CAU AI Graduate School Introduction

1. About CAU AI Graduate School

1-1. Overview

1-2. Research Areas

1) recommendation systems
2) natural language processing
3) optimization in deep learning

VISION

Vision of Da Vinci AI Graduate School

Vision	Nurturing talents contributing to human society using AI
CORE Ability	Creative, Open, Renovative, Ethical

AI Campus

- AI Campus Construction
- Foundation of CAU AI Committee
- Foundation of Da Vinci AI Academy
- CAU AI Data Lake Construction
- AI K-MOOC lecture

AI R & D

- Development of AI defense technology
- Development of e-Advisor with Hanhwa
- AI image process technology for practical satellites 3, 3A, 7A
- Cooperation of Fuel System-Drone-Robot with Doosan

Da Vinci AI Talents

- Da Vinci Institute of Learning Innovation
  - AI Da Vinci Learning
  - Da Vinci Classroom
- Student Excellence
- AI and programming education for all students

Research

Long-term AI Core Research Tasks

Credible AI

Overcoming the limitations of the black box model for efficient decision-making

eXplainable AI

- **AI+Medical** — Active research field of AI industry
- **AI+ Defense** — Active research field of PI

Automated AI

Bridging the gap in application of industrial AI technology

Automated ML

- **AI+Vehicles** — Active research field of AI industry
- **AI+Robot** — Active research field on high demand

Universal AI

Generalization of AI due to diversification of learning strategies

Robust AI

- **AI+Contents** — Active research field of CAU
- **AI+Language** — Active research field of CAU

Research

Faculty Members

Core AI

Applied AI


Cho, Yoon-Sik
Credible AI


Hong, Byung-Woo
AI+Medical


Lee, Kyungjae
AI+Robots


Lee, Changhee
AI+Medical


Kim, Bugeun
AI+Language


Kim, Eunwoo
Automated AI


Paik, Joonki
AI+Defense


Kim, Youngbin
AI+Language


Kim, Junyeong
AI+Language


Kwon, Junseok
Universal AI


Choi, Jongwon
AI+Vehicles


Lee, Jaesung
AI+Contents


Lee, Hwanhee
AI+Language

1. About CAU AI Graduate School

1-1. Overview

1-2. Research Areas

1) recommendation systems

2) natural language processing

3) optimization in deep learning

1. About CAU AI Graduate School

1-1. Overview

1-2. Research Areas

1) recommendation systems

2) natural language processing

3) optimization in deep learning

1. About CAU AI Graduate School

1-1. Overview

1-2. Research Areas

1) recommendation systems
2) natural language processing
3) optimization in deep learning

2. Programs in AI Graduate School

2-1. Education

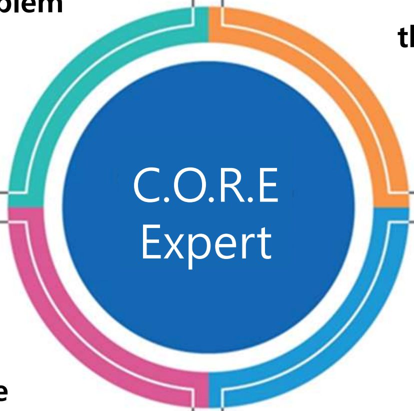
2-2. Internship in Industry

2-3. International Research Collaboration

Education

Da Vinci AI Graduate School

Creative	Open	Renovative	Ethical
Creative AI experts solving social problems	Open AI expert Pursuing convergence	Innovative AI expert leading the future society	Ethical AI Experts Creating the Common Good



Creative

Creative AI experts training for on-site problem solving based on industrial demand

- Industrial demand-based projects
- AI applications in all courses

Open

Open AI education through the use of AI open source platform

- Use of AI open source platform
- Open education with AI literacy course

Renovative

Convergence thinking education through completion of other academic convergence

- Collaboration with professors from other fields
- Convergence of other majors

Ethical

Ethical AI experts training through AI ethics and fairness education

- Human-centered AI education
- AI Ethics and Fairness Course

CAU-AI Core Tech Seminar

Bi-weekly online seminar about trends of artificial intelligence

International/Domestic Researchers

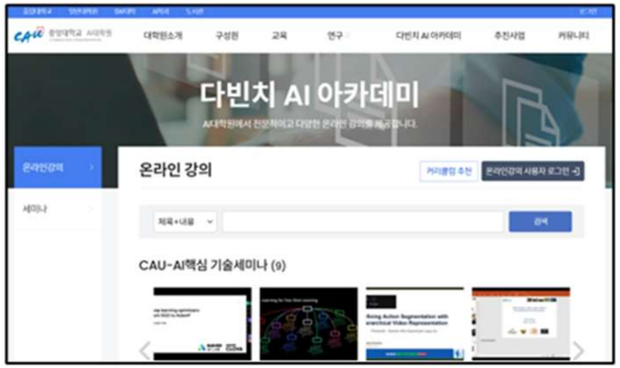
Date	Name	Affiliation	Topic
Jun. 22, 2022	Jason Friedman	Tel Aviv Univ.	Using arm movements to understand perceptual decision making, and vice-versa
Jul. 06, 2022	Youngdeok Seo	Inha Univ.	Recommendation System
Aug. 17, 2022	Jaemin Jo	Univ. of North Carolina at Chapel Hill	Vision-and-Language Learning: Pretraining, Transfer Learning, and Evaluation
Sep. 02, 2022	Seungho Seo	DFKI	Multimodal Human Activity Recognition with Industrial Applications
Sep. 30, 2022	Mina Lee	Stanford	Writing with Artificial Intelligence
Oct. 28, 2022	Kimin Yun	ETRI	DeepView Project
Nov. 25, 2022	Simon Korman	Univ. of Haifa	Computer Vision in the Wild

International/Domestic Industrial Speaker

Date	Name	Affiliation	Topic
May. 26, 2022	Byoungho Heo	NAVER	Optimizers for deep learning: From SGD to AdamP
Jun, 10, 2022	Seunghwan Kim	LG AI Research	LG and AI - 1
Jul. 22, 2022	Donghyun Won	Motional, USA	Challenges in Perception System for Autonomous Driving
Aug. 04, 2022	Youngjae Lee	S2W	Shedding new light on the language of the Dark Web
Oct. 14, 2022	Kyoungsik Moon	META	Towards 3D Human Reconstruction in the Wild
Oct. 18, 2022	Woohyung Lim	LG AI Research	LG and AI - 2
Dec. 09, 2022	Junbeom Cha	Kakao Brain	Computer Vision in the Wild

AI Special Course

Online AI Curriculum



AI Seminar for Non-majors

KMOOC Open Lecture

AI Curriculum for Freshman

International Education

ACDL 2022 an Online and Onsite Course

· **The 5th Advanced Course on Data Science & Machine Learning(ACDL)**

- August 22 – August 26, 2022
- University of Catania, Siena, Italy
- The course will involve a total of 36~40 hours of lectures

Topics

- Artificial Intelligence Reinforcement Learning Algorithm
- Big Data Networks
- Cognitive Computing
- General
- Generative Adversari
- And so on

중앙대학교

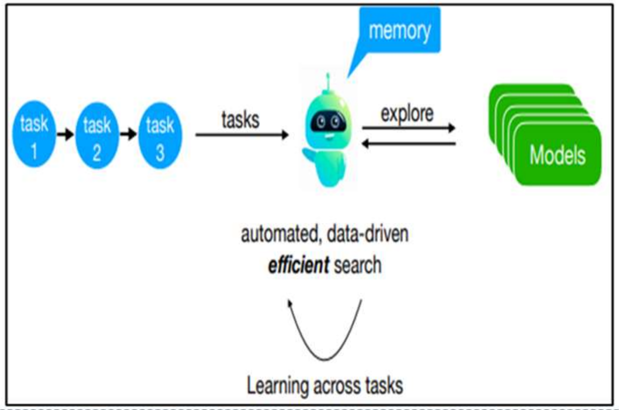
Università di Catania

Automatic Machine Learning

· **Part 1 : Why automate machine Learning?**
  - High-level goals

· **Part 2 : How AutoML works?**
  - The machinery

· **Part 3 : Learning to (automatically) learn?**



International Education

CES 2023

CVPR 2023

2. Programs in AI Graduate School

2-1. Education

2-2. Internship in Industry

2-3. International Research Collaboration

'22 AI Graduate School
- NC Soft Cooperation Fall Long-Term Intern Program

- AI Graduate School and NC Soft collaboration intern program to cultivate exceptional students
- The program aims to nurture talents who can understand industry-used technologies
- We are currently recruiting 5-10 interns every semester, starting from the second half of 2022

■ Recruitment Field

NCSOFT

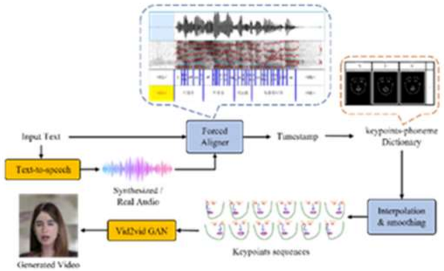
Center	Lab
AI Center	Vision AI Lab, Graphics Lab, AI Production Lab(Digital Human Solution Team, MLOps Team)
AI Biz Center	Applied AI Lab, Finance Biz Lab(Finance AI RD)
NLP Center	NLP Lab

Research on text/voice-based virtual human's facial generation technology (CJ Olive Networks Internship Program)

Two Ph.D. candidates from the AI Graduate School participated

1. Generating Korean-speaking virtual human videos based on text and voice

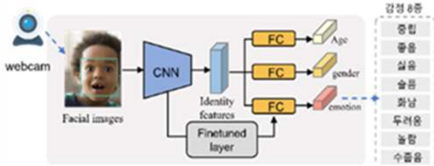
▶ Built a dictionary matching facial landmarks and phonemes with short-length videos and texts for each person
▶ Generating facial landmarks for the GAN model
▶ Facial synthesis using GAN based on the generated facial landmarks



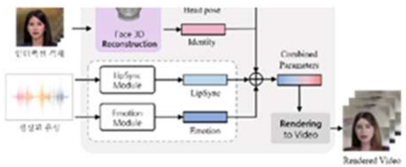
▶ Text-based model shows flexible results
▶ Possible to build a dictionary of facial landmarks and phonemes with just short

2. Nonverbal understanding and expression model

▶ Development of a method for recognizing user's emotions, age, and gender

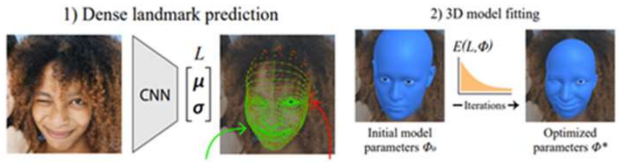


▶ Robust generation method for changes in facial angles through Face 3D reconstruction
▶ Nonverbal expression method based on the given virtual human's emotions

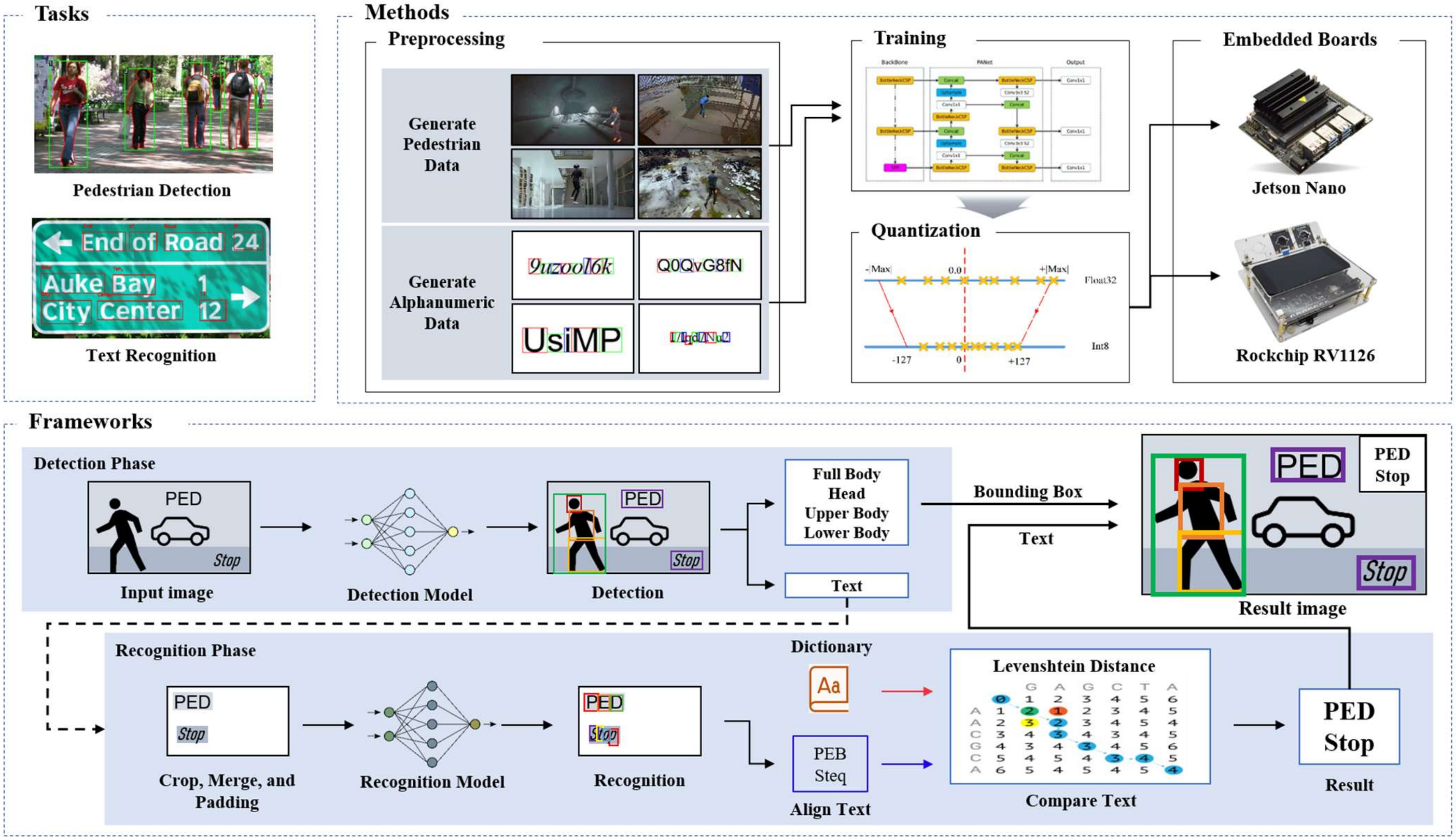


3. Development of the next-generation interactive digital human solution

▶ Blending method for natural emotion motions and lip animations
▶ Development of a method for generating chin, tongue, and Adam's apple animations that match lip animation



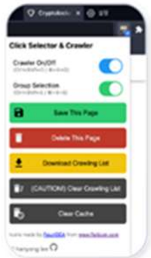
Doosan AI CoE: Simultaneous Pedestrian Detection & Text Recognition on Embedded Board



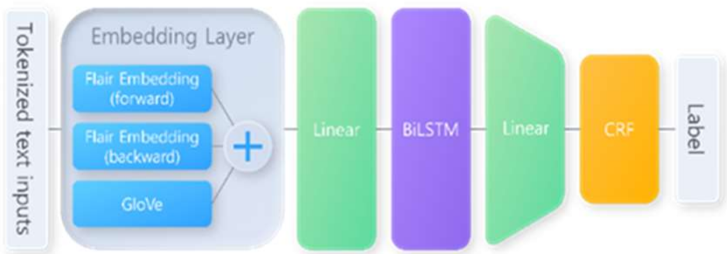
Other Internship Projects

S2W Safe and Secure World — NLP Team

▪ **NER annotation, Web Crawling Tool**

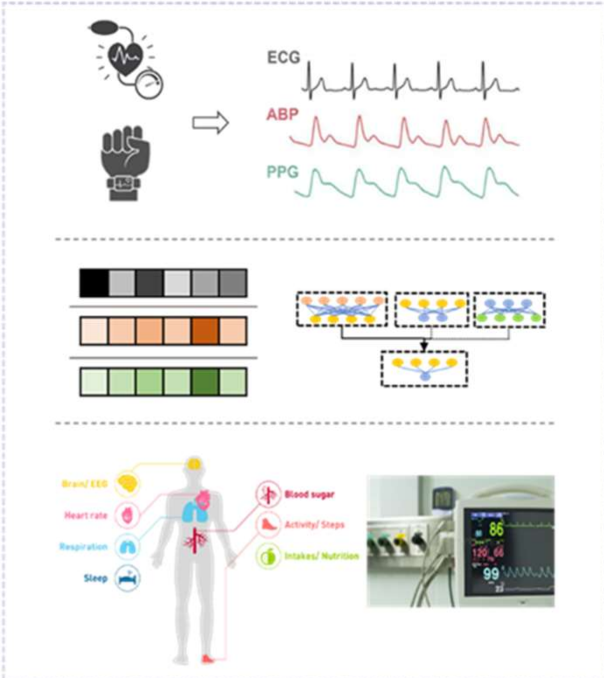


▪ **Security Sentence Classification Modeling**



infomining — Sensor Data Processing Team

▪ **웨어러블 디바이스의 생체 신호 모니터링**



2. Programs in AI Graduate School

2-1. Education

2-2. Internship in Industry

2-3. International Research Collaboration

International Research Collaboration (1/2)

1

Resource-aware Machine Learning

Instruction on data analysis techniques and implementation of machine learning algorithms on embedded systems

2

A Study on Next Generation Journalism Based on Big Data and Deep Learning

The goal is to take automated journalism to the next level by utilizing news big data and deep learning language models.

