

SALE! Use code `blackfriday` for 40% off everything!

Hurry, sale ends soon! [Click to see the full catalog.](#)



Navigation



Machine Learning Mastery

Making Developers Awesome at Machine Learning

[Click to Take the FREE Crash-Course](#)

Search...



Need Help Getting Started with Applied Machine Learning?

These are the Step-by-Step Guides that You've Been Looking For!

What do you want help with?

Foundations

- [How Do I Get Started?](#)
- [Step-by-Step Process](#)
- [Probability](#)
- [Statistical Methods](#)
- [Linear Algebra](#)
- [Optimization](#)

Beginner

- [Understand ML Algorithms](#)
- [ML + Weka \(no code\)](#)
- [ML + Python \(scikit-learn\)](#)
- [ML + R \(caret\)](#)
- [Time Series Forecasting](#)
- [Data Preparation](#)

Intermediate

- [Code ML Algorithms](#)
- [XGBoost Algorithm](#)
- [Imbalanced Classification](#)
- [Deep Learning \(Keras\)](#)
- [Better Deep Learning](#)
- [Ensemble Learning](#)

Advanced

- [Long Short-Term Memory](#)
- [Natural Language \(Text\)](#)
- [Computer Vision](#)
- [CNN/LSTM + Time Series](#)
- [GANs](#)

How Do I Get Started?

The most common question I'm asked is: "*how do I get started?*"

My best advice for getting started is machine learning is broken down into 5 steps:

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

- Advanced: R Platform.
- Best Programming Language for Machine Learning
- **Step 4: Practice on Datasets.** Select datasets to work on and practice the process.
 - Practice Machine Learning with Small In-Memory Datasets
 - Tour of Real-World Machine Learning Problems
 - Work on Machine Learning Problems That Matter To You
- **Step 5: Build a Portfolio.** Gather results and demonstrate your skills.
 - Build a Machine Learning Portfolio
 - Get Paid To Apply Machine Learning
 - Machine Learning For Money

For more on this top-down approach, see:

- The Machine Learning Mastery Method
- Machine Learning for Programmers

Many of my students have used this approach to go on and do well in Kaggle competitions and get jobs as Machine Learning Engineers and Data Scientists.

Applied Machine Learning Process

The benefit of machine learning are the predictions and the models that make predictions.

To have skill at applied machine learning means knowing how to consistently and reliably deliver high-quality predictions on problem after problem. You need to follow a systematic process.

Below is a 5-step process that you can follow to consistently achieve above average results on predictive modeling problems:

- **Step 1:** Define your problem.
 - [How to Define Your Machine Learning Problem](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

- [How To Choose The Right Test Options When Evaluating Machine Learning Algorithms](#)
- [A Data-Driven Approach to Choosing Machine Learning Algorithms](#)
- **Step 4:** Improve results.
 - [How to Improve Machine Learning Results](#)
 - [Machine Learning Performance Improvement Cheat Sheet](#)
 - [How To Improve Deep Learning Performance](#)
- **Step 5:** Present results.
 - [How to Use Machine Learning Results](#)
 - [How to Train a Final Machine Learning Model](#)
 - [How To Deploy Your Predictive Model To Production](#)

For a good summary of this process, see the posts:

- [Applied Machine Learning Process](#)
- [How to Use a Machine Learning Checklist to Get Accurate Predictions](#)

Probability for Machine Learning

Probability is the mathematics of quantifying and harnessing uncertainty. It is the bedrock of many fields of mathematics (like statistics) and is critical for applied machine learning.

Below is the 3 step process that you can use to get up-to-speed with probability for machine learning, fast.

- **Step 1:** Discover what Probability is.
 - [Basics of Mathematical Notation for Machine Learning](#)
 - [What Is Probability?](#)
- **Step 2:** Discover why Probability is so important for machine learning.
 - [5 Reasons to Learn Probability for Machine Learning](#)
 - [A Gentle Introduction to Uncertainty in Machine Learning](#)

- **Step 3:** Dive into Probability topics.
 - [Probability for Machine Learning Mini-Course](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

Probability

Machine Learning

Bayes Theorem

- [A Gentle Introduction to Bayes Theorem for Machine Learning](#)
- [Develop a Naive Bayes Classifier from Scratch in Python](#)
- [Implement Bayesian Optimization from Scratch in Python](#)

Information Theory

- [A Gentle Introduction to Information Entropy](#)
- [Calculate the Divergence Between Probability Distributions](#)
- [A Gentle Introduction to Cross-Entropy for Machine Learning](#)

Statistics for Machine Learning

Statistical Methods an important foundation area of mathematics required for achieving a deeper understanding of the behavior of machine learning algorithms.

