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**PennState**  
World Campus

# AI 574: NATURAL LANGUAGE PROCESSING

## COURSE DESCRIPTION

(3 credits) Natural Language Processing (NLP) is a subfield of Artificial Intelligence. This course covers basic as well as advanced concepts to gain a detailed understanding of NLP tasks such as language modeling, text-to-speech generation, natural language understanding, and natural language generation. Students will learn the necessary skills to design a range of applications, including sentiment analysis, translating between languages, and answering questions. Throughout the course, the practical implementation of these applications with deep neural networks is also discussed.

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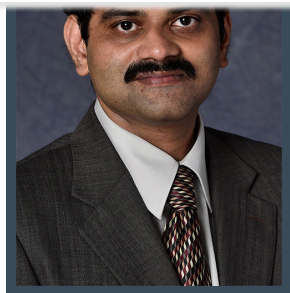
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**DAAN/AI FACULTY: Dr. Satish Mahadevan Srinivasan**

**Associate Professor of Information Science, Engineering Division**

**Email:** [sus64@psu.edu](mailto:sus64@psu.edu)

## OVERVIEW

This course presents an overview of statistical natural language processing. However, it mainly focuses on representation learning and deep neural networks to quickly build breakthrough NLP systems (e.g., question answering) using single end-to-end neural networks, instead of relying on a pipeline of separate intermediate tasks (e.g., part-of-speech tagging and dependency parsing). The course also covers the main theory and cutting-edge research in NLP and emphasizes hands-on experience and assignments to implement many of the algorithms discussed in class.

Throughout this course, you will learn to implement NLP tasks presented in each lesson, ranging from text classification to language models, automatic machine translation, dialogue systems, and speech recognition via hands-on assignments. Throughout the course, the practical implementation of these applications with deep neural networks is also discussed. You will also have the opportunity to prove your skills by building small projects using Keras/ Tensorflow and NLTK.

**\*This course has two prerequisites: AI 801 (Foundation of Artificial Intelligence) and DAAN 570 (Deep Learning).**



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in Natural Language Processing. After successfully completing this course, you will be able to:

- Demonstrate understanding of natural language processing tasks, models, and techniques.
- Identify suitable representation models for natural language problems.
- Implement end-to-end NLP systems.
- Evaluate, validate, optimize, and fine-tune NLP systems' performance and accuracy.
- Evaluate safety, bias, and ethics issues related to models of natural language processing.

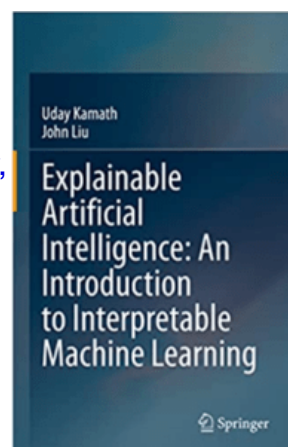
## COURSE MATERIALS

There are no required textbooks for this course. However, you may find the following text to be beneficial:



### Recommended Textbook

- Kamath, U., Liu, J., Whitaker, J. (2019). Deep Learning for NLP and Speech Recognition (1st. ed.). Springer Publishing Company, Incorporated. ISBN: 978-3030145958.
  - A free PDF version of the *Deep Learning for NLP and Speech Recognition* is available via the Springer website, where you can download a digital copy.
  - If you'd prefer a physical copy, you may purchase the textbook from a vendor of your choice.



### Required Software

Instructions on how to access the required software will be provided in Lesson 2.

- Anaconda: <https://www.anaconda.com/download/>
- Jupyter, as the web-based interactive shell.



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assignments should be directed to your course instructor.

If you have any technical difficulties using the tools within this course, please contact the Penn State Helpdesk.