3

Advanced Online & Onsite Course on Data Science & Machine Learning

Introduction and study of the latest data analysis techniques and machine learning techniques

4

An international joint study of AI technology for predicting complications after orthopedic surgery

Using health care big data, we developed a gastric cancer prediction model using a gastric cancer patient and other diseases diagnosed together.

International Research Collaboration (2/2)

1

An International Joint Study on the Development of Healthcare and Medical AI

A study of a high-performance disease prediction model based on deep learning. An interpretable deep learning model study. A study on the causal relationship and treatment effect of machine learning-based questions.

2

An International Joint Study on the Analysis Technology of Healthcare Data Variables Based on Deep Learning

This study proposes a deep learning-based feature selection technique using self-supervised learning and the correlation structure of data using unlabeled public data.

3

An International Joint Study on the Development of Healthcare and Medical AI

This study proposes a complex time series data-based survival analysis model through a deep learning-based model.

4

An international joint study of AI technology for predicting complications after orthopedic surgery

This study examines AutoML technology that can be easily used by artificial intelligence non-experts by reflecting the specificity of healthcare and medical data.

3. Partnership Programs

3-1. Hungary-CAU Research/Education Collaboration

Hungary-CAU Research/Education Collaboration

Graduate Scholarship Program

- CAU awards scholarships to 5 graduate students selected by Hungarian Rector's Conference
- Chung-Ang University Young Scientist Scholarship (CAYSS)
- AI Graduate School Scholarship
- Benefits: Tuition fee waivers for four semesters (including Application and Admission Fees)

Undergraduate Student Exchange Program

- Hungarian universities currently collaborating
: The University of Szeged,
University of Debrecen, University of Pec

Scholarship and On-Campus Internship for International Students

Scholarship	Eligibility	Benefits
CAU Global Student Internship	- Native speakers of English or French - Selection via interview	- Approximately $1000 per semester - Official certificate by OIA
CAU OIA Fellowship	- Fluency in English - Good computer skills - Selection via interview	- Approximately $1000 per month - Official certificate by OIA
CAU Global Opportunity Scholarship	According to student exchange agreement	On-campus accommodation expenses
Global Korea Scholarship	Exchange students deemed qualified by the NIIED(National Institute for International Education)	Airfare, Monthly stipend, Settlement Allowance, Insurance Fee
ASEM DUO Scholarship	Students from European partner universities	4,000 Euros (8,000 Euros for 1 pair)
Scholarship for Fee-paying students	According to student exchange agreement	For 40 students or above, 50% of tuition waived (differs according to number of students)

Summary table of international partnership

	No. of Countries (Europe)	No. of Universities
Overall	74 (31)	621 (187)
Partnership for Exchange Student	69 (29)	458 (150)
Partnership for Visiting Professor/Scholar	40 (23)	113 (57)

Supports for International Students

- **GLAM** — Global Ambassador
- **CALIS** — Leaders of International Students
- **GCC** — Global Community Center
- **GF** — Global Fairs
- **CAKE** — Korean Editing
- **CANGO** — Cultural Activity for Next Great Opportunity

Number of exchange students in the recent 3 years

Long-term Exchange		Short-term Exchange	
Invited	Dispatched	Invited	Dispatched
1980	814	129	286

International Partnership

AMERICAS

Brazil

- Brazilian Association(ABRUEM)
- The Federal University of Minas Gerais (UFMG)
- Mackenzie Presbyterian University
- Pontifical Catholic University of Rio de Janeiro
- University of Campinas

Canada

- Ryerson University
- Lakehead University
- Memorial University of Newfoundland
- Memorial University of Newfoundland, Grenfell Campus
- Memorial University of Newfoundland, St.John's Campus
- Université de Montréal
- University of Alberta
- University of Manitoba
- University of Ottawa
- University of Saskatchewan
- University of the Fraser Valley
- Vancouver Island University

Chile

- Finis Terrae University
- Universidad Adolfo Ibanez
- Universidad de los Andes

Columbia

- Universidad de los Andes
- Universidad del Rosario
- Universidad Tecnologica de Bolivar

Costa Rica

- Universidad Latina De Costa Rica

Mexico

- Tecnologico De Monterrey
- Universidad de Monterrey
- Universidad La Salle
- Universidad Tecmilenio
- Universidad Nacional Autonoma de Mexico

Peru

- Universidad San Ignacio de Loyola S.A.

Uruguay

- Universidad ORT Uruguay

USA

- Alaska Methodist University
- Alaska Pacific University
- American University
- Asia Pacific College (CAPE)
- Brookhaven College
- California State University, Bakersfield
- California State University, East Bay
- California State University, Fullerton
- California State University, Long Beach
- California State University, Los Angeles
- California State University, Sacramento
- California State University, Stanislaus
- Campbellsville University
- Central Washington University
- Columbia College
- Findlay College
- George Washington University
- Georgia State University
- Hawaii Pacific University
- Kansas State University
- Loyola University New Orleans
- Michigan State University
- Mississippi State University
- Minnesota State University, Moorhead
- Monterey Institute of International Studies
- North Dakota State University
- Northern Illinois University
- Oklahoma State University
- School of Visual Arts
- Southeast Missouri State University
- Southwest State University
- St.Louis College of Pharmacy
- State University of New York, Oneonta
- State University of New York, Oswego
- State University of New York, Plattsburgh
- Stevens Institute of Technology
- Temple University
- The Ohio State University
- Towson University
- Tufts University
- University of Cincinnati
- University of Guam
- University of Hawaii, Hilo
- University of Houston
- University of Iowa
- University of Nebraska, Kearney
- University of North Carolina, Chapel Hill
- University of San Francisco
- University of Southern California
- University of Wisconsin, Stout
- Utah State University
- Virginia Commonwealth University
- Widener University
- Winona State University

ASIA

Bangladesh

- Daffodil International University

Brunei

- Universiti Brunei Darussalam

Cambodia

- Life University
- Pannasastra University of Cambodia
- The Royal University of Fine Arts

China

- Beihang University
- Beijing International Studies University
- Beijing Normal University
- Capital Normal University
- Central University of Finance and Economics
- Central University of Nationalities
- Chang'an University
- Changchun University of Technology
- China Univ. of Politic Science and Law
- China University of Geosciences
- Chinese Academy of Sciences'Inst' of Automation
- City University of Hong Kong
- Communication University of China, Nanjing
- Dalian Art College
- Dalian Maritime University
- Dalian University of Technology
- Fudan University
- Guangdong University of Foreign Studies
- Guilin University of Technology
- Harbin Engineering University
- Harbin Institute of Technology
- Henan Normal University
- Hong Kong Baptist University
- Hong Kong College of Technology
- Hong Kong Shue Yan University
- Hubei Institute of Fine Arts
- Institute for Tourism Studie
- Institute of Advanced Technology Heilongjiang Acad
- Jiangsu Ocean University
- Jilin Agricultural University
- Jilin Normal University
- Jinan University
- Jinling Institute of Technology
- Lanzhou University
- Liaoning University
- Lignan University
- Macau University of Science and Technology
- Nanjing University
- Nanjing University of the Arts
- Nankai University
- National Academy of Chinese Theatre Arts
- Northeast Normal University
- Northeastern University
- Northwest University of Politics & Law
- Northwestern Polytechnical University
- Qingdao Agricultural University
- Renmin University of China
- Shandong University of Finance and Economics
- Shandong University of Technology
- Shandong University
- Shanghai Jiao Tong University
- Shanghai University
- Shenzhen University
- Sichuan Fine Arts Institute
- Sichuan International Studies University
- Sichuan Normal University
- Sichuan University
- South China Normal University
- Southwestern University of Finance and Economics
- The Chinese University of Hong Kong(Shenzhen)
- The Education University of Hong Kong
- The Hang Seng University of Hong Kong
- The Hong Kong Polytechnic University
- Tianjin Foreign Studies University
- University of International Business and Economics
- University of Nottingham, Ningbo
- Wuhan University
- Xiamen University
- Xi'an International University
- Xiangtan University
- Yanbian University
- Yangzhou University
- Zhanjiang Normal University
- Zhengzhou University

India

- Banaras Hindu University
- Chandigarh University
- Chitkara University
- Indian Institute of Technology Madras
- S. V. National Institute of Technology, Surat
- Vel Tech Dr.RR & Dr.SR Technical University

Indonesia

- Atma Jaya Catholic University
- Binus University
- Bogor Agricultural University
- Diponegoro University
- Duta Wacana Christian University
- Gadjah Mada University
- Institut Teknologi Bandung
- Sepuluh Nopember Institute of Technology
- Syiah Kuala University
- Universitas Airlangga
- University of Surabaya

Japan

- Aichi Shukutoku University
- Aichi University
- Chiba University
- Chuo University
- Doshisha University
- Hokkaido University
- Hosei University
- J.F.Oberlin University
- Kagoshima University
- Kindai University
- Kobe University
- Kochi University
- Kwansei Gakuin University
- Kyushu Sangyo University
- Kyushu University
- Mie University
- Nagasaki University
- Nagoya City University
- Osaka City University
- Osaka University
- Ritsumeikan Asia Pacific University
- Ritsumeikan University
- Ryukoku University
- Saitama University
- Sapporo University
- Tohoku University
- Tokyo Metropolitan University
- Toyo Eiwa Jogakuin

Jordan

- Jordan University of Science and Technology

Kazakhstan

- Al-Farabi Kazakh National University
- Kazakh Ablai Khan University of IRWL
- Kazakh Academy of Sports and Tourism
- Kazakh National Pedagogical University named after Abay
- Kazakhstan Institute of Management, Economics and Strategic Research
- Korkyt Ata Kyzylorda State University

Kyrgyz

- Bishkek Humanities University

Lebanon

- American University of Beirut
- Lebanese American University

Malaysia

- HELP University
- Limkokwing Univeristy of Creative Technology
- Taylor's University Universiti Putra Malaysia
- The Malaysia University of Science and Technology
- UCSI University
- Universiti Malaysia Pahang
- University Kebangsaan Malaysia
- University of Malaya
- University of Nottingham Malaysia
- Universiti Putra Malaysia

Mongolia

- Mongolian University of Arts and Culture
- Mongolian University of Science and Technology
- Ulaanbaatar University

North Korea

- Pyongyang University of Science and Technology

Pakistan

- National University of Sciences and Technology

Philipines

- Adamson University
- Ateneo de Manila University
- De La Salle University
- Mapua Institute of Technology
- The Polytechnic University of the Philippines
- University of San Carlos
- University of The Philippines Diliman

Singapore

- Nanyang Technological University
- Singapore Institute of Management
- Singapore Management University
- Singapore Polytechnic

Taiwan

- Asia University
- Chung Yuan Christian University
- Feng Chia University
- Fu Jen Catholic University
- Hsing Wu University
- Ming Chuan University
- National Central University
- National Chengchi University
- National Chi Nan University
- National Chiao Tung University
- National Chung Cheng University
- National Chung Hsing University
- National Dong Hwa University
- National Kaohsiung Normal University
- National Sun Yat Sen University
- National Taipei University of Technology
- National Taiwan Normal University
- National Taiwan Ocean University, ROC
- National Taiwan University of Arts
- National Taiwan University of Science and Technology
- National Tsing Hua University
- National University of Kaohsiung
- National Yang-Ming University
- Shih Hsin University
- Soochow University
- Tainan University of Technology
- Tamkang University
- Tatung University
- University of Taipei

Thailand

- Burapha University
- Chiang Mai University
- Chulalongkorn University
- Kasetsart University
- Khon Kaen University
- King Mongkut's Institute of Technology Ladkrabang
- King Mongkut's University of Technology North Bangkok
- King Mongkut's University of Technology Thonburi
- Prince of Songkla University
- Silpakorn University

United Arab Emirates

- Canadian University Dubai
- Institute of Management Technology
- RAK Medical & Health Sciences University

Uzbekistan

- State Conservatory of Uzbekistan
- Tashkent State Institute of Oriental Studies
- Tashkent State Pedagogical University named after Nizami
- Uzbek State University of World Languages

Vietnam

- Dalat University
- Foreign Trade University
- Ha Noi University of Industry
- Hanoi University of Pharmacy
- Hoa Sen University
- Ho Chi Minh City University of Technology
- Hue University
- Hue University of Medicine and Pharmacy
- Ton Duc Thang University
- University of Economics Ho Chi Minh City
- University of Medicine and Pharmacy HoChiMinh City
- Vietnam International Education Development
- VNU Hanoi, College of Foreign Languages
- VNU Hanoi, University of Economics and Business
- VNU Hanoi, University of Languages&International Studies
- VNU Hanoi, University of Social Sciences & Humanities
- VNU Hanoi, University of Engineering & Technology
- VNU Hanoi, University of Science
- VNU-HCM, Univ. of Social Sciences & Humanities
- VNU-HCM, University of Science
- VNU-HCMC University of Economics and Law

EUROPE

Austria

- University of Applied Sciences Bfi Vienna
- Alpen adria Universitaet Klagenfurt

Belgium

- ICHEC Brussels Management School
- University of Namur
- Vrije Universiteit Brussel

Czech Republic

- University of Ostrava
- VSB-Technical University of Ostrava

Denmark

- Copenhagen Business School
- Jutland Art Academy
- Roskilde University
- University of Southern Denmark

Estonia

- University of Tartu

Finland

- Aalto University
- South-Eastern Finland University of Applied Sciences
- Savonia University of Applied Science
- University of Turku

France

- Association Leonard de Vinci
- ECE Paris-Ecole d Ingenieurs
- EDHEC Business School
- ESCE International Business School
- ESSCA School of Management, EDHEC Business School
- European Institute of Technology(EPITECH)
- Haute ecole des arts du Rhin(HEAR)
- IGS Groupe
- INSA Rouen Normandie
- INSA Toulouse
- INSEEC School of Business and Economics
- IPAG Business School
- IPSA(Polytechnic Institute of Advanced Science)
- ISC Paris School of Management
- ISEN Lille
- ISTC (Strategies Et Communications)
- Lumiere University Lyon 2
- Neoma Business School
- Paris West University Nanterre La Defense
- Sciences Po Bordeaux
- The American Business School, IGS University
- Toulouse Business School
- Toulouse Catholic University
- Universite Catholique de Lille
- University of Rennes 1

Germany

- Baden-Wuertemberg Cooperative State University Stuttgart
- Baden-Wuerttemberg Cooperative State University Mosbach
- Folkwang University of the Arts
- HTW Berlin University of Applied Science
- Johannes Gutenberg University of Mainz
- University of Augsburg
- University of Music Detmold
- University of Osnabruck
- Technische Hochschule Nuernberg Georg Simon OHM

Greece

- University of Western Macedonia

Hungary

- The University of Szeged
- University of Debrecen
- University of Pecs

Ireland

- Institute of Technology Carlow
- Waterford Institute of Technology

Italy

- Ca' Foscari University of Venice
- Universita Cattolica Del Sacro Cuore
- University of Udine

Lithuania

- Kaunas University of Technology
- Siauliai University
- Vilnius University
- Vytautas Magnus University

Netherlands

- Erasmus University Roterdam
- Fontys Venlo University of Applied Sciences
- Hague Conference on Private International Law
- HAN University of Applied Sciences
- Hanze University of Applied Sciences
- HZ University of Applied Sciences
- Radboud University
- University of Twente
- Windesheim University of Applied Sciences

Malta

- American University of Malta

Norway

- Norwegian University of Science&Technology

Poland

- Cracow University of Economics
- Cracow University of Technology

Portugal

- University of Porto

Romania

- Alexandru Ioan Cuza University
- University of Bucharest

Russia

- Irkutsk National Research Technical University
- National Research University HSE
- Peter the Great St Petersburg Polytechnic Univ
- Saint-Petersburg State University
- Herzen State Pedagogical University
- Novgorod State University
- Repin University
- Ural Federal University
- Yaroslav The Wise Novgorod State University

Slovenia

- University of Ljubljana

Slovakia

- Technical University in Zvolen
- University of Zilina

Spain

- Autonomous University of Barcelona(UAB)
- Comillas Pontifical University
- Universidad Catolica San Antonio
- Universidad de Navarra
- Universitat de Valencia
- University of Alicante
- University of Jaen
- University of Malaga
- University of Mondragon
- University of Technology, Arts and Design (U-Tad)

Sweden

- Chalmers University of Technology
- Halmstad University
- Linnaeus University, Vaxjo
- Orebro University
- Swedish Red Cross University
- Umea University
- Uppsala University

Switzerland

- University of Applied Sciences of Western Switzerland
- Zurich University of Applied Sciences
- Zurich University of the Arts

