

# Developing a Data-Driven Learning Interest Recommendation System to Promoting Self-Paced Learning on MOOCs

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# Abstract

This work proposes a learning-based energy management policy that takes into consideration the trade-off between the depth-of-discharge (DoD) and the lifetime of batteries. The impact of DoD on the energy management policy is often neglected in the past due to the inability to model its effect on the marginal cost per battery usage. In this work, a novel battery cost evaluation method that takes into consideration the DoD of each battery usage is proposed, and is utilized to devise the day-ahead energy management policy using reinforcement learning and linear value-function approximations. The policy determines the amount of energy to purchase for the next day in the day ahead market. A least-square policy iteration (LSPI) with linear approximations of the value function is used to learn the energy management policy. Simulations are provided based on real load profiles, pricing data, and renewable energy arrival statistics. The consideration of the battery cost due to DoD provides a more accurate evaluation of the actual energy cost and leads to an improved energy management policy.

**Keywords** -Smart grid, energy management system, reinforcement learning, battery, energy storage, depth-of-discharge.

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# Chapter 1

## Introduction

Massive Online Open Courses (MOOCs) refer to an open educational resources, which allows learners worldwide to take well-designed online courses of interest free of charge. On MOOCs, learners watch the high-quality instructional videos made by professors from prestigious universities, share their ideas and reflections on the discussion forum, and use the online exercise system to evaluate their learning outcome. Due to the fact that the MOOCs provide with high-quality self-directed learning environment without costing much for online learners, MOOCs have been thought of as a contemporary way of 21-century learning.

There are two type of MOOCs, cMOOCs (connectionism MOOCs) and xMOOCs (instructionism MOOCs). These two types of MOOCs are base on different philosophical positions underpinning, cMOOCs focuses on connections between participants in particular on strong content contributions from the participants themselves [1], xMOOCs, by contrast focus on instructor's design of the course. Many famous MOOCs platform such as Coursera[2], edX[3], and Udacity[4] are belong to xMOOCs.

For current xMOOCs, the instructional videos play a significant role in the on-line learning process [5,6]. In essence, the learning focuses in the form of visual and

audial presented in the instructional videos. Traditionally, video-based learning follows structured instructor-designed sequences for the better results. Owing to the technological nature of the online stream video, it is found that many students drag the play bar replaying specific concept in the video for consolidating their understanding. Therefore, many studies aim to improve the video-based learning environment by adding additional features in video-watching, such as embedded assessment, caption tool, as so on.

In view of the rapid development of data sciences, more and more studies on educational data mining and learning analytics take the advantages of the learners data to optimize learning process. For example, [7] develops a step-by-step annotations feature to improve the learning experience of existing how-to videos. Study [8] constructs a system that recommends students videos best on their forum post, making a self-solved confusion system and meanwhile reducing the teaching load. Therefore, considering the learning needs and the authentic learner data, this study develops a data-driven learning interest recommendation system to promote self-paced learning by integrating educational data mining and word segmentation in the Chinese-speaking MOOC environment. Videomark combines both the learning seek event counts and the subtitles of each video to automatically generate learning concepts for learners in friendly user interface. Through the huge amount of video watching/seeking log data, the Videomark helps learners to quickly identify popular video seek events for consolidating their concept of the learning focus in hope of promoting better self-paced video-based learning environment.

This thesis proposes a learning interest recommendation system on xMOOCs, the system generate keywords relative to lecture video content base on students' video watch activity records and lecture video transcripts. Moreover, each keyword

collects video segment about the specific keyword. We hope this system will help students sketch the course when they first come to the class, and review the whole course after the course.

The remainder of this thesis is organized as follows. In Section ??, we first introduce the Markov decision process and brief review the reinforcement learning algorithm which is called least-square policy iteration. In Section ??, the energy management problem at the consumer side is examined. We designed our system model by considering a EMS center which want to regulate energy flow such as day-ahead energy purchasing, real-time energy purchasing, and energy dumping to minimize marginal cost and prolong battery life. In Section ??, the reinforcement learning based energy management problem is examined. In Section ??, the performance of purposed algorithm is examined.



# Chapter 2

## Related Work

blablabla this is related work hello hello hello



# Chapter 3

## Architecture

hello im architecture





# Chapter 4

## Implementation

hello im sys implementation



# Bibliography

- [1] Carol Yeager, Betty Hurley-Dasgupta, and Catherine A Bliss. cmoocs and global learning: An authentic alternative. *Journal of Asynchronous Learning Networks*, 17(2):133–147, 2013.
- [2] Andrew Ng and Daphne Koller. Coursera. Retrieved May 15, 2016, from the World Wide Web: <https://zh-tw.coursera.org/>, 2012.
- [3] Massachusetts Institute of Technology and Harvard University. edx. Retrieved May 15, 2016, from the World Wide Web: <https://www.edx.org/>, 2012.
- [4] Mike Sokolsky Sebastian Thrun, David Stavens. Udacity. Retrieved May 15, 2016, from the World Wide Web: <https://www.udacity.com/>, 2012.
- [5] Lori Breslow, David E Pritchard, Jennifer DeBoer, Glenda S Stump, Andrew D Ho, and Daniel T Seaton. Studying learning in the worldwide classroom: Research into edx’s first mooc. *Research & Practice in Assessment*, 8, 2013.
- [6] Daniel T Seaton, Yoav Bergner, Isaac Chuang, Piotr Mitros, and David E Pritchard. Who does what in a massive open online course? *Communications of the ACM*, 57(4):58–65, 2014.
- [7] Juho Kim, Phu Tran Nguyen, Sarah Weir, Philip J Guo, Robert C Miller, and Krzysztof Z Gajos. Crowdsourcing step-by-step information extraction

to enhance existing how-to videos. In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems*, pages 4017–4026. ACM, 2014.

- [8] Akshay Agrawal, Jagadish Venkatraman, Shane Leonard, and Andreas Paepcke. Youedu: Addressing confusion in mooc discussion forums by recommending instructional video clips. 2015.

