

**TO:** The Engineering Faculty  
**FROM:** The Faculty of the Elmore Family School of Electrical and Computer Engineering  
**RE:** New undergraduate course – ECE 40802

The Faculty of the Elmore Family School of Electrical and Computer Engineering has approved the following new undergraduate course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM (IF ALREADY OFFERED WITH TEMPORARY NUMBER):

ECE 49595 Natural Language Processing

3 total credits; 3 credit lecture

Requisites: ECE 26400 and ECE 20875 and ECE 30100 and ECE 30200 and ECE 36800 and ECE 36900 and MA 26100 and (MA 26500 or MA 26200)

Spring semesters: 2023, 2024, 2025

TO:

ECE 40802 Introduction to Natural Language Processing

3 total credits; 3 credit lecture

Requisites: ECE 26400 and ECE 20875 and ECE 30100 and ECE 30200 and ECE 36800 and ECE 36900 and MA 26100 and (MA 26500 or MA 26200)

This course is an introduction to modern natural language processing and computational linguistics. This course covers morphological, syntactic, semantic, and pragmatic processing as well as applications such as information extraction, question answering, and machine translation. This course will cover fundamental topics as well as recent advances from the literature.

Learning Outcomes:

1. design and implement a natural language parser.
2. construct a semantic representation from natural-language input.
3. train and use a neural network for NLP.
4. use natural-language technology to construct and demo a new application.

RATIONALE:

This course ran years ago as an experimental course at the graduate-level; however, the need is there for it to be available to undergraduates who are not quite ready for graduate material. It has ran successfully for over three years with increasing enrollment each time.

A handwritten signature in black ink on a light gray background. The signature reads "T.S. Mithuna" followed by a long, horizontal flourish.

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Mithuna Thottethodi  
Associate Head of Teaching and Learning  
Professor of the Elmore Family School of Electrical and Computer Engineering

Link to Curriculog entry: <https://purdue.curriculog.com/proposal:32692/form>

## ECE 40802 Introduction to Natural Language Processing

### Course Information

**Course number and title:** ECE 40802 Introduction to Natural Language Processing

**Instructional Modality:** Face-to-Face

**Course credit hours:** 3.000

**Prerequisites:** ECE 26400, ECE 20875, MA 261, MA 265, ECE 301, ECE 302, ECE 368, ECE 369, or permission of instructor

**Prerequisites by topic:** programming in C and/or Python, multivariate calculus, linear algebra, probability, data structures, discrete math

**Course web page:** <https://engineering.purdue.edu/~ece495n1>

**Course Brightspace page:** <https://purdue.brightspace.com/d21/home/1220690>

### Instructor(s) Contact Information

**Name of the instructor:** Jeffrey Mark Siskind

**Office Location:** BHEE 313e

**Office Phone Number:** 765/496-3197

**Purdue Email Address:** [qobi@purdue.edu](mailto:qobi@purdue.edu)

**Student Consultation hours, times, and location:** T 5:00pm–6:00pm BHEE 313e

### Course Description

An introduction to modern natural language processing and computational linguistics. Covers morphological, syntactic, semantic, and pragmatic processing as well as applications such as information extraction, question answering, and machine translation. The course will cover fundamental topics as well as recent advances from the literature.

### Learning Resources, Technology & Texts

Foundations of Statistical Natural Language Processing, Chris Manning & Hinrich Schütze, MIT Press, May 1999, ISBN No. 13: 978-0262133609.

[https://icog-labs.com/wp-content/uploads/2014/07/Christopher\\_D.\\_Manning\\_Hinrich\\_Schütze\\_Foundations\\_Of\\_Statistical\\_Natural\\_Language\\_Processing.pdf](https://icog-labs.com/wp-content/uploads/2014/07/Christopher_D._Manning_Hinrich_Schütze_Foundations_Of_Statistical_Natural_Language_Processing.pdf)

[https://doc.lagout.org/science/0\\_Computer%20Science/2\\_Algorithms/Statistical%20Natural%20Language%20Processing.pdf](https://doc.lagout.org/science/0_Computer%20Science/2_Algorithms/Statistical%20Natural%20Language%20Processing.pdf)

Speech and Language Processing, 2nd Edition, Dan Jurafsky and James H. Martin, Prentice Hall, ISBN No. 13: 978-0131873216.

