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**CS688:**  
**Web-Scale Image Search**

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**Sung-Eui Yoon**  
(윤성의)

**Course URL:**  
**<http://sgvr.kaist.ac.kr/~sungeui/IR>**

**KAIST**



# About the Instructor

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- **Joined KAIST at 2007**
- **Notable recognitions**
  - **Organized tutorial on image search at CVPR**
  - **Worked with Adobe, Naver, Hancom, etc.**
  - **Produced a professor on image search (SKKU)**
  - **Received next-generation scientist award (IT category) at 2019 from S-Oil and Korea Academy of Science**
- **Related materials**
  - **Paper and video:**  
<http://sgvr.kaist.ac.kr/publication>
  - **YouTube videos:**  
<http://www.youtube.com/user/sglabkaist>

# Research Theme: Scalable Ray Tracing, Image Search, Motion Planning

- Designing *scalable techniques* to efficiently handle massive models on commodity hardware or clouds



Photo-realistic rendering

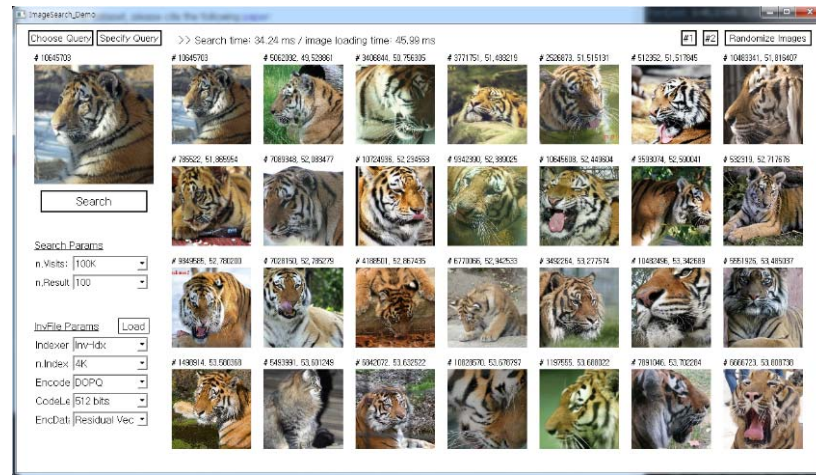


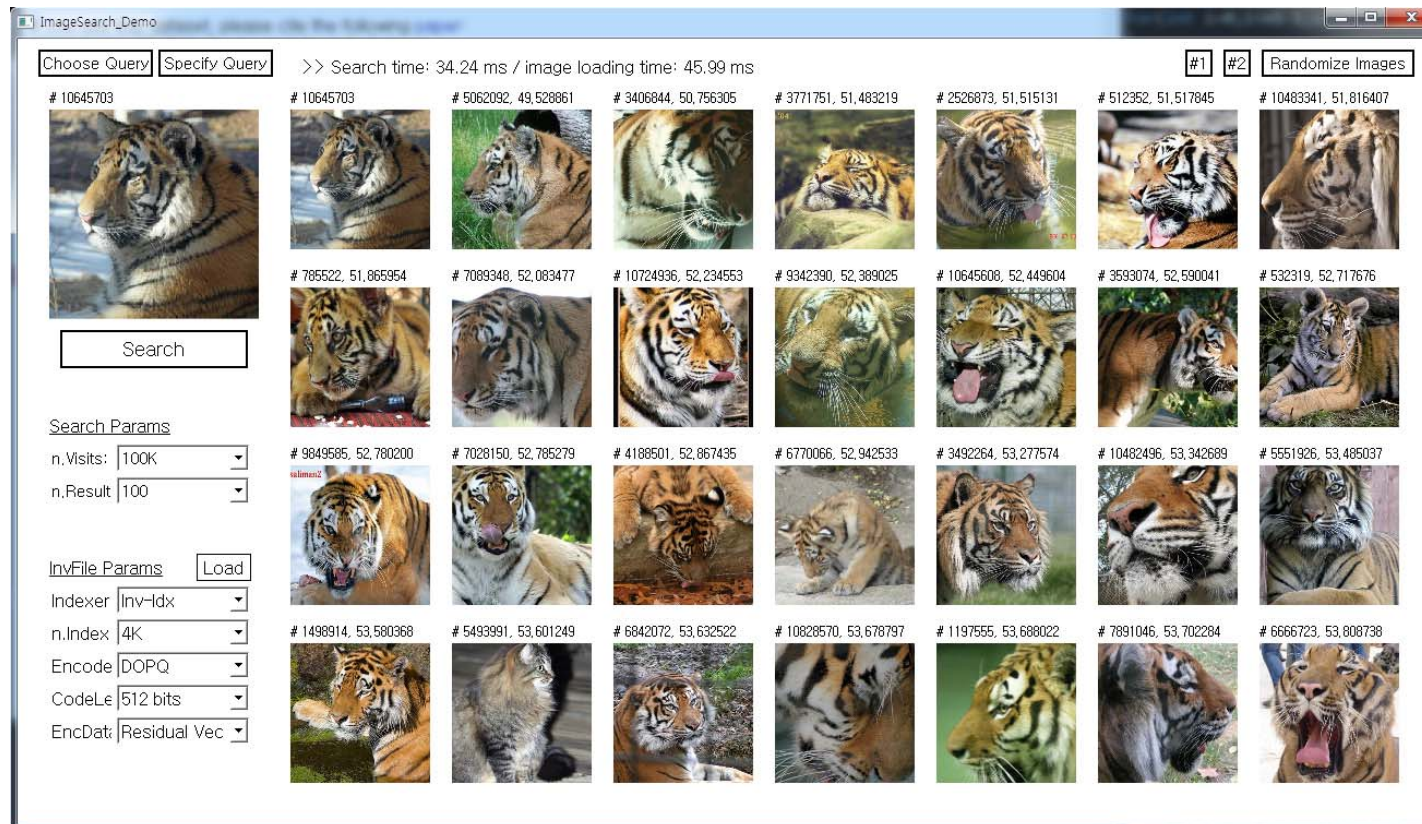
Image search



Motion planning

# Results of Image Search

- Collaborated with Adobe, NAVER, Hancorn
  - 11M images
  - Use deep neural nets for image representations
  - Spend only 35 ms for a single CPU thread



# About the Instructor

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- **Contact info**

- **Email: [sungeui@kaist.edu](mailto:sungeui@kaist.edu)**
