT STATUS	MANDATORY CORE: PgC/PgD/MSc GIS; PgD/MSc GIS and Management; PgD/MSc GIS and Environment; PgD/MSc GI Science.		
PRE-REQUISITES	None		

LEARNING OUTCOMES

On successful completion of this unit students will be able to have attained or demonstrated:
ACADEMIC & RESEARCH SKILLS/ SOCIAL AND PROFESSIONAL SKILLS

1. Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text. TAA1 and TAA2

BRIDGING THEORY AND PRACTISE: THEORY

2. A knowledge and understanding of the key characteristics of different types of spatial data. TAA1 and TAA2
3. The ability to assess the impact of national and international data infrastructures and standards on the sourcing and availability of spatial data. TAA1
4. The ability critically evaluate the potential impacts of errors on spatial data quality. TAA1 and TAA2

BRIDGING THEORY AND PRACTISE: APPLICATION

5. The practical skills to design and implement an informed strategy for capturing or sourcing spatial data and associated metadata. TAA1
6. The knowledge to specify fitness for purpose criteria and apply them to the critical evaluation of spatial data for specific applications. TAA2

CURRICULUM OUTLINE

This unit aims to provide students with the requisite knowledge and practical skills to source and evaluate, against recognised quality standards, data for use in Geographical Information-based projects and assess the quality of information output from those projects.

Sourcing spatial data – focusing on how to identify sources of spatial data using discovery metadata, how to capture spatial data into a GIS and how to design a data capture strategy
Data standards – identify the range of national and international data standards, introduce case studies on specific standards, assessment the impact standards have on the development of Spatial Data Frameworks at national and international levels.
Data quality - define the different measures of data quality and how they might be assessed, introduce the concepts of spatial uncertainty, identify the sources of error in spatial data and how they might propagate when data is combined, and consider the impact of data quality on spatial analysis.
Evaluating fitness for purpose – the process by which the suitability of data for a specific application can be determined, the management of data quality within an organisation.

TEACHING AND LEARNING STRATEGIES

The learning and teaching strategies are student centred. They aim to encourage a deep- learning approach by using reflection and self-evaluation. A written Directed Reader will be provided on-line, which will provide the essential background, the framework for study and essential detail. It will include self-assessment exercises. Each section of this Reader will be framed with a context setting introduction, clearly identified learning outcomes and additional reading within the academic and professional literature. Students will be required to reflect on their learning as part of the self-assessment exercises and the summative assignments. Opportunities for students to discuss issues with staff and fellow students will be provided via an online bulletin board.

ASSESSMENT STRATEGIES

Assessment is by coursework. There will be two assignments of equal weighting, the first assesses the student's evaluation of data strategies and the implications of data standards; the second assesses their evaluation of data quality for a particular application.

ASSESSMENT CRITERIA FOR UNIT/ELEMENTS OF ASSESSMENT

Assessment 1Data sourcing analysis (50%) (2000 words)
Students will identify and evaluate issues relating to the sourcing of spatial data and in particular the impact of data standards and spatial data infrastructure initiatives.

Assessment 2 Data quality evaluation (50%) (2000 words)
Students will evaluate the quality of data being used for a particular application. This evaluation will involve an assessment of the requirements of the project and the identification of relevant data quality issues.

INDICATIVE STUDENT LEARNING RESOURCES

The primary resource will be the Directed Reader supplemented by a mixture of academic journal and professional references.
See the online module for more information on the primary and recommended reading material.

UNIT CODE NUMBER AND TITLE	**P1-04 Research Methods**		
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network		
HOME DEPARTMENT	Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU		
UNIT LEADER(S)	Niels van Manen		
CREDIT VALUE (ECTS)	4	STUDENT EFFORT (HOURS)	112
UNIT STATUS	MANDATORY CORE: PgD/MSc GIS; PgD/MSc GIS and Management; PgD/MSc GIS and Environment; PgD/MSc GI Science.		
PRE-REQUISITES	None		

UNIT LEARNING OUTCOMES

On completion of this unit, students will be able to:
ACADEMIC & RESEARCH SKILLS/ PROFESSIONAL AND SOCIAL SKILLS

i. Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text. TAA1 and TAA2

ACADEMIC & RESEARCH SKILLS

ii. Ability to construct, design, implement and analyse GIS-based research projects.
iii. Ability to discuss, critically, the range and appropriateness of qualitative and quantitative research methods in GIS and the strengths and weaknesses of the data that they generate.
iv. Ability to interpret spatial data critically.
v. Apply an integrating approach, including ethical and professional practice considerations, to designing a GIS based research project.

CURRICULUM OUTLINE

This unit aims to develop critical awareness of research design, data interpretation and presentation. It aims to achieve this through an understanding of the research methods of the natural and social sciences and the interactions between them in GIS applications.

Research Design: problem statement, purposes and benefits. Theory, assumptions, validity and background literature. Variables and hypotheses. Data collection including ethical and professional practice considerations. Reporting results and outcomes: conclusions, interpretations and recommendation.

Qualitative and Quantitative Techniques: Qualitative research, sampling, surveys, questionnaires, other methods, ethical issues. Critical appreciation of quantitative techniques such as univariate data analysis / statistics, bivariate statistics, tests for significance, correlation and regression. Data interpretation: natural / physical science data, social science data, secondary data, trend analysis, data mining, data quality and metadata.

TEACHING AND LEARNING STRATEGIES

The learning and teaching strategies are student centred. They aim to encourage a deep- learning approach by using reflection and self-evaluation. A written Directed Reader will be provided on-line, which will provide the essential background, the framework for study and essential detail. It will include self- assessment exercises. Each section of this Reader will be framed with a context setting introduction, clearly identified learning outcomes and additional reading within the academic and professional literature. Students will be required to reflect on their learning as part of the self-assessment exercises and the summative assignments. Opportunities for students to discuss issues with staff and fellow students will be provided via an online bulletin board.

ASSESSMENT STRATEGIES

Assessment is by coursework. There will be two assignments of equal weighting, the precise content may vary year by year but will typically include one based upon research design and a second based upon quantitative or qualitative methods of data interpretation and analysis.

ASSESSMENT CRITERIA FOR UNIT/ELEMENTS OF ASSESSMENT

Assessment 1 Research Design (50% (1500 words))
Students will be assessed on their critical appraisal of a research design at postgraduate level.

Assessment 2 Data interpretation and Analysis (50%) (n/a words)
This will be case study based and students will be assessed on their critical evaluation of either a qualitative or quantitative data analysis/ interpretation study.

INDICATIVE STUDENT LEARNING RESOURCES

The primary resource will be the Directed Reader supplemented by a mixture of academic journal and professional references.
See the online module for more information on the primary and recommended reading material.

UNIT CODE NUMBER AND TITLE	**P1-W2 Workshop Year 1: Spatial Analysis**
TUTOR Niels van Manen, Eduardo Dias	
CONTRIBUTING DEPARTMENT Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU	

PREREQUISITES
modules P1-01 and P1-02 and, preferably, P1-03

AIMS
- Application of the theory from modules 1 to 4 in a co-ordinated team exercise
- Obtain practical experience with desktop GIS software
- Discuss broader and actual issues from the field of study
- Foster student contact

INTENDED LEARNING OUTCOMES
On completion of this unit students should be able to:

ACADEMIC & RESEARCH SKILLS
i. adequately analyse, interpret and critically examine his/her own research results and those of others

BRIDGING THEORY AND PRACTISE: THEORY
ii. analyse how spatial data models are used in the representation of geographical phenomena

BRIDGING THEORY AND PRACTISE: APPLICATION
iii. apply geo-information solutions to a complex geospatial problem using technology, data and methods
iv. develop appropriate advice from the results of a geo-information solution

PROFESSIONAL/SOCIAL SKILLS
v. present and justify the results of own analyses verbally to professionals

BROADEN YOUR HORIZON
vi. distinguish between a generic GI-science solution and the specific requirements arising form the international or social context of a given problem

WORKSHOP CONTENTS
- pre-workshop preparation
- workshop exercise (approximately 15 hrs.)
- lectures
- presentation by guest speakers
- presentation of workshop exercise by students

INDICATIVE TEACHING AND LEARNING ACTIVITIES (Hours for the Unit):

Directed Reading:	Practical/ Fieldwork:	Seminar/ Tutorial:	Student Centred Learning:	Total Student effort:
6	15	8		28

2.5.2 Postgraduate Diploma (PgD)

UNIT CODE NUMBER AND TITLE	**P2-EM5/Sc1 GIS and Modelling**
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network
HOME DEPARTMENT	Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU
UNIT LEADER(S)	Sanne Hettinga