<https://github.com/rain1024/slp2-pdf>

<https://web.stanford.edu/~jurafsky/slp3/ed3book.pdf>

These books are only references. We will not follow these books exactly. Students are not required to purchase these books.

For some lectures, we will cover a recent paper from the literature. The papers will be posted at

<http://engineering.purdue.edu/~ece495n1> before each lecture. Students should read each paper before the associated lecture and come to class prepared to discuss and ask questions.

### Learning Outcomes

**Outcome i)** ability to design and implement a natural language parser. [1,2,6]

**Outcome ii)** ability to construct a semantic representation from natural-language input. [1,2,6,7]

**Outcome iii)** ability to train and use a neural network for NLP [1,6,7]

**Outcome iv)** ability to use natural-language technology to construct and demo a new application. [1,2,3,4,5,6,7]

## Assignments

There will be no exams. There will be approximately six pop quizzes at the beginning of lectures. There are no makeup quizzes. There will be two homework assignments and a term project. Beyond this, there will be reading assignments for some lectures. A recent paper will be posted on the course web page for some lectures. Students are expected to read the paper prior to lecture and come to class prepared to discuss and ask questions.

The homeworks will be handed out as follows:

Homework 1 in class Friday 17 January 2025  
Homework 2 in class Friday 14 February 2025

The due dates for the two homework assignments and term project are as follows:

Homework 1 5pm Friday 14 February 2025  
Homework 2 5pm Friday 28 March 2025  
Term Project 5pm Friday 25 April 2025

There will be no extensions.

Logistics for the homework assignments is still being worked out. It is anticipated the homework 1 will be handed out within the first two weeks of class and will be due four weeks later. It is anticipated the homework 2 will be handed out shortly after homework 1 is due and will be due six weeks later later. These are tentative estimates and subject to change.

Each homework assignment and term project should be submitted as a single zip file. You should create a directory whose name is your Purdue Career account name, then put everything you wish to submit in that directory, and then package that as a zip file. In my case, my Purdue Career account name is qobi. So I would do something like this:

```
qobi@sapiencia>cd /tmp/  
qobi@sapiencia>mkdir qobi  
# put stuff in the qobi directory  
qobi@sapiencia>zip -r qobi qobi  
  adding: qobi/ (stored 0%)  
qobi@sapiencia>
```

Obviously, there will be more files appropriate for a real homework submission. Homeworks will be submitted through Brightspace. What I will do to grade your homework and term project is something like this:

```
qobi@sapiencia>unzip qobi.zip  
Archive: qobi.zip  
  creating: qobi/  
qobi@sapiencia>  
# look at stuff in the qobi directory
```

one at a time for each submission.

You are free to prepare your homework on any machine that you wish.

The university provides accounts for all enrolled students on the RCAC Scholar cluster. However, I do not know anything about the RCAC Scholar cluster and am unable to provide any support.

The homeworks assignments are still being developed. The current plan for homework 1 is to create an Integrated Development Environment (IDE) for Python where you edit and run simple Python programs using spoken natural-language dialog without any keyboard input. The current plan for homework 2 is to create a mobile robot vehicle that is driven by natural-language dialog as the sole source of control. For these, students will work in teams. Nonetheless, each team member must submit a copy of the homework.

There will be a competition for each homework. For homework 1, there will be public time trials. I will give out a simple programming exercise. Each team will need to use their spoken IDE to write, debug, and run code that solves the exercise. Each team will be timed while doing so. The time trials will be held either in class, during one or more lectures, or in the Bill and Shirley Rice Design Studio in MSEE, during a time slot to be determined.

