

Pre-requisite Material for EEE 4773 Fundamentals of Machine Learning

The following includes a list of topics that you should know to succeed in this course. This covers material from programming concepts, calculus, linear algebra, and statistics. Please review the following material carefully.

If you do not feel confident in all the following material, you may want to reconsider taking the course at this time.

1. Programming Concepts Review

These are some programming concepts you should be familiar with:

- Syntax: https://www.youtube.com/watch?v=ZhJcd_E7A_M
- Variables: https://www.youtube.com/watch?v=G41G_PEWfJE,
<https://www.youtube.com/watch?v=aeoGGabJhAQ>
- Variable Types: <https://www.youtube.com/watch?v=9QIFXyBYJQY>
- Arithmetic and Boolean Operators: <https://www.youtube.com/watch?v=0e-wcx7Jaag>,
<https://www.youtube.com/watch?v=gl-qXk7XojA&list=PL8dPuuaLjXtNIUrzyH5r6jN9ullgZBpdo&index=4>
- Conditional Statements and Loops: <https://www.youtube.com/watch?v=2DnChqggSUw>,
<https://www.youtube.com/watch?v=l26oaHV7D40&list=PL8dPuuaLjXtNIUrzyH5r6jN9ullgZBpdo&index=13>
- Functions: https://www.youtube.com/watch?v=PTTNDi1_cc
- Libraries and Frameworks: https://www.youtube.com/watch?v=FQAQTXE_vt4,
<https://www.youtube.com/watch?v=LimOOe6l4eo>
- Algorithm: <https://www.youtube.com/watch?v=kaG4xeLqeH0>

Other Resources:

- Complete Computer Science Crash Course:
<https://www.youtube.com/playlist?list=PL8dPuuaLjXtNIUrzyH5r6jN9ullgZBpdo>

2. Calculus Review

Calculus topics to review include:

- Derivatives: <https://www.youtube.com/watch?v=9vKqVkmQHk&list=PLZHQObOWTQDMsr9K-rj53DwVRMYO3t5Yr&index=2>,
https://www.youtube.com/watch?v=S0_qX4VJhMQ&list=PLZHQObOWTQDMsr9K-rj53DwVRMYO3t5Yr&index=3
- Chain rule and product rule:
<https://www.youtube.com/watch?v=YG15m2VwSjA&list=PLZHQObOWTQDMsr9K-rj53DwVRMYO3t5Yr&index=4>
- Integration: <https://www.youtube.com/watch?v=rfG8ce4nNh0&list=PLZHQObOWTQDMsr9K-rj53DwVRMYO3t5Yr&index=8>

- Taylor Series: <https://www.youtube.com/watch?v=3d6DsJlBzJ4&list=PLZHQObOWTQDMSr9K-rj53DwVRMYO3t5Yr&index=11>

Additional resources:

- Full 3Blue1Brown Calculus series: <https://www.youtube.com/playlist?list=PLZHQObOWTQDMSr9K-rj53DwVRMYO3t5Yr>
- ML-CheatSheet for Calculus: <https://ml-cheatsheet.readthedocs.io/en/latest/calculus.html>

3. Linear Algebra Review

Topics and definitions to know include:

- Vector: https://www.youtube.com/watch?v=fNk_zzaMoSs&list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab&index=2&t=0s
- Transpose operation:
- Vector/Matrix scaling: https://www.youtube.com/watch?v=XkY2DOUCWMU&list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab&index=5&t=0s
- Vector/Matrix addition:
- Inner product
- Outer product
- Linear transformations: https://www.youtube.com/watch?v=kYB8lZa5AuE&list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab&index=3
- Inverse: https://www.youtube.com/watch?v=uQhTuRIWMxw&list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab&index=7
- L-p norm
- Eigenvectors and Eigenvalues: https://www.youtube.com/watch?v=PFDu9oVAE-g&list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab&index=14

Additional reading and videos to review linear algebra concepts:

- Strang, Gilbert, et al. Introduction to linear algebra. Vol. 4. Wellesley, MA: Wellesley-Cambridge Press, 2009. Chapters 1-7
- Lay, David C. "Linear Algebra and its Applications, 3rd updated Edition." (2005).
- MITOpenCourseWare Linear Algebra: <https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/>
- 3Blue1Brown Linear Algebra Review: https://www.youtube.com/playlist?list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab
- SciPy Cheat Sheet - Linear Algebra in Python: <https://www.datacamp.com/community/blog/python-scipy-cheat-sheet>

4. Statistics Review

Topics and definitions to know include:

- Likelihood and Probability
- Expected Value: https://www.youtube.com/watch?v=j_Kred7vY
- Variance and covariance: <https://www.youtube.com/watch?v=ualmyZiPs9w>
- Random variables: <https://www.youtube.com/watch?v=3v9w79NhsfI>
- Probability density functions: https://www.youtube.com/watch?v=Fvi9A_tEmXQ
- Marginal and conditional probability: <https://www.youtube.com/watch?v=CAXQvTKP8sg>
- Independence and conditional independence: <https://www.youtube.com/watch?v=uzkc-qNVoOk>
- Normal/Gaussian distribution: <https://www.youtube.com/watch?v=hgtMWR3TFnY>
- Central Limit Theorem: <https://www.youtube.com/watch?v=JNm3M9cqWyc>
- Bayes' Rule: <https://www.youtube.com/watch?v=XQoLVI31ZfQ>

Additional Reading:

Goodfellow, I. et al. "Deep Learning", MIT Press, 2016. Chapter 3: Probability and Information Theory, Pages 51-70. <http://www.deeplearningbook.org/contents/prob.html>