Course Syllabus (online)

1. General Information

- **Instructor**: Dr. Arie Croitoru (a.k.a "Dr C")
- **Teaching Assistant**: TBD
- **Where**: online via Blackboard
- **When**: a learning module will be released each week on Wednesday and should be completed by the following Tuesday (11:59pm Eastern time). Due dates of other course activities will be specified separately in the instructions of the activity (see Section 5).
- **Course website**: Blackboard
- **Credits**: 3.0
- **Instructor's Office Hours**:
  - Online: Monday at 5:00pm – 6:00pm via Blackboard Collaborate (your attendance in this session is not mandatory but highly recommended).
  - Face-to-face: Monday, 9:30am - 10:30am, Tuesday at 3:00pm – 4:00pm, or by appointment. My office is located in Exploratory Hall 2205, the Fairfax campus.

- **Contact method**: message board via Blackboard. Messages will typically be answered within 24-36 hours Monday to Friday; messages sent during the weekend will be answered on the following Monday.

2. Course objectives

Imagery has become a primary data source in geospatial applications. From satellite remote sensing to aerial and terrestrial imaging systems and networks, vast amounts of imagery are being collected and utilized in various application areas. The wide variety of imagery data sources are now challenging our ability to manage such data, process it, and derive useful high-level information from it. Motivated by this, the primary objective of the course is to provide a systematic introduction to Digital Image Processing (DIP) techniques and related topics in Remote Sensing (RS) to enable the extraction of spatial and spatiotemporal information from imagery. In particular, the objectives of this course are to:

1. Review basic **ideas** and **theories** of image processing and their relation to earth observations.
2. Introduce **analytical techniques** and **tools** that are used in satellite image analysis.
3. Develop the ability to **apply** these tools in various application areas.
4. Identify and gain **insight** into some of the emerging trends in DIP as

applied to earth image processing.

↕ 3. Learning outcomes

By the end of the course each student will be able to:

1. Have a broad knowledge-base on fundamentals, theory and techniques of Digital Image Processing and Remote Sensing in the context of earth image processing and Geo-Intelligence and other geospatial applications.
2. Articulate and effectively communicate concepts and ideas related to Digital Image Processing and Remote Sensing to both image processing experts, non-experts, and other professionals in a work environment. This objective is particularly important in today's interdisciplinary work environment.
3. Have the ability to appropriately apply the tools, algorithms and concepts covered in the course for various hypothetical and real-world data processing tasks.
4. Given a problem or task, be able to effectively analyze it, identify key elements and potential difficulties, and define a strategy for successfully addressing it.
5. Perform a critical review of the potential, effectiveness, and reliability of Digital Image Processing and Remote Sensing processing processes and outcomes.

↕ 4. Course schedule (tentative)

Please note that this schedule is **tentative** – The course instructor may change this schedule depending on the course needs and the instructor's evaluation of the overall class progress. For up-to-date information on the course schedule please refer to the course website on Blackboard.

* For information on the release and due dates of learning modules and assignments, please see Section 5 of the syllabus

Module Release Date	**Learning Module**	**Test**	**Project Activity**	**Assignment Release***	**Assignment Due***
8/28	(1) Why image processing?				
9/4	(2) The human visual system				
9/11	(3) Image acquisition			1	
9/18	(4) Image resolution and relations between pixels				1
9/25	(5) Gray level	Test 1		2	

	transformations				
10/2	(6) Histogram processing				2
10/9	(7) Spatial filtering / part 1			3	
10/16	(8) Spatial filtering / part 2				3
10/23	(9) Filtering in the frequency domain / part 1			4	
10/30	(10) Filtering in the frequency domain / part 2		Project introduction		4
11/6	(11) Introduction to image morphology	Test 2		5	
11/13	(12) Image morphology algorithms				5
11/20	(13) Introduction to image segmentation				
11/27	*** Thanksgiving Break ***				
12/4	Summary and project presentations		Project submission		

5. Course format

The course will be delivered as a distance-learning course that combines individual review and study of course materials, as well as online synchronous and asynchronous discussions and other interactions. The key building blocks of this course are **learning modules**, which are built around a specific topic in the course. Throughout the semester course activities will be following this schedule:

- Each week a learning module will be released on **Wednesday**. Each module should be completed within one week (unless stated otherwise in the course schedule, see Section 9). If a learning module includes a an assignment it will be released with the module.
- Assignments will be due by **Tuesday** by 11:59pm Eastern Time. Typically one or two weeks will be given to complete the assignment, depending on its scope. The exact due date of each assignment will be indicated in the assignment instructions.
- Each **Monday** at 5:00pm – 6:00pm a Blackboard Collaborate session will be held to discuss any questions or issues. This session is optional, however it is highly recommended that you attend it or review its recording.

