KENTECH
Korea Institute of Energy Technology

Advanced Computer Vision
Week 01

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Seokju Lee

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Course Overview

General Information

- **Professor:**

Prof. Seokju Lee
slee@kentech.ac.kr

- **Classroom:** KENTECH Core Bldg. (1-dong, 핵심개교동) 2nd floor, Room 201 (컴퓨터 실습실)
- **Time:** Tue./Fri., 13:30 ~ 14:45
- **Office hour:** upon appointment (zoom or face-to-face)
- **Office location:** The Class building 5th floor

Course Syllabus

Basics of computer vision, **Learning-based method**, **Presentation**

Week #01	Course Overview & Camera Theory	**Week #09**	Representation Learning	
Week #02	Image Processing with Python	**Week #10**	Generative Adversarial Network	
Week #03	Image Feature Extraction	**Week #11**	Optical Flow & Stereo Matching	
Week #04	Camera Geometry	**Week #12**	Structure-from-Motion	
Week #05	Deep Neural Networks	**Week #13**	Neural Radiance Field	
Week #06	Image Classification with Attention	**Week #14**	Paper reviews (1)	Preliminary slots
Week #07	Object Detection	**Week #15**	Paper reviews (2)	
Week #08	Semantic Segmentation	**Week #16**	Individual Project Presentation	

*Every coursework is covered with **lecture** + **in-class project**.

Grading: Projects & Paper Reviews

Attendance	In-class projects	Paper reviews	Individual projects	Total
10 %	30 %	30 %	30 %	100 %

- **At least 10 in-class projects (with mild grading).** → To improve your application ability!
  - Toy projects related to the coursework.
- **For each student, 3 paper reviews (with grading, 10/10/10).** → To build your basic research mind!
  - List of the papers will be announced.
  - Each 20 mins, English presentation
- **For each student, 2 presentations for an individual project (with peer review + grading, 10/20).**
  - Mid-term presentation (dataset analysis, baseline review) → To derive your research potential!
  - Final presentation (proposed method, discussion)
- No mid-term & final exams

