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# CAP 5516

## Medical Image Computing (Spring 2022)

Dr. Chen Chen

Center for Research in Computer Vision (CRCV)

University of Central Florida

Office: HEC 221

Address: 4328 Scorpius St., Orlando, FL 32816-2365

Email: [chen.chen@crcv.ucf.edu](mailto:chen.chen@crcv.ucf.edu)

Web: <https://www.crcv.ucf.edu/chenchen/>

# Announcement

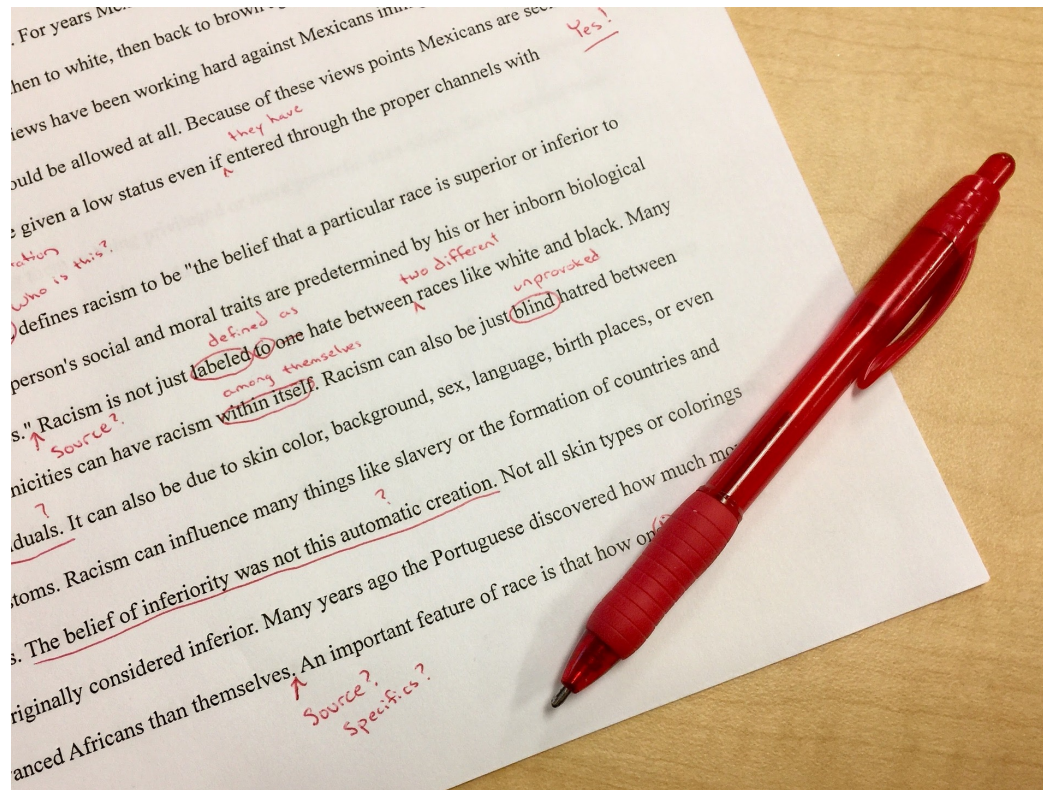
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- Please complete Assignment 0 – Survey by this Friday, 1/14/2022.

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# Lecture 2: How to review research papers & project ideas introduction

# Part 1: How to review research papers



Source: <https://owl.excelsior.edu/research/revising-and-editing-a-research-paper/>

# How to read research papers? (1)

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- Ask questions before you start
  - What are the motivations for this paper?
  - What problem is being solved?
  - What is the proposed solution?
  - What experiments are designed to test the solution?
  - What are the evaluation methods and metrics ?
  - What are the contributions?
  - What are the future directions?
  - How is the paper related to what you previously knew?
  - How is the paper related to other works?

