AI-Driven Future of Transportation: Cross-Camera Multi-Target Vehicle Tracking Competition – Model Development Session

Competition Description

In recent years, surveillance camera systems have been widely used on roads due to the demands for home security and crime prevention. Since most surveillance systems are currently based on single-camera recording, each camera operates independently, making it impossible to continue identifying moving objects once they leave the field of view. Additionally, in the event of accidents or criminal incidents, because each camera records independently and there is no mechanism for cooperative operation between cameras, law enforcement agencies must expend significant manpower resources to manually search through surveillance recordings to track the paths and trajectories of suspicious vehicles or pedestrians.

This competition focuses on the technology of cross-camera multi-object tracking to address the above issues. The competition dataset provides videos of vehicles traveling on roads captured by multiple cameras, allowing participating teams to develop AI models for Cross-Camera Multi-Object Tracking. The goal is to detect and identify the same vehicle in different cameras. It is hoped that this competition will deepen Taiwan's AI technology in intelligent transportation and promote its diversified development.

Rules for Registration

1. Anyone over the age of 18 can sign up to participate, while participants under the age of 18 can sign up with the consent of their legal guardian.
2. Industry individuals can also participate, but they will not be eligible to receive awards and prizes from the Ministry of Education. However, they can receive sponsorship prizes from the industry and certificates from the Project Office.
3. Each team can consist of 1 to 5 members.
4. The competition is divided into two sessions: "Model Development Session" and "Parameter Adjustment Session." Participants can only join one team and cannot change teams once they have joined. Each team can only register for one session. After the registration deadline, participants and teams cannot change the session they have registered for.
5. After the registration deadline, changes to the team member list and the number of members are not allowed.
6. Participants can only register for either the Model Development Session or the Parameter Adjustment Session. In case of duplicate registrations, the organizer will notify the team leader by phone or email after the registration deadline and request the team leader to respond by email within a specified period. Failure to respond within the specified period will result in disqualification from the competition, and the team's participation in both sessions will be canceled.

7. Teams cannot be merged or split during the competition.
8. Participants who participate in the competition based on school curriculum requirements should fill in the course code as part of the team name in the registration system to facilitate class grading.

Register method

1. Each member of the registering team must register as a member on "T-Brain AI 實戰吧" (https://tbrain.trendmicro.com.tw/) using a Google or Facebook account.
2. Each member of the registering team must log in to the AI CUP registration system (https://go.aicup.tw/) and fill in the information of each team member as indicated on the registration page (Note 1). After completing the team member registration process, the team can proceed with competition registration.
3. After completing the competition registration on the AI CUP registration system, each team member can participate in the competition on "T-Brain AI 實戰吧" within 1-2 working days.
4. The competition is divided into the student group and the industry group. The student group requires all team members to be students. If there is at least one non-student member within the team, the entire team will be categorized as the industry group.
5. After registration, each participant is requested to assist in completing the pre-competition questionnaire of "AI-Driven Future of Transportation: Cross-Camera Multi-Target Vehicle Tracking Competition – Model Category." [The URL for the pre-competition questionnaire will be provided later.]
6. After the competition ends, each participant is requested to assist in completing the post-competition questionnaire of "AI-Driven Future of Transportation: Cross-Camera Multi-Target Vehicle Tracking Competition – Model Category." [The URL for the post- competition questionnaire will be provided later.]

Note 1: Please refer to the registration process of the AI CUP registration system for registration guidelines. Please fill in the email of each team member registered in "T-Brain AI 實戰吧". If the email filled in the registration page does not match the email of "T-Brain AI 實戰吧" the registration will be considered unsuccessful.

Eligibility Rules for Award

1. The competition is divided into the student group and the industry group. The student group requires all team members to be students. If at least one non-student member is within the team, the entire team will be categorized as a social group.

