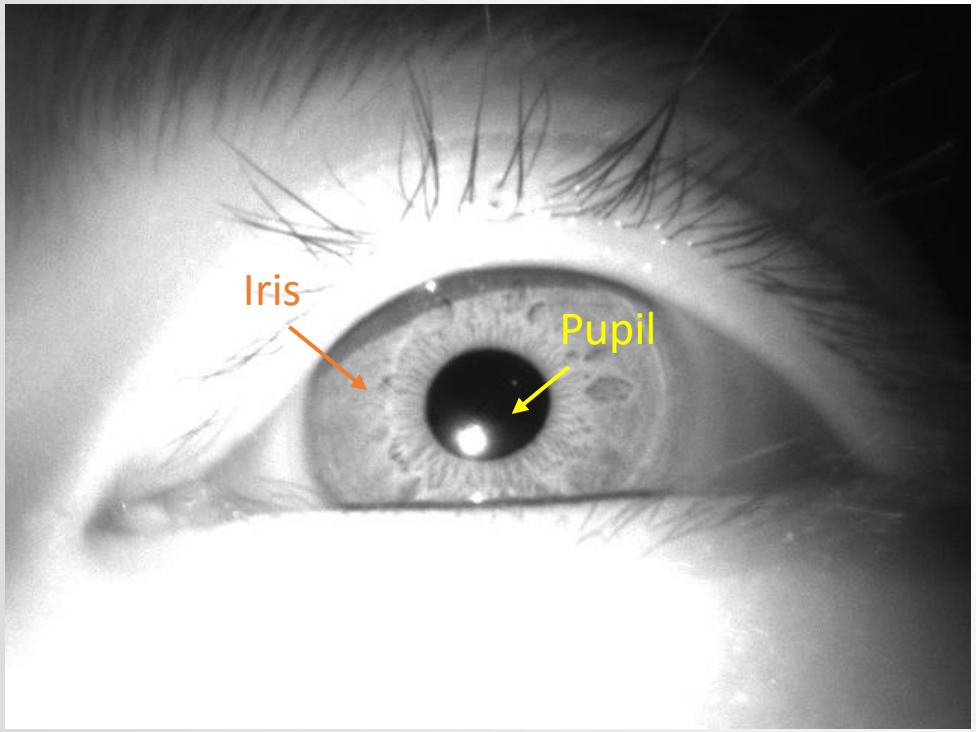
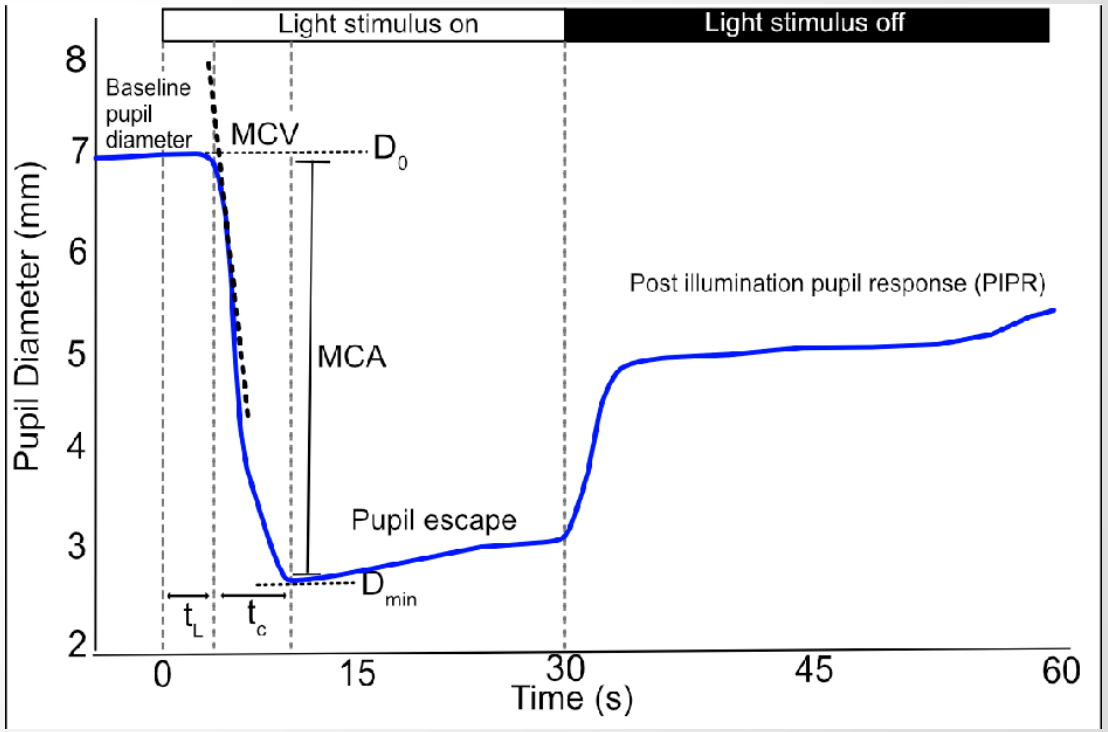

Computer Vision 2022
Final Project Topic
Pupil Tracking
Ganzin Technology, Inc.
見臻科技