CREDIT VALUE (ECTS)	5	STUDENT EFFORT (HOURS)	140
UNIT STATUS	CORE OPTION: PgD/MSc GI Science.		
PRE-REQUISITES	None		

UNIT LEARNING OUTCOMES

On completion of this unit students should be able to:
ACADEMIC & RESEARCH SKILLS/ PROFESSIONAL AND SOCIAL SKILLS

1. Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text. TAA1 and TAA2

BRIDGING THEORY AND PRACTISE: THEORY

2. Explain and critically evaluate the three methodologies for spatial modelling (external, hybrid and full GIS) and evaluate which one is most suitable for environmental modelling. TAA1
3. Analyse how different studies have applied your chosen methodology for spatial modelling and evaluate why this was or was not the correct methodology. TAA1
4. Evaluate what changes need to be made to one of the methodologies for spatial modelling (external, hybrid and full GIS) to maximise its applicability to spatial environmental modelling situations. TAA1

BRIDGING THEORY AND PRACTISE: APPLICATION

5. Investigate all relevant parameters that influence environmental processes for a specific geospatial case study and visualize them in a mindmap. TAA2
6. Assess which parameters can and should be included in a spatial environmental model for a specific geospatial case study and design a model. TAA2
7. Implement a spatial environmental model and evaluate the results, discussing how your modelling choices influence your results and conclusions. TAA2

CURRICULUM OUTLINE

This unit aims to provide students with a critical understanding of the issues involved in designing and implementing software and GI based models. In addition it aims to enable students to write small scale GIS applications and design GIS based models.

Models and modelling – the concept of models in science and operations. Strategies and design, rule-based/simple logic models, empirical/statistical, dynamical models.
GIS-Model interaction – data model, updating and automation, visualisation, systems approach, issues in GIS hosted modelling: interpolation, thresholds, hybrid systems and component failure/system reliability.

TEACHING AND LEARNING STRATEGIES

The learning and teaching strategies are student centred. They aim to encourage a deep- learning approach by using reflection and self-evaluation. A written Directed Reader will be provided on-line, which will provide the essential background, the framework for study and essential detail. It will include self- assessment exercises. Each section of this Reader will be framed with a context setting introduction, clearly identified learning outcomes and additional reading within the academic and professional literature. Opportunities for students to discuss issues with staff and fellow students will be provided via an online bulletin board.

ASSESSMENT STRATEGIES

Assessment is by coursework. There will be two assignments of equal weighting.

ASSESSMENT CRITERIA FOR UNIT/ELEMENTS OF ASSESSMENT

Assessment 1 The use of GIS in an environmental modelling tool (50%) (n/a words)
Assessment 2 Implementing a Forest Fire Detection System with a GIS (50%) (n/a words)

INDICATIVE STUDENT LEARNING RESOURCES

The primary resource will be the Directed Reader supplemented by a mixture of academic journal and professional references.
See the online module for more information on the primary and recommended reading material.

UNIT CODE NUMBER AND TITLE	**P2-EM5/Sc2 Databases for Enterprise GIS**		
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network		
HOME DEPARTMENT	Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU		
UNIT LEADER(S)	Maurice de Kleijn		
CREDIT VALUE (ECTS)	5	STUDENT EFFORT (HOURS)	140
UNIT STATUS	CORE OPTION: PgD/MSc GI Science.		
PRE-REQUISITES	None		

UNIT LEARNING OUTCOMES

On completion of this unit students should be able to:
ACADEMIC & RESEARCH SKILLS/ PROFESSIONAL AND SOCIAL SKILLS

1. Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text. TAA1 and TAA2

BRIDGING THEORY AND PRACTISE: THEORY

2. Critically assess the organisational benefits and challenges of developing 'Enterprise GIS' systems. TAA2
3. Evaluate the advantages and disadvantages of holding geographical data in ORDBMS. TAA2
4. Critically discuss the importance of OGC and SQL99 spatial/MM. TAA2

BRIDGING THEORY AND PRACTISE: APPLICATION

5. Implement a simple geo-database, using a spatial extended ORDBMS. TAA1
6. Provide high-quality documentation of the database design (process) and its implementation. TAA1

CURRICULUM OUTLINE

This unit aims to provide students with a critical understanding of the issues in building GIS databases for Enterprise GIS together with the necessary skills to implement a small geo- database using current standards/technologies.

From desk-top to Enterprise GIS: The organisational advantages and dangers of adopting Enterprise GIS strategies. Limitations of Desk-top technologies. Limitations of Relational databases. Alternative enterprise strategies -universal storage vs. universal access. Spatial Information Management.
The technologies that underpin EnterpriseGIS: The promise and limitations of Object Oriented databases. Failure in the market. The rise of Universal servers (ORDBMS). Requirements for a spatially extended ORDBMS. Passive and active servers.
The standards that underpin EnterpriseGIS: Limitations of vendor specific spatial extensions. The role of standards bodies – e.g. OGC. SQL99 – the Object Relational Standard. SQL99 MM/Spatial – the standard for spatial servers. The XML/GML standard. XDBMS.
A Spatial ORDBMS tutorial: Experience of establishing and interrogating a spatially extended database.

TEACHING AND LEARNING STRATEGIES

The learning and teaching strategies are student centred. They aim to encourage a deep- learning approach by using reflection and self-evaluation. A written Directed Reader will be provided on-line, which will provide the essential background, the framework for study and essential detail. It will include self- assessment exercises. Each section of this Reader will be framed with a context setting introduction, clearly identified learning outcomes and additional reading within the academic and professional literature. Students will be required to reflect on their learning as part of the self-assessment exercises and the summative assignments. Opportunities for students to discuss issues with staff and fellow students will be provided via an online bulletin board.

ASSESSMENT STRATEGIES

Assessment is by coursework. There will be two assignments of equal weighting, one will assesses the student's analysis of key issues – benefits/challenges of enterprise GIS, ORDBS evaluation -by requiring answers to set of targeted questions to be written up as a workbook; the other will assess practical skills and the understanding of concepts by requiring the development of a working geo-database.

ASSESSMENT CRITERIA FOR UNIT/ELEMENTS OF ASSESSMENT

Assessment 1 – Workbook (50%) (n/a words)

Students will answer a series of targeted questions on the organisational benefits and challenges of developing Enterprise GIS. Critical assessment of the advantages/disadvantages of ORDBMS for Geodata will be assessed.

Assessment 2 – Geo-database design and implementation (50%) (n/a words)
Students will be assessed on their application of principles in designing a Geo-database, and effectiveness in implement their design using an spatially extended RDBMS.

INDICATIVE STUDENT LEARNING RESOURCES

The primary resource will be the Directed Reader supplemented by a mixture of academic journal and professional references.
See the online module for more information on the primary and recommended reading material.

UNIT CODE NUMBER AND	**P2-EM45 Internet GIS**
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network

HOME DEPARTMENT	Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU		
UNIT LEADER(S)	Simeon Nedkov		
CREDIT VALUE (ECTS)	4	STUDENT EFFORT (HOURS)	112
UNIT STATUS	CORE: PgD/MSc GIS and Environment		
PRE-REQUISITES	None		

UNIT LEARNING OUTCOMES

On completion of this unit students should be able to (A = Assessed; NA = Taught but not assessed):

ACADEMIC & RESEARCH SKILLS

[A] Can independently set up, prepare and carry out a code-driven GIS analysis in an effective and repeatable (= collaborator friendly and well-documented) way. TAA1 and TAA2

[A] Can demonstrate knowledge of the different phases, components and best-practices of code-driven spatial research and analysis. TAA1

[NA] Can formulate adequate problem statements and research questions and indicate which code-based geo-information solutions can be used to solve the issues

BRIDGING THEORY AND PRACTISE: THEORY

[NA] Can effectively and quickly identify which (combination of) different geospatial software libraries and online services are suitable for the development of long-term solution for a given problem/task.

