PoC: Success through Build-a-thon

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Presented during
FG-AN Workshop on "Advances in Autonomous
Networks: 2023 and beyond"
Geneva, Switzerland, 24 October 2023
24 Oct 2023

FG-AN: Build-a-thon intro

Create a distributed eco-system: In collaboration with ITU AI/ML in 5G Challenge enable participants to connect with new partners in industry and academia https://aiforgood.itu.int/ai-ml-in-5g-challenge/).

Diverse participation: A mix of participants (not only data scientists) from various backgrounds came together to solve problems, and students were provided mentoring by experts.

Publish solutions in https://www.itu.int/pub/S-JNL-VOL2.ISSUE4

https://www.itu.int/pub/S-JNL-VOL3.ISSUE2-2022

Create practical implementations : the Build-a-thon was more than just predictions and inferences, but also about coding and proving the concepts in FG specifications.

I have a question!!!
https://github.com/vrra/FGAN-Build-a-thon/discussions

What is a Build-a-thon?

Build-a-thon is an almost year long PoC activity led by ITU-T FG AN.
It is aligned with ITU AI/ML 5G Challenge and offered as a problem statement

Who can participate in the Build-a-thon?

Anyone can. For example - you could be a student, a startup, a small enterprise, a university professor, from anywhere.

How can I register?
https://github.com/vrra/FGAN-Build-a-thon/issues/new/choose

Register for Build-a-thon 2023
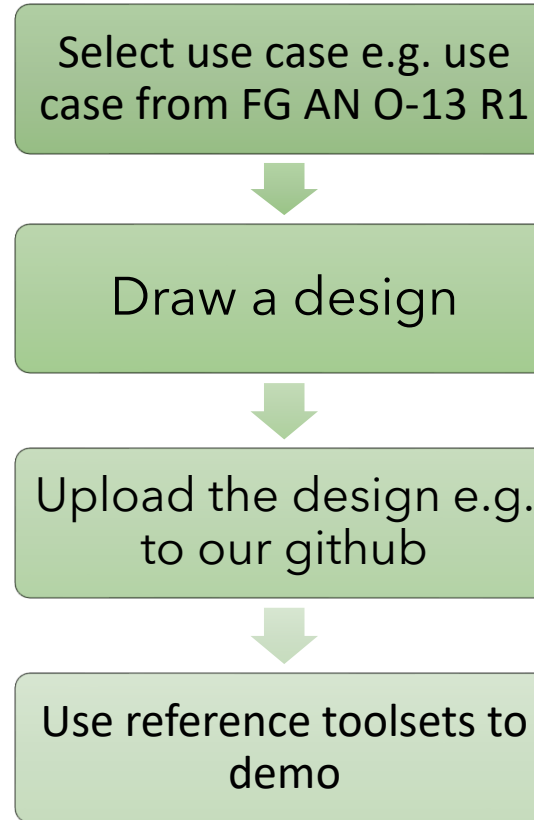Register for Build-a-thon 2023