**Schedule may be updated as progress*

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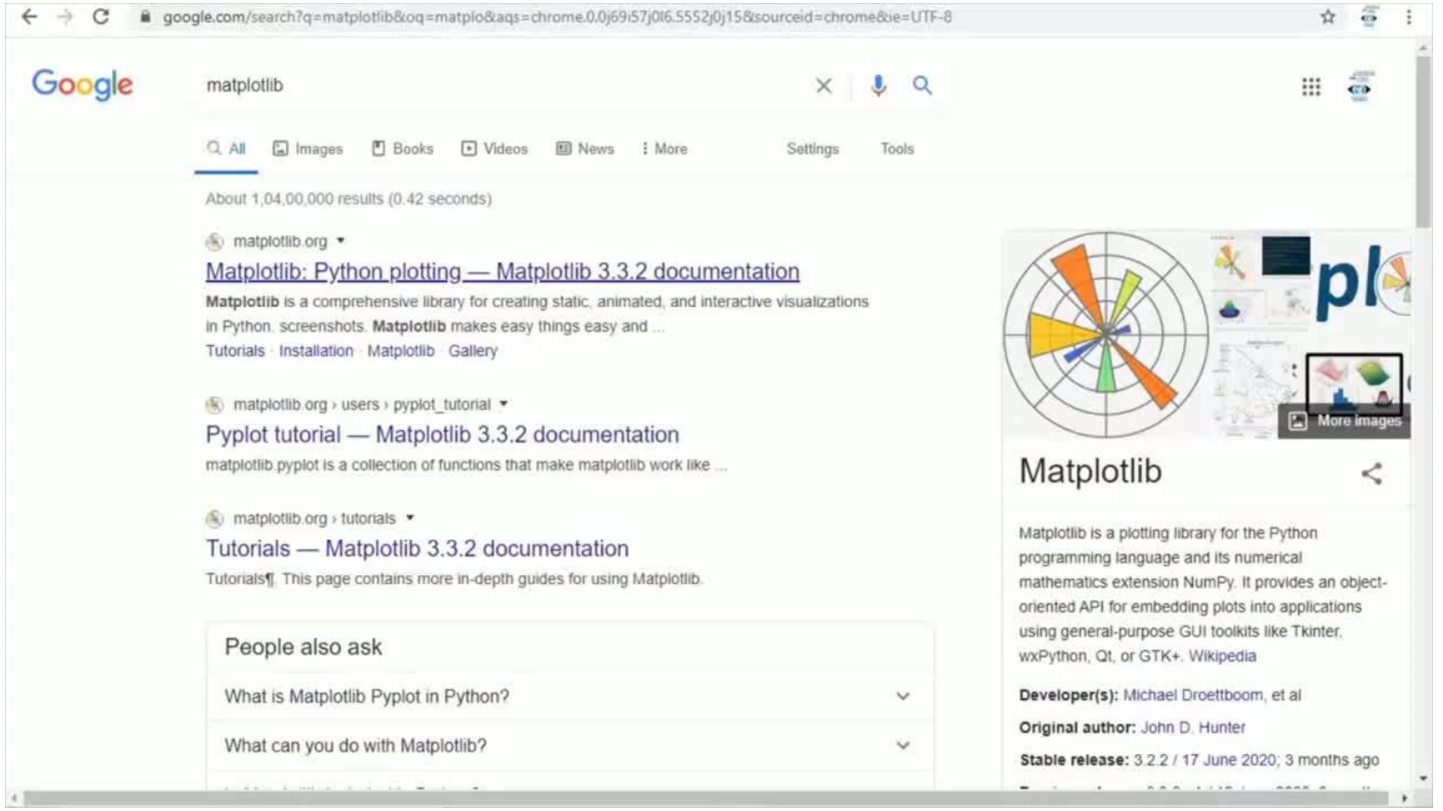
Examples of In-Class Projects

Examples of In-Class Projects (#1)

Getting used to image processing using Python

→ Basic **debugging** with image **visualization**



Reading and displaying image in Matplotlib. | Image in Matplotlib

Examples of In-Class Projects (#2)