BRIDGING THEORY AND PRACTISE: APPLICATION

[A] Can develop online and interactive geo-information solutions (applications, visualisations) to complex geospatial problems. TAA2

[A] Can access and prepare spatial data and information from various online/offline, structured/unstructured, official/non-official sources to enable an integrated, repeatable and reusable solution to a complex geospatial problem. TAA2

PROFESSIONAL AND SOCIAL SKILLS

[A] Can interact with professionals and colleagues on online open/closed (collaborative) platforms to present the applied workflow and results of analyses.TAA1

[NA] receive and manage feedback in the form of code additions, bug reports and/or improvements request assistance and/or report software imperfections and shortcomings

SELF-AWARENESS

[A] Can critically assess the limitations of his/her own expertise and solutions. TAA2

[A] Can work independently and professionally (i.e. produces traceable and repeatable work that can easily be reused by others). TAA1

CURRICULUM OUTLINE

In this module, you will get acquainted with the basic building blocks needed for creating interactive geospatial web applications from start to finish. You will start with raw data and end with a functioning and publically accessible web application. To this end you will learn how to

- automatically (and periodically) gather data from online sources such as Application Programming Interfaces and web pages
- perform basic spatial analysis on this data with Python
- create a simple interactive web page using HTML, CSS and JavaScript
- create a simple interactive geospatial application with Carto or any other web mapping framework

In addition, you will learn a number of non-code related skills aimed at helping oy become a self-reliant and effective geo-IT expert who is able to collaborate with fellow experts on well-documented applications. You will learn how to

- quickly and effectively locate and evaluate external Python and JavaScript modules for their fitness of purpose for the job at hand
- read and write documentation
- set up and maintain a repeatable workflow
- interact with fellow developers on public/private collaboration platforms such as GitLab/GitHub and StackOverflow

Coding is best learned by doing. This module therefore consists of (fairly) short interactive lessons followed by extensive hands-on efforts in the form of ungraded exercises and graded assignments.

TEACHING AND LEARNING STRATEGIES

The learning and teaching strategies are student centred. They aim to encourage a deep- learning approach by using reflection and self-evaluation. A written Directed Reader will be provided on-line, which will provide the essential background, the framework for study and essential detail. It will include self- assessment exercises. Each section of this Reader will be framed with a context setting introduction, clearly identified learning outcomes and additional reading within the academic and professional literature. Students will be required to reflect on their learning as part of the self-assessment exercises and the summative assignments. Opportunities for students to discuss issues with staff and fellow students will be provided via an online bulletin board.

ASSESSMENT STRATEGIES

Assessment is by coursework. There will be two assignments of equal weighting, the first assesses the student's evaluation of the organisational and technological challenges of internet GIS by construction of a workbook in response to a series of targeted questions; the second will assess, via a practical demonstration, their implementation of current standards for distributed GIS.

UNIT CODE NUMBER AND	**P2-EM5/En1 Environmental Impact Assessment & GIS**		
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network		
HOME DEPARTMENT	Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU		
UNIT LEADER(S)	Eric Koomen		
CREDIT VALUE (ECTS)	5	STUDENT EFFORT (HOURS)	140

UNIT STATUS	CORE OPTION: PgD/MSc GIS and Environment.
PRE-REQUISITES	None

UNIT LEARNING OUTCOMES

On completion of this unit, students will be able to:
ACADEMIC & RESEARCH SKILLS/ PROFESSIONAL AND SOCIAL SKILLS

1. Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text. TAA1-Part1, 2 and 3

BRIDGING THEORY AND PRACTISE: THEORY

2. Demonstrate a competent knowledge of the critical parameters that contribute to a successful GIS-based environmental impact assessment model. TAA1-Part1

BRIDGING THEORY AND PRACTISE: APPLICATION

3. Define, describe and critically analyse the EIA process in a chosen case study. TAA1-Part2
4. Identify the interaction and integration of social and environmental assessments in a specific case study. TAA1-Part2

BROADEN YOUR HORIZON

5. Evaluate recent trends and future prospects for the application of GIS in social and environmental assessments. TAA1-Part3

CURRICULUM OUTLINE

This unit aims to provide a historic and contemporary planning background to EIA, a knowledge of the concepts and techniques utilized in the EIA process, and assessment as related to specific environmental parameters.

EIA – the need for EIA, history, planning background, concepts and definitions for EIA, EIA procedure vs. EIA process, case study.

Critical parameters – highlighting the critical parameters that contribute to a successful EIA.

Integration of elements – introduction to the integration of social and environmental assessments.

Recent trends – highlighting the application of GIS in social and environmental assessments.

TEACHING AND LEARNING STRATEGIES

The learning and teaching strategies are student centred. They aim to encourage a deep- learning approach by using reflection and self-evaluation. A written Directed Reader will be provided on-line, which will provide the essential background, the framework for study and essential detail. It will include self- assessment exercises. Each section of this Reader will be framed with a context setting introduction, clearly identified learning outcomes and additional reading within the academic and professional literature. Students will be required to reflect on their learning as part of the self-assessment exercises and the summative assignments. Opportunities for students to discuss issues with staff and fellow students will be provided via an online bulletin board.

ASSESSMENT STRATEGIES

Assessment is by coursework. There will be two assignments of equal weighting, the precise content may vary year by year but will typically include a case study based analysis of the impacts and a design/examination of a design for GIS support of EIA.

ASSESSMENT CRITERIA FOR UNIT/ELEMENTS OF ASSESSMENT

TAA1-Part1 – Design (max. 5 pages)
The first part of the assignment focuses on the development of a GIS-based environmental impact assessment model.

TAA1-Part2 – Analysis (max. 6 pages)
In this part of the assignment you are asked to critically review an EIA/SEA case. Therefore we ask you to use one of the case studies presented in the module or to find a case study yourself about which you can find sufficient information. If possible use an actual EIA/SEA report. The use of GIS in your selected case is not a prerequisite.

TAA1-Part3 – Reflecting on the potential of GIS in EIA (max. 1 page)
To conclude this assignment you are invited to take a more abstract look at what you have learned in this EIA&GIS module. We ask you to write a column (opinion article) for a magazine for environmental professionals. Your readers have very basic knowledge on GIS. Your column should deal with: the acceptance of GIS in EIA/SEA, its benefits and hindrances, public participation and GIS and trends that you see.

INDICATIVE STUDENT LEARNING RESOURCES

The primary resource will be the Directed Reader supplemented by a mixture of academic journal and professional references.
See the online module for more information on the primary and recommended reading material.

UNIT CODE NUMBER AND TITLE	**P2-EM5/EN2 Remote Sensing for GIS Applications**		
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network		
HOME DEPARTMENT	Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU		
UNIT LEADER(S)	Marieke Eleveld & Marijke Bekkema		
CREDIT VALUE (ECTS)	5	STUDENT EFFORT (HOURS)	140
UNIT STATUS	CORE OPTION: PgD/MSc GIS and Environment. *ELECTIVE: PgD/MSc GIS*		
PRE-REQUISITES	None		

UNIT LEARNING OUTCOMES

On completion of this unit, students will be able to:

ACADEMIC & RESEARCH SKILLS/ PROFESSIONAL AND SOCIAL SKILLS

1. Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text. TAA1 and TAA2

BRIDGING THEORY AND PRACTISE: THEORY

2. Explain the principles of remote sensing and evaluate the strengths and weakness of data from different remote sensing systems. TAA1 and TAA2
3. Discuss, critically, the principles of information extraction from remotely sensed data. TAA1 and TAA2

BRIDGING THEORY AND PRACTISE: APPLICATION

4. Generate environmental information from remotely sensed data and appreciate the importance of selecting data appropriate for a given task. TAA1
5. Critically evaluate methods for integrating remotely sensed data with GIS for a specific case study. TAA2

CURRICULUM OUTLINE

This unit aims to provide students with a broad insight into the sources, applications and future potential of remote sensing data for GIS applications. The unit comprises four components:

Principles of remote sensing - highlighting the principles of remote sensing including interactions between electromagnetic radiation, atmosphere and surface, but with particular emphasis on land surface characteristics.

Satellite systems - describing of a range of satellite systems, their spectral, spatial and temporal characteristics and range of applications

Quantitative Data - examining the extraction of quantitative data from remotely sensed images including the development and application of image-based data extraction techniques, spectral indices, and application of canopy reflectance models

GIS Integration - highlighting the key issues in the integration of remotely sensed data in GIS, addressing issues of spatial scale, data availability and information content.

TEACHING AND LEARNING STRATEGIES

The learning and teaching strategies are student centred. They aim to encourage a deep- learning approach by using reflection and self-evaluation. A written Directed Reader will be provided on-line, which will provide the essential background, the framework for study and essential detail. It will include self- assessment exercises. Each section of this Reader will be framed with a context setting introduction, clearly identified learning outcomes and additional reading within the academic and professional literature. Students will be required to reflect on their learning as part of the self-assessment exercises and the summative assignments. Opportunities for students to discuss issues with staff and fellow students will be provided via an online bulletin board.