FG-AN: PoC activities

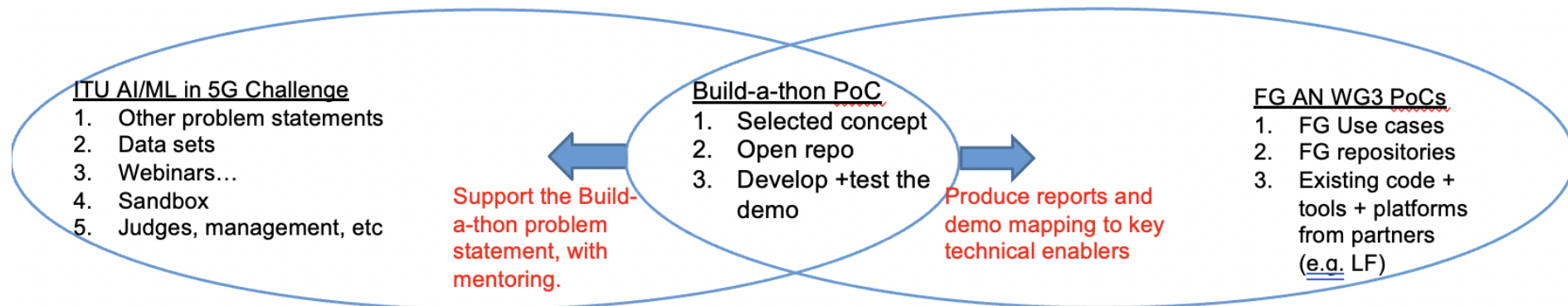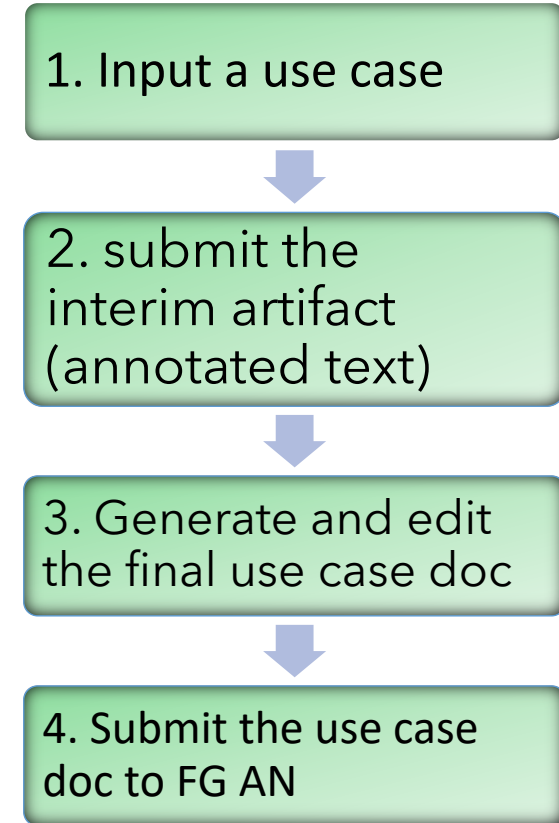## PoC / Build-a-thon 2021, 2022, 2023

Progressing proof of concept activities.
In conjunction with the ITU AI/ML in 5G Challenge under the Build-a-thon initiative.
Proving concepts **practically** with codes,
test setup and demo setup

2022 PoC

- Select use case e.g. use case from FG AN O-13 R1
  - ↓
- Draw a design
  - ↓
- Upload the design e.g. to our github
  - ↓
- Use reference toolsets to demo

2023 PoC

1. Input a use case
   - ↓
2. submit the interim artifact (annotated text)
   - ↓
3. Generate and edit the final use case doc
   - ↓
4. Submit the use case doc to FG AN

ITU AI/ML in 5G Challenge
1. Other problem statements
2. Data sets
3. Webinars…
4. Sandbox
5. Judges, management, etc

Support the Build-a-thon problem statement, with mentoring.

Build-a-thon PoC
1. Selected concept
2. Open repo
3. Develop +test the demo

Produce reports and demo mapping to key technical enablers

FG AN WG3 PoCs
1. FG Use cases
2. FG repositories
3. Existing code + tools + platforms from partners (e.g. LF)

Rules: FGAN Build-a-thon

- FG AN Build-a-thon ==is open to anyone.==

- ==Participant-== you could be a student, a startup, a small enterprise, a university professor, from anywhere.
  You are welcome to form a team and submit solutions.

- We prepare mentoring sessions for you to code. You can find the notebooks [here](#).

- ==Mentor==: If you are an experienced professional or teacher or professor or leader, ==we welcome your guidance== in the form of mentoring to the teams.

FG-AN: Deliverables

Technical Report on Proof of Concept activities

FG-AN output document

Provides the technical report on the PoC activities conducted by ITU FG AN during the period.

The technical report is currently in the process of being published as FG AN deliverables and has been submitted to ITU-T SG13.

ITU J-FET publications from our members

2022 paper based on Build-a-thon PoC

ITUJournal
Future and evolving technologies

Network resource allocation for emergency management based on closed-loop analysis

Authors: Guda Blessed, Ibrahim Aliyu, James Agajo, Thiago Lima Sarmento, Cleverson Veloso Nahum, Lucas Novoa, Rebecca Aben-Athar, Mariano Moura, Lucas Matni, Aldebaro Klautau, Deena Mukundan, Divyani R Achari, Mehmet Karaca, Doruk Tayli, Özge Simay Demirci, V. Udaya Sankar, Sai Jnaneswar Juvvisetty, V.M.V.S. Aditya, Abhishek Dandekar, Shabnam Sultana, Jinsul Kim, Vishnu Ram OV