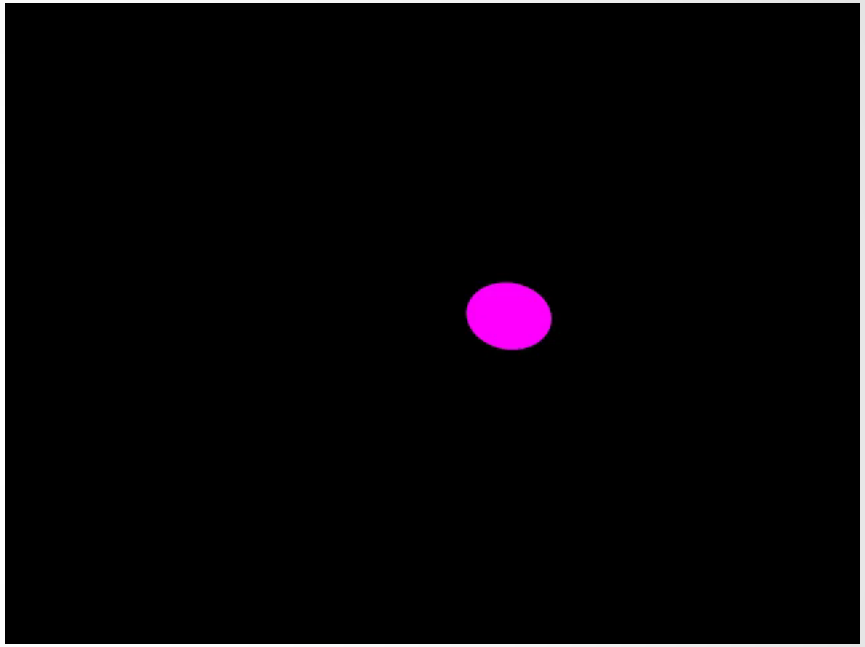
Pupillometry

- The measurement of pupil size and reactivity, is a key part of the clinical neurological exam for patients with a wide variety of neurological injuries