ASSESSMENT STRATEGIES

Assessment is by coursework. There will be two assignments of equal weighting, the precise content may vary year by year but will typically include a piece of work requiring students to carry out practical work with remotely sensed images and a review paper on a particular application of remote sensing.
ASSESSMENT CRITERIA FOR UNIT/ELEMENTS OF ASSESSMENT *Assessment 1 Remotely Sensed Image (50%) (1700 words)* Students will be assessed on the manipulation of, and data extraction from, a remotely sensed image data set, including ancillary data. *Assessment 2 Review Paper (50%) (3000 words)* Students will be assessed on the critical evaluation of the use of remote sensing (airborne laser scanning) and integration in GIS in a specific application area.
INDICATIVE STUDENT LEARNING RESOURCES The primary resource will be the Directed Reader supplemented by a mixture of academic journal and professional references. For the practical exercises and assignment 1 TerrSet 18.3 with IDRISI will be used.

UNIT CODE NUMBER AND TITLE	**Geovisualization**		
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network		
HOME INSTITUTION	Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU		
UNIT LEADER(S)			
CREDIT VALUE EC	5	STUDENT EFFORT (HOURS)	140
UNIT STATUS	CORE OPTION: PgD/MSc GIS and Environment		
PRE-REQUISITES	PG Certificate		
UNIT LEARNING OUTCOMES On completion of this module, students should be able to: 1. plan, prepare and conduct all phases of map making 2. manage geodata for map compilation 3. create map symbols, select colors and place labeling 4. print paper maps or publish digital maps			
Any geospatial study involves maps as either input information sources or output information presentations. The Geovisualization course consists of two main blocks: (i) cartographic concepts of coding and encoding of spatial information via maps and (ii) practical practicing in GIS-based maps. The course starts with GIS-related topics of data management and Bertin's principles of graphic variables.			

Students learn to think about map design, map projection and map content compilation. Many illustrations and map examples will be used for studying various ways of visual representations and map making concepts. Practical skill will be taught by the most applicable techniques of map compilation. The cartographic concepts of coding and encoding of spatial information via maps will include following topics: map projections, map design, map language principles, methods of thematic cartography, labelling, map reading, map analysis and map interpretation. The practical practicing in GIS-based maps will include designing maps, color schemes, generalisation and publishing. The course does not distinguish if the maps will be presented in paper or digital form
TEACHING AND LEARNING STRATEGIES The learning and teaching will be conducted by student-centered e-learning approaches. The detail presentation with further readings, tutorials and manuals will be provided for each lesson.
ASSESSMENT STRATEGIES An evaluation will be based on practical activities. All students will both evaluate existing maps and compile their own maps. After assessment the students will receive the prepared examples of correct solution.
INDICATIVE STUDENT AND LEARNING RESOURCES

UNIT CODE NUMBER AND TITLE	**P2-EM5/EN3 Geodesign**		
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network		
HOME INSTITUTION	Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU		
UNIT LEADER(S)	Dr. Niels van Manen		
CREDIT VALUE EC	5	STUDENT EFFORT (HOURS)	140
UNIT STATUS	CORE OPTION: PgD/MSc GIS and Environment		
PRE-REQUISITES	PG Certificate		

UNIT LEARNING OUTCOMES

On completion of this module, students should be able to:

Explain the origins of the GeoDesign framework and reflect on the degree to which its current conception makes is fit to address complex design problems in the 21st century.

2. Discuss, critically, the systems approach and how the latest geospatial technologies can support spatial data management, analysis and visualisation of system performance and system interactions;

3. Analyze, critically, the power relations in the GeoDesign process and how geospatial technologies can support the capturing of different cultural, political and technical perspectives of the stakeholders on the spatial problem at hand;

4. Process in a reflective manner the feedback derived from both quantitative impact modelling and qualitative cultural, disciplinary and technological knowledge and prepare appropriate visualisations as input for multi-stakeholder design and decision making;

5. Operate collaborative software and web services to facilitate multi-stakeholder design and decision making with quantitative and qualitative spatial information.

6. Explain the legal, sustainability, ethical and professional issues that using Geodesign methods provoke.

CURRICULUM OUTLINE

"Geodesign [is] an iterative design and planning method whereby an emerging solution is influenced by (scientific) geospatial knowledge derived from geospatial technologies." (Lee, Dias and Scholten 2014). The concept of Geodesign enables us to harness the power of GIS to design and develop with nature and geography in mind to create a better and more sustainable world (Miller, 2010). Geodesign does not only apply to landscape architects and spatial planners, but all stakeholders that are involved in shaping the future environment. The Geodesign framework supports the effective collaboration between four groups of participants in community-based spatial planning and design: people of the place, design professionals, spatial scientists and information technology experts.

GIS has the capabilities to support the GeoDesign team to collaboratively develop the best sustainable spatial outcome, taking all available aspects and values into account. GIS professionals can build on the geospatial data that can be gathered for a particular Geodesign study area and the data management, analysis, visualisation and sketching capabilities of geospatial technologies.

The module on Geodesign seeks to train GIS professionals, to act as the information technology experts in the Geodesign process. The module encompasses an explanation of the concept and the framework and where these came from, highlighting the four domains that are involved. Subsequently all aspects of Geodesign are discussed with a specific focus on how geospatial technology and methods can support the process.

TEACHING AND LEARNING STRATEGIES

The learning and teaching strategies are student-centred and based on e-learning. They aim to encourage a deep-learning approach by using reflection and self-evaluation.

Each lesson on the e-learning platform will comprise an introductory text identifying the lesson's learning objectives and its contributions to the module learning outcomes, a short video lecture setting the context and introducing the core concepts and links to academic and professional readings.

Students will be required to reflect on their learning as part of self-assessment exercises and assignments assessed by the teaching staff. Online interactions with teaching staff and fellow students, including peer review exercises will provide opportunities for deepening learning and reflection.

ASSESSMENT STRATEGIES

TAA1. Geodesign case study review (50%) (1500 words)
The student can select a recently implemented and reported spatial planning and design project that was supported by geospatial technologies and review the design process and the application of geospatial technologies in particular.

TAA2. Practical assignments (50%) (1200 words)
For a given Geodesign case, the student prepares value maps that capture the different cultural, political and technical perspectives of the stakeholders on the spatial problem at hand and reflects on the choices made in the data acquisition, analysis and visualization.

INDICATIVE STUDENT AND LEARNING RESOURCES

The primary resource will be the Directed Reader supplemented by a mixture of academic journal and professional references.
See the online module for more information on the primary and recommended reading material.

UNIT CODE NUMBER AND TITLE	**P2-W3 Workshop III: GI(S) and Decision Making**

TUTOR
Eric Koomen, Henk Scholten, and others

CONTRIBUTING DEPARTMENT
Spatial Information Laboratory (SPINlab), Department of Spatial Economics, School of Business and Economics, VU

PREREQUISITES
Modules P1-01, P1-02, P1-03 and P1-04. Further, both 5 ECTS core-modules from any the Diploma-part of the Programme

AIMS
- Application of parts of the theory from all modules in a coordinated team exercise
- To create a better understanding of the role and possibilities of GIS in decision making processes
- Develop oral communication and negotiation skills using your GIS knowledge
- Foster student contact

INTENDED LEARNING OUTCOMES

On completion of this unit students should be able to:

ACADEMIC & RESEARCH SKILLS

i. adequately analyse, interpret and critically examine his/her own research results and those of others

BRIDGING THEORY AND PRACTISE: THEORY

ii. analyse how spatial data models are used in the representation of geographical phenomena

BRIDGING THEORY AND PRACTISE: APPLICATION

iii. apply geo-information solutions to a complex geospatial problem using technology, data and methods
iv. develop appropriate advice from the results of a geo-information solution
v. design a model to represent a complex geospatial problem

PROFESSIONAL/SOCIAL SKILLS

vi. present and justify the results of own analyses verbally to professionals

BROADEN YOUR HORIZON

vii. explain the limitations of geo/information science
viii. distinguish between a generic GI-science solution and the specific requirements arising form the international or social context of a given problem.

WORKSHOP CONTENTS

- Pre-workshop preparation
- Lectures
- Presentation by guest speakers
- Excursion
- Exercises
- Presentation of workshop exercise by students

INDICATIVE TEACHING AND LEARNING ACTIVITIES (Hours for the Unit):

Directed Reading:	Practical/	Seminar/ Tutorial:	Student Centred Learning:	Total Student effort:
6	1	8		28

ADDITIONAL NOTES AND COMMENTS	This workshop is part of the UNIGIS Annual Conference.

