

# Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization

by DeepLearning.AI


## About this Course

In the second course of the Deep Learning Specialization, you will open the deep learning black box to understand the processes that drive performance and generate good results systematically.


By the end, you will learn the best practices to train and develop test sets and analyze bias/variance for building deep learning applications; be able to use standard neural network techniques such as initialization, L2 and dropout regularization, hyperparameter tuning, batch normalization, and gradient checking; implement and apply a variety of optimization algorithms, such as mini-batch gradient descent, Momentum, RMSprop and Adam, and check for their convergence; and implement a neural network in TensorFlow.

The Deep Learning Specialization is our foundational program that will help you understand the capabilities, challenges, and consequences of deep learning and prepare you to participate in the development of leading-edge AI technology. It provides a pathway for you to gain the knowledge and skills to apply machine learning to your work, level up your technical career, and take the definitive step in the world of AI.







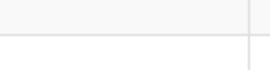
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**Taught by:** [Andrew Ng](#), Instructor  
Founder, DeepLearning.AI & Co-founder, Coursera



**Taught by:** [Kian Katanforoosh](#), Senior Curriculum Developer  
Founder, Workera


 <b>Basic Info</b>	Course 2 of 5 in the <a href="#">Deep Learning Specialization</a>
 <b>Level</b>	Intermediate
 <b>Commitment</b>	At the rate of 5 hours a week, it typically takes 5 weeks to complete this course
 <b>Language</b>	English, <b>Subtitles:</b> Chinese (Traditional), Arabic, French, Bengali, Ukrainian, Chinese (Simplified), Greek, Italian, Portuguese (Brazil), Vietnamese, Dutch, Korean, German, Pashto, Urdu, Russian, Thai, Indonesian, Swedish, Turkish, Azerbaijani, Spanish, Dari, Hindi, Japanese, Kazakh, Hungarian, Polish
 <b>How To Pass</b>	Pass all graded assignments to complete the course.
 <b>User Ratings</b>	 Average User Rating 4.9

## Syllabus

Week 1


Practical Aspects of Deep Learning


Discover and experiment with a variety of different initialization methods, apply L2 regularization and dropout to avoid model overfitting, then apply gradient checking to identify errors in a fraud detection model.


 15 videos, 5 readings


- Video:** [Train / Dev / Test sets](#)
- Video:** Bias / Variance
- Video:** Basic Recipe for Machine Learning
- Reading:** [IMPORTANT] Have questions, issues or ideas? Join our Forum!
- Reading:** Clarification about Upcoming Regularization Video
- Video:** Regularization
- Video:** Why Regularization Reduces Overfitting?
- Video:** Dropout Regularization
- Reading:** Clarification about Upcoming Understanding Dropout Video
- Video:** Understanding Dropout
- Video:** Other Regularization Methods
- Video:** Normalizing Inputs
- Video:** Vanishing / Exploding Gradients
- Video:** Weight Initialization for Deep Networks
- Video:** Numerical Approximation of Gradients
- Video:** Gradient Checking
- Video:** Gradient Checking Implementation Notes
- Reading:** Lecture Notes W1
- Reading:** (Optional) Downloading your Notebook, Downloading your Workspace and Refreshing your Workspace
- Video:** Yoshua Bengio Interview

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 **Graded:** Practical aspects of Deep Learning

 **Graded:** Initialization


 **Graded:** Regularization

 **Graded:** Gradient Checking

Week 2


Optimization Algorithms


Develop your deep learning toolbox by adding more advanced optimizations, random minibatching, and learning rate decay scheduling to speed up your models.

 11 videos, 3 readings

- Video:** [Mini-batch Gradient Descent](#)
- Video:** Understanding Mini-batch Gradient Descent
- Video:** Exponentially Weighted Averages
- Video:** Understanding Exponentially Weighted Averages
- Video:** Bias Correction in Exponentially Weighted Averages
- Video:** Gradient Descent with Momentum
- Video:** RMSprop
- Reading:** Clarification about Upcoming Adam Optimization Video
- Video:** Adam Optimization Algorithm
- Reading:** Clarification about Learning Rate Decay Video
- Video:** Learning Rate Decay
- Video:** The Problem of Local Optima
- Reading:** Lecture Notes W2
- Video:** Yuanqing Lin Interview

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 **Graded:** Optimization Algorithms

 **Graded:** Optimization Methods

Week 3


Hyperparameter Tuning, Batch Normalization and Programming Frameworks


Explore TensorFlow, a deep learning framework that allows you to build neural networks quickly and easily, then train a neural network on a TensorFlow dataset.

 11 videos, 7 readings

- Video:** [Tuning Process](#)
- Video:** Using an Appropriate Scale to pick Hyperparameters
- Video:** Hyperparameters Tuning in Practice: Pandas vs. Caviar
- Reading:** Clarification about Upcoming Normalizing Activations in a Network Video
- Video:** Normalizing Activations in a Network
- Video:** Fitting Batch Norm into a Neural Network
- Video:** Why does Batch Norm work?
- Video:** Batch Norm at Test Time
- Reading:** Clarifications about Upcoming Softmax Video
- Video:** Softmax Regression
- Video:** Training a Softmax Classifier
- Video:** Deep Learning Frameworks
- Video:** TensorFlow
- Reading:** (Optional) Learn about Gradient Tape and More
- Reading:** Lecture Notes W3
- Reading:** [IMPORTANT] Reminder about end of access to Lab Notebooks
- Reading:** References
- Reading:** Acknowledgments

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 **Graded:** Hyperparameter tuning, Batch Normalization, Programming Frameworks

 **Graded:** TensorFlow Introduction

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## How It Works

**General**

**How do I pass?**

To earn your Certificate, you'll need to earn a passing

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**Programming assignments**


**Programming assignments require you to write and run a computer program to solve a problem.**

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## Course 2 of Specialization

### Become a Machine Learning expert

Master the fundamentals of deep learning and break into AI. Recently updated with cutting-edge techniques!




**Deep Learning**  
DeepLearning.AI

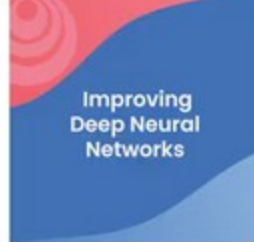
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Related Courses



**Structuring Machine Learning Projects**  
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**Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization**  
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