About this Course

★★★★½ **4.9** 89,803 ratings

Machine learning is the science of getting computers to act without being explicitly programmed. In the past decade, machine learning has given us self-driving cars, practical speech recognition, effective web search, and a vastly improved understanding of the human genome. Machine learning is so pervasive today that you probably use it dozens of times a day without knowing it. Many researchers also think it is the best way to make progress towards human-level AI. In this class, you will learn about the most effective machine learning techniques, and gain practice implementing them and getting them to work for yourself. More importantly, you'll learn about not only the theoretical underpinnings of learning, but also gain the practical know-how needed to quickly and powerfully apply these techniques to new problems. Finally, you'll learn about some of Silicon Valley's best practices in innovation as it pertains to machine learning and AI.

SHOW ALL

100% online
Start instantly and learn at your own schedule.

This course provides a broad introduction to machine learning, datamining, and statistical pattern recognition. Topics include: (i) Supervised learning (parametric/non-parametric algorithms, support vector machines, kernels, neural networks). (ii) Unsupervised learning (clustering, dimensionality reduction, recommender systems, deep learning). (iii) Best practices in machine learning (bias/variance theory; innovation process in machine learning and AI). The course will also draw from numerous case studies and applications, so that you'll also learn how to apply learning algorithms to building smart robots (perception, control), text understanding (web search, anti-spam), computer vision, medical informatics, audio, database mining, and other areas.

Flexible deadlines
Reset deadlines in accordance to your schedule.

Approx. 55 hours to complete
Suggested: 7 hours/week

English
Subtitles: English, Chinese (Simplified), Hebrew, Spanish, Hindi, Japanese

SKILLS YOU WILL GAIN

Logistic Regression · Artificial Neural Network · Machine Learning (ML) Algorithms · Machine Learning

Syllabus - What you will learn from this course

WEEK

2 hours to complete

Introduction

Welcome to Machine Learning! In this module, we introduce the core idea of teaching a computer to learn concepts using data—without being explicitly programmed. The Course
Wiki is under construction. Please visit the resources tab for the most complete and up-to-date information.

5 videos (Total 42 min), 9 readings, 1 quiz **SEE LESS**

5 videos

Welcome to Machine Learning! 1m

Welcome 6m

What is Machine Learning? 7m

Supervised Learning 12m

Unsupervised Learning 14m

9 readings

Machine Learning Honor Code 8m

What is Machine Learning? 5m

How to Use Discussion Forums 4m

Supervised Learning 4m

Unsupervised Learning 3m

Who are Mentors? 3m

Get to Know Your Classmates 8m

Frequently Asked Questions 11m

Lecture Slides 20m

1 practice exercise

Introduction 10m

2 hours to complete

Linear Regression with One Variable

Linear regression predicts a real-valued output based on an input value. We discuss the application of linear regression to housing price prediction, present the notion of a cost
function, and introduce the gradient descent method for learning.

Stanford University 7 videos (Total 70 min), 8 readings, 1 quiz SEE LESS

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About **Syllabus** Reviews Instructors Enrollment Options FAQ

7 videos

Model Representation 8m

Cost Function 8m

Cost Function - Intuition I 11m

Cost Function - Intuition II 8m

Gradient Descent 11m

Gradient Descent Intuition 11m

Gradient Descent For Linear Regression 10m

8 readings

Model Representation 3m

Cost Function 3m

Cost Function - Intuition I 4m

Cost Function - Intuition II 3m

Gradient Descent 3m

Gradient Descent Intuition 3m

Gradient Descent For Linear Regression 6m

Lecture Slides 20m

1 practice exercise

Linear Regression with One Variable 10m

2 hours to complete

Linear Algebra Review

This optional module provides a refresher on linear algebra concepts. Basic understanding of linear algebra is necessary for the rest of the course, especially as we begin to cover
models with multiple variables.

6 videos (Total 61 min), 7 readings, 1 quiz SEE LESS

6 videos

Matrices and Vectors 8m

Addition and Scalar Multiplication 6m

Stanford University

Matrix Vector Multiplication 13m

Matrix Matrix Multiplication 11m

Matrix Multiplication Properties 9m

Inverse and Transpose 11m

7 readings

Matrices and Vectors 2m

Addition and Scalar Multiplication 3m

Matrix Vector Multiplication 2m

Matrix Matrix Multiplication 2m

Matrix Multiplication Properties 2m

Inverse and Transpose 3m

Lecture Slides 10m

1 practice exercise

Linear Algebra 10m

WEEK

2

3 hours to complete

Linear Regression with Multiple Variables

What if your input has more than one value? In this module, we show how linear regression can be extended to accommodate multiple input features. We also discuss best
practices for implementing linear regression.