# How to read research papers? (2)

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- Get the general idea first (title, abstract and conclusion)
  - What problem is being solved?
  - What are the main steps in the solution?
  - What is the high-level idea of the solution?
  - What are the take-away messages?
- Scam through the paper (figures and tables)
  - There is often a figure of the general framework of the proposed method

# How to read research papers? (3)

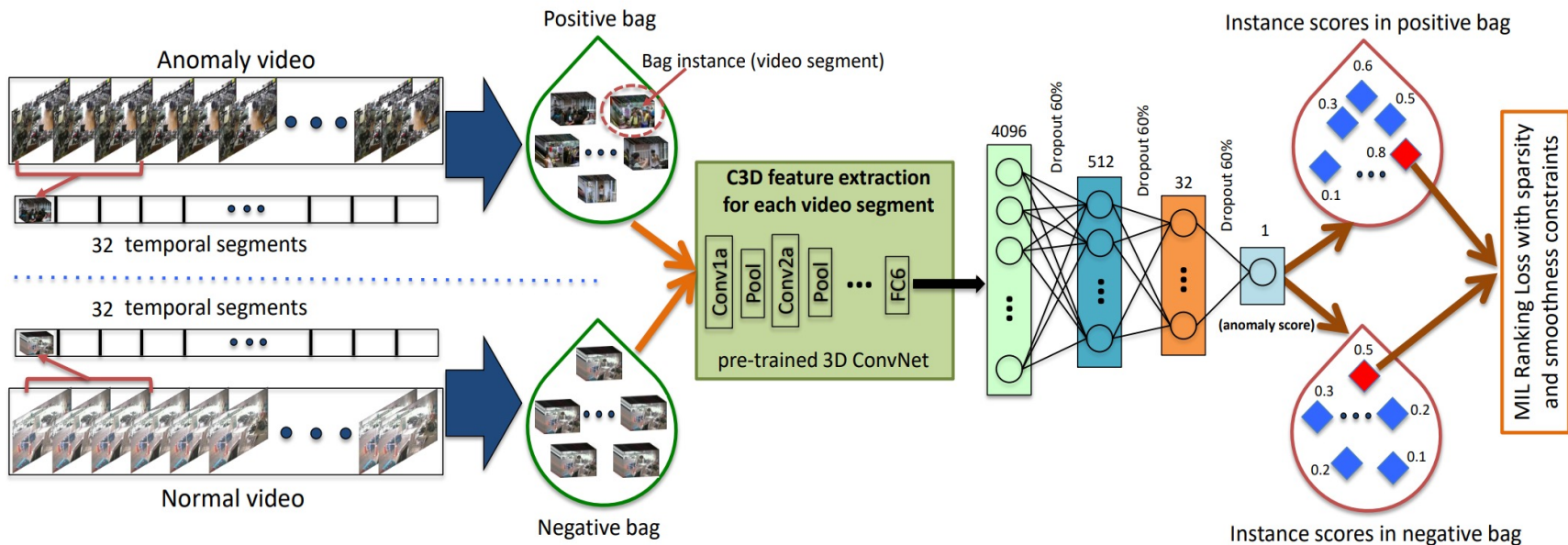


Figure 1. The flow diagram of the proposed anomaly detection approach. Given the positive (containing anomaly somewhere) and negative (containing no anomaly) videos, we divide each of them into multiple temporal video segments. Then, each video is represented as a bag and each temporal segment represents an instance in the bag. After extracting C3D features [36] for video segments, we train a fully connected neural network by utilizing a novel ranking loss function which computes the ranking loss between the highest scored instances (shown in red) in the positive bag and the negative bag.

Sultani, Waqas, Chen Chen, and Mubarak Shah. "Real-world Anomaly Detection in Surveillance Videos." CVPR 2018.

# How to read research papers? (4)

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- Dive into details (especially the proposed method and experiments)
  - What's new for the proposed method? And the motivation?
  - How is the method evaluated? (dataset, experimental setting, evaluation metrics) Are the results convincing?
- <https://developer.nvidia.com/blog/how-to-read-research-papers-a-pragmatic-approach-for-ml-practitioners/>
- The three-pass approach by Dr. Srinivasan Keshav:  
<http://ccr.sigcomm.org/online/files/p83-keshavA.pdf>





# Question?

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# How to review research papers? (1)

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- Write a review on the paper
  - Summarize a take-home message
  - Recall the main strengths of the paper
    - Novelty
    - Technical correctness
    - Clarity
    - Experimental evaluation

# How to review research papers? (2)

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- Write a review on the paper
  - Summarize a take-home message
  - Recall the main strengths of the paper
  - Be picky: weakness of the paper
    - Lack of novelty: comparing to prior work
    - Lack of clarity: language, organization, presentation
    - Technical errors: rare
    - Mismatched experiment design
    - Insufficient experiments
    - Unfair comparison with other methods
    - **Justify your comment**



