Oyeon Kwon

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https://scholar.google.com/citations?user=HppM-owAAAAJ&hl=ko

Research Interests

My research interests lie within the broad area of practical machine learning, which enables our lives to make better. Previously, I have developed machine learning tools for its applications to health care, which range from intermittent area to real-time area. Recently, I am very interested in building an automated learning system which can broaden an audience without requiring neither expertise nor computational environments in the field of deep learning.

Career Summary

Research ability: [Research Pespective]

- The latest paper: NAS-based AutoML system (submitted in ICASSP)
- 1% ML journal (TNNLS) 1st author publication
- Physionet Challenge Hackton 5th ranked
- Total Citation: 209, h-index:5, i10-index: 4 (2021.11.08)

Involvement in product development: [Practical Pespective]

- DeepECG at VUNO Inc. (Main role : Part Lead) : Heart disease early prediction/classification model development.
  - Spatial & temporal (1D, 2D, 1D & 2D CNN) model development & Ensemble strategy
  - Long range signal (48 hours) classification (CNN & Transformer)
- DeepCARS at VUNO Inc. (Main role : Part Member) : Deteriorating patient early prediction/classifiaction model development.
  - LSTM & Transformer based architecture design for sequential data analysis
  - Data sampling & Feature tokenization
  - Missing data imputation by using graph-based Transformer

Various experience using deep learning: [Broaden Pespective]

- Multi-label class classification/prediction (LSTM/CNN/Transformer)
- Network architecutre search (based on REINFORCE concept)
- Hyperparamter optimization (Baysian optimization, etc)

Highly motivated in other fields

- For discussing deep learning knowledge (annual deep learning seminars)
- For efficient training (distributed learning system, multi-processing, and so on)
- For convenient traininig (docker environment, ..)
- Open-source contributor (https://github.com/PatternRecognition/OpenBMI)

Project Experiences

March. 2021– Current **Automated Learning system project: Build biosignal AutoML system**.
Build AutoML system based on reinforcement learning for analysis of time-series biosignal data.

- Main role and Contribution (Team Lead)
  - an end-to-end Automl system framework from preprocessing to archiecture search
- Major development
  - consturct AutoML system based on ENAS and apply additional ideas
  - a variety of experiments to improve the controller of the system
- Development issues
  - Implementation and training process of Macro&Micro-CNN (There were several issues when I trained)
  - When search spaces increased, controller should be modified.
- Implementation tools
  - Python & pytorch, multiprocessing, etc..
- Major acheivements
  - It showed improved performance compared to the backbone in use and confirmed the possibility of using it as a baseline project.
  - ICASSP 2022 paper sumbission
  - Recently, hyperparmeter optimization integration is ongoing.

April. 2020– March. 2021 **Deep Learning Project III**.
Heart disease early prediction/classification model development.

- Main role and Contribution (Part Lead)
  - Study design, data processing, architecture build and evaluation
- Major development
  - Spatial & temporal (1D, 2D, 1D & 2D CNN) model development & Ensemble strategy
  - Long range signal (48 hours) classification (CNN & Transformer)
- Development issues
  - Data imbalance
  - Conisering a numer of preprocessing functions (filtering, centering, etc)
  - Long range signal (48 hours data)
- Implementation tools
  - Python & TF2, CNN & Transformer implementation
  - Mixed precision training, multi-processing, distributed training, etc ..
- Major acheivements
  - 4th Int. Conf. of the ESC Council on Stroke: Stroke patient prediction (co-first))
  - Involve other developments before the product

July. 2018– April. 2020 **Deep Learning Project II**.

Deteriorating patient early prediction/classifiaction model development.

- Main role and Contribution (Part Member)
  - Study design, data processing, architecture build and evaluation
- Major development
  - LSTM & Transformer based architecture design for sequential data analysis
  - Data sampling & Feature tokenization
  - Missing data imputation by using graph-based Transformer
- Development issues
  - Raw data, preprocessing, the difficulty of data cleaning
  - Data imbalance & Feature Tonknization
  - Sequential architecture design (irregularly data missing and noisy data)
- Implementation tools
  - Python & TF1 implementation
- Major acheivements
  - Four papers in clinical journals (Details in Publications, co-first three papers)
  - Physionet Challenge Hackton 5th ranked
  - Involve other developments before the product

July. 2016–July. 2018 **Deep Learning Project 1**.

Brain signal classification model development

- Main role and Contribution (Part Member)
  - Study design, data processing, architecture build and evaluation
- Major development
  - Participating open source development (One of main contributors)
  - Open dataset management and experiment
  - Mutual Information maximization (frequency sampling) for obtaining common features
  - CNN architecture design for achieving stable performance
- Development issues
  - Open Source development & Data management
  - Common feature extraction and CNN architecture design
- Implementation tools
  - Matlab & Python and TF1
- Major acheivements
  - ML 1% journal (TNNLS) 1st author publication
  - Public Dataset (2nd author paper publication)
  - Open source development (https://github.com/PatternRecognition/OpenBMI)

Education

Sept. 2016–July. 2018 **Master of Brain & Cognitive Engineering**, *Korea University*, Korea,
Overall GPA: 4.44/4.50.