- **HelpDesk Website:** <https://www.it.psu.edu/support/>
- **HelpDesk Email:** [techsupport@worldcampus.psu.edu](mailto:techsupport@worldcampus.psu.edu)
- **HelpDesk Phone:** (800) 252-3592

## CONTACT INFORMATION

All course-related e-mails should go through Canvas's course mail function (Canvas Inbox). Using Canvas to contact your instructor ensures that your message will be read, and your instructor will respond to you in a timely manner.

## USING THE LIBRARY

Many of the University Libraries' resources can be utilized from a distance. Through the Library website, you can access magazines, journals, and articles; borrow materials and have them delivered to your doorstep; and get research help via email chat or phone from a librarian.

For more information, view the [Penn State University Library](#) website.

\*\*\*You must have an active Penn State Access Account to take full advantage of the Libraries' resources and services. Once you have a Penn State account, you will automatically be registered with the library within 24–48 hours. If you would like to determine whether your registration has been completed, visit the [Libraries home page](#) and select **My Account**.

## COURSE REQUIREMENTS AND GRADING

**\*Grades will be based on the following scale:**



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Assignment	Points Each	Quantity	Final Grade)
Assignments	100	3	30%
Scientific Reading	100	1	8%
Project Proposal	100	1	10%
Project Presentation	100	1	10%
Project Deliverable	100	1	30%
Discussion Forums	5	5	10%
SEEQ survey	100	1	2%

### Assignment Details



## Final Programming Project

Throughout this course, you will work in teams of 2-3 students to create an NLP Project. Please read the Project Description provided in the Student Resources module thoroughly. Do not hesitate to contact your instructor if you need additional guidance or support.

Please contact your group members and begin discussing the project within the first two weeks of the course. To locate your group, select People from the course navigation menu and click on the Groups tab. Join your assigned group and visit the group homepage. On your group homepage click the People tab to see the names of students in your group.

A Project Proposal and Preliminary Write-Up for your project will be due in Week 5. Your team will prepare a project proposal and preliminary write-up in a MS Word document (2-3 pages)

The final project will be due at the end of the course and will consist of the deliverables outlined on the Project Description page. Your instructor will create team folders on OneDrive for each



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## Scientific Reading

You will be assigned a scientific paper on various topics related to NLP and you will write a review in your own words. You are expected to work independently on the paper and use whatever material that you have at your disposal. Scientific Reading & Review is worth 10% of your grade.



## Assignments

Assignments will be given periodically throughout this course. Due dates are specified in the syllabus. Assignments will constitute 30% of your final grade. Completing the Assignments promptly and carefully is necessary for learning the material. Collaboration with fellow students is allowed and encouraged on Assignments. However, each student must turn in their own written work which reflects their own understanding of the material. Please be sure to complete all parts of each question and upload your completed file to the assignment by the due date indicated in the Course Syllabus.

*Please Note: After you have submitted an assignment, you will typically be able to review your grade and any comments made by your instructor within 7 days after the due date. This process is used for all homework assignments, exams, or other graded submissions. Some instructors may also send you a message informing you that the assignment has been graded. Some instructors may choose to release all the grades to all students at once; other instructors may release grades per student one at a time.*

## Grading

Within 3-5 days after you have submitted an assignment, you will be able to review your grade and any comments made by your instructors. This process is used for all homework assignments, exams, quizzes, projects, papers, or other graded submissions. Some instructors may also send a message to your inbox informing you that the assignment has been graded.

Some instructors for some assignments may choose to release all the grades to all students at once; other instructors may release grades per student one at a time.

Additional questions about grading procedures can be addressed by posting to the General Discussion Forum or by sending a message to the course instructor.



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(.doc), or Portable Document Format (PDF) documents. Material that you submit for the course assignments must be submitted to the appropriate Lesson assignment and should be submitted as PDF files, .DOC, .DOCX files, and in appropriate cases, PowerPoint or Excel files. In most cases, I can read files from open-source equivalents. If I can't read a particular file, I will let you know and ask for you to convert it to one of the above formats. Thank you.