8 videos (Total 65 min), 16 readings, 1 quiz SEE LESS

8 videos

Multiple Features 8m

Gradient Descent for Multiple Variables 5m

Gradient Descent in Practice I - Feature Scaling 8m

Gradient Descent in Practice II - Learning Rate 8m

Features and Polynomial Regression 7m

Normal Equation 16m

Normal Equation Noninvertibility 5m

Working on and Submitting Programming Assignments 3m

16 readings

Setting Up Your Programming Assignment Environment 8m

Access MATLAB Online and Upload the Exercise Files 3m

Installing Octave on Windows 3m

Installing Octave on Mac OS X (10.10 Yosemite and 10.9 Mavericks and Later) 10m

Installing Octave on Mac OS X (10.8 Mountain Lion and Earlier) 3m

Installing Octave on GNU/Linux 7m

More Octave/MATLAB resources 10m

Multiple Features 3m

Gradient Descent For Multiple Variables 2m

Gradient Descent in Practice I - Feature Scaling 3m

Gradient Descent in Practice II - Learning Rate 4m

Features and Polynomial Regression 3m

Normal Equation 3m

Normal Equation Noninvertibility 2m

Programming tips from Mentors 10m

Lecture Slides 20m

1 practice exercise

Linear Regression with Multiple Variables 10m

5 hours to complete

Octave/Matlab Tutorial

This course includes programming assignments designed to help you understand how to implement the learning algorithms in practice. To complete the programming assignments,
you will need to use Octave or MATLAB. This module introduces Octave/Matlab and shows you how to submit an assignment.

6 videos (Total 80 min), 1 reading, 2 quizzes SEE LESS

6 videos

Basic Operations 13m

Moving Data Around 16m

Computing on Data 13m

Plotting Data 9m

Control Statements: for, while, if statement 12m

Vectorization 13m

1 reading

Lecture Slides 10m

1 practice exercise

Octave/Matlab Tutorial 10m

WEEK

3

2 hours to complete

Logistic Regression

Logistic regression is a method for classifying data into discrete outcomes. For example, we might use logistic regression to classify an email as spam or not spam. In this module,
we introduce the notion of classification, the cost function for logistic regression, and the application of logistic regression to multi-class classification.

7 videos (Total 71 min), 8 readings, 1 quiz **SEE LESS**

7 videos

Classification 8m

Hypothesis Representation 7m

Decision Boundary 14m

Cost Function 10m

Simplified Cost Function and Gradient Descent 10m

Advanced Optimization 14m

Multiclass Classification: One-vs-all 6m

8 readings

Classification 2m

Hypothesis Representation 3m

Decision Boundary 3m

Cost Function 3m

Simplified Cost Function and Gradient Descent 3m

Advanced Optimization 3m

Multiclass Classification: One-vs-all 3m

Lecture Slides 10m

1 practice exercise

Logistic Regression 10m

4 hours to complete

Regularization

Machine learning models need to generalize well to new examples that the model has not seen in practice. In this module, we introduce regularization, which helps prevent models
from overfitting the training data.

4 videos (Total 39 min), 5 readings, 2 quizzes SEE LESS

4 videos

The Problem of Overfitting 9m

Cost Function 10m

Regularized Linear Regression 10m

Regularized Logistic Regression 8m

5 readings

The Problem of Overfitting 3m

Cost Function 3m

Regularized Linear Regression 3m

Regularized Logistic Regression 3m

Lecture Slides 10m

1 practice exercise

Regularization 10m

WEEK 4

5 hours to complete

Neural Networks: Representation

Neural networks is a model inspired by how the brain works. It is widely used today in many applications: when your phone interprets and understand your voice commands, it is
likely that a neural network is helping to understand your speech; when you cash a check, the machines that automatically read the digits also use neural networks.