Getting used to image processing using Python

→ Implementation of **surround-view** system using basic image transformation

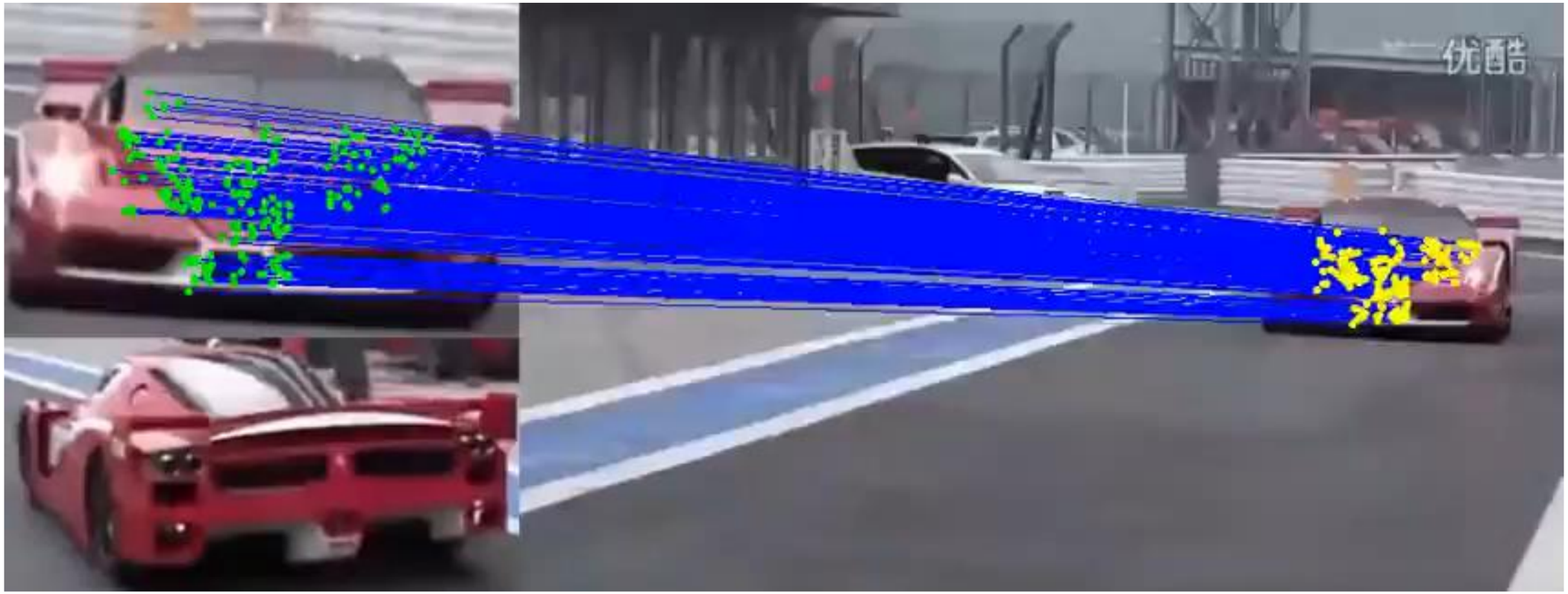
Mercedes S-Class 360 Camera 3D View

Sensor fusion

Examples of In-Class Projects (#3)

Understanding **traditional** computer vision algorithm

→ Finding feature correspondence (with Python library)