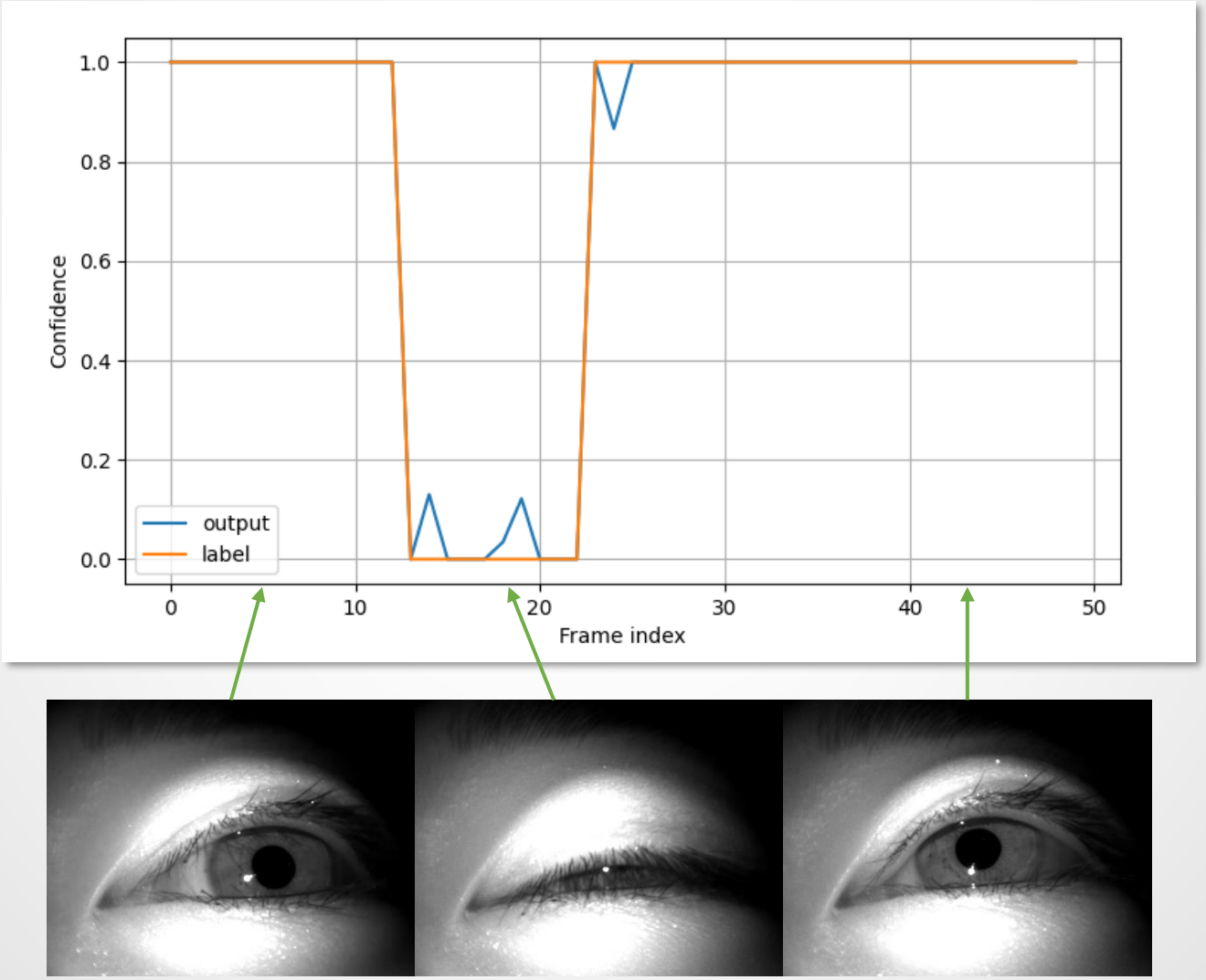


Pupil Tracking

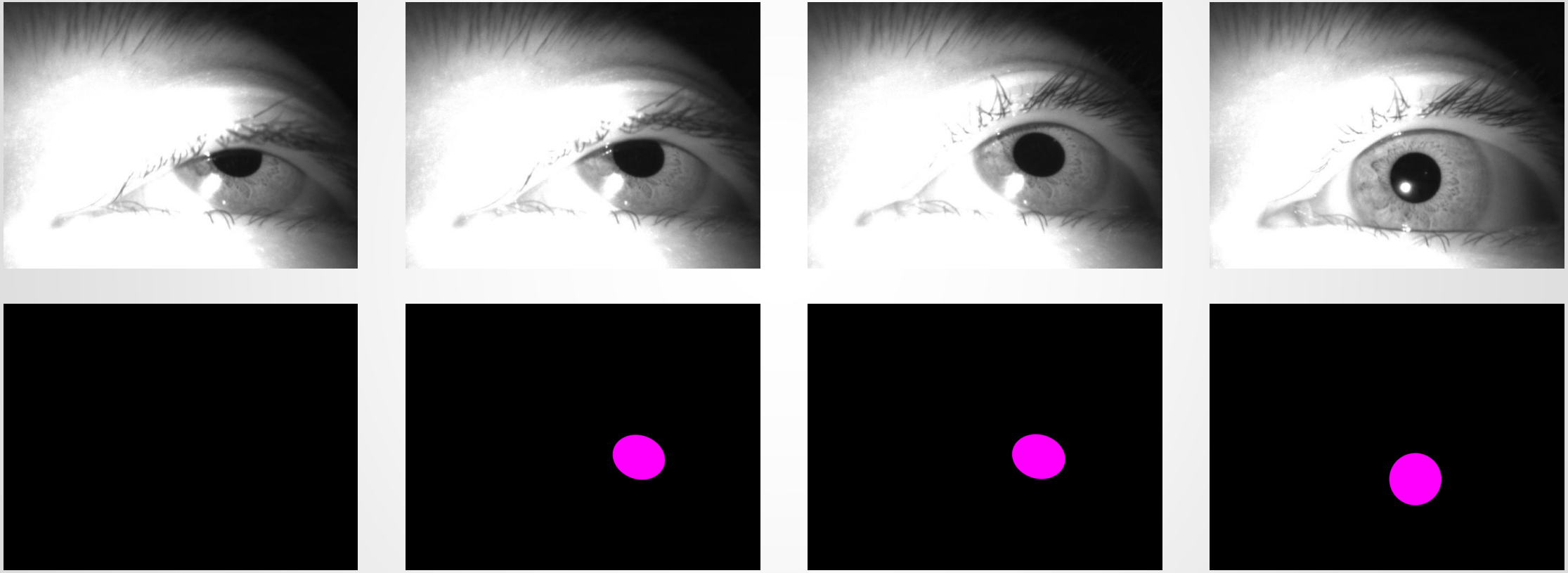


- Segment pupils in eye images
- Return the segmentation mask with a confidence value $\omega \in [0, 1]$
- We can threshold ω to obtain a binary sequence indicating the existence of pupils

