Syllabus for Image Analysis and Recognition with Learning
Fall 2025 Math569,
Cross listed with MATH 569.4RE-7RE and CSCI 569.1SE
Meets 8/25/2025 through 12/12/2025, Day and Time: TTH 5PM-6:15PM, Bin 326

Instructor:	Dr. Nikolay Metodiev Sirakov	**Office:**	Bin 322
Office Hours:	M W 3:30PM- 5PM	**E-mail:**	Nikolay.Sirakov@tamuc.edu
	T Th 4PM- 5PM	**Office Phone:**	903 886 5943
	Others by appointment	**Office Fax:**	903 886 5945
	Friday research meetings		

You may find supporting image processing lectures through the link:
http://faculty.tamuc.edu/nsirakov/Teaching/Image%20Processing%20With%20Applications.aspx
Additional materials on Machine Learning will be given during the study.

Text: Digital Image Processing, 3rd Edition, by Rafael C. Gonzalez, Richard E. Woods, Prentice Hull, 2008, 0-13-168728-x, 978-0-13-168728-8
Helpful Text: Linear Algebra and Optimization for Machine Learning, ISBN 978-3-030-40343-0 ISBN 978-3-030-40344-7 (eBook), ©Springer Nature Switzerland AG 2020 .
A book which provides Image Analysis (IA) algorithms and Matlab code: Digital Image Processing Using Matlab, by Rafael C. Gonzalez, Richard E. Woods, S. L. Eddins, Prentice Hull, 2004,ISBN 0-13-008519-7

Students Learning Outcomes:
(1) Students will gain knowledge and skills and will be able to transform one color model to another;
(2) Students will learn and will be able to utilize the basic multi-resolution methods: Scaling Functions, Wavelet transforms;
(3) Students will learn and will be able to utilize object recognition methods based on distance metrics and matching.
(4) The students will learn the theoretical basis and fundamentals of **Neural Networks** (NN) and **Machine Learning (ML)** architectures, activation and loss functions;
(5) Students will know the fundamentals of the **Gradient Descent method** for **NN** optimization;
(6) *New*-Upon time permission the students will learn basics of Image Databases Distillation and Augmentation;
(7) Students will conduct independent project development, which will help them develop skills for: survey, theoretical work, coding, performing experiments, writing and presenting reports.

Requirements: *instructor's permission*
 Knowledge which may be of help: Integral and Differential Calculus of two variables;
For the project development the students may use any language including: Python, C++, Java, C sharp, or Computer algebra programming systems as MatLab or Mathematica.

List of Topics
1. Defining the area of Image Analysis and Recognition;
2. Color Image Processing. Color Models. Transformation between models. Automatic coloring of gray level images and movies ;
3. Multi resolution images and processing. Multi resolution Expansion. Scaling and Wavelet functions. Discrete and continuous wavelet transformations.
4. Introduction to the theoretical foundations of Neural Networks, basic concepts and notions;
5. Machine Learning, basic concepts, functions and algorithms;
6. *From the Helpful Text* – section 1.5 Optimization for **Machine Learning (ML)**; 1.5.1-1.5.2 The Taylor Expansion for Function Simplification.

7. Gradient descent method;

8. Pattern Recognition: fundamentals; based on correlation; decision functions; rotational and scaling invariant methods. *From the Helpful Text* section: *1.4.3.*Classification and regression modeling.

9. *New*-Upon time permission, the instructor will teach some fundamentals of Image Databases Distillation and Augmentation.

Course Content & Calendar: *The 1ˢᵗ lecture will take place on August 26.*
1ˢᵗ & 2ⁿᵈ weeks – **topics** 1. and 2.; *3ʳᵈ to 5ᵗʰ weeks –* **topic** 3 and independent study projects assignment; *6ᵗʰ & 7ᵗʰ weeks –* **topics** 4, 5; *8ᵗʰ to 9ᵗʰ week –* **topic** 6. Guidelines on the projects development and writing reports; *10ᵗʰ & 11ᵗʰ* weeks – **topic** 7; *12ᵗʰ to 13ᵗʰ week –* **topic** 8; 14ᵗʰ week- Submission Projects Report, **topic** 9; 15ᵗʰ week – Return the reviewed reports. Guidelines on how to prepare and deliver a presentation.

COURSE EVALUATION

Mid Term Exam	- 26%
HW	- 20%
Lab work	- 10 %
Project	- 24%
Final Exam (Project Presentation, and corrections)	- 20%

Grading Policy: *A:*   100%- 90%
B: 89% - 80%
C: 79% - 70%
D: 69% - 60%;   *F:*   Less than 59 %

The professor reserves the rights to reward students for continuous hard work.

Additional Activities: Experiments; Home Practice Problems; Extra Credit Problems (ECP)

Instructional Method: Teaching lectures with proofs and example applications, testing the students with HW, quizzes, Exams, ECP, Final Project.

If the technical capabilities of the room permit, the lectures will be recorded and posted on the Web.