2. The awards for this competition include the following:
   - 16 awards for the "Student Group Ranking Award"
   - 2 awards for the "Trend Micro Model Execution Efficiency Award"
   - 2 awards for the "Trend Micro Model Design Creativity Award"
   - 1 award for the "Trend Micro Enterprise Special Award"

3. Student Group Ranking Award (Note 2): Winning teams must agree to the following arrangements by the organizer, otherwise they will lose their eligibility for the award:
   - All team members must be currently enrolled students in a college or university in the Republic of China (Taiwan) on the registration date. The team is eligible for the Student Group Ranking Award, and relevant proof should be provided during the award ceremony.
   - The prize money will be awarded in New Taiwan Dollars via bank transfer, and winning teams must comply with the relevant income tax regulations of the Republic of China (Taiwan).
   - Each winning "Student Group Ranking Award" team will be presented with a certificate for their supervising professor. However, the supervising professor cannot register with the students. Please provide the name, institution, department, and contact email of the supervising professor in the final report.
   - If any member of the winning team of the "Student Group Ranking Award" has achieved a top three ranking (including first, second, or third place) in the "Ministry of Education National College Artificial Intelligence Competition (AI CUP)" organized by the Office for "AI Competition and Data Collection" of the Ministry of Education for three times or more, they will only receive a certificate from the Ministry of Education, and no cash prize will be awarded. The cash prize will be awarded to the next ranked team, and both teams will be ranked equally. This provision applies from the Autumn 2022 competition onwards.
   - The top 25% of the overall ranking, as determined by the judging committee (not exceeding 30 teams), will be awarded a certificate from the Ministry of Education or an electronic certificate from the Office for AI Competition and Data Collection. However, the supervising professor cannot register with the students. Please provide the name of the supervising professor in the registration system and the final report.

4. **Trend Micro Model Execution Efficiency Award** and **Trend Micro Model Design Creativity Award**: Winning teams must agree to assist with the following arrangements by the organizer, otherwise they will lose their eligibility for the award:
   - The eligibility for these awards is not restricted to any specific groups.
   - The evaluation criteria are based on the potential for presenting conference papers, which may include problem statements, method optimization, and innovative ideas, while also considering the completeness, accuracy, and originality of the report (evaluation criteria are subject to adjustment). If the evaluation criteria are not met, the award may be vacant.

- These awards are not based on leaderboard scores or rankings.
- Each winning team will receive a cash prize of NT$10,000. At least one member of the team must be a citizen of the Republic of China (Taiwan) or hold a work or student visa for the Republic of China (Taiwan) to be eligible for the award.
- The cash prize will be awarded in New Taiwan Dollars via bank transfer. The winning team should appoint a team member with a local New Taiwan Dollars account to receive the prize money on behalf of the team, and this member will be the tax declarant for the Republic of China (Taiwan), signing relevant documents including tax and personal data usage according to regulations.

5. **Trend Micro Enterprise Special Award**: Winning teams must agree to assist with the following arrangements by the organizer, otherwise they will lose their eligibility for the award:
   - The eligibility for this award is not restricted to any specific groups.
   - The scoring criteria are based on the use of generative AI, data augmentation, or external data. If the submissions do not meet the standard, the decision to vacate the award will be made by the selection judging committee of the organizer.
   - This award is not based on leaderboard scores or rankings.
   - The winning team will receive a cash prize of NT$10,000. At least one member of the team must be a citizen of the Republic of China (Taiwan) or hold a work or student visa for the Republic of China (Taiwan) to be eligible for the award.
   - The cash prize will be awarded in New Taiwan Dollars via bank transfer. The winning team should appoint a team member with a local New Taiwan Dollars account to receive the prize money on behalf of the team, and this member will be the tax declarant for the Republic of China (Taiwan), signing relevant documents including tax and personal data usage according to regulations.

6. Explanation of Award Eligibility:
   - Participants can only register for either the Model Development Session or the Parameter Adjustment Session. If duplicate registrations occur, the organizers will notify the teams by phone or email after the registration deadline. The team leader must then respond via email within the specified period to indicate their preferred session. Failure to respond within the specified period will result in disqualification from the competition, and the team's participation in both sessions will be canceled.
   - The final score is based on the following components: (1) the team's performance on the Public Dataset, accounting for 30%; and (2) the team's performance on the Private Dataset, accounting for 70%.
   - However, winning teams must be among the top 25% of the overall ranking (not exceeding 30 teams) and must submit a model explanation and methodology report within the specified deadline. The report must be deemed complete by the majority vote of the judging committee during the committee meeting to qualify for the award.
   - Winning teams must submit original code that is reproducible and can be used to validate the model within the specified deadline. The code should be in Jupyter Notebook format and

executable on Google Colab to verify its correctness.

