

Course Syllabus

Course Information

Course Prefix, Number, Section:
EESC, 7v86, 501

Course Title:
Special Topics in Wireless Communications: Deep Learning in 5G

Term:
Spring 2025

Meeting Days & Times:
MoWe 5:30-6:45 pm

Professor Contact Information

Dr. Faris B. Mismar, fbm090020@utdallas.edu

Office hours are after class or by appointment (MS Teams). Students can also post questions in the eLearning forum provided for this purpose.

About your instructor: Faris B. Mismar is a technical leader and consultant. He received the B.S. degree with high distinction in computer engineering from the University of Jordan in 2004, the M.S. degree in electrical engineering and MBA degree both with the highest distinction from the University of Texas at Dallas in 2011 and 2014, and the Ph.D. degree in electrical and computer engineering from the University of Texas at Austin in 2019. He was the recipient of the 2016 and 2017 Marcus Wallenberg Foundation Scholarship for Scientific Research and Education. Over the last two decades, Dr. Mismar held various senior positions and leadership roles at Motorola, Ericsson, Samsung, and Nokia. He was elevated to IEEE Senior Member in 2017 and was recognized as a Nokia Bell Labs Distinguished Member of Technical Staff in 2023. He is currently a Senior Principal Consultant at Nokia Bell Labs (since 2022) and an Adjunct Associate Professor of Electrical and Computer Engineering at the University of Texas at Dallas (joined in Fall 2021). His research interests include machine learning, artificial intelligence, and wireless communications.

Course Pre-requisites, Co-requisites, and/or Other Restrictions

Linear algebra, probability, and statistics. Familiarity with Python 3 and some of its relevant libraries (numpy, pandas, scikit-learn, and TensorFlow) will be helpful for the course project and assignments. We will review pre-requisites in class in the first two weeks.

Course Description

Introduction to Python; review of linear algebra, probability, and statistics with Python; fundamentals of wireless communications; linear regression for channel modeling; classifiers in Python: symbol detection; deep learning in Python using Keras and TensorFlow; introduction to 5G New Radio (NR): NR overall architecture and protocol stack; NR physical, medium access control, and radio resource control layers; NR radio resource management procedures; fully connected feedforward neural networks; convolutional neural networks; recurrent neural networks; deep reinforcement learning; applications and use cases in 5G NR and beyond.

Student Learning Objectives/Outcomes

This course is primarily designed for graduate students with background in wireless communications and practical research interest in deep learning and its applications to wireless communications. Upon completion of this course, students have the ability to:

- explain the 5G radio access network architecture, the 5G air interface protocol stack, and the various procedures at different layers in the stack
- explain the various deep learning algorithms and some use cases towards wireless procedures, and
- produce a written project report commensurate with guidelines and conventions prevailing in the industry.

Required Textbooks and Materials

- A Quick Primer on Machine Learning in Wireless Communications. <https://arxiv.org/pdf/2312.17713> (to be updated in Jan 2025).
- Other material may be handed out from the suggested material below as needed.

Suggested Course Materials

- Andreas F. Molisch, *Wireless Communications*, 2nd ed. West Sussex, UK: Wiley-IEEE Press, 2010. ISBN: 978-0521845274.

- Ian Goodfellow, Yoshua Bengio, and Aaron Courville, *Deep Learning*, 1st ed. Cambridge, MA, USA: The MIT Press, 2016. ISBN: 978-0262035613. Available: <https://www.deeplearningbook.org/>.
- Christopher M. Bishop, *Pattern Recognition and Machine Learning*, New York, NJ, USA: Springer, 2006. ISBN: 978-0387310732.
- Machine Learning For Communications Emerging Technologies Initiative <https://mlc.committees.comsoc.org/>
- Open Radio Access Networks (O-RAN) Alliance. <https://www.o-ran.org/>
- Third Generation Partnership Project (3gpp) RAN1 <https://www.3gpp.org/Specifications-groups/ran-plenary/45-ran1-radio-layer-1>

Assignments & Academic Calendar

Proposal submission: (*towards the middle of the semester*).