Turkey

- Ondokuz Mayis University
- Sabanci University
- Istanbul Bilgi University

UK

- Cardiff University
- Coventry University
- Royal Holloway and Bedford New College, University
- University of Central Lancashire (UCLAN)
- University of London, Goldsmiths
- University of Sheffield
- University of Sussex
- University of Wales, New Port
- York St John University

OCEANIA

Australia

- Deakin University
- Griffith University
- James Cook University
- Swinburne University of Technology
- University of Canberra
- University of South Australia

New Zealand

- Massey University

AFRICA & MIDDLE EAST

Egypt

- The American University in Cairo

Kenya

- Kenyatta University

Morocco

- Groupe ISCAE
- Institute of Higher Education in Management (HEM)

(Provisional) Hungary-CAU Research/Education Collaboration

Selection Criteria	• TBD
Participants	• CAU: TBD • ELTE: TBD
Programs	• Research on AI and contents • Education on AI and contents

AI Graduate School,
Chung-Ang University

(06974) 84 Heukseok-ro, Dongjak-gu, Seoul, Republic of Korea,
Building 310, Room 824, AI Graduate School
Tel: +82-2-820-6748

Web

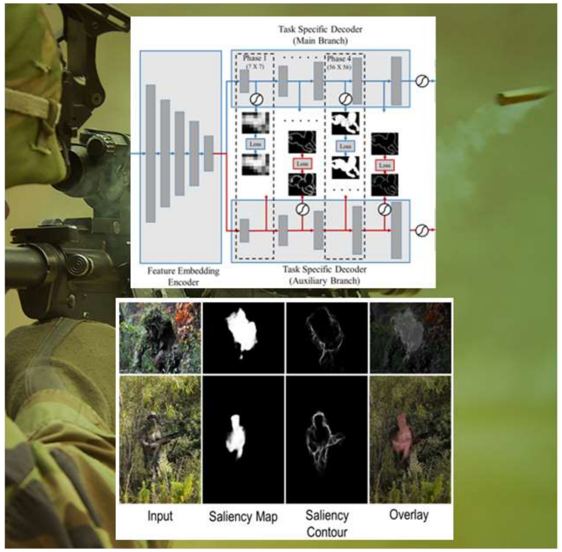
- CAU - https://www.cau.ac.kr/
- AI Graduate School – https://aigs.cau.ac.kr/

Appendix

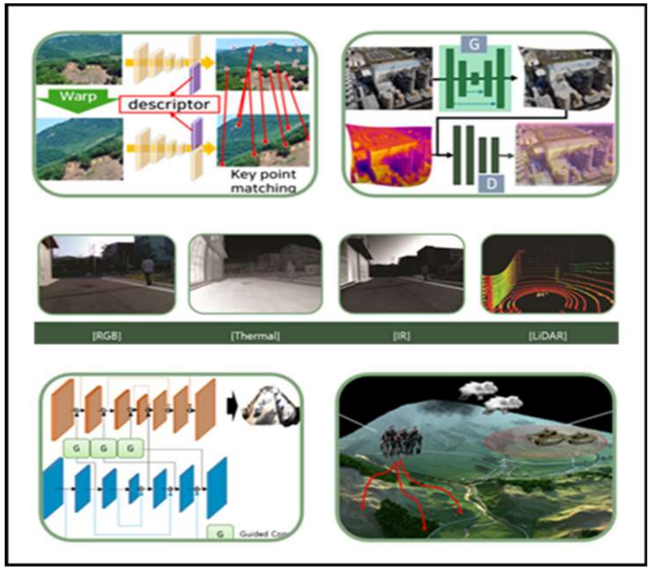
Research Topics

Image Processing and Intelligent systems Laboratory

AI Defense Monitoring



AI based Battlefield Visualization



Dual-Use Semantic AI

Research Projects

"Artificial Intelligence Future Defense Technology"

- Edge Camera Boundary Monitoring (2017-2021)
- Future Defense (2020-2023)
- Dual-Use technology (2020-2023)
- Deep View Stage 3 (2021-2023)

Publications

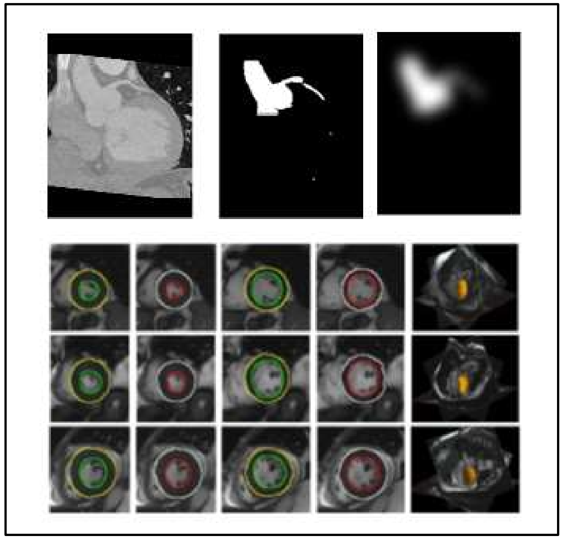
- Region-Based Dehazing via Dual-Supervised Triple-Convolutional Network, **IEEE Trans. Multimedia, 2021.**
- Camera Orientation Estimation Using Motion-Based Vanishing Point Detection for Advanced Driving Assistance, **IEEE Trans. ITS, 2021.**
- HLDNet: Abandoned Object Detection Using Hand Luggage Detection Network, **IEEE Consumer Electronics Magazine, 2021.**

Research Topic

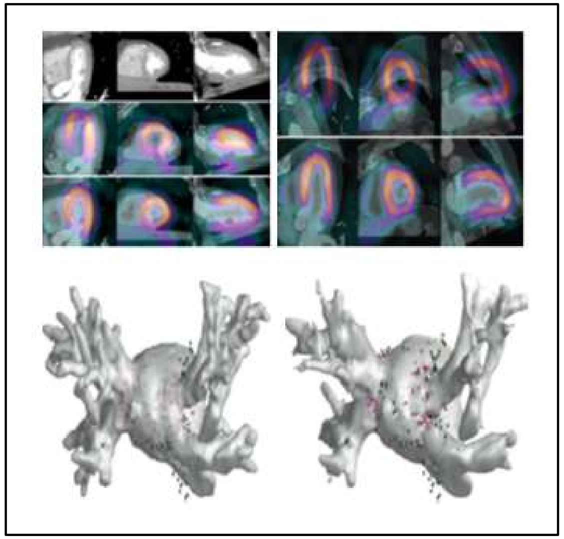
Image Laboratory

http://image.cau.ac.kr

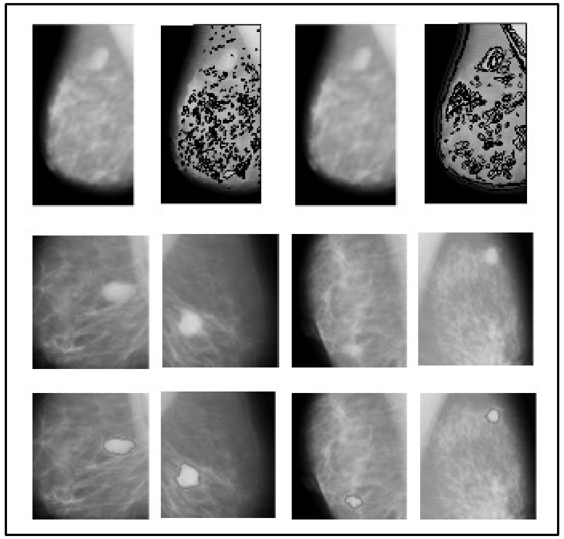
Segementation



Registration



Salient contour map



Collaborations

Recent Studies

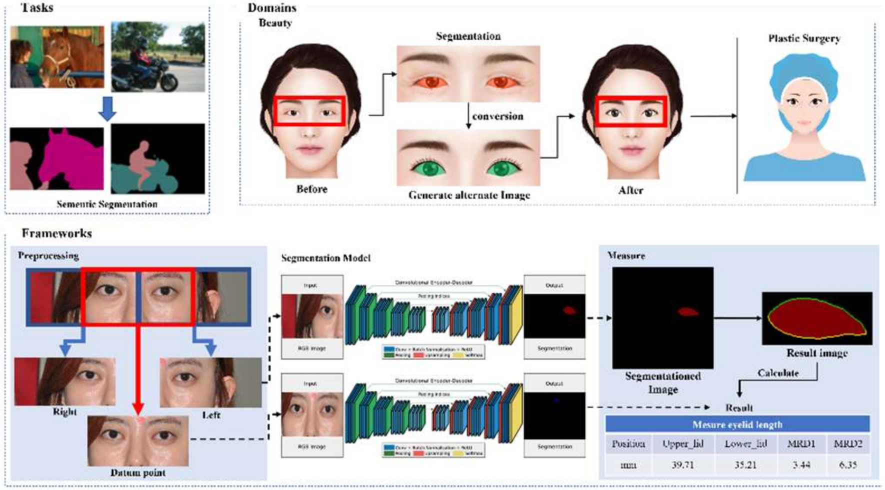
- IEEE Conference on Computer Vision and Pattern Recognition, July.2017.
- IEEE Transactions on Image Processing(TIP), 2020
- International Conference on Computer Vision(ICCV), 2021
- International Conference on Robotics and Automation(ICRA), 2021

Research Progress

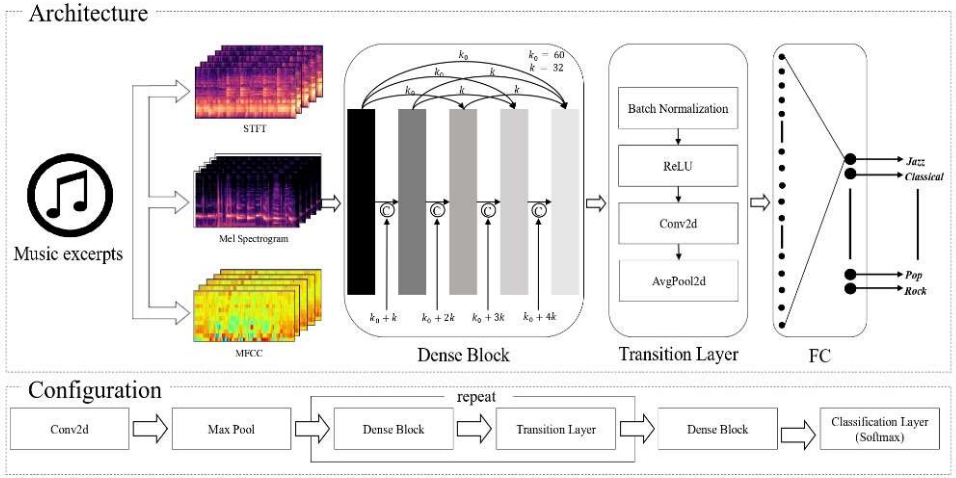
AutoML Lab(Professor Jaesung Lee)

Auto ML

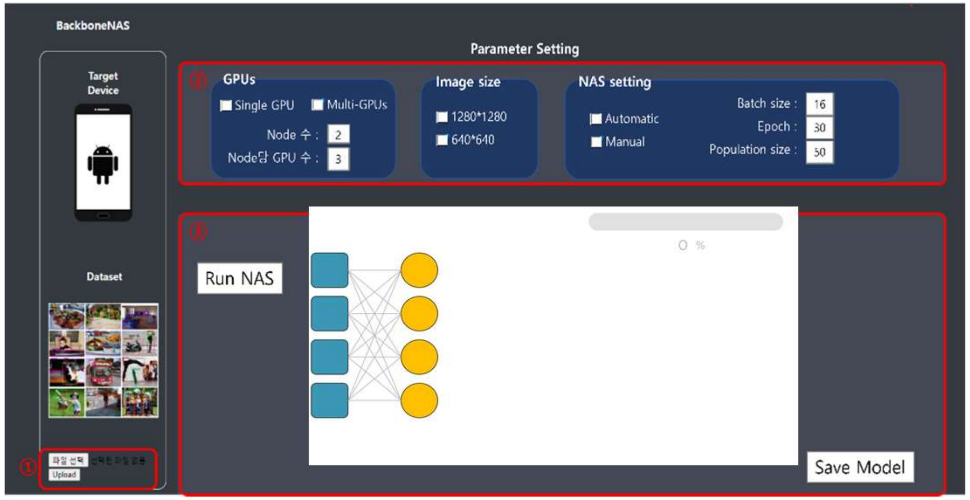
AI+Medical
Eyelid length measurement using semantic segmentation



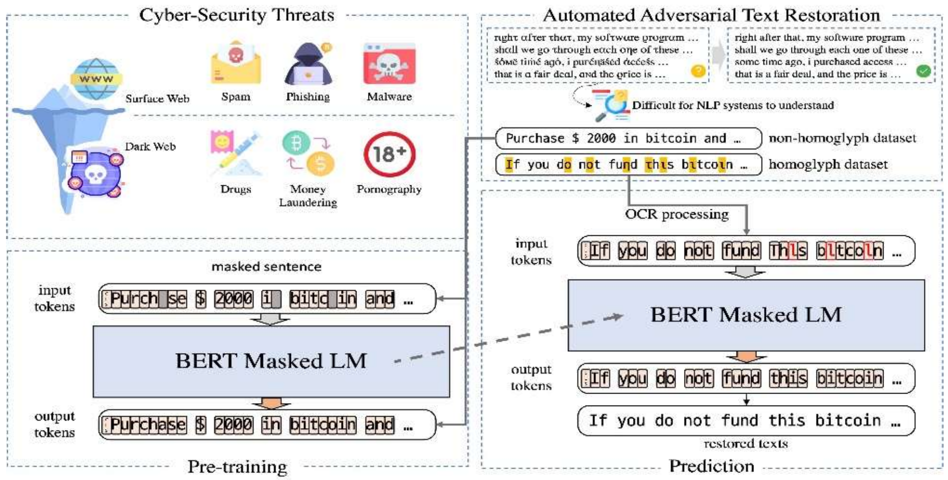
AI+Contents
Music recommendation system using multiple music features



AI+Core
Neural Architecture Search in Limited Resources



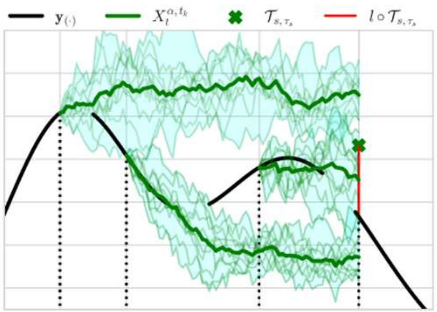
AI+Security
Homoglyph reconstruction using a language model



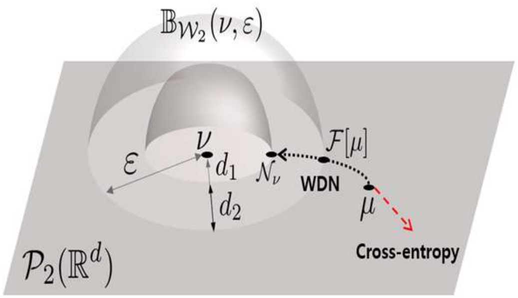
Research Topic

Computer Vision Machine Learning Lab (prof. Junseok Kwon)

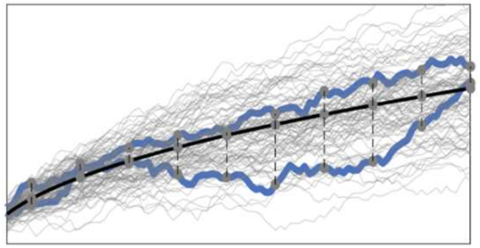
- **Machine learning**: Optimal transport, Wasserstein ambiguity, Neural ODE, MCMC
- **Deep learning:** Generative adversarial network, Graph convolution, Meta learning
- **High-level vision:** Object detection, Object tracking, Segmentation, 3D Point clouds
- **Low-level vision:** Dehazing, Super-resolution, and Low-light enhancement



Stochastic Dynamics Estimation for
Stock Market Data



Distributional Certification of
Noisy Labeled Data



Markovian Temporal Dynamics Generation for
Stochastic Continuous Data

Our goal is to develop an artificial intelligence model that is robust to changes in the external environment such as noise and can theoretically explain the ambiguity of data.