7 videos (Total 63 min), 6 readings, 2 quizzes **SEE LESS**

7 videos

Non-linear Hypotheses 9m

Neurons and the Brain 7m

Model Representation I 12m

Model Representation II 11m

Examples and Intuitions I 7m

Examples and Intuitions II 10m

Multiclass Classification 3m

6 readings

Model Representation I 6m

Model Representation II 6m

Examples and Intuitions I 2m

Examples and Intuitions II 3m

Multiclass Classification 3m

Lecture Slides 10m

1 practice exercise

Neural Networks: Representation 10m

WEEK 5

Neural Networks: Learning

In this module, we introduce the backpropagation algorithm that is used to help learn parameters for a neural network. At the end of this module, you will be implementing your
own neural network for digit recognition.

8 videos (Total 78 min), 8 readings, 2 quizzes SEE LESS

8 videos

Cost Function 6m

Backpropagation Algorithm 11m

Backpropagation Intuition 12m

Implementation Note: Unrolling Parameters 7m

Gradient Checking 11m

Random Initialization 6m

Putting It Together 13m

Autonomous Driving 6m

8 readings

Cost Function 4m

Backpropagation Algorithm 10m

Backpropagation Intuition 4m

Implementation Note: Unrolling Parameters 3m

Gradient Checking 3m

Random Initialization 3m

Putting It Together 4m

Lecture Slides 10m

1 practice exercise

Neural Networks: Learning 10m

WEEK

6

5 hours to complete
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Advice for Applying Machine Learning

Applying machine learning in practice is not always straightforward. In this module, we share best practices for applying machine learning in practice, and discuss the best ways to
evaluate performance of the learned models.

7 videos (Total 63 min), 7 readings, 2 quizzes **SEE LESS**

7 videos

Deciding What to Try Next 5m

Evaluating a Hypothesis 7m

Model Selection and Train/Validation/Test Sets 12m

Diagnosing Bias vs. Variance 7m

Regularization and Bias/Variance 11m

Learning Curves 11m

Deciding What to Do Next Revisited 6m

7 readings

Evaluating a Hypothesis 4m

Model Selection and Train/Validation/Test Sets 3m

Diagnosing Bias vs. Variance 3m

Regularization and Bias/Variance 3m

Learning Curves 3m

Deciding What to do Next Revisited 3m

Lecture Slides 10m

1 practice exercise

Advice for Applying Machine Learning 10m

1 hour to complete

Machine Learning System Design

To optimize a machine learning algorithm, you'll need to first understand where the biggest improvements can be made. In this module, we discuss how to understand the
performance of a machine learning system with multiple parts, and also how to deal with skewed data.

5 videos (Total 60 min), 3 readings, 1 quiz **SEE LESS**

5 videos

Prioritizing What to Work On 9m

Error Analysis 13m

Error Metrics for Skewed Classes 11m

Trading Off Precision and Recall 14m

Data For Machine Learning 11m

3 readings

Prioritizing What to Work On 3m

Error Analysis 3m

Lecture Slides 10m

1 practice exercise

Machine Learning System Design 10m

WEEK

7

5 hours to complete

Support Vector Machines

Support vector machines, or SVMs, is a machine learning algorithm for classification. We introduce the idea and intuitions behind SVMs and discuss how to use it in practice.

6 videos (Total 98 min), 1 reading, 2 quizzes **SEE LESS**

6 videos

Optimization Objective 14m

Large Margin Intuition 10m

Mathematics Behind Large Margin Classification 19m

Kernels I 15m

Kernels II 15m

Using An SVM 21m

1 reading

Lecture Slides 10m

Support Vector Machines 10m

WEEK

8

1 hour to complete

Unsupervised Learning

We use unsupervised learning to build models that help us understand our data better. We discuss the k-Means algorithm for clustering that enable us to learn groupings of
unlabeled data points.

5 videos (Total 39 min), 1 reading, 1 quiz **SEE LESS**

5 videos

Unsupervised Learning: Introduction 3m

K-Means Algorithm 12m

Optimization Objective 7m

Random Initialization 7m

Choosing the Number of Clusters 8m

1 reading

Lecture Slides 10m

1 practice exercise

Unsupervised Learning 10m

4 hours to complete

Dimensionality Reduction

In this module, we introduce Principal Components Analysis, and show how it can be used for data compression to speed up learning algorithms as well as for visualizations of
complex datasets.