- Reports must include the content items specified by the organizer and the evaluation criteria include the completeness and correctness of the report. The judging committee, composed of experts from the Office for AI Competition and Data Collection of the Ministry of Education, will determine the content of the report.

- For the top 25% of teams in the overall ranking (not exceeding 30 teams), after submitting the report as required and passing the review by the organizer's judging committee, winning teams in the student group will receive a certificate from the Ministry of Education. Winning teams in the industry group are not eligible to receive certificates and cash prizes from the Ministry of Education, but they will receive an electronic certificate from the Office for AI Competition and Data Collection of the Ministry of Education, as well as sponsorship prizes from the industry. If a team in the industry group ranks first, it will be noted as "Ranked 1st overall" on the certificate.

- The allocation of awards may be adjusted depending on the number of entries and performances. If submissions do not meet the standard, the decision to vacate the award or selection of fewer winners will be made by the judging committee of the organizer.

- Winning teams must have at least one representative to participate in the subsequent award ceremony as notified by the organizer. If there is no teammate available to assist, they may invite one friend or family member to attend the award ceremony and share the presentation.

- To meet the requirements of registration qualification review and award document verification, please ensure that the Chinese name on your T-Brain registration account is correct. If necessary, corrections can be made in the "My Profile" section of your T-Brain account.

- Except for the Student Group Ranking Award, other awards can be received repeatedly and are not limited to the identity of the participating teams.

Note 2: If there are industry groups among the top 16 rankings, the slots for Student Group Ranking Awards will be filled sequentially by the next student teams in line. These teams will receive certificates and cash prizes from the Ministry of Education.

Grading Criteria

1. File submissions should use the .csv format and follow the competition format guidelines. Please upload the file content using UTF-8 encoding (without BOM) and Unix system line breaks. Do not use other non-printable characters to avoid potential scoring failures.

2. The Public Leaderboard system evaluates each submission and presents the highest score on the Public Leaderboard. The Private Leaderboard uses the score from the Private Dataset of the highest-scoring submission on the Public Dataset as the ranking basis. In case of tie scores among participating teams, the submission upload time will determine the ranking order.

3. The competition consists of two execution stages:
   - Stage 1 (Training, 3/15 to 5/30): The Public Training Dataset is released, and teams conduct modeling and training.
   - Stage 2 (Testing, 5/28 11:00 AM to 5/30 4:00 PM): The testing datasets for this stage - Public Dataset and Private Dataset - are released. Both datasets do not include ground truth. Teams upload their answers to the competition platform within three days of the competition. The scores for the Public Dataset will be publicly available in the Submission History and Public Leaderboard. During Stage 2, teams can submit a maximum of 3 times per day. Scores from both the Public Leaderboard and Private Leaderboard will contribute to the final score calculation. The final ranking of the top 30 teams will be announced on 6/3 (Monday).

4. During Stage 2 of the competition, participating teams will receive scores from the Public Leaderboard evaluation. At the end of the competition, the results of the Private Leaderboard will be announced separately. The ranking will be based on the score of the highest-scoring submission on the Private Dataset corresponding to the highest-scoring submission on the Public Dataset. The final ranking will be determined based on the scores from both the Public and Private Leaderboards. The top 30 teams will undergo a report review to confirm eligibility for awards.

5. The evaluation criteria for the final scores of teams undergoing report review include the following components: (1) Performance on the Public Dataset, accounting for 30%; (2) Performance on the Private Dataset, accounting for 70%. Teams undergoing report review must submit model explanations, method reports, and Colab code before the announcement deadline. Eligibility will be determined by a majority vote of the judging committee regarding the completeness of the report.