- The course discussion board will be monitored every day (with the exception of weekends and university holidays).

↕ 6. Reading materials and video resources

The learning modules in the course will typically include both reading materials (e.g. scientific papers, book chapters, written tutorials, etc.) and short videos that review, explain, or demonstrate various topics. You are required to review all these materials.

Textbooks: The following book is a required textbook for this course: "Digital Image Processing, 4th Edition" by R. C. Gonzalez and R. E. Wood, Prentice-Hall 2018 (ISBN 9780133356724). This book is also available for rent and as an eBook (please refer to the Mason Bookstore, the publisher, or other online retailers for further details).

In addition, during the course we will use supplementary materials from several resources, which are available to you electronically through the Mason library (for additional information and direct links to these resources please visit the "Course textbooks" section under the Syllabus menu item in the course website):

- "Introduction to Video and Image Processing - Building Real Systems and Applications" by Thomas B. Moeslund, Springer-Verlag, 2012 (ISBN 978-1-4471-2502-0).
- "Practical Image and Video Processing Using MATLAB" by Oge Marques, Wiley-IEEE Press, 2011 (ISBN 978-1-1180-9348-1).
- "Remote Sensing Digital Image Analysis – An Introduction" by John Richards, Springer-Verlag, 2015 (ISBN 978-3-642-30062-2).

Other supplementary materials: As the theme of this course is part of a field that is advancing rapidly the course materials will include a combination of selected collection of academic papers, reports and white papers, book chapters, and other online resources. Links to (or instructions on how to obtain) materials that are available online will be made available on the course website according to the course schedule.

↕ 7. Technology Requirements

Please note: for your convenience, the GGS computer lab that is in Exploratory Hall 2202 is available to you for your work in this course. This lab is equipped with high-end PCs and have the software components you will need to participate in this course. Alternatively, you may use your own computer (laptop/desktop) by installing and configuring the necessary software on it. Installing the required software components is relatively easy on most computers for non-expert users. If you choose to configure your own computer for this course please note that we are generally unable to support personal computers or configure your personal computer for you. If you encounter any issues with your personal computer you should contact Mason's ITS for assistance.

Mason's 113 for assistance.

7.1 Hardware

- A Windows, Macintosh, or Linux Intel-based computer with **at least 4 GB of RAM** (having more than 4 GB of ram is highly recommended), and a dual core (or better) processor.
- A dedicated graphics card with at least 2GB of ram is recommended but not required.
- A reliable broadband Internet connection.
- A headset (or ear buds as a minimum). A computer headset with a built-in microphone is highly recommended.
- A microphone. Please note that if you wish to use your computer "built-in" microphone you **must** use a headset.
- A web camera is highly recommended but not required.

7.2 Instructional software

- A supported web browser (See Blackboard Support for supported web browsers)
- Blackboard (Log into http://mymason.gmu.edu, select the Courses Tab)
- Blackboard Collaborate (Select Tools from the Blackboard Course Menu, then select "Blackboard Collaborate")
- Respondus lock-down browser (available through Blackboard)
- Adobe Acrobat Reader (free download)
- A document editing software, such as Microsoft Word (part of Office 365 ProPlus) or OpenOffice
- PDF Creator (optional) - An open source PDF printer (free download)

7.3 Other software

Throughout this course we will use the Matlab software suite as the main tool for data processing. In addition, we may use open source and freely available software packages when possible. The materials of the course are designed to be compatible with Matlab 2018a or later. While we recognize that the topics covered in this course could be implemented in other programming environments exist (e.g. Python, IDL, Java, C/C++, etc.), we will generally not be able to support such programming environments at this time.

Note: If you are using an employer-provided computer or corporate office for class attendance, it is your responsibility to verify with the computer owner that you will be able to install the necessary applications and that any firewalls installed on such a computer will allow you to gain access to all the electronic course content that is posted on Blackboard.

↕ 8. Course expectations

8.1 General requirements

1. This is a graduate-level course in the College of Science that involves some use of mathematical and statistical concepts.

2. The course involves the use of algorithms and computer-based processing tools. During the course, you will be required to develop and demonstrate your understanding of these tools. Some course activities will require you to use and/or write code in a computer environment (i.e. Matlab scripts and functions).
3. Your work should show attention to detail, with the expectation that the experience will provide the basis for potential employers to consider your skills.
4. I expect that you will **review all the assigned materials** in every learning model, including any assigned readings, videos, and other resources. This is essential to your success of this course.
5. You are expected to **actively participate** in the scheduled office hours Collaborate sessions as well as in the course discussions.

