Missouri University of Science and Technology	Department of Computer Science
Spring 2024	**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/SP2024_MLCV/index.html
Lecture Venue and Time:	207 Comp Sci Building, T/Th 11:00AM - 12:15AM
Instructor's Office Hours:	Wednesday 1:00PM - 2:00PM, or by appointment
Instructor's Contact Details:	nadendla@mst.edu, (573) 341-4090
GTA's Name and Email:	Mukund Telukunta, mt3qb@mst.edu
GTA Meeting Venue and Time:	TBD, Friday TBD (biweekly recitations), or by appointment

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:

- Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning," The MIT Press, Cambridge, MA, 2016. URL: https://www.deeplearningbook.org/

- 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).

- 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/

- Kush R. Varshney, "Trustworthy Machine Learning," Chappaqua, NY, USA, 2021.
  URL: http://trustworthymachinelearning.com/

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.

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

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, lack of transparency, or adversarial threats.

6 Tentative Schedule & Prospective List of Topics

Topic	Subtopics	# Lectures
Basics of Learning	Learning with Neural Networks, Optimization Algorithms	7-8
Efficient Computation	Computational Graphs, Computing on GPUs, Software	4
Deep Learning for CV	Advanced Architectures, Object Detection, Generative Models	10
Trustworthy Vision	Fairness, Explainability, Adversarial Machine Learning	5-6

7 Grading Information

Students' grades will be calculated based on 4 topic-wise assignments[2], 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.

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[2]These topic-wise assignments could be further split into sub-assignments, if it helps students to better learn concepts.

8 Course Policies & Requirements

8.1 Required Materials and Homework Submissions

Students will submit all of their homework assignments via Gitlab, regarding which the instructor will discuss in the first class. Feedback will be uploaded back into the respective Gitlab folders privately, and the grades will be maintained on CANVAS. Late submissions will only be considered at the discretion of the instructor and the responsible teaching assistant/grader, only under valid circumstances. 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[3] (if submitting a hand-written assignment), headsets, microphones, or other resources to learn effectively. Most of these items are available for checkout from the Service Desk in the library.

8.2 Lecture Format and Contingency Plans

This course will be offered to both in-person and distance students. In-person students are expected to attend the class lectures in-person. However, distance students are expected to attend the class over a live Zoom call. All lectures will be recorded in SP'24 via Zoom, and will be made available only to distance students through CANVAS after the lecture. If the instructor has travel plans in the midst of the semester, alternative lecture arrangements (if any) will be communicated with the students well in advance. Any changes in the class schedule will be reported on the schedule page maintained on the course website.

All students are strongly encouraged to get vaccinated (and with a booster shot) against COVID-19 and Flu. If a student is unable to attend class in-person due to any illness, it is their responsibility to report their illness to Student Health Services (mstshs@mst.edu), 573-341-4284, to receive an absence note. The student should forward this absence note to the instructor so that appropriate arrangements can be made for the student to attend the class remotely.

9 Campus Policies and Resources

9.1 Artificial Intelligence

Unauthorized use of artificially generated content violates University Student Academic Standards without consent of the instructor. Although strongly discouraged, students are allowed to learn using ChatGPT and/or other generative AI systems only under the following condition. Assignments will be given credit only when students clearly compare the automatically generated content with their own work, in addition to citing the tool used, stating the specific input provided, and including the automatically generated content.

9.2 Accessibility and Accommodations

It is the university's goal that learning experiences be as accessible as possible. Student Accessibility and Testing provides services and accommodations that facilitate full participation in Missouri S&T's learning experience for students with disabilities. If you anticipate or experience physical, academic, and/or digital barriers due to a disability, please contact Student Accessibility and Testing at (573) 341-6655, email dss@mst.edu, or visit https://saat.mst.edu/ for information.

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

9.3   Student Veterans Resource Center

The Student Veterans Resource Center (SVRC) is the nexus of resources and support for student veterans at S&T. The SVRC provides student veterans with a "safe space" and a familiar atmosphere. The center's Veteran Consuls provide one-on-one consultations to guide students to various resources on campus, while its advisor provides students with VA health and benefits resources. Visit the SVRC at Harris Hall, Suite G10, and contact us at svrc@mst.edu.

9.4   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

9.5   Student Well-Being

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

Your well-being is important, and it contributes to your success in this course. At S&T, we provide resources to support your mental, physical, and social well-being. Any of us can experience challenges that make learning difficult. If you are struggling, take advantage of the following resources offered by the university:

The Department of 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, 8 a.m. – 5:00 p.m. On the website, you can find information related to confidential individual and group counseling, wellness consultations and trainings, resources for many health and wellness topics, and help for mental health crisis situations.

For the National Suicide Prevention Lifeline, call or text 988, or visit missouri988.org.

9.6   Student Support and Community Standards

Link: https://studentsupport.mst.edu/

Student Support and Community Standards is your "Google Maps" for support. During your time at S&T, you or a friend may need help navigating their student experience, facing a barrier, or experiencing a challenge. You are not alone!

Student Support has a dedicated team and numerous resources such as UCARE and the student emergency fund to help you navigate the S&T experience and support your success. This includes support to address barriers related to academic, personal, emotional, medical, financial, or any other needs. All students can learn and grow from challenges or setbacks, they are stepping stones to success and we are here to help.

9.7   Student Veterans Resource Center

Link: https://svrc.mst.edu/

The Student Veterans Resource Center (SVRC) is the nexus of resources and support for student veterans at S&T. The SVRC provides student veterans with a "safe space" and a familiar atmosphere. The center's

Veteran Consuls provide one-on-one consultations to guide students to various resources on campus, while its advisor provides students with VA health and benefits resources. Visit the SVRC at Harris Hall, Suite G10, and contact us at svrc@mst.edu.

9.8   Student Honor Code and Academic Integrity

- All students are expected to follow the Honor Code, which can be found at this link:
  https://stuco.mst.edu/documents/honor-code/

- Student Academic Regulations (Ref. https://registrar.mst.edu/academicregs/conductofstudents/) 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, any of which will be reported to the Vice Provost for Undergraduate Education.

- Other resources for students regarding academic integrity can be found at
  https://undergrad.mst.edu/academicintegrity/studentresources-ai/

9.9   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. The course is free for all students, is non-credit, and students can enroll at any point in the semester.

9.10   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 prohibits discrimination and harassment 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. Sexual harassment violations of this law include quid pro quo, hostile environment, sexual assault, dating/domestic violence, and stalking. The U.S. Department of Education has stated the prohibition on discrimination on the basis of sex includes sexual orientation and gender identity.

Students who are experiencing pregnancy or pregnancy-related conditions, including the birthing parent and non-birthing parent, have rights protected under Title IX. Students should contact the Office of Equity and Title IX to learn more about their rights and pregnancy-related assistance/accommodations provided by the University to ensure equitable access to University educational programs and activities.

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.

For more information regarding support for those that have been impacted or to report an incident of discrimination or harassment as defined by Chapter 600 of the University's Collected Rules and Regulations, visit the Office of Equity and Title IX or visit their website at equity.mst.edu.

Office of Equity and Title IX:

Equity Officer and Title IX Coordinator: Dr. Paul Hirtz
Phone: (573) 341-7734
Location: 900 Innovation Drive, Suite 500
E-mail: equity@mst.edu

9.11 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/.