Below is the 3 step process that you can use to get up-to-speed with statistical methods for machine learning, fast.

- **Step 1:** Discover what Statistical Methods are.
 - [What is Statistics \(and why is it important in machine learning\)?](#)
- **Step 2:** Discover why Statistical Methods are important for machine learning.
 - [The Close Relationship Between Applied Statistics and Machine Learning](#)
 - [10 Examples of How to Use Statistical Methods in a Machine Learning Project](#)
- **Step 3:** Dive into the topics of Statistical Methods.
 - [Statistics for Machine Learning \(7-Day Mini-Course\)](#)
 - [Statistical Methods for Machine Learning \(*my book*\)](#)

You can see all of the [statistical methods posts here](#). Below is a selection of some of the most popular tutorials.

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

(Cheat Sheet)

• [Introduction to Tolerance Intervals](#)

- [Introduction to Statistical Hypothesis Tests](#)
- [Introduction to Nonparametric Statistical Significance Tests](#)
- [Introduction to Parametric Statistical Significance Tests](#)
- [Statistical Significance Tests for Comparing Algorithms](#)

Linear Algebra for Machine Learning

Linear algebra is an important foundation area of mathematics required for achieving a deeper understanding of machine learning algorithms.

Below is the 3 step process that you can use to get up-to-speed with linear algebra for machine learning, fast.

- **Step 1:** Discover what Linear Algebra is.
 - [Basics of Mathematical Notation for Machine Learning](#)
 - [A Gentle Introduction to Linear Algebra](#)
- **Step 2:** Discover why Linear Algebra is important for machine learning.
 - [5 Reasons to Learn Linear Algebra for Machine Learning](#)
 - [10 Examples of Linear Algebra in Machine Learning](#)
 - [Linear Algebra for Machine Learning](#)
- **Step 3:** Dive into Linear Algebra topics.
 - [Linear Algebra for Machine Learning Mini-Course](#)

- [Linear Algebra for Machine Learning \(*my book*\)](#)

You can see all [linear algebra posts here](#). Below is a selection of some of the most popular tutorials.

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

- [Machine Learning](#)
- [Introduction to Tensors for Machine Learning](#)
- [Introduction to Principal Component Analysis \(PCA\)](#)

Optimization for Machine Learning

Optimization is the core of all machine learning algorithms. When we train a machine learning model, it is doing optimization with the given dataset.

You can get familiar with optimization for machine learning in 3 steps, fast.

- **Step 1:** Discover what Optimization is.
 - [A Gentle Introduction to Applied Machine Learning as a Search Problem](#)
 - [A Gentle Introduction to Function Optimization](#)
- **Step 2:** Discover the Optimization Algorithms.
 - [Function Optimization With SciPy](#)
 - [Basin Hopping Optimization in Python](#)
 - [How to Implement Gradient Descent Optimization from Scratch](#)
- **Step 3:** Dive into Optimization Topics.
 - [How to Manually Optimize Machine Learning Model Hyperparameters](#)
 - [Optimization for Machine Learning \(*my book*\)](#)

You can see all [optimization posts here](#). Below is a selection of some of the most popular tutorials.

Local Optimization

- [Function Optimization With SciPy](#)
- [Basin Hopping Optimization in Python](#)

Gradient Descent

- [How to Implement Gradient Descent Optimization from Scratch](#)

- [Stochastic Hill Climbing in Python from Scratch](#)

- [Code Adam Optimization Algorithm From Scratch](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

Understand Machine Learning Algorithms

Machine learning is about machine learning algorithms.

You need to know what algorithms are available for a given problem, how they work, and how to get the most out of them.