Publications

ICCV 2019 Seoul, Korea · CVF · IEEE COMPUTER SOCIETY

CVPR

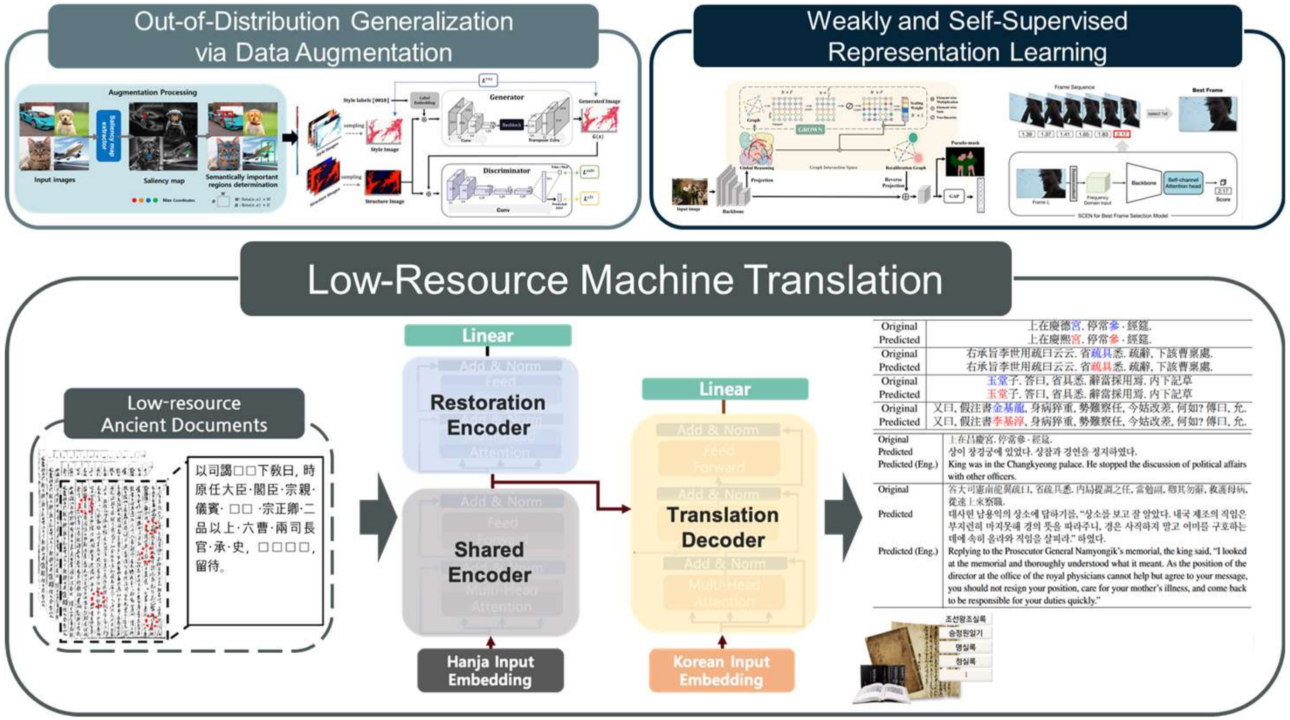
NEURAL INFORMATION PROCESSING SYSTEMS

ICML International Conference On Machine Learning

Research Topic

Intelligent Information Processing Lab.(Prof. YoungBin Kim)

Intelligent Information Processing Lab. IIPL



"Research on accurate restoration and efficient multilingual translation of diverse low-resource documents"

Publications

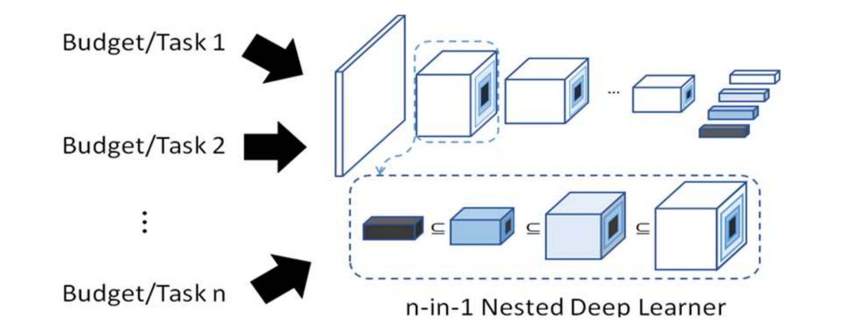
- Weakly supervised semantic segmentation via Graph RecalibratiOn with Scaling Weight uNit; **Engineering Applications of Artificial Intelligence, 2023**
- Game effect sprite generation with minimal data via conditional GAN; **Expert Systems with Applications, 2023**
- Restoring and Mining the Records of the Joseon Dynasty via Neural Language Modeling and Machine Translation; **NAACL, 2021.**
- TrafficBERT: Pre-trained Model with Large-scale Data for Long-range Traffic Flow Forecasting; **Expert Systems with Applications, 2021.**
- Whose Opinion Matters? Analyzing Relationships between Bitcoin Prices and User Groups in Online Community; **Social Science Computer Review, 2020.**
- Visual Analytics with Interpretable and Interactive Recurrent Neural Networks on Electronic Medical Records; **IEEE VIS, 2019.**

Research Topics

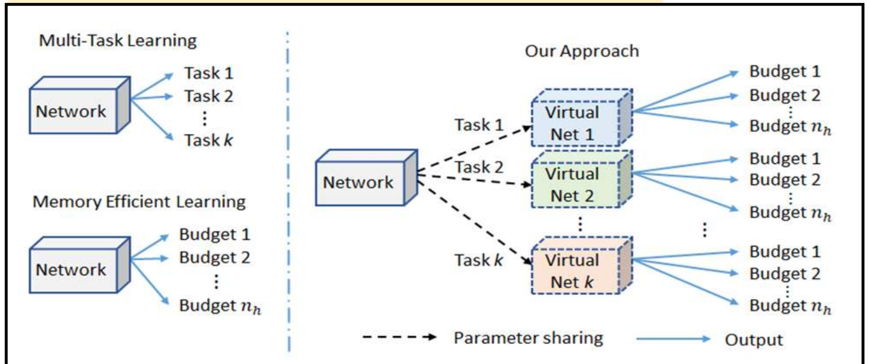
Vision & Learning Laboratory (Prof. Eunwoo Kim)

VLLAB

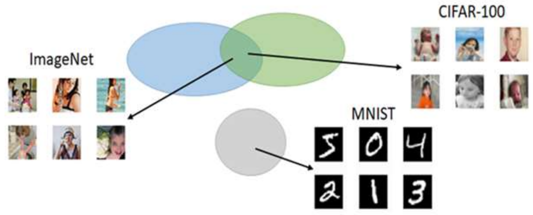
Multi-Task Deep Learning

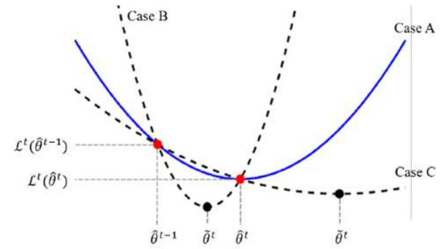


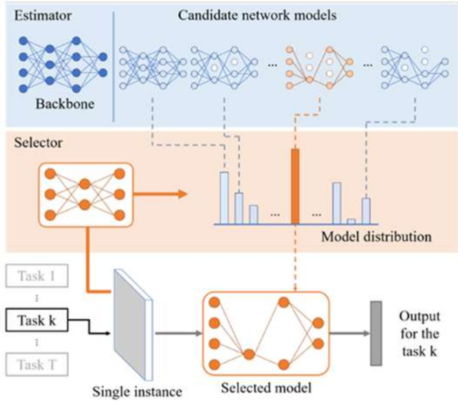
Resource-Efficient Deep Learning



Automated Machine Learning / Continual Learning







Statistical Machine Learning

Applications: Computer Vision, Robotics, Autonomous Vehicles

Lab Members

9 Grad Students, 5 Undergrad Students (2022.09)

Recent Studies

- Helpful or Harmful: Inter-Task Association in Continual Learning, **ECCV, 2022.**
- Deep Elastic Networks with Model Selection for Multi-Task Learning, **ICCV, 2019**
- Deep Virtual Networks for Memory Efficient Inference of Multiple Tasks, **CVPR, 2019.**
- NestedNet: Learning Nested Sparse Structures in Deep Neural Networks, **CVPR, 2018.**

Collaborations

삼성미래기술육성사업 · SAMSUNG SDS · DOOSAN · ETRI 한국전자통신연구원 · NRF 한국연구재단 · BK21 FOUR · IITP 정보통신기획평가원

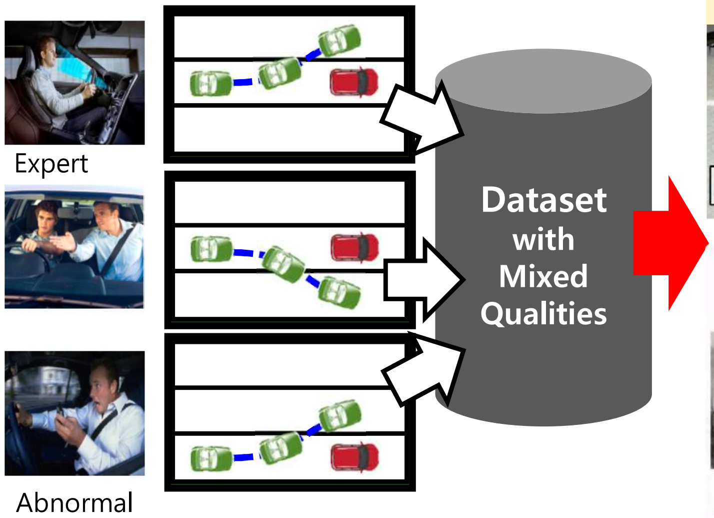
Research Topic

Robotics and Artificial Intelligence Lab

RAI LAB

Human Level Robot Learning

Robust Imitation Learning



Indoor Navigation

Efficient Reinforcement Learning

$$\max_{\pi} \mathbb{E}\left[\sum_{t=0}^{\infty} \gamma^t \Big(\underbrace{r(s_t, a_t)}_{\text{Return}} - \underbrace{\ln_q\big(\pi(a_t|s_t)\big)}_{\text{Tsallis Entropy}}\Big)\right]$$

- Entropy-based Efficient Exploration
- Online Learning for Robotics
- Control of complex dynamical systems

Learning-based Control

Object Manipulation

Publications

- SWAD: Domain Generalization by Seeking Flat Minima, **NeurIPS, 2021.**
- Optimal Algorithms for Stochastic Multi-Armed Bandits with Heavy Tailed Rewards, **NeurIPS, 2020.**
- Maximum Causal Tsallis Entropy Imitation Learning, **NeurIPS, 2018.**

Research Topics

Visual Intelligence Laboratory

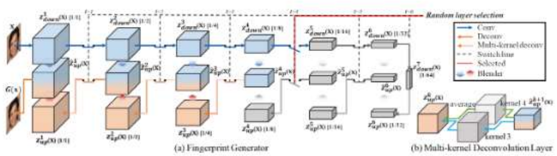
VILab

- **Semi-supervision – Domain Adaptation, Active Learning**
- **AI security – Deepfake detection, Anti-spoofing**
- **AI+X – AI+Contents, AI+Heritage, AI+Autonomous driving**

- **1 Faculty – Jongwon Choi (Ph.D.)**
- **4 Ph.D Candidate – MinGyu Lee, Seo Seung Mo, Seungjin Jung, Hojoon Jung**
- **17 MS Candidate –Jong Min Lee, PyoungGeon Kim, Youn Jong Su, JaeYoon Lee, Soo Hyun Park, Hwang Jin Soo, Minji Kwak, Jongwook Choi, Hyungjun Lim, Dohee Kim, Suk Hyun Kim, Yujeong Oh, Taeheon Lee, Suyeon Cha, Taehoon Kim, Jooyoung Lee, Cho Hyun Jin**

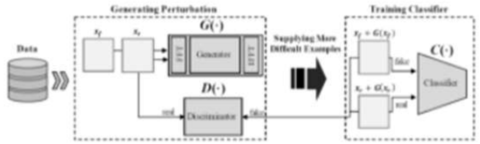
Recent Studies

AAAI2022 & ECCV2022 & WACV2022
Self-supervised Deepfake Detection



FingerprintNet: Synthesized Fingerprints for Generated Image Detection

Yonghyun Jeong, Doyeon Kim, Youngmin Ro, Pyounggeon Kim, Jongwon Choi
European Conference on Computer Vision 2022 (ECCV2022) [Top-tier CV Conference],
[Paper] [Arxiv] [Supplementary] [Github]



FrePGAN: Robust Deepfake Detection Using Frequency-level Perturbations

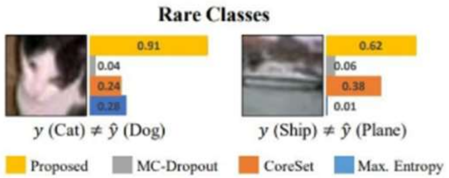
Yonghyun Jeong, Doyeon Kim, Youngmin Ro, Jongwon Choi
AAAI Conference on Artificial Intelligence 2022 (AAAI2022) [Top-tier AI Conference],
[Paper] [Arxiv] [Supplementary] [Github]

WACV2022
Novel-view Synthesis (NeRF)

Novel-View Synthesis of Human Tourist Photos

Jonathan Freer, Kwang Moo Yi, Wei Jiang, Jongwon Choi, Hyung Jin Chang
Winter Conference on Applications of Computer Vision 2022 (WACV2022),
[Paper] [Supplementary] [Github]

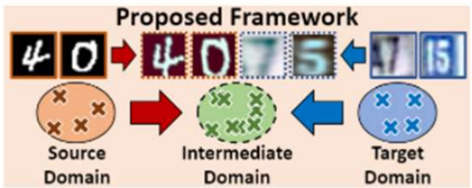
CVPR2021
Active Learning in the Wild



VaB-AL: Incorporating Class Imbalance and Difficulty with Variational Bayes for Active Learning

Jongwon Choi*, Kwang Moo Yi*, Jihoon Kim, Jinho Choo, Byoungjip Kim, Jin-Yeop Chang, Youngjune Gwon, Hyung Jin Chang
(* Equally contributed)
IEEE Conference on Computer Vision and Pattern Recognition 2021 (CVPR2021) [Top-tier CV Conference],
[Paper] [Arxiv] [Supplementary] [Github]

AAAI2020
Domain Adaptation for Large Gap

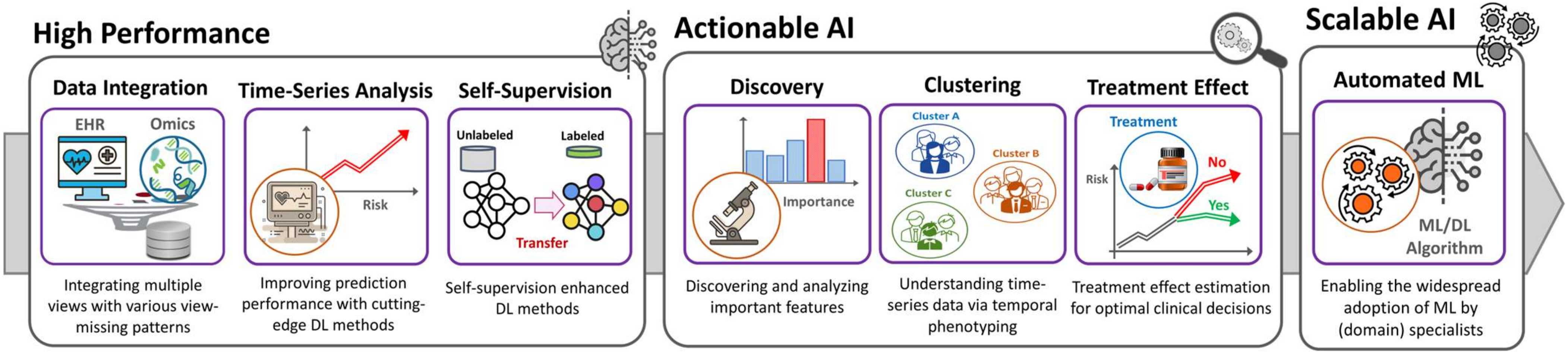


Visual Domain Adaptation by Consensus-based Transfer to Intermediate Domain

Jongwon Choi, Youngjoon Choi, Jihoon Kim, Jinyeop Chang, Ilhwan Kown, Youngjune Gwon, Seungjai Min
AAAI Conference on Artificial Intelligence (AAAI2020) [Top-tier AI Conference],
[Paper] [Supplementary]

Research Pillars

Decision Intelligence Lab



"**Revolutionizing Healthcare** through cutting-edge machine learning methods"

Research Collaborations

Universities

- UCLA
- University of Cambridge

National Institutes

- Cystic Fibrosis Trust
- The Alan Turing Institute
- Public Health England

Selected Papers

- **C Lee,** F. Imrie, M. van der Schaar, "Self-Supervision Enhanced Feature Selection with Correlated Gates," ***ICLR*, 2022.**
- A. Curth, **C. Lee**, M. van der Schara, "SurvITE: Learning Heterogeneous Treatment Effects from Time-to-Event Data," ***NeurIPS*, 2021.**
- **C. Lee**, A. Light, E. Saveliev, M. van der Schaar, V. Gnanapragasam, "Developing Machine Learning Algorithms for Dynamic Estimation of Progression during Active Surveillance for Prostate Cancer," ***npj Digital Medicine*, 2022.**
- **C. Lee**, A. Light, A. Alaa, D. Thurtle, M. van der Schaar, V. Gnanapragasam, "Application of a novel ML framework for predicting non-metastatic PC-specific mortality in men using the SEER database," ***The Lancet Digital Health*, 2021.**

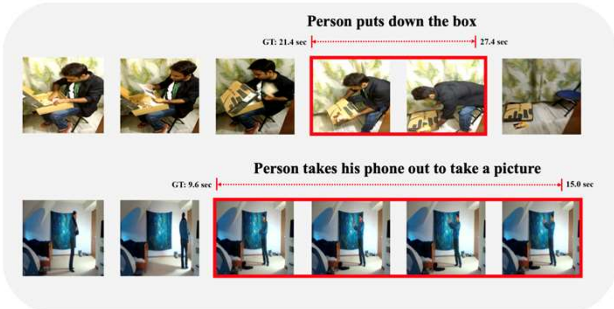
Research Topic

Intelligent Multimodal Reasoning (IMR) Lab.

