ITU AI/ML in 5G Challenge Open House and Roundtable No. 2

19 August 2020

ITUEvents

ITU
AI/ML in 5G
Challenge
Applying machine learning in communication networks

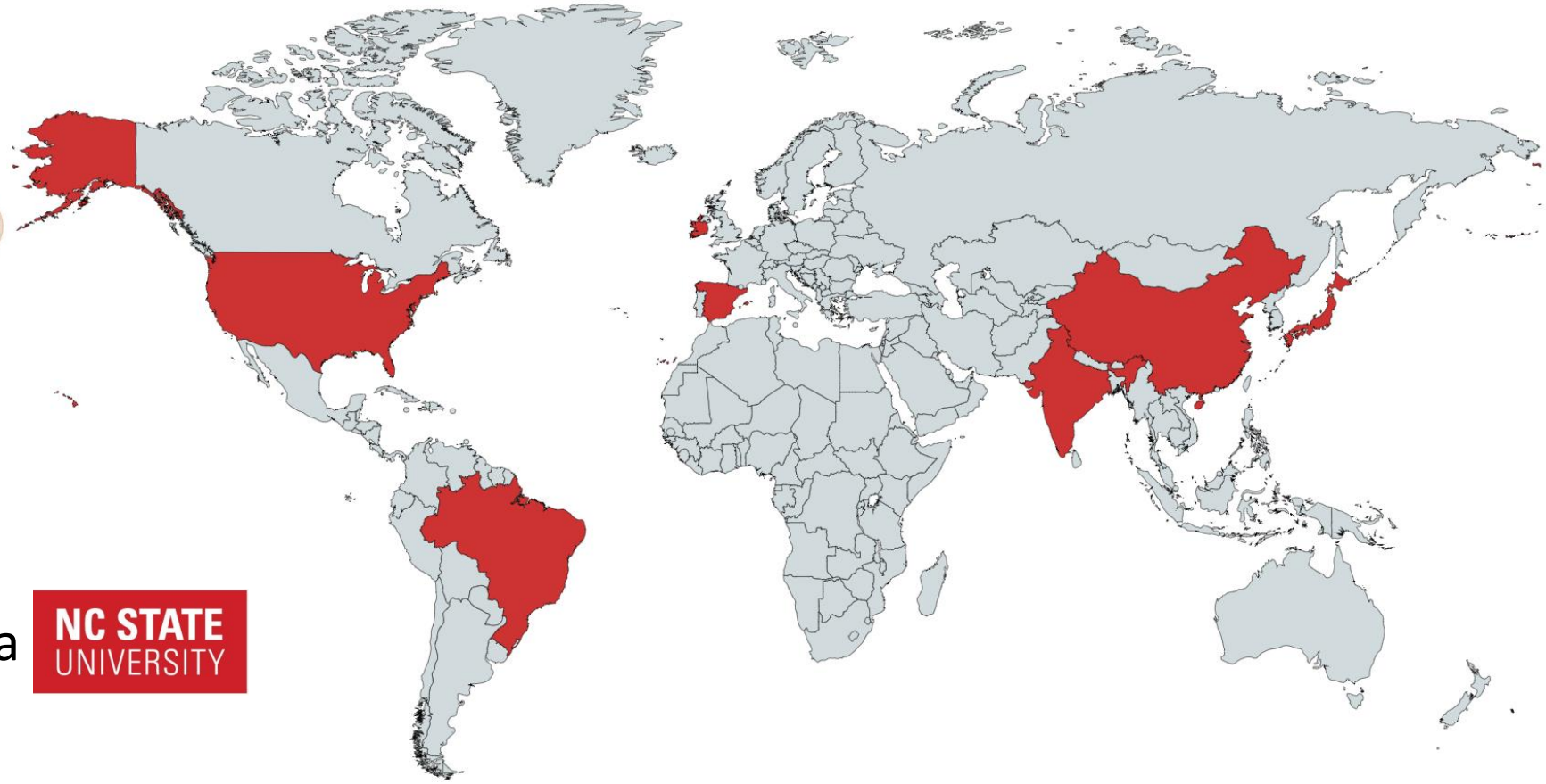
ai5gchallenge@itu.int

Sponsors: cisco ZTE

Organizer: ITU

Regional Hosts for Global Round

1. China
2. Spain 1
3. Spain 2
4. Brazil
5. India
6. Ireland
7. United States of America
8. Japan
9. Turkey
10. Adlik/ZTE