Here's how to get started with machine learning algorithms:

- **Step 1:** Discover the different types of machine learning algorithms.
 - [A Tour of Machine Learning Algorithms](#)
- **Step 2:** Discover the foundations of machine learning algorithms.
 - [How Machine Learning Algorithms Work](#)
 - [Parametric and Nonparametric Algorithms](#)
 - [Supervised and Unsupervised Algorithms](#)
 - [The Bias-Variance Trade-Off](#)
 - [Overfitting and Underfitting With Algorithms](#)
- **Step 3:** Discover how top machine learning algorithms work.
 - [Machine Learning Algorithms Mini-Course](#)
 - [Master Machine Learning Algorithms \(*my book*\)](#)

You can see all [machine learning algorithm posts here](#). Below is a selection of some of the most popular tutorials.

Linear Algorithms

- [Gradient Descent](#)
- [Linear Regression](#)
- [Logistic Regression](#)
- [Linear Discriminant Analysis](#)

Ensemble Algorithms

- [Bagging and Random Forest](#)
- [Boosting and AdaBoost](#)

How to Study/Learn ML Algorithms

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

Weka Machine Learning (no code)

Weka is a platform that you can use to get started in applied machine learning.

It has a graphical user interface meaning that no programming is required and it offers a suite of state of the art algorithms.

Here's how you can get started with Weka:

- **Step 1:** Discover the features of the Weka platform.
 - [What is the Weka Machine Learning Workbench](#)
- **Step 2:** Discover how to get around the Weka platform.
 - [How to Download and Install the Weka Machine Learning Workbench](#)
 - [A Tour of the Weka Machine Learning Workbench](#)
- **Step 3:** Discover how to deliver results with Weka.
 - [How to Run Your First Classifier in Weka](#)
 - [Applied Machine Learning With Weka Mini-Course](#)
 - [Machine Learning Mastery With Weka \(*my book*\)](#)

You can see all [Weka machine learning posts here](#). Below is a selection of some of the most popular tutorials.

Prepare Data in Weka

- [How To Load CSV Machine Learning Data in Weka](#)
- [How to Better Understand Your Machine Learning Data in Weka](#)

Weka Algorithm Tutorials

- [How to Use Machine Learning Algorithms in Weka](#)
- [How To Estimate The Performance of Machine Learning Algorithms in Weka](#)

- [How to Normalize and Standardize Your Machine Learning Data in Weka](#)

- [How To Use Regression Machine Learning Algorithms in Weka](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

Python is one of the fastest growing platforms for applied machine learning.

You can use the same tools like pandas and scikit-learn in the development and operational deployment of your model.

Below are the steps that you can use to get started with Python machine learning:

- **Step 1:** Discover Python for machine learning
 - [A Gentle Introduction to Scikit-Learn: A Python Machine Learning Library](#)
- **Step 2:** Discover the ecosystem for Python machine learning.
 - [Crash Course in Python for Machine Learning Developers](#)
 - [Python Ecosystem for Machine Learning](#)
 - [Python is the Growing Platform for Applied Machine Learning](#)
- **Step 3:** Discover how to work through problems using machine learning in Python.
 - [Your First Machine Learning Project in Python Step-By-Step](#)
 - [Python Machine Learning Mini-Course](#)
 - [Machine Learning Mastery With Python \(*my book*\)](#)

You can see all [Python machine learning posts here](#). Below is a selection of some of the most popular tutorials.

Prepare Data in Python

- [How To Load Machine Learning Data in Python](#)
- [Understand Your Machine Learning Data With Descriptive Statistics in Python](#)
- [Visualize Machine Learning Data in Python With Pandas](#)
- [How To Prepare Your Data For Machine Learning in Python with Scikit-Learn](#)
- [Feature Selection For Machine Learning in Python](#)

Machine Learning in Python

- [Evaluate the Performance of Machine Learning Algorithms](#)
- [Metrics To Evaluate Machine Learning Algorithms in Python](#)
- [Spot-Check Classification Machine Learning Algorithms in Python with scikit-learn](#)
- [Spot-Check Regression Machine Learning Algorithms in Python with scikit-learn](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

these methods such as the powerful caret package.

Here's how to get started with R machine learning:

- **Step 1:** Discover the R platform and why it is so popular.
 - [What is R](#)
 - [Use R For Machine Learning](#)
 - [Super Fast Crash Course in R](#)
- **Step 2:** Discover machine learning algorithms in R.
 - [How To Get Started With Machine Learning Algorithms in R](#)
- **Step 3:** Discover how to work through problems using machine learning in R.
 - [Your First Machine Learning Project in R Step-By-Step](#)
 - [R Machine Learning Mini-Course](#)
 - [Machine Learning Mastery With R \(*my book*\)](#)

You can see all R machine learning posts [here](#). Below is a selection of some of the most popular tutorials.