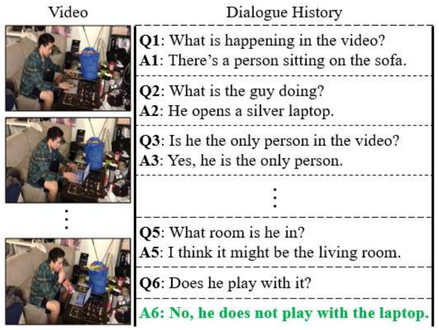
IMR Intelligent Multimodal Reasoning

Multimodal Learning (CV + NLP)

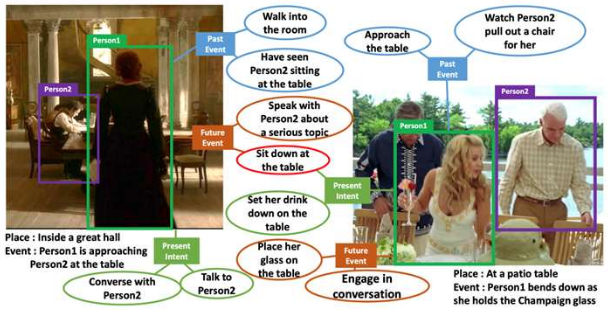
Multimodal Video QA



Video Search & CLS

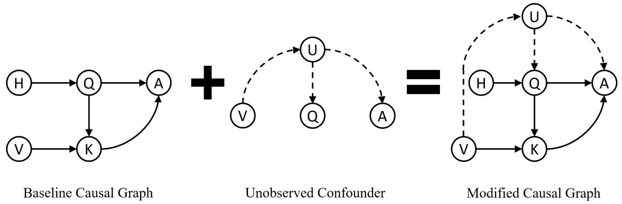


Video Dialogue Generation



Visual Commonsense Generation

Machine Learning



Causality in AI

Fairness in AI

Publications

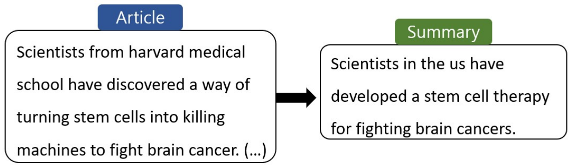
- Information-Theoretic Text Hallucination Reduction for Video-Grounded Dialogue, **EMNLP, 2022**
- Selective Query-guided Debiasing for Video Corpus Moment Retrieval, **ECCV, 2022**
- Structured Co-reference Graph Attention for Video-grounded Dialogue, **AAAI, 2021**
- Modality Shifting Attention Network for Multi-modal Video Question Answering, **CVPR, 2020**
- VLANet: Video-Language Alignment Network for Weakly-supervised Video Moment Retrieval, **ECCV, 2020**
- Progressive Attention Memory Network for Movie Story Question Answering, **CVPR, 2019**

Research Topic

Language Intelligence Laboratory

Document Summarization

Article Summarization



Dialogue Summarization

Dialogue

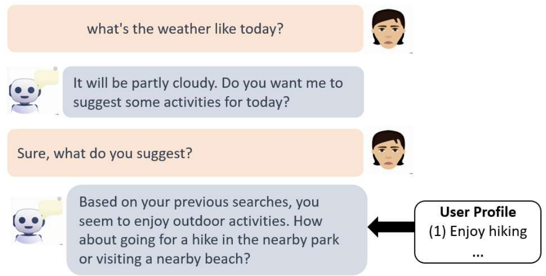
Person1: What makes you think you are able to do the job?
Person2: My major is Automobile Designing and I have received my master's *degree* in science. I think I can do it well.
Person1: What kind of work were you *responsible* for the past employment?
Person2: I am a student engineer who mainly took charge of understanding the *corrosion resistance* of *various* materials.

Summary

Person1 is interviewing Person2 about Person2's ability and previous experience.

Dialog System

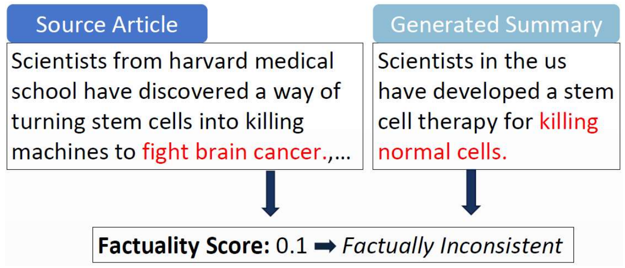
Personalized Dialog



Task-Oriented Dialog

Factuality Checking

Factual Consistency Evaluation

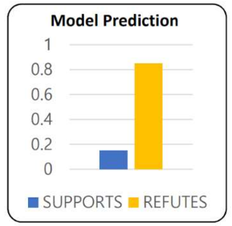


Fact Verification

Claim: Magic Johnson ***did not*** play for the Lakers.

Evidence: Magic Johnson played for the Giants and no other team.

Label: SUPPORTS



"Research on Core Technologies for Knowledge Grounded Text Generation"

Selected Publications

- Masked Summarization to Generate Factually Inconsistent Summaries for Improved Factual Consistency Checking, **NAACL 2022 Findings**
- QACE: Asking Questions to Evaluate an Image Caption, **EMNLP 2021 Findings**
- CrossAug: A Contrastive Data Augmentation Method for Debiasing Fact Verification Models, **CIKM 2021**
- UMIC: An Unreferenced Metric for Image Captioning via Contrastive Learning, **ACL 2021**
- KPQA: A Metric for Generative Question Answering Using Keyphrase Weights, **NAACL 2021**
- Improving Neural Question Generation using Answer Separation, **AAAI 2019**

Research Topic

Explainable Language Understanding Laboratory

Natural Language Inference

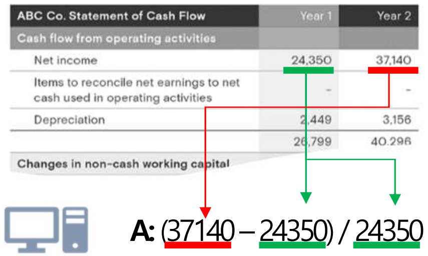
Numerical/Mathematical Inference

Juan drives to work. Because of traffic conditions, he averages 22 miles per hour. He returns home, averaging 32 miles per hour. The total travel time is 2.25 hours.

Q. Write and solve an equation to find the time Juan spends driving to work.

A: 22x = 32y and x+y = 2.25

Inference with **Text** and **Tables**



ABC Co. Statement of Cash Flow	Year 1	Year 2
Cash flow from operating activities		
Net income	24,350	37,140
Items to reconcile net earnings to net cash used in operating activities	-	-
Depreciation	2,449	3,156
	26,799	40,296
Changes in non-cash working capital		

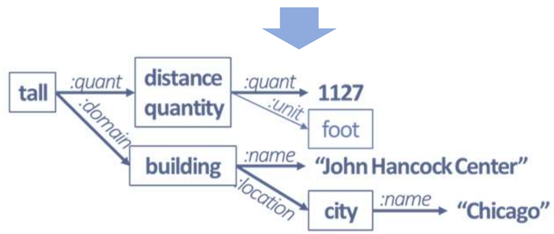
Q. Compute the one-year growth rate of net income, in percentage.

A: (37140 – 24350) / 24350 = 52.52%

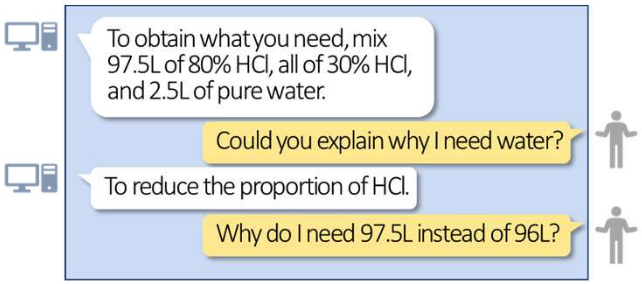
Explainable NLI model

Semantic Parsing

The John Hancock Center in Chicago is 1127 feet tall.

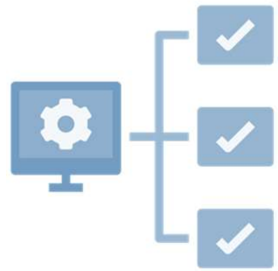


Interactive explanation

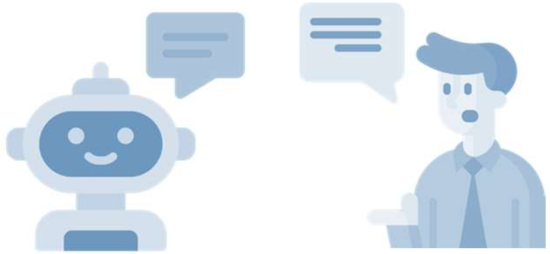


Credible Application of NLI

Credible NLI system



Explainable NLI system



"Towards **an AI system** that **ensures its explainability and credibility** through **language-based interactions.**"

Publications

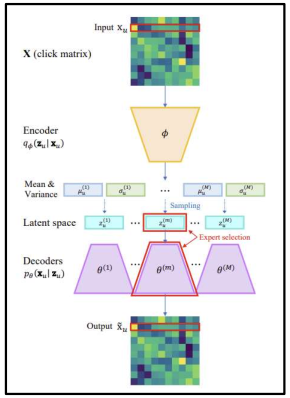
- **B. Kim**, K. Ki, S. Rhim, G. Gweon, "EPT-X: An Expression Pointer Transformer model that generates eXplanations for numbers," ***ACL*, 2022**
- D. Lee, K. Ki, **B. Kim**, G. Gweon, "TM-generation model: a template-based method for automatically solving mathematical word problems," ***J. of Supercomputing 77(12)*, 2021**
- K. Ki, D. Lee, **B. Kim**, G. Gweon, "Generating equation by utilizing operators: GEO model," ***COLING*, 2020**
- **B. Kim**, K. Ki, D. Lee, G. Gweon, "Point to the expression: Solving algebraic word problems using the expression-pointer transformer model," ***EMNLP*, 2020**

Research Topic

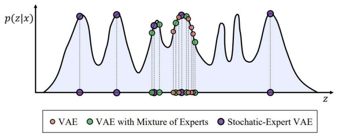
Data Science Lab

Recommender System

Stochastic-Expert VAE for CF

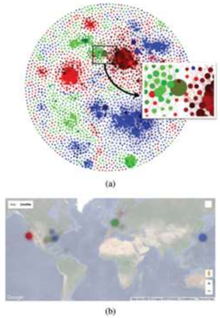


Learning User Behavior Pattern using Stochastic embedding,
SOTA results on Netflix, MovieLens datasets



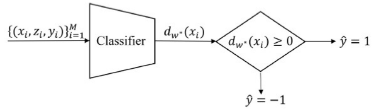
Multimodal Generative model

Apache Spark based multimodal social network implementation
Using Map-Reduce framework for distributed computation

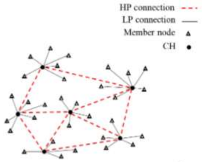


Fair - AI

Removing data bias through AI



ML Prediction under fairness constraints
: Distributed Fair AI



Toward Graph-based XAI using Multimodal Social network

International Collaborations

UNIVERSITY of WASHINGTON

HYUNDAI GLOVIS

Selected Publications

- MEME: Multi-Encoder Multi-Expert Framework with Data Augmentation for Video Retrieval, **SIGIR, 2023.**
- Stochastic Expert Variational Autoencoder for Collaborative Filtering, **WWW, 2022.**
- Detecting incongruent news headlines with auxiliary textual information**, Expert Syst Appl, 2022**
- Point of interest recommendations based on the anchoring effect in location-based social network services, **Expert Syst Appl, 2021.**
- Latent Space Model for Multi-Modal Social Data, **WWW, 2016.**