8.2 Being a distance learning student

All course related correspondence should be made through the discussion board on course Blackboard website. Please refrain from emailing the instructor or the TA through their @gmu.edu address regarding non-sensitive (or non-personal) matters, as it is very likely that other students would benefit from your questions. If you wish to email the course teaching team directly please include "**GGS680Fa19**" at the beginning of the email subject line.

8.3 Being a distance learning student

Being a distance-learning student is different from being a face-to-face student. Learning online requires self-discipline, time management, and organization since the learning tasks are not set for a specific class hours ? instead the material is formed as a set of learning modules, which students may complete at their own pace. While each one of us may have a different learning style, there are several key themes that you should consider and incorporate as you develop your approach to taking a distance-learning course. In particular:

- Review this syllabus as well as the course website and make sure you have a good understanding of the course expectations.
- Ensure access to the required hardware and software before the semester begins (see the Technical Requirements section below). Not having the necessary hardware and software tools will impact your ability to participate in the course.
- Build a schedule for your learning activities and follow it. Note that while distance-learning course often do not include extensive face-to-face time, you are required to spend time reading materials, completing assignments, and taking exams.
- Take the time to review all of the assigned course materials (videos, written instructions, book chapters, etc.), and keep notes and comments on what you reviewed. Try to identify key themes and strive to develop a thorough understanding of them.
- Complete assignments on time and submit all assignments. While this is true for both face-to-face and online courses, in a distance learning course it is sometimes more difficult to notice that you are missing work. Keeping in touch with the course instructor and your peers can help with this.
- Keep track of all the important dates of the course (assignment due dates, exam dates, etc.), as well as the completion time of each learning module.
- Participate in face-to-face or synchronous online sessions as much as possible, and attend face-to-face office hours as necessary. While the course is offered online, you should seek opportunity to interact with the teaching team and other students as much as possible.

Such interactions could make a big difference in your learning experience.

A key factor in your success as a distance-learning student is being proactive and self-aware. Like any other learning experience, distance learning requires you to be responsible for your own learning experience. As most of the learning is done individually, it is often easy to overlook important details or even miss key ideas in the material. This is why it is essential that you keep in touch with the class and with the instructor, and seek feedback on your progress and work. Throughout the course you will have several ways accomplish this:

- **The Discussion Board**: the course discussion board on blackboard contains several discussion themes. Post any questions or feedback in the board.
- **Online Virtual Class Meeting**: during the semester we will hold virtual class meetings via blackboard Collaborate. This is a great opportunity to ask any questions you might have, learn from the questions of others, and interact with both the instructors and students.
- **Face-to-face office Hours**: we hold weekly office hours, as indicated above. You are welcome to drop in during these office hours. If these times are not convenient for you, please contact me to schedule a spate appointment.

The benefit you will gain from any of these options, however, depends on how proactive you are with respect to seeking interaction, feedback, or help. Your success in the course, especially if this is your first distance learning experience, depends on how proactive you are in identifying any issues you have and seeking feedback.

In addition, the course instructor will send students **announcements and updates** via the blackboard announcements tool. Often you will receive these messages as emails to your Mason email account. Please do not ignore these messages ? it is your responsibility to check your Mason email account and the course website several times during the week.

Another important resource that could contribute significantly to your success is the **class community**. If you have questions about a course topic, it?s likely that some students in your class could help, and sometimes simply discussing the topic with a fellow student will help you understand it better. This is why it is important that you establish from early on some connections with other students, participate in discussions in one of the class forums, and form study groups.

When communicating with your peers (and your instructor) it is important to **be respectful** of one another. Please be aware that innocent remarks can be easily misconstrued, and that sarcasm and humor can be easily taken out of context. When communicating, please try to be positive and offer **constructive feedback**.

↕ 9. Assessment

Your assessment in this course includes several interrelated components as described below.

9.1 Assignments

The course will include several mandatory assignments on selected topics from the material covered in class and in the assigned reading. Assignments may include tasks such as (but are not limited to) code implementation, data analyses, analysis of processing results, and discussion/review of theoretical concepts and test cases. Generally, each assignment will have a different weight in the overall assignments component of the course grade, and the weight of each assignment will be provided in the assignment instructions. Typically, one week will be allocated for every assignment. Submission of assignments should be done only through the Blackboard course website. Unless noted otherwise, we will only grade assignments that are submitted through the "Assignments" section of the Blackboard system. Submission of assignments should be done only through the Blackboard course website. Please do no email assignments directly to the instructor's @gmu.edu or through their Blackboard email.

Please note: Deferral of course work is a privilege and not a right; there is no guarantee that a deferral will be granted. Please notify the instructor or the teaching assistant in writing as soon as you know you would like to request a deferral.