Data Preparation in R

- [How To Load Your Machine Learning Data Into R](#)
- [Better Understand Your Data in R Using Descriptive Statistics](#)
- [Better Understand Your Data in R Using Visualization](#)
- [Feature Selection with the Caret R Package](#)
- [Get Your Data Ready For Machine Learning in R with Pre-Processing](#)

Applied Machine Learning in R

- [How to Evaluate Machine Learning Algorithms with R](#)
- [Spot Check Machine Learning Algorithms in R](#)
- [Tune Machine Learning Algorithms in R](#)
- [How to Build an Ensemble Of Machine Learning Algorithms in R](#)
- [Compare The Performance of Machine Learning Algorithms in R](#)

Code Algorithm from Scratch (Python)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

- [Stop Coding Machine Learning Algorithms From Scratch](#)
- [Don't Start with Open-Source Code When Implementing Machine Learning Algorithms](#)
- **Step 3:** Discover how to code machine learning algorithms from scratch in Python.
 - [Machine Learning Algorithms From Scratch \(*my book*\)](#)

You can see all of the [Code Algorithms from Scratch](#) posts [here](#). Below is a selection of some of the most popular tutorials.

Prepare Data

- [How to Load Machine Learning Data From Scratch](#)
- [How to Scale Machine Learning Data From Scratch](#)

Linear Algorithms

- [How To Implement Simple Linear Regression From Scratch](#)
- [How To Implement The Perceptron Algorithm From Scratch](#)

Algorithm Evaluation

- [How to Code Resampling Methods From Scratch](#)
- [How To Code Algorithm Performance Metrics From Scratch](#)

Nonlinear Algorithms

- [How to Code the Backpropagation Algorithm From Scratch](#)
- [How To Code The Decision Tree Algorithm From Scratch](#)

Introduction to Time Series Forecasting (Python)

Time series forecasting is an important topic in business applications.

Many datasets contain a time component, but the topic of time series is rarely covered in much depth from a machine learning perspective.

Here's how to get started with Time Series Forecasting:

Step 1: Discover Time Series Forecasting

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

- 7 Time Series Datasets for Machine Learning
- How to Load and Explore Time Series Data in Python
- How to Normalize and Standardize Time Series Data in Python
- Basic Feature Engineering With Time Series Data in Python
- How To Backtest Machine Learning Models for Time Series Forecasting
- How to Make Baseline Predictions for Time Series Forecasting with Python
- How to Check if Time Series Data is Stationary with Python
- How to Create an ARIMA Model for Time Series Forecasting with Python
- How to Grid Search ARIMA Model Hyperparameters with Python
- How to Work Through a Time Series Forecast Project

Data Preparation for Machine Learning (Python)

The performance of your predictive model is only as good as the data that you use to train it.

As such data preparation may be the most important parts of your applied machine learning project.

Here's how to get started with Data Preparation for machine learning:

- **Step 1:** Discover the importance of data preparation.
 - What Is Data Preparation in a Machine Learning Project
 - Why Data Preparation Is So Important in Machine Learning
- **Step 2:** Discover data preparation techniques.
 - Tour of Data Preparation Techniques for Machine Learning
 - Framework for Data Preparation Techniques in Machine Learning
- **Step 3:** Discover how to get good at delivering results with data preparation.

- [How to Choose Data Preparation Methods for Machine Learning](#)
- [Data Preparation for Machine Learning \(7-Day Mini-Course\)](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

- [Introduction to Feature Importance Methods](#)
- [How to use Recursive Feature Selection \(RFE\)](#)
- [How to Use Feature Selection for Regression](#)
- [Methods](#)
- [How to use PCA for Dimensionality Reduction](#)
- [How to use LDA for Dimensionality Reduction](#)

XGBoost in Python (Stochastic Gradient Boosting)

XGBoost is a highly optimized implementation of gradient boosted decision trees.

It is popular because it is being used by some of the best data scientists in the world to win machine learning competitions.

