BSAN 995

Machine Learning Seminar

Spring 2023

KU SCHOOL OF BUSINESS
The University of Kansas

business.ku.edu

Time: 9:30am-10:45am, MW
Location: 4046 CAPF

Instructor: Michael T. Lash, PhD
Office: 4166 CAPF
Office hours: 11am-1pm M and by appointment
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COURSE PREREQUISITES

None formally required. Although some background in multivariate calculus, linear algebra, and algorithmic thinking will be assumed/necessary.

COURSE DESCRIPTION

This seminar will introduce graduate students to the vast, exciting, and ever-growing research area of machine learning. Both historical and current research papers on the subject will be presented and discussed to cultivate a trajectory-based perspective of the field. Furthermore, the course adopts a "model-based machine learning" (C. Bishop) perspective and emphasis: the application should inform the selection and development of a particular machine learning model (i.e., an application-focused). Both supervised (learning from data with a target outcome) and unsupervised methods (learning from data without a definitive outcome) will be presented and discussed. The particular methods and applications covered are based on student interests, determined at the onset of the semester. The instructor introduces the field during the first few weeks of the semester, with instructor, guest, and student research paper presentations taking place thereafter. Students from all areas are welcome!

The course is centered on four primary activities: (1) instructor-presented research papers, lectures (primarily the first few weeks of the course) and tutorials; (2) guest-presented research papers (by faculty from both KU and elsewhere); (3) student-presented research papers; (4) and an individual machine learning research project. Students will select 2-3 (based on enrollment) research papers to present over the course of the semester. The option will be given to select from either a pool of papers or to propose papers not found in the pool, allowing the course to be tailored to students' specific research interests. The individual project will also have a large amount of leeway and encouragement will be given to develop a project that fits with the student's intended research.

At the beginning of the term, the instructor will introduce the topic of machine learning and cover a brief review of the necessary background material (matrix algebra, multivariate calculus, algorithmic thinking, etc.) to familiarize students with the elements of a machine learning research paper. The instructor will also present several research papers. The first instructor-presented paper will simultaneously focus on illustrating the best practices of presenting machine learning research. A variety of machine learning tool tutorials, including web-scraping and data acquisition, will then

be given and the project will be introduced. Guest and student-led presentations will then commence throughout the rest of the term. Please see the schedule at the end of this document for a more detailed schedule.

This is a 3-credit-hour semester-long course, with two 75-minute in-person class sessions on Tuesdays and Thursdays at 9:30am-10:45am in CAPF 4046. For every credit hour students can expect to spend at least two hours per week in additional study and preparation.

LEARNING OUTCOMES

1. An understanding of historical and ongoing areas of machine learning research.
2. A research-oriented perspective of various machine learning methods, algorithms, and applications.
3. Experience reading, presenting, and writing machine learning papers.
4. Experience conducting machine learning research.

TEXTS & MATERIALS

The primary reference materials for this course are the slides and articles linked/uploaded on Canvas. No textbook is required.

COURSE REQUIREMENTS AND GRADED ACTIVITIES

Students' performance will be assessed through four categories of course deliverables: attendance and participation, presentation of research papers, a project presentation, and project report. The breakdown of grade percentage according to these four categories is as follows:

Deliverable	Percentage of grade
Attendance and Participation	15
Paper Presentations	10 x 3 (30)
Project Presentation	20
Project Report	35

Cumulatively, student performance in these four areas will determine a final letter grade according to the following scale:

Overall score	Grade
>= 85	A ±
65-85	B ±
50-65	C ±
35 – 50	D ±
< 60	F

Note: Scores on individual components will be scaled to the appropriate earned percentage. For instance, if a student earned 75/100 for "Attendance and participation" then they will earn 11.25 percentage points (i.e., 75/100 * 15).

Attendance and Participation

Attendance: Students are expected to attend every class and are responsible for the material presented and discussed therein. If class must be missed, the student should contact the instructor as far in-advance as possible.

Participation: A large portion of class time will be devoted to the presentation of research papers by students. Non-presenting students (i.e., those in attendance of student presentations) are expected to ask relevant questions and will be required to submit their documented notes and questions at the conclusion of each class (along with a grade for the presentation, if a student is presenting). The attendance and participation grade will primarily be assessed based on the "note, question, and grade" sheet turned in each class by students.