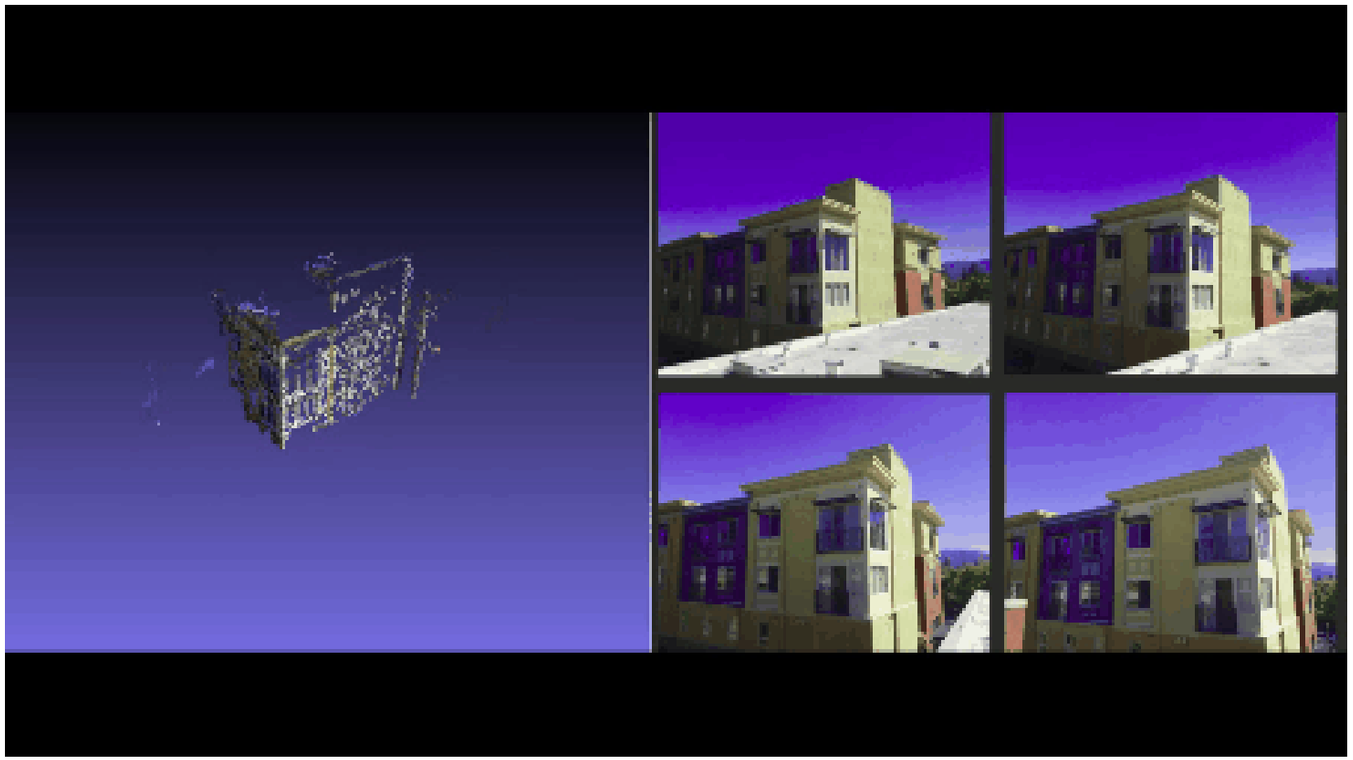


[CVPR 2017] Grid-based Motion Statistics for Fast, Ultra-robust Feature Correspondence

Examples of In-Class Projects (#4)

Understanding **traditional** computer vision algorithm

→ 3D reconstruction (with open source package)



3D reconstruction from four images captured in different poses

The Structure from Motion Pipeline

Examples of In-Class Projects (#5)

Understanding internal mechanism of **deep neural networks**

→ Activation/attention while classifying images (with open source package)

Class activation map for different class

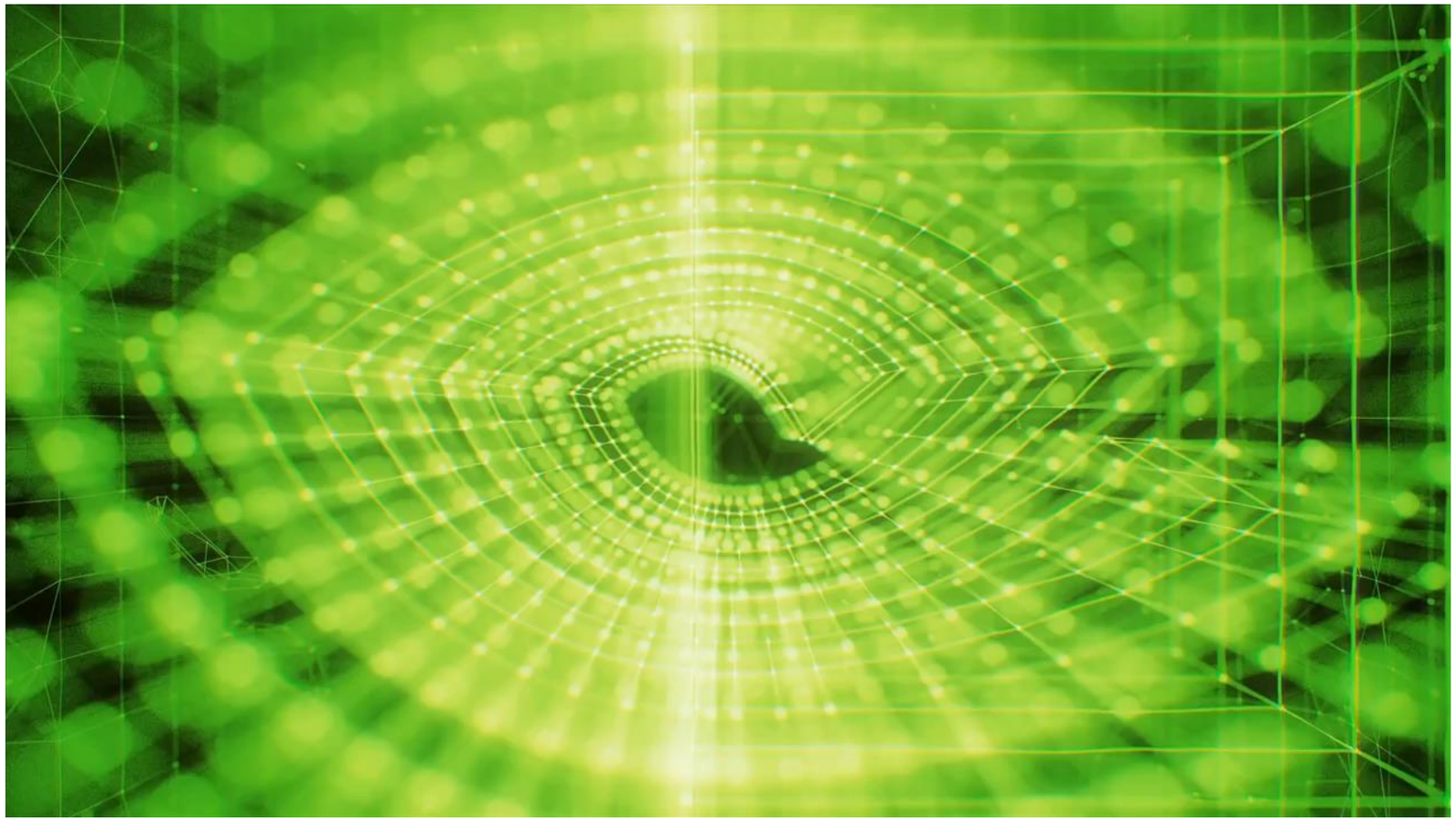
Examples of In-Class Projects (#6)