Example of Confidence



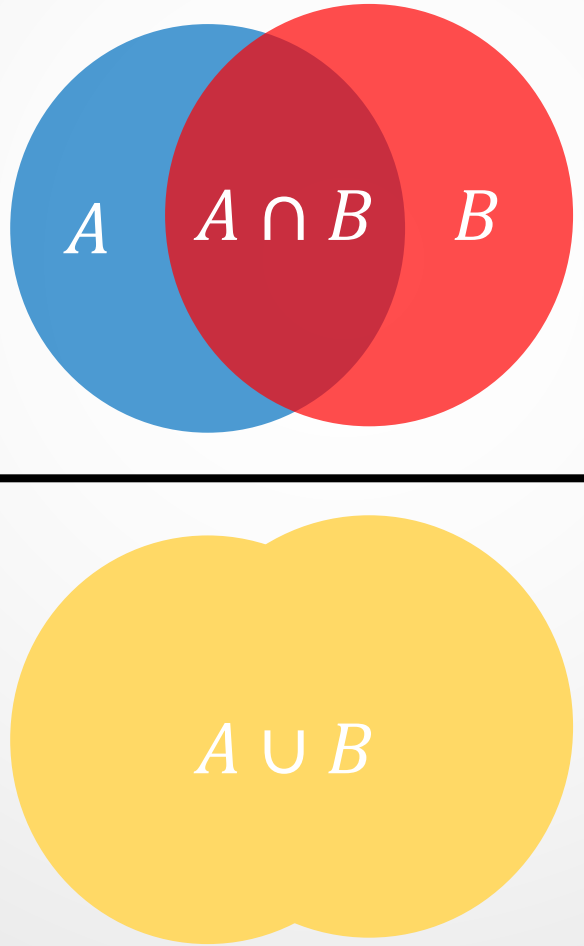
Occluded Pupil



Evaluation Metric

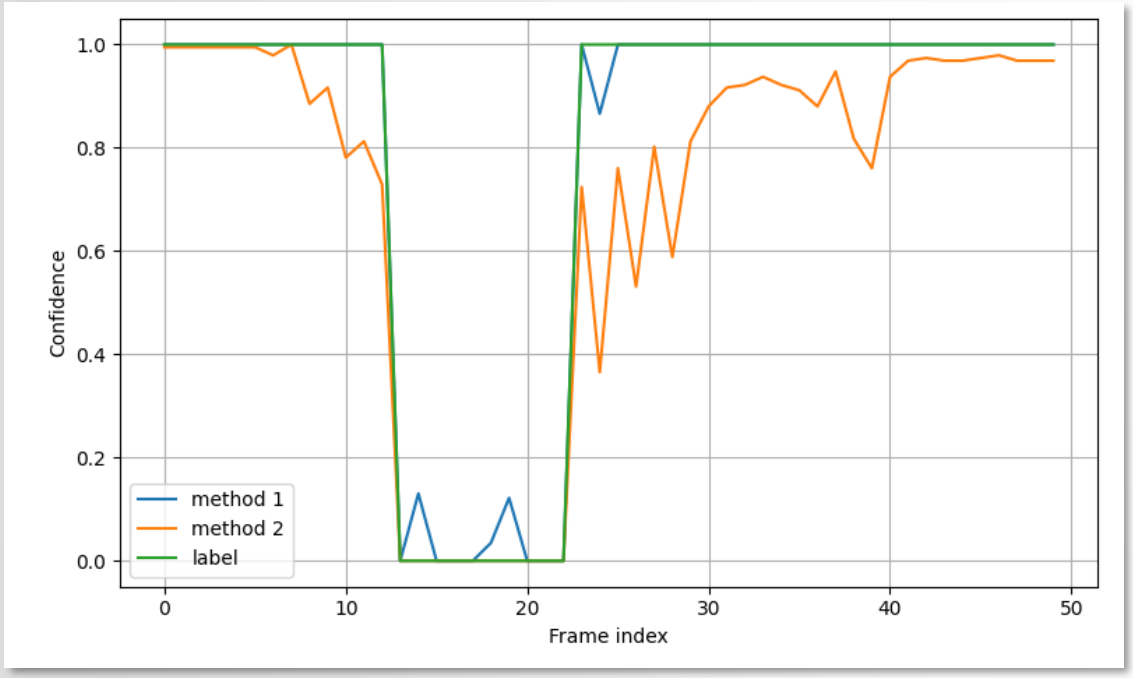
- Intersection over union (IoU)

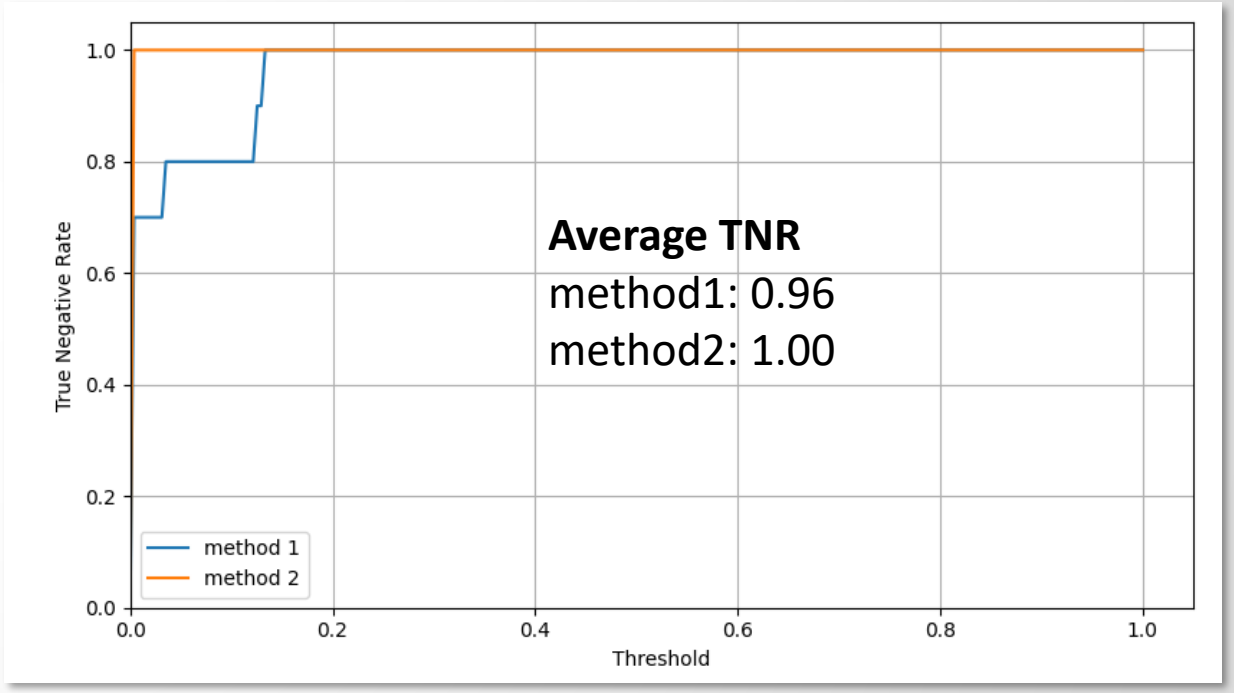
$$IoU = \frac{A \cap B}{A \cup B}$$



Evaluation Metric

- True negative rate (TNR)