- **Office: 3432 at CS building (E3-1)**
- **Homepage: <http://sgvr.kaist.ac.kr/~sungeui>**

# Class Information

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- **Class time**
  - **4:00pm ~ 5:15pm on TTh**
- **Office hours**
  - **Right after the class time**
  - **You can make arrangements by sending emails**

# TA

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- **Junsik Jung (정준식)**
  - Room: E3-1 #3443
  - [tounk92@gmail.com](mailto:tounk92@gmail.com)
- **Use KLMS first** for questions and discussions, instead of sending emails



# About the Course

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- **We will focus on the following things:**
  - **Broad understanding on image (and video) search techniques and classification**
  - **In-depth knowledge on recent methods for web-scale data**
  - **Design better technologies as your final project**
- **Main theme:**
  - **Think about how we can connect any techniques (e.g., classification) to search and matching problems**



# Image Search or Content-Based Image Retrieval (CBIR)

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- **Identify similar images given a user-specified image or other types of inputs**

# Image Search

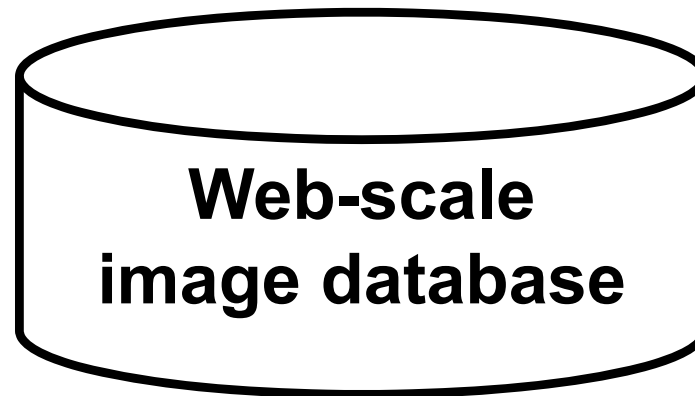
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- **Identify similar images given a user-specified image or other types of inputs**

