Missouri University of Science and Technology — Department of Computer Science
Spring 2022 — **CS 6406: Machine Learning for Computer Vision**

SYLLABUS

Instructor: *Sid Nadendla* — **Email:** *nadendla@mst.edu*

1 Course Information

Course Website:	https://sid-nadendla.github.io/teaching/SP2022_MLCV/index.html
Lecture Venue and Time:	221 Comp Sci Building, T/Th 9:30AM - 10:45AM
Instructor's Office Hours Location:	327 Comp Sci Building
Instructor's Office Hours:	Friday 3:00PM - 4:00PM, or by appointment
Instructor's Contact Details:	nadendla@mst.edu, (573) 341-4090
Grader's Name and Email:	TBD
Grader's Office Hours:	TBD

2 Intended Audience & Prerequisites

Students are expected to have a strong background in introductory machine learning and/or data mining ('C' or better in Comp Sci 5402), or introductory computer vision ('C' or better in Comp Sci 5404). Exposure to deep learning ('C' or better in Comp Sci 5001 – Introduction to Deep Learning) will greatly benefit students.

3 Textbook

In this course, we will **not** be following any one textbook. However, students are encouraged to refer the following reference books[1] from the following (non-exhaustive) list:

- Bruce Hajek, Maxim Raginsky, "Statistical Learning Theory," Lecture Notes for ECE 543, University of Illinois, Urbana-Champaign, IL, USA, 2021, URL: http://maxim.ece.illinois.edu/teaching/SLT/.
- Matus J. Telgarsky, "Deep Learning Theory," Lecture Notes for CS 540, Version: 2021-10-27 v0.0-e7150f2d (alpha), University of Illinois, Urbana-Champaign, IL, USA, 2021.
  URL: https://mjt.cs.illinois.edu/dlt/
- Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning," Release 0.17.0, Available on ArXiv: 2106.11342, URL: https://d2l.ai
- Aurlien Gron, "Hands-on machine learning with Scikit-Learn and TensorFlow : Concepts, Tools, and Techniques to Build Intelligent Systems," O'Reilly Media, Sebastopol, CA, 2017
  (Online copy available through S&T library).
- Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning," The MIT Press, Cambridge, MA, 2016. URL: https://www.deeplearningbook.org/
- Kush R. Varshney, "Trustworthy Machine Learning," Chappaqua, NY, USA, 2021.
  URL: http://trustworthymachinelearning.com/

[1] Links to free electronic copies of the books will be provided on the course website, if they are available.

The instructor will provide relevant articles/papers and open-source chapters as reading assignments on topics that are not covered in any of the reference books.

4 Description

Machine Learning for Computer Vision (MLCV) is a course that focuses on the fundamentals of deep learning (DL) and its application to solving computer vision (CV) problems. Fundamentals of learning are reintroduced from a PAC learning perspective (with special focus on neural networks), in addition to covering computationally efficient learning algorithms (including state-of-the-art software) to training/implementing deep neural networks. The course also covers the application of DL to a few well-known CV problems such as object detection. Finally, the course also introduces various techniques that address trust concerns (e.g. discrimination and lack of transparency) when DL based solutions are deployed in real-world applications.

5 Course Objectives

- Develop a deep understanding of the fundamental limits, design and analysis of neural networks.
- Gain mastery in computing gradients and necessary optimization-based training algorithms.
- Become proficient in solving well-known computer vision problems using deep learning.
- Cultivate the ability to reason how/why machine learning algorithms can lead to distrust upon deployment, either due to discrimination, or lack of transparency.

6 Tentative Schedule & Prospective List of Topics

Topic	**Subtopics**	**# Lectures**
Basics of Learning	PAC Learning, Neural Networks, Optimization Algorithms	10
Computational Methods	Hardware, Computational Graphs, Asynchronous Computation	7
Problems in Computer Vision	Alignment, Object Recognition, and Temporal Models	8
Trustworthy Vision	Fairness, Explainability	5

7 Grading Information

Students' grades will be calculated based on 4 assignments, as shown below:

Assignment 1:	25% of total grade
Assignment 2:	25% of total grade
Assignment 3:	25% of total grade
Assignment 4:	25% of total grade
Final Grade:	$[85-100]$: A, $[70-85)$: B, $[55-70)$: C, <55: F

All the grades will be posted and maintained on Canvas.

8 Course Policies & Campus Resources

8.1 Required Materials and COVID-19 Contingency Plans

This course will be offered in-person as well as in distance-mode. Registered students (in both sections) are strongly encouraged to attend the class in person with a face covering, so that we have a safe and trustworthy learning environment. The instructor will also teach the class (in-person) using a transparent face-shield in the classroom. Furthermore, all lectures will be streamed and recorded in SP'22 via Zoom to primarily serve the distance section. The lecture recordings will be available through CANVAS.

All students are strongly encouraged to get vaccinated (and with a booster shot) against COVID-19. Although there is no requirement to provide proof of immunization, voluntary reporting is strongly encouraged at MyHR. For more details, please visit **https://coronavirus.mst.edu** to learn about the campus policy. If quarantined, or are unable to attend class or take tests on campus due to any illness, students are advised to work through Care Management (cm@mst.edu), 573-341-4209. In case of rampant spread of COVID-19 (or any other infection) in the midst of SP'22, the campus can mandate all the instructors to switch to online instruction, in which case, in-class exams will be replaced by take-home exams.