For homework 2, there will be a Race ladder. Pairs of teams will compete driving their vehicle by speech alone around a race track. The winners of each round will advance to the next round, until a first-place team is determined. The Race will be held in the Bill and Shirley Rice Design Studio during a time slot to be determined.

For both homeworks, as well as the term project, student should self organize into teams of two to four enrolled students. (The same teams can be used for both homeworks and the the term project, though I also will allow team changes.) Each team should send email to [ece49595nl-staff-list@ecn.purdue.edu](mailto:ece49595nl-staff-list@ecn.purdue.edu) by 5pm Friday 17 January 2025 with the names and Purdue Career account email addresses of the team members. Only one team member need send me email. Students can change teams at any time by sending me email with names of the new team members.

The term project is organized as follows. Each team should collectively send a one-page pdf term project description proposal to [ece49595nl-staff-list@ecn.purdue.edu](mailto:ece49595nl-staff-list@ecn.purdue.edu) by 5pm Friday 31 January 2025. I will meet with each team during office hours prior to Friday 14 February 2025 to discuss the term project description proposal and offer suggestions and guidance. We will have team term project presentations with demos in class during the last two or three weeks of class. These will be scheduled later in the semester.

Each team member should submit a copy of their team's homework and term project on Brightspace under their own name with a file named with their Purdue Career account name.

Students will be required to attend all classes, and all sessions in in the Bill and Shirley Rice Design Studio, with homework 1 and homework 2 competitions and term project presentations. Attendance will be taken in those classes and meetings.

### **Grading Scale**

I don't give Ds, Es, and pluses or minuses. The only grades I give are As, Bs, Cs, and Fs. There are no makeup pop quizzes. No late submissions for homeworks or term projects are accepted. I give an F if and only if you cheat, miss more than four pop quizzes, do not submit all of the homeworks, do not submit a term project, do not attend and participate in all of the homework competitions, do not attend all of the term project presentations, and do not participate in a term project presentation. The grades on homework 1 are based on class rank in the time trials. The grades on homework 2 are based on class rank in the Race ladder. The grades on the term project are subjective based on my perception of the level of effort your team expended to do something substantive. The overall grade is a mixture computed as 10% of the pop quizzes, 25% of homework 1, 25% of homework 2, and 40% of the term project. Please don't ask me for a letter of recommendation, to hire you as an RA, or to take you on as a graduate student on the basis of your grade in this course, or even on the basis of the term project/presentation you prepared for this course. You need to do something else that distinguishes you for me to do those things.

### **Attendance Policy**

There will be six pop quizzes at random unannounced times during the semester. They will be at the beginning of lecture. There will be no makeups. If you miss more than four, you will get an F.

Attendance at and participation in the competition for homework 1 is mandatory, whether it is class or in the Bill and Shirley Rice Design Studio during a time slot to be determined. If you miss that, you will get an F.

Attendance at and participation in the competition for homework 2 in the Bill and Shirley Rice Design Studio during a time slot to be determined is mandatory. If you miss that, you will get an F.

Attendance at all lectures with term project presentations is mandatory. Participation in a term project presentation for your team is mandatory. If you miss those, you will get an F.

Please don't ask me for permission to miss class. And please don't ask me to repeat material from a missed class. All

of the course material is on the web.

### **Course Schedule**

The homeworks will be handed out as follows:

Homework 1	in class Friday 17 January 2025
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There will be no extensions.

The term project is organized as follows. Student should self organize into teams of two to four enrolled students. Each team should send email to [ece49595nl-staff-list@ecn.purdue.edu](mailto:ece49595nl-staff-list@ecn.purdue.edu) by 5pm Friday 17 January 2025 with the names and Purdue Career account email addresses of the team members. Each team should then collectively send a one-page pdf term project description proposal to [ece49595nl-staff-list@ecn.purdue.edu](mailto:ece49595nl-staff-list@ecn.purdue.edu) by 5pm Friday 31 January 2025. I will meet with each team during office hours prior to Friday 14 February 2025 to discuss the term project description proposal and offer suggestions and guidance. We will have team term project presentations with demos in class during the last two or three weeks of class. These will be scheduled later in the semester.