# How to review research papers? (3)

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- Write a review on the paper
- Summarize a take-home message
- Recall the main strengths of the paper
- Be picky: weakness of the paper
- Overall rating (adapted from NIPS reviewer instructions)
  - **0: Top 10% of the papers I have read, an excellent paper, a strong accept.**
    - I will fight for acceptance. I will consider not reviewing papers for XX if this is rejected.
  - **1: Top 50% of accepted NIPS papers, a very good paper, a clear accept.**
    - I vote and argue for acceptance.
  - **2: Good paper, accept.**
    - I vote for acceptance, although would not be upset if it were rejected.
  - **3: Marginally above the acceptance threshold.**
    - I tend to vote for accepting it, but leaving it out of the program would be no great loss.
  - **4: Marginally below the acceptance threshold.**
    - I tend to vote for rejecting it, but having it in the program would not be that bad.
  - **5: An OK paper, but not good enough. A rejection.**
    - I vote for rejecting it, although would not be upset if it were accepted.



# How to review research papers? (4)

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- Write a review on the paper Summarize a take-home message
  - Recall the main strengths of the paper
  - Be picky: weakness of the paper
- Overall rating
  - Explain your rating: how you weigh the strengths and weaknesses

# How to review research papers? (5)

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- Write a review on the paper
  - Summarize a take-home message
  - Recall the main strengths of the paper
  - Be picky: weakness of the paper
  - Overall rating (0, 1--5)
  - Explain your rating: how you weigh the strengths and weaknesses
- Brainstorm future directions
  - New solutions
  - New solutions extending or inspired by the paper's solution
  - Open problems
  - Other problems that could benefit from the paper



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# Example Review Form (1)

**Paper ID**

215

**Paper Title**

Simultaneous Time-Dependent Inference for Dynamic Bayesian Networks

## REVIEW QUESTIONS

**1. [Summary] Please provide a short summary of the paper and its contributions.**

*\* (visible to author during feedback, visible to author after notification, visible to other reviewer, visible to meta-reviewer)*

**2. [Paper Strengths] Please discuss the positive aspects of the paper. Be sure to comment on the paper's novelty, technical correctness, clarity and experimental evaluation. Notice that different papers may need different levels of evaluation: an algorithm paper may need fewer experiments, while an application paper may require thorough comparisons to existing methods. Also, please be sure to justify your comments in detail. For example, if you think the work is novel, not only say so, but also explain in detail why you think this is the case.**

*\* (visible to author during feedback, visible to author after notification, visible to other reviewer, visible to meta-reviewer)*



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# Example Review Form (2)

**3. [Paper Weaknesses]** Please discuss the negative aspects of the paper: lack of novelty or clarity, technical errors, insufficient experimental evaluation, etc. Justify your comments in detail; don't provide just generic critique. It is not reasonable to ask for comparisons with unpublished, non-peer-reviewed papers (eg. arXiv), or papers published after the ACCV 2018 deadline.

*\* (visible to author during feedback, visible to author after notification, visible to other reviewer, visible to meta-reviewer)*

**4. [Rebuttal Requests]** Please note specific points that you would like the authors to address in their rebuttal. *(visible to author during feedback, visible to author after notification, visible to other reviewer, visible to meta-reviewer)*



# Example Review Form (3)

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5. **[Recommendation Justification / Detailed Comments]** Please explain to the AC, your fellow reviewers, and the authors your current recommendation for the paper. This explanation may include how you weigh the importance of the various strengths and weaknesses you described above. \* *(visible to author during feedback, visible to author after notification, visible to other reviewer, visible to meta-reviewer)*

6. **[Overall Rating]** \* *(visible to author during feedback, visible to author after notification, visible to other reviewer, visible to meta-reviewer)*

- ☐ Strong Accept
- ☐ Weak Accept
- ☐ Borderline
- ☐ Weak Reject
- ☐ Strong Reject

7. **[Confidential Comments to Area Chair]** *(visible to meta-reviewer)*

# Question?

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- What do you care the most about a research paper?

