MS in Artificial Intelligence
Course: Natural Language Processing
Credits: 3.0
Prerequisites: Python and Programming, Linear Algebra, Probability and Statistics, Basic Calculus, and Deep Learning Introductory Courses

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COURSE DESCRIPTION

The course will be an introductory course in natural language processing – the study of human language from a computational approach-- using Python in applications.

COURSE LEARNING OUTCOMES

The course objectives will include the following:
- Foundational understanding of natural language processing approaches: rule-based and machine based
- Ability to distinguish across the various techniques and basic theory among the NLP approaches
- Exposure to practical applications of Natural Language Processing using Python

REQUIRED TEXTS & SUGGESTED READINGS

Required readings will be provided throughout the semester, but here are the textbooks that are often referred to:

Textbooks
- [Speech and Language Processing (3rd ed. draft)](). Jurafsky and Martin.
- Jacob Eisenstein. [Natural Language Processing]()
- Michael A. Nielsen. [Neural Networks and Deep Learning]()

Software Requirements
Below are the software instance options that you may choose to install locally to your computer to conduct the work outlined in this class:
- A code editor (e.g., [Notepad ++](), [Visual Studio](), etc.)
- Python 3.0 and an associated IDE (e.g., Jupyter)
- [Google Colab]()

ASSIGNMENTS & GRADING

Use this area to describe your breakdown on grades. Below is an example:

Assignment	Grade Weight
Participation in Live Sessions and Readings for Discussion	30%
Assignments	40%
Quizzes/Stick-checks	10%
Final Project	20%

Participation in Live Sessions and Readings for Discussion. Participation in live sessions will be 30% of your overall grade. Missing more than one class could significantly impact your ability to pass. Thus, it is imperative that you make these classes. You will also be assessed on your participation during class discussions which could range from guest lectures to class demonstrations, to asks to share your screen and demonstrate an in-class group activity. In some cases, there may be readings required in advance of the session. Weekly readings may be assigned and will be available for you to support your class.

Assignments. In this class, participation and completion of assignments are critical. Assignments are problem sets typically using Python and the mode of submission will typically be a written summary and a code output. In some cases, the assignment shall be a preparation for a presentation on a selected topic in the class or preparation for the Final Project.

Quizzes/Stick-checks. Stick checks are embedded in each module and could take the form of a quiz, case study or brief exercise.

Final Project. As a class, we will split up into teams. Teams develop a project that incorporates the spectrum of content covered in the class. The project will provide students with the opportunity to solve a real-world problem using NLP techniques. We will have three components to the project: Literature Review, Dataset Creation, and Final Project Delivery.

The project will have several components:
- Peer Score
- Design and Planning
- Development of the Solution
- Written academic paper
- Presentation

Yeshiva Grading Scale

ACADEMIC GRADES				ADMINISTRATIVE GRADES	
Quality of Performance	**Letter Grade**	**Range %**	**GPA/Quality Pts.**	**GRADE**	**DESCRIPTION**
Excellent - work is of exceptional quality	A	94- 100	4	G	Stopped attending without filing an official withdrawal form (counted as failure)
	A-	90 – 93.9	3.7	I	Incomplete
Good - work is above average	B+	87 - 89.9	3.3	L	Audit (no credit)
Satisfactory	B	83 - 86.9	3	W	Withdrawal without penalty or prejudice
Below Average	B-	80 - 82.9	2.7		
Poor	C+	77 - 79.9	2.3	Note that credit is given only for grades A through C and P. No credit is given for grades F, G, I, L, N, or W.	
	C	70 - 76.9	2		
Failure	F	< 70	.000		

KATZ SCHOOL CLASS ATTENDANCE POLICY

Students are expected to attend all scheduled classes in their entirety. Students who fail to fulfill this requirement will receive an academic penalty appropriate for the course work missed.

Students may not miss 30% or more of their scheduled class. If a student misses 30% or more of a course during the semester, they will receive a final grade of "F." This grade will be reflected on the student's official university transcript.

If the student is absent because of a disability which is documented with the Office of Disability Services at Yeshiva, falls ill or there are other extenuating circumstances, the student must inform the instructor in advance. The instructor may require appropriate documentation to make any exception to this policy.

Course Schedule

The standard week for all courses in the program begins on Monday and concludes the following Sunday. However, weekly modules will open every Friday morning to allow you to get a head start on the next module's work. Please check the due dates in the course schedule for weekly assignments.

Week	Title	Topic(s)	Assignments

1	Introduction to Natural Language Processing and Deep Learning	- Rule-Based vs Machine Based Approach - Logit - Python Refresher	- Module 1 – Exercise/Quiz - Assignment 1 Available
2	Regular Expressions and Word Vectors String Edit Distance	- NLTK, Numpy, Pytorch Python 3 and the Jupyter Notebook - Introduction to HPC Levenshtein Distance/ Jaro-Winkler	Module 2 – Exercise/Quiz
3	Word Vectors I	- Words as Discrete Symbols - Distributed Representation - Distributional Semantics - n-grams	- Assignment 2 Available - Assignment 1 Due - Module 3 – Exercise/Quiz
4	Word Vectors II	- Word Senses - Skip-grams (SG) - Continuous Bag of Words (CBOW) - Naïve-Bayes - Spam Detection - How to reduce dimensionality? - Singular Value Decomposition - Reduced SVD – Least Squares	Module 4 – Exercise/Quiz
5	Word Vectors III	- Vector Semantics and Introductory Word Embeddings - Global Vectors for Word Representations (GloVe) - Singular Value Decomposition - Reduced SVD – Least Squares - Extrinsic vs Intrinsic Evaluation	Module 5 – Exercise/Quiz
6	Neural Network-Based Approach, Word-Window Classification	- Deep learning concepts: - Recurrent Neural Network (intro) - Feed-forward network or Multi-Layer Perceptron (MLP) - Cross-entropy loss function and gradient descent optimization	- Assignment 2 Due (Group Assignment) - Assignment 3 Available - Module 6 – Exercise/Quiz
7	Linguistic Structure: Dependency Parsing	- Named Entity Recognition and Speech Parsing - Segmentation and Type Ambiguity - POS tagging	Module 7 – Exercise/Quiz
8	RNN and Language Modeling	- Recurrent Neural Network - Long Short-Term Memory (LSTM) Introduction - Inference and Training models - Generative RNN	Module 8 – Exercise/Quiz
9	RNN and LSTM, Seq2Seq and Machine Translation	- Stacked and Bi-Directional RNN - Managing context in RNN: LSTM and GRU - Word order and lexical gap - Encoder-Decoder/Seq2Seq Model - BEAM search	- Module 9 – Exercise/Quiz - Assignment 3 Due - Assignment 4 Available