THE WEB CONFERENCE ACM

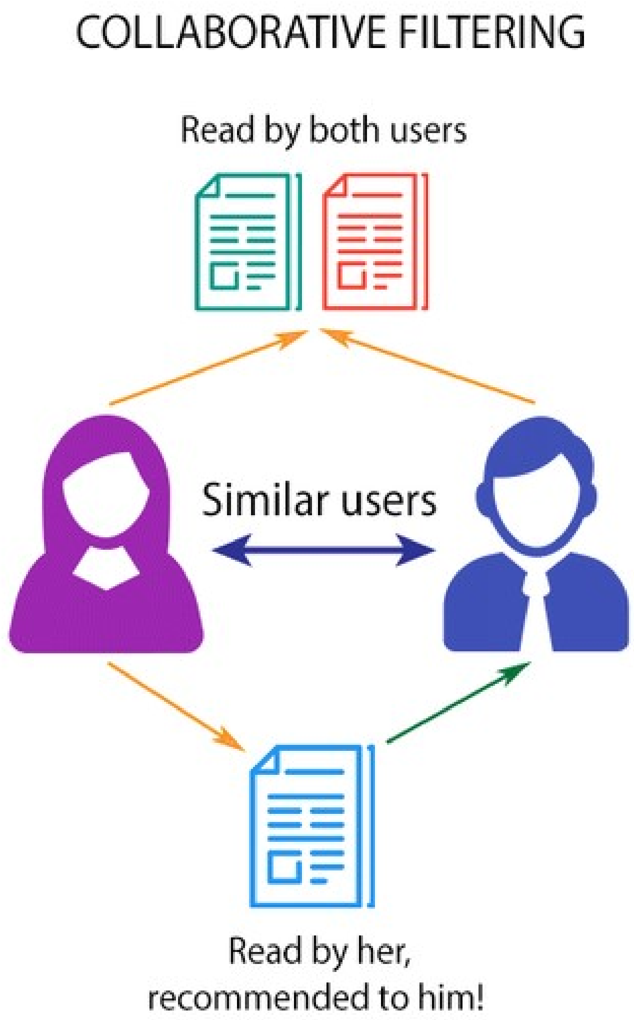
Lyon, France, 25-29 April 2022

Stochastic-Expert Variational Autoencoder for Collaborative Filtering

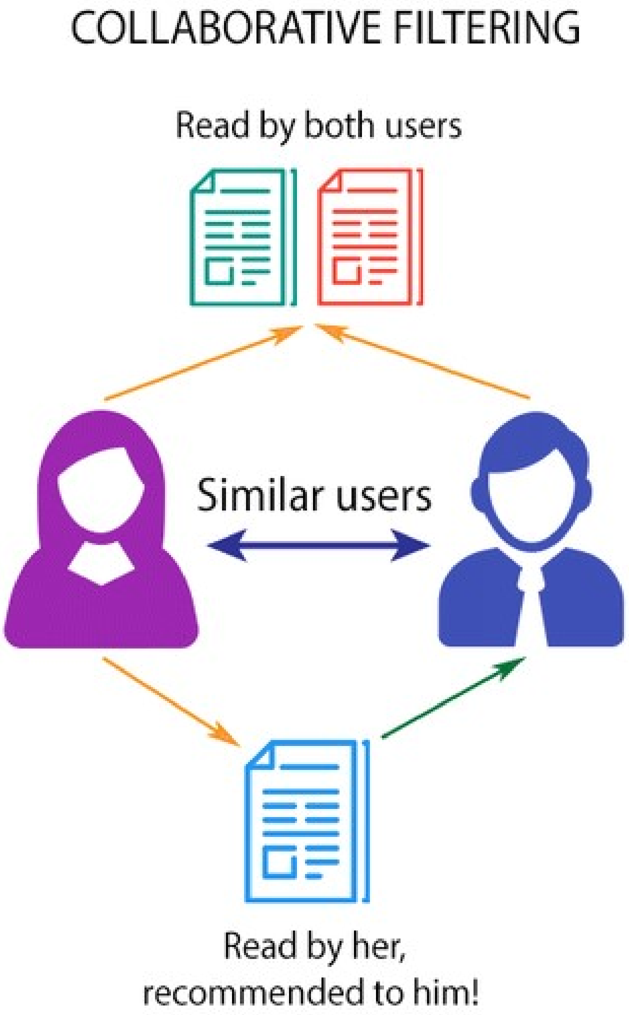
INTERNATIONAL WWW CONFERENCE COMMITTEE

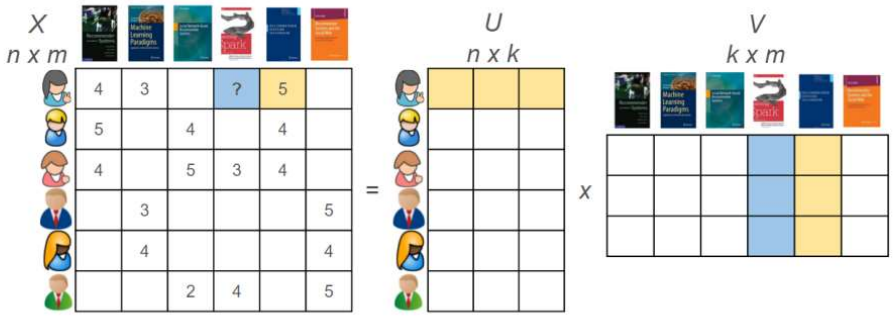
acm sig web

Collaborative Filtering



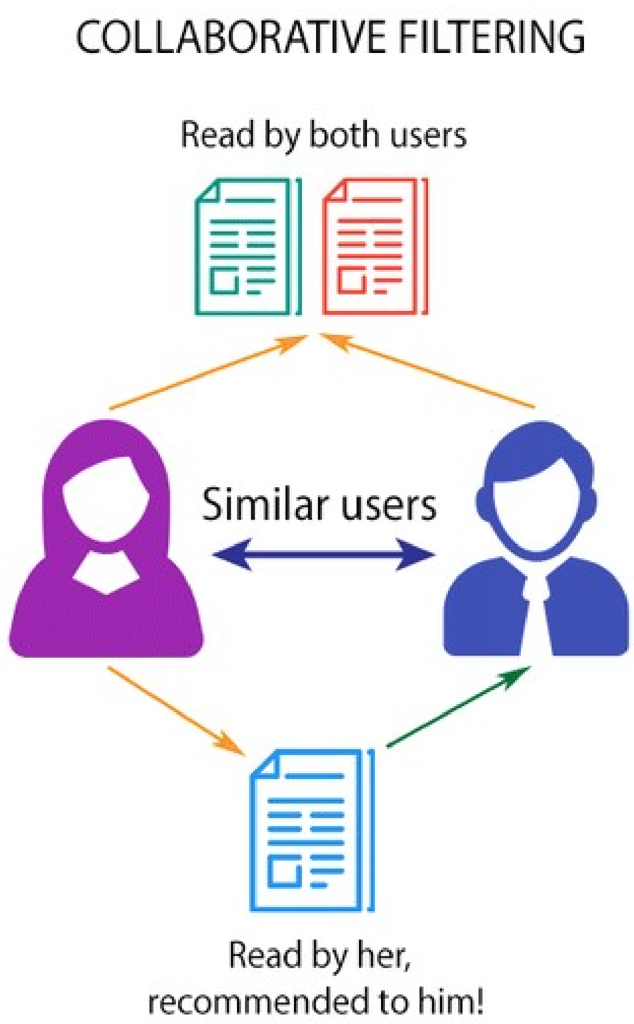
Collaborative Filtering

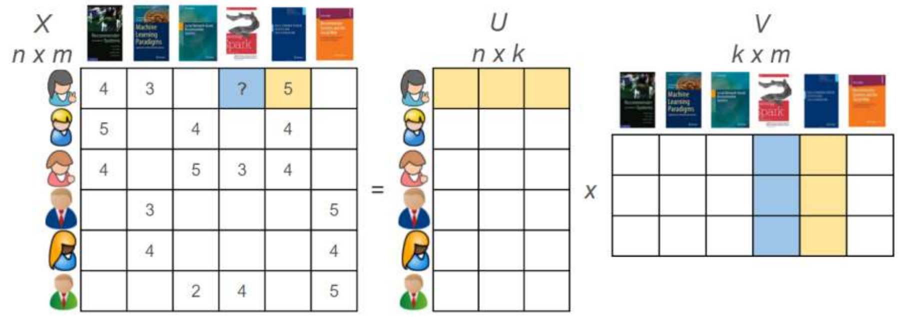




Matrix Factorization

Neural Collaborative Filtering



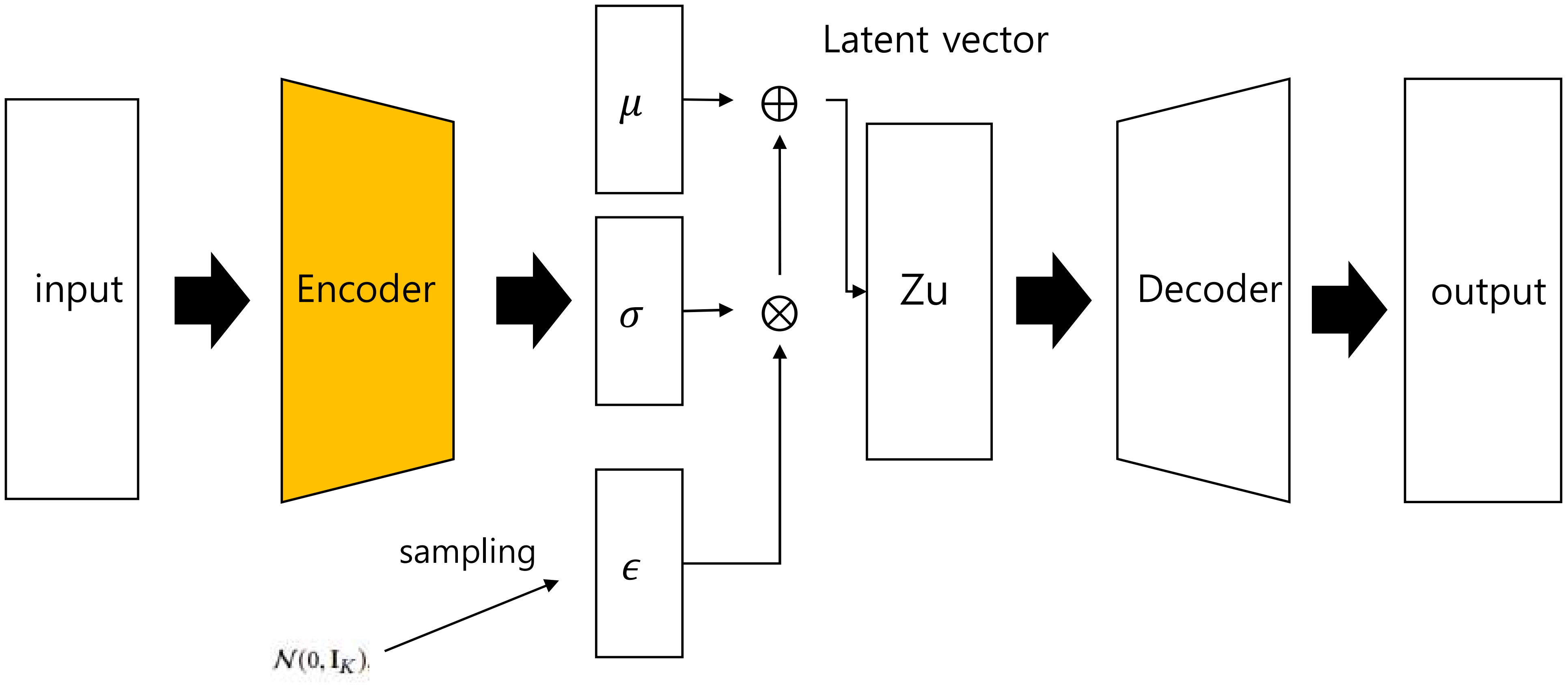


Matrix Factorization

Dawen Liang, Rahul G. Krishnan, Matthew D. Hoffman, and Tony Jebara. **Variational Autoencoders for Collaborative Filtering**. In Proceedings of the 2018 World Wide Web Conference (Lyon, France) (**WWW '18**)

Preliminary

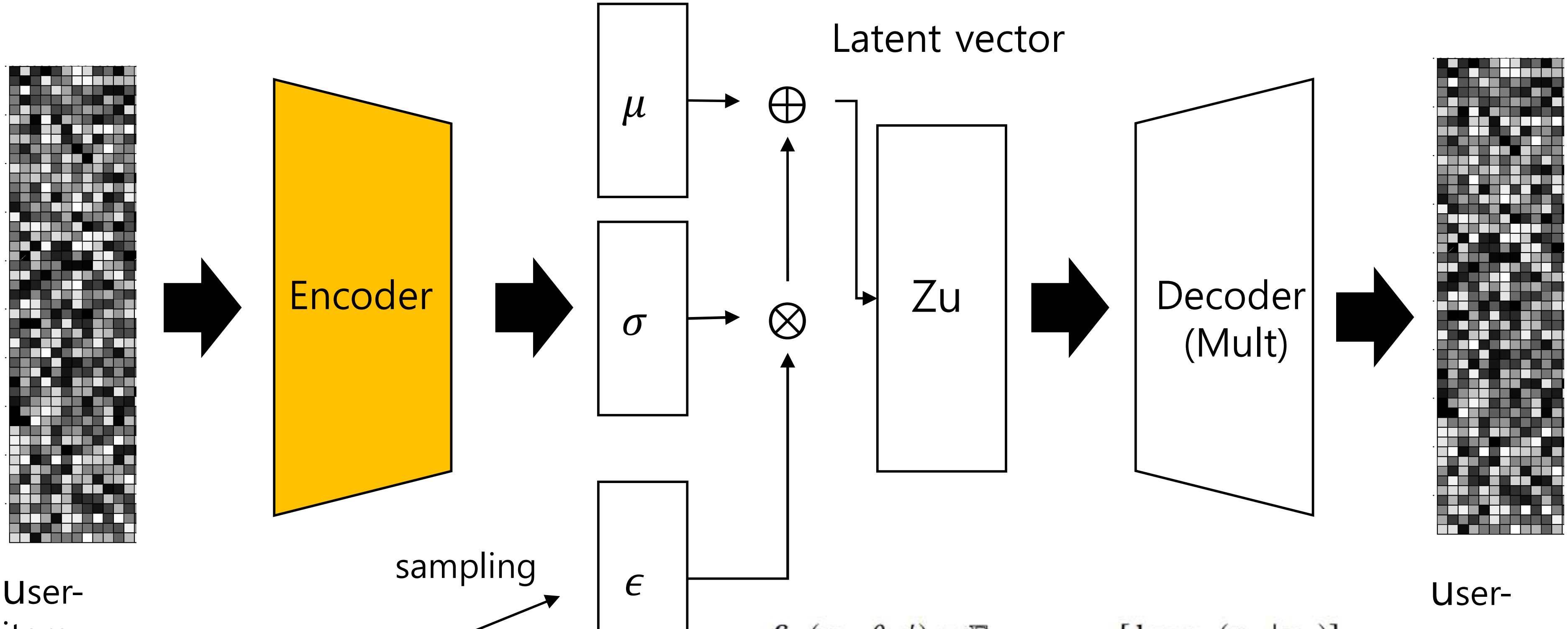
- Variational Autoencoder



Preliminary

- Variational Autoencoder for CF

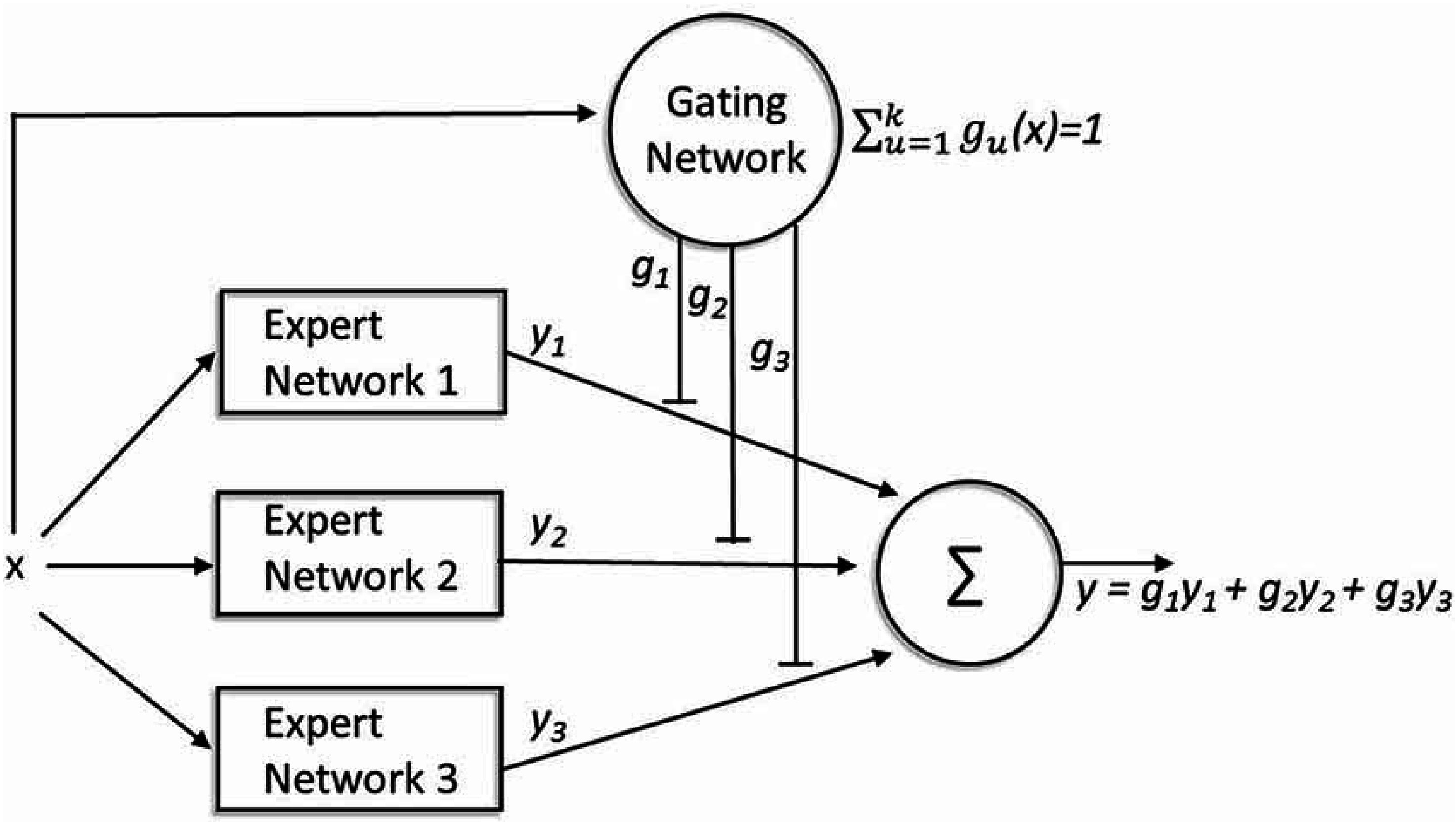
Dawen Liang, Rahul G. Krishnan, Matthew D. Hoffman, and Tony Jebara.
Variational Autoencoders for Collaborative Filtering.
In Proceedings of the 2018 World Wide Web Conference (Lyon, France) (**WWW ’18**)



$$\mathcal{L}_\beta(\mathbf{x}_u; \theta, \phi) \equiv \mathbb{E}_{q_\phi(\mathbf{z}_u \mid \mathbf{x}_u)}[\log p_\theta(\mathbf{x}_u \mid \mathbf{z}_u)] - \beta \cdot \mathrm{KL}(q_\phi(\mathbf{z}_u \mid \mathbf{x}_u) \| p(\mathbf{z}_u))$$

Preliminary

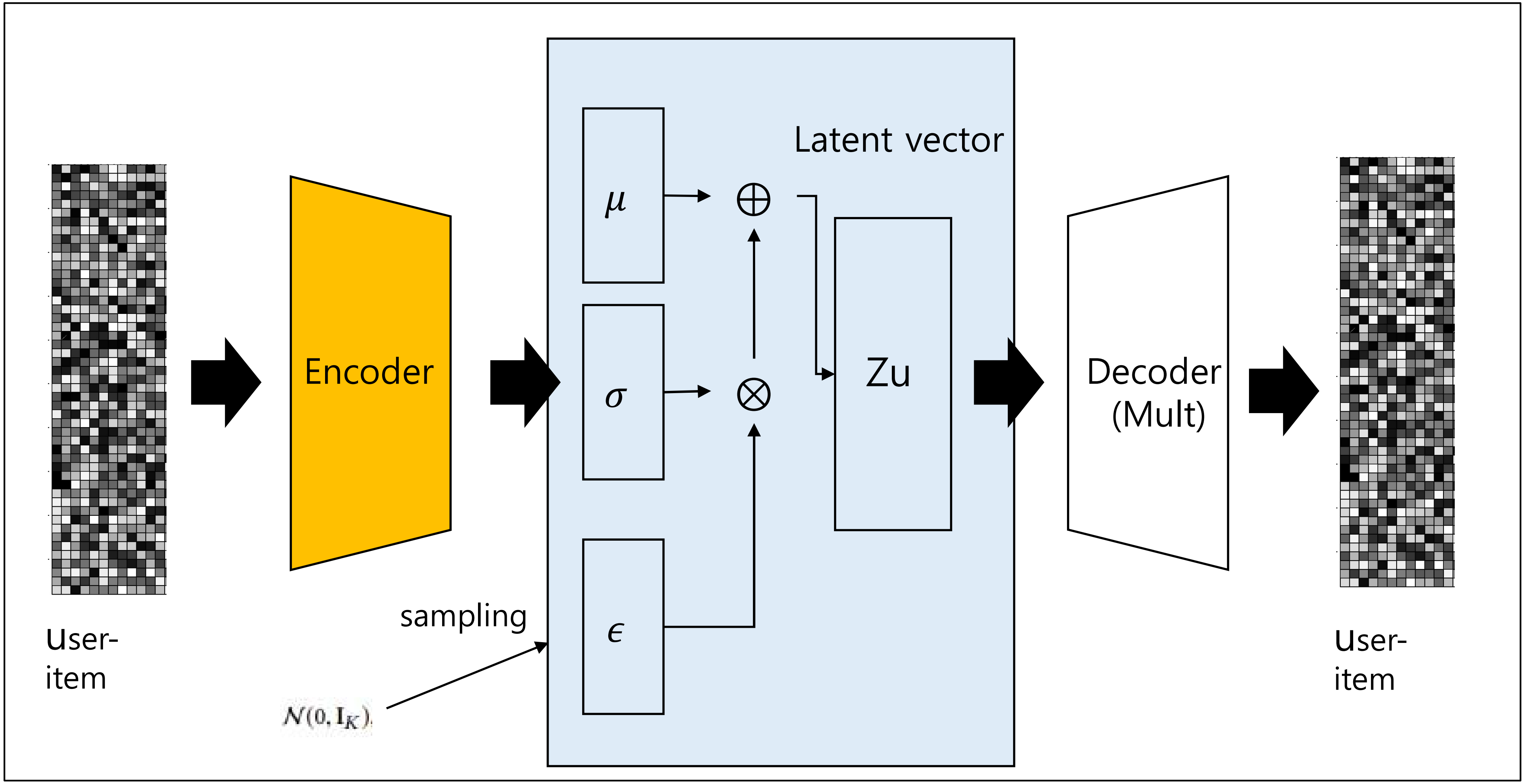
- Mixture-of-Experts (MoE)



Bock, Andrew & Fine, Ione. (2014). Anatomical and Functional Plasticity in Early Blind Individuals and the Mixture of Experts Architecture. Frontiers in human neuroscience. 8. 971. 10.3389/fnhum.2014.00971.