Extract image descriptors (e.g., SIFT or CNNs)



**Input**



**Output**



apple



SafeSearch moderate

About 177,000,000 results (0.46 seconds)

Advanced search

- Everything
- Images
- Videos
- News
- Shopping
- More

Related searches: [apple iphone 5](#) [apple logo](#) [apple wallpaper](#) [red apple](#) [apple background](#) [apple mac](#)



Sort by relevance

Sort by subject

Any size

- Large
- Medium
- Icon
- Larger than...
- Exactly...

Any color

- Full color
- Black and white





sungeui.jpg x describe image here



About 4 results (0.29 seconds)

Advanced search

- Everything
- Images
- Videos
- News
- Shopping
- More



Image size: 200 x 272

Find other sizes of this image: All sizes - Small

Pages that include matching images



Sungeui Yoon (성익, 윤성익) Q

sglab.kaist.ac.kr/~sungeui/ - Cached

Sung-Eui Yoon (윤 성익) Assistant professor. Scalable Graphics/Geometric Algorithm Lab. Dept. of Computer Science · KAIST ...

200 x 272



درس این صفحه - 웹사이트스 공학 WebST :..... Q

- [ Translate this page ]

webst.kaist.ac.kr/content.php?db=professor - Cached

미름Cha, Meeyoung (차미영) 조교수; 연구분야Social Computing, Data-Driven Social Science; 학위PhD, KAIST, 2008; 전화번호+82-42-350-2922; 이 메일meeyoungcha ...

120 x 140



2010.09.13 - KGC 2011 Q - [ Translate this page ]

www.kgconf.com/kor/html/conference\_c\_view.html?cate3... - Cached

Kristian Segerstrale Playfish, 소셜게임의 미래 현재 소셜게임의 현주소와 빠르게 성장하는 소셜게임의 미래를 예리한 견식으로 소개 ...

100 x 100

# Applications

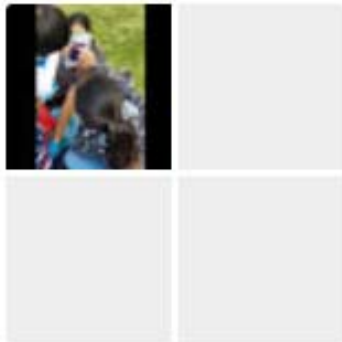
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- **Search**
- **Image stitching**
- **Object/scene/location recognitions**
- **Robot motion planning**
- **Copyright detection**

# Google Photos and Many Search Functionality

Google Photos

Search "Daehak-ro"