ASSESSMENT CRITERIA FOR UNIT/ELEMENTS OF ASSESSMENT

Assignment 1. Embracing the Git-based workflow

The student is asked to manage and document their workflow and progress through the module's assignment in the Version Control System Git and to sync it with their online account at GitLab.

Deliverables: an up-to-date GitLab project/repository that contains the latest version of the student's work a history of the project dating back to its inception.

Assignment 2. Visualising rural vs. urban population

The student is asked to create an interactive geospatial visualization of the ratio of people living in cities vs. people living in rural areas based on Dutch open data.

In the first part of the assignment, the student is expected to locate and obtain the required data, transform and processed it as needed for the envisioned spatial analysis. The second part involves the creation of interactive and compelling visualization of the outcomes from the first part.

Deliverables: a functioning web application, its source code and a short reflection on the taken path that discusses the 1) strengths/weaknesses of the geospatial analysis and 2) the strengths/weaknesses of the chosen online delivery method.

INDICATIVE STUDENT LEARNING RESOURCES The primary resource will be the Directed Reader supplemented by a mixture of academic journal and professional references. See the online module for more information on the primary and recommended reading material.

2.5.3 Master of Science in GIS (MSc)

UNIT CODE NUMBER AND TITLE	**P3-MSc MSc Proposal and Thesis**		
HOME PROGRAMME	PgC/PgD/MSc by Distance Learning GIS Network		
HOME DEPARTMENT	Department of Spatial Economics, Vrije Universiteit Amsterdam		
UNIT LEADER(S)	Niels van Manen		
CREDIT VALUE	22		
STUDENT EFFORT (HOURS)	616	CLASS CONTACT TIME (HOURS)	Directed Learning 8 hrs (Optional Workshop)
UNIT STATUS	MANDATORY CORE: MSc GIS; MSc GI Science; MSc GIS and Management; MSc GIS and Environment.		
PRE-REQUISITES	PgD completed		

UNIT LEARNING OUTCOMES

On completion of this unit, students should be able to:

ACADEMIC & RESEARCH SKILLS

- Can demonstrate knowledge of the different phases of spatial research and analysis;
- Can formulate adequate problem statements and research questions and indicate which geo-information solutions can be used to solve the issues.
- Can individually identify relevant academic and professional literature, and assess its quality.
- Can determine which geo-information methods can be used to solve an issues.
- Can evaluate the moral and ethical dimensions of scientific knowledge and its application.
- Can individually identify relevant data and determine data quality
- Can independently set up, prepare, carry out a GIS analysis
- Can adequately analyse, interpret and critically examine his/her own research results and those of others

BRIDGING THEORY AND PRACTISE: THEORY

- Can demonstrate theoretical and methodological knowledge of the relevant concepts in Geographical Information Science from different perspectives (technical, geographical, organisational).
- Can explain the limitations of theoretical and technical state-of-the art-in GI science.

BRIDGING THEORY AND PRACTISE: APPLICATION

- Can apply geo-information solutions to a complex geospatial problem using technology, data and methods
- Can develop appropriate advice from the results of a geo-information solution
- Can design a model to represent a complex geospatial problem

PROFESSIONAL/SOCIAL SKILLS

- Can present and justify the results of own analyses verbally to professionals
- Can present and justify the results of own analyses verbally to non-experts
- Can present the results of own analyses on paper to professionals

BROADEN YOUR HORIZON

- Can explain the limitations of geo/information science
- Can explain the relevance of the field of Geographical Information Science in to developments in other domains
- Can distinguish between a generic GI-science solution and the specific requirements arising from the international or social context of a given problem

SELF-AWARENESS

- Can critically assess the limitations of his/her own expertise
- Can develop a personal learning strategy in line with the “life-long-learning” concept.

CURRICULUM OUTLINE

This unit aims to enable students to design and execute an original/ independent study in their field of GIS and in doing so to develop an in-depth knowledge of the relevant GIS literature and research activities in that field.

Applicable to the award undertaken – the project outline will demonstrate the appropriateness to the philosophy of the award. Students will be required to consider the planning of their research programme, time management, health and safety and ethical considerations and the project outline will also require evidence of researching the literature. Guidance on the presentation of the dissertation will be provided.

TEACHING AND LEARNING STRATEGIES

The MSc project is student directed. The preparative programme/workshop will examine the whole process for the MSc project from problem definition to dissertation writing. This will be integrated with the assessments which will ensure (a) appropriate aims and objectives for the research project; (b) effective literature use and presentation of the project outcomes. An optional workshop covering these issues will be held at the beginning of the MSc stage but all students will be issued with a MSc guide covering this material.

ASSESSMENT STRATEGIES

There will be two unequal assessments; a project outline (10%) which examines their research design and the MSc Dissertation (90%) which examines implementation, 'data gathering', analysis and presentation.

ASSESSMENT CRITERIA FOR UNIT/ELEMENTS OF ASSESSMENT

Assessment 1 Project Outline (10%) (2000 words)

Students will be assessed on how well formulated the research /problem statement is, including aims and objectives, risk/safety assessments and ethical considerations.

Assessment 2 MSc Dissertation (90%) (15,000 max words)
Assessment is based on the critical review of the research question and the literature; implementation, analysis and presentation of research in the dissertation.

INDICATIVE STUDENT LEARNING RESOURCES

The primary resources will be the directed student reader covering the undertaking of MSc projects and an MSc workshop (Study Guide part III). These will be supplemented by a mixture of academic journal references, on-line material and texts.

Appendix I - Assessment plan 2019-2020

SBE ASSESSMENT PLAN

MSc Geographical Information Sciences

2019-2020

Assurance of Learning: Assessment

Content

Version January 2018

Introduction

In the past years the government puts more emphasis on the quality and quality assurance of exams and theses. Since 2011 the quality and quality assurance of assessment take a more prominent place in the (Dutch) Higher Education And Research Act (WHW). The quality assurance of assessment has explicitly become a responsibility of the Examination Board. From 2011 the accreditation framework emphasises the quality of assessment, a programme that scores unsatisfactory on this topic will not be accredited. In the revised accreditation framework (2014) assessment quality is split into two standards, Assessment and Realised Learning Objectives. Both standards have to score satisfactory to have a program accredited.

The Vrije Universiteit has translated the emphasis on assessment quality in the Quality Assurance Handbook, chapter Assessment Policy (last revised in 2017). This document states that all faculties must have an Assessment Policy and all programs must have an Assessment Plan. These Assessment Plans give program management, examination board and faculty more insight into the assessment quality.

Based on the chapter Assessment Policy of the Quality Assurance Handbook the School of Business and Economics has formulated an assessment policy in 2012. The assessment policy describes the roles and responsibilities of all stakeholders of the assessment process based on the quality assurance cycle of the faculty (Plan-Do-Check-Act, see figure 1). Drawing up an assessment plan by the program director is part of the quality assurance cycle.

This is the assessment plan of the Master's programme Geographical Information Sciences. The assessment plan aims to:

a. clarify the vision behind and the way of assessment,
b. clarify how the program ensures that students attain the learning objectives, and
c. give insight in the faculty's quality assurance and improvement of assessment.