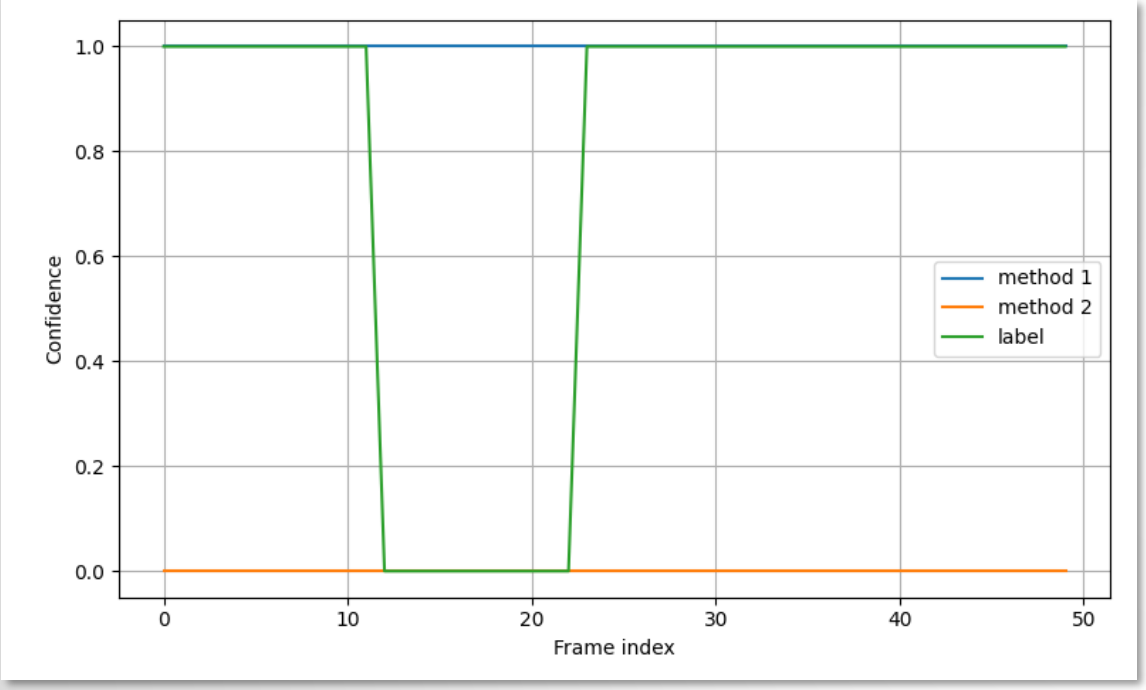
$$TNR = \frac{TN}{N} = \frac{TN}{TN + FP}$$