## Policy on Late/Missing Assignments

Late Assignment Policy will be strictly applied in this course. If a personal emergency should arise that affects your ability to turn in an assignment in a timely fashion, you must contact me **BEFORE** the deadline to get a "Special Late Submission Approval".

Without the "Special Late Submission Approval"; Exercises and Assignments submissions will be still accepted up to 7 days late, **but with a 10% penalty per day.**

- **No "Special Late Submission Approval" will be granted after the deadline.**
- **No submission will be accepted after 7 days from the submission deadline.**

## Specifications for Writing and Submitting Assignments

- Homework must be submitted in .doc, .docx, or PDF files.

## Netiquette: Internet Etiquette Guidelines

*A few basic reminders:*

- It is generally bad form to type your messages IN ALL CAPITAL LETTERS. In addition to proper capitalization (first words of sentences, proper nouns, names, etc.), a majority of online students have reported that complete sentences and punctuation make online text communication easier to read.
- It is much better **not** to post inflammatory or accusatory remarks than it is to "get it off of your chest." Profanity and personal attacks *will have no part* of this course. If you discover such remarks, please notify me immediately, and I will personally address the source of those remarks

## UNIVERSITY POLICIES AND RESOURCES

Be sure to review the University Policies and Resources which includes important





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## COURSE SCHEDULE

The schedule below outlines the topics we will be covering in this course, along with the associated time frames and assignments.

**Please note:** All submissions must be submitted to the proper assignment in Canvas prior to 6:00AM EST on the Monday following the lesson week unless otherwise noted.

- **Course Begins:** May 12, 2025
- **Course Ends:** August 17, 2025

<b>Timeframe:</b>	May 12 - May 18
<b>Readings:</b>	<ul style="list-style-type: none"><li>• Read the Course Syllabus and Course Schedule thoroughly</li><li>• Read the Lesson Content</li></ul>
<b>Activities and Assignments:</b>	<ul style="list-style-type: none"><li>• Connect with classmates and help build our learning community in the <i>Introduction Activity Discussion Forum</i></li><li>• Participate in the Lesson 1 Discussion Forum</li></ul>

### Lesson 1: Overview of Natural Language Processing (NLP)

<b>Timeframe:</b>	May 19 - May 25
<b>Readings:</b>	<ul style="list-style-type: none"><li>• Read the Lesson Content</li><li>• Read or view any supplementary Python materials (PowerPoint or video tutorials)</li></ul>
<b>Activities and Assignments:</b>	<ul style="list-style-type: none"><li>• Contact your Group members and begin discussing the NLP Project</li><li>• Download and Install Anaconda and</li></ul>





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## Lesson 2: Extracting and Processing Text Data

<b>Timeframe:</b>	May 26 - June 1
<b>Readings:</b>	<ul style="list-style-type: none"><li>• Read the Lesson Content</li><li>• Optional: View <a href="#">Supplemental Resources</a></li></ul>
<b>Activities and Assignments:</b>	<ul style="list-style-type: none"><li>• Continue to work with your group on the NLP Project</li><li>• Participate in the <a href="#">Lesson 3 Discussion Forum</a></li></ul>

## Lesson 3: Common NLP Tasks

<b>Timeframe:</b>	June 2 - June 8
<b>Readings:</b>	<ul style="list-style-type: none"><li>• Read the Lesson Content</li><li>• Optional: View <a href="#">Supplemental Resources</a></li></ul>
<b>Activities and Assignments:</b>	<ul style="list-style-type: none"><li>• Continue working on the NLP Project</li><li>• Participate in the <a href="#">Lesson 4 Discussion Forum</a></li></ul>

## Lesson 4: Vector Semantics and Embeddings

<b>Timeframe:</b>	June 9 - June 15
<b>Readings:</b>	<ul style="list-style-type: none"><li>• Read the Lesson Content</li></ul>



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- Start working on State of the Art related to your project (Due at the end of Lesson 7)