Here's how to get started with XGBoost:

- **Step 1:** Discover the Gradient Boosting Algorithm.
 - [A Gentle Introduction to the Gradient Boosting Algorithm for Machine Learning](#)
- **Step 2:** Discover XGBoost.
 - [A Gentle Introduction to XGBoost for Applied Machine Learning](#)
- **Step 3:** Discover how to get good at delivering results with XGBoost.
 - [How to Develop Your First XGBoost Model in Python with scikit-learn](#)
 - [XGBoost With Python Mini-Course](#)
 - [XGBoost With Python \(*my book*\)](#)

You can see all [XGBoosts posts here](#). Below is a selection of some of the most popular tutorials.

XGBoost Basics

- [Data Preparation for Gradient Boosting with XGBoost in Python](#)

XGBoost Tuning

- [How to Configure the Gradient Boosting Algorithm](#)

- [How to Evaluate Gradient Boosting Models with XGBoost in Python](#)

- [Tune Learning Rate for Gradient Boosting with XGBoost in Python](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

Imbalanced classification refers to classification tasks where there are many more examples for one class than another class.

These types of problems often require the use of specialized performance metrics and learning algorithms as the standard metrics and methods are unreliable or fail completely.

Here's how you can get started with Imbalanced Classification:

- **Step 1:** Discover the challenge of imbalanced classification
 - [A Gentle Introduction to Imbalanced Classification](#)
- **Step 2:** Discover the intuition for skewed class distributions.
 - [Develop an Intuition for Severely Skewed Class Distributions](#)
- **Step 3:** Discover how to solve imbalanced classification problems.
 - [Step-By-Step Framework for Imbalanced Classification Projects](#)
 - [Imbalanced Classification With Python \(7-Day Mini-Course\)](#)
 - [Imbalanced Classification with Python \(*my book*\)](#)

You can see all [Imbalanced Classification posts here](#). Below is a selection of some of the most popular tutorials.

Performance Measures

- [Tour of Evaluation Metrics for Imbalanced Classification](#)
- [Failure of Classification Accuracy](#)
- [How to Calculate Precision, Recall, and F-Measure](#)

Cost-Sensitive Algorithms

- [Cost-Sensitive Logistic Regression](#)

Data Sampling

- [Tour of Data Sampling Methods for Imbalanced Classification](#)
- [Random Oversampling and Undersampling](#)
- [SMOTE Oversampling for Imbalanced Classification](#)

Advanced Methods

- [Threshold Moving Methods](#)

- [Cost-Sensitive Decision Trees](#)
- [How to Configure XGBoost for Imbalanced](#)
- [One-Class Classification](#)
- [Customised Ensemble Algorithms](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

that cannot be ignored.

Here's how to get started with deep learning:

- **Step 1:** Discover what deep learning is all about.
 - [What is Deep Learning?](#)
 - [8 Inspirational Applications of Deep Learning](#)
- **Step 2:** Discover the best tools and libraries.
 - [Introduction to the Python Deep Learning Library Theano](#)
 - [Introduction to the Python Deep Learning Library TensorFlow](#)
 - [Introduction to Python Deep Learning with Keras](#)
- **Step 3:** Discover how to work through problems and deliver results.
 - [Develop Your First Neural Network in Python With Keras Step-By-Step](#)
 - [Applied Deep Learning in Python Mini-Course](#)
 - [Deep Learning With Python \(*my book*\)](#)

You can see all [deep learning posts](#) here. Below is a selection of some of the most popular tutorials.

Background

- [Crash Course On Multi-Layer Perceptron Neural Networks](#)
- [Crash Course in Convolutional Neural Networks for Machine Learning](#)
- [Crash Course in Recurrent Neural Networks for Deep Learning](#)

Multilayer Perceptrons

- [5 Step Life-Cycle for Neural Network Models in Keras](#)
- [How to Grid Search Hyperparameters for Deep Learning Models in Python With Keras](#)

Convolutional Neural Networks

- [Handwritten Digit Recognition using Convolutional Neural Networks in Python with Keras](#)
- [Object Recognition with Convolutional Neural Networks in the Keras Deep Learning Library](#)
- [Predict Sentiment From Movie Reviews Using Deep Learning](#)

Recurrent Neural Networks

- [Time Series Prediction with LSTM Recurrent Neural Networks in Python with Keras](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

Although it is easy to define and fit a deep learning neural network model, it can be challenging to get good performance on a specific predictive modeling problem.