7 videos (Total 67 min), 1 reading, 2 quizzes **SEE LESS**

7 videos

Motivation I: Data Compression 10m

Motivation II: Visualization 5m

Principal Component Analysis Problem Formulation 9m

Principal Component Analysis Algorithm 15m

Reconstruction from Compressed Representation 3m

Choosing the Number of Principal Components 10m

Advice for Applying PCA 12m

1 reading

Lecture Slides 10m

1 practice exercise

Principal Component Analysis 10m

WEEK

9

2 hours to complete

Anomaly Detection

Given a large number of data points, we may sometimes want to figure out which ones vary significantly from the average. For example, in manufacturing, we may want to detect
defects or anomalies. We show how a dataset can be modeled using a Gaussian distribution, and how the model can be used for anomaly detection.

8 videos (Total 91 min), 1 reading, 1 quiz **SEE LESS**

8 videos

Problem Motivation 7m

Gaussian Distribution 10m

Algorithm 12m

Developing and Evaluating an Anomaly Detection System 13m

Anomaly Detection vs. Supervised Learning 7m

Choosing What Features to Use 12m

Multivariate Gaussian Distribution 13m

Anomaly Detection using the Multivariate Gaussian Distribution 14m

1 reading

Lecture Slides 10m

1 practice exercise

Anomaly Detection 10m

4 hours to complete

Recommender Systems

When you buy a product online, most websites automatically recommend other products that you may like. Recommender systems look at patterns of activities between different
users and different products to produce these recommendations. In this module, we introduce recommender algorithms such as the collaborative filtering algorithm... SHOW ALL

6 videos (Total 58 min), 1 reading, 2 quizzes SEE LESS

6 videos

Problem Formulation 7m

Content Based Recommendations 14m

Collaborative Filtering 10m

Collaborative Filtering Algorithm 8m

Vectorization: Low Rank Matrix Factorization 8m

Implementational Detail: Mean Normalization 8m

1 reading

Lecture Slides 10m

1 practice exercise

Recommender Systems 10m

WEEK

10

1 hour to complete

Large Scale Machine Learning

Machine learning works best when there is an abundance of data to leverage for training. In this module, we discuss how to apply the machine learning algorithms we have learned about to very large datasets.

6 videos (Total 64 min), 1 reading, 1 quiz SEE LESS

6 videos

Learning With Large Datasets 5m

Stochastic Gradient Descent 13m

Mini-Batch Gradient Descent 6m

Stochastic Gradient Descent Convergence 11m

Online Learning 12m

Map Reduce and Data Parallelism 14m

1 reading

Lecture Slides 10m

1 practice exercise

Large Scale Machine Learning 10m

WEEK

11

1 hour to complete

Application Example: Photo OCR

Identifying and recognizing objects, words, and digits in an image is a challenging task. We discuss how a pipeline can be built to tackle this problem and how to analyze and
improve the performance of such a system.

5 videos (Total 57 min), 1 reading, 1 quiz SEE LESS

5 videos

Problem Description and Pipeline 7m

Sliding Windows 14m

Getting Lots of Data and Artificial Data 16m

Ceiling Analysis: What Part of the Pipeline to Work on Next 13m
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Summary and Thank You 4m

1 reading

Lecture Slides 10m

1 practice exercise

Application: Photo OCR 10m

Show Less

4.9 ★★★★½

22,972 Reviews >

Top Reviews

★★★★★ By AD • APR 22ND 2017

Very good coverage of different supervised and unsupervised algorithms, and lots of practical insights around implementation. All the explanations provided helped to understand the concepts very well.

★★★★★ By MM • JUL 8TH 2018

Great course! Learned lots of stuffs about ML. I think the programming exercises and the quizzes are efficient way to me to master this course, just watching videos without any practice benefits less.

Instructor

Andrew Ng

CEO/Founder Landing AI; Co-founder, Coursera; Adjunct Professor, Stanford University; formerly Chief Scientist,Baidu and founding lead of Google Brain

About Stanford University

The Leland Stanford Junior University, commonly referred to as Stanford University or Stanford, is an American private research university located in Stanford, California on an 8,180-acre (3,310 ha) campus near Palo Alto, California, United States.

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Frequently Asked Questions

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What will I get if I purchase the Certificate?

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