Sponsors and Promotional Partners

Sponsorship

- Cisco Systems and ZTE

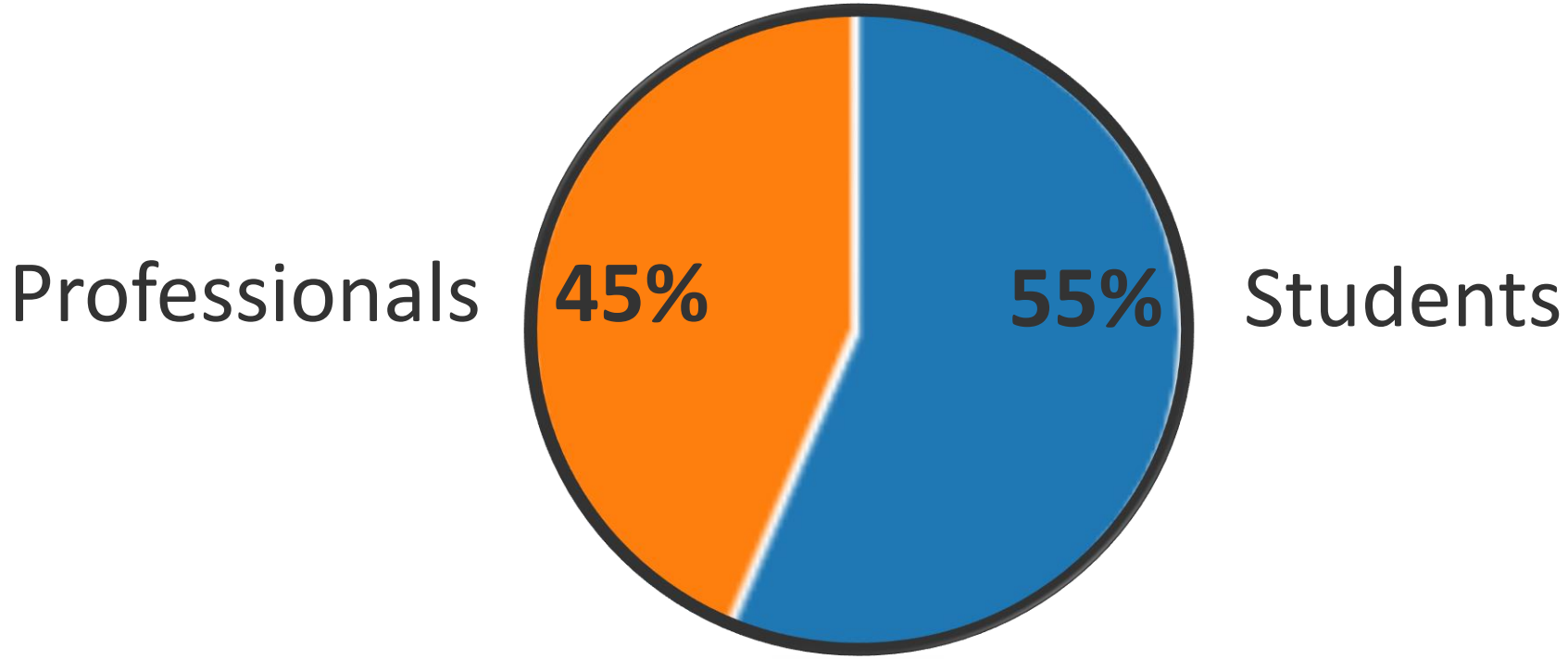
Challenge Promotion

- LF AI Foundation:
- SG Innovate (Singapore):
- Next Generation Mobile Networks Alliance:

ITU AI/ML in 5G Challenge: Registrations

We have more than 400 Registrations

Over 50 countries



The Grand Challenge Finale

Tentative Schedule: To take place in mid- December (15 – 17 Dec, 2020)

Finals Presentation: Participants or teams that are invited to take part in the final conference and compete for the ITU Challenge Prizes. 10 - 15 minutes presentation including Q&A.

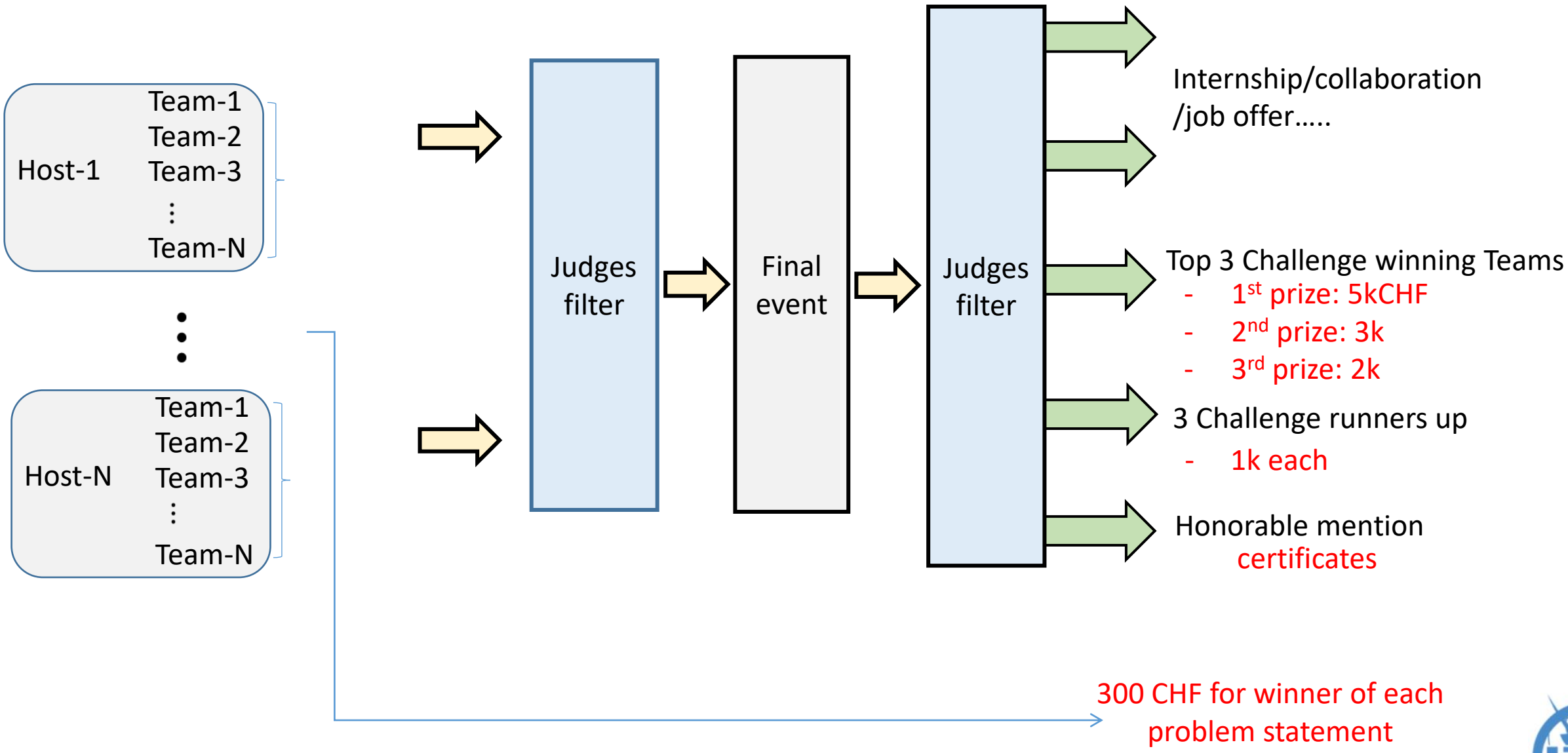
ITU AI/ML in 5G Challenge: Prizes

Participants/Teams across different problem statements will compete for the following titles and prizes:

- 1st prize: "ITU AI/ML in 5G Challenge Gold Champion": 5,000 CHF
- 2nd prize: "ITU AI/ML in 5G Challenge Silver Champion": 3,000 CHF
- 3rd prize: "ITU AI/ML in 5G Challenge Bronze Champion": 2,000 CHF

3 Runners up will receive 1, 000 CHF each

ITU Prizes



Some regional hosts provide additional prizes. Please check their websites

ITU AI/ML in 5G Challenge: Submission Deadlines

PS_#	Title	Current Deadline	Submission Method
PS-012	ML5G-PHY -Beam-Selection	Test dataset: Sep xxth Submission Deadline: Oct 15th	upload files to a cloud storage server
PS-013	Improving the capacity of WLANs through ML	Test dataset: Sep xxth Submission Deadline: Oct 15th	Email: francisco. wilhelmi[at]upf.edu
PS-014	Graph Neural Networking Challenge 2020	Test dataset: Sep 30th Score-based evaluation phase: Oct 1 - 15th	gnnetchallenge <at> bnn.upc.edu
PS-018	Compression of Deep Learning models	Deadline: October 10th	create a private Github
PS-019	5G+AI (Smart Transportation)	Deadline: Sep 25th	Email:preranam.jnu@gmail.com
PS-020	Improving experience and enhancing immersiveness of Video conferencing and collaboration	Deadline: Sep 25th	Email:fauziyafarheen@gmail.com, amitg@dview.ai
PS-021	5G+ML/AI (Dynamic Spectrum Access)	Deadline: Sep 25th	Email:amit.oberoi@alumni.iitd.ac.in
PS-022	Privacy Preserving AI/ML in 5G networks for healthcare applications	Deadline: Sep 25th	Email: prashantchugh1234@gmail.com
PS-023	Shared Experience Using 5G+AI (3D Augmented + Virtual Reality)	Deadline: Sep 25th	Email: ankur@hike.in, neerajku@hike.in
PS-024	Demonstration of MLFO capabilities via reference implementations	Phase I: 20th Sept Phase II: 20th Oct.	Github
PS-025	ML5G-PHY- Channel Estimation @NCSU:	Submission Deadline: Oct 15th	Email: ml5gphy.ncsu@gmail.com
PS-031	Network State Estimation by Analyzing Raw Video Data	Submission deadline: September 20th	Email:5gc@nakao-lab.org or rising-itu-support@mail.ieice.org
PS-032	Analysis on route information failure in IP core networks by NFV-based test environment.	Submission deadline: September 20th	Email:info_itu5G_jp@lists.cc1g.kddi-research.jp
PS-036	Using weather info for radio link failure (RLF) prediction	Deadline: Oct 15th	Email:aydin.cetin[at]turkcell.com.tr

ITU AI/ML in 5G Challenge: Submission

ITU recommends (or encourages) Open Source submissions for the Challenge solutions

- documentation
- code
- results
- etc

We have created a GitHub page - please submit your solutions using this platform

https://github.com/ITU-AI-ML-in-5G-Challenge/Main

Each problem statement or challenge will have a Repo associated with it

Any Questions?

Email: ai5gchallenge@itu.int

Slack: join

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ITU-ML5G-PS-022: Privacy Preserving AI/ML in 5G networks for healthcare applications

The next steps

Assumptions:

- Participant has gone through the problem statement description hosted on ITU web-site
- Participant has seen the video/ppt slides related to the problem, dated 27th July 2020 hosted on ITU web-site
- Participant has taken an overview of references mentioned with the problem statement description and the above mentioned presentation
- Participant has some experience in Deep Learning

ITU-ML5G-PS-022
The next steps

Step 0: (Expected Duration: 1 Wk)

- To identify a medical diagnostic problem for which deep learning has been applied in the past and sufficient data & deep learning models exist in literature. For example, this problem may be screening for tuberculosis.
- To run deep learning training and inference for the selected problem using models and open datasets in literature

ITU-ML5G-PS-022: The next steps

Step 1: (Expected Duration: 1 Week)

To study more and program simple examples about one or more of the following techniques:

- Homomorphic Encryption
- Federated Learning
- Differential Privacy
- Secure Multi Party Computation

