



Boston University Questrom School of Business

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## BA865 – Advanced Analytics Topics (Intro to Neural Networks)

*Spring 2024*

### Course Administrative Details

- **instructor:** [Mohannad Elhamod](#) (Contact exclusively through [Piazza](#))
  - **office hours:** Thursday 2:15 pm – 3:15 pm/ HAR 546D or [Zoom](#).
- **TAs:** (Contact exclusively through [Piazza](#))
  - **office hours (all through [Zoom](#)):**
    1. Atharva: Wednesday 10:00 am– 11:0 am. [Zoom](#) only.
    2. Gowtham: Tuesday 12:30 pm – 1:30 pm. [Zoom](#) only.
- **Class time and place:**
  - A1: TR 3:30 pm – 6:15 pm / HAR 304
  - B1: TR 6:30 pm – 9:15 pm / HAR 222

*The instructor reserves the right to update the syllabus at any time.*

### Course Description & Learning Goals

The course will begin with a brief review of relevant concepts in Python and mathematics, before covering theory and implementation of (Deep) Neural Networks to address prediction problems. Students will learn various architectures, including multimodal networks, Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) and attention-based models, employing various types of data (images, text, audio). Implementation will be conducted using PyTorch and Keras, and course material will be presented through a combination of lecture slides and Jupyter notebooks (e.g., Google Colab). By the end of this course, you should be able to demonstrate a conceptual understanding of the various concepts covered in the course, You will also be able to implement various neural network architectures in Python, employing PyTorch and Keras.

### **Diversity & Inclusion Statement**

In this classroom, your value and dignity are recognized. We deeply respect your academic freedom and encourage you to express thoughts, pose challenging questions, and explore diverse viewpoints. We are dedicated to cultivating an atmosphere where everyone feels welcome and respected. Respectful dialogue is not just encouraged—it's essential. Critical thinking is at the heart of our learning process. By upholding these principles, we aim to create an inclusive and intellectually stimulating atmosphere that celebrates the pursuit of knowledge for everyone.

### **Course Materials and Logistics:**

- **Learning platforms and tools:** The following tools will be used during this course:
  - **Datacamp** – Use the following [link](#) to associate your @bu.edu email with the class. Datacamp will host some of the reading materials as well as some assignments/tests. This is specific to this offering:
  - **Github Account** - All slides and class resources will be found through this [Github repository](#).
  - In addition to the above, it is assumed that you have the ability to analyze data via **Python in Google Colab**.
  - **SCC (Shared Computing Cluster)** – Deep Learning has high computational demands. While Google Colab should be sufficient for in-class exercises and possibly assignments, it will not suffice for larger datasets and/or more complex analyses (e.g., in projects). As such, you have been provided access to SCC to address your needs. To use [SCC](#), please refer to the [SCC-guide - Jupyter Notebook.pdf](#) for guidance. We have a limited number of compute hours. So, please use allocations wisely. Finally, when facing issues, ask the professor or TA for help first. Do not contact IT support until authorized by your instructor!
- **Textbooks and supplemental material:** While there isn't a required textbook for this course, the following two books are excellent resources and are highly recommended for deep learning with PyTorch and Keras:
  - [Deep Learning with PyTorch](#)  
Eli Stevens, Luca Antiga, and Thomas Viehmann  
ISBN 9781617295263
  - [Deep Learning with Python](#)  
François Chollet  
ISBN 9781617296864
- **Class format:** A typical session will begin with an informative lecture introducing new concepts. This will be followed by an interactive, hands-on segment designed to deepen understanding and allow for practical application of these concepts from both a technical and real-world perspective.

## Course Policies

### - Contact Policy

All communications for this course will exclusively be through [Piazza](#). This includes sending messages to your instructors privately or posting and replying to questions and discussion topics. When posting a question to your instructor/TAs, make sure it is posted to ALL of them. This helps getting your question answered promptly. Any communiques sent through Blackboard or direct email will most likely not receive attention. For a tutorial on how to use Piazza, please refer to this [video](#).

### - Attendance Policy

Satisfactory class contributions require regular attendance (including arriving to class on time); preparation of all materials for every session; and active, quality participation in class discussions. Simply attending class, however, does not constitute a positive contribution to class and will not yield high class contribution scores. Class attendance will be taken through <https://www.polleverywhere.com/> 15 minutes after the start of the class at the latest. Two unexcused late attendances will count as an unexcused absence.

The following table outlines the penalty for missing/arriving late to classes:

Number of unexcused absences or late arrivals	Penalty
2	-
3	3 points
4	6 points
6	An entire letter grade of final grade.
7 or more	Failing the course

Finally, for 'excused absences' (See policy [here](#)), the instructor will, where feasible, help arrange for missed graded components.

### - Academic accommodations for students with special needs

In keeping with university policy, any student with a disability who needs or thinks they need academic accommodations must call the Office of Disability Services at 617-353-3658 or stop by 19 Deerfield Street to arrange a confidential appointment with a Disability Services staff member. Accommodation letters must be delivered to your instructor in a timely fashion (not later than two weeks before any major examination). While your instructor is happy to accommodate reasonable requests when possible, please note that accommodations may still not be delivered absent an official letter of accommodation.