Presentation week: (*towards the end of the semester*).

Actual dates will be communicated to students during the semester.

Grading Policy

Homework (20%), quizzes (10%), one-page project proposal (20%), and final project (50%). There are no exams.

The final project is further broken down to: 15% oral in-class presentation and 35% term-paper due on the last day of instruction.

Quizzes will be held in class for 15-30 mins. Their objective is to review key concepts introduced in class. There will be 6 pop quizzes and the least score will be dropped.

One homework entails the task of lecture scribing. A group of students volunteer to take detailed notes and upload them online in a readable format. All scribed notes will be assessed for quality and content. They are due no later than 11:59 pm Central US Time two days after class (i.e., Monday's class notes are due by 11:59 pm on Wednesday; Wednesday's class notes are due by 11:59 pm on Friday, all in the same week). The instructor will provide a LaTeX template for lecture scribing.

At the end of the class, you will get a score out of 100 rounded up to two decimals and based on the percentages above. Letter grades: A 100-90%, A- 89.99-86.67%, B+ 86.66-83.34%, B 83.33-80.00%, etc.

Course & Instructor Policies

No make-ups permitted. Regular attendance and active participation in class are encouraged. Receiving and placing calls with electronic devices (e.g., smartphones) is not allowed in class. You are welcome (and encouraged) to use your laptop to lookup online material during the class or follow what is being done. Homework must be submitted at the beginning of the class. Late submission is *not* accepted. Check the class GitHub page for working code examples.

Class Materials

The instructor may provide class materials that will be made available to all students registered for this class as they are intended to supplement the classroom experience. These materials may be downloaded during the course; however, these materials are for registered students' use only. Classroom materials may not be reproduced or shared with those not in class or uploaded to other online environments except to implement an approved AccessAbility Resource Center accommodation. Failure to comply with these University requirements is a violation of the [Student Code of Conduct](#).

Class Attendance

Regular attendance is encouraged. However, punctual class attendance is expected. If you must leave during class, it has to be without disruption to the class.

Class Participation

Active participation in class is highly encouraged. Regular class participation is expected. Students who fail to participate in class regularly are inviting scholastic difficulty. While there is no grade for participation, an instructor's discretionary portion of the grade for this course is directly tied to your participation in this class. Participation includes engaging in group or other activities during class that solicit the instructor's feedback on assignments, readings, or materials covered in the lectures. Class participation is documented by faculty. Successful participation is defined as consistently adhering to University requirements, as presented in this syllabus. Failure to comply with these University requirements is a violation of the [Student Code of Conduct](#).

Class Recordings

Students are expected to follow appropriate University policies and maintain the security of passwords used to access recorded lectures. Unless the AccessAbility Resource Center has approved the student to record the instruction, students are expressly prohibited from recording any part of this course. Recordings may not be published, reproduced, or shared with those not in the class, or uploaded to other online environments except to implement an approved AccessAbility Resource Center accommodation. Failure to comply with these University requirements is a violation of the [Student Code of Conduct](#).

The instructor may record meetings of this course. These recordings will be made available to all students registered for this class if the intent is to supplement the classroom experience. If the instructor or a UTD school/department/office plans any other uses for the recordings, consent of the students identifiable in the recordings is required prior to such use unless an exception is allowed by law.

Classroom Citizenship

Respect, honesty, a sense of responsibility, and desire to learn.

Off-campus Instruction and Course Activities

(Below is a description of any travel and/or risk-related activity associated with this course.)

Not applicable.

Comet Creed

This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:

“As a Comet, I pledge honesty, integrity, and service in all that I do.”

Accommodations for Students with Disabilities

Please review [the section](#) within the UT Dallas Syllabus Policies and Procedures webpage.

Academic Support Resources

Please visit the [Academic Support Resources](#) page to view the University's academic support resources for all students.

UT Dallas Syllabus Policies and Procedures

Please visit the [Syllabus Policies](#) page to view the University's policies and procedures segment of the course syllabus.

Please review the catalog sections regarding the [credit/no credit](#) or [pass/fail](#) grading option and withdrawal from class.

The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.