Программа учебной дисциплины
Байесовские методы машинного обучения
(преподается на английском языке)

Утверждена
Академическим советом ООП
Протокол № 3 от «29» мая 2018 г.

Автор	
Число кредитов	2
Контактная работа (час.)	0
Самостоятельная работа (час.)	76
Курс	1,2 курс
Формат изучения дисциплины	С использованием онлайн-курса

I. ЦЕЛЬ, РЕЗУЛЬТАТЫ ОСВОЕНИЯ ДИСЦИПЛИНЫ И ПРЕРЕКВИЗИТЫ

Bayesian methods are used in lots of fields: from game development to drug discovery. They give superpowers to many machine learning algorithms: handling missing data, extracting much more information from small datasets. Bayesian methods also allow us to estimate uncertainty in predictions, which is a really desirable feature for fields like medicine.
When Bayesian methods are applied to deep learning, it turns out that they allow you to compress your models 100 folds, and automatically tune hyperparametrs, saving your time and money.
In six weeks we will discuss the basics of Bayesian methods: from how to define a probabilistic model to how to make predictions from it. We will see how one can fully automate this workflow and how to speed it up using some advanced techniques.
We will also see applications of Bayesian methods to deep learning and how to generate new images with it. We will see how new drugs that cure severe diseases be found with Bayesian methods.

ПРИОБРЕТАЕМЫЕ НАВЫКИ

Bayesian Optimization, Gaussian Process, Markov Chain Monte Carlo (MCMC), Variational Bayesian Methods

II. СОДЕРЖАНИЕ УЧЕБНОЙ ДИСЦИПЛИНЫ

НЕДЕЛЯ 1
Introduction to Bayesian methods & Conjugate priors
Welcome to first week of our course! Today we will discuss what bayesian methods are and what are probabilistic models. We will see how they can be used to model real-life situations and how to make conclusions from them. We will also learn about conjugate priors — a class of models where all math becomes really simple.

НЕДЕЛЯ 2
Expectation-Maximization algorithm
This week we will about the central topic in probabilistic modeling: the Latent Variable Models and how to train them, namely the Expectation Maximization algorithm. We will see models for clustering and dimensionality reduction where Expectation Maximization algorithm can be ap-

plied as is. In the following weeks, we will spend weeks 3, 4, and 5 discussing numerous extensions to this algorithm to make it work for more complicated models and scale to large datasets.

НЕДЕЛЯ 3
Variational Inference & Latent Dirichlet Allocation
This week we will move on to approximate inference methods. We will see why we care about approximating distributions and see variational inference — one of the most powerful methods for this task. We will also see mean-field approximation in details. And apply it to text-mining algorithm called Latent Dirichlet Allocation.

НЕДЕЛЯ 4
Markov chain Monte Carlo
This week we will learn how to approximate training and inference with sampling and how to sample from complicated distributions. This will allow us to build simple method to deal with LDA and with Bayesian Neural Networks — Neural Networks which weights are random variables themselves and instead of training (finding the best value for the weights) we will sample from the posterior distributions on weights.

НЕДЕЛЯ 5
Variational Autoencoder
Welcome to the fifth week of the course! This week we will combine many ideas from the previous weeks and add some new to build Variational Autoencoder -- a model that can learn a distribution over structured data (like photographs or molecules) and then sample new data points from the learned distribution, hallucinating new photographs of non-existing people. We will also the same techniques to Bayesian Neural Networks and will see how this can greatly compress the weights of the network without reducing the accuracy.

НЕДЕЛЯ 6
Gaussian processes & Bayesian optimization
Welcome to the final week of our course! This time we will see nonparametric Bayesian methods. Specifically, we will learn about Gaussian processes and their application to Bayesian optimization that allows one to perform optimization for scenarios in which each function evaluation is very expensive: oil probe, drug discovery and neural network architecture tuning.

Final project
In this module you will apply methods that you learned in this course to this final project.

III. ОЦЕНИВАНИЕ

Порядок формирования оценок по дисциплине

Оценка за итоговый контроль выставляется по 10-балльной шкале.
Оценивание проводится в форме собеседования после предъявления студентом результатов тестирования.

Оценка в ведомости	Результат изучения курса
10	Total = 100%
9	90% =< Total < 100%
8	80% =< Total < 90%
7	70% =< Total < 80%
6	60% =< Total < 70%
5	55% =< Total < 60%
4	50% =< Total < 55%
3	Total < 50 %
0	Не представлено подтверждение результатов изучения курса

V. РЕСУРСЫ

Доступ к дисциплине - https://www.coursera.org/learn/bayesian-methods-in-machine-learning