AMMI- 2019/2020 list of Courses

These courses where taught together with Labs, Mentoring Sessions, Assignments, Projects and Quizzes for the 10 month course duration of the AMMI 2019/2020 program.

- **Bootcamp**
  - ⋆ Introduction to machine learning
  - ⋆ Data structures and algorithms
  - ⋆ Statistical computing tools
  - ⋆ Linear Regression, bias, variance and regularization
  - ⋆ Decision trees and neural networks
  - ⋆ Computer Vision and transfer laerning
  - ⋆ Sequence models and natural language processing
  - ⋆ Cloud machine learning (Azure, Google Cloud, AWS)
  - ⋆ Introduction to Pytorch Environment
  - ⋆ Advanced Features in Pytorch Environment
  - ⋆ Introduction TensorFlow Environment
  - ⋆ Advanced Features in Tensorflow Environment
- **Mathematics of Machine Learning**
  - ⋆ Linear algebra
  - ⋆ Analytical Geometry
  - ⋆ Vector Calculus
  - ⋆ Matrix Decomposition
  - ⋆ Statistics and Probability
  - ⋆ Linear Regression
  - ⋆ Dimensionality Reduction: PCA
  - ⋆ Computing Integrals
- **Foundations of Machine Learning**
  - ⋆ Logistic regression and linear classification
  - ⋆ Debugging, model and parameter search
  - ⋆ Data visualization (PCA, t-SNE)
  - ⋆ Convnets, vision
  - ⋆ Natural Language Processing
  - ⋆ Reinforcement Learning
- **Bayesian Inference in ML**
  - ⋆ Bayesian Linear Regression
  - ⋆ Empirical Risk Minimization
  - ⋆ Bayesian Logistic Regression and Neural Networks
  - ⋆ Gaussian Processes
  - ⋆ Regression Inference, Model selection
- **Deep Learning**
  - ⋆ Introduction to Deep learning
  - ⋆ Deep Learning Fundamentals
  - ⋆ Multilayer Perceptron and Backpropagation algorithm
  - ⋆ Learning Arbitrary Networks of Operators and Autograd
  - ⋆ Supervised Learning: Convolutional Neural Networks
  - ⋆ Unsupervised Learning: Autoencoders
  - ⋆ Initialization and Optimization

- ⋆ Implicit and Explicit Regularization in Deep Learning
- ⋆ Debugging Deep Learning models, Going Deeper
- ⋆ Variational Autoencoders

- **Natural Language Understanding**
  - ⋆ Introduction to NLP
  - ⋆ Representation Learning in NLP
  - ⋆ Word, Sentence Representation
  - ⋆ Unsupervised Learning in NLP
  - ⋆ Structured Prediction in NLP
  - ⋆ Sequence-to-sequence models

- **Natural Language Processing**
  - ⋆ Language modelling
  - ⋆ FF-LM RNN-LM OpenAI GPT-2
  - ⋆ Conditional Machine Translation
  - ⋆ Attention Mechanism
  - ⋆ Transformers for Machine Translation
  - ⋆ Generation Algorithms
  - ⋆ Masked ML and latent-variable MT
  - ⋆ Decoding algorithms

- **Deep Natural Language Processing**
  - ⋆ Machine Reading with Deep Learning
  - ⋆ ElMo, BERT
  - ⋆ Open-domain Question Answering
  - ⋆ Dialogue Learning
  - ⋆ Chatbots

- **Machine Learning with Kernel Methods**
  - ⋆ Positive definite kernel, RKHS, Aronszajn's theorem
  - ⋆ Kernel trick, Representer theorem, kernel ridge regression
  - ⋆ Supervised classification, Kernel logistic regression, large margin classifiers, SVM
  - ⋆ Unsupervised analysis, kernel PCA, kernel CCA, kernel K-means

- **Probabilistic Graphical Models**
  - ⋆ Introduction and Maximum Likelihood Estimation
  - ⋆ Expectation Maximization and Gaussian Mixtures
  - ⋆ Graph Theory, Directed and Undirected Graphical Models
  - ⋆ Exponential Families and Information Theory
  - ⋆ Approximate Inference I: sampling and MCMC
  - ⋆ Model Selection

- **Reinforcement Learning**
  - ⋆ Introduction to RL
  - ⋆ Markov Decision Processes
  - ⋆ Exploration and Exploitation
  - ⋆ Planning by Dynamic Programming
  - ⋆ Model-Free Prediction
  - ⋆ Model-Free Control
  - ⋆ Value Function Approximation

- ⋆ Policy Gradient Methods
- ⋆ Integrating Learning and Planning
- ⋆ Case Study: RL in classic Games

- **Optimization for Machine Learning**
  - ⋆ Introduction to Optimization
  - ⋆ Quadratic programming
  - ⋆ Duality optimization (Lagrange dual)

- **Computer Vision I**
  - ⋆ Introduction: Computer Vision Overview
  - ⋆ Image Classification
  - ⋆ Loss function and Optimization
  - ⋆ Convolutional Neural Networks: Architectures and Components
  - ⋆ CNNs Training and Debugging
  - ⋆ Visualizing and Understanding CNNs
  - ⋆ Detection and Segmentation
  - ⋆ Generative Models in Computer Vision
  - ⋆ Video Understanding

- **Computer Vision II**
  - ⋆ Visual Recognition
  - ⋆ Object Detection and Semantic Segmentation
  - ⋆ Instance Segmentation and Pose Prediction
  - ⋆ Video architectures (ConvNets, LSTM, 3D convnets, Two-stream)
  - ⋆ Video Understanding: Action classification, Localization, Tracking

- **AI + Computational Biology**
  - ⋆ Introduction to the Area of AI Computational Biology
  - ⋆ Principal resources in Computational Biology
  - ⋆ Decoding Genomic sequences
  - ⋆ AI Application to Cancer
  - ⋆ AI Application to Agriculture and Farming
  - ⋆ AI in viruses, pathogen and Covid

- **Matrix and Tensor Factorization for Machine Learning**
  - ⋆ Introduction to tensor decomposition techniques (CP, Tucker, Tensor Train decomposition).
  - ⋆ Introduction to tensor networks.
  - ⋆ Optimization techniques for tensor problems (gradient descent, alternating minimization)
  - ⋆ Efficient Computations with Tensor Networks
  - ⋆ Image Completion, Collaborative filtering
  - ⋆ Compressing Neural Networks, Learning Latent variables

- **Final Project**
  - ⋆ Final Project with Supervision.