Advisor: Dr. Seong-Whan Lee

Thesis: Subject to Subject Transfer Learning for Zero-Training Brain-Computer Interfaces

Graduate Coursework.

Introduction to Machine Learning	Pattern Recognition
Linear Algebra (Auditing in Math Depart.)	Detection and Estimation I
Probability and Statistics for Brain and Cognitive Eng.	Applied Mathmatics I, II

Apr. 2016, Jul. 2016 **Research Intern**, *Seoul National University*, Republic of Korea..

Research Intern.

Developing Motor Imagery Algorithm

Sept. 2015, Mar. 2016 **Intern**, *Maureen Data System*, Manhattan, NY, USA.

Abroad Experience.
Marketing experience targeting Korean markets

Aug. 2014, Aug. 2015 **Research Intern**, *Yonsei University*, Republic of Korea..

For Pre-Graduate Coursework.
A bachelor's degree dissertation based-on brain emotion analysis; a degree of arousal from brain while watching movies

Aug. 2013– Aug. 2014 **Exchange Student, Northern State University, Eberdeen, SD, USA.**

Abroad Experience.
For English development

Mar. 2011–Aug. 2015 **Bachelor of Bio Medical Engineering**, *Yonsei University*, Korea,
Overall GPA: 3.70/4.50.
Supervised by Kyung-Hwan Kim for a dissertation

Undergraduate Coursework.
Microcomputer Application Visual Programming
Human Anatomy Computer Programming Biomechanics
Principles of Medical Imaging Biomedical Laboratory Capstone Design 1, 2
Design of Biomedical Devices and Systems Medical Terminology
Engineering Math. 1, 2 Biomedical Signals and Systems
Digital Signal Processing

Publications

Selected Journal

1. **O.-Y. Kwon**, M.-H. Lee, C. Guan, and S.-W. Lee, "Subject-Independent Brain-Computer Interfaces Based on Deep Convolutional Neural Networks," *IEEE Trans. on Neural Networks and Learning Systems*, 2019 (IF:11.683; 0.97% (2019 years: 1 of 104, Computer Science, Theory and Methods.)

International Journal & Conference

1. M.-H. Lee, **O.-Y. Kwon**, Y.-J. Kim, H.-K. Kim, Y.-E. Lee, J. Williamson, S. Fazli, and S.-W. Lee, "EEG Dataset and OpenBMI Toolbox for Three BCI Paradigms: An Investigation into BCI Illiteracy," *GigaScience*, Vol. 8, No. 5, 2019, pp. 1-16. (IF: 7.267, 10% Journal, 2019.)
2. B.-T. Lee, K.-J. Cho, **O.-Y. Kwon**, and Y.-H. Lee, "Improving the performance of a neural network for early prediction of sepsis," *2019 Computing in Cardiology (CinC)*. 2019.
3. K.-J. Cho*, **O.-Y. Kwon***, J.-M. Kwon, Y.-H. Lee, H.-H. Park, K.-H. Jeon, K.-H. Kim, J.-S. Park, and B.-H. Oh, , "Detecting patient deterioration using artificial intelligence in a rapid response system," *Critical Care Medicine* (IF:7.447), 2020, (*Two authors are equally contributed).

4. B.-T. Lee*, **O.-Y. Kwon***, H Park, KJ Cho, JM Kwon, and Y.-H. Lee, "Graph Convolutional Networks-Based Noisy Data Imputation in Electronic Health Record", (IF:7.447), *Critical Care Medicine* (IF:7.447), 2020, (*Two authors are equally contributed).
5. D.-Y. Kang*, K.-J. Cho,* **O.-Y. Kwon***, J.-M. Kwon, K.-H. Jeon, H.-H. Park, Y.-H, Lee, J.-S. Park, B.-H. Oh, "Artificial intelligence algorithm to predict the need for critical care in prehospital emergency medical services", *Scandinavian journal of trauma, resuscitation and emergency medicine*, 2020, (*Three authors are equally contributed).
6. SJ Park*, KJ Cho*, **O.-Y. Kwon**, H Park, Y Lee, WH Shim, CR Park, WK Jhang "Development and validation of a deep-learning-based pediatric early warning system: a single-center study," *Biomedical Journal*, 2021
7. Yeon Joo Lee, Kyung-Jae Cho, **O.-Y. Kwon**, Hyunho Park, Yeha Lee, Joon-Myoung Kwon, Jinsik Park, Jung Soo Kim, Man-Jong Lee, Ah Jin Kim, Ryoung-Eun Ko, Kyeongman Jeon, You Hwan Jo, "A Multicenter Validation Study of the Deep Learning-based Early Warning Score for Predicting in-hospital Cardiac Arrest in Patients Admitted to General Wards," *Resuscitation*, 2021

Ongoing Papers

1. **O.-Y. Kwon** and Yeha Lee, "An end-to-end automated machine learning framework for multi-label ECG classification " *submitted in ICASSP 2022*

Extra works

1. Competition

- Physionet Challenge 2019
  - Objective: Risk prediction using tabular EMR data
  - Sponsor and Rank: Physionet Challenge at Hacker-ton Challenge in Singapore, Ranked 5th
  - Idea: Using graph convolutional networks
  - Reward: Critical Care Medicine (Impact factor:7.442)