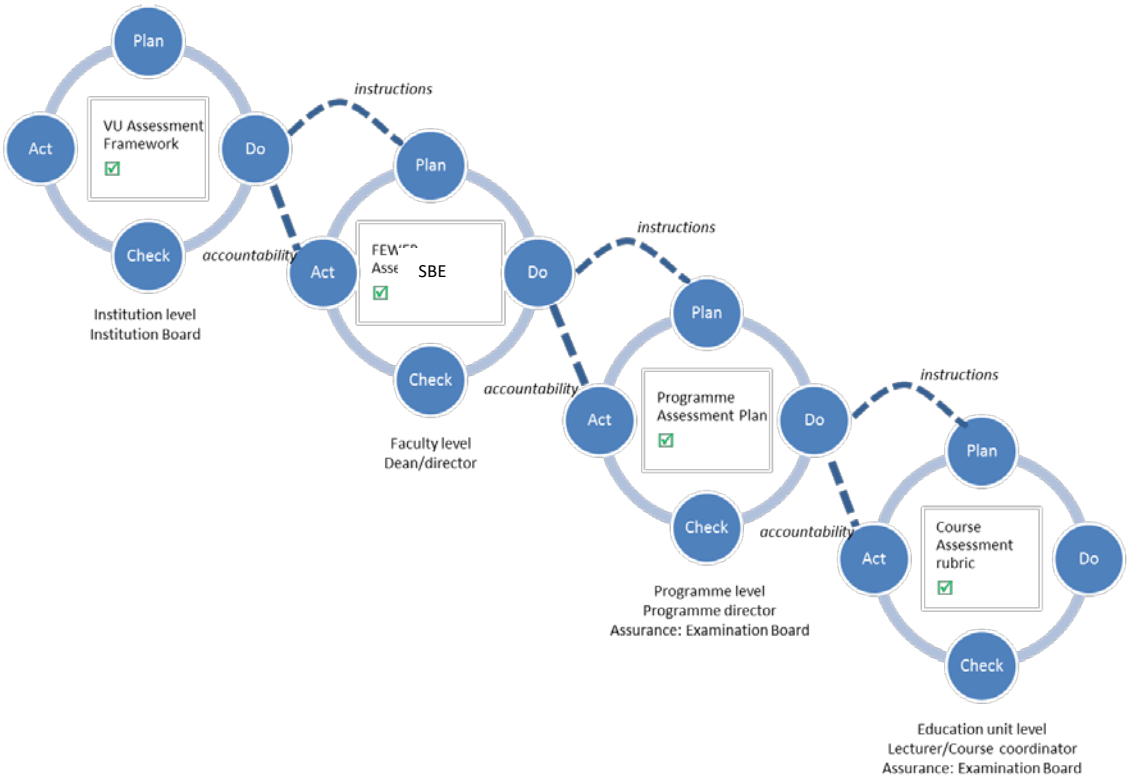


Figure 1: Quality assessment cycle

1 Educational and assessment vision

1.1 Educational vision

The educational vision of the Vrije Universiteit reflects the academic culture which is characterised by three core values: *Personal*, *Open* and *Responsible*. The faculty has given substance to the VU vision by formulating our objectives for both education and research along two dimensions. The first dimension is the behavioural component which is strongly rooted in the core values of the Vrije Universiteit: *Responsible, Personal*, and *Open*. In addition SBE defined a content component, elaborating on the knowledge and expertise of the three key roles of our graduates and staff, namely that of the *Academic*, *Professional* and *Citizen*. Attention to this behavioural component and content component is reflected in all SBE's educational and research programs, differentiated based on the character of the various programs. Students are assessed on both the behavioural as well as the content component at several occasions. See for an elaboration of the vision of education sbe.vu.nl ---> education.

1.2 Assessment vision

Based on the VU assessment framework, faculty assessment policy, academic and examination regulations and the rules and guidelines of the examination board the faculty has formulated the following quality requirements:

Programme level

- Each programme has well described learning goals and levels of qualifications (Dublin Descriptors).
- Each programme has an assessment plan with attention for curricular learning paths.
- Assessment is such that it becomes clear in the first phase of the programme if the student will be able to successfully complete the program.

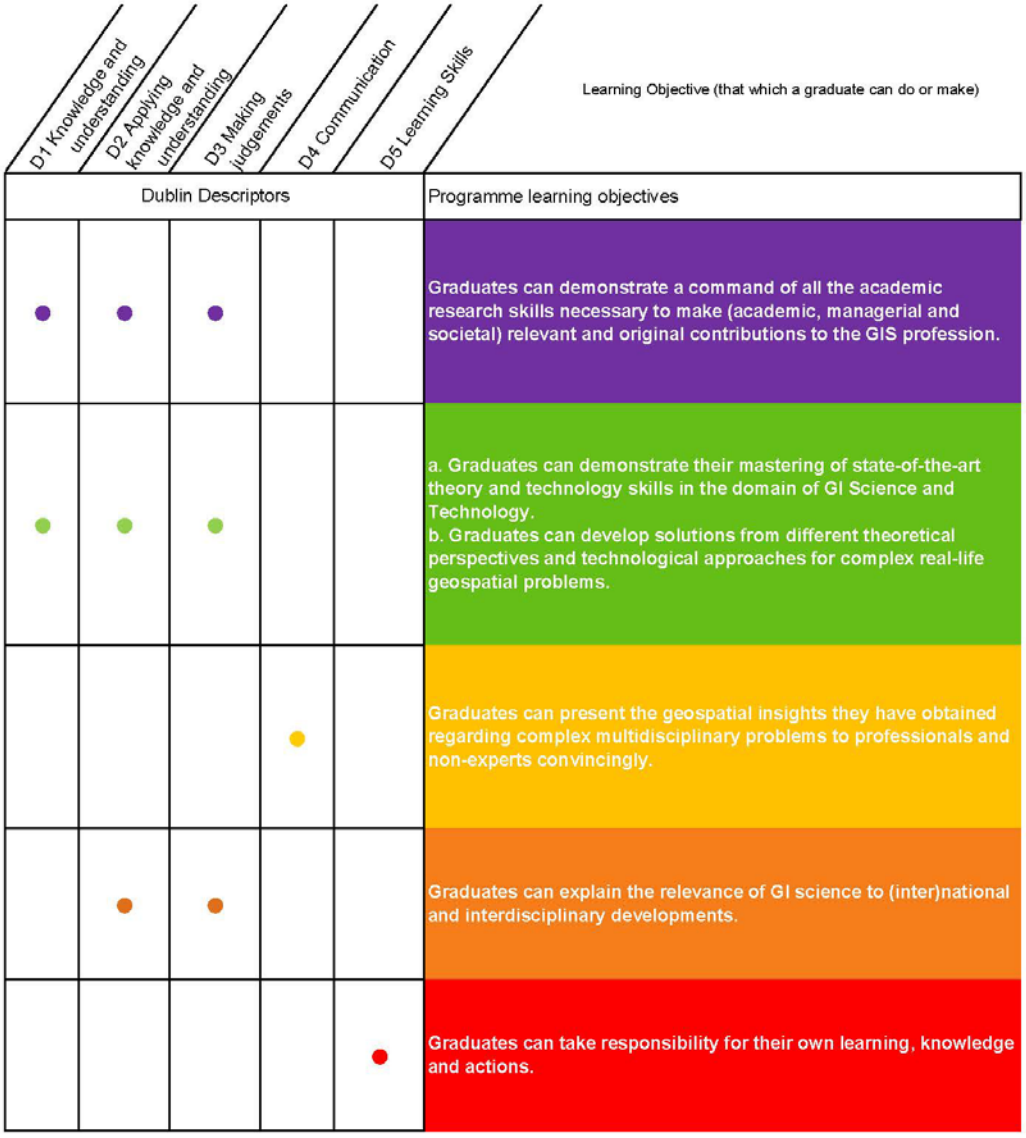
Course level

- Each course has learning objectives that reflect the program learning objectives.
- Assessment types are consistent with learning objectives and education methods.
- Each test has an assessment rubric.
- Each test has a scoring guide, standards and pass mark.
- Test results are analysed.
- Each test meets the quality criteria of validity, reliability and transparency.
- The examiners are competent in constructing, executing, assessing and analysing tests.

2 Assessment plan

2.1 Learning Objectives MSc Geographical Information Sciences

MSc GEOGRAPHICAL INFORMATION SCIENCES LEARNING OBJECTIVES



2.2 Curriculum Map MSc Geographical Information Sciences

MSc GEOGRAPHICAL INFORMATION SCIENCE CURRICULUM MAP

		Year 1 - Postgraduate Certificate					Year 2 - Postgraduate Diploma									
		Core module: Advanced GIS	Core module: Database Theory	Core module: Geodata Capture, Standards and Quality	Core module: Research Methods	Core module: Workshop Spatial Analysis and Decision Support	Specialisation module: GIS in Organisations	Specialisation module: GIS Project Management	Specialisation module: GIS and Modelling	Specialisation module: Databases for Enterprise GIS	Specialisation module: Environmental Impact Assessment and GIS	Specialisation module: Remote Sensing Applications for GIS	Elective module: Internet GIS	Elective module: European Aspects of GIS	Workshop Spatial Modelling and Decision Support	Research Proposal and Thesis
ACADEMIC & RESEARCH SKILLS	i. Graduates can demonstrate a command of all the academic research skills necessary to make (academic, managerial and societal) relevant and original contributions to the GIS profession.	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
BRIDGING THEORY AND PRACTISE Theory	ii. Graduates can demonstrate their mastering of state-of-the-art theory and technology skills in the domain of GI Science and Technology.	●	●		○	●	●	●	●	●	●	●	○	●	●	
BRIDGING THEORY AND PRACTISE Application	iii. Graduates can develop solutions from different theoretical perspectives and technological approaches for complex real-life geospatial problems.	●	●	●	○	●	●	●	●	●	●	●	●	○		
PROFESSIONAL/SOCIAL SKILLS	iv. Graduates can present the geospatial insights they have obtained regarding complex multidisciplinary problems to professionals and non-experts convincingly.	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
BROADENING YOUR HORIZON	v. Graduates can explain the relevance of GI science to (inter)national and interdisciplinary developments.	●	○		○	●	○	○	○	○	○	○	○	○	●	
SELF-AWARENESS	vi. Graduates can take responsibility for their own learning, knowledge and actions.	○				○	i						●		○	

