# AI Saturdays Lesson Plan

Here are learning roadmaps organised in weeks. Each week consists of lecture videos, reading materials and programming assignments. Feel free to head to the [AI6 forums](https://ai6forums.nurture.ai/) to discuss or ask questions you might have.

## Machine Learning from Scratch

This is for anyone who wants to learn Machine Learning or TensorFlow. The only prerequisite is high school math and a ton of passion. We will follow [Machine Learning Crash Course](https://developers.google.com/machine-learning/crash-course/) by Google - it breaks down concepts of Machine Learning in fun, bite-sized portions and provides thoughtful exercises to deepen your understanding.

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| Timeline | Learning material | Assignments |
| Week 1/ Week of 4 August 2018 | Prerequisites: Linear Algebra   * [Khan academy Linear Algebra](https://www.khanacademy.org/math/linear-algebra) (Finish Complete Vectors and Spaces and Matrix Transformations modules) * Still hungry for more? Try [Essence of linear algebra](https://www.youtube.com/playlist?list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab) | [Assignments and readings](https://ai6forums.nurture.ai/t/assignment-1-linear-algebra/766) |
| Week 2/ Week of 11 August 2018 | Prerequisites: Python basics  For those **without** any programming experience:   * Automate the boring stuff with python: [Chapter 0](https://automatetheboringstuff.com/chapter0/) * [Python for Data Science](https://www.kaggle.com/learn/python?utm_medium=social&utm_source=twitter.com&utm_campaign=new%20python%20course%20announcement) (7 hours)   For those **with** programming experience:   * Automate the boring stuff with python: [Chapters 1 - 5](https://automatetheboringstuff.com/) | Finish 5 python exercises [here](http://www.practicepython.org/) (solutions provided) |
| Week 3/ Week of 18 August 2018 | Prerequisites: Python advanced   * A Byte of Python ebook: [Object oriented programming](https://python.swaroopch.com/oop.html) * [Udemy Numpy stack in Python](https://www.udemy.com/deep-learning-prerequisites-the-numpy-stack-in-python/learn/v4/overview): Numpy, Matplotlib, Scipy, Pandas * [MIT Course Object Oriented Programming](https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/lecture-videos/lecture-8-object-oriented-programming/) | Replicate the codes in “A Byte of Python”  Create a Cheat Sheet summarising all that you have learnt about Python. |
| Week 4/ Week of 25 August 2018 | Recommended reading:   * [Machine Learning is Fun!](https://medium.com/@ageitgey/machine-learning-is-fun-80ea3ec3c471)   [Machine Learning Crash Course by Google:](https://developers.google.com/machine-learning/crash-course/)   * Introduction to ML * Framing * Descending into ML | Complete “Check Your Understanding”  [Discuss: Artificial Intelligence, Machine Learning, Deep Learning, Data Science](https://ai6forums.nurture.ai/t/discuss-artificial-intelligence-machine-learning-deep-learning-data-science/781) |
| Week 5/ Week of 1 September 2018 | [Machine Learning Crash Course by Google](https://developers.google.com/machine-learning/crash-course/):   * Reducing Loss | Complete “Check Your Understanding”  Code up a simple gradient descent algorithm on a linear regression problem ([example](https://towardsdatascience.com/linear-regression-using-gradient-descent-in-10-lines-of-code-642f995339c0)).  [Linear regression from scratch](https://github.com/justmarkham/scikit-learn-videos/blob/master/06_linear_regression.ipynb)  [Another Linear regression from scratch in Python](https://mubaris.com/2017/09/28/linear-regression-from-scratch/) |
| Week 6/ Week of 8 September 2018 | This week, explore different frameworks for Machine Learning. Recommended readings:   * [What are Machine Learning Frameworks](https://analyticsindiamag.com/machine-learning-framework-10-need-know/) * [Best Python libraries for Machine Learning and Data Science](https://towardsdatascience.com/best-python-libraries-for-machine-learning-and-data-science-part-1-f18242424c38) * [TensorFlow or Keras?](https://medium.com/implodinggradients/tensorflow-or-keras-which-one-should-i-learn-5dd7fa3f9ca0) * [Introduction to scikit-learn](https://www.oreilly.com/ideas/intro-to-scikit-learn) * [Machine Learning Crash Course by Google](https://developers.google.com/machine-learning/crash-course/): First Steps with TensorFlow     Note: Don’t spend too much time on picking a framework. If you cannot decide, try out TensorFlow first, since assignments offered in the Crash Course are in TensorFlow. | [Programming exercise with tensor flow](https://developers.google.com/machine-learning/crash-course/first-steps-with-tensorflow/programming-exercises)  [Official scikit-learn tutorial](http://scikit-learn.org/stable/tutorial/basic/tutorial.html) |