### **Academic Integrity**

For the course, the only requirements are the pop quizzes, the two homeworks and the term project/presentation. There is a simple requirement: you cannot plagiarize. You must follow standard academic practice and cite the source of all material that you (re)use. If you violate this anti-plagiarism policy you will be prosecuted by the standard University mechanisms for such violations.

### **Nondiscrimination Statement**

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies.

### **Accessibility**

Purdue University is committed to making learning experiences accessible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: [drc@purdue.edu](mailto:drc@purdue.edu) or by phone: 765-494-1247.

### **Mental Health/Wellness Statement**

**If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack.** Sign in and find information and tools at your fingertips, available to you at any time.

**If you need support and information about options and resources,** please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M–F, 8 am–5 pm.

**If you find yourself struggling to find a healthy balance between academics, social life, stress, etc.** sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at [evans240@purdue.edu](mailto:evans240@purdue.edu).

**If you're struggling and need mental health services:** Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological

Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

### **Basic Needs Security**

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.–5 p.m. Monday through Friday. Considering the significant disruptions caused by the current global crisis as it related to COVID-19, students may submit requests for emergency assistance from the Critical Needs Fund

### **Emergency Preparedness**

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

### **Instructor Email Policies**

Please do not send any course-related email to my personal email account. Please send all course-related email to one of the following two mailing lists:

- [ece49595nl-staff-list@ecn.purdue.edu](mailto:ece49595nl-staff-list@ecn.purdue.edu)
- [ece49595nl-students-list@ecn.purdue.edu](mailto:ece49595nl-students-list@ecn.purdue.edu)

The former just goes to me, and any TAs if we have any in the future. The latter goes to me, any TAs if we have any in the future, and to all students enrolled. All students are automatically added to the latter under their Purdue Career account. Please send all course-related email from your Purdue Career account.

### **Missed or Late Work**

The only assignments this semester are the two homeworks and the term project/presentation. These all have strict deadlines as specified above. There will be no exceptions. No late work will be accepted and no credit will be given for missed or late assignments.

### **Incompletes**

No incompletes will be given.

## **References**

- A. G. Baydin, B. A. Pearlmutter, A. A. Radul, and J. M. Siskind. Automatic differentiation in machine learning: A survey. *Journal of Machine Learning Research (JMLR)*, 18(153):1–43, 2018.
- S. Hochreiter and J. Schmidhuber. Long short-term memory. *Neural Computation*, 9(8):1735–1780, 1997.
- B. A. Pearlmutter and J. M. Siskind. Reverse-mode AD in a functional framework: Lambda the ultimate backpropagator. *ACM Transactions on Programming Languages and Systems (TOPLAS)*, 30(2):1–36, 2008.
- J. M. Siskind and B. A. Pearlmutter. Nesting forward-mode AD in a functional framework. *Higher-Order and Symbolic Computation (HOSC)*, 21(4):361–376, 2008.
- N. Ward. SHRDLU. *Encyclopedia of Cognitive Science*, 2006.
- J. Weizenbaum. Eliza-A computer program for the study of natural language communication between man and machine. *Communications of the ACM*, 9(1):36–45, 1966.
- T. Winograd. *Procedures as a representation for data in a computer program for understanding natural language*. PhD thesis, 1971.

W. A. Woods. Progress in natural language understanding: An application to lunar geology. In *Proceedings of the National Computer Conference and Exposition*, pages 441–450, 1973.

W. A. Woods, R. M. Kaplan, and B. Nash-Webber. The lunar sciences natural language system: Final report. Technical report, Bolt, Beranek and Newman, Inc., 1972.