★ Favorites



People & Pets



Places



Things

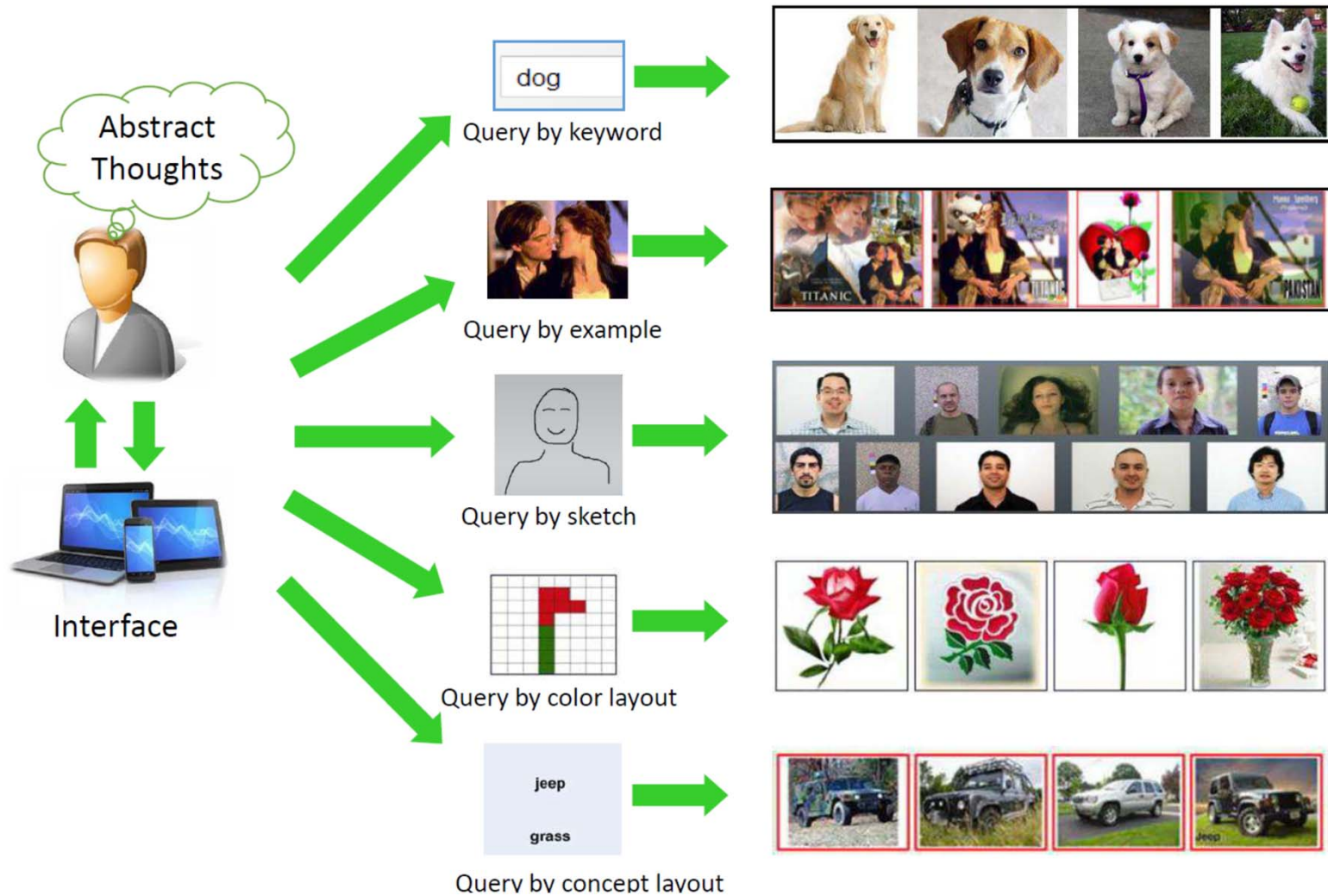
# Cross Domain Image Search

- Visual similarity across image domains



Shrivastava et al., SIGA

# Different Search Scenario



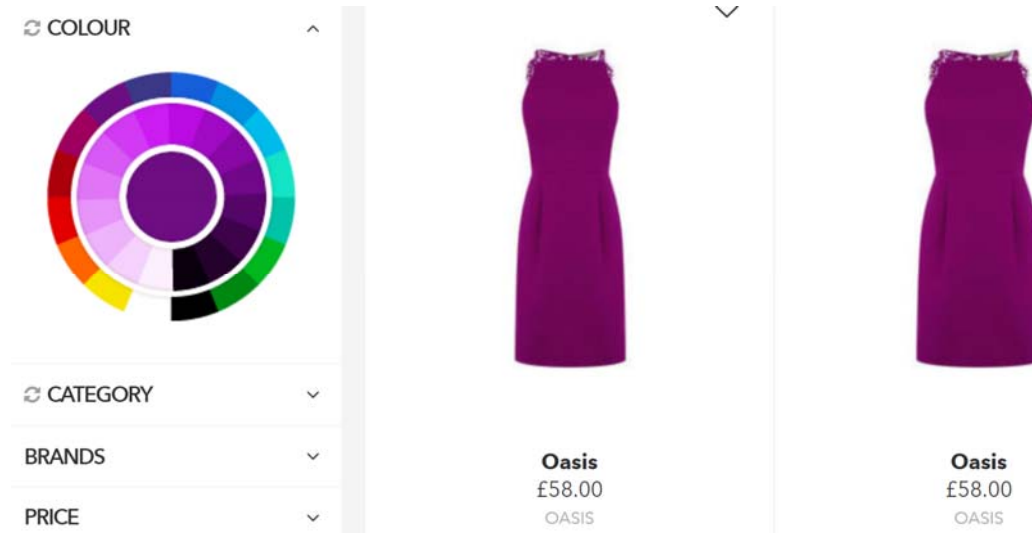
Zhou et al., arxiv



# Some Image Search Companies



Based on near duplicate image search



Snap fashion

# Some Startups

- 학생 창업
  - 클디, 2011년 창업



클디 팀원들, 왼쪽부터 김효은 연구원, 백승욱 CEO, 이경인 CTO

기술기반 스타트업으로서 좋은 모범 사례를 남기고 싶다

# Panorama Stitching



(a) Matier data set (7 images)



iPhone version  
available



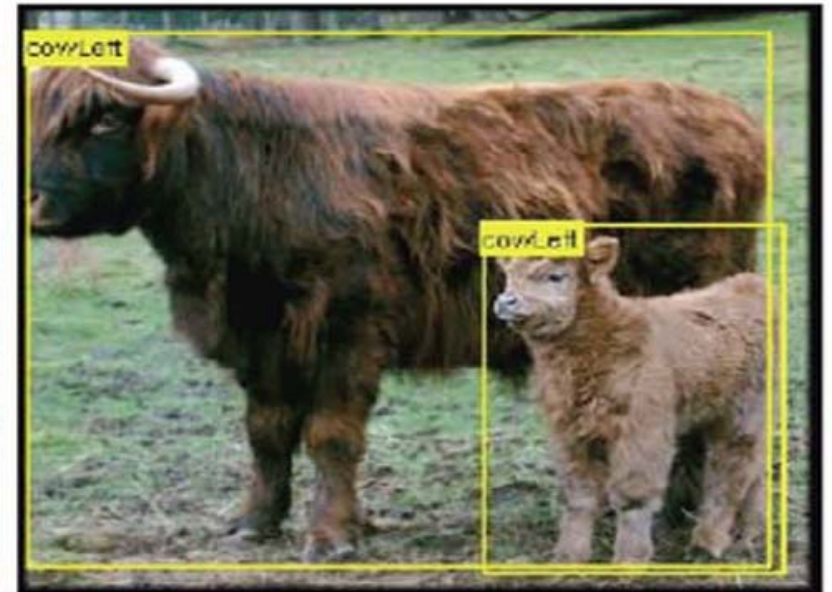
(b) Matier final stitch

[Brown, Szeliski, and Winder, 2005]

<http://www.cs.ubc.ca/~mbrown/autostitch/autostitch.html>

# Object Detection

## PASCAL challenge



# Product Image Recognition

[X. Shen et al., ECCV 2012]



Examples of product images in the database



Examples of query images taken by mobile phones

# Landmark or Location Detection

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query



City-scale image DB

# 3D Reconstruction

- Conducted by feature matching among many images



Photo tourism

# Example: Transfiguring Portraits [SIG. 16]



input



"curly hair"



"india"



"1930"

