How Can I Learn X? Learning Machine Learning +8

How do I learn machine learning?

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Shivaram K R, Co-Founder, CEO at Curl Analytics (2017-present)
Answered Dec 19, 2017

(Rewriting the same answer to help more people)

To master Machine Learning (ML) one has to be good at maths, programming and domain knowledge. Domain knowledge (Eg: how to deal with images, audio, financial time series etc) changes from one class of problem to another, so let us focus on first two.

Why Maths?: we need maths to understand the machine learning algorithms/ models or to implement new ones. There are large number of models which are already built. Even when we are using existing models we need to understand the internal working of the algorithm so that we can **tune the hyper parameters**. Single model may not give best results for all the problems (no free lunch). Which model to use for the given problem is very important and to **choose the right model**, one needs to understand the internal working/ maths.

Thankfully you don't need all the maths but only some subbranches:

- Linear algebra
- Probability theory
- Optimization
- Calculus
- Information theory and decision theory (good to know)

Why Programming? Programming is needed to use ML models (or build new one), get the data from various sources, clean the data, choose the right features and to validate if the model has learned correctly. Thankfully you don't have to be an expert programmer. Some programming languages are preferred for doing ML than others because they have large number of libraries with most of the ML models already implemented.

Languages suited for ML

- Python (best for both beginner and advanced level)

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- Julia (Future best: very fast, good, limited libraries as it is new)
- C++ (difficult, very fast, used in production)

I recommend beginners to start with Python and learn only the required math from book and online courses. Some good books in ML and Deep Learning (DL)

Books:

- Elements of Statistical Learning
- Pattern Recognition and Machine Learning
- Deep Learning Book

Courses:

- Machine Learning in Coursera
- Deep Learning in Coursera

For advanced level you need to get the intuition of how the models work (not just reading math equations). For that you need to spend lot of time working on various ML/ DL problems. At the end of the day ML is more of an art, you become good by practice. You also need to read lot of papers.

Practice:

- Kaggle

Papers:

- arXiv.org e-Print archive (pick good once, not all are good)
- CVPR, NAACL
- NIPS, ICLR, ICML etc

If you read and implement lot of good papers (say 100 :)) you will become an expert in ML/ DL. After this point you can create your own algorithms and start publishing your work.

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Prasoon Goyal, Have been working in Machine Learning for a few years

Answered Nov 3, 2017

I have written about this in other answers. Copying the answer here for

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Problem we are trying to solve: Given some data, the goal of machine learning is to find pattern in the data. There are various settings, like supervised learning, unsupervised learning, reinforcement learning, etc. But the most common one is supervised learning; so we're going to focus only on that in the big picture. Here, you are given *labelled* data [called the "training data"], and you want to infer labels on new data [called the "test data"]. For instance, consider self-driving cars. Labelled data would include the image of the road ahead at a particular instance as seen from the car, and the corresponding label would be the steering angle [let's assume the speed is controlled manually, for simplicity]. The goal of self-driving car is, given a new image of the road ahead, the system should be able to figure out the optimal steering angle.

How to solve: Most of supervised machine learning can be looked at using the following framework — You are given training data points $(x_1, y_1), \ldots, (x_n, y_n)$, where x_i is the data [e.g. road image in the example above], and y_i is the corresponding label. You want to find a function f that fits the data well, that is, given x_i, it outputs something close enough to y_i. Now where do you get this function f from? One way, which is the most common in ML, is to define a class of functions $\mathcal{F}$, and search in this class the function that best fits the data. For example, if you want to predict the price of an apartment based on features like number of bedrooms, number of bathrooms, covered area, etc. you can reasonably assume that the price is a linear combination of all these features, in which case, the function class $\mathcal{F}$ is defined to be the class of all linear functions. For self-driving cars, the function class $\mathcal{F}$ you need will be much more complex.

How to evaluate: Note that just fitting the training data is not enough. Data are noisy — for instance, every apartment with the same number of bedrooms, same number of bathrooms and same covered area are not priced equally. Similarly, if you label data for self-driving cars, you can expect some randomness due to the human driver. What you need is that your framework should be able to extract out the pattern, and ignore the random noise. In other words, it should do well on *unseen* data. Therefore, the way to evaluate models is to hold out a part of the training data [called "validation set"], and predict on this held out data to measure how good your model is.