Legend

○	taught
●	taught and assessed
	assessed at final level

2.3 Program Learning Objectives, Course Learning Objectives and assessment types

MSc GEOGRAPHICAL INFORMATION SCIENCE EXAMINATION TYPES

Legend CI: Case/Paper Individual ES: Essay Individual PR: Presentation RP: Research Project	Demonstrate a command of all the academic research skills necessary to make (academic, managerial and societal) relevant and original contributions to the GIS profession.	Demonstrate mastering of state-of-the-art theory and technology skills in the domain of GI Science and Technology.	Develop solutions from different theoretical perspectives and technological approaches for complex real-life geospatial problems.	Present the geospatial insights obtained regarding complex multidisciplinary problems to professionals and non-experts convincingly.	Explain the relevance of GI science to (inter)national and interdisciplinary developments.	Take responsibility for own learning, knowledge and actions.
Year 1						
Core course: Advanced GIS						
Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text.	CI/ES			CI/ES		
Analyse the changing definitions of GIS/GIScience since the 1960s and what these signify or the development of GIS/GIScience as a field of engineering and science.		ES				
Identify the different components of GIS/GIScience and discussing their linkages.		ES				
Analyse how GIS components have transformed from the early stages when GIS was used as an automated map making technology (1960s) to a widely used spatial decision-making tool (21st century).		ES				
Evaluate how spatial data models are used in the representation of geographical phenomena.		CI				
Explain the purpose, techniques and algorithms of basic spatial operations used in GIS.		CI				
Select the appropriate data in particular applications.			CI			
Evaluate the constraints placed on the use of data by particular data types and models.			CI			
Use GIS software effectively and be able to design and implement appropriate analysis procedures for any given application.			CI			
Appraise for a case study the effectiveness of GIS in supporting decision making, including the impact of the absence/underdevelopment of GIS/GIScience components in the case study.					ES/ CI	
Core course: Database Theory						
Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text.	CI/ES			CI/ES		
Critically assess the limitations of conventional database structures as a means of storing spatial data.		ES				
Decide when relational database management systems are not fit for a purpose (e.g. Big Data) and which other DBM systems should be used (e.g. NoSQL).		ES				
Design well formed database models, using appropriate design techniques.			CI			
Implement such designs using relational database software.			CI			
Provide high-quality documentation of the database design (process) and its implementation.			CI			
Use high-quality and well-formatted SQL to establish and interrogate databases.			CI			
Core course: Geodata capture, standards and quality						
Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text.	CI/ES			CI/ES		
A knowledge and understanding of the key characteristics of different types of spatial data.		CI/ES				
The ability to assess the impact of national and international data infrastructures and standards on the sourcing and availability of spatial data.		CI				
The ability critically evaluate the potential impacts of errors on spatial data quality.		CI/ES				
The practical skills to design and implement an informed strategy for capturing or sourcing spatial data and associated metadata.			CI			
The knowledge to specify fitness for purpose criteria and apply them to the critical evaluation of spatial data for specific applications.			ES			
Core course: Research methods						
Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text.	CI/ES			CI/ES		
Ability to construct, design, implement and analyse GIS-based research projects.	CI/ES					
Ability to discuss, critically, the range and appropriateness of qualitative and quantitative research methods in GIS and the strengths and weaknesses of the data that they generate.	CI/ES					
Ability to interpret spatial data critically.	CI/ES					
Apply an integrating approach, including ethical and professional practice considerations, to designing a GIS based research project.	CI					
Workshop Spatial Modelling and Decision Support						
Adequately analyse, interpret and critically examine his/her own research results and those of others.	PR					
Analyse how spatial data models are used in the representation of geographical phenomena.		PR				
Apply geo-information solutions to a complex geospatial problem using technology, data and methods			PR			
Develop appropriate advice from the results of a geo-information solution.			PR			
Present and justify the results of own analyses verbally to professionals.				PR		
Distinguish between a generic GI-science solution and the specific requirements arising form the international or social context of a given problem.					PR	

Legend CI: Case/Paper Individual ES: Essay Individual PR: Presentation RP: Research Project	Demonstrate a command of all the academic research skills necessary to make (academic, managerial and societal) relevant and original contributions to the GIS profession.	Demonstrate mastering of state-of-the-art theory and technology skills in the domain of GI Science and Technology.	Develop solutions from different theoretical perspectives and technological approaches for complex real-life geospatial problems.	Present the geospatial insights obtained regarding complex multidisciplinary problems to professionals and non-experts convincingly.	Explain the relevance of GI science to (inter)national and interdisciplinary developments.	Take responsibility for own learning, knowledge and actions.
Year 2						
Specialisation course: GIS in Organisations						
Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text.	CI/ES			CI/ES		
Critically assess your own approach to the GI case study with the methodologies presented.	CI					
Discuss, critically, the importance of Information Systems Development methods (ISDMs) as a guide to developing successful information systems.		CI				
Critically analyse the importance of organisational issues in Geographical Information Systems application and development.		ES				
Explain the legal, ethical and/or professional issues that using GIS within and between organisations provoke.		ES				
Use Soft Systems Analysis (SSA) /Multiview to structure/ model problem situations (including the GI and other domains involved) and collect and analyse information systems requirements.			CI			
Specialisation course: GIS Project Management						
Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text.	ES/CI			ES/CI		
Independent identification of relevant academic literature related to GIS project management methodologies and their application.	ES/CI					
Identify and critically analyse the issues involved in organising, planning, monitoring and controlling a GIS project.		CI				
Review current GIS Project Management methodologies and appraise their effectiveness and adaptation to managing different types of GIS projects.			ES			
Review current GIS Project Management methodologies and discuss the role, significance and impact of people in a project management setting and evaluate and implement strategies for managing people.			ES			
Initiate a small scale GIS project, by developing project plans and financial budgets, assessing project costs and benefits, developing investment appraisal methods and using authorisation, monitoring and controlling processes.			CI			
Specialisation course: GIS and Modelling						
Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text.	CI/ES			CI/ES		
Explain and critically evaluate the three methodologies for spatial modelling (external, hybrid and full GIS) and evaluate which one is most suitable for environmental modelling.		ES				
Analyse how different studies have applied your chosen methodology for spatial modelling and evaluate why this was or was not the correct methodology.		ES				
Evaluate what changes need to be made to one of the methodologies for spatial modelling (external, hybrid and full GIS) to maximise its applicability to spatial environmental modelling situations.		ES				
Investigate all relevant parameters that influence environmental processes for a specific geospatial case study and visualize them in a mindmap.			CI			
Assess which parameters can and should be included in a spatial environmental model for a specific geospatial case study and design a model.			CI			
Implement a spatial environmental model and evaluate the results, discussing how your modelling choices influence your results and conclusions.			CI			
Specialisation course: Databases for Enterprise GIS						
Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text.	CI/ES			CI/ES		
Critically assess the organisational benefits and challenges of developing 'Enterprise GIS' systems.		ES				
Evaluate the advantages and disadvantages of holding geographical data in ORDBMS.		ES				
Critically discuss the importance of OGC and SQL99 spatial/MM.		ES				
Implement a simple geo-database, using a spatial extended ORDBMS.			CI			
Provide high-quality documentation of the database design (process) and its implementation.			CI			
Specialisation course: Environmental Impact Assessment and GIS						
Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text.	CI/ES			CI/ES		
Demonstrate a competent knowledge of the critical parameters that contribute to a successful GIS-based environmental impact assessment model.		CI				
Define, describe and critically analyse the EIA process in a chosen case study.			ES			
Identify the interaction and integration of social and environmental assessments in a specific case study.			ES			
Evaluate recent trends and future prospects for the application of GIS in social and environmental assessments.				ES		
Specialisation course: Remote Sensing Applications for GIS						
Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text.	CI/ES			CI/ES		
Explain the principles of remote sensing and evaluate the strengths and weakness of data from different remote sensing systems.		CI/ES				
Discuss, critically, the principles of information extraction from remotely sensed data.		CI/ES				
Generate environmental information from remotely sensed data and appreciate the importance of selecting data appropriate for a given task.			CI			
Critically evaluate methods for integrating remotely sensed data with GIS for a specific case study.			ES			