There are standard techniques that you can use to improve the learning, reduce overfitting, and make better predictions with your deep learning model.

Here's how to get started with getting better deep learning performance:

- **Step 1:** Discover the challenge of deep learning.
 - [Why Training a Neural Network Is Hard](#)
 - [The Challenge of Training Deep Learning Neural Network Models](#)
- **Step 2:** Discover frameworks for diagnosing and improving model performance.
 - [How To Improve Deep Learning Performance](#)
 - [Framework for Better Deep Learning](#)
 - [Introduction to Learning Curves for Diagnosing Model Performance](#)
- **Step 3:** Discover techniques that you can use to improve performance.
 - [How to Get Better Deep Learning Results \(7-Day Mini-Course\)](#)
 - [Better Deep Learning \(*my book*\)](#)

You can see all better deep learning posts [here](#). Below is a selection of some of the most popular tutorials.

Better Learning (fix training)

- [How to Control Model Capacity With Nodes and Layers](#)
- [How to Choose Loss Functions When Training Neural Networks](#)
- [Understand the Impact of Learning Rate on Model Performance](#)
- [How to Fix Vanishing Gradients Using the ReLU](#)

Better Predictions (ensembles)

- [Ensemble Methods for Deep Learning Neural Networks](#)
- [How to Develop Model Averaging Ensembles](#)
- [How to Develop a Cross-Validation and Bagging Ensembles](#)
- [How to Develop a Stacking Deep Learning Ensemble](#)

Tips, Tricks, and Resources

Better Generalization (fix overfitting)

- [Regularization to Reduce Overfitting of Neural](#)

- [8 Tricks for Configuring Backpropagation](#)
- [Tricks of the Trade Review](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

Ensemble Learning

Predictive performance is the most important concern on many classification and regression problems. Ensemble learning algorithms combine the predictions from multiple models and are designed to perform better than any contributing ensemble member.

Here's how to get started with getting better ensemble learning performance:

- **Step 1:** Discover ensemble learning.
 - [A Gentle Introduction to Ensemble Learning](#)
 - [Why Use Ensemble Learning](#)
- **Step 2:** Discover ensemble learning algorithms.
 - [A Gentle Introduction to Ensemble Learning Algorithms](#)
- **Step 3:** Discover techniques that you can use to improve performance.
 - [Ensemble Machine Learning With Python \(7-Day Mini-Course\)](#)
 - [Ensemble Learning Algorithms With Python \(*my book*\)](#)

You can see all [ensemble learning posts](#) here. Below is a selection of some of the most popular tutorials.

Ensemble Basics

- [Ensemble Learning Algorithm Complexity](#)
- [What Is Meta Learning](#)
- [How Ensemble Learning Works](#)

Stacking Ensembles

- [Essence of Stacking](#)
- [Stacking Ensemble Algorithms](#)
- [Blending Ensemble Algorithms](#)

Bagging Ensembles

- [Bagging Ensemble With Python](#)
- [Bagging Data Transformations](#)
- [Random Subspace Ensemble](#)

Boosting Ensembles

- [Gradient Boosting Machine](#)
- [Extreme Gradient Boosting](#)
- [Histogram-based Gradient Boosting](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

- Making Predictions with Sequences
- A Gentle Introduction to Long Short-Term Memory Networks by the Experts
- Introduction to Models for Sequence Prediction
- **Step 3:** Discover how to use LSTMs on your project.
 - The 5 Step Life-Cycle for Long Short-Term Memory Models in Keras
 - Long Short-Term Memory Networks (Mini-Course)
 - Long Short-Term Memory Networks With Python (*my book*)

You can see all [LSTM posts](#) here. Below is a selection of some of the most popular tutorials using LSTMs in Python with the Keras deep learning library.