Now whatever you study in machine learning, you should try to relate the topics to the above big picture. For instance, in linear regression, the function class is linear and the evaluation method is square loss, in linear SVM, the function class is linear and the evaluation method is hinge loss, and so on. First understand these algorithms at high-level. Then, go into the technical details. You will see that finding the best function f in the function class $\mathcal{F}$ often results in an optimization problem, for which you use stochastic gradient descent.

II. ROADMAP FOR LEARNING MACHINE LEARNING:

To have a basic mathematical background, you need to have some knowledge of the following mathematical concepts:

- Functional analysis (not essential)
- First-order logic (not essential)

You can find some reasonable material on most of these by searching for "<topic> lecture notes" on Google. Usually, you'll find good lecture notes compiled by some professor teaching that course. The first few results should give you a good set to choose from. See Prasoon Goyal's answer to How should I start learning the maths for machine learning and from where?

Skim through these. You don't need to go through them in a lot of detail. You can come back to studying the math as and wh...(more)

Anoop Deoras, Does ML research in recommender system and NLP space
Updated Feb 20, 2016

Originally Answered: How do I learn machine learning, artificial intelligence, and natural language processing?

[Original question was: How do I learn Machine Learning, Artificial Intelligence and Natural Language Processing?]

Artificial Intelligence is a very big field and it encompasses sub fields like NLP, Speech Recognition, Computer Vision, Robotics etc. These sub fields that I just mentioned are applications of Machine Learning, which basically is nothing more than applied statistics and probability. Thus, in order to begin to understand any of the above areas, one has to start with basics -- probability theory, statistics, linear algebra, optimization and information theory. Mastery on these 5 subjects, in my opinion, are absolutely essential to understand and appreciate theory behind the fields such as NLP, Computer Vision and Machine Learning in general.

If you are just starting and have not taken any of the courses I mentioned, I would suggest you spend a year or two learning about them, solving problems from behind the chapters and gaining confidence in these areas. Believe me, these first few years that you invest in getting your basics clear will pay off really well in future. If you have your foundation strong, you will not only appreciate the theory behind these fields but also may be come up with innovative new ideas.

There are very many books that teach probability and statistics and information theory etc, but I personally found the following very useful in my graduate school days

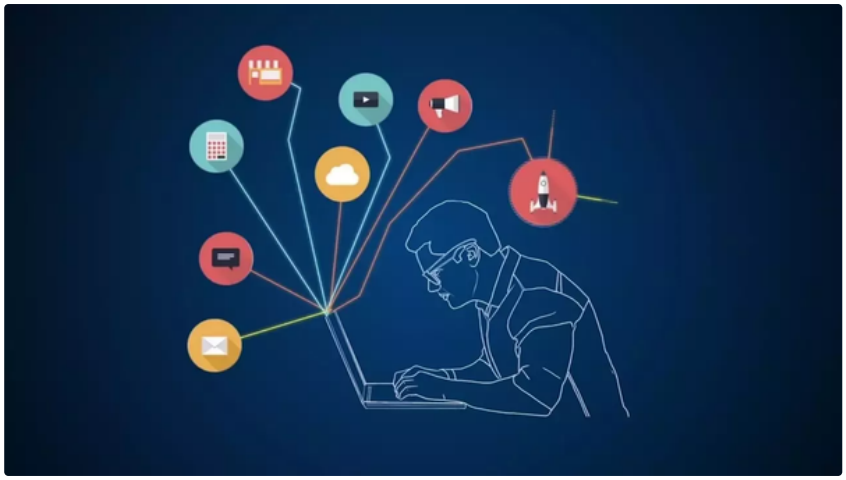
For information theory: Book by Thomas and Cover 'Elements of Information Theory'

For linear algebra, apart from many great books such as 'Matrix Analysis' by 'Horn and Johnson', I would also recommend Gilbert Strang's video lectures on linear algebra (courtesy of OCW-MIT).

As for the programming languages, one could use any. I would, however, choose Python. Python is a well supported high level language with many 3rd party libraries written in order to do machine learning research.

Narmada Sweety, M.S Computer Science, University of Toronto
Updated Sep 30

Originally Answered: How does a beginner start to learn machine learning?