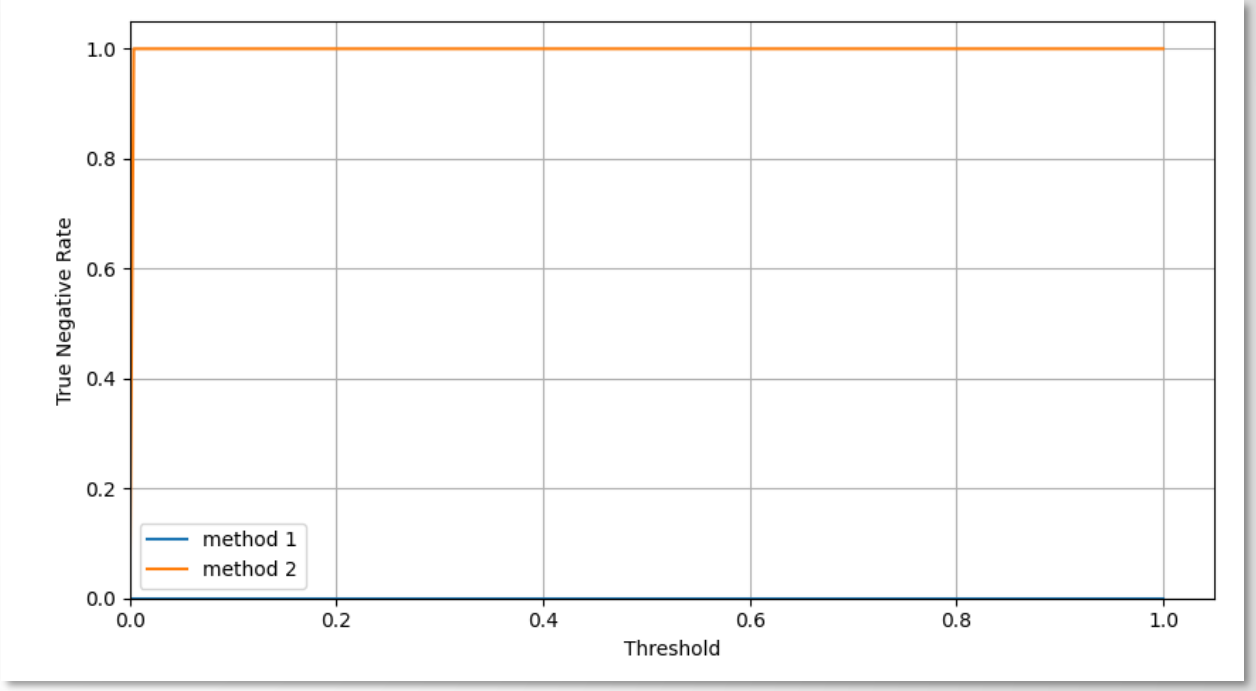
Evaluation Metric

- Weighted IoU: 70%
  - N_{valid}: Number of valid frames whose labels are not empty
- ATNR: 30%
  - Computed using 1000 thresholds uniformly sampled from 0 to 1
  - Accumulated over all data frames

$$Score = 0.7 \cdot \frac{\sum_i \omega_i \cdot IoU_i}{N_{valid}} + 0.3 \cdot ATNR$$

不想努力了





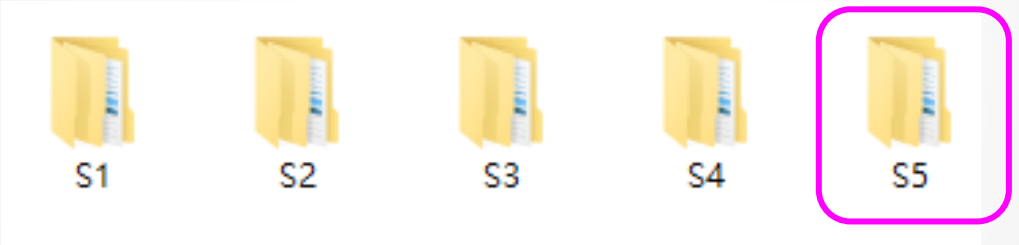
$$Score = 0.7 \cdot WIoU + 0.3 \cdot ATNR$$

Dataset

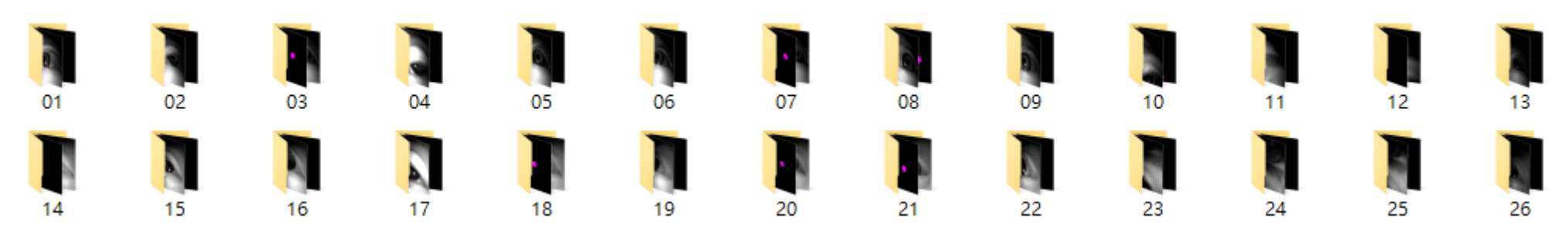
- Public set
  - 130 clips of eye movement
  - ~26k frames in total (~90% eyes open)
- Hidden test set
  - Not given
- Challenge set
  - Will be released soon
- External dataset
  - You are welcome to use any dataset to facilitate your project
  - Note it in your report