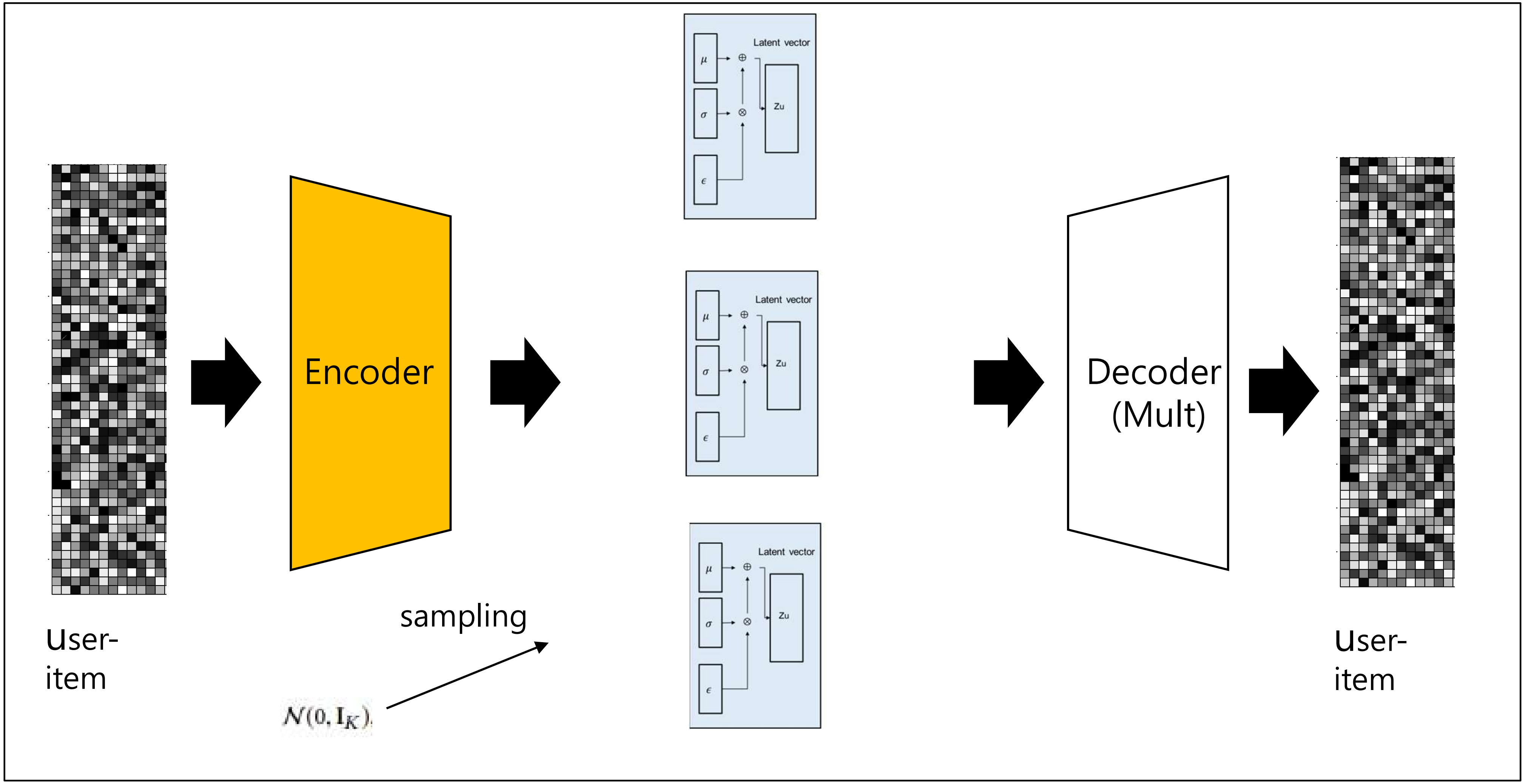
SE-VAE motivation

- Based on VAECF



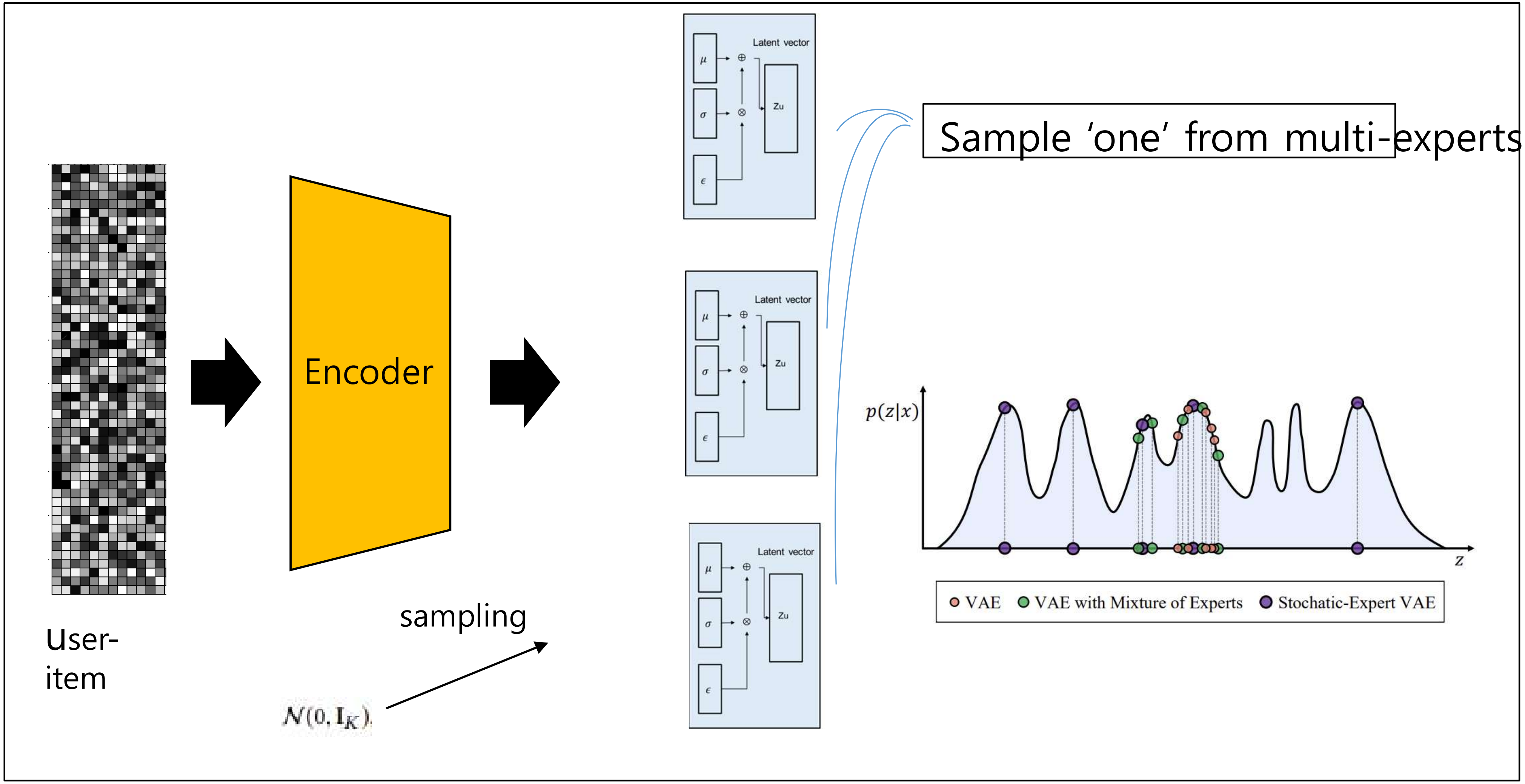
SE-VAE motivation

- Extend VAECF to Multi-Experts

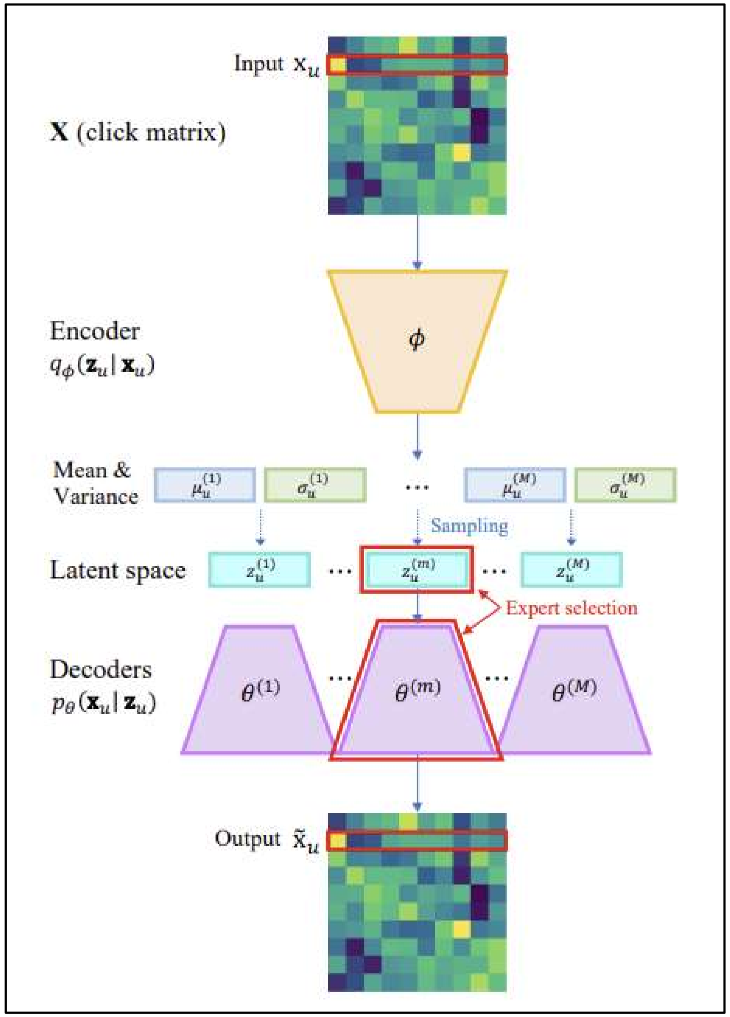


SE-VAE motivation

- Extend VAECF to Multi-Experts



SE-VAE Generative Process



Require: $\mathbf{X} \in \mathbb{N}^{U \times I}$
Ensure: $\phi, \theta = \{\theta^{(1)}, \dots, \theta^{(M)}\}$
  Initialize θ, ϕ
  while not converged **do**
    Obtain batch of users
    for user u in a batch **do**
      Sample $\mathbf{z}_u$ and $\mathbf{w}_u$ using the RT
      Compute gradient of $\boxed{\mathcal{L}}$ w.r.t. θ, ϕ with $\mathbf{z}_u$ and $\mathbf{w}_u$
    end for
    Take average of gradients from the batch
    Update θ and ϕ with SGD
  end while

probability of expert (m) being selected for user u

$$\mathcal{L}(\mathbf{x}_u; \theta, \phi) = \sum_{m=1}^{M} \mathbb{E}_{q_\phi(\mathbf{z}_u|\mathbf{x}_u)}[q_{\text{cat}}(\mathbf{e}_{u,m} = 1) \log p_{\theta_m}(\mathbf{x}_u | \mathbf{z}_u^{(m)})]$$
$$- \mathrm{KL}(q_\phi(\mathbf{z}_u \mid \mathbf{x}_u) || p(\mathbf{z}_u)) - \mathrm{KL}(q_\phi(\mathbf{w}_u \mid \mathbf{x}_u) || p(\mathbf{w}_u)).$$

fully factorized Gaussian distribution which is used in Gumbel-Softmax as input logits

Experimental Results

- Experimental Setup

Datasets

- MovieLens 20M
  136,677 users
  20,108 items
  On average, a user has clicked **73** items
- Netflix
  435,435 users
  17,769 items
  On average, a user has clicked **122** items

Evaluation Metrics

- Recall@R
  proportion of relevant (clicked) items predicted in the top R items
- NDCG@R
  emphasizes the importance of higher ranking than lower ones

Experimental Results

Mul-VAE vs Mult-VAE with SE

- Apply Stochastic Expert on VAECF (Mult-VAE)

Model	MovieLens20M			Netflix		
	NDCG@100	Recall@50	Recall@20	NDCG@100	Recall@50	Recall@20
Mult-VAE	0.42700	0.53524	0.39569	0.38711	0.44427	0.35255
Mult-VAE (**SE**)	**0.43057**	**0.53688**	**0.40010**	**0.38789**	**0.44512**	**0.35332**

Follow the same settings, hyper parameters in VAECF

Experimental Results

Model	MovieLens20M			Netflix		
	NDCG@100	Recall@50	Recall@20	NDCG@100	Recall@50	Recall@20
WMF [7]	0.386	0.498	0.360	0.351	0.404	0.316
SLIM [17]	0.401	0.495	0.370	0.379	0.428	0.347
CDAE [24]	0.418	0.523	0.391	0.376	0.428	0.343
Mult-VAE [14]	0.426	0.537	0.395	0.386	0.444	0.351
VAEGAN (AVB+D+C) [25]	0.438	0.541	0.407	0.396	0.447	0.363
EASE [21]	0.420	0.521	0.319	0.393	0.445	0.362
RaCT [15]	0.434	0.543	0.403	0.392	0.450	0.357
RecVAE [20]	0.442	0.553	0.414	0.394	0.452	0.361
H+Vamp (Gated) [9]	0.445	0.551	0.413	0.408	0.462	0.376

Model	MovieLens20M			Netflix		
	NDCG@100	Recall@50	Recall@20	NDCG@100	Recall@50	Recall@20
Mult-VAE	0.42700	0.53524	0.39569	0.38711	0.44427	0.35255
Mult-VAE (**SE**)	**0.43057**	**0.53688**	**0.40010**	**0.38789**	**0.44512**	**0.35332**
H+Vamp (Gated)	0.44522	0.55109	0.41308	0.40861	0.46252	0.37678
H+Vamp (Gated,**SE**)	**0.44718**	**0.55551**	**0.41787**	**0.40907**	**0.46312**	**0.37713**

Experimental Results

Model	MovieLens20M			Netflix		
	NDCG@100	Recall@50	Recall@20	NDCG@100	Recall@50	Recall@20
WMF [7]	0.386	0.498	0.360	0.351	0.404	0.316
SLIM [17]	0.401	0.495	0.370	0.379	0.428	0.347
CDAE [24]	0.418	0.523	0.391	0.376	0.428	0.343
Mult-VAE [14]	0.426	0.537	0.395	0.386	0.444	0.351
VAEGAN (AVB+D+C) [25]	0.438	0.541	0.407	0.396	0.447	0.363
EASE [21]	0.420	0.521	0.319	0.393	0.445	0.362
RaCT [15]	0.434	0.543	0.403	0.392	0.450	0.357
RecVAE [20]	0.442	0.553	0.414	0.394	0.452	0.361
H+Vamp (Gated) [9]	0.445	0.551	0.413	0.408	0.462	0.376
SE-VAE (H+Vamp, Gated)	**0.447**	**0.556**	**0.418**	**0.409**	**0.463**	**0.377**

All the benchmark models use the same training set/ val set/ test set

MEME : Multi-Encoder Multi-Expert Framework with Data Augmentation for Video Retrieval