First you need to learn Basics .

Fundamental Maths topics:

1. Algebra
2. Probability & Statistics
3. Calculus

Programming:

1. R

Algorithms , Python libraries

Then you are ready to learn Machine Learning .....

Then you can go with Any Online course, here i can suggest you

Best Machine Learning Online Courses:

1. Machine Learning A-Z™: Hands-On Python & R In Data Science
2. Python for Data Science and Machine Learning Bootcamp
3. Data Science and Machine Learning Bootcamp with R

Choose the first course..

From this course you may learn about:

This course has been designed by two professional Data Scientists so that we can share our knowledge and help you learn complex theory, algorithms and coding libraries in a simple way.

It is structured the following way:

- Part 1 - Data Preprocessing
- Part 2 - Regression: Simple Linear Regression, Multiple Linear Regression, Polynomial Regression, SVR, Decision Tree Regression, Random Forest Regression
- Part 3 - Classification: Logistic Regression, K-NN, SVM, Kernel SVM, Naive Bayes, Decision Tree Classification, Random Forest Classification
- Part 4 - Clustering: K-Means, Hierarchical Clustering
- Part 5 - Association Rule Learning: Apriori, Eclat
- Part 6 - Reinforcement Learning: Upper Confidence Bound, Thompson Sampling
- Part 7 - Natural Language Processing: Bag-of-words model and algorithms for NLP
- Part 8 - Deep Learning: Artificial Neural Networks, Convolutional Neural Networks
- Part 9 - Dimensionality Reduction: PCA, LDA, Kernel PCA
- Part 10 - Model Selection & Boosting: k-fold Cross Validation, Parameter Tuning, Grid Search, XGBoost

And also...

- Master Machine Learning on Python & R
- Have a great intuition of many Machine Learning models
- Make accurate predictions
- Make powerful analysis

- Use Machine Learning for personal purpose
- Handle specific topics like Reinforcement Learning, NLP and Deep Learning
- Handle advanced techniques like Dimensionality Reduction
- Know which Machine Learning model to choose for each type of problem
- Build an army of powerful Machine Learning models and know how to combine them to solve any problem

ALL THE BEST...

Aman Goel, Co-founder at AllinCall Research & Solutions

Updated Nov 12

Machine Learning today is one of the most sought-after skills in the market. A lot of Software Engineers are picking up ML, simply because it is a highly paid skill.

So, how do you learn Machine Learning?

- First things first - the prerequisites:
  - *Basic calculus*. In Machine Learning, you'd be working on a lot of optimizations that require knowledge of Calculus. It would be highly recommended that you are aware of functions, limits, differentiation, maxima, minima, etc.
  - *Linear Algebra*. When you talk about ML, you will be dealing with matrices and vectors every day. So, knowledge of Linear Algebra is a must. However, you'd also be required to know about other important topics like Eigenvalues and Eigenvectors.
  - *Probability*. Most ML algorithms try to "model" the underlying phenomena that generated the observed data. All of this modelling is probabilistic. It is therefore highly recommended that you are comfortable with the theory of Probability.
- Getting into actual ML:
  - Take a great online course on ML. The most well-known course is the one offered by Andrew Ng (Coursera). It is a great course and it teaches you the basics of Machine Learning - Regression, classification, various ML algorithms, etc. The course also requires you to build a digit recognition system.
  - Once you have the basics in place, it would be a great idea to practice

- Take up ML projects. This is the most important point. Ideally, you'd want to have not only ML experience but also some great projects on your resume that you can showcase. These projects will help you distinguish yourself from other candidates. After searching a lot for courses that teach ML through projects, I found the one by Eduonix quite relevant.

The best way to learn Machine Learning is to actually apply it to real datasets and solve real problems. Machine Learning is as much of an art as it is a science. You will learn it from experience. Your focus should be on attempting multiple ML projects so as to gain experience and build a strong profile.

You may also want to read these answers:

- Aman Goel's answer to Which are the best online courses for Machine learning?
- (ignore the title of the question. Focus on the answer) - Aman Goel's answer to How do I compete with the students studying in IITs while studying in a mediocre college?

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Sandesh Patkar
Few weeks back, I started learning Python 3. I have a long way to go, but is Python us...