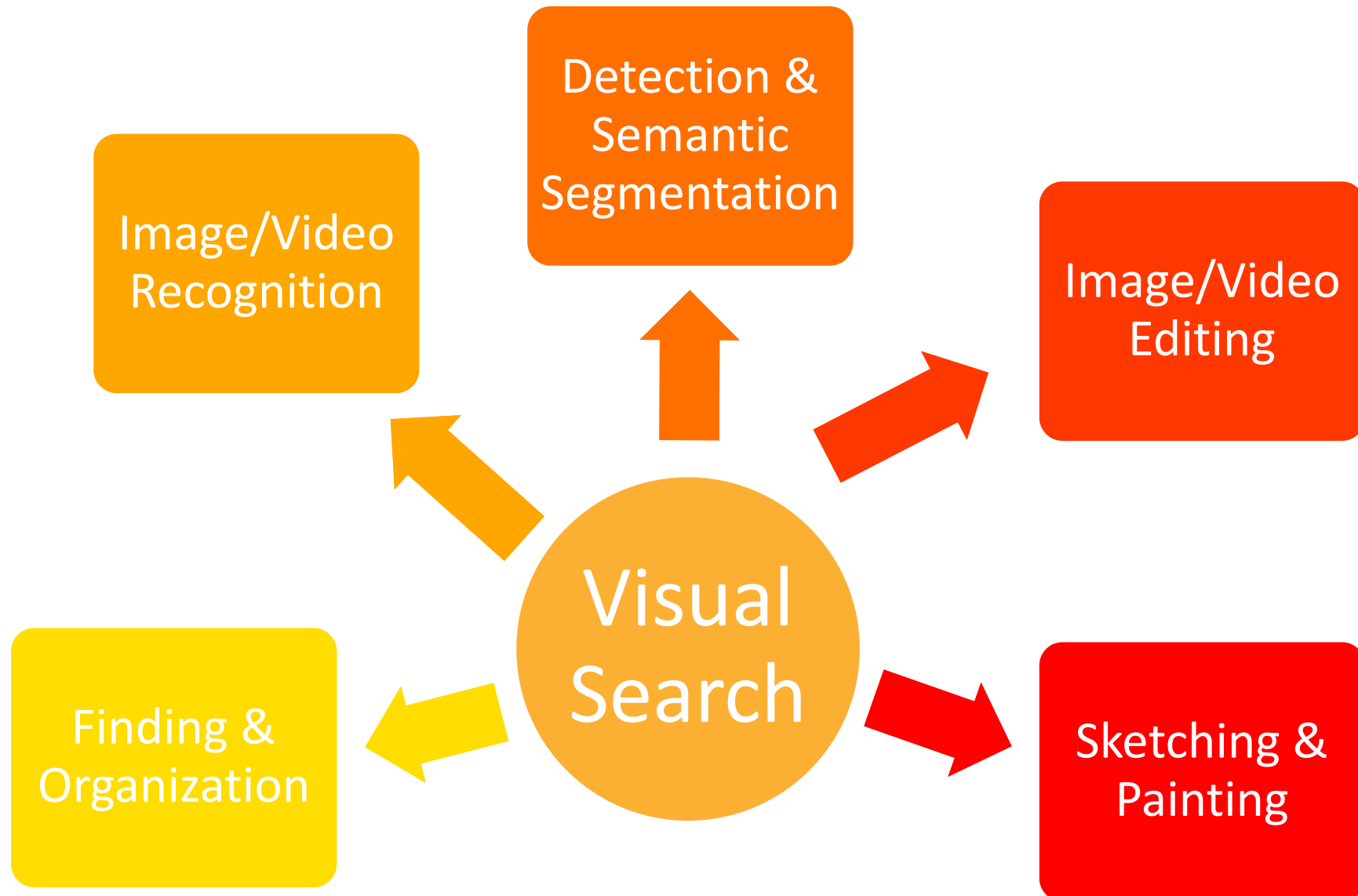


# Time-Lapse Photography and Edit Transfer [Shen et al.]



Figure 1: Our regional foremost matching for Internet images estimates accurate regional correspondence and enables several applications.

# Possible Application Domains



# Web-Scale Visual Data and Novel Applications

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- **Visual data are getting more widely used in our daily life**
  - **YouTube, Facebook, Flickr, etc.**
- **Many challenging issues**
  - **Processing them requires scalable algorithms**
  - **Web-scale visual data can enable new applications (e.g., photo tourism)**
  - **Achieving high accuracy, each search UI, etc.**



Ack.: Hays



sungeui.jpg describe image here

About 4 results (0.29 seconds)

Advanced search

- Everything
- Images
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- Shopping
- More



100 x 100

2010.09.13 - KGC 2011 - [ Translate this page ]

www.kgconf.com/kor/html/conference\_c\_view.html?cate3... - Cached

Kristian Segerstrale Playfish, 소셜게임의 미래 현재 소셜게임의 현주소와 빠르게 성장하는 소셜게임의 미래를 예리한 견식으로 소개 ...



200 x 272

Welcome to ISAC2009!! - [ Translate this page ]

isac2009.or.kr/isac2009/speakers/domestic\_bio.php - Cached

Yoo Mi Choi. 소속: 디자인여성학회 회장 한국디자인 학회 이사 한국애니메이션학회 부회장 인포디자인학회 이사 한국 애니메이션 필름협회 이사 ...

