ITU AI/ML in 5G Challenge 2022

Participation guidelines (Version 07; 23 June 2022)

Contents

1 Executive Summary

The ITU AI/ML in 5G Challenge rallies like-minded students and professionals from around the globe to solve real-world problems in communication networks by applying artificial intelligence (AI) and machine learning (ML).

- **Global reach:** The first edition of the Challenge was conducted in 2020. Over 1'300 students and professionals from 62 countries participated in the inaugural edition. The second edition took place in 2021 with more than 1'600 participants from 82 countries.
- **Timeframe:** The ITU AI/ML in 5G Challenge consists of the following stages:
  - Curation Phase: February – May 2022
  - Competition Phase: June – October 2022
  - Evaluation Phase: November – December 2022
- **Teams** comprising 1 to 4 members solve problem statements. Teams will be required to enable, create, train, and deploy ML models such that participants will acquire hands-on experience of AI/ML in communication networks.
- **Problem statements** are provided by hosts. A host in general is a university, a company, or an organization.
- **Participation** is open to any individual from one of the 193 Member States of the ITU. No membership in ITU or any other organization is required.
- All participants must adhere to a **code of conduct**.
- **Motivation of participants**: Teams compete for prizes, ITU certificates and global recognition. They value the opportunities to learn, to publish their findings in per-reviewed journals (see below), to network with other colleagues, and to find employment opportunities and internships.
- **Compute platform:** ITU provides a state-of-the-art, free-of-charge compute platform to participants of the Challenge who do not have adequate access to compute in their respective institutions. The compute platform will provide participants with access to:
  - Free GPUs and CPUs
  - Hosted Jupyter notebook server
  - Python kernel
  - Pre-installed machine learning packages, e.g. PyTorch and Tensorflow

  In some of the problem statements, a baseline or reference solution may be offered which may include implementations using Jupyter notebooks.
- **Mentoring**: Several activities accompany the Challenge such as webinars, roundtables, and hands-on sessions. The ML5G Discovery Channel of the AI for Good platform features related events (https://aiforgood.itu.int/eventcat/discovery-ml5g/) are all available for replay.
- **Playoffs:** The (up to) three best teams selected by the hosts of their respective problem statements advance to the Playoffs, a 2-3 day event in the November/December time frame where teams compete against the best teams across all problem statements. The Challenge culminates in the **Grand Challenge Finale** in December, an award ceremony where the best teams of the Playoffs receive global recognition through prizes and ITU certificates.

- **Prizes and certificates:**
    - The best team for each of the problem statements will receive a cash prize of 1'000 CHF if the Judges Panel determines that the solution satisfies the judging criteria.
    - The best teams across all problem statements, selected from the Playoffs and the Grand Challenge Finale, will receive a cash prize of 3'000 CHF, the runner-up 2'000 CHF.
    - Hosts of problem statement may issue additional prizes.
    - ITU will also issue various types of certificates to teams who submitted valid solutions to the Challenge.
- All events take place **online**.
- Participants are encouraged to submit **open-source solutions**.
- **IPRs (Intellectual Property Rights)** belong to the submitter of the solution.
- **Publish**: Solutions from the AI/ML in 5G Challenge submitted to the peer-reviewed ITU Journal "Future and evolving technologies" (Editor-in-Chief: Prof. Ian Akyildiz, 135'000 citations, Google scholar h-index 132) will be published in a special issue. The ITU Journal is free-of-charge for both readers and authors.
    - Published papers from the 2020 Challenge: https://www.itu.int/en/journal/j-fet/2021/005.
    - Published papers from the 2021 Challenge: https://www.itu.int/en/journal/j-fet/2022/004.
- **Sponsorship**: For sponsorship inquiries, please reach out to https://aiforgood.itu.int/sponsor/.
    - The 2020 edition of the AI/ML in 5G Challenge was sponsored by
        - Gold Sponsor TRA (United Arab Emirates)
        - Bronze Sponsors Cisco (USA) and ZTE (China).
    - The 2021 edition was sponsored by
        - Xilinx
        - Ministry of Science and ICT (MSIT), Republic of Korea.
    - The 2022 edition is sponsored by
        - Ministry of Science and ICT (MSIT), Republic of Korea
        - ZTE.
    - AIIA (Artificial Intelligence Industry Association, China) and Jarvislabs.ai (India) and are technical partners.