Legend CI: Case/Paper Individual ES: Essay Individual PR: Presentation RP: Research Project	Demonstrate a command of all the academic research skills necessary to make (academic, managerial and societal) relevant and original contributions to the GIS profession.	Demonstrate mastering of state-of-the-art theory and technology skills in the domain of GI Science and Technology.	Develop solutions from different theoretical perspectives and technological approaches for complex real-life geospatial problems.	Present the geospatial insights obtained regarding complex multidisciplinary problems to professionals and non-experts convincingly.	Explain the relevance of GI science to (inter)national and interdisciplinary developments.	Take responsibility for own learning, knowledge and actions.
Workshop Spatial Modelling and Decision Support						
Adequately analyse, interpret and critically examine his/her own research results and those of others.	PR					
Analyse how spatial data models are used in the representation of geographical phenomena.		PR				
Apply geo-information solutions to a complex geospatial problem using technology, data and methods			PR			
Develop appropriate advice from the results of a geo-information solution.			PR			
Design a model to represent a complex geospatial problem.			PR			
Present and justify the results of own analyses verbally to professionals.				PR		
Explain the limitations of geo/information science.					PR	
Distinguish between a generic GI-science solution and the specific requirements arising form the international or social context of a given problem.					PR	
Elective course: Internet GIS						
Independently set up, prepare and carry out a code-driven GIS analysis in an effective and repeatable (= collaborator friendly and well-documented) way.	CI/ES					
Demonstrate knowledge of the different phases, components and best-practices of code-driven spatial research and analysis.	CI/ES					
develop online and interactive geo-information solutions (applications, visualisations) to complex geospatial problems.			ES			
Access and prepare spatial data and information from various online/offline, structured/unstructured, official/non-official sources to enable an integrated, repeatable and reusable solution to a complex geospatial problem.			ES			
Interact with professionals and colleagues on online open/closed (collaborative) platforms to present the applied workflow and results of analyses.				CI		
Critically assess the limitations of his/her own expertise and solutions.						ES
Work independently and professionally (i.e. produces traceable and repeatable work that can easily be reused by others).						CI
Elective course: European Aspects of GIS						
Write and communicate appropriately at postgraduate level through key skills such as literature searching, developing and presenting a coherent argument and correctly citing references in the text.	ES			ES		
Justify why there is a need for international geospatial information at various scales.		ES				
Explain the problems associated with crossing borders in European Datasets.		ES				
Describe which European datasets are available and which initiatives are in place to create missing datasets.		ES				
Locate and combine geographical data in Europe and demonstrate knowledge about data catalogues, spatial reference systems, metadata and standards.		ES				
Explain which technological developments are taking place in the European GI-field and what their impact on the European GIS community might be.		ES				
Explain what is necessary to set up a Geographical Information Infrastructure (GII) in Europe		ES				
Evaluate which problems and issues are faced in setting up a European GII and what has already been done in realizing a common infrastructure.		ES				
Explain how can the GI community make a European GII work.		ES				
Year 3						
Research proposal and Thesis						
Demonstrate knowledge of the different phases of spatial research and analysis.	RP					
Formulate adequate problem statements and research questions and indicate which geo-information solutions can be used to solve the issues.	RP					
Individually identify relevant academic and professional literature, and assess its quality.	RP					
Determine which geo-information methods can be used to solve an issues.	RP					
Evaluate the moral and ethical dimensions of scientific knowledge and its application.	RP					
Individually identify relevant data and determine data quality	RP					
Independently set up, prepare, carry out a GIS analysis	RP					
Adequately analyse, interpret and critically examine his/her own research results and those of others	RP					
Demonstrate theoretical and methodological knowledge of the relevant concepts in Geographical Information Science from different perspectives (technical, geographical, organisational).		RP				
Explain the limitations of theoretical and technical state-of-the art-in GI science.		RP				
Apply geo-information solutions to a complex geospatial problem using technology, data and methods			RP			
Develop appropriate advice from the results of a geo-information solution			RP			
Design a model to represent a complex geospatial problem			RP			
Present and justify the results of own analyses verbally to professionals				RP		
Present and justify the results of own analyses verbally to non-experts				RP		
Present the results of own analyses on paper to professionals				RP		
Explain the limitations of geo/information science					RP	
Explain the relevance of the field of Geographical Information Science in to developments in other domains					RP	
Distinguish between a generic GI-science solution and the specific requirements arising from the international or social context of a given problem					RP	
Critically assess the limitations of his/her own expertise						RP
Develop a personal learning strategy in line with the “life-long-learning” concept.						RP

Appendix II – Example of rubrics form

Database Theory – TAA 1								
Section	Criterion	Insufficient (<5.5)	Sufficient (5.5-7)	Good (7-8.5)	Excellent (8.5-10)	Weight	Grade	Comm
Review & Development of Argument	*Description of spatial information, their characteristics, and the challenges which they pose with respect to data management.*	No introduction to spatial information is given or only barely, or an introduction is given but the characteristics and challenges are not explained	An introduction of spatial information is given, but the characteristics and/or challenges are only touched upon	An introduction to spatial information is provided, its core characteristics and challenges are discussed sufficiently, and one or more examples and/or use cases are given.	An excellent introduction to spatial information is provided, various granularities of characteristics and challenges are discussed in depth and indicate an understanding by the author, and one or more examples and/or use cases are given.	0,1	0	
	Evaluation of the shortcomings of the Relational Model within the context of spatial information	The shortcomings are not or only marginally explained	The main shortcomings are presented but not thoroughly discussed or they do not emphasise the context of spatial information. The need for NoSQL is (briefly) discussed.	The main shortcomings wrt spatial information are presented and thoroughly discussed, and the need for NoSQL is discussed and flows naturally from the arguments.	A clear overview of the shortcomings wrt spatial information are presented and thoroughly discussed with the help of one or more use cases. The need for NoSQL is thoroughly discussed and flows naturally from the arguments.	0,2	0	
	Introduction to NoSQL and description of the selected NoSQL paradigms	Less than three paradigms are covered, or more are covered but not or only marginally explained.	Three paradigms are covered and their core properties explained, but no examples or use cases are given.	Three or more paradigms are covered with the help of one or more short examples, and a basic understanding of their principles is shown.	Three or more paradigms are covered in depth, explained using one or more detailed use cases, and a deep understanding of their principles is shown.	0,15	0	
	Evaluation of the advantages and disadvantages of the selected NoSQL paradigms in the context of spatial information	The advantages and disadvantages are not evaluated, or only a list of characteristics or differences is provided.	Core advantages and disadvantages of the selected paradigms are presented but are not discussed or do not emphasise the context of spatial information, or each paradigm is only compared to the Relational Model without taking the other paradigms into account.	Core advantages and disadvantages of the selected paradigms in the context of spatial information are presented and discussed, accompanied by one or more examples, and are compared to all other paradigms	A clear overview of the advantages and disadvantages of the selected paradigms in the context of spatial information is presented, accompanied by an evaluation of the comparison to all other paradigms and by one or more detailed examples and/or use cases per paradigm	0,25	0	
Literature, Citation & Referencing	*Evidence of library search skills,"up-to-date" reading and research and use of peer-reviewed journal papers*	(Hardly) any literature is used.	There is limited use of literature and/ or the chosen literature are not (all) relevant or do not meet academic standards.	There is a considerable range of relevant sources used that meet academic standards.	There is a wide range of relevant and recent sources used including peer-reviewed articles.	0,1	0	
	Use of resources	The essay consist largely of ideas of others (citation or paraphrasing).	There is no separation between own ideas and those of others (citation or paraphrasing).	There is a distinction between own ideas and those of others (citation or paraphrasing).	There is a clear distinction between own ideas and those of others (citation or paraphrasing). The references clearly support the argument.	0,1	0	
Presentation & Structure	*Overall coherence including clarity of Introduction, Conclusion and transition from one section to the next, as well as layout and style*	Poor presentation and confusing structure	Essay structure is fine but presentation is poor	Very well presented and clearly structured essay	Excellent logical structure and high quality presentation	0,05	0	
	Writing style, grammar and spelling	Academic writing skills clearly require considerable development	Academic writing skills require some development	Very well presented and clearly structured essay	Clearly demonstrates understanding and application of the skills required when presenting written academic work	0,05	0	
						Final Grade	0	
						Out of 50 points	0	
Further Remarks						Final Remarks		