Visually similar images - Report images



Search Help Give us feedback



sungeui.jpg x About 4 results (0.29 seconds)

It took a few seconds to get this result on my desktop computer.

- Everything
- Images
- Videos
- News
- Shopping
- More



Image size:  
200 x 272

Find other sizes of this image:  
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Pages that include matching images



[Sungeui Yoon \(성익, 윤성익\)](#)  
[sglab.kaist.ac.kr/~sungeui/](#) - [Cached](#)  
Sung-Eui Yoon (윤 성익) Assistant professor. Scalable Graphics/Geometric Algorithm Lab. Dept. of Computer Science · KAIST ...

200 x 272



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- [\[ Translate this page \]](#)  
[webst.kaist.ac.kr/content.php?db=professor](#) - [Cached](#)  
미름Cha, Meeyoung (차미영) 조교수; 연구분야Social Computing, Data-Driven Social Science; 학위PhD, KAIST, 2008; 전화번호+82-42-350-2922; 이 메일meeyoungcha ...

120 x 140



[2010.09.13 - KGC 2011](#) - [\[ Translate this page \]](#)  
[www.kgconf.com/kor/html/conference\\_c\\_view.html?cate3...](#) - [Cached](#)  
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100 x 100



About 453 results (0.64 seconds)



Image size:  
240 × 400

Find other sizes of this image:  
[All sizes](#) - [Small](#) - [Medium](#) - [Large](#)

Best guess for this image: *eiffel tower*

### Visually similar images

[Report images](#)



All **Images** Maps Shopping More Search tools

About 7 results (0.61 seconds)




Image size:  
433 × 624

Find other sizes of this image:  
[All sizes - Medium](#)

Best guess for this image: *landmark*

**Visually similar images** [Report images](#)



The 'Visually similar images' section displays a grid of eight images. The first row contains four images: a modern building by a river, a city skyline at night with a prominent tower, a large stone building with a clock tower, and a modern glass building. The second row contains four images: a city skyline with a prominent tower, a city skyline with a prominent tower, a city skyline with a prominent tower, and a city skyline with a prominent tower.

# Some of Topic Lists

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- **Feature detectors**
- **Descriptors**
- **Nearest neighbor search**
- **Bag-of-Word**
- **Recognition**
- **Convolutional neural network**
- **Feature aggregation**
- **Hashing techniques**
- **Large-scale retrieval indexing techniques**
- **Video related techniques**
- **Various applications**
- **Image generation for cross domain**
- **Attention**



# Prerequisites

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- **Basic knowledge of linear algebra and data structures**
- **Basic knowledge on machine learning (e.g., regression) and deep learning**
  - **Assume you to know deep learning and modify it for your application**
- **Some prior experiences on programming**
- **If you are not sure, please consult the instructor at the end of the course**

# Course Overview

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- **Half of lectures and other half of student presentations**
  - **This is a research-oriented course**
- **What you will do:**
  - **Choose papers and present them**
  - **Propose ideas that can improve the state-of-the-art techniques**
  - **Quiz, mid-term, final-term exams, and**
  - **Have fun!**

# Course Overview

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- **Grade policy**
  - Quiz, assignment, and exams: 30%
  - Class attendance and presentations: 30%
  - Final project: 40%
  - **Class presentation and projects are the most important activities in this class**
- **Instructor and students will evaluate presentations and projects**
  - Instructor: 50% weights
  - Students: 50% weights

# Presentations

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- **Choose and present papers that are related to the course theme**
  - **Two talks for each student**
  - **Present a paper in each talk**

# Final Project

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- **Propose ideas to address problems identified from your presentation papers**
  - **Show benefits of your ideas and how your ideas can improve the state-of-the-art techniques in a logical manner**
  - **Implementation of your ideas is not required, but is recommended**
- **Team project is allowed**
  - **Role of each student should be very clear**

# Course Awards

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- **Best speaker and best project awards**
  - **Lunch or dinner for awardees with me and TAs**
- **A high grade will be given to members of the best project**