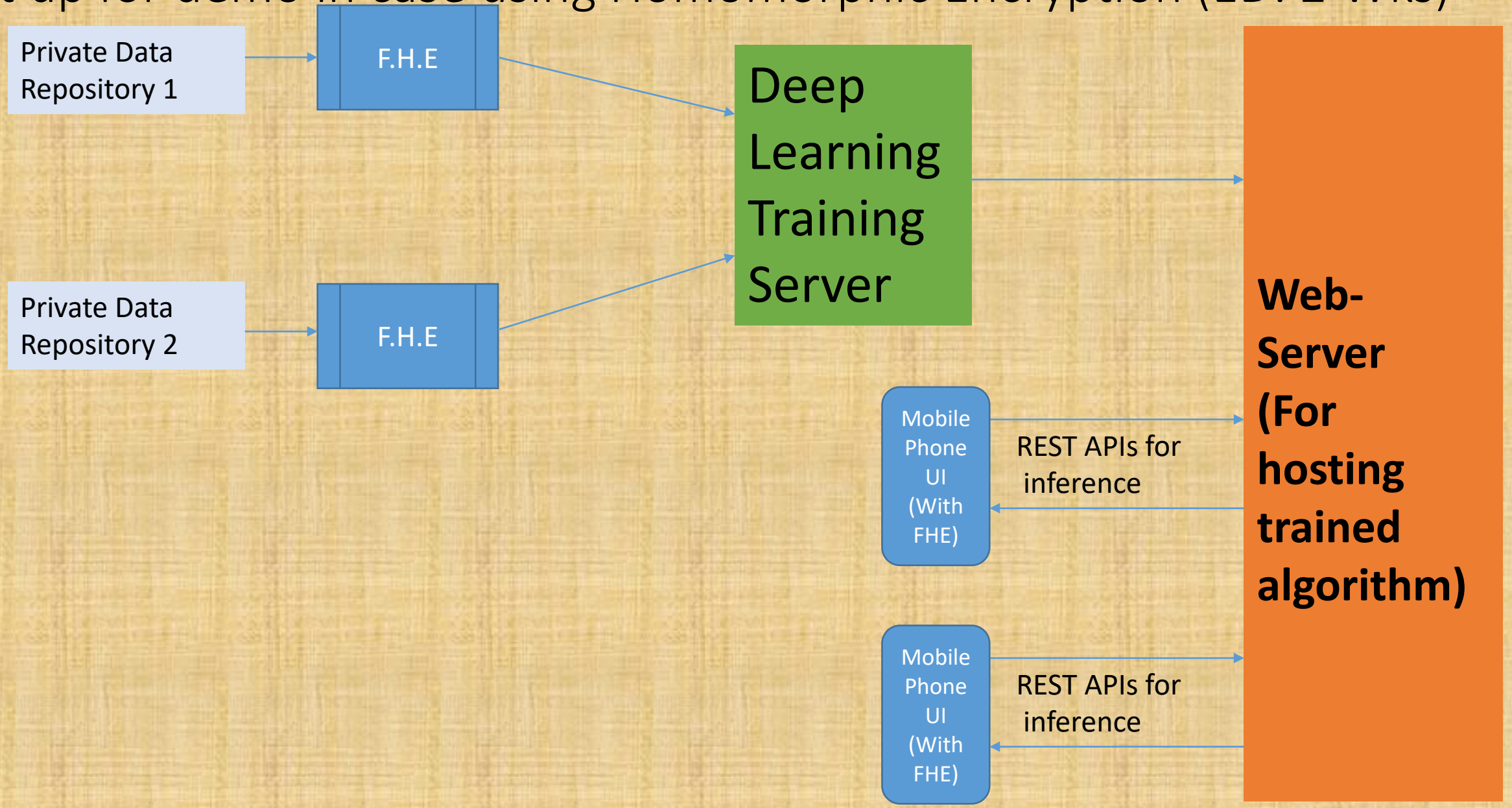
Hint: Each of the above technique can be taken up by different team members as well

Step 2 (Expected Duration: 1 Week)

Simulate Private Datasets by Appending Privacy Information to open Datasets used in Step 0