# How to present research papers (in class)? (1)

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- Make good presentations
  - Know your audience: fellow graduate students with good background
  - Adapt the presentation goal: explain and discuss the paper
  - *Assume no one in the class has read the paper before*

# How to present research papers? (2)

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- Make good presentations
  - Title, authors (full name), authors' institutes, your name
  - Motivation of the research (1—2 slides)
  - Problem statement
    - What is being solved?
    - Why is it an important problem?
  - Main contributions of the paper
    - Studied a new and important problem
    - Proposed a novel approach
    - Improved or extended existing methods
    - Compared several popular methods
    - Explored a variety of use cases (many datasets of different kinds)
    - Presented new theories
    - Presented a new dataset and benchmark results
    - Introduced new methodologies or tools to the field



# How to present research papers? (3)

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- Make good presentations
  - Title, authors (full name), authors' institutes, your name
  - Motivation of the research (1—2 slides)
  - Problem statement (1—2 slides)
    - It would be helpful to lay out some background about the problem
  - Main contributions of the paper
  - Approach outline (1 slide)
  - Details of the proposed approach
  - Experiments
    - Data, features, baselines, evaluation metrics, results
  - Related work (1—3 slides)
  - Conclusion: take-home message (1—2 slides)



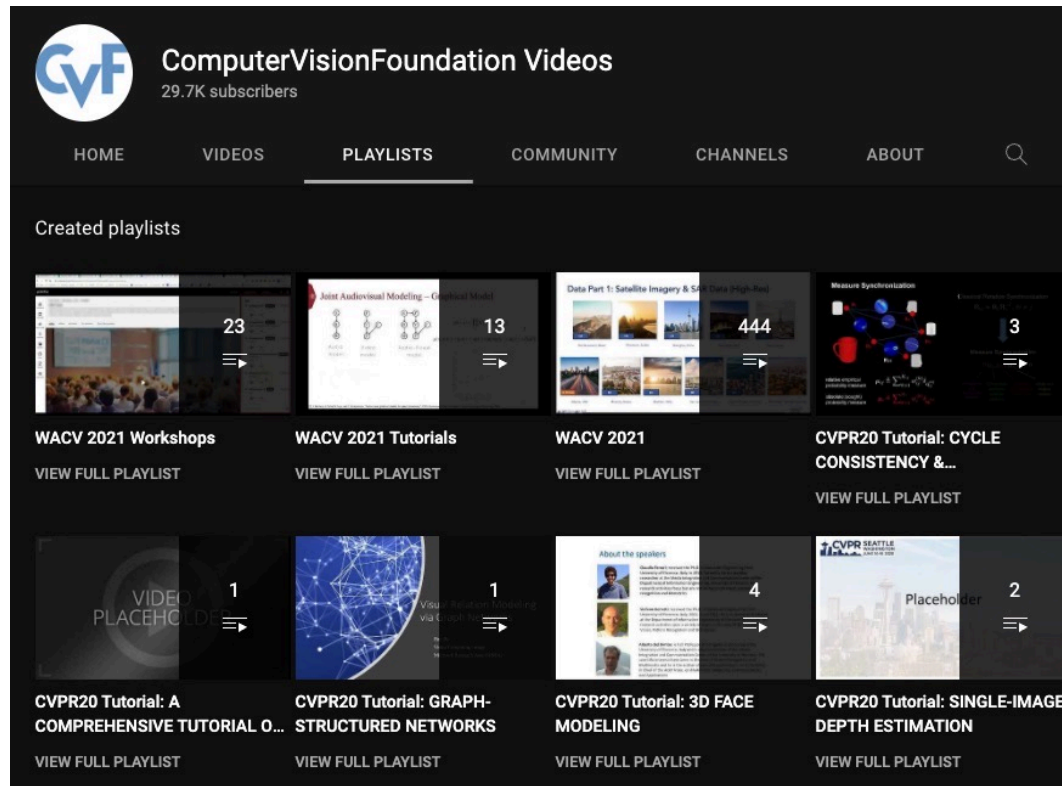
# How to present research papers? (4)

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- Make good presentations
  - Title, authors (full name), authors' institutes, your name and email
  - Motivation of the research (1—2 slides)
  - Problem statement (1—2 slides)
  - Main contributions of the paper
  - Approach outline (1 slide)
  - Details of the proposed approach
  - Experiments
  - Related work (1—3 slides)
  - Conclusion: take-home message (1—2 slides)
  - Strengths & weaknesses of the paper (1—2 slides)
  - Overall rating & why (how you weigh the strengths and weaknesses) (1 slide)
  - Future directions (1—3 slides)



# How to present research papers? (5)



- Computer Vision Foundation open access (CVPR, ICCV conference papers over the past years)
- YouTube channel for CVF
  - [https://www.youtube.com/channel/UC0n76gicaarsN\\_Y9YShWwhhw/videos](https://www.youtube.com/channel/UC0n76gicaarsN_Y9YShWwhhw/videos)

# Papers for Presentation

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- A list of papers for presentation is provided in Canvas
- Each student selects one paper for presentation in class



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## **Part 2: Project ideas**

**Note: the project must be medical image analysis  
using deep learning methods**

# Interactive segmentation

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- Project goal: develop an interactive segmentation algorithm/tool for **medical image segmentation**

Interactive image segmentation aims to extract the object-of-interest using limited human interactions such as clicks, bounding boxes, and scribbles.