10	Context Free Grammer ConvNets/CNN for NLP	● Constituency ● Narrow vs. Wide convolution	● Module 10 – Exercise/Quiz
11	Contextual Word Representation: BERT and ELMO I	● Neural supervised relation classifiers and sentence classification	● Module 11 – Exercise/Quiz ● Assignment 4 Due ● Assignment 5 Available
12	Contextual Word Representation: BERT and ELMO II	● ELMo: Embeddings from Language Models ● biLSTM	● Module 12 – Exercise/Quiz
13	Ethics	● Ethical considerations in Natural Language Processing Algorithms	● Module 13 – Exercise/Quiz ● Assignment 5 Due
14	Class Wrap-Up	● Next steps in NLP ● Final Project Office Hours	● No Assignments or Quizzes
15	Final Project Presentations	● Final Project Presentation	● Final Project Due

ONLINE AND/OR BLENDED LEARNING POLICIES

Online Learning Engagement Policy

A successful online class only happens when there is an active community. Students are required to
attend both the weekly live synchronous sessions and participate in other community building activities such as the discussion boards.

Netiquette

Netiquette is a set of rules for behaving properly in an online course. Often the anonymity of online courses can cause a lapse in judgement when learners are excited or passionate about a subject. This can lead to statements that could be demeaned as offensive. You are all adults and are treated as such. However, it is still important to talk about these issues. The following bullet points cover some basics communicating in an online course:

- Be sensitive to the fact that there will people with different cultural and linguistic backgrounds, as well as different political and religious beliefs.
- Use good taste when composing your responses in Discussion Forums. Swearing and profanity is also part of being sensitive to your classmates and should be avoided.
- Don't use all capital letters when composing your responses as this is considered "shouting" on the Internet and is regarded as impolite or aggressive.
- Be respectful of your others' views and opinions. Avoid "flaming" (publicly attacking or insulting) them as this can cause hurt feelings and decrease the chances of getting all different types of points of view.

- Be careful when using acronyms. If you use an acronym it is best to spell out its meaning first, then put the acronym in parentheses afterward, for example: Frequently Asked Questions (FAQs). After that you can use the acronym freely throughout your message.
- Use good grammar and spelling (avoid using text messaging shortcuts).
- If you aren't sure what someone meant, consider asking for clarification.
- Remember that your peers are not required to respond to your specific post, so don't be offended if your question goes unanswered.

UNIVERSITY POLICIES AND RESOURCES

KATZ SCHOOL POLICIES
Click here and select "Katz School" Polices.

ACCESSIBILITY AND ACCOMMODATIONS
The Office of Disability Services collaborates with students, faculty and staff to provide reasonable accommodations and services to students with disabilities. Students with disabilities who are enrolled in this course and who will be requesting documented disability-related accommodations should make an appointment with the Office of Disability Services by calling (646) 592-4132 or emailing rkohn1@yu.edu, during the first week of class. Once you have been approved for accommodations, please submit your accommodation letter to ensure the successful implementation of those accommodations. For more information, please visit: https://www.yu.edu/Student-Life/Resources-and-Services/Disability-Services

ACADEMIC INTEGRITY
The submission by a student of any examination, course assignment, or degree requirement is assumed to guarantee that the thoughts and expressions therein not expressly credited to another are literally the student's own. Evidence to the contrary will result in appropriate penalties.
Academic integrity is a set of responsibilities and standards to facilitate high academic quality and rigor with the purpose of clarifying expectations and student conduct. The submission by a student of any coursework, or degree requirement is assumed to guarantee that the thoughts and expressions therein not expressly credited to another are literally the student's own. Examples of violations on academic integrity are, but not limited to:
- Cheating
- Plagiarism
- Dishonesty
- Assisting or attempting to assist another student in an act of academic dishonesty
- Providing papers, essays, research, or other work to aid another student in Intentional Misrepresentation
- Engaging in unauthorized cooperation with other individuals in completing assignments or examinations
- Submitting the same assignment, in part or whole, in more than one course, whether at YU or another institution, without prior written approval from both faculty members.

For more information, visit http://yu.edu/registrar/grad-catalog/

YU Refund Policy
You should be aware of the universities refund policy. Please review this information:
https://www.yu.edu/osf/undergraduate-accounts/withdrawal.

Academic Calendar
You should review the academic calendars, including add/drop dates. Please review this
information: https://www.yu.edu/registrar/grad-calendar.

STUDENT SUPPORT SERVICES
Katz School offers academic support through the Learning Hub. This support service includes
writing, academic integrity (APA format), English as a Second Language, and general academic
tutoring. For more information, please contact katz@yu.edu.

If you need any additional help, please visit Student Support Services at
http://yu.edu/academics/services/