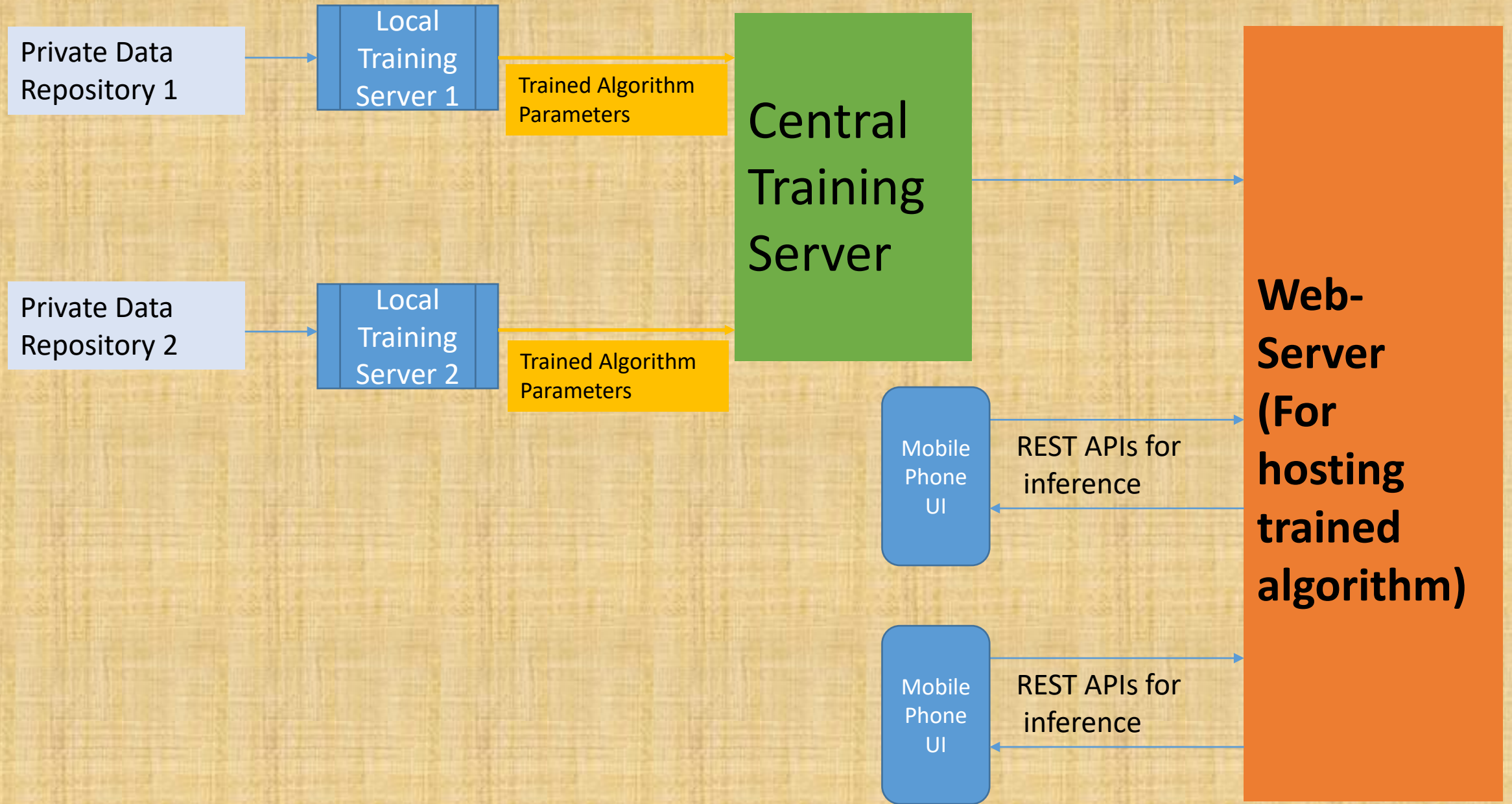
Step 3A

Set up for demo in case using Homomorphic Encryption (ED: 2 Wks)



Step 3B

Set up for demo in case using Federated Learning (ED:2Wks)



Step 4: Conclusion (ED: 1Wk)

- Check through packet dump on Central Server that Personal Identifiable Information cannot be deciphered
- Make Report for Evaluation

Additional Steps for Advanced users

- Do Step 3C similarly for Differential Privacy
- Do Step 3D similarly for Multi-Party Computing
- Compare 3A, 3B, 3C, 3D
- Combine two or more of 3A,3B,3C,3D to combine their advantages

Questions from participants ?

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ITU-ML5G-PS-019

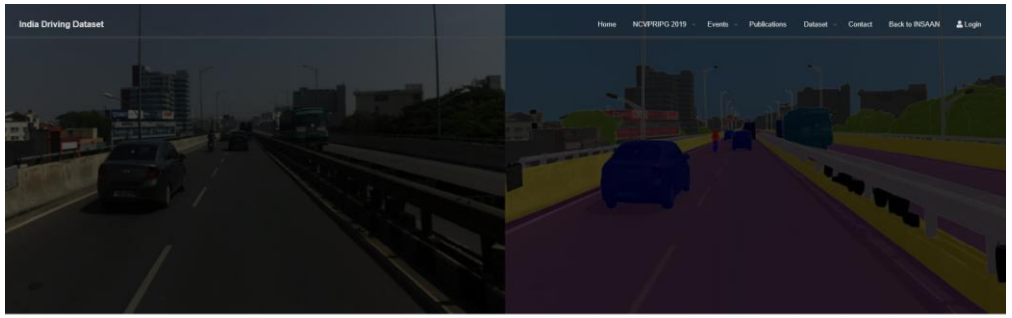
e.g. take example of available sensors

- scenario-0: What are the sensor inputs that I can assume?
- scenario-1: pick 1 problem in scenario understanding. E.g. pothole handling
- scenario-2: what are the inference outputs possible for this problem?
- how to verify my output?

- Scenario 0: Smartphone's IMU data: accelerometer, gyroscope, magnetometer readings, camera data: monocular, stereo: RGBD data, LIDAR (point clouds), GPS

  Available datasets:

http://www.cvlibs.net/datasets/kitti/



https://idd.insaan.iiit.ac.in/evaluation/an19-leader-board/

ITU-ML5G-PS-019

- Scenario-1: pick 1 problem in scenario understanding. E.g. pothole handling
- scenario-2: what are the inference outputs possible for this problem?

Datasets: -Nienaber, S.: Detecting potholes with monocular computer vision: A performance evaluation of techniques. Ph.D. thesis, Stellenbosch: Stellenbosch University
-IDD dataset: 237 pothole annotations
Problem Statement: E.g. Pothole localization and alerting the driver for lane change
Inputs: RGB or RGBD data, Method: Use vision and depth to get the drivable path and detect pothole, depth would further assist, Output: Recommendation to driver to do lane shift as pothole ahead.

IDD dataset

South African dataset

ITU-ML5G-PS-019

- How to verify my output? https://sites.google.com/view/iitd5g/challenge-problems/5g-ai-smart-transportation/evaluation-criteria

Depending upon the problem chosen, metrics would differ:
-Semantic segmentation: mIoU
Mean IoU is defined as the average IoU or Jaccard Index over all classes.
It is defined as the area of intersection between the predicted segmentation regions and the ground-truth, divided by the area of union between the predicted and the ground truth:

$$mIoU = mean(\frac{A \cap B}{A \cup B})$$

-Object localization: Precision / Recall / F1 score are popular metrics for reporting the accuracy of Object detection/localization models. Recall and Precision can be defined for each class, as follows:

$$Precision = \frac{TP}{TP + FP} \qquad Recall = \frac{TP}{TP + FN}$$

F1-score indicates the harmonic mean of precision and recall: $F1score = \frac{2 \times Precision \times Recall}{Precision + Recall}$

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Shagufta Henna, Letterykenny Institute of Technology, Ireland

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MLFO Functionalities

Functionalities of the MLFO:

- MLFO can monitor & manage ML pipeline
- Policy-based ML pipeline deployment
- Optimal placement of ML pipeline nodes in the network
- Intent-based specification
- Standard representation
- Interoperable integration of data handling [ITU-T Y.3174], [ITU-T Y.3173], and ML marketplaces [ITU-T Y. 3176]
- Chaining/split of ML pipeline nodes, selection of ML models, monitoring model performance, reselection and update

MLFO Reference Implementation Challenge

Implementation of specific concepts including:

- Handling ML Intent from operator: a mechanism for operator specify ML use cases via the ML Intent as specified in [ITU-T Y.3172]
- Control of model management, e.g., selection, training and deployment using MLFO
  - NOTE- No dataset is required for the model management implementation, only meta-data should suffice
- Interaction with ML Marketplace, i.e., ITU-T Y.3176
- Handling of asynchronous operations
- Any other concepts relevant to MLFO functionality or integration

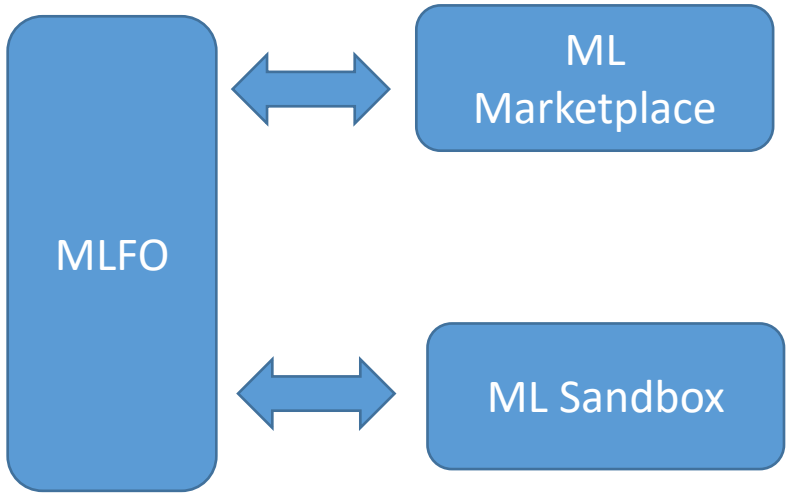
Example-1: ITU-ML5G-PS-024

e.g. Reference point 15 [MLFO <-> ML marketplace]

- Model_Query API
- Model_Selection API
- Model_Discovery_Poll API
- Model_Discovery_Asynchronous_Update API
- Model_Deployment API

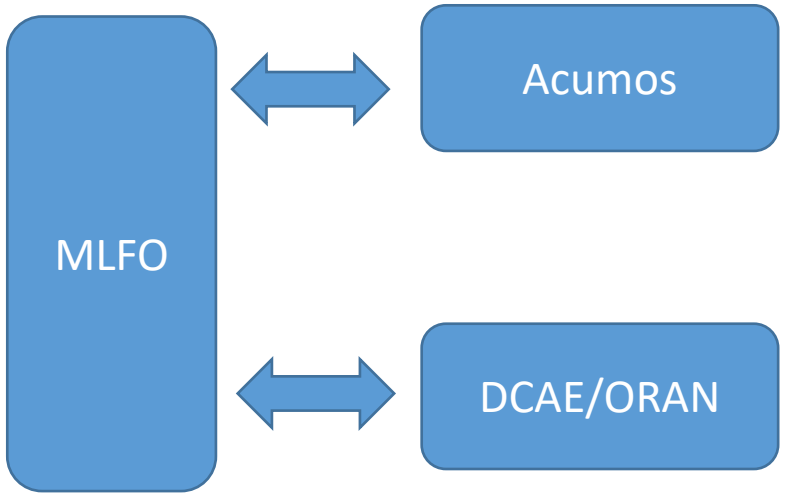
e.g. Reference point 6 [MLFO <-> Sandbox]

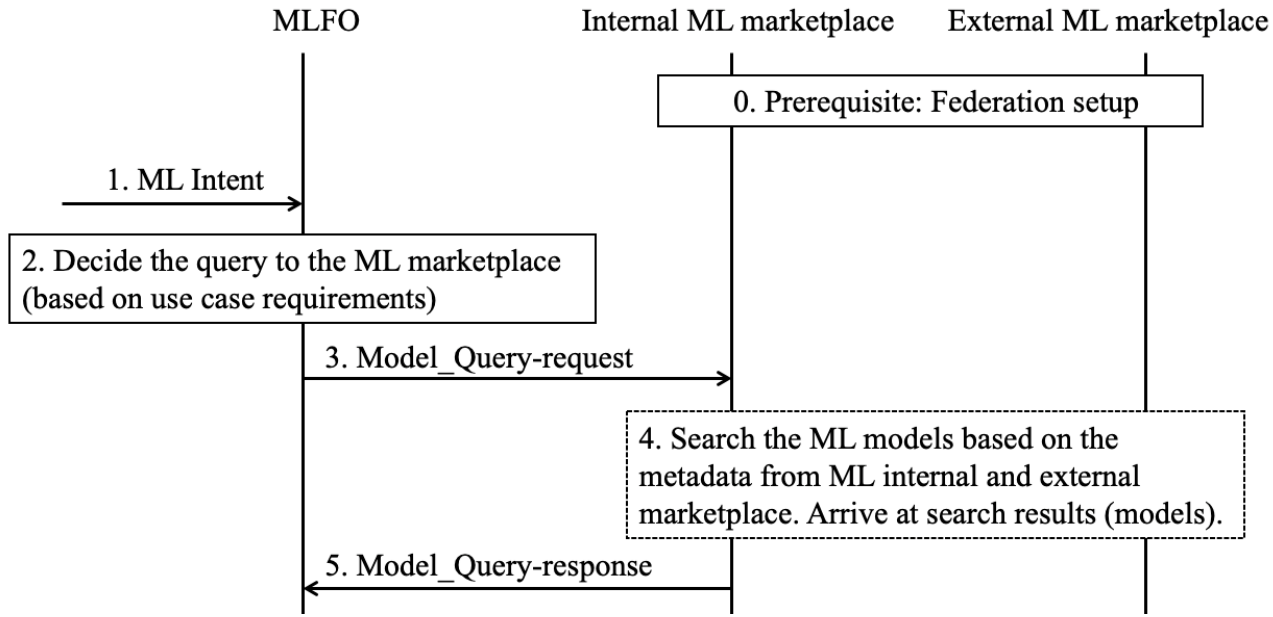
- Model training trigger
- model training notification
- model update trigger request
- model update trigger response



Participant can pick any API and implement it in a Restful manner.