Late submission Policy: assignments submitted between 1 to 3 calendar days past the due date would result in a late penalty of 3 points per day. As a general rule, labs submitted after more than 3 days will not be accepted and incomplete lab work may not be completed after the due date. Exceptions to this policy may be made on a case-by-case basis at the discretion of the Instructor. Deferral of course work is a privilege and not a right; there is no guarantee that a deferral will be granted. Please make sure you notify the instructor as soon as you know you would like to request a deferral.

9.2 Tests

The course will include two tests that will be delivered through Blackboard. The material covered in the exam will be announced in advance. Generally, all test dates are firm, and exceptions to the test dates (e.g., test “make-up” dates) will not be made. A student who cannot take a course examination because of an incapacitating illness, severe domestic affliction or other compelling reasons can apply for extension of time to complete an assignment. Generally, exceptions to the exam date will not be made.

Please note: Deferral of a test is a privilege and not a right; there is no guarantee that a deferral will be granted. Please notify the instructor in writing as soon as you know you would like to request a deferral.

9.3 Mini-Project

The goal of the course mini project is to bridge theory and practice by providing you the opportunity to gain hands-on experience with implementing digital image analysis methods on real-world data. The mini project will be individual, and will include a written report and a video presentation of the project. Specific instructions on the format of the project components and timeline for submitting it will be provided separately.

9.4 Course grades

Each grade component will be given a numerical grade on a 0-100 scale. Some assignments may include bonus tasks. At the end of the term all the marks will be totaled as a **weighted average** according to the following weights:

- **Assignments: 45%**
- **Tests (10% x 2): 20%**
- **Course mini-project: 25%**
- **Active participation: (10%)**

Final grades at the end of the course will be assigned using a combination of absolute achievements and relative standing in the class.

↕ 10. Other important dates

In addition to the course schedule outlined in this syllabus, please refer to Mason's academic calendar for information on important dates and follow Mason's announcements on any calendar changes during the semester. The Fall 2019 Mason calendar is available at https://registrar.gmu.edu/calendars . In case of any discrepancy between the Mason calendar and the course schedule in the syllabus the Mason calendar shall prevail.

↕ 11. Student expectations

11.1 Academic Integrity

George Mason University is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the GMU honor code . [See http://oai.gmu.edu].

11.2 Honor Code

Students must adhere to the guidelines of the George Mason University Honor Code [See https://oai.gmu.edu/mason-honor-code/].

11.3 MasonLive/Email (GMU Email)

Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account. [See http://mail.gmu.edu/].

11.4 Patriot Pass

Access to Mason's online system is done through a personal username and password known as the Patriot Pass. Once you sign up for your Patriot Pass, your passwords will be synchronized, and you will use your Patriot Pass username and password to log in to the following systems: Blackboard, University Libraries, MasonLive, myMason, Patriot Web, Virtual Computing Lab, and WEMS. [See https://password.gmu.edu/index.jsp , this link also enables you to reset your password].

11.5 Responsible Use of Computing

Students must follow the university policy for Responsible Use of Computing. [See http://universitypolicy.gmu.edu/policies/responsible-use-of-computing/].

11.6 Students with Disabilities

Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester [See http://ods.gmu.edu]. Please be proactive and let me know how I can help you with any disability issue so that I could provide the best learning environment for your specific needs.

↕ 12. Student services

12.1 University Libraries

University Libraries provides resources for distance students. [See http://library.gmu.edu].

12.2 Writing Center

The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing. [See http://writingcenter.gmu.edu]. You can now sign up for an Online Writing Lab (OWL) session as well as face-to-face session in the Writing Center (see the Tutoring section in the link above).

12.3 Counseling and Psychological Services

The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See http://caps.gmu.edu].

12.4 Family Educational Rights and Privacy Act (FERPA)

The Family Educational Rights and Privacy Act of 1974 (FERPA), also known as the "Buckley Amendment," is a federal law that gives protection to student educational records and provides students with certain rights. [See http://registrar.gmu.edu/privacy].

12.5 Student Services

In addition to the services noted here, Mason offers students a wide range of great academic and personal support and development services. Additional information about these services can be found at the Stearns Center for Teaching and Learning website.

↕ Disclaimer and copyright

Any typographical errors in this Course Outline are subject to change and will be announced in class. The date of the final examination is set by the Registrar and takes precedence over the final examination date reported by the instructor.

Notice: Recording of any kind (audio, video), reuse or remix of course materials, and further dissemination of the course content is not permitted unless prior written consent of the professor and George Mason University has been given or if recording is part of an approved accommodation plan.