## Lesson 5: Convolutional Neural Networks for Text Classification

<b>Timeframe:</b>	June 16 - June 22
<b>Readings:</b>	<ul style="list-style-type: none"> <li>• Read the Lesson Content</li> <li>• Optional: View the <a href="#">Supplemental Resources</a></li> </ul>
<b>Activities and Assignments:</b>	<ul style="list-style-type: none"> <li>• Continue working on State of the Art</li> <li>• Submit <a href="#">Assignment 1</a></li> <li>• <a href="#">Continue working</a> on the NLP Project</li> </ul>

## Lesson 6: Sequence Processing with RNN

<b>Timeframe:</b>	June 23 - June 29
<b>Readings:</b>	<ul style="list-style-type: none"> <li>• <a href="#">Read the Lesson Content</a></li> <li>• <a href="#">Optional: View the Supplemental Resources</a></li> </ul>
<b>Activities and Assignments:</b>	<ul style="list-style-type: none"> <li>• <a href="#">Submit your Scientific Reading and Review Paper</a></li> <li>• <a href="#">Submit Mid-course Survey</a></li> <li>• Continue working on the <a href="#">NLP Project</a></li> </ul>

## Lesson 7: Language Modeling

<b>Timeframe:</b>	June 30 - July 6
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**Activities and  
Assignments:**

- Submit Assignment 2

## Lesson 8: Transformers and Attention

<b>Timeframe:</b>	July 7 - July 13
<b>Readings:</b>	<ul style="list-style-type: none"><li>• Read the Lesson Content</li><li>• Optional: View the Supplemental Resources</li></ul>
<b>Activities and Assignments:</b>	<ul style="list-style-type: none"><li>• Continue working on the NLP Project</li></ul>

## Lesson 9: Machine Translation and Seq2Seq

<b>Timeframe:</b>	July 14 - July 20
<b>Readings:</b>	<ul style="list-style-type: none"><li>• Read the Lesson Content</li></ul>
<b>Activities and Assignments:</b>	<ul style="list-style-type: none"><li>• Submit Assignment 3</li><li>• Continue working on the NLP Project</li></ul>

## Lesson 10: Transfer Learning

<b>Timeframe:</b>	July 21 - July 27
<b>Readings:</b>	<ul style="list-style-type: none"><li>• Read the Lesson Content</li></ul>



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## Lesson 11: Chatbot/Conversational AIng

<b>Timeframe:</b>	July 28 - August 3
<b>Readings:</b>	<ul style="list-style-type: none"><li>• <a href="#">Read the Lesson Content</a></li></ul>
<b>Activities and Assignments:</b>	<ul style="list-style-type: none"><li>• Continue working on the NLP Project</li></ul>

## Lesson 12: Speech Recognition

<b>Timeframe:</b>	August 4 - August 10
<b>Readings:</b>	<ul style="list-style-type: none"><li>• <a href="#">Read the Lesson Content</a></li></ul>
<b>Activities and Assignments:</b>	<ul style="list-style-type: none"><li>• Participate in the Lesson Discussion activities</li><li>• Continue working on the NLP Project</li><li>• <b>SEEQ Evaluation Form</b></li></ul>

## Lesson 13: Advanced Topics in NLP and End-to-End NLP Process

<b>Timeframe:</b>	August 11 - August 17
<b>Readings:</b>	<ul style="list-style-type: none"><li>• No assigned readings</li></ul>
<b>Activities and Assignments:</b>	<ul style="list-style-type: none"><li>• Submit your Final Project Deliverables to the appropriate assignment</li></ul>



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[View all other teams' presentations and](#)

provide feedback as instructed in the  
Presentation Discussion Forum

- Provide personal feedback on the **Individual Feedback Form**
- **Submit the Course Design Survey**

## Lesson 14: Project Presentation and Evaluation

*Disclaimer: Please note that the specifics of this Course Syllabus are subject to change, and you will be responsible for abiding by any such changes. Your instructor will notify you of any changes.*