**Spring 2019**

**SysEng 5212 - EE 5370 Introduction to Neural Networks and Applications**

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[**Google Scholar Citations**](http://scholar.google.com/citations?user=blas90AAAAAJ)

**Synopsis:**

The course provides an introduction to basic neural network architectures and their applications. Students learn to construct neural networks and train them to solve engineering problems, specifically pattern recognition and function approximation. Mathematical analysis of network architectures, training algorithms and practical applications of neural networks are emphasized.

**Specific Topics Covered:**

• Neuron models and network architectures

• Learning rules and learning paradigms

• Perceptron model

• Feedforward networks with backpropagation

• Radial-basis function networks and regularization theory

• Support vector machines

• Principal component analysis

• Self organizing maps

**Lectures**

Tuesdays 4:00-6:30 PM US Central Time

Lectures are webcasted from [Missouri S&T Global- St. Louis](http://global-stl.mst.edu/about/contactus/) and through Zoom on Internet. On campus students will connect to St. Louis from the class room at Missouri S&T.

**Grading**

Six homework assignments (5% each) 30%   
Exam I on March 12, 2019 (in class) 15%   
Exam II (take home given on May 3, 2019 and due on May 7, 2019) 15%   
Project Progress Reports 10%

Engineering Project Code due on April 30, 2019 10%  
Final project report due on May 3, 2019 20%

**Text and Reference Text**  
Simon O. Haykin, Neural Networks and Learning Machines (3rd Edition), Upper Saddle River, NJ 2009, Prentice Hall,

**Software MatLab and Neural Networks Tool Box**  
Each lecture will include implementation of computer experiments using Matlab. A brief introduction to Matlab will be provided at the start of the semester, and the Matlab Neural Network toolbox will be discussed in detail throughout the class. Students are not required to know Matlab but basic programming skills in any language will be helpful.

# Recommended Matlab Book Duane C. Hanselman, Bruce L. Littlefield, Mastering MatLab (latest edition), Prentice Hall Upper Saddle River, NJ

**Recent Procedia**

You can download papers from this site without any charge.

1. Complex Adaptive Systems Volume 8, Procedia Computer Sciences Volume 140-2018, Cihan H Dagli Editor , Elsevier, SciVerse ScienceDirect ([www.sciencedirct.com](http://www.sciencedirct.com)) ISSN 1877-0509, November 2018. https://www.sciencedirect.com/journal/procedia-computer-science/vol/140/suppl/C
2. Complex Adaptive Systems Volume 7, Procedia Computer Sciences Volume 114-2017, Cihan H Dagli Editor , Elsevier, SciVerse ScienceDirect ( www.sciencedirct.com) ISSN 1877-0509, November 2017. <http://www.sciencedirect.com/science/journal/18770509/114>
3. Complex Adaptive Systems Volume 6, Procedia Computer Sciences Volume 95-2016, Cihan H Dagli Editor , Elsevier, SciVerse ScienceDirect ( www.sciencedirct.com )  ISSN 1877-0509, November 2016 .http://www.sciencedirect.com/science/journal/18770509/95
4. Complex Adaptive Systems Volume 5, Procedia Computer Sciences Volume 61-2015,  Cihan H Dagli Editor , Elsevier, SciVerse ScienceDirect ( www.sciencedirct.com )  ISSN 1877-0509, November 2015. [http://www.sciencedirect.com/science/journal/18770509/61](http://www.sciencedirect.com/science/journal/18770509/61 %20)
5. Complex Adaptive Systems Volume 4, Procedia Computer Sciences Volume 36-2014,  Cihan H Dagli Editor , Elsevier, SciVerse ScienceDirect ( www.sciencedirct.com )  ISSN 1877-0509, November 2014. [http://www.sciencedirect.com/science/journal/18770509/36](http://www.sciencedirect.com/science/journal/18770509/36%C2%A0)
6. Complex Adaptive Systems Volume 3, Procedia Computer Sciences Volume 20-2013,  Cihan H Dagli Editor , Elsevier, SciVerse ScienceDirect ( www.sciencedirct.com )  ISSN 1877-0509, November 2013. [http://www.sciencedirect.com/science/journal/18770509/20](http://www.sciencedirect.com/science/journal/18770509/20%C2%A0)
7. Complex Adaptive Systems Volume 2, Procedia Computer Sciences Volume 12-2012,  Cihan H Dagli Editor , Elsevier, SciVerse ScienceDirect ( www.sciencedirct.com)  ISSN 1877-0509, November 2012. [http://www.sciencedirect.com/science/journal/18770509/12](http://www.sciencedirect.com/science/journal/18770509/12%20)
8. Complex Adaptive Systems Volume 1, Procedia Computer Sciences Volume 6-2011,  Cihan H Dagli Editor , Elsevier, SciVerse ScienceDirect ( www.sciencedirct.com)  ISSN 1877-0509, November 2011.[http://www.sciencedirect.com/science/journal/18770509/6 (Links to an external site.)](http://www.sciencedirect.com/science/journal/18770509/6)
9. 2015 Conference on Systems Engineering Research Procedia Computer Science Volume 44, Pages 1-718 (2015)  Edited by Jon Wade and Robert Cloutier SciVerse ScienceDirect ( www.sciencedirct.com )  ISSN 1877-0509 March 2015   [http://www.sciencedirect.com/science/journal/18770509/44](http://www.sciencedirect.com/science/journal/18770509/44%C2%A0)
10. 2014 Conference on Systems Engineering Research, Procedia Computer Science, Volume 28, Azad M. Madni and Barry Boehm Editors  ( www.sciencedirct.com )  ISSN 1877-0509, March 2014 <http://www.sciencedirect.com/science/journal/18770509/28>.
11. 2013 Conference on Systems Engineering Research, Procedia Computer Sciences Volume 16 Christiaan J.J. Paredis, Carlee Bishop and Douglas Bodner Editors, Elsevier SciVerse ScienceDirect ( www.sciencedirct.com)  ISSN 1877-0509, March 2013 [http://www.sciencedirect.com/science/journal/18770509/16 (Links to an external site.)](http://www.sciencedirect.com/science/journal/18770509/16)
12. Challenges in Systems Engineering and Architecting, Procedia Computer Sciences Volume 8-2011, Cihan H Dagli Editor, Elsevier, SciVerse ScienceDirect ( www.sciencedirct.com)  ISSN 1877-0509, March  2012 [http://www.sciencedirect.com/science/journal/18770509/8 (Links to an external site.)](http://www.sciencedirect.com/science/journal/18770509/8)
13. Disciplinary Convergence in Systems Engineering Research - 2018, Azad M. Madni, Barry Boehm, Roger G. Ghanem, Daniel Erewin and Marilee J. Wheaton, Editors, Springer, Cham, 2018.

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| Week | Topic |
| Week 1 January 22, 2019 | Course introduction Biological motivation and history, Activation functions Neuron model and architectures |
| Week 2 January 29, 2019 | Math review  Introduction to Matlab NN Toolbox |
| Week 3 February 5, 2019 | Learning rules and learning paradigms  Perceptron model |
| Week 4 February 12, 2019 | Adaptive filtering  Least mean square algorithm |
| Week 5 February 19, 2019 | Multilayer Perceptron  Backpropagation - I |
| Week 6 February 26, 2019 | Backpropagation - II |
| Week 7 March 5, 2019 | Radial basis functions - I |
| Week 8 March 12, 2019 | In class exam |
| Week 9 March 19, 2019 | Radial basis functions - II  Regularization theory |
| ***March 26, 2019*** | ***Spring Break*** |
| Week 11 April 2, 2019 | Radial basis Example and data Processing |
| Week 12 April 9, 2019 | Project Status Presentation and Data preprocessing |
| Week 13 April 16, 2019 | Support vector machines |
| Week 14 April 23, 2019 | Self-organizing maps and Learning vector quantization |
| Week 15 April 30, 2019 | Project Presentations |
| Week 16 May 7, 2019 | Project Presentations |