2023 paper based on Build-a-thon PoC

ITUJournal
Future and evolving technologies

Build your own closed loop: Graph-based proof of concept in closed loop for autonomous networks

Authors: Jaime Fúster de la Fuente, Álvaro Pendás Recondo, Paul Harvey, Tarek Mohamed, Chandan Singh, Vipul Sanap, Ayush Kumar, Sathish Venkateswaran, Sarvasuddi Balaganesh, Rajat Duggal, Sree Ganesh Lalitaditya Divakarla, Vaibhava Krishna Devulapali, Ebeledike Frank Chukwubuikem, Emmanuel Othniel Eggah, Abel Oche Moses, Nuhu Kontagora Bello, James Agajo, Wael Alron, Fathi Abdeldayem, Melanie Espinoza Hernández, Abigail Morales Retana, Jackeline García Alvarado, Nicolle Gamboa Mena, Juliana Morales Alvarado, Ericka Pérez Chinchilla, Amanda Calderón Campos, Derek Rodríguez Villalobos, Oscar Castillo Brenes, Kodandram Ranganath, Ayushi Khandal, Rakshesh P Bhatt, Kunal Mahajan, Prikshit CS, Ashok Kamaraj, Srinwaynti Samaddar, Sivaramakrishnan Swaminathan, M Sri Bhuvan, Nagaswaroop S N, Blessed Guda, Ibrahim Aliyu, Kim Jinsul, Vishnu Ram
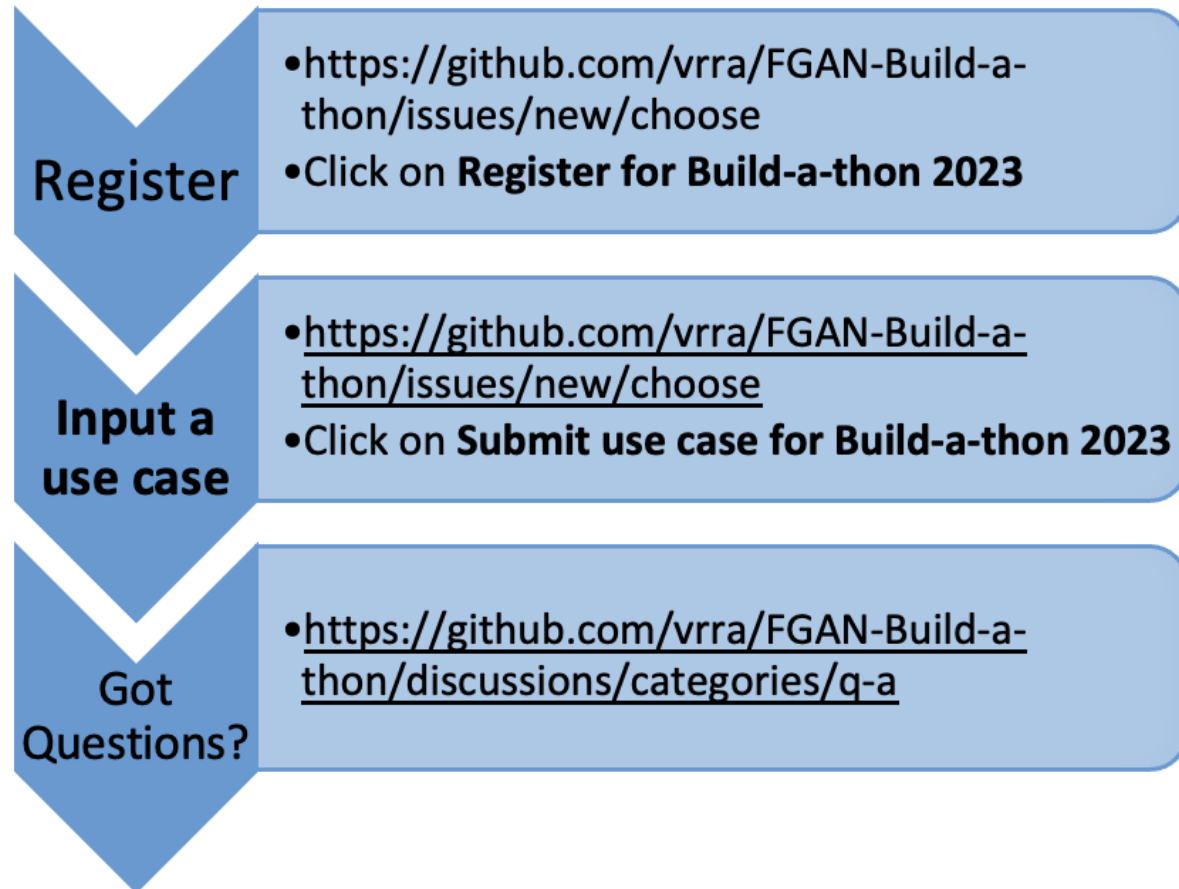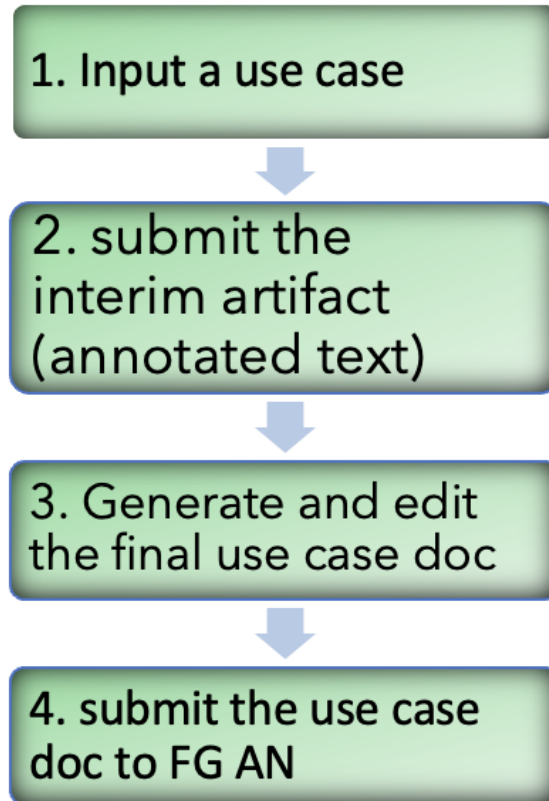
FG-AN: Build-a-thon welcomes participation