### - Academic Integrity Policy

- **Standard policy:** Please refer to the [university's general academic integrity policy](#) and [code of conduct](#). Unless specifically instructed to the contrary, these policies will be enforced.
- **Use of AI:** We live in interesting and disruptive times where technology is moving faster than our ability to grapple with it. Still, integrating the latest technological tools into your knowledge and skillset is more important now than ever. During this course, **occasionally, you will be allowed to use AI tools, but only under specific conditions set by your instructor for each task. Unless explicitly instructed, the use of AI for a task is strictly**

**forbidden.**

If AI use is permitted, you must clearly disclose the prompts you used and properly credit the AI tool(s) in APA Style. You may also be required to provide evidence of your prompts and the AI's responses. It is important to note that simply replicating AI-generated content without any intellectual engagement will be regarded as plagiarism. Non-compliance with these rules constitutes a violation of the honor code and will result in appropriate disciplinary actions.

- **Project Collaboration:** The ultimate goal of education is to help you prepare for success in real-life. Recognizing the critical role of teamwork and communication in professional environments, this class includes a project component. In this component, teams of 3-4 students will work together to produce results. However, it's crucial to **remember that each student is expected to fully grasp, discuss, defend, and take ownership of the entire project.** Therefore, all team members must actively engage in various aspects of their projects, including research, coding, documentation, and presentation. This ensures a comprehensive understanding and contribution from every member. Significant imbalances in the distribution of responsibilities or the type of work undertaken by team members will result in penalties.
- **Citations and References:** For all submissions, you are required to provide citations and references to any articles, repositories, or other materials you use. Omission will lead to losing points.

- **Professional Conduct Policy**

- **Cellphones are prohibited** unless specifically allowed by the instructor for certain in-class activities.
- **Place your name tent:** This helps your instructor learn your names. *It is also needed so your TA could record your participation in class. Please, add your formal name as shown on Blackboard so the TAs could identify you.*
- **Bring your laptop:** You will be required to use your laptops for in-class activities such as coding. While laptops and tablets are acceptable for notetaking, ensure they are not to cause disruptions or distractions. Also, don't forget your power cords.
- **Food and drinks are not allowed**, except for water. A 15-minute break will be provided midway through the class.

**Course Evaluation & Expectations**

For details on Questrom's program-wide guidelines for grading MSBA courses, please refer to the following [link](#). If you have any questions about grades that you receive on particular assignments, you must raise them within a week of receiving your grade on that assignment. If you have particular grade-related considerations that you think are important, please raise these with your instructor as early as possible (during the first half of the semester at the latest!), so that your instructor can help you approach the course in a way that will help you achieve your best possible performance.

Grades will be determined according to the following table:

Grading Component	Percent of Course Grade
Class preparation and participation	15%
Two Individual Assignments	35%
Team project	25%
Final Exam	25%
<b>Total</b>	<b>100%</b>

- **Final Exams (25%):** The exam will be based on class notes, in-class discussions and exercises, and individual assignments outside of class. Anything discussed in class can be tested, unless explicitly excluded. Therefore, being present and participating in class and working through the individual assignments and DataCamp chapters is critical for success on the exams. The exam format will be mostly short-answer questions and problem sets aimed at assessing analytical reasoning and ability to produce insights using python. As part of the exam, you may be required to submit a Python notebook as a standalone file, including module installation statement at the outset of your script, such that the script can be executed by the grader within a clean Google Colab environment, without error or modification.
- **Class Preparation and Participation (15%):** Regularly engaging in discussion of the topics, asking questions that lead to better understanding of a concept by the class as a whole, clarifying concepts, and sharing professional experience about course topics constitute superior class participation and contribute to our collective learning. Simply attending class is not a pathway to full credit. Multiple minor contributions may constitute a single significant contribution.  
You will also be given some material to view and/or tasks to complete before class. In addition to contributing to your final grade when completing these deliverables on time (by 11:59 PM), they will better prepare you for in-class discussion and understanding.

	7.5%	5%	2.5%	0%
Participation (7.5%)	At least 3 significant contributions throughout the course	At least 2 significant contributions throughout the course	At least 1 significant contribution throughout the course	No contributions
Pre-class deliverables (7.5%)	Completing at least 75% of the assigned deliverables	Completing at least 50% of the assigned deliverables	Completing at least 25% of the assigned deliverables	No deliverables completed