Data Preparation for LSTMs

- How to Reshape Input Data for Long Short-Term Memory Networks
- How to One Hot Encode Sequence Data
- How to Remove Trends and Seasonality with a Difference Transform
- How to Scale Data for Long Short-Term Memory Networks
- How to Prepare Sequence Prediction for Truncated BPTT
- How to Handle Missing Timesteps in Sequence Prediction Problems

LSTM Behaviour

- A Gentle Introduction to Backpropagation Through Time
- Demonstration of Memory with a Long Short-Term Memory Network

Modeling with LSTMs

- Generative Long Short-Term Memory Networks
- Stacked Long Short-Term Memory Networks
- Encoder-Decoder Long Short-Term Memory Networks
- CNN Long Short-Term Memory Networks
- Diagnose Overfitting and Underfitting of LSTM Models
- How to Make Predictions with Long Short-Term Memory Models

LSTM for Time Series

- On the Suitability of LSTMs for Time Series Forecasting
- Time Series Forecasting with the Long Short-Term Memory Network
- Multi-step Time Series Forecasting with Long Short-Term Memory Networks

- [How to Use the TimeDistributed Layer for Long Short-Term Memory Networks](#)

- [Multivariate Time Series Forecasting with LSTMs in Keras](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

working with text data is hard because of the messy nature of natural language.

Text is not “solved” but to get state-of-the-art results on challenging NLP problems, you need to adopt deep learning methods

Here’s how to get started with deep learning for natural language processing:

- **Step 1:** Discover what deep learning for NLP is all about.
 - [What is Natural Language Processing?](#)
 - [What is Deep Learning?](#)
 - [Promise of Deep Learning for Natural Language Processing](#)
- **Step 2:** Discover standard datasets for NLP.
 - [7 Applications of Deep Learning for Natural Language Processing](#)
 - [Datasets for Natural Language Processing](#)
- **Step 3:** Discover how to work through problems and deliver results.
 - [Crash-Course in Deep Learning for Natural Language Processing](#)
 - [Deep Learning for Natural Language Processing \(*my book*\)](#)

You can see all [deep learning for NLP posts](#) here. Below is a selection of some of the most popular tutorials.

Bag-of-Words Model

- [What is the Bag-of-Words Model?](#)
- [How to Prepare Text Data for Machine Learning with scikit-learn](#)
- [How to Develop a Bag-of-Words Model for Predicting Sentiment](#)

Language Modeling

- [Gentle Introduction to Statistical Language Modeling and Neural Language Models](#)

Word Embeddings

- [What are Word Embeddings?](#)
- [How to Develop Word Embeddings in Python with Gensim](#)
- [How to Use Word Embedding Layers for Deep Learning with Keras](#)

Photo Captioning

- [How to Automatically Generate Textual Descriptions for Photographs with Deep](#)

- [How to Develop a Character-Based Neural Language Model in Keras](#)

- [A Gentle Introduction to Deep Learning](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

- [Best Practices for Text Classification with Deep Learning](#)
- [How to Develop a Bag-of-Words Model for Sentiment Analysis](#)
- [How to Develop a CNN for Sentiment Analysis](#)

Deep Learning for Computer Vision

Working with image data is hard because of the gulf between raw pixels and the meaning in the images.

Computer vision is not solved, but to get state-of-the-art results on challenging computer vision tasks like object detection and face recognition, you need deep learning methods.

Here's how to get started with deep learning for computer vision:

- **Step 1:** Discover what deep learning for Computer Vision is all about.
 - [What is Computer Vision?](#)
 - [What is the Promise of Deep Learning for Computer Vision?](#)
- **Step 2:** Discover standard tasks and datasets for Computer Vision.
 - [9 Applications of Deep Learning for Computer Vision](#)
 - [How to Load and Visualize Standard Computer Vision Datasets With Keras](#)
 - [How to Develop and Demonstrate Competence With Deep Learning for Computer Vision](#)
- **Step 3:** Discover how to work through problems and deliver results.
 - [How to Get Started With Deep Learning for Computer Vision \(7-Day Mini-Course\)](#)
 - [Deep Learning for Computer Vision \(*my book*\)](#)

You can see all [deep learning for Computer Vision posts here](#). Below is a selection of some of the most popular tutorials.