1. Input a use case

↓

2. submit the interim artifact (annotated text)

↓

3. Generate and edit the final use case doc

↓

4. submit the use case doc to FG AN

Register
- https://github.com/vrra/FGAN-Build-a-thon/issues/new/choose
- Click on **Register for Build-a-thon 2023**

Input a use case
- https://github.com/vrra/FGAN-Build-a-thon/issues/new/choose
- Click on **Submit use case for Build-a-thon 2023**
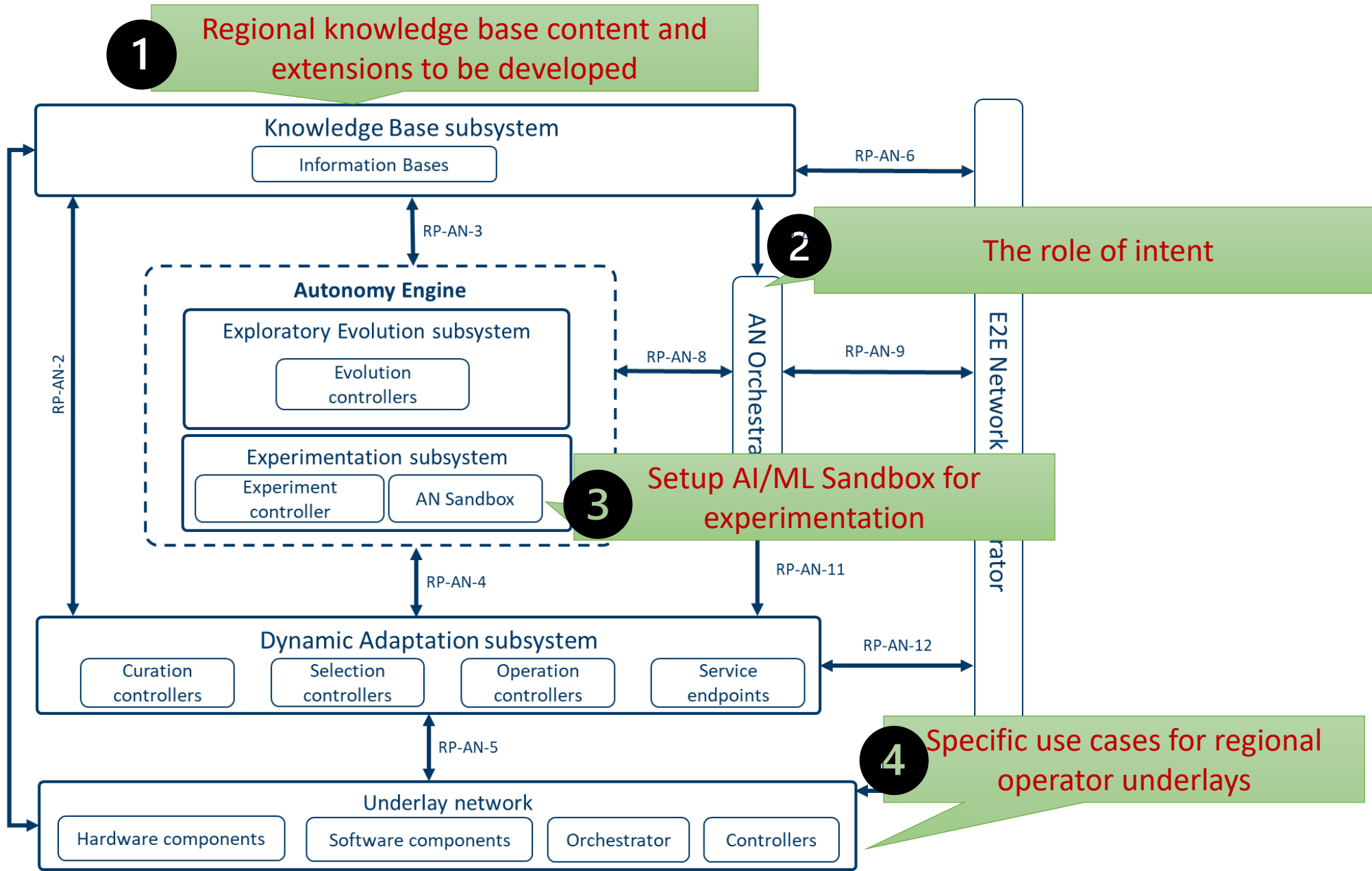
Got Questions?
- https://github.com/vrra/FGAN-Build-a-thon/discussions/categories/q-a