| Week 7/ Week of 15 September 2018 | [Machine Learning Crash Course by Google](https://developers.google.com/machine-learning/crash-course/):   * Generalization * Training and Test Sets   Validation   * Representation | Complete “Check Your Understanding” and “Programming Exercises”, if any |
| Week 8/ Week of 22 September 2018 | [Machine Learning Crash Course by Google](https://developers.google.com/machine-learning/crash-course/)   * Feature Crosses | Complete “Check Your Understanding” and “Programming Exercises”, if any |
| Week 9/ Week of 29 September 2018 | [Machine Learning Crash Course by Google](https://developers.google.com/machine-learning/crash-course/)   * Regularization: Simplicity * Logistic Regression | Complete “Check Your Understanding” and “Programming Exercises”, if any  [Logistic Regression with Tensor Flow](https://www.tensorflow.org/tutorials/wide)  [Logistic Regression from scratch in Python](https://beckernick.github.io/logistic-regression-from-scratch/)  [Titanic challenge using sklearn](https://github.com/aidevelopersboise/ai6-boise-materials/blob/master/week3/Titanic%20-%20Machine%20Learning%20for%20Disaster%20-%20Binary%20Classification.ipynb)  Alternatively, find your own dataset to perform logistic regression |
| Week 10/ Week of 6 October 2018 | You are at the halfway mark! Use this week to take a good break and re- energize. | |
| Week 11/ Week of 13 October 2018 | [Machine Learning Crash Course by Google](https://developers.google.com/machine-learning/crash-course/)   * Classification * Regularization: Sparsity | Complete “Check Your Understanding” and “Programming Exercises”, if any  AUC curve: [discussion and analogy](https://ai6forums.nurture.ai/t/auc-and-auroc-classification-thresholds-intuitive-analogy/782)  [Evaluating a classification model](https://github.com/justmarkham/scikit-learn-videos/blob/master/09_classification_metrics.ipynb) (using scikit learn)  [K-means clustering algorithm](http://modelai.gettysburg.edu/2016/kmeans/) (hands-on assignment) |
| Week 12/ Week of 20 October 2018 | Video Lecture: [What is a Neural Network?](https://www.youtube.com/watch?v=aircAruvnKk)  [Machine Learning Crash Course by Google](https://developers.google.com/machine-learning/crash-course/)   * Introduction to Neural Nets | Complete “Check Your Understanding” and “Programming Exercises”, if any  [Create a Neural Network using Keras](https://sempwn.github.io/blog/2017/03/24/keras_basic_intro)  [Implementing a Neural Network from Scratch in Python](http://www.wildml.com/2015/09/implementing-a-neural-network-from-scratch/) |
| Week 13/ Week of 27 October 2018 | Video Lectures:   * [Gradient descent](https://www.youtube.com/watch?v=IHZwWFHWa-w) * [What is backpropagation really doing?](https://www.youtube.com/watch?v=Ilg3gGewQ5U)   [Machine Learning Crash Course by Google](https://developers.google.com/machine-learning/crash-course/)   * Training Neural Nets * Multi-Class Neural Nets | Complete “Check Your Understanding” and “Programming Exercises”, if any  [Tutorial on Backpropagation](https://medium.com/@karpathy/yes-you-should-understand-backprop-e2f06eab496b) (highly recommended) |
| Week 14/ Week of 3 November 2018 | [Machine Learning Crash Course by Google](https://developers.google.com/machine-learning/crash-course/)   * Embeddings * All sections under “ML Engineering” and “ML Real World Examples” | Complete “Check Your Understanding” and “Programming Exercises”, if any |

## Deep Learning Specialization Lesson Plan

This lesson plan is for those who have understood the basics of Machine Learning and would like to gain a deeper understanding in Deep Learning. It follows [deeplearning.ai](https://www.deeplearning.ai/)’s [Deep Learning Specialization](https://www.coursera.org/specializations/deep-learning) on Coursera. This course is one of the **highest rated** courses on Deep Learning.