Example-2: ITU-ML5G-PS-024





- Participant should align with attached sequence diagram
- Use a setup with Acumos and ORAN
- Provide adapters for integration with Acumos/ORAN

Model Query API for : ITU-ML5G-PS-024

Direction: MLFO → ML marketplace (Model Query)

Information element	Type	Mandatory/Optional /Conditional	Description
Model Identifier	String	Optional	Allows query based on model identifier if MLFO has the identifier.
Model metadata	<Attribute, value> array	Mandatory	Allows query based on metadata.

Direction: ML marketplace → MLFO (Model Query Response)

Information element	Type	Mandatory/Optional /Conditional	Description
Result	Enum	Mandatory	Indicates whether the query was successful and whether the conditional_information given below are present (e.g. success/failure).
Model Identifiers	array of String	Conditional	Contains the ID of the models returned from the ML marketplace (if the result == success). If the result == failure, this field is not present.
Model metadata	<Attribute, value> array	Conditional	Contains the metadata (if the result == success).

API description: enables internal ML marketplace to query from external ML marketplace for models that meet the requirements indicated in ML intent

Model Selection API for : ITU-ML5G-PS-024

API description: Model select enables MLFO to select a model from the ML marketplace for the ML pipeline subsystem.

Direction: MLFO → ML marketplace

Information element	Type	Mandatory/Optional /Conditional	Description
Identifier	String	Mandatory	MLFO already knows the ID from the search.

Direction: ML marketplace → MLFO

Information element	Type	Mandatory/Optional /Conditional	Description
Result	Enum	Mandatory	Indicates whether the select was successful and whether the conditional information given below are present (e.g. success/failure).
Identifier	String	Conditional	Present only if result == success. Indicates the ID of the model selected.

Model_Discovery_Poll API for : ITU-ML5G-PS-024

API description: For models that are already deployed in ML pipeline subsystem, MLFO polls for the updated version from the ML marketplace.

Direction: MLFO → ML marketplace

Information element	Type	Mandatory/Optional /Conditional	Description
Model Identifier	String	Mandatory	MLFO already knows the ID from the search.

Direction: ML marketplace → MLFO

Information element	Type	Mandatory/Optional /Conditional	Description
Result	Enum	Mandatory	Indicates whether the poll was successful and whether the conditional information given below are present (e.g. success/failure).
Model Identifier	String	Conditional	Present only if result == success. Indicates the ID of the model polled.
Model metadata	<Attribute, value> array	Conditional	Contains the metadata (if the result == success). Indicates the updated metadata if the model was updated in Marketplace.

Model discovery async update : ITU-ML5G-PS-024

Direction: ML marketplace → MLFO

Information element	Type	Mandatory/Optional /Conditional	Description
Model Identifier	String	Conditional	Present only if result == success. Indicates the ID of the model polled.
Model metadata	<Attribute, value> array	Conditional	Contains the metadata (if the result == success). Indicates the updated metadata if the model was updated in Marketplace.

API description: For models that are already deployed in ML pipeline subsystem, if/when the model is updated in the marketplace, marketplace will asynchronously update the MLFO.

Model_deployment API: ITU-ML5G-PS-024

Direction: Direction: MLFO → ML marketplace

Information element	Type	Mandatory/Optional /Conditional	Description
Model Identifier	String	Mandatory	MLFO already knows the ID.
ML pipeline- identifier	String	Mandatory	Indicates the ML pipeline which may be deployed in sandbox or underlay.

Direction: ML marketplace → MLFO

Information element	Type	Mandatory/Optional /Conditional	Description
Result	Enum	Mandatory	Indicates whether the deployment was successful and whether the conditional information given below are present (e.g. success/failure).
Model Identifier	String	Conditional	Present only if result == success. Indicates the ID of the model deployed.
ML pipeline identifier	String	Conditional	Present only if result == success. Indicates the ML pipeline to which the model was deployed. This may be deployed in sandbox or underlay. This ID may be in the form of a URI.

MLFO-triggered operations API: ITU-ML5G-PS-024

Request (pull mechanism): MLFO → ML sandbox subsystem

Information element	Type	Mandatory/Optional /Conditional	Description
Message ID	Integer	Mandatory	Identifier of the message, indicating "ML-triggered operation"
Operation code	Integer	Mandatory	Code of the operation to be performed
Policies & Requirements	Json	Conditional	Metadata including policies, requirements.
Simulation environment metadata	Json	Conditional	Includes simulation configuration, available resources, time constraints, etc.

Response (or push method): ML sandbox subsystem → MLFO

Information element	Type	Mandatory/Optional /Conditional	Description
Message ID	Integer	Mandatory	Identifier of the message, indicating "ML-triggered operation"
Response code	Integer	Mandatory	Code of the operation response (OK, Bad request, Error, etc.)
Response data	(variable)	Conditional	Depending on the request type, different response data types can be provided (e.g., training data set, trained ML model, validated ML model).