Register for Build-a-thon 2023
Register for Build-a-thon 2023

Futuristic opportunities for collaboration

1 Regional knowledge base content and extensions to be developed

Knowledge Base subsystem
- Information Bases

RP-AN-6

2 The role of intent

RP-AN-3

RP-AN-2

Autonomy Engine

Exploratory Evolution subsystem
- Evolution controllers

RP-AN-8   RP-AN-9

Experimentation subsystem
- Experiment controller
- AN Sandbox

3 Setup AI/ML Sandbox for experimentation

AN Orchestrator

E2E Network Operator

RP-AN-11

RP-AN-4

Dynamic Adaptation subsystem
- Curation controllers
- Selection controllers
- Operation controllers
- Service endpoints

RP-AN-12

RP-AN-5

4 Specific use cases for regional operator underlays

Underlay network
- Hardware components
- Software components
- Orchestrator
- Controllers

FG-AN Build-a-thon: Progress

Build-a-thon 2022:

Build-a-thon Workshop Kickoff, 3 Jun 2022

Build-a-thon Workshop 2.0, 2 Sep 2022

Build-a-thon Workshop 3.0, 7 Nov 2022

Build-a-thon 2023:

Build-a-thon Workshop Kickoff, 3 Feb 2023

Build-a-thon Workshop 2.0, 22 Apr 2023

Build-a-thon Workshop 3.0, 15 Jul 2023

Build-a-thon Workshop 4.0, 29 Sep 2023

Events and Deadlines

Activity	Timeline
Registration opens	May 1
Dataset preparation (Graphs, reference parser)	June 3
2022 Build-a-thon kickoff workshop	June 3
Podcasts, webinars	May-June
Registration closes	31 Oct 2023
Mentoring support, round-tables with participants.	May-Sep
Last date for submissions by participants	28 Oct 2023
Judging and demo event	7 Nov 2023
Reports to ITU-T SG13	Nov/Dec
Grand Challenge Finale	Dec 2023

FG-AN: Build-a-thon (PoC) 2021

Build-a-thon 2021attracted 5 teams from across the globe. During the ITU Grand Challenge Finale Evaluation, 3 of the Build-a-thon teams presented their solutions to global audience. top team from 2021 FG AN Build-a-thon was presented with a prize courtesy Rakuten Mobile.