1 more comment from Satpal Singh Rathore

Akash Kandpal, Btech Computer Science, Noida Institute of Engineering and Technology (2019)
Updated Mar 1

I've created sections below that contain: well-known researchers, AI organizations, video courses, bloggers, Medium writers, books, YouTube channels, Quora topics, subreddits, Github repos, podcasts, newsletters, conferences, research links, tutorials, and cheat sheets.

> Let me know if there anything good I'm missing! I'm always looking to add to the list.

Researchers

Many of the most well-known AI researchers have a strong presence on the web. Below I've listed around twenty and included links to their website, Wikipedia page, Twitter profile, Google Scholar profile, and Quora profile. Quite a few have done an Ask-Me-Anything on Reddit or a Quora Session so I've included that is well when applicable.

I could include dozens more in a list like this. See Quora for more names.

- Sebastian Thrun (Wikipedia / Twitter / GScholar / Quora / AMA)

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- Andrew Ng (Wikipedia / Twitter / GScholar / Quora / AMA)
- Daphne Koller (Wikipedia / Twitter / GScholar / Quora / Quora Session)
- Adam Coates (Twitter / GScholar / AMA)
- Jürgen Schmidhuber (Wikipedia / GScholar / AMA)
- Geoffrey Hinton (Wikipedia / GScholar / AMA)
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- Michael Jordan (Wikipedia / GScholar / AMA)
- Peter Norvig (Wikipedia / GScholar / Quora / AMA)
- Yoshua Bengio (Wikipedia / GScholar / Quora / AMA)
- Ian Goodfellow (Wikipedia / Twitter / GScholar / Quora / Quora Session)
- Andrej Karpathy (Twitter / GScholar / Quora / Quora Session)
- Richard Socher (Twitter / GScholar / Interview)
- Demis Hassabis (Wikipedia / Twitter / GScholar / Interview)
- Christopher Manning (Twitter / GScholar)
- Fei-Fei Li (Wikipedia / Twitter / GScholar / Ted Talk)
- François Chollet (Twitter / GScholar / Quora / Quora Session)
- Larry Carin (GScholar)
- Dan Jurafsky (Wikipedia / Twitter / GScholar)
- Oren Etzioni (Wikipedia / Twitter / GScholar / Quora / AMA)

Organizations

There are a handful of well-known organizations that are dedicated to furthering AI research and development. Below are the ones with websites/blogs and Twitter accounts.

- OpenAI / Twitter (127K followers)
- DeepMind / Twitter (80K followers)
- Google Research / Twitter (1.1M followers)
- AWS AI / Twitter (1.4M followers)
- Facebook AI Research (no Twitter :)
- Microsoft Research / Twitter (341K followers)
- Baidu Research / Twitter (18K followers)
- IntelAI / Twitter (2K followers)
- AI² / Twitter (4.6K followers)

There are an overwhelming number of video courses and tutorials available online now—many of them free. There are some good paid options too, but for this article, I'm focusing exclusively on free content. There are considerably more college courses where the professor has made the course materials available online, but there are no videos. Those can be more challenging to follow along and you probably don't need them. The following courses would keep you busy for months:

- Coursera—Machine Learning (Andrew Ng)
- Coursera—Neural Networks for Machine Learning (Geoffrey Hinton)
- Udacity—Intro to Machine Learning (Sebastian Thrun)
- Udacity—Machine Learning (Georgia Tech)
- Udacity—Deep Learning (Vincent Vanhoucke)
- Machine Learning (mathematicalmonk)
- Practical Deep Learning For Coders (Jeremy Howard & Rachel Thomas)
- Stanford CS231n—Convolutional Neural Networks for Visual Recognition (Winter 2016) (class link)
- Stanford CS224n—Natural Language Processing with Deep Learning (Winter 2017) (class link)
- Oxford Deep NLP 2017 (Phil Blunsom et al.)
- Reinforcement Learning (David Silver)
- Practical Machine Learning Tutorial with Python (sentdex)

YouTube

Below I include links to YouTube channels or users that have regular content that is AI or machine learning-related. I've ordered by subscriber/view count to give a sense of their popularity.

- sentdex (225K subscribers, 21M views)
- Siraj Raval (140K subscribers, 5M...

(more)