# Interactive segmentation

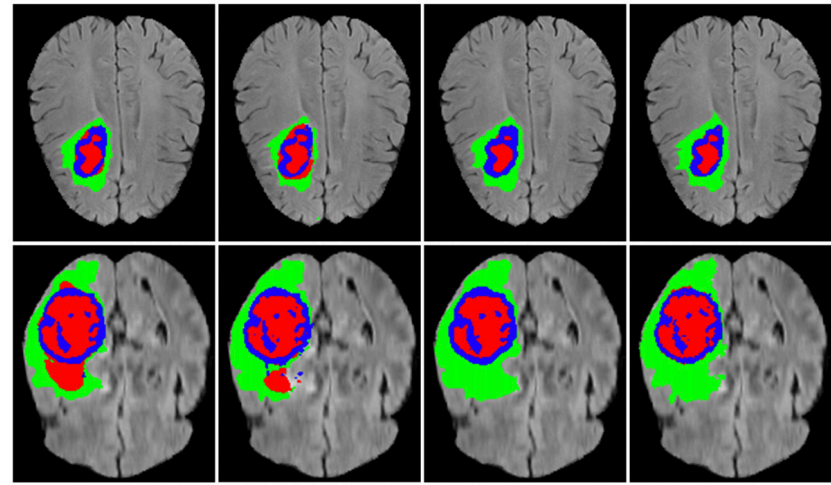
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- Resources:
  - [https://github.com/saic-vul/ritm\\_interactive\\_segmentation](https://github.com/saic-vul/ritm_interactive_segmentation)
  - <https://github.com/qinliuliuqin/iSegFormer>
  - iSegFormer: Interactive Image Segmentation with Transformers  
<https://arxiv.org/pdf/2112.11325.pdf>
- References:
  - [1] <https://paperswithcode.com/task/interactive-segmentation/codeless>
  - [2] Interactive Image Segmentation with First Click Attention,  
[https://www.shaopinglu.net/publications\\_files/FirstClick\\_cvpr20.pdf](https://www.shaopinglu.net/publications_files/FirstClick_cvpr20.pdf)
  - [3] Rethinking Interactive Image Segmentation: Feature Space Annotation, <https://arxiv.org/pdf/2101.04378.pdf>
  - [4] Interactive Medical Image Segmentation with Self-Adaptive Confidence Calibration, <https://arxiv.org/pdf/2111.07716v1.pdf>

# MRI Brain tumor segmentation

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- Each sample is composed of four modalities of brain MRI scans. Each modality has a volume of  $240 \times 240 \times 155$ .
- The labels contain 4 classes: background, necrotic and non-enhancing tumor, peritumoral edema and GD-enhancing tumor.



# MRI Brain tumor segmentation

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- Dataset: <https://ipp.cbica.upenn.edu/>
- **Note:** You need to submit a form to request the access to download the dataset.
- Resources:
  - Wang, Wenxuan, et al. "Transbts: Multimodal brain tumor segmentation using transformer." International Conference on Medical Image Computing and Computer-Assisted Intervention. Springer, Cham, 2021.
  - Code: <https://github.com/Wenxuan-1119/TransBTS>
- References:
  - [1] Swin UNETR: Swin Transformers for Semantic Segmentation of Brain Tumors in MRI Images  
<https://arxiv.org/pdf/2201.01266.pdf>
  - [2] TransBTS: Multimodal Brain Tumor Segmentation Using Transformer  
[https://link.springer.com/chapter/10.1007/978-3-030-87193-2\\_11](https://link.springer.com/chapter/10.1007/978-3-030-87193-2_11)
  - [3] nnU-Net for Brain Tumor Segmentation  
[https://link.springer.com/chapter/10.1007/978-3-030-72087-2\\_11](https://link.springer.com/chapter/10.1007/978-3-030-72087-2_11)

