Biometrics for Recognition and Identification

Biometrics for Recognition and Identification ENPM808L

Semester: Fall 2022

Course Overview

This course introduces the theory and application of biometric processing for use in recognition and identification systems. Such systems range from automating time and attendance at workplaces and border-crossing control stations to access authentication processing to replace passwords. The course focuses on the three primary modalities (fingerprints, facial analysis, and iris processing) to provide an understanding of the underlying image processing technologies in use. This processing is coupled with decision thresholds and use of multi-modal biometrics form the basis for Recognition (one to one) and Identification (one to many) processing. Alternative biometric techniques are presented in relationship to the technologies used in the primary modalities to understand how alternative biometric markers would be used when needed.

Learning Outcomes

After successfully completing this course, you will be able to:

- Understand biometric characteristics and the roles of biometrics systems to perform recognition and identification tasks.

- Understand recognition and identification modalities and processing models for industry applications/problems.

- Lead/collaborate to implement a biometrics project to support organizational goals and measure its effectiveness.

- Design and deliver effective presentation/visualization of biometrics recognition and identification systems.

- Be able to take a role in the planning of a biometrics platform to fit into existing organizational recognition and identification infrastructure.

Dr. W. Lewis Collier

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Class Meets

Mondays

7:00pm – 9:40pm

Location: TBD

Office Hours

TBD

and by appointment

Teaching Assistants

TBD

Prerequisites

Basic statistics and programming experience.

Course Communication

All communications outside of class time will be via email. Please ensure that an email that is accessible by you from mobile devices, or on which you are receiving constant updates is provided in case alerts are needed to be sent.
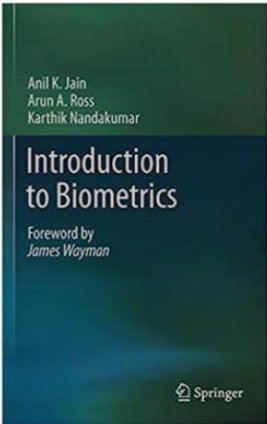
Course website
elms.umd.edu

Resources

Course website \text{elms.umd.edu}

Readings

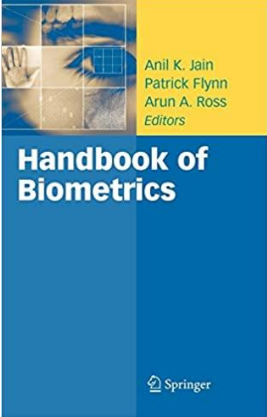Additional materials (slides) will be provided in class.

	Introduction to Biometrics 2011th **Edition**
	by Anil K. Jain (Author), Arun A. Ross (Author), Karthik Nandakumar (Author)
	ISBN-13: 978-0387773254
	ISBN-10: 0387773258
	This book can be found relatively inexpensively and provides additional material for the topics covered in this course.

Hardware/Software

This is TBD, but some version of Python is to be used.

Supplemental Resources

Readings:

	Handbook of Biometrics 2008th **Edition**
	by Anil K. Jain (Editor), Patrick Flynn (Editor), Arun A. Ross (Editor)
	ISBN-13: 978-0387710402
	ISBN-10: 038771040X
	This book provides excellent background and deeper material for those who seek to perform in the Biometrics career path.

https://www.biometricupdate.com/ provides Daily email updates as well as other insights into the overall Biometrics market.

Hardware/Software

TBD, but none expected.

Campus Policies

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses. Please visit https://academiccatalog.umd.edu/graduate/policies/academic-record/ for the Office of Graduate Studies' list of campus-wide policies.

Code of Academic Integrity

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity of the Student Honor Council, please visit https://tltc.umd.edu/integrity.

Activities, Learning Assessments, and Expectations for Students

The phenomenal growth of biometrics recognition and identification systems (both within organizations and publicly) combined with advances in technology (in cloud computing and machine learning) have allowed organizations to leverage biometrics processing to enhance their recognition and identification processes to achieve their missions. In addition, the availability of low-cost computing resources and sensors have accelerated this process.

This course focuses on traditional methods to extract usable recognition and identification information from biometrics sensors and communicate those technologies to stakeholders so they can be incorporated in operational work processes to achieve organizational goals. Students will gain a comprehension of and use relevant tools, technologies and approaches for biometrics recognition and identification processing. Architectural approaches for implementing biometrics-based recognition and identification will be covered.