# Programming HWs and Exams

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- **Two programming assignments**
  - **Implement basic image search components**
- **Late policy**
  - **No score for late submissions**
  - **Submit your work before the deadline!**
- **Two exams**
  - **Mid-term exam covers class materials**
  - **Final-term exam covers presentation materials of students**

# Question HWs for Every Class

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- **Come up with one question in the class and submit at the end of the class**
  - **1 for typical questions (that were answered in the class)**
  - **2 for questions with thoughts or that surprised me**
- **Submit questions three times before the mid-term exam**



# Homework for Every Week

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- **Go over recent papers on image search**
  - Those should be high quality and recent ones
  - Find two papers, and **submit your summary before every beginning of the Tue. class**
  - **Online submission is possible**
- **Think about possible team members**
- **Too late if you think them later..**

# Honor Code

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- **Collaboration encouraged, but *assignments must be your own work***
- **Cite any other's work if you use their code**
  
- **Classroom etiquette: help you and your peer to focus on the class**
  - **Turn off cell phones**
  - **Arrive to the class on time**
  - **Avoid private conversations**
  - **Be attentive in class**

# Class Attendance Rule

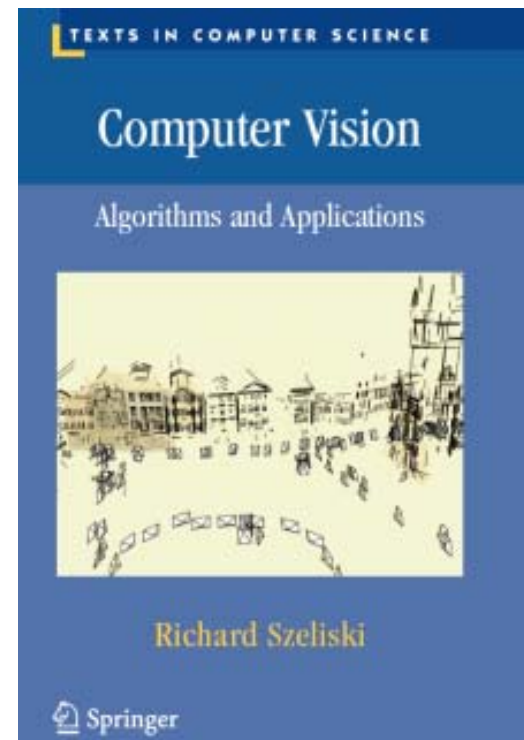
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- **Late two times → count as one absence**
- **Every two absences → lower your grade (e.g., A- → B+)**
- **To check attendance, I'll call your names**
- **If you are in situations where you should be late, notify earlier**

# Resource

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- **My ongoing draft on image search**
  - pdf file is available at the webpage
- **Reference**
  - **Computer vision: algorithms and applications**
    - Its file is available (<http://szeliski.org/Book/>)



# Other Resources

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- **Technical papers**
  - **CVPR, ICCV, ICLR, NeurIPS, ICMR, ACM MM, SIGGRAPH, etc.**
  - **Youtube (technical talks)**
  - **Computer vision resource**  
(<http://www.cvpapers.com/>)
  - **Multimedia information retrieval**  
(<http://www.mirsociety.org/mweb/>)
- **Course homepages**
- **Google or Google scholar**



# Schedule

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- **Please refer the course homepage:**
  - <http://sgvr.kaist.ac.kr/~sungeui/IR>

# Official Language in Class

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- **English**
  - **I'll give lectures in English**
  - **I may explain again in Korean if materials are unclear to you**
  - **You are not required to use English, but are recommended**
- **To non-native Korean speakers**
  - **Many Korean students prefer to use Korean for deeper discussions**
  - **In these cases, we will use Korean, but I will summarize main points in English**

# My Wish for You

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- **Follow up lecture materials and do various class activities/HWs**
- **Hopefully, they will:**
  - **Lead to your next publication, or**
  - **Lead to your next start-up**



# About You

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- **Name**
- **Your (non hanmail.net) email address**
  
- **What is your major?**
- **Previous experience on image search and computer vision**
- **Credit/audit**
  
- **Online submission:**  
<https://forms.gle/gRcHfvfdP9DnQBjj8>

# Next Time

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- **Feature detectors**