- **Individual Assignments (35%):** The individual assignments are intended to reinforce the fundamentals covered within the course while simultaneously building skills using tools commonly found in today's data science pipelines. Assignments are always due based on the posted date and time, even if you are unable to attend class that day. These assignments are graded on two dimensions: technical accuracy (e.g. the code functions properly and is consistent with the stated problem) and analytical reasoning and presentation of the results. All assignments are to be completed individually. **You may discuss with other students, but you cannot / should not copy/share code or collaborate directly with other students.** You are required to submit a Python notebook as a standalone file, including module installation statement at the outset of your script, such that the script can be executed by the grader within a clean Google Colab environment, without error or modification.
- **Team Project (25%):** In assigned teams of 2-3 students, work on a problem to evaluate your practical and conceptual understanding of the course material. Pick a real-world topic that interests you and/or is relevant to your career, where neural network-based predictions can be applied to add real value. The problem domain you identify and the dataset you work with will ideally involve some form of text, audio or image data, to make the application of neural network methods most relevant. You are expected to conduct in-depth research on the topic/problem, to motivate your project. You will need to meet a few milestones along the way:
  - present your work and findings in a 10–15-minute presentation on the 12th session. Attendance is mandatory. The following are the detailed project steps/deliverables:
    - Students will be allowed to self-select their groups.
    - **Deliverable 1 (15% of project grade), A 1-page project proposal:** The proposal should summarize (a) the problem that motivates the analysis you will conduct, (b) the data set you plan to use, and if possible (c) your proposed analysis methodology.
    - **Deliverable 2 (10% of project grade),** Attend a mid-point check-in with me to ensure you are on track (5% of project grade). Signup for a 15-min in-person meeting with me during regular class time on April 16th. When you are not meeting with me, you can be collaborating with your group members to make progress on the project. During this meeting, you will need to demonstrate your initial analysis of the data and some preliminary results.
    - **Deliverable 3 (75% of project grade):**
      - Submit a final deliverable that summarizes everything you have learned/completed on the topic (30% of project grade). This deliverable will take the form of a blog post, explaining your project background/motivation, data, your neural network architecture, and the performance of your model, employing in-line code samples or visuals along the way to clarify points. Note that I am not asking you to publish a post to Medium; this is merely a point of reference for style / formatting purposes. The blog should discuss (a) the problem, (b) the data, (c) the methods applied and (d) your analytical findings, conclusions and recommendations as they relate to your business problem.
      - Deliver a 15–20-minute presentation on the date indicated on the course schedule (30% of project grade). The expectation is that you will motivate the research by covering background on the topic, you will explain your dataset, you will introduce your neural network and its architecture, and you will explain your evaluation of your model's performance. All group members are expected to participate in the presentation.

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- You will also complete a peer-evaluation component where team members evaluate each other's contributions. Peer evaluation will count as 15% of the overall project grade.
- **Late Submission:** 10% will be deducted from a deliverable grade for each midnight that passes following the deadline indicated in the course schedule, until a deduction of 30% has been reached, beyond which a grade of 0 will be assigned.

### Other Logistics

- **Blackboard Usage:** Though several learning platforms and tools are used in this class, Blackboard will act as the hub from where all information can be found. All deliverables and their deadlines will be posted through Blackboard. It is essential you pay close attention to announcements, which contain critical information, such as schedule updates, assignment feedback, and other valuable discussions. Also, your instructor will regularly update the class website with fresh materials and assignments. And while a weekly announcement will generally be sent as a reminder, it is still your responsibility to setup your email alerts appropriately and regularly for any updates in the schedule, assignments, or reading materials.

### Course Schedule

Note that while the following table provides a holistic overview of the course's schedule, it is only meant to give general guidance. The exact dates, topics, readings, and deliverables will be posted on Blackboard. Whenever there is a conflict between the syllabus and Blackboard, Blackboard is correct.

Session	Date	Readings/Podcasts/Datacamp	Learning Goals	Deliverable
1	3/19	<b>Datacamp: What is Machine Learning?</b>  <b>Datacamp: Machine Learning Models</b>	Course Intro: Review of ML.	
2	3/21	<b>Datacamp: Deep Learning</b>	The Math of Neural Nets.	
3	3/26	<b>TBD</b>	Intro to NNs: The Multi-Layer Perceptron (MLP).	<b>Team Project Formation DUE</b>  <b>Project proposal RELEASED</b>

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4	3/28	<b>TBD</b>	Intro to Convolutional Nets (CNNs)	<b>Assignment 1 RELEASED</b>
5	4/2	<b>TBD</b>	Convolutional Nets (continued)	<b>Project Check-in RELEASED</b>  <b>Project proposal DUE</b>
6	4/4	<b>TBD</b>	Auto-Encoders	
7	4/9	<b>TBD</b>	Recurrent Nets (RNNs)	<b>Assignment 2 RELEASED</b>  <b>Assignment 1 DUE</b>
8	4/11	<b>TBD</b>	Recurrent Nets (RNNs) (continued)	<b>Final Project Deliverable RELEASED</b>
9	4/16	<b>TBD</b>	Attention and Transformers  <b>Project Check-in</b>	
10	4/18	<b>TBD</b>	Attention and Transformers (continued)	<b>Assignment 2 DUE</b>
11	4/23	<b>TBD</b>	<i>Advanced topics in Deep Learning: Interpretability, Bias, Ethics, Privacy, and Generalizability</i>	
12	4/25	<b>TBD</b>	<b>Project Presentations</b>	<b>Final Project Deliverable DUE</b>
13	4/30	<b>TBD</b>	<b>Final Exam</b>	