Students will use analytics tools and scripting languages for the implementation of projects. Some example languages/tools introduced are using the Python scripting language. Prior knowledge of scripting language such as Python or R will be helpful – but not required. If not already capable, students will learn these basic scripting skills in order to complete assignments during the class.

All assignments include a written description that clearly, and concisely presents the results of the assignment. The goal of the reports is to build confidence in reporting of data analysis efforts. All assignments are to be presented in a "mini-report" format that follows the standard academic paper structure of abstract, introduction, methodology, results, and discussion. The final project is to be presented as a more in-depth report that follows the same structure as assignments, with an accompanying slide presentation.

While strongly recommended, but ultimately not required, the use of LaTeX for the reports if preferred. Instructions for utilizing LaTeX are readily available and instructions will be posted, including a sample class (style format) file, on the course website. TeXnic Center (a full featured IDE) with the MiKTeX distribution for MS-Windows is preferred, so that help can be found from multiple sources.

Performance in this class, and your associated grade, will be measured via four (4) assessment areas:

1. Biometrics (Group) Assignments
2. Biometrics Modality Tests (3)
3. Final (Individual) Project
4. Final Exam

You are expected to complete assignments on the target dates. The instructor may grant limited extensions of time for specific assignments for health or personal emergencies. That extension normally will be granted only if arranged with the instructor in advance. Otherwise, penalties will be assigned for late completion up to 15% per day.

To maximize your learning/success, class participation is important and expected. There is no specific grading component for attendance or participation, but these facets will contribute greatly to necessary understanding for the graded items.

For each class, I have prepared items to be completed before you arrive at the class, what will be covered during the class, and what is expected to be completed after the class. These are provided at the end of the syllabus. The overall schedule of topics for the class are:

Date		
		Part 1 – Understanding Biometrics Terminology
	Week 1	Introduction to Biometrics and Scoring Technology
		Part 2 – Fingerprints
	Week 2	Image processing details and statistical measures Start fingerprint assignment
	Week 3	Minutiae detection/matching details and recognition methods
	Week 4	Turn in fingerprint biometrics assignment Image acquisition, partial prints, and other details Begin take-home test on fingerprint biometrics material
		Part 3 – Faces
	Week 5	Turn in fingerprint test Image processing details and statistical measures Start face assignment
	Week 6	Feature detection/matching details and recognition methods
	Week 7	Turn in face biometrics assignment Image acquisition, partial faces, and other details Begin take-home test on face biometrics material
		Part 4 - Irises
	Week 8	Turn in face test Image processing details and statistical measures Start iris assignment
	Week 9	Structure detection/matching details and recognition methods
	Week 10	Turn in iris biometrics assignment Image acquisition, partial iris imagery, and other details Begin take-home test on iris biometrics material
		Part 5 –Multi-modal (and Other) Techniques
	Week 11	Turn in iris test Multimodal Identification (using more than 1 mode to improve results)
	Week 12	Speech Recognition and Identification
	Week 13	Other Biometrics modalities (e.g., gait, earlobe, palm, vein, retina, etc.)
		Part 6 – Presentation of Analysis Results
	Week 14	Final Projects Delivery and Presentations (First N/2)
	Week 15	Final Projects Delivery and Presentations (Final N/2)
	Week 16	Reading day, Assign Final Exam
	Week 17	Final Exam Due

Course-Specific Policies

I expect you to make the responsible and respectful decision to refrain from using your cellphone during class time. If you have critical communication to attend to, please excuse yourself and return when you are ready. For more information about the science behind the policy watch: http://youtu.be/WwPaw3Fx5Hk

Likewise, as I do not expect students to be buried in their computers, this will not be a PowerPoint presentation-centric course. I will use slides to highlight topics, and data sets, but I will not be reading them to you. I expect students to have read the material before the class so that in depth discussions can be had during class (see note above about grading for class participation). As stated above, the overarching goal of this class is to provide an understanding of decision-making algorithms. Hands on practice will lead to a better understanding when real data is processed, but discussion beforehand will afford the base understanding that enables the deeper comprehension when data is processed and analyzed.

The course is structured so that group efforts are used in the beginning of the course, followed by individual efforts. The intent is that the group members work together to get up to speed on the tools and methodologies. In addition, group study is encouraged for the mid-term, which focuses on the presented algorithms. The second half of the course focuses on ensuring that all students can utilize the base decision algorithm information and utilize the baseline understanding of the first half of the course to individually evaluate the data analysis tools for various applications. In this way, students can utilize the course methods for data that is pertinent to each individual's needs and interests. Group study for the individual projects and final exam are also encouraged, but *ALL* work products marked as individual efforts are expected to be created individually.