Paper Presentations

Each student will be expected to present **two-three** (based on enrollment) research papers. The papers will be self-selected from a pool provided by the instructor. *The instructor does, however, reserve the right to assign specific papers in certain circumstances.* Students will have the option of also suggesting a paper they would like to present; approval will be given at the discretion of the instructor. Students, are, however highly encouraged to recommend papers that align with their own research interests and efforts will be made to accommodate such interests.

Students in attendance of the presentation will be required to actively engage with and ask questions of the student giving the presentation and will also provide an assessment of presentation quality (a single value ranging from 0 to 10, with 10 being a top-notch presentation). *See "Participation" (above).*

Student presentation grades will ultimately be assessed by the instructor. Assessment of a presentation will be based on presentation clarity and organization, slide relevance, communication of the research, and how well the student was able to address the questions posed (the latter being highly subjective and paper-dependent). The difficulty of the paper being presented will also be taken into consideration.

Term Project

Students will be expected to complete a project on a topic of their choosing. Topics that relate directly to their research interests or ongoing research are encouraged. Projects must involve some aspect of machine learning. The project will be decomposed into several project milestones and culminate in a presentation and written report, which will be due toward the end of the term. The milestones are briefly summarized below.

Proposal. Each student will propose a course project at the beginning of the term. The proposal will include a brief description of the data that will be used, what the student hopes to achieve with said data, and the steps needed to achieve that goal. Generally speaking, the goal will involve predicting an outcome of some sort, although not necessarily (i.e., we will discuss several methods that can be used in an unsupervised fashion). Students are welcome to speak with the instructor about possible datasets and project ideas at the

beginning of the term, prior to the proposal due date, if they so wish (there are many publicly available datasets spanning many domains).

Project Updates. There will be two project updates throughout the term that will require the student to submit a brief (i.e., one page or less) update on what has been accomplished thus far and what is yet to be done to meet the project goal.

Project Presentation. The last week of the term is reserved for in-class project presentations. The presentation will include a description of the problem being solved, the data, the method/s used, the results, and a discussion of insights gleaned.

Project Report. Each student will prepare a written report of their project. The format will be that of a research paper (albeit more abbreviated). A relevant introduction and abbreviated literature review should be included, as well as sections describing the methodology, data, and experiments. The report will be due during finals week (in lieu of a final exam).

COURSE POLICIES

Communication. Students can expect to receive weekly communications from the instructor (via the "Announcements" section on Canvas) and are responsible for the information communicated therein. Students are also responsible for any official correspondence sent through their University of Kansas email address. Students are expected to use such an email address (i.e. University address) to communicate with the instructor and can expect a response within 24-48 hours. Privacy considerations, such as federal law, may apply when using a non-University address for communication.

Timeliness. **Late work will be penalized**. If you have obligations that conflict with exam/assignment/report due dates, you should contact the instructor as soon as possible and ahead of the due date. Only in extremely rare circumstances will make-up exams be permitted after-the-fact. Equipment failure or conflicting time availability of team members is not an acceptable reason for turning in an assignment late. Late submissions will be penalized 25% of the assignment total each 24 hour period (i.e., after 72 hours, a late assignment will be assigned a 0).

Score/Grade appeals. If you feel that an assigned grade inaccurately reflects your performance, feel free to discuss the matter with the instructor. Timeliness is the responsibility of the student, however. As such, grades that have been assigned for more than one month are not open for appeal.

Software support. The instructor will provide very minimal software support. There is no explicitly provided or used software for this course. As such, students will be responsible for troubleshooting virtually all potential software issues encountered. That said, students are welcome to bring issues to the attention of the instructor who, provided relevant background and experience in the software in question, may be able to assist in troubleshooting the issue.

ACADEMIC CODE OF HONOR

The KU School of Business seeks to develop future leaders with the highest ethical standards. It is through a strong code of conduct that we maintain mutual trust and respect among students, faculty, and staff. This code of conduct was developed by the students, faculty, and staff to articulate the School's core values and provide guidance on academic integrity. This code applies to the conduct of students, faculty, and staff at any function or academic activity conducted by the School of Business at the University of Kansas. See https://business.ku.edu/services/student-academic-services/honor-code.