Final Presentation/Test: Math569/CSCI569 **Date: Monday**, Dec. 9th   **Time:** 6PM-8:30PM

COURSE POLICIES
As directed from the Provost Office - "A&M-Commerce requires the use of face-coverings in all instructional and research classrooms/laboratories. Exceptions may be made by faculty where warranted. Faculty have management over their classrooms. Students not using face-coverings can be required to leave class. Repetitive refusal to comply can be reported to the Office of Students' Rights and Responsibilities as a violation of the student Code of Conduct. "
"Students should not attend class when ill or after exposure to anyone with a communicable illness. Communicate such instances directly with your instructor. Faculty will work to support the student getting access to missed content or completing missed assignments."

HW: *problems, which involve theoretical and practical skills above the average level.*
Lab work: conduct experiments, during non-class time, with given Image Analysis tools and images
Midterm comprehensive exam: *Is to be given around mid-semester. It will take 2/3 of a class period.*
Makeup: *Except in the case of a formal institutional excuse, no individual makeup test will be permitted.*
Project Report (most likely group): *self-contained innovative problem, whose development includes: survey of the present state of the art; theoretical model; its implementation; algorithm design and coding; performing experiment and deriving conclusions.*
Cheating: In case of cheating and copy/paste from any source without proper notation leads to cancellation of the assignment and grade of 0.

AI use policy ETAMU acknowledges that there are legitimate uses of Artificial Intelligence, ChatBots, or other software that has the capacity to generate text, or suggest replacements for text beyond individual words, as determined by the instructor of the course. Any use of such software must be documented. Any undocumented use of such software constitutes an instance of academic dishonesty (plagiarism). Individual instructors may disallow entirely the use of such software for individual assignments or for the entire course. Students should be aware of such requirements and follow their instructors 'guidelines. If no instructions are provided the student should assume that the use of such software is disallowed. In any case, students are fully responsible for the content of any assignment they submit, regardless of whether they used an AI, in any way. This specifically includes cases in which the AI plagiarized another text or misrepresented sources. 13.99.99.R0.03 Undergrad Academic Dishonesty, 13.99.99.R0.10 Grad Student Academic Dishonesty

Students with Disabilities: The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, contact: **Office of Student Disability Resources and Services; Texas A&M University-Commerce; Halladay Student Services Building; Room 132 A/D; Phone (903) 886-5150 or (903) 886-5835; Fax (903) 468-8148** StudentDisabilityServices@tamu-commerce.edu

All students enrolled at the University shall follow the tents of common decency and acceptable behavior conducive to a positive learning environment (Student's Guide Handbook, Polices and Procedures, Conduct).

Texas Senate Bill - 11 *(Government Code 411.2031, et al.) authorizes the carrying of a concealed handgun in TAMUC buildings only by persons who have been issued and are in possession of a Texas License to Carry a Handgun. Qualified law enforcement officers or those who are otherwise authorized to carry a concealed handgun in the State of Texas are also permitted to do so. Pursuant to Penal Code (PC) 46.035 and A&M-Commerce Rule 34.06.02.R1, license holders may not carry a concealed handgun in restricted locations. For a list of locations, please refer to* http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/34SafetyOfEmployees AndStudents/34.06.02.R1.pdf *and/or consult your event organizer). Pursuant to PC 46.035, the open carrying of handguns is prohibited on all TAMUC campuses. Report violations to the University Police Department at 903-886-5868 or 9-1-1.*

***Nondiscrimination Notice* Texas A&M University-Commerce** will comply in the classroom, and in online courses, with all federal and state laws prohibiting discrimination and related retaliation on the basis of race, color, religion, sex, national origin, disability, age, genetic information or veteran status. An environment free from discrimination on the basis of sexual orientation, gender identity, or gender expression will be maintained.

The Counseling Center at A&M-Commerce, located in the Halladay Building, Room 203, offers counseling services, educational programming, and connection to community resources for students. Students have 24/7 access to the Counseling Center's crisis assessment services by calling 903-886-5145. For more information regarding Counseling Center events and confidential services, please visit www.tamuc.edu/counsel .

Any use of such software must be documented. Any undocumented use of such software constitutes an instance of academic dishonesty (plagiarism).

Individual instructors may disallow entirely the use of such software for individual assignments or for the entire course. Students should be aware of such requirements and follow their instructors 'guidelines. If no instructions are provided the student should assume that the use of such software is disallowed.

In any case, students are fully responsible for the content of any assignment they submit, regardless of whether they used an AI, in any way. This specifically includes cases in which the AI plagiarized another text or misrepresented sources.
13.99.99.R0.03 Undergraduate Academic Dishonesty
13.99.99.R0.10 Graduate Student Academic Dishonesty

The road that will lead you to find a good job is the road of coding, learning, and developing yourself through accumulating a new knowledge.

Commerce, Texas
July 15, 2025   Dr. Nikolay Metodiev Sirakov