Sandbox asynchronous messages API: ITU-ML5G-PS-024

Request: ML sandbox subsystem → MLFO

Information element	Type	Mandatory/Optional /Conditional	Description
Message ID	Integer	Mandatory	Identifier of the message, indicating “Sandbox asynchronous message”
Message code	Integer	Mandatory	Code of the asynchronous message type
Additional information	String list	Conditional	Additional information related to the message type

References

- ITU-T Y.3176
- ML5G-I-238

Thank You

Q&A

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Senior Member IEEE, ACM (India, ESP)

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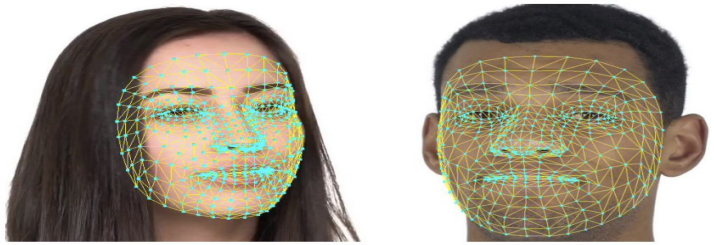
ITU-ML5G-PS-023

e.g. take example of Unity

- scenario-0: how to setup? What are the steps from content -> VR ?
- scenario-1: are there examples of “shared” baselines content?
- scenario-2: are there development setups? (so that I can reduce hardware dependency)
- scenario-n: what are the steps to the final demo? Just as an example.



https://github.com/tensorflow/tfjs-models

ITU-ML5G-PS-023

Scenario 0 : Unity Setup Steps:

1. Link to download unity: https://unity3d.com/get-unity/download
2. Choose "Download Unity Hub"
3. Start Unity Hub Installation.
4. Click on "Skip the wizard" on the bottom left corner.
5. Go to Installs.
6. Install the latest beta version (2020.x.x) and all dependencies (check mark the boxes) by going on "Install" on the left panel and then clicking on "Add".
7. Log/Sign up to Unity by clicking on the icon on the top right corner.
8. Go to settings by clicking the "settings"/"gear" icon on the top right. Go to licence management and choose 'activate new license'. Choose the type and activate.
9. Clone any sample git repository(e.g.: https://github.com/hsunami10/Unity-Projects)
10. Go to the "Projects" in the left pane in unity hub, click on "Add" and fill the path to the cloned repository, then, choose the unity version you just installed and click on the name of the project.

For more help, checkout https://docs.unity3d.com/Manual/UnityManual.html

In order to export characters from some external library, we simply need to install the SDK for unity.

Live2d Setup:

1. Link to download the SDK.https://www.live2d.com/en/download/cubism-sdk/
2. To generate a 2d character with Live2D and import it to the Unity project.

Follow the given link for tutorials on the same:
https://docs.live2d.com/cubism-sdk-tutorials/getting-started/

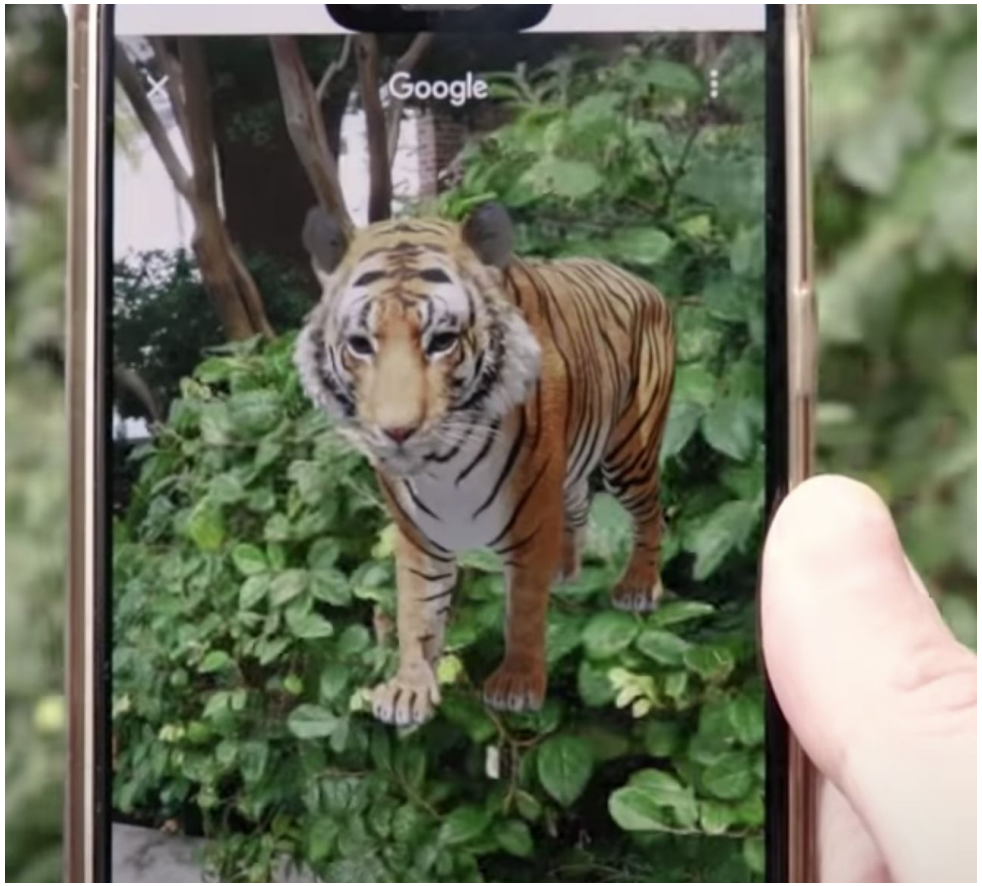
ITU-ML5G-PS-023

Scenario 1: ARCore as Augmented Reality tool and integration with Unity

- You can place an animal like tiger in the garden using ARCore and it is open source .

- Other use case - using the hand gesture , model can predict the certain do certain activities in live cricket matches like victory sign can be used for showing 6 on paper using ARCore

- Rendering can be done on Unity , UnReal Engine , etc,
- https://developers.google.com/ar - ARCore Developers Guide



ARCore

Scenario 2: Development Set up - We can use Unity developers guide and programming is done in C# to reduce the hardware dependency . ARCore objects can be rendered using Unity.

Scenario n : Steps for Final demo :

- Step 1 : Pick a use case
- Do a 2D or 3D model and incorporate it in ARCore .
- Render it in Unity or Unreal Engine

References -1. https://opensource.com/article/18/6/open-source-augmented-reality-sdks
2 . https://www.infoq.com/articles/augmented-reality-best-skds/