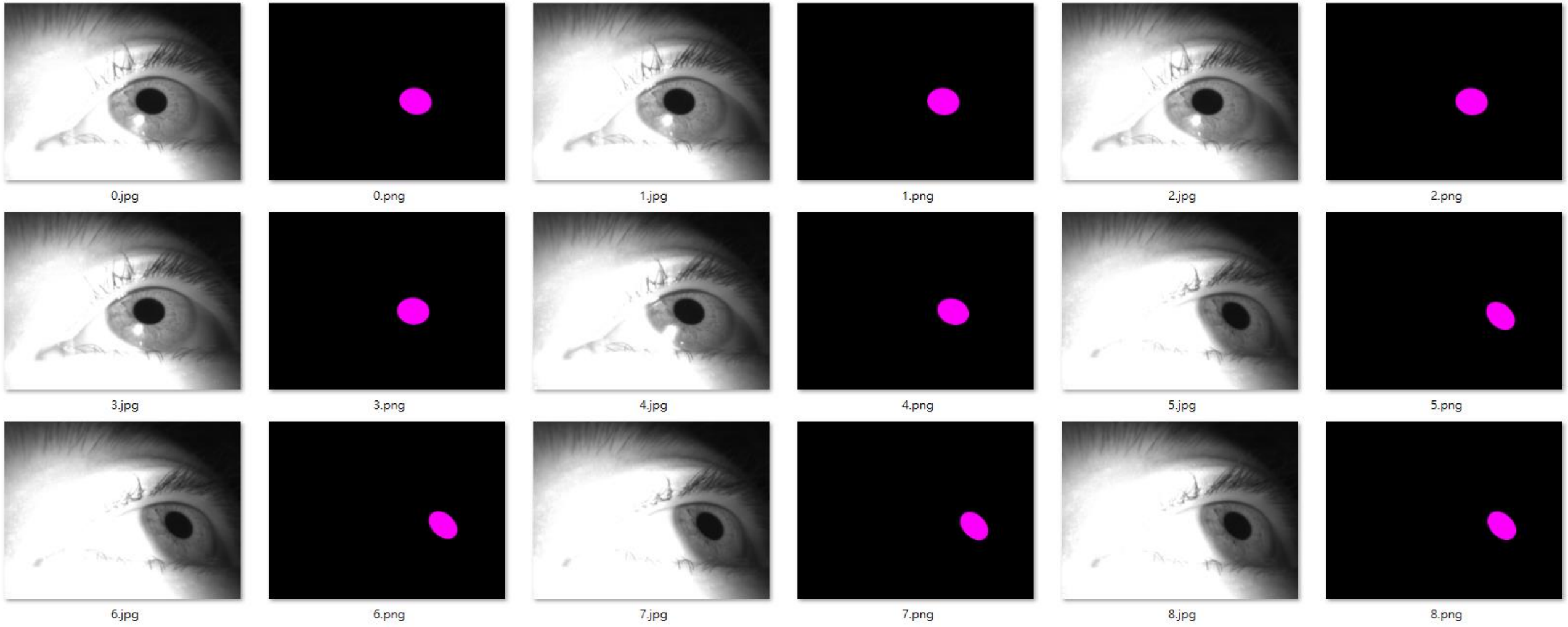
Public Dataset Structure

- Public
  - Subject level: 5 subjects in public set
    - Sequence level: 26 sequences in each subject folder



Note: labels of S5 are not given




0.jpg
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8.png

Evaluation Scripts

- See **eval.py** for details
- You may need to modify the code to evaluate your method:
  - **Line 77-80:** Run your code here

```
# TODO: Modify the code below to run your method or load your results from disk
# output, conf = my_awesome_algorithm(image)
output = label
conf = 1.0
```

  - **Line 102-103:** Change the path to dataset; you may also partially evaluate the dataset

```
dataset_path = r'D:\CV22S_Ganzin_final_project\dataset\public'
subjects = ['S1', 'S2', 'S3', 'S4']
```

  - **Line 69-71:** This script by default will skip evaluating a sequence if ground truths are not available

```
label_name = os.path.join(image_folder, '0.png')
if not os.path.exists(label_name):
    print(f'Labels are not available for {image_folder}')
    continue
```

NEW!

Schedule

- **Evaluation Server Open**
  - 2022/06/01 12:00 (GMT+8)
- **Evaluation Server Close**
  - 2022/06/15 12:00 (GMT+8)
- **Code Submission**
  - 2022/06/15 15:00 (GMT+8)
  - After we evaluate your codes on the hidden set, final leaderboard will be released before 06/15 23:59.

- **Oral Presentation**
  - 2022/06/17 14:20 – 17:20 (GMT+8) **(TBD)**
- **NTU COOL Submission Deadline**
  - 2022/06/17 23:59 (GMT+8)
- **NTU COOL Technical Report Deadline (for top 3 teams selected for cash awards)**
  - 2022/06/24 23:59 (GMT+8)

NEW!

Evaluation Server

- Our final project challenge is hold on Codalab competition server.
  - Link: https://codalab.lisn.upsaclay.fr/competitions/5120?secret_key=24b7ac22-7fd9-4c1b-b3da-198485c6899d
- Please read all the rules written in the server carefully.

- **Maximum submissions: 60**
- **Maximum submissions per day: 5**

NEW!

Evaluation Server: Submission

- We will evaluate both WIoU and ATNR on **S5 in the public set**.
- Directory architecture:

  S5_solution/

  + 01/ **{all mask files in png format & conf.txt}**
  + 02/ 0.png, 1.png, …, 421.png, conf.txt
  + 03,04,…,26/