2 Participation

Participation is open to ITU members and any individual from one of the 193 ITU Member States. No membership in ITU or any other organization is required.

"Participants" are individuals or teams that participate in the ITU AI/ML in 5G Challenge, providing solutions to problem statements of the Challenge. In past Challenges, slightly more students than professionals participated.

Participants can form teams comprising 1-4 members. Experts will mentor participants on problems, providing guidance and good practices for participation in this Challenge.

3 Problem statements

3.1 Problem statements

Participants will be able to solve problem statements, i.e., real-world problems, some of which are based on ITU standards for ML in future networks, with access to real-world and simulated data, collected and curated by experts.

Teams will be required to enable, create, train and/or deploy ML models such that participants will acquire hands on experience in AI/ML in areas relevant to future networks.

The host is the entity which defines and provides the problem statement including data. The host can be a university or a company (e.g. an equipment manufacturer, a telecom operator, or others) or an organization. Participants are required to pick one or more of the problem statements they are interested to work on.

3.2 Data privacy policy

Data will be handled in accordance with policies and regulations relevant to the entities and data concerned. Data may be pre-processed and provided using pre-published APIs, and may be secured using login/token. Data handling APIs (according to ITU-T Y.3174) will be provided based on the use case and filtered based on the policies of the involved organization(s). Data anonymization may be applied according to relevant policies and regulations. A non-disclosure agreement (NDA) may be included in the terms of participation. In cases where the Challenge involves local user data, the results may be presented in the form of a competition paper not including local user data. API access to data shall be monitored and licensed based on agreement. Some test data set may be private and will not be disclosed.

NOTE - Some problem statements use "**restricted data**" which is available only under certain conditions set forth by the host as follows:

Example 1: Restricted data may be made available after signing an NDA.

Example 2: Restricted data may be available only for use within the hosted platform and not for moving out of the hosted platform (i.e., no downloading of data may be allowed).

Example 3: Restricted data may be available to citizens of a particular country or region, e.g. under data privacy regulations of specific regions.

3.3 Training and testing data

Training, validation, and testing data will be provided by the host. Data will be hosted either by the host or by ITU.

4 Phases and Governance Structure

4.1 Three Phases

The Challenge consist of three phases:

- Curation Phase of problem statements: February – May 2022
- Competition Phase: June – October 2022
- Evaluation Phase (Playoffs, Grand Challenge Finale): November – December 2022

4.2 Governance Structure

4.2.1 Challenge Management Board

The Challenge Management Board comprises individuals with the expertise to advise on technical and governance aspects of the ITU AI/ML in 5G Challenge.

The Challenge Management Board coordinates the Challenge in alignment with the hosts, working together to ensure the success of the Challenge.

4.2.2 Judges Panel

The Judges Panel comprises individual experts who will evaluate the progress and merit of the solutions proposed by the participants. The Judges Panel evaluates entries in the Playoffs and the Grand Challenge Finale. Individuals in the Judges Panel will be selected by the Challenge Management Board.

4.2.3 Administrative support of the Challenge

The ITU Secretariat provides administrative support for the ITU AI/ML in 5G Challenge, in collaboration with the hosts, collaborators, participants, the Challenge Management Board and the Judges Panel.

5 Phase 1: Curation Phase

The table below is the template that is used for the submission of problem statements for the ITU AI/ML in 5G Challenge.

Table 1: The template for a problem statement

Id	ITU-ML5G-PS-TEMPLATE
Title	<<Add a title for the problem statement>> e.g. ”Where is WALDO? - sensing using mmWave communications and ML”
Description	NOTE 1 - include a brief overview followed by a description about the problem, its importance to IMT-2020 networks and ITU, highlight any specific research or industry problem under consideration.
Evaluation criteria	NOTE 2 - this should include the expected submission format e.g. video, comma separated value (CSV) file, etc. NOTE 3 - this should include any currently available benchmarks. e.g. accuracy.
Data source	NOTE 4 - e.g. description of private data which may be available only under certain conditions to certain participants, pointers to open data, pointers to simulated data.
Resources	NOTE 5 - e.g. simulators, APIs, lab setups, tools, algorithms, add a link in clause 2.
Any controls or restrictions	NOTE 6 - e.g. this problem statement is open only to students or academia, data is under export control, employees of XYZ corporation cannot participate in this problem statement, any other rules applicable for this problem, specific IPR conditions, etc.
Specification/Paper reference	NOTE 7 - e.g. arxiv link, ITU-T link to specifications, etc.

