

EESC 7V86: SELECTED TOPICS IN WIRELESS COMMUNICATIONS: DEEP LEARNING FOR 5G

Fall 2022

Instructor:	Prof. Faris B. Mismar	Time:	MoWe 5:30 – 6:45
Email:	fbm090020@utdallas.edu	Place:	TBD

Office Hours: After class or by appointment. You can also post your questions in the eLearning forum provided for this purpose.

Main References: Required reading material will come from the following sources supplemented with online material:

- 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/>.
- Andreas F. Molisch, *Wireless Communications*, 2nd ed. West Sussex, UK: Wiley-IEEE Press, 2010. ISBN: 978-0521845274.
- Christopher M. Bishop, *Pattern Recognition and Machine Learning*, New York, NJ, USA: Springer, 2006. ISBN: 978-0387310732.

eLearning: Grades, announcements, and communication will be performed using eLearning. It is your responsibility to check the platform and your email for any communication related to this course.

Objectives: This course is primarily designed for graduate students with background in wireless communications and practical research interest in machine learning and its applications to wireless communications.

Prerequisites: Linear algebra, probability and statistics. Familiarity with Python 3 and some of its important 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 2 weeks.

Grading Policy: Homeworks (20%), quizzes (10%), project proposal (20%), final project (50%). There will be no final exam.

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

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.

Academic Dishonesty: *to be filled per the university's standard procedure.*

Topics:

1. Introduction to Python
2. Review of linear algebra, probability, and statistics with Python
3. Fundamentals of wireless communications

4. Linear regression in Python: channel modeling
5. Classifiers in Python: symbol detection
6. Deep Learning in Python: Keras and TensorFlow
7. Introduction to 5G New Radio (NR): overall architecture and protocol stack
8. NR Physical layer procedures
9. NR Medium Access Control procedures
10. NR Radio Resource Management procedures
11. Deep Learning: fully connected feedforward neural networks
12. Deep Learning: convolutional neural networks
13. Deep Learning: recurrent neural networks
14. Deep learning applications and use cases in 5G NR

Class Policy:

- 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.
- Homeworks must be submitted at the beginning of the class. Late submission is *not* accepted.
- Check the class GitHub page for code examples <https://github.com/farismismar/eesc7v86-fall122/tree/main>.

Online Resources:

- 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>

About Your Instructor: Faris B. Mismar received the B.S. degree with high distinction in electrical and computer engineering from The University of Jordan in 2004, the M.S. degree in electrical engineering and MBA degree 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. Dr. Mismar is a senior member of the IEEE and he held various senior positions and leadership roles at Motorola, Ericsson, Samsung, and Nokia. He also served as a consultant for many leading wireless communications service providers in different continents. He has been with Nokia Bell Labs as a Senior Principal Consultant since 2022. His research interests include machine learning, artificial intelligence, and wireless communications.