Diverse **applications** of **deep learning:** running open source packages

Semantic segmentation

Examples of In-Class Projects (#7)

Diverse **applications** of **deep learning:** running open source packages



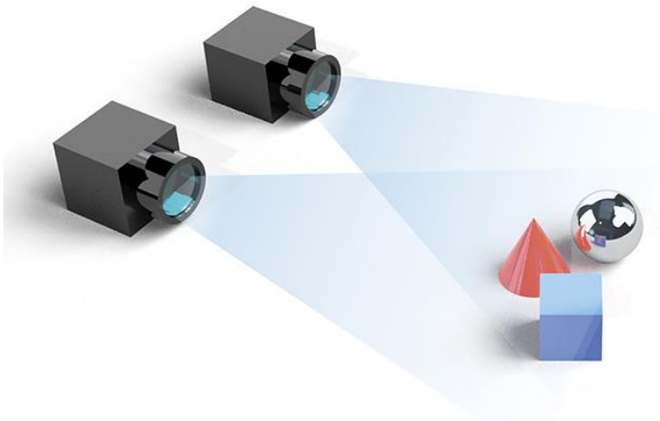
[CVPR 2019] A Style-Based Generator Architecture for Generative Adversarial Networks

Digital human, “ROZY”

Examples of In-Class Projects (#8)

Diverse **applications** of **deep learning:** running open source packages

Stereo matching (IROS'21)



Videre stereo camera

Examples of In-Class Projects (#9)

Diverse **applications** of **deep learning:** running open source packages

One Shot 3D Photography (SIGGRAPH 2020): 2D image → 3D effect

Various AR/VR applications

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Individual Project

About Individual Project

For each student, there will be two presentations for the individual project

1. Mid-term presentation (task definition + dataset analysis + baseline review)
2. Final presentation (your proposed method + discussion)

Practice for proposal & defense progress of your Ph.D. thesis!

1) What is your task?

2) Motivation & Objective?

3) Previous Methods?

4) Proposed method?

5) Contributions?

6) Limitations?

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Definition of Computer Vision

Human Visual Systems (HVS)

아기성장보고서, EBS

✓ **Visual Capabilities:**

- "*What*": object recognition
- "*Where*": localization

✓ **Reasoning & Learning:**

- Reasoning based on *uncertain* information
- Learning *functional* and *contextual* information

Next Contents

- More about **human** visual system
- "**What-path**" and "**Where-path**" in human brain
- **Definition** of computer vision
- **Challenges** in computer vision
- Breakthroughs with **AI**