Contact	NOTE 8- email id or social media contact of the person who can answer questions about this problem statement.

6 Phase 2: Competition Phase

6.1 Participant Registration

The participants registered for the ITU AI/ML in 5G Challenge will choose one or more problem statements, depending on their interests, and provide solutions to the problem statement(s).

The problem statements are collected in the ITU document "Problem statements and data resources" available here: https://aiforgood.itu.int/about-ai-for-good/aiml-in-5g-challenge/.

Participants can register at the ITU website (Problem Statement Portal: https://challenge.aiforgood.itu.int/match). The ITU Secretariat will assist participants who register at the ITU website in selecting problem statements and connecting them with a specific host if necessary.

For some problem statements, participants can also register with the host. The host will coordinate with ITU to extend support and guidance.

Participants should start tackling the problem statement as soon as registrations opens, and submit solutions during the competition phase.

6.2 Guidance and Mentoring

Hosts of problem statements may provide baseline code/models as a starting point for participants. During the competition phase, ITU, in conjunction with hosts, will hold webinars to describe the problem statements, round-tables, and hands-on-sessions to help participants advance smoothly and submit their solutions.

The host will present the problem statement as part of the ITU ML5G Webinar series, a curated series of expert talks on AI/ML in communication networks. The format is one hour, about 45 min for the talk, plus 15 min Q&A. The talks are recorded and available for replay (https://aiforgood.itu.int/eventcat/discovery-ml5g/).

6.3 ITU Challenge Compute Platform

ITU has put together a state-of-the-art compute platform hosted on its Geneva premises. The compute platform is provided free-of charge to registered participants of the Challenge who lack adequate compute resources. The resources will be provided on a need basis. The compute platform will provide participants with access to:

I. Free GPUs and CPUs
II. Hosted Jupyter notebook server
III. Python Kernel
IV. Pre-installed machine learning packages, e.g. PyTorch and Tensorflow

In some of the problem statements, a baseline or reference solution may be offered which may include implementations using Jupyter notebooks.

To allow fair access to the ITU Challenge compute platform for all participants with needs, access will be time-limited. Participants must use the ITU Compute Platform only for the purposes of the Challenge.

Participants are asked to fill out the request form available on the website of the ITU AI/ML in 5G Challenge.

7 Phase 3: Evaluation Phase

7.1 Evaluation of solutions submitted to a problem statement

The host of a problem statement evaluates the solutions from participants using the evaluation criteria set out by the host. The evaluation criteria are contained in the respective descriptions of the problem statement.

In general, the following points serve as a guide in evaluating solutions:

- Novelty & originality.
- Performance (evaluation based on performance measures such as accuracy, speed, scalability and quality).
- Resource needs (memory, CPU, size or others), evaluated with respect to the design criteria
- Status and maturity of technical implementation, reproducibility.
- Robustness under failure conditions
- Viability & impact on market (practicality of the solution and significance of its impact).
- Ease of integration (e.g. via (ITU) standard APIs, containers etc.)
- Interoperability and mapping to international standards (including ITU standards), as appropriate.
- Documentation.
- Quality of demonstration and presentation at the Playoffs and the Grand Challenge Finale.

Some criteria are objective, while others are subjective and dependant on the human beings who are evaluating the solution.

Scores will be displayed on a leaderboard.

The host chooses the (up to) three best teams for their problem statement to advance to the Playoffs. However, the host may select fewer than three teams (or perhaps even no team) to advance to the Playoffs if the quality of submissions does not meet the judging criteria established by the host.

The winner of each problem statement receives a cash prize. The best teams of each problem statement also receive certificates (see below).

Some hosts of problem statements may wish to hold a final event specific to their problem statement where they may give out prizes.