Seong-Min Kang
kang7734@cau.ac.kr

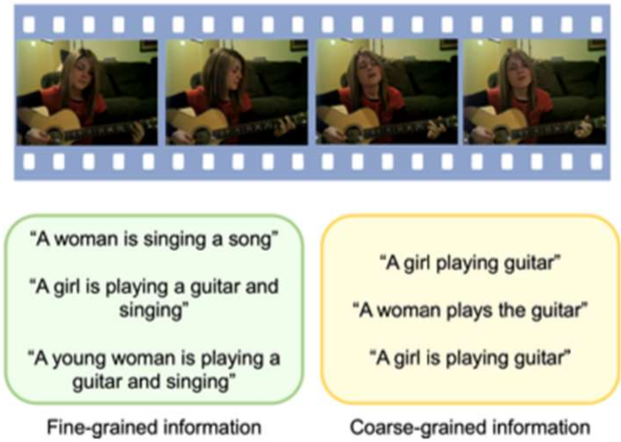
Yoon-Sik Cho
yoonsik@cau.ac.kr

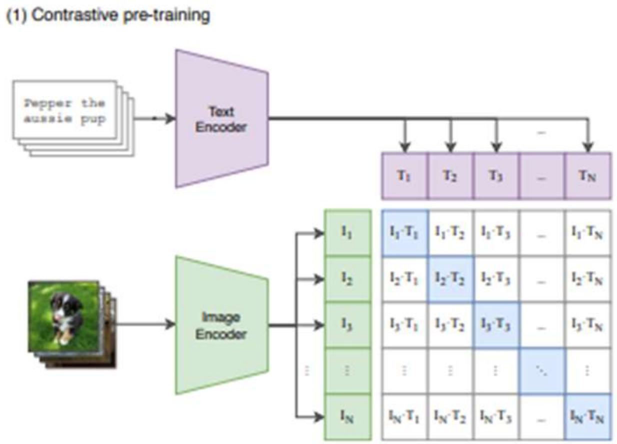
https://github.com/kang7734/MEME_
_

CAU
중앙대학교

#01

Motivation



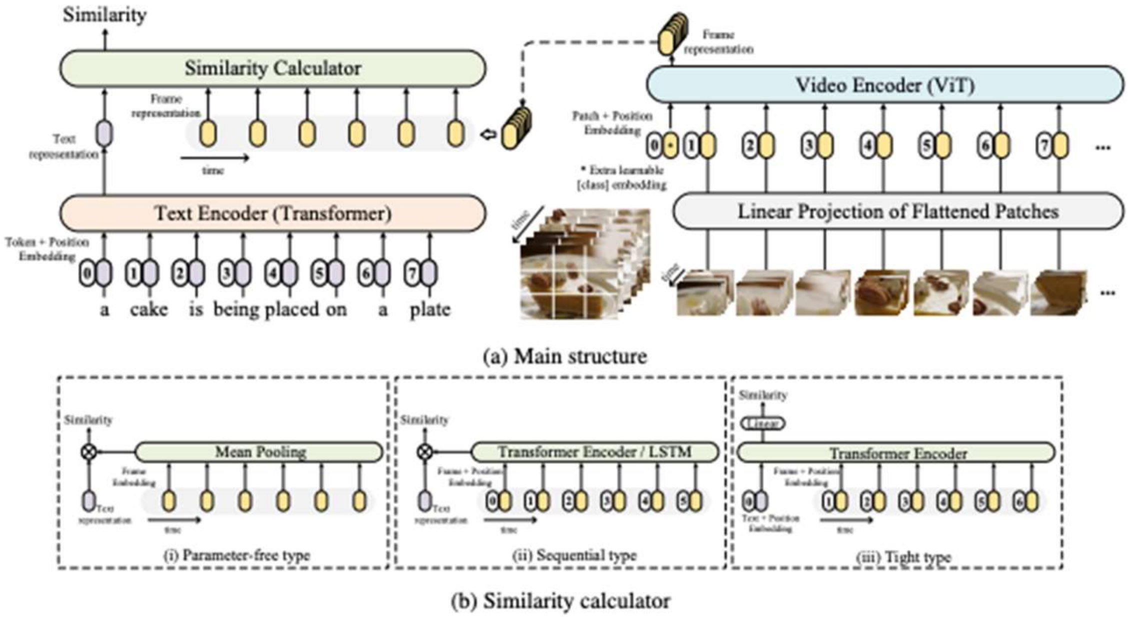


CLIP[1]

[1] Alec Radford, Jong Wook Kim, Chris Hallacy, Aditya Ramesh, Gabriel Goh, Sandhini Agarwal, Girish Sastry, Amanda Askell, Pamela Mishkin, Jack Clark, et al. Learning transferable visual models from natural language supervision. In International Conference on Machine Learning, pages 8748–8763. PMLR, 2021.

#01

Motivation

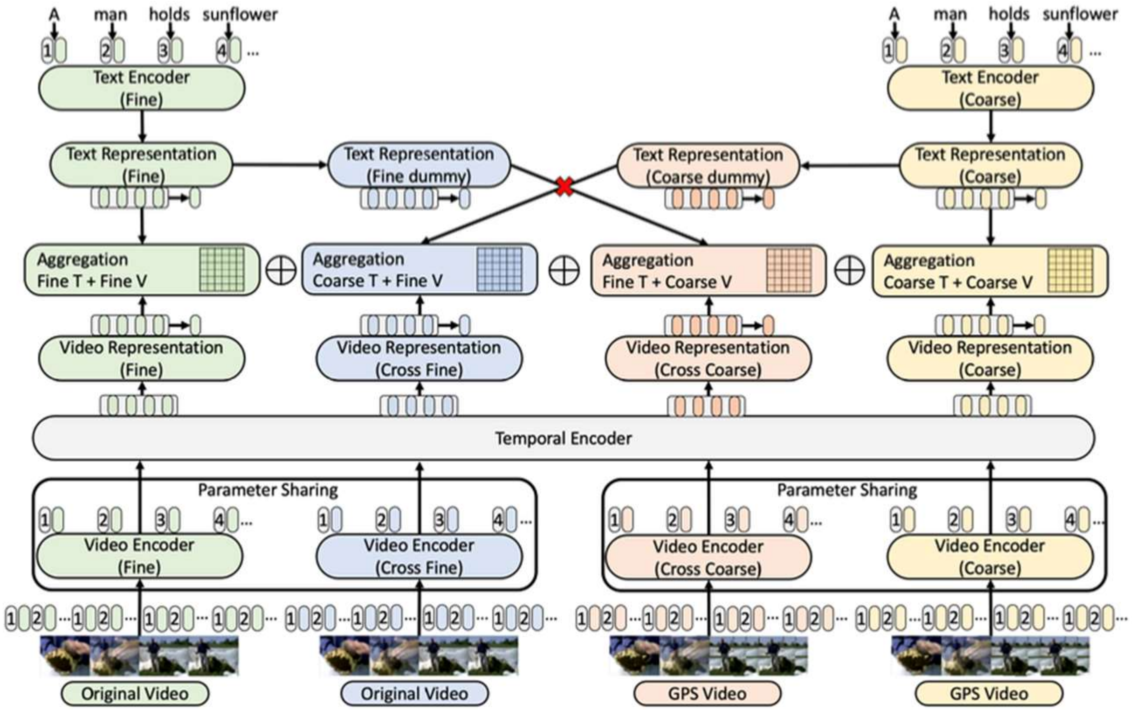


CLIP4Clip

#02

Method

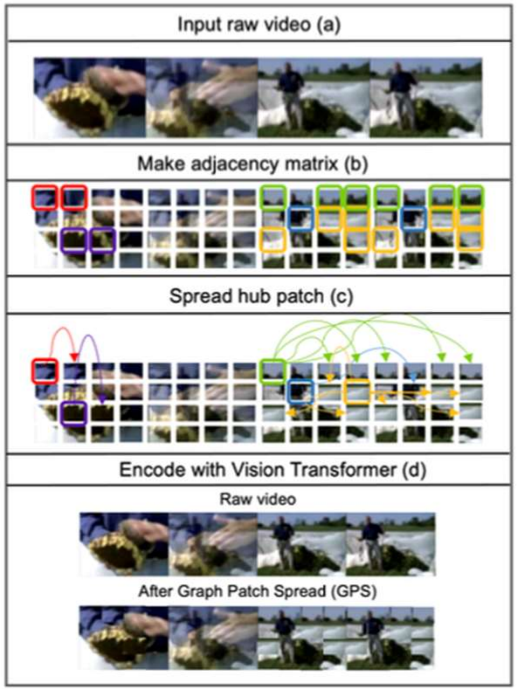
Multi-Encoder Multi-Expert



#02

Method

GPS(Graph Patch Spreading) Algorithm



Algorithm 1 GPS: Graph Patch Spread

Require: Video $V = (v_1, v_2, ..., v_n)$ ▹ n is the number of frames
Frame $v_i = (x_p^1, x_p^2, ..., x_p^N)$ ▹ N is the number of patches
Ensure: output = []

```
v_i = v_i / v_i.norm()
S = V · V^T                                ▹ S is similarity matrix of each token
S[S ≥ k] = 1                               ▹ k is similarity threshold
S[S < k] = 0                               ▹ Now S is Adjacency matrix
for S_j in S do
    while sum(S_j) = len(S_j) do
        C = nonzero count(S_j)
        h = argmax(C, dim = 0)             ▹ h is the index of hub patch
        L = arange(len(S_j[h])) + 1
        L = S_j[h] * L                     ▹ L is linked patches idx with hub patch
        S_j^T[h, L] = 1                    ▹ Spread hub patch
    end while
    v_i = v_i · S_j^T
    output.append(v_i)
end for
V = stack(output)
```

#03

Experiments

Methods	Text-to-Video Retrieval				Video-to-Text Retrieval			
	R@1↑	R@5↑	R@10↑	MeanR↓	R@1↑	R@5↑	R@10↑	MeanR↓
TT-CE+ [8]	29.6	61.6	74.2	-	32.1	62.7	75.0	-
Frozen [9]	31.0	59.5	70.5	-	-	-	-	-
CLIP [1]	31.2	53.7	64.2	-	27.2	51.7	62.6	-
*CLIP4Clip [2](MeanP)	43.9	70.9	81.1	15.9	42.6	70.9	81.1	12.0
CLIP2Video [11]	45.6	72.6	81.7	14.6	43.5	72.3	82.1	10.2
CAMoE [16]	44.6	71.6	82.1	15.1	45.1	72.4	83.1	10.0
QB-Norm [39]	47.2	73.0	83.0	-	-	-	-	-
CenterCLIP [17]	44.2	71.6	82.1	15.1	42.8	71.7	82.2	10.9
CLIP2TV [13]	46.1	72.5	82.9	15.2	43.9	73.0	82.8	11.1
*CLIP4Clip(seqTransf) [2]	43.1	**72.7**	81.5	15.7	**43.4**	70.0	80.3	11.8
*CLIP4Clip(seqTransf+MEME)	**45.0(+1.9)**	72.3(-0.4)	**82.2(+0.7)**	**13.7(-2.0)**	42.5(-0.9)	**71.0(+1.0)**	**81.4(+1.1)**	**10.3(-1.5)**
*ts2net [18]	46.4	**74.7**	82.8	14.0	45.6	**73.1**	83.4	9.6
*ts2net(+MEME)	**46.6(+0.2)**	73.1(-1.6)	**82.9(+0.1)**	**12.6(-1.4)**	**45.8(+0.2)**	71.8(-1.3)	**83.7(+0.3)**	**8.4(-1.2)**
*ts2net(DSL) [18]	50.5	76.5	**85.9**	12.1	45.6	**73.1**	83.4	9.6
*ts2net(DSL+MEME)	**51.6(+1.1)**	**76.6(+0.1)**	85.7(-0.2)	**11.8(-0.3)**	**45.8(+0.2)**	71.8(-1.3)	**83.7(+0.3)**	**8.4(-1.2)**
*X-CLIP [5]	46.8	**73.8**	**83.1**	13.1	47.3	73.6	81.8	9.6
*X-CLIP(+MEME)	**49.0(+2.2)**	73.5(-0.3)	82.0(-1.1)	**13.0(-0.1)**	**47.7(+0.4)**	**74.0(+0.4)**	**83.3(+1.5)**	**9.4(-0.2)**

Table 1: Results on MSR-VTT [40], * denotes that the results are reproduced by our experimentation with the original code.

Methods	Text-to-Video Retrieval				Video-to-Text Retrieval			
	R@1↑	R@5↑	R@10↑	MeanR↓	R@1↑	R@5↑	R@10↑	MeanR↓
TT-CE+ [8]	17.2	36.5	46.3	-	17.5	36.0	45.0	-
Frozen [9]	15.0	30.8	39.8	-	-	-	-	-
CLIP [1]	15.1	28.3	35.8	132	7.5	18.4	25.1	151
*CLIP4Clip [2](MeanP)	20.6	39.8	47.7	60.6	20.0	38.4	48.4	55.4
CAMoE [16]	22.5	42.6	50.9	56.5	-	-	-	-
QB-Norm [39]	17.8	37.7	47.6	-	-	-	-	-
CenterCLIP [17]	21.9	41.1	50.7	57.2	21.1	41.2	50.2	48.7
*CLIP4Clip(seqTransf) [2]	23.0	40.9	48.4	58.8	20.4	39.6	**49.3**	54.2
*CLIP4Clip(seqTransf+MEME)	**23.4(+0.4)**	**42.0(+1.1)**	**49.3(+0.9)**	**57.3(-1.5)**	**21.1(+0.7)**	**40.4(+0.8)**	49.2(-0.1)	**53.1(-1.1)**
*ts2net [18]	20.4	40.1	**47.5**	68.3	20.5	37.3	46.4	**62.4**
*ts2net(+MEME)	**21.4(+1.0)**	**40.3(+0.2)**	46.6(-0.9)	**67.5(-0.8)**	**20.8(+0.3)**	37.3(±0.0)	**46.6(+0.2)**	63.7(+1.3)
*ts2net(DSL) [18]	21.9	40.1	48.7	**64.5**	20.5	37.3	46.4	**62.4**
*ts2net(DSL+MEME)	**22.2(+0.3)**	**41.1(+1.0)**	**48.9(+0.2)**	65.3(+0.8)	**21.1(+0.6)**	37.3(±0.0)	**46.8(+0.4)**	65.2(+2.8)
*X-CLIP [5]	23.2	41.0	51.1	55.8	22.4	40.4	48.7	51.7
*X-CLIP(+MEME)	**24.0(+0.8)**	**41.7(+0.7)**	**51.4(+0.3)**	**53.5(-2.3)**	**22.5(+0.1)**	**42.3(+1.9)**	**50.3(+1.6)**	**49.3(-2.4)**

Table 3: Results on LSMDC [42], * denotes that the results are reproduced by our experimentation with the original code.

#03

Experiments

Methods	Text-to-Video Retrieval				Video-to-Text Retrieval			
	R@1↑	R@5↑	R@10↑	MeanR↓	R@1↑	R@5↑	R@10↑	MeanR↓
TT-CE+ [8]	23.5	56.9	71.3	-	27.1	55.3	67.0	-
Frozen [9]	33.7	64.7	76.3	-	-	-	-	-
CLIP [1]	37.0	64.1	73.8	-	59.9	85.2	90.7	-
*CLIP4Clip [2](MeanP)	46.1	76.0	84.6	10.0	56.1	78.9	83.9	8.0
CLIP2Video [11]	47.0	76.8	85.9	9.6	58.7	85.6	91.6	4.3
CAMoE [16]	46.9	76.1	85.5	9.8	-	-	-	-
QB-Norm [39]	47.6	77.6	86.1	-	-	-	-	-
CenterCLIP [17]	47.6	77.5	86.0	9.8	54.2	78.4	84.9	7.6
CLIP2TV [13]	46.1	72.5	82.9	15.2	43.9	73.0	82.8	11.1
*CLIP4Clip(seqTransf) [2]	45.7	**75.6**	84.0	10.6	49.9	70.8	76.8	15.2
*CLIP4Clip(seqTransf+MEME)	**45.8(+0.1)**	75.4(-0.2)	**84.2(+0.2)**	**10.3(-0.3)**	**59.1(+9.2)**	**81.7(+10.9)**	**87.8(+11.0)**	**6.8(-8.4)**
*ts2net [18]	45.1	75.5	84.5	10.2	56.4	79.1	85.2	9.4
*ts2net(+MEME)	**45.4(+0.3)**	**75.9(+0.4)**	**84.7(+0.2)**	10.2(±0.0)	**58.1(+1.7)**	**84.6(+5.5)**	**89.0(+3.8)**	**6.0(-3.4)**
*ts2net(DSL) [18]	47.6	**78.0**	**86.0**	10.1	56.4	79.1	85.2	9.4
*ts2net(DSL+MEME)	**47.7(+0.1)**	77.9(-0.1)	85.9(-0.1)	10.1(±0.0)	**57.0(+0.6)**	**79.5(+0.4)**	**85.3(+0.1)**	**8.9(+0.5)**
*X-CLIP [5]	46.4	76.4	84.6	**9.8**	53.9	79.0	85.3	7.1
*X-CLIP(+MEME)	**46.6(+0.2)**	**76.5(+0.1)**	**85.0(+0.4)**	10.0(+0.2)	**63.8(+9.9)**	**87.8(+8.8)**	**92.5(+7.2)**	**4.2(-2.9)**

Table 2: Results on MSVD [41], * denotes that the results are reproduced by our experimentation with the original code.

Thank you

yoonsik@cau.ac.kr