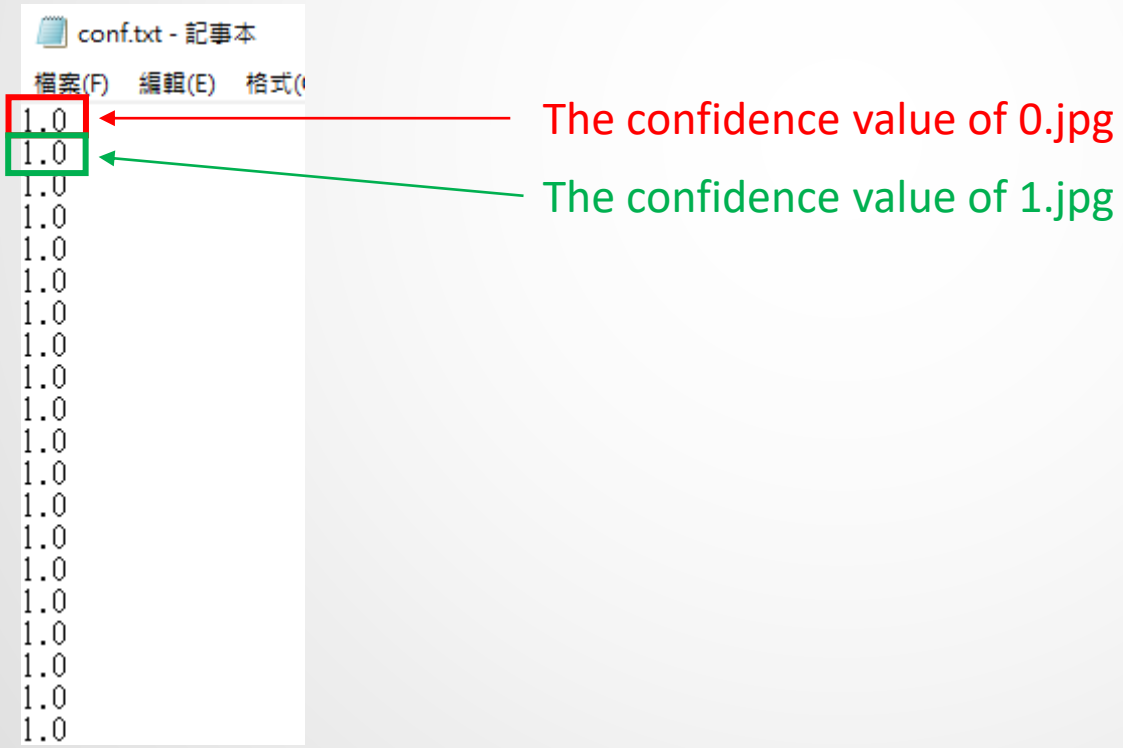
- You need to **compress** "S5_solution" into a zip file. **The file name of the zip file is free**.
  - After unzipping it in Linux system, it should generate **one directory named S5_solution**.
  - Example file: https://drive.google.com/file/d/1PQkfLOQt1XZspwp3oqX2vFs--7Ayj7VM/view?usp=sharing

- If any of the file format is wrong, the evaluation process may be failed, and you will lose your submission quota without any compensation.

NEW!

Evaluation Server: Submission

- In each sequence, you need to generate one “conf.txt” to save your predicted confidence values. The format of conf.txt is shown below.



NEW!

Code Submission

- Only the team leader need to upload your code to **NTU COOL**.
- All your code should be uploaded (including training & testing).
- **DO NOT** upload the dataset !!!
- **You should also upload the model file which can generate the score on the Codalab leaderboard**.
- Deadline: **2022/06/15 15:00**

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Code Submission

- R07654321/
  - **README file (Important!!!)**
  - Model file
  - All your codes
- Compress all above files in a zip file named StudentID.zip (e.g. R07654321.zip)
  - After Tas run “unzip R07654321.zip”, it should generate one directory named “R07654321”.

- In **README** file, you need to clearly describe your **environments** and **the steps** to run your code (training & testing), so that TAs will be able to reproduce your results on the leaderboard.
- If TAs cannot reproduce your results on the leaderboard, you will receive 0 point in the performance part. Minor errors are acceptable.
- **TAs will evaluate the performance of hidden test set in this stage, so make sure to clearly describe how to run your code in detail.**

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NTU COOL Submission

- Only the team leader need to upload your code to **NTU COOL**.
- You need to upload your presentation or report (either ppt or pdf).
- Deadline: **2022/06/17 23:59.**

- For the **top 3 teams** selected for cash awards, an additional technical report needs to be submitted as well by **6/24 23:59**. We will open another NTU COOL submission place.
  - Approach (e.g., data preprocessing, model architecture, implementation details, hyperparameter choices, etc.)
  - Experiments
  - Maximum **4** pages (exclude reference)
  - A latex template is provided. https://drive.google.com/drive/folders/12Lb7xAcKtBNGWOnlRo0Hl92fqFHcJJ_l?usp=sharing

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Grading

- Quantitative: 50%
  - Both S5 in public set and hidden set will be considered
- Presentation: 50% (top 10 teams)
  - Novelty and technical contribution (20%)
  - Completeness of experiments (25%)
    - comparison with different models, ablation studies, visualization, etc
  - Presentation (5%)
- Bonus: 10%
  - Challenge set

Score	Points	# of teams
highest	**50%**	**1**
	48%	**1**
	46%	**1**
	42%	4
	38%	5
	34%	5
lowest	30%	4

Note:
Only top-10 teams on the final leaderboard (we release after code submission) will be chosen for final presentation.
For other teams, the other 50% will based on your report.

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Report (50%)

- Only other teams (not the top-10) need to write the report
  - Novelty and technical contribution (25%)
  - Completeness of experiments (25%)
    - comparison with different models, ablation studies, visualization, etc

Possible Directions

- Fancy approaches
  - Show us how you formulate the problem into deep learning
  - How do you supervise the confidence estimation?
  - How do you leverage the unlabeled data? Few-shot learning?
  - Object detection? Object tracking?
  - Pre-training on semantic segmentation?
- Classical CV may also be useful
  - Edge detection
  - Motion segmentation
  - Correlation filter
  - Processing in gradient domain
- Hybrid solution

NEW!

Award

- Top 3 teams will receive cash prizes from Ganzin Technology
  - 1st prize: NTD 5,000/team
  - 2nd prize: NTD 3,000/team
  - 3rd prize: NTD 2,000/team

- The final ranking is decided by judges based on the **total points (Quantitative and Presentation)** and the content of your work.

Contact

- 陳昱愷
  - chenyukai@media.ee.ntu.edu.tw