7.2 Advancing to the Playoffs

7.2.1 Who qualifies for the Playoffs

The (up to) three best teams of each problem statement advance to the Playoffs. In the Playoffs, the best teams of each problem statement compete across the board with the best teams of all the other problem statements for the overall winner of the Challenge.

The Playoffs are a 2-3 day open online event (about three hours each day), to be held in the November/ December 2022 timeframe, where each of the teams will present their solution to a Judges Panel. The Judges Panel evaluates the best solutions across all problem statements.

Teams are encouraged to submit an updated solution to the Playoffs. Those submissions could form the basis of possible submissions to the ITU Journal on Future and Evolving Technologies.

Teams may be asked to provide additional material for the Playoffs:

- Demo video (short, can be uploaded to the Challenge website) as appropriate.
- A slide deck explaining the concept and solution using AI/ML in 5G.
- A brief paper / report explaining the problem and solution, with, as appropriate, a section explaining the relationship to standards, e.g. ITU-T Y.3172 "Architectural framework for machine learning in future networks including IMT-2020", or any other standard.

7.2.2 Additional output for open-source code submissions to the Grand Challenge Finale

In the case that the output will be shared as open source, participants are expected to provide in addition the following for the Playoffs:

- Final version of the code.
- Reproducibility: it is recommended that participants create a docker image which contains all dependencies and environments required for the algorithm to run.
- ReadMe file containing the description of the algorithm.
- Minimum system configuration required to run the algorithm.
- Details of any data used to train the model (metadata).
- Another key value-add would be the alignment of open source with standards – the application of standards-based ML mechanisms in 5G would be encouraged in open source as part of this Challenge. Wherever applicable, outcomes of the Challenge will be encouraged to be shared in an open forum as an open-source project.
- Test cases and results which proves the benefits of the solution.

7.2.3 Additional output for proprietary code submissions to the Grand Challenge Finale

In the case that the output is proprietary (not open source), participants are expected to provide in addition the following for the Playoffs:

- Reproducibility: It is recommended that participants create a docker image which contains all dependencies and environments required for the algorithm to run.
- ReadMe file containing the description of the algorithm.
- Minimum system configuration required to run the algorithm.
- Details of any data used to train the model (metadata).
- Test cases and results demonstrating the benefits of the solution.
- Licence statement.

7.3 Advancing to the Grand Challenge Finale

7.3.1 Who qualifies for the Grand Challenge Finale

The best teams of the Playoffs, as determined by the Judges Panel, will advance to the Grand Challenge Finale, a 2-hour awards ceremony in December 2022.

7.3.2 Prizes

The following prizes will be awarded:

- **Prize per problem statement**: The winner of each problem statement will receive a cash prize of 1'000 CHF as determined by the Judges Panel. Not every problem statement may necessarily have a winner if the quality of the solution does not satisfy the judging criteria. The Judges Panel may also decide to split the prize.
- The respective host of a problem statement may hand out additional prizes.
- **Prize across all problem statements**
  - Overall Best Solution [ITU AI/ML in 5G Challenge Gold Champion] 3'000 CHF
  - Overall Best runner up solution [ITU AI/ML in 5G Challenge Silver Champion] 2'000 CHF

  The Judges Panel may decide to split prizes.
- **Audience prize**, based on a customized poll run by ITU during the Grand Challenge Finale: 300 CHF.
- **Student award**: 500 CHF.

There may be additional prize categories as determined by the Judges Panel.

7.3.3 Certificates

ITU will issue various categories of certificates such as:

- Winners' Certificate Gold
- Winners' Certificate Silver
- Winner per problem statement
- Honorable Mention
- Encouragement award
- Certificate of participation, Finalists Playoffs
- Certificate of participation, Finalists Grand Challenge Finale
- Certificate of participation (for teams who submitted a valid solution but were not among the top teams)

Below are the cerificates of last year's overall winners.

Figure 2: Winners of the Grand Challenge Finale 2021

8 Standards, open source and IPR

8.1 Standards

ITU has developed a range of standards-based Machine Learning mechanisms in 5G. The goal is to provide a full toolkit to build Machine Learning into networks. Participants of the ITU AI/ML in 5G Challenge are encouraged to base their work on international standards.