Academic misconduct in this class will not be tolerated. Academic misconduct is not only an unethical behavior; it also deprives you of educational opportunities. There are many forms of cheating, including but not limited to:

- Possession of course material from previous sessions of this course.
- Plagiarism. All written work will be monitored by plagiarism detection software subscribed to by KU.
- Giving, receiving or unauthorized uses of aids during tests or giving test questions to another student who has not yet taken a given test.
- Following KU policy, posting content found on Canvas or any other class materials to a public website is a violation of intellectual property rights.
- Disrupting class is a violation of the honor code and is classified as behavioral misconduct.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

KU's Academic Achievement & Access Center (http://www.achievement.ku.edu/; 22 Strong Hall; 785-864-4064) coordinates services and accommodations for KU students with disabilities. Any students with disabilities for which they may request accommodation in KU classes should contact AAAC as soon as possible. Students should also contact the instructor privately regarding any requested accommodations.

POSITIVE CODE OF CONDUCT (R-E-S-P-E-C-T)

The School of Business promotes a Positive Code of Conduct based on seven principles:

Responsibility: We will accept and be accountable for the outcomes of our actions, work to exceed expectations, meet established deadlines for assignments, and represent the School of Business in a positive manner.

Enthusiasm: We will exhibit leadership, drive and passion in all of our pursuits both inside and outside of classroom by actively engaging in classroom discussions, events, and student organizations.

Self-Development: We will challenge ourselves to seek out opportunities for self-development, for cultivating belief in ourselves will enable us to foster respect for others.

Professional Integrity: We will be honest, trustworthy and genuine in all interactions.

Equity: We will contribute to the learning community at least as much as we receive, support equal opportunity for all students to learn, and act with respect toward the community and the environment.

Compassion: We will practice care, empathy, and understanding toward others by providing them with support or feedback when it is needed.

Teamwork: We will create an open atmosphere where everyone can contribute ideas and engage in respectful discussion without undue criticism, recognizing the value of a team in working toward a common goal.

COMMERCIAL NOTETAKING

Pursuant to the University of Kansas' Policy on Commercial Note-Taking Ventures, commercial notetaking is not permitted in this class. Lecture notes and course materials may be taken for personal use, for the purpose of mastering the course material, and may not be sold to any person or entity in any form.

Any student engaged in or contributing to the commercial exchange of notes or course materials will be subject to discipline, including academic misconduct charges, in accordance with University policy. Notetaking provided by a student volunteer for a student with a disability, as a reasonable accommodation under the ADA, is not the same as commercial notetaking and is not covered under this policy.

EQUAL OPPORTUNITY

The University of Kansas is proud of its goal to help all individuals realize their potential. To this end, the university is committed to providing an equal opportunity for all qualified individuals to be considered for employment, benefits and conditions of employment, educational programs and activities, regardless of race, religion, color, ethnicity, sex, disability, national origin, ancestry, age, status as a veteran, sexual orientation, marital status, parental status, gender identity, gender expression, or genetic information.

DIVERSITY & INCLUSION

As a premier international research university, the University of Kansas is committed to an open, diverse, and inclusive learning and working environment that nurtures the growth and development of all. KU holds steadfast in the belief that an array of values, interests, experiences, and intellectual and cultural viewpoints enrich learning and our workplace. The promotion of and support for a diverse and inclusive community of mutual respect require the engagement of the entire university.

CONCEALED CARRY LAW

Individuals who choose to carry concealed handguns are solely responsible to do so in a safe and secure manner in strict conformity with state and federal laws and KU weapons policy (refer to **http://concealedcarry.ku.edu/**). Safety measures outlined in the KU weapons policy specify that a concealed handgun:

- Must be under the constant control of the carrier.
- Must be out of view, concealed either on the body of the carrier, or backpack, purse, or bag   that remains under the carrier's custody and control.
- Must be in a holster that covers the trigger area and secures any external hammer in an un-cocked position.
- Must have the safety on, and have no round in the chamber.