### Neural Networks and Deep Learning (Weeks 1-6)

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| **Period** | [**Youtube lecture videos**](https://www.youtube.com/watch?v=CS4cs9xVecg&list=PLkDaE6sCZn6Ec-XTbcX1uRg2_u4xOEky0) **(each video is labelled with an alphanumeric string, e.g C1W1L01)** | **Assignment** |
| Week 1/ 4 August 2018 | [Revision on Python](https://www.udemy.com/deep-learning-prerequisites-the-numpy-stack-in-python/) | |
| Week 2/ 11 August 2018 | C1W1L01 - C1W1L06 | [Assignment 1](https://ai6forums.nurture.ai/t/wiki-neural-networks-and-deep-learning-assignment-1/744) |
| Week 3/  18 August 2018 | C1W2L01 - C1W2L06 | [Assignment 2](https://ai6forums.nurture.ai/t/wiki-neural-networks-and-deep-learning-assignment-2/745) |
| Week 4/  25 August 2018 | C1W2L07 - C1W2L18 | [Assignment 3](https://ai6forums.nurture.ai/t/wiki-neural-networks-and-deep-learning-assignment-3/746) |
| Week 5/  1 September 2018 | C1W3L1 - C1W3L11 | [Assignment 4](https://ai6forums.nurture.ai/t/wiki-neural-networks-and-deep-learning-assignment-4/747) |
| Week 6/  8 September 2018 | C1W4L01 - C1W4L18 | [Assignment 5](https://ai6forums.nurture.ai/t/wiki-neural-networks-and-deep-learning-assignment-5/748) |
| Week 7/ 15 September 2018 | Break | |

### Improving deep neural networks: hyperparameter (Weeks 8-13)

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| **Period** | [**Youtube lecture videos**](https://www.youtube.com/watch?v=1waHlpKiNyY&list=PLkDaE6sCZn6Hn0vK8co82zjQtt3T2Nkqc) **(each video is labelled with an alphanumeric string, e.g C2W1L01)** | **Assignment** |
| Week 8/ 22 September 2018 | C2W1L01 - C2W1L06 | [Assignment 1](https://ai6forums.nurture.ai/t/wiki-improving-nn-assignment-1/783) |
| Week 9/ 29 September 2018 | C2W1L07 - C2W1L14 | [Assignment 2](https://ai6forums.nurture.ai/t/wiki-improving-nn-assignment-2/784) |
| Week 10/ 6 October 2018 | C2W2L01 - C2W2L05 | [Assignment 3](https://ai6forums.nurture.ai/t/wiki-improving-nn-assignment-3/785) |
| Week 11/  13 October 2018 | C2W2L06 - C2W2L09 | [Assignment 4](https://ai6forums.nurture.ai/t/wiki-improving-nn-assignment-4/786) |
| Week 12/  20 October 2018 | C2W3L01 - C2W3L05 | [Assignment 5](https://ai6forums.nurture.ai/t/wiki-improving-nn-assignment-5/787) |
| Week 13/  27 October 2018 | C2W3L06 - C2W3L11  NOTE: C2W3L10 and C2W3L11 are mislabeled as C2W2L10 and C2W2L11 respectively. | [Assignment 6](https://ai6forums.nurture.ai/t/wiki-improving-nn-assignment-6/788) |

## Research-focused Lesson Plan

Learners of this track are those who have acquired the prerequisites to understand and implement state of the art AI models. They can choose from one or more of the following courses : UCL course on Reinforcement Learning (UCL RL), Berkeley CS294, Stanford Natural Language Processing (CS224n) and Stanford Computer Vision (CS231n).

These courses are offered by their respective universities and (fortunately for us) are freely accessible by the public. Learning materials for the courses can be quite ‘scattered’, i.e lecture videos for these courses are not found on the official website but on youtube; they are also not aligned with the course outline on the official website. We will follow one lecture video from youtube every week and refer to the official pages for lecture notes or assignments.