# Pill Image Classification

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- Project goal: develop deep learning-based methods for pill image recognition
- Dataset and resources:
- ePillID Benchmark: <https://github.com/usuyama/ePillID-benchmark>
- ePillID Dataset: A Low-Shot Fine-Grained Benchmark for Pill Identification, <https://arxiv.org/pdf/2005.14288.pdf>
- References:
- [1] Fast and accurate medication identification, <https://www.nature.com/articles/s41746-019-0086-0.pdf>

# Other Resources to Look for Project Ideas

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- Look for topics from conference proceedings
- Example:
  - MICCAI 2021 accepted papers by topics:  
<https://miccai2021.org/openaccess/paperlinks/categories/index.html>

# Other Resources to Look for Project Ideas

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- Conference workshops (check different years)
  - MICCAI Workshops: <https://www.miccai2021.org/en/MICCAI2021-WORKSHOPS.html>
  - MICCAI Challenges: <https://www.miccai2021.org/en/MICCAI2021-CHALLENGES.html>
  - CVPR 2021 Medical Computer Vision Workshop: <https://sites.google.com/view/cvprmcv21>
  - ICCV 2021 Workshop - AI-enabled Medical Image Analysis Workshop and Covid-19 Diagnosis Competition (MIA-COV19D): <https://mlearn.lincoln.ac.uk/mia-cov19d/>
  - ICCV 2021 Workshop - Computer Vision for Automated Medical Diagnosis: <https://sites.google.com/view/cvamd2021/home?authuser=0>
- Kaggle Competitions (search key words like “medical”)
- Ideas inspired by the papers you read
- Projects ideas that are related to your research (e.g., topics related to your MS thesis or Ph.D. dissertation)



# Open Access Medical Image Datasets

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- **Open-Access Medical Image Repositories**
  - <https://www.aylward.org/notes/open-access-medical-image-repositories>
- **Computer Vision Online Image Archive – medical image**
  - <https://homepages.inf.ed.ac.uk/rbf/CVonline/Imagedbase.htm#biomed>
- Google Dataset Search: <https://datasetsearch.research.google.com/>
- Kaggle dataset search: <https://www.kaggle.com/datasets>

# Project Proposal

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- Your initial proposal should be at least one page (two-column) and it should cover the following items:
  - The problem that you are trying to solve.
  - The motivation behind the problem.
  - Your proposed approach, and how it relates to prior work.
  - The experiments that you plan to conduct.
  - The datasets that you plan to use.
- **Project proposal due: Feb. 4, 2022, 11:59PM**

# Project Milestone Report (mid-semester)

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- You should extend your project proposal to include the following:
  - A preliminary set of results.
  - Your analysis of those results.
  - Additional experiments that you plan to run.
- Project milestone report due: April 8, 2022, 11:59PM

# Project Final Report

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- You should extend your project milestone to include:
  - The final set of results.
  - Your analysis of those results.
  - Your overall conclusions and findings from the project.
- If you leverage existing source codes, you should
  - Clearly state it in the report
  - Properly credit/cite the original authors (source) in your report and code
  - Identify which part is your own work.
- Replicating one project (e.g., one that is on GitHub) is NOT acceptable
- Final report due: May 2, 2022, 11:59PM

# How to write research papers/reports? (1)

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- Write a paper from your project
  - What problem did you attack?
  - Why it matters?
  - What were the previous solutions, their pros and cons?
  - Know the literature well
  - Explain your approach in detail
  - Present your results
  - Illustrate your data and figures
  - Discuss and conclude your method, pros and cons
  - Future work
  - Common: share the code in an accompanying website, e.g. GitHub
  - Brainstorm future directions

# How to write research papers/reports? (2)

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- How to write a good CVPR submission - William T. Freeman - MIT  
<https://billf.mit.edu/sites/default/files/documents/cvprPapers.pdf>

## How to write a good CVPR submission



Bill Freeman  
MIT CSAIL  
Nov. 6, 2014

# Question?

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- How do you quickly know a research topic?
  - Find a survey paper on this topic
- How to find the state-of-the-art methods for comparison in your experiments?

# Possible outcome - Publish a paper on your project

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- Set a high standard for your project
- Discuss new ideas with the instructor
- Aim for a conference or even a journal paper



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# Thank you!

# Question?

Slides credits: some of the slides are adapted from Ali Borji, Mubarak Shah