8.2 Open Source

The Challenge encourages the submission of open-source implementations, based on (ITU) standards. Open-source implementations will enable a broad range of stakeholders to access the outcomes of the Challenge and continue collaborating with relevant Challenge participants.

However, solutions based on proprietary implementations may also be accepted based on conditions in the problem statement.

8.3 Quality of Submissions and intellectual property rights

Submissions must be original unpublished works that are not currently under review by another contest or journal and must be solely owned by the participant. In addition, Submissions must not: (a). violate the intellectual property rights of third parties; (b). be illegal under applicable national laws and international law; and (c). depict or incite hatred, defame, abuse, harass, stalk, threaten a specific person or social group, incite violence or conflict or otherwise violate the legal rights of third parties (including those of privacy and publicity).

Participants will retain the intellectual property rights on the contents of their submissions. However, each participant grants ITU a limited, non-exclusive, global royalty-free right and license to use, reproduce, communicate, demonstrate, make available for public display, and distribute the contents of his/her submission for ITU's and the Challenge's, informational and educational or awareness purposes, via digital or other means, including ITU's website. The participant hereby represents that he/she has the legal right to grant such license to ITU.

By entering the Challenge, each participant agrees to release and hold ITU harmless from and against any and all claims, expenses, and liability, including but not limited to negligence and damages of any kind to persons and property, infringement of trademark, copyright or other intellectual property rights arising out of or relating to their participation in the Challenge and the contents of their submissions.

9 Code of Conduct

All participants must adhere to the following code of conduct:

1. Participants will treat each other, other teams and participants with respect, professionalism, fairness, and sensitivity to our many differences and strengths.
2. All discussions will be courteous. Participants must not accept or engage in abusive behaviour in any form, whether it is verbal, physical, sexual, or implied.
3. We value giving credit when credit is due. Participants must only take credit for their own original work. Where required, participants shall add citations and give credits to others. Plagiarism will result in immediate disqualification from the Challenge.
4. Judges' decisions will be final.

10 Sponsorship

The sponsorship package at the Diamond, Gold, Silver and Supporter level is available upon request (ai5gchallenge@itu.int), or reach out to https://aiforgood.itu.int/sponsor/.

11 Benefits

11.1 Benefits for partners

The Challenge offers partners the following:

- Visibility throughout the year
- Find global talent
- Find innovative solutions to your AI/ML use cases in networks.

11.2 Benefits for participants

- Shape the future: Opportunity to define, provide inputs and shape the technologies related to AI/ML and 5G networks.
- Create your network: Network with ITU experts and peers.
- Be practical: Platform to gain hands-on experience related to AI/ML and concepts related to future networks.
- Be known: Gain global recognition in the form of prizes, appreciation and publications of the results in the ITU News Magazine and ITU Journal on Future and Evolving Technologies (ITU J-FET; https://www.itu.int/en/journal/j-fet), subject to acceptance.

- Realize your dreams: Receive expert support to implement use cases and technology ideas using software and access to platforms, e.g. baseline solutions, notebooks and toolsets.
- Employment and internship opportunities.
- Free (hosted) access to AI/ML platforms and GPUs.

11.3 Special Benefits for certain sponsor categories

- Brand visibility on ITU's AI for Good platform, supported by 40 United Nations organizations; ML5G webinar series, weekly newsletters; promotion campaigns (see sponsorship package for details)
- Program opportunities
- Media opportunities

The 2020 edition of the AI/ML in 5G Challenge was sponsored by

- Gold Sponsor TRA (United Arab Emirates)
- Bronze Sponsors Cisco (USA) and ZTE (China).

The 2021 edition was sponsored by

- Xilinx
- Ministry of Science and ICT (MSIT), Republic of Korea.

The 2022 edition is sponsored by

- Ministry of Science and ICT (MSIT), Republic of Korea
- ZTE.

AIIA (Artificial Intelligence Industry Association, China) and Jarvislabs.ai (India) are technical partners.

12 Contact

Email: AI5GChallenge@itu.int

Website: https://aiforgood.itu.int/ai-ml-in-5g-challenge/

Problem Statement Portal: https://challenge.aiforgood.itu.int/match

Slack Channel: itu-challenge.slack.com