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### Important links

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| **UCL RL** | **CS231n (Computer vision)** | **CS224n (NLP)** |
| * [Lecture Videos](https://www.youtube.com/playlist?list=PLqYmG7hTraZDM-OYHWgPebj2MfCFzFObQ) from youtube * [Official Page](http://www0.cs.ucl.ac.uk/staff/d.silver/web/Teaching.html) * [Code and exercises](https://github.com/dennybritz/reinforcement-learning) * [Berkeley CS294](https://www.youtube.com/playlist?list=PLkFD6_40KJIznC9CDbVTjAF2oyt8_VAe3) (advanced RL) | * [Lecture Videos](https://www.youtube.com/playlist?list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv) from youtube * [Official Page](http://cs231n.github.io/) * [Assignments](https://github.com/cs231n/cs231n.github.io/tree/master/assignments/2018) | * [Lecture Videos](https://www.youtube.com/playlist?list=PL3FW7Lu3i5Jsnh1rnUwq_TcylNr7EkRe6) from youtube * [Official Page](http://web.stanford.edu/class/cs224n/syllabus.html) * [Lecture Notes](https://github.com/stanfordnlp/cs224n-winter17-notes) (click on ‘notes1.pdf’ or similar) * [Independent Review of this course](https://machinelearningmastery.com/stanford-deep-learning-for-natural-language-processing-course/) |