This is a graduate course so there is an expectation that all group members will contribute equally to the group work products. Some will provide more help in coding aspects, some with the underlying math, and some with the writing. The goal is for the groups to help all members become stronger in their less-effective areas so all students can thrive in data analysis for the second part of the course, and beyond.

For this course, some of your assignments will be collected via Turnitin on our course ELMS page. I have chosen to use this tool because it can help you improve your scholarly writing and help me verify the integrity of student work. For information about Turnitin, how it works, and the feedback reports you may have access to, visit Turnitin Originality Checker for Students

Accessibility and Reasonable Accommodations

The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The University of Maryland provides reasonable accommodations to qualified individuals. Reasonable accommodations shall be made in a timely manner and on an individualized and flexible basis.

Discrimination against individuals on the grounds of disability is prohibited. The University also strictly prohibits retaliation against persons arising in connection with the assertion of rights under this Policy.

Accessibility & Disability Service (ADS) facilitates reasonable accommodations to qualified individuals. For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301.314.7682, or adsfrontdesk@umd.edu. More information is available from the Counseling Center.

Get Some Help!

You are expected to take personal responsibility for your own learning. This includes acknowledging when your performance does not match your goals and doing something about it. Everyone can benefit from some expert guidance on time management, note taking, and exam preparation, so I encourage you to consider visiting http://ter.ps/learn (there are specific resources for graduate students under handouts, but please explore to find what you need). Sharpen your communication skills (and improve your grade) by visiting https://gradschool.umd.edu/graduate-school-writing-center and schedule an appointment with the campus Graduate Writing Center. Finally, if you just need someone to talk to, visit http://www.counseling.umd.edu.

Everything is free because you have already paid for it, and **everyone needs help**… all you have to do is ask for it.

Names/Pronouns and Self Identifications

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). The pronouns someone indicates are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity, is your choice whether to disclose (e.g., should it come up in classroom conversation about our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Grades

Grades are not given, but rather, they are earned. Your grade is determined by your performance on the learning assessments in the course and is assigned individually (not curved). If earning a particular grade is important to you, please speak with me at the beginning of the semester so that I can offer some helpful suggestions for achieving your goal. Grades for each will be weighted in the following manner:

1. Biometrics Assignments (Group or Individual) (10% each, 30% total). A rubric will be supplied for details on expectations of reports.
2. Biometrics Modality Tests (Individual) (3) (10% each, 30% total)
3. Final Project (Individual) (20%)
4. Final Exam (Individual) (20%)

As the assignments and reports are not expressly quantitative assessments, grades will be assigned as A+, A, A-, B+, and so forth) rather than strict numerical grades.

All assessment scores will be posted on the course ELMS page. If you would like to review any of your grades (including the exams), or have questions about how something was scored, please email me to schedule a time for us to meet before or after class, or virtually during office hours.

You are expected to complete assignments on the target dates. The instructor may grant limited extensions of time for specific assignments for health or personal emergencies. That extension normally will be granted only if arranged with the instructor in advance. Otherwise, penalties will be assigned for late completion of a fractional letter grade (A to A-, A- to B+, B+ to B, and so on) per day.

I am happy to discuss any of your grades with you, and if I have made a mistake, I will review it in very short order and correct it as applicable. Any formal grade disputes must be submitted in writing and within one week of receiving the grade.

Final letter grades are assigned based on the weighted percentage of total assessment points earned. The standard 4.0 scale will be applied to the letter grades for each assignment, exam, or final presentation, with a slight bonus for marks of A+. Final grades will be tabulated from the weighted averages, rounding upwards from fractional values. Thus, an average of 3.77 would equate to a letter grade of A and an average of 3.67 would equate to a letter grade of A-. To be fair to everyone I have to establish clear standards and apply them consistently, so please understand that being close to a cutoff is not the same this as making the cut (3.699 $\neq$ 3.700). It would be unethical to make exceptions for some and not others.

A+	4.5
A	4.0
A-	3.7
B+	3.4
B	3.0
B-	2.7
C+	2.4
C	2.0
C-	1.7
D+	1.4
D	1.0
D-	0.7
F	0.0

Detailed Course Schedule

The course will follow the schedule presented above. Each week consists of things to do before class, topics to be covered during the class, and things to do after the class.

Note: This is a tentative schedule, and subject to change as necessary – monitor the course ELMS page for current deadlines. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.