

EE 535- Engineering Applications of Neural Networks- 3 Hours  
Elective course

1. *2007-2008 Catalog description*

Provides a working knowledge of the theory, design and engineering applications of artificial neural networks. Emphasis will be directed to low-level implementation such as embedded microcontrollers and integrated circuits. Specific architectures such as correlation matrix memory, perceptron, adaline, multilayer networks, radial-basis function networks, and Hopfield networks will be examined as well as their corresponding learning rules. Prerequisites: EE 302 or graduate standing.

2. *Prerequisites by topics*

- a. Differential and integral calculus.
- b. Laplace transforms.
- c. Theory of signals and systems.
- d. Analysis of operational amplifier circuits.

3. *Textbook(s) and/or other required material*

Required: EE 535 Lecture Workbook (700 pages), G. Dempsey

4. *Class Schedule:* Three sessions per week, each 50 minutes, for 14 weeks

5. *Topics Covered (Outcomes influenced)*

- Adaptive signal processing methods: adaline and perceptron using Widrow-Hoff algorithm (7 a,b,e)
- Adaptive signal processing applications: pattern/speech recognition, control systems, system identification, noise cancellation (7 b)
- Non-linear networks, decision boundaries, non-linear mappings, back-propagation algorithm (7c, d)
- Standard back-propagation limitations, modifications for improvement (momentum, adaptive learning rate) (7c,d,e)
- Applications for back-propagation algorithm: pattern and speech recognition, control systems, system identification, noise cancellation, data and image compression (7d)
- Local learning versus global learning (7e)
- Application of linear algebra to neural networks (7a,b,d,e)
- MATLAB and Neural Network Toolbox use (7b,d)
- Hardware and software implementations of neural networks (7b,c,d,e)
- Algorithms for correlation matrix memory, CMAC, Hopfield and radial-basis function networks (7d,e)
- Applications for correlation matrix memory, CMAC, Hopfield and radial-basis function networks (7e)

6. *Contribution of course to meeting the professional component*

Engineering science - 50%, Engineering design - 50%

7. *Course Outcomes (Program Outcome contributions): In learning the course topics, the student will attain the following outcomes.*

- a. The student will analyze adaptive signal processing and neural methods using linear algebra to determine decision boundaries and input-output mappings. (9A,B,C,D)
- b. The student will design adaptive signal processors in the MATLAB environment (m-code) for pattern and speech recognition applications. (9A,B,C,D)
- c. The student will develop software (m-code) to solve the XOR problem using the back-propagation algorithm. (9A,B,C,D)
- d. The student will use the Neural Network Toolbox to develop software neural networks to solve pattern and speech recognition and signal processing applications. (9A,B,C,D)
- e. The student will be able to compare the advantages and disadvantages of adaptive signal processing algorithms with the common neural network algorithms (back-propagation, correlation matrix memory, CMAC, Hopfield, and radial-basis function networks). (9A,B,C,D)

8. *Grading policy:* The degree to which students achieve the course objectives is determined by the following grading policy.

Homework 0% (17 assignments used to determine borderline grades)

Test 1: 23% (closed-notes)

Test 2: 23% (open-notes)

Test 3: 23% (open-notes)

Final Exam: 31% (open-notes)

The students will also complete a required reading assignment on a contemporary issue in the area of neural networks. A one page summary of the findings is required. If the assignment is not completed by the day of final exam, 5 points will be deducted from the final exam score. A grade of C corresponds to meeting the minimum competency required to understand course topics and meet course objectives.

9. *Relationship of course to program objectives*

label	Program Objective (A graduate from the program will)	Contribution
A	demonstrate knowledge of the mathematical and scientific foundation of electrical engineering.	Strong
B	demonstrate knowledge of and the ability to apply techniques and technology of electrical engineering.	Strong
C	complete a design project sequence, culminating in a capstone project at or near the professional level.	Moderate
D	understand that acquisition of new knowledge is needed for success in the electrical engineering profession.	Moderate
E	meet Bradley=s general education requirements which are based on the principles of liberal education.	NA
F	have experience in communicating technical information and working on teams.	Weak
G	understand the importance of professional and ethical behavior.	Moderate

10. *Prepared by:* Gary Dempsey 3/13/08