### Lesson schedule

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| Week of | UCL RL | CS231n (Computer vision) | CS224n (NLP) |
| 4 August 2018 | Revision of prerequisites: Python, Linear Algebra etc | See “[Module 0](http://cs231n.github.io/)”  [Assignments](https://ai6forums.nurture.ai/t/wiki-cs231n-lecture-1-course-introduction/27) | See “[Suggested readings on Jan 9](http://web.stanford.edu/class/cs224n/syllabus.html)” |
| 11 August 2018 | UCL/Deep Mind Reinforcement Learning Lecture 1 – Intro to Reinforcement Learning  [Assignments/ Links to materials](https://ai6forums.nurture.ai/t/wiki-lesson-1-introduction-to-rl/46/4) | [Youtube lecture video: Image Classification](https://www.youtube.com/watch?v=OoUX-nOEjG0&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv)  [Course Notes](http://cs231n.github.io/classification/)  [Assignments](https://ai6forums.nurture.ai/t/wiki-cs231n-lecture-2-image-classification/29) | [Youtube lecture video: Word Vector Representations:word2vec](https://www.youtube.com/watch?v=ERibwqs9p38&index=2&list=PL3FW7Lu3i5Jsnh1rnUwq_TcylNr7EkRe6)  [Assignments and readings](https://ai6forums.nurture.ai/t/wiki-lecture-2-word-vector-representations/55) |
| 18 August 2018 | UCL/Deep Mind Reinforcement Learning Lecture 2 – Markov Decision Processes  [Assignments/ Links to materials](https://ai6forums.nurture.ai/t/wiki-lesson-2-markov-decision-processes/273) | [Youtube lecture video: Loss Functions and Optimization](https://www.youtube.com/watch?v=h7iBpEHGVNc&index=3&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv)  [Assignments and readings](https://ai6forums.nurture.ai/t/wiki-cs231n-lecture-3-loss-functions-and-optimization/237) | [Youtube lecture video: Global Vectors for Word Representation](https://www.youtube.com/watch?v=ASn7ExxLZws&index=3&list=PL3FW7Lu3i5Jsnh1rnUwq_TcylNr7EkRe6)  [Lecture Notes](https://github.com/stanfordnlp/cs224n-winter17-notes/blob/master/notes2.pdf)  [Assignments and readings](https://ai6forums.nurture.ai/t/wiki-lecture-3-glove-global-vectors-for-word-representation/275) |
| 25 August 2018 | UCL/Deep Mind Reinforcement Learning Lecture 3 – Planning by Dynamic Programming  [Assignments/ Links to materials](https://ai6forums.nurture.ai/t/wiki-lesson-3-dynamic-programming/448) | [Youtube lecture video: Introduction to Neural Networks](https://www.youtube.com/watch?v=d14TUNcbn1k&index=4&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv)  [Assignment and readings](https://ai6forums.nurture.ai/t/wiki-cs231n-lecture-4-introduction-to-neural-networks/238) | [Youtube lecture video: Word Window Classification and Neural Networks](https://www.youtube.com/watch?v=uc2_iwVqrRI&index=5)  [Lecture Notes](https://github.com/stanfordnlp/cs224n-winter17-notes/blob/master/notes3.pdf) |
| 1 September 2018 | UCL/Deep Mind Reinforcement Learning Lecture 4 – Model-free Prediction  [Assignments/ Links to materials](https://ai6forums.nurture.ai/t/wiki-lesson-4-model-free-prediction/472) | [Youtube lecture video: Convolutional Neural Networks](https://www.youtube.com/watch?v=bNb2fEVKeEo&list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv&index=5)  [Assignments and readings](https://ai6forums.nurture.ai/t/wiki-cs231n-lecture-5-convolutional-neural-networks/240) | [Youtube lecture video: Backpropogation](https://www.youtube.com/watch?v=isPiE-DBagM)  [Assignments and readings](https://ai6forums.nurture.ai/t/wiki-lecture-5-backpropagation/644) |
| 8 September 2018 | UCL/Deep Mind Reinforcement Learning Lecture 5 – Model-free Control | Youtube lecture video: Training Neural Networks Part 1 | [Youtube lecture video: Dependency parsing](https://www.youtube.com/watch?v=PVShkZgXznc)  [Lecture Notes](https://github.com/stanfordnlp/cs224n-winter17-notes/blob/master/notes4.pdf)  [Assignments and readings](https://ai6forums.nurture.ai/t/wiki-lecture-6-dependency-parsing/712) |
| 15 September 2018 | Break | | |
| 22 September 2018 | UCL/Deep Mind Reinforcement Learning Lecture 6 – Value Function Approximation | Youtube lecture video: Training Neural Networks Part 2 | [Youtube lecture video: Introduction to TensorFlow (optional)](https://www.youtube.com/watch?v=PicxU81owCs)  [Youtube lecture video: Recurrent Neural Networks and Language Models](https://www.youtube.com/watch?v=Keqep_PKrY8)  [Lecture Notes](https://github.com/stanfordnlp/cs224n-winter17-notes/blob/master/notes5.pdf)  [Assignments and readings](https://ai6forums.nurture.ai/t/wiki-lecture-8-recurrent-neural-networks-and-language-models/714) |
| 29 September 2018 | UCL/Deep Mind Reinforcement Learning Lecture 7 – Policy Gradient Methods | Youtube lecture video: Deep Learning Software | [Youtube lecture video: Machine Translation and Advanced Recurrent LSTMs and GRUs](https://www.youtube.com/watch?v=IxQtK2SjWWM&index=11&list=PL3FW7Lu3i5Jsnh1rnUwq_TcylNr7EkRe6) |
| 6 October 2018 | UCL/Deep Mind Reinforcement Learning Lecture 8 – Integrating Learning & Planning | Youtube lecture video: CNN Architectures | Youtube lecture video: Neural Machine Translation and Models with Attention |
| 13 October 2018 | UCL/Deep Mind Reinforcement Learning Lecture 9 – Exploration & Exploitation | Youtube lecture video: Recurrent Neural Networks | Youtube lecture video: Gated Recurrent Units and Further Topics in NMT |
| 20 October 2018 | UCL/Deep Mind Reinforcement Learning Lecture 10 – Classic Games | Youtube lecture video: Detection and Segmentation | Youtube lecture video: End-to-End Models for Speech Processing |
| 27 October 2018 | Break | | |
| 3 November 2018 | Berkeley CS294 Deep Reinforcement Learning | Youtube lecture video: Visualizing and Understanding | Youtube lecture video: Tree Recursive Neural Networks and Constituency Parsing |
| 10 November 2018 | Berkeley CS294 Deep Reinforcement Learning | Youtube lecture video: Generative Models | Youtube lecture video: Coreference Resolution |
| 17 November 2018 | Berkeley CS294 Deep Reinforcement Learning | Youtube lecture video: Deep Reinforcement Learning | Youtube lecture video: Dynamic Neural Networks for Question Answering |
| 24 November 2018 | Berkeley CS294 Deep Reinforcement Learning | Youtube lecture video: Efficient Methods and Hardware for Deep Learning | Youtube lecture video: Issues in NLP and Possible Architectures in NLP |
| 1 December 2018 | Berkeley CS294 Deep Reinforcement Learning | Youtube lecture video: Adversarial Examples and Adversarial Training | Youtube lecture video: Tackling the Limits of Deep Learning for NLP |
| Until January 2019 | Work on projects | | |

### Bonus tips

* The lecture videos go up to 2 hours; watch the lecture video at 2x speed, slowing down only at parts that cover important concepts
* Revise and make sure that you have **mastered** the fundamentals of deep learning
* Don’t aim to understand everything and anything.