Students will submit all of their homework assignments via Gitlab, regarding which the instructor will discuss in the first class. All other submissions will be disregarded and will be treated as a no submission. In order for this plan to work successfully, students are mandated to have laptops, web cams, scanners[2] (if submitting a hand-written assignment), headsets, microphones, or other resources to learn in an online synchronous setting. Most of these items are available for checkout from the Service Desk in the library.

8.2 S&Tconnect

S&Tconnect enables students to request appointments with their instructors and advisors via the S&Tconnect calendar, which syncs with the instructor's Outlook Exchange calendar. S&Tconnect tracks each student's performance. S&Tconnect Early Alert enables students to be provided with services. S&Tconnect training is provided by Rachel Morris at rachelm@mst.edu or 341-7600.
https://canvas.mst.edu/ ("Starfish" icon on left toolbar)

8.3 Accessibility and Accommodations

It is the university's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on a disability, please contact Student Disability Services at (573) 341-6655, sdsmst@mst.edu, visit http://dss.mst.edu/ for information.

8.4 S&T Writing Center

The Writing Center's mission is to assist all students in their efforts to become better writers through structured one-on-one conversations with peer consultants. Writing Center consultants are fellow students whose strong writing skills and special training allow them to offer meaningful feedback and guidance. More information can be found at their website and through email: writing@mst.edu

[2]There are several mobile applications available in different platforms that can use the camera in smart devices to scan documents.

8.5 Student Success Center

SSC was developed as a campus-wide initiative to foster a sense of responsibility and self-directedness to all S&T students by providing peer mentors, caring staff, and approachable faculty and administrators who are student centered and supportive of student success. The Student Success Center in Toomey Hall was designed for students to visit and feel comfortable about utilizing the campus resources available.

Visit the SSC at 198 Toomey Hall; 573-341-7596; success@mst.edu, or join us on social media @sandtssc

Facebook: https://www.facebook.com/SandTssc,

Web: https://studentsuccess.mst.edu/

8.6 Statement about Copyright, FERPA, and Use of Video

It is vitally important that our classroom environment promote the respectful exchange of ideas. This entails being sensitive to the views and beliefs expressed during discussions whether in class or online. Please obtain instructor permission before recording any class activity. It is a violation of University of Missouri policy to distribute such recordings without authorization and the permission of all who are recorded. More information is provided online at this link: https://www.umsystem.edu/ums/elearning/policies

8.7 Student Well-Being

Link: https://wellbeing.mst.edu/

Student Well-Being provides counseling services, health promotion initiatives, and prevention programs to empower the S&T community to thrive and enhance personal, academic, and professional success. Department office hours are Monday-Friday, 8am-5pm. On the website, you can find information related to individual and group counseling, wellness consultations and trainings, resources for many health and wellness topics, and help for mental health crisis situations.

8.8 UCARE

Link: https://go.mst.edu/ucare-report

Any of us may experience strained relationships, increased anxiety, feeling down, alcohol/drug misuse, decreased motivation, challenges with housing and food insecurity, and any other number of mental health or well-being concerns. If you notice these or other alarming concerns in a friend or fellow student and would like to consult with a Care Manager, please make a UCARE referral for support and assistance.

8.9 Health and Well-Being Canvas Course

Link: https://umsystem.instructure.com/enroll/G3LY3G

The Health and Well-Being Canvas Course features trainings, presentations, and other health and well-being resources for students. One feature of the course is the Miner Well-Being Certification Program, a semester-long certification where participants can engage with campus-wide services and initiatives and develop skills that contribute to personal well-being and student success. Students can enroll in the free, non-credit course at any time.

8.10 Student Honor Code and Academic Integrity

- All students are expected to follow the Honor Code, which can be found at this link: http://stuco.mst.edu/honor-code/
- Page 30 of the Student Academic Regulations handbook describes the student standard of conduct relative to the University of Missouri System's Collected Rules and Regulations section 200.010, and offers descriptions of academic dishonesty including cheating, plagiarism and sabotage (http://registrar.mst.edu/academicregs/index.html),
  any of which will be reported to the Vice Provost for Academic Support.
- Other resources for students regarding academic integrity can be found at http://academicsupport.mst.edu/academicintegrity/studentresources-ai

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8.13 Nondiscrimination, Equity, and Title IX

Missouri S&T is committed to the safety and well-being of our campus community, and to creating an environment free from discrimination and harassment. The University does not discriminate on the basis of race, color, national origin, ancestry, religion, sex, pregnancy, sexual orientation, gender identity, gender expression, age, disability, protected veteran status, and any other status protected by applicable state or federal law. As used in this policy, the word "sex" is also inclusive of the term "gender."

Additionally, US Federal Law Title IX states that no member of the university community shall, on the basis of sex, be excluded from participation in, or be denied benefits of, or be subjected to discrimination under any education program or activity. Violations of this law include sexual harassment, sexual assault, dating/domestic violence, and stalking.

In accordance with the University of Missouri's Collected Rules and Regulations, all faculty and staff are required to report any information concerning discrimination disclosed through communication including, but not limited to, direct conversation, email, social media, classroom papers and homework exercises to the Equity Officer/Title IX Coordinator.

8.13.1 Office of Equity and Title IX

Equity Officer and Title IX Coordinator: Dr. Paul Hirtz
Phone: (573) 341-7734

Location: 900 Technology Drive, Suite 500
E-mail: equity@mst.edu

8.14 Classroom Egress Maps

For all in-person instruction, faculty should explain where the classroom emergency exits are located. Classroom egress maps are posted at http://designconstruction.mst.edu/floorplan/.