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

- [How to Configure and Use Image Data Augmentation](#)
- [Introduction to Test-Time Data Augmentation](#)

Image Classification

- [How to Develop a CNN for CIFAR-10 Photo Classification](#)
- [How to Develop a CNN to Classify Photos of Dogs and Cats](#)
- [How to Develop a CNN to Classify Satellite Photos](#)

CNNS

- [Gentle Introduction to Padding and Stride in CNNs](#)
- [Gentle Introduction to Pooling Layers in CNNs](#)

Object Recognition

- [A Gentle Introduction to Object Recognition](#)
- [How to Perform Object Detection with Mask R-CNN](#)
- [How to Perform Object Detection With YOLOv3 in Keras](#)

Deep Learning for Time Series Forecasting

Deep learning neural networks are able to automatically learn arbitrary complex mappings from inputs to outputs and support multiple inputs and outputs.

Methods such as MLPs, CNNs, and LSTMs offer a lot of promise for time series forecasting.

Here's how to get started with deep learning for time series forecasting:

- **Step 1:** Discover the promise (and limitations) of deep learning for time series.
 - [The Promise of Recurrent Neural Networks for Time Series Forecasting](#)
 - [On the Suitability of Long Short-Term Memory Networks for Time Series Forecasting](#)
 - [Results From Comparing Classical and Machine Learning Methods for Time Series Forecasting](#)
- **Step 2:** Discover how to develop robust baseline and defensible forecasting models.

- Taxonomy of Time Series Forecasting Problems
- How to Develop a Skillful Machine Learning Time Series Forecasting Model

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

Time Series Forecasting

- Develop Deep Learning Models for Univariate Forecasting

Time Series Forecasting

- How to Develop LSTMs for Time Series Forecasting

Human Activity Recognition (multivariate classification)

- How to Model Human Activity From Smartphone Data
- How to Develop CNN Models for Human Activity Recognition
- How to Develop RNN Models for Human Activity Recognition

Time Series Case Studies

- Indoor Movement Time Series Classification
- Probabilistic Forecasting Model to Predict Air Pollution Days
- Predict Room Occupancy Based on Environmental Factors
- Predict Whether Eyes are Open or Closed Using Brain Waves

Forecast Electricity Usage (multivariate, multi-step)

- How to Load and Explore Household Electricity Usage Data
- Multi-step Time Series Forecasting with Machine Learning
- How to Develop CNNs for Multi-Step Time Series Forecasting

Forecast Air Pollution (multivariate, multi-step)

- Load, Visualize, and Explore a Air Pollution Forecasting
- Develop Baseline Forecasts for Air Pollution Forecasting
- Develop Autoregressive Models for Air Pollution Forecasting
- Develop Machine Learning Models for Air Pollution Forecasting

Generative Adversarial Networks (GANs)

Generative Adversarial Networks, or GANs for short, are an approach to generative modeling using deep learning methods, such as convolutional neural networks.

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

- **Step 3:** Discover how to develop GAN models in Python with Keras.
 - [How to Get Started With Generative Adversarial Networks \(7-Day Mini-Course\)](#)
 - [Generative Adversarial Networks with Python \(*my book*\)](#)

You can see all [Generative Adversarial Network](#) tutorials listed here. Below is a selection of some of the most popular tutorials.

GAN Fundamentals

- [How to Code the GAN Training Algorithm and Loss Functions](#)
- [How to use the UpSampling2D and Conv2DTranspose Layers](#)
- [How to Implement GAN Hacks in Keras to Train Stable Models](#)

GAN Loss Functions

- [How to Implement Wasserstein Loss \(WGAN\)](#)
- [How to Develop a Least Squares GAN \(LSGAN\)](#)

Develop Simple GAN Models

- [How to Develop a 1D GAN From Scratch](#)
- [How to Develop a GAN for Generating MNIST Digits](#)
- [How to Develop a GAN to Generate CIFAR10 Photos](#)

GANs for Image Translation

- [How to Implement Pix2Pix GAN Models From Scratch](#)
- [How to Implement CycleGAN Models From Scratch](#)

Need More Help?

I'm here to help you become awesome at applied machine learning.

If you still have questions and need help, you have some options:

- **Ebooks:** I sell a catalog of Ebooks that show you how to get results with machine learning, fast.
- [Machine Learning Mastery EBook Catalog](#)

Start Machine Learning



You can master applied Machine Learning

without math or fancy degrees.

Find out how in this *free* and *practical* course.

START MY EMAIL COURSE

[Privacy](#) | [Disclaimer](#) | [Terms](#) | [Contact](#) | [Sitemap](#) | [Search](#)