Instructors are allowed by Kansas Board of Regents policy, to require backpacks, purses and other bags be placed at the front of the classroom during exams and quizzes, and as such those items will not be under the constant control of the individual. Students who choose to carry a concealed handgun in a purse, backpack, or bag must review and plan each day accordingly, and are responsible for making alternate arrangements as

necessary. The university does not provide appropriate secured storage for concealed handguns. Individuals who violate the KU weapons policy may be asked to leave campus with the weapon and may face disciplinary action under the appropriate university code of conduct.

FREEDOM OF EXPRESSION

Encouraging students to engage in debate and deliberation on any topic in an effective and responsible manner is an essential part of the educational mission of a university. This course does not focus on sensitive or potentially divisive social issues, but regardless it is not the proper role of a university to insulate individuals from ideas and opinions they might find challenging, unwelcome, disagreeable, or even offensive. All university community members share a responsibility to maintain a climate of mutual respect, but concerns about civility and mutual respect should never be used to justify silencing the discussion of ideas. Therefore, consistent with principles of free expression embraced by Purdue University, the University of Chicago, and other institutions, the instructor supports freedom of expression for students to discuss any course-related topic that presents itself.

SCHEDULE (tentative)

Date	Topic	Assigned	Due
Jan 18 (W)	Syllabus and Intro to Machine Learning	1) Paper Presentations 2) Student Background	
Jan 23 (M)	Machine Learning Background Material		1)Student Background 2) Paper Presentations **5pm**
Jan 25 (W)	No Class (Instructor away)		
Jan 30 (M)	Machine Learning Background Material		
Feb 1 (W)	Intro to Neural Networks and Decision Trees		
Feb 6 (M)	Lecture: Presenting Machine Learning Research + Instructor Research Paper Presentation		
Feb 8 (W)	Instructor Research Paper Presentation		
Feb 13 (M)	Tutorial: Intro to Weka (ML GUI)	Project Proposal	
Feb 15 (W)	Tutorial: Intro to Python and Scraping Data from the Web		
Feb 20 (M)	Prof Trambak Banerjee Presentation		
Feb 22 (W)	Tutorial: Continue Scraping Data from the Web and Scikit Learn + Keras/Tensorflow		

Date	Topic		
Feb 27 (M)	Bayesian network classifiers (Shun Dong)	Project Update	Project Proposal **11:59pm**
Mar 1 (W)	Random forests (Shaolin Pu)		
Mar 6 (M)	Q-learning (Aayush Pandit)		
Mar 8 (W)	[RNN] Finding structure in time (Mona Shaheen)		
Mar 13 (M)	**Spring Break: No Class**		
Mar 15 (W)	**Spring Break: No Class**		
Mar 20 (M)	[GAN] Generative adversarial nets (Rushil Mojidra)		
Mar 22 (W)	XGBoost: A scalable tree boosting system (Shun Dong)		
Mar 27 (M)	GloVe: Global vectors for word representation (Shaolin Pu)		
Mar 29 (W)	[LSTM] Long short-term memory (Aayush Pandit)		
Apr 3 (M)	[GRU] Learning phrase representations using RNN encoder-decoder for statistical machine translation (Mona Shaheen)		Project Update **11:59pm**
Apr 5 (W)	[DQN] Human-level control through deep reinforcement learning (Rushil Mojidra)		
Apr 10 (M)	Deep learning for event-driven stock prediction (Shun Dong)		
Apr 12 (W)	[SHAP] A unified approach to interpreting model predictions (Shaolin Pu)		
Apr 17 (M)	[LIME] "Why should I trust you?" Explaining the predictions of any classifier (Aayush Pandit)		
Apr 19 (W)	Physics-informed multi-LSTM networks for metamodeling of nonlinear structures (Mona Shaheen)		
Apr 24 (M)	[Transformers] Attention is all you need (Rushil Mojidra)		
Apr 26 (W)	Michael Lash Research Presentation		
May 1 (M)	Project Work Day		Presentation (due **Tues 11:59pm**)
May 3 (W)	Project Presentations		
May 8 (M)	**Finals Week**		
May 10 (W)	**Finals Week: Project Report Due!!**		Project Report **11:59pm**