Grading Method

This competition utilizes two metrics, IDF1 Score and MOTA, to evaluate the ranking of participating teams. The scores of these two metrics will be combined additively to determine the final result. Below are explanations and formulas for each metric:

IDF1 Score: After obtaining True Positives (TP), False Positives (FP), and False Negatives (FN) for each ID, Precision and Recall are calculated. This metric is used to measure the accuracy of tracking IDs. It can be represented by the following equations:

$$IDP = \frac{IDTP}{IDTP + IDFP}, \qquad IDR = \frac{IDTP}{IDTP + IDTF}$$

$$IDF_1 = 2\frac{IDP * IDR}{IDP + IDR} = \frac{2IDTP}{2IDTP + IDFP + IDFN}$$

The ID of the bounding box that detects and matches the ground truth bounding box the most is considered the correct ID. IDTP, IDFN, and IDFP are defined as follows:
- IDTP: Bounding boxes in the detection results that match the ground truth and have consistent IDs are considered as IDTP.
- IDFN: The number of ground truths that were not correctly matched, calculated as the ground truth minus IDTP.
- IDFP: The number of bounding boxes in the detection results that failed to match the ground truth, calculated as the total number of detection results minus IDTP.

MOTA (Multiple Object Tracking Accuracy) is an indicator used to measure the accuracy of multiple object tracking. It is represented by the following formula:

$$MOTA = 1 - \frac{FN + FP + IDS}{GT}$$

The explanations for FN, FP, IDS, and GT are as follows:
- FN: False Negative refers to the instances where a positive sample is incorrectly predicted as negative, specifically when a bounding box in the ground truth is not detected by the model.
- FP: False Positive indicates instances where a negative sample is incorrectly predicted as positive, particularly when a bounding box not present in the ground truth is detected by the model.
- IDS: ID-switch count refers to the number of times a tracking trajectory undergoes ID switching.
- GT: Ground truth represents the total number of ground truth instances.

The final score is the sum of IDF1 Score and MOTA, expressed by the following formula:

$$Total\ Score = \frac{2IDTP}{2IDTP + IDFP + IDFN} - \frac{FN + FP + IDS}{GT} + 1 = IDF_1 + MOTA$$

Competition Rules

1. The competition is divided into two sessions: the Model Development Session and the Parameter Adjustment Session. In the Model Development Session, participating teams may either construct various sub-models of cross-camera tracking systems or modify the baseline models provided by the organizer.

2. Participating teams may employ generative AI to augment data or utilize additional open-source resources to enhance model training results. However, it is imperative that machine learning/deep learning models are employed for vehicle tracking. Manual corrections to vehicle tracking results are strictly prohibited. Should additional external data sources be utilized, the relevant sources must be disclosed in the written report submitted after the competition. In the event of disputes, the organizer retains the right to make the final decision.

3. In the case of employing additional custom data or external open-source data, including but not limited to third-party open-source programs sourced online or reference code provided by instructors during classes, it is mandatory to provide the sources in the written report submitted after the competition. Participants must also elucidate the contribution of external data to the competition results. In the event of disputes, the organizer retains the right to make the final decision.

4. There are no restrictions on the platforms used during the training phase. To ensure fairness, the top 30 ranked teams must submit the same implementation code and final report executable on Google Colab after the competition ends. The submitted code must be the model with the highest performance on the Public test dataset. The report should follow the writing instructions provided by the organizers and include (but not limited to) (1) team members; (2) model algorithm explanation; (3) data preprocessing, data augmentation, and generative AI usage methods; (4) complete code; (5) program execution environment; (6) model weight files. The code must be executable and produce consistent results with the final submission; otherwise, it may affect the eligibility for awards. The report will be reviewed by a panel of experts from the Ministry of Education's AI Competition and Annotation Data Collection Project Office, and the completeness and correctness of the report will affect the award eligibility and ranking. In cases where formidable impediments preclude the submission of executable code in Jupyter Notebook format on Google Colab, alternative forms of code submission are permissible, subject to jury approval.

5. Participants are strictly prohibited from manually correcting the answers uploaded to avoid compromising the fairness of the competition.

6. Post-competition reports should be composed independently. Nevertheless, they may be publicly discussed in the official discussion forum, and sharing and discussion among other teams for reference is permissible.

7. Teams must exercise caution to protect data processing, model code, and related concepts. Sharing or transferring data, code, draft reports, or any other materials privately with other teams during the competition is strictly prohibited. Should reports and codes submitted by different teams be found to be similar, it will affect the evaluation scores of all involved teams, and severe cases may result in the direct disqualification of awards.

8. The organizer retains the right to adjust the datasets during the competition if deemed necessary.

9. The organizer reserves the right to disqualify participants or revoke award eligibility without prior notice in the following situations:
    - Concrete evidence indicates that a team has engaged in any form of plagiarism, cheating, or fraud.
    - Concrete evidence indicates that a team has violated the intellectual property rights of others.
    - Concrete evidence indicates that a team has attacked the Leaderboard system.
    - Concrete evidence indicates that a team has influenced other participating teams, resulting in unfair incidents.
    - A team has violated the rules of the competition, the terms of use of the "T-Brain AI Practical Platform," or the terms of use for participants of the "AI-Driven Future Mobility: Cross-Camera Multi-Object Vehicle Tracking Competition."
10. The organizer reserves the right to interpret and adjudicate on the activities and competition rules.

Award Description

AI-Driven Future of Transportation: Cross-Camera Multi-Target Vehicle Tracking Competition – Model Development Session (Student Group Ranking Awards: Total prize money of NT$180,000.)

Award Name	Number of Awards	Prize Money
1st Place	1	NT$50,000
2nd Place	1	NT$30,000
3rd Place	1	NT$20,000
Excellence Award	3	NT$10,000
Honorable Mention Award	10	NT$5,000

For the top 16 teams in the student group, in addition to the prize money awards, they will also receive the "Certificate of Excellence" from the Ministry of Education. From the 17th place to the top 25% of the total ranking (not exceeding 30 teams), regardless of identity, teams are required to submit reports according to the regulations. After review by the organizers' judging committee, they will receive the "Electronic Certificate of Excellence" from the Project Office.

- [Trend Micro Model Execution Efficiency Award]   NT$10,000
- [Trend Micro Model Execution Efficiency Award]   NT$10,000
- [Trend Micro Model Design Creativity Award]   NT$10,000
- [Trend Micro Model Design Creativity Award]   NT$10,000
- [Trend Micro Enterprise Special Award]   NT$10,000

Competition Schedule

Project	Schedule	Description
Registration	2024/03/01 – 2024/05/22	Registration opens on 03/01 and the competition officially starts on 03/15.
Stage 1: **Training Dataset Downloading and Model Training**	2024/03/15 – 2024/05/30	1. Teams can download the Training Dataset on the same day the competition officially starts. They can test it on any platform. 2. T-Brain does not provide answer submission and scoring functions during this phase.
Stage 2: **Testing Dataset Downloading and Scoring**	2024/05/28 11:00 – 2024/05/30 16:00	1. Teams can download both the Public Dataset and Private Dataset starting from 11:00 AM on 05/27. The unzip password will be announced in the announcement area of the official website on 05/28 at 11:00 AM. Note: Please download in advance to avoid peak download times that may affect competition time utilization. 2. Answer submission and scoring for the Testing Dataset: From 11:00 AM on 05/28 to 4:00 PM on 05/30, three days. Teams can submit up to 3 times per day. Note: The submitted answer file must include answers for both Public Dataset and Private Dataset to avoid affecting the final score calculation. 3. During this period, participants can obtain the evaluation results of the Public Dataset for reference, while the evaluation results of the Private Dataset will not be disclosed. 4. Participants must upload their answers within the specified time, and the answer format must comply with the scoring method instructions.
Announcement of Results	2024/06/03	1. Announcement of the Private Leaderboard (based on the score of the Private Dataset from the highest score of the Public Dataset). 2. Announcement of the list of teams in the top 25% of the final overall score (not exceeding 30 teams).

Submission and Uploading Report	2024/06/03 – 2024/06/11	1. Teams in the top 25% of the final score must submit executable code that can be run on Google Colab, including preprocessing code, training code, recognition code, setting of various parameters (including training weights), and execution environment. The report should provide detailed explanations such as Model size, time, number of parameters, and memory usage. The executability and verifiability of the code will affect the report score. 2. The submitted code must be the model with the highest score in the Public test dataset. If there is any inconsistency between the execution result of the code and the submitted result, or if the submitted work does not meet the requirements, the team's eligibility for the award will be canceled, and relevant supplementary procedures will be carried out.
Announcement of Winners	2024/07/15	The final list of winners will be announced on the T-Brain platform and the AI CUP official website.
Awards Ceremony and Competition Commencement	Expected in early 2025 (tentative)	Details of the awards ceremony will be announced separately. Winners are requested to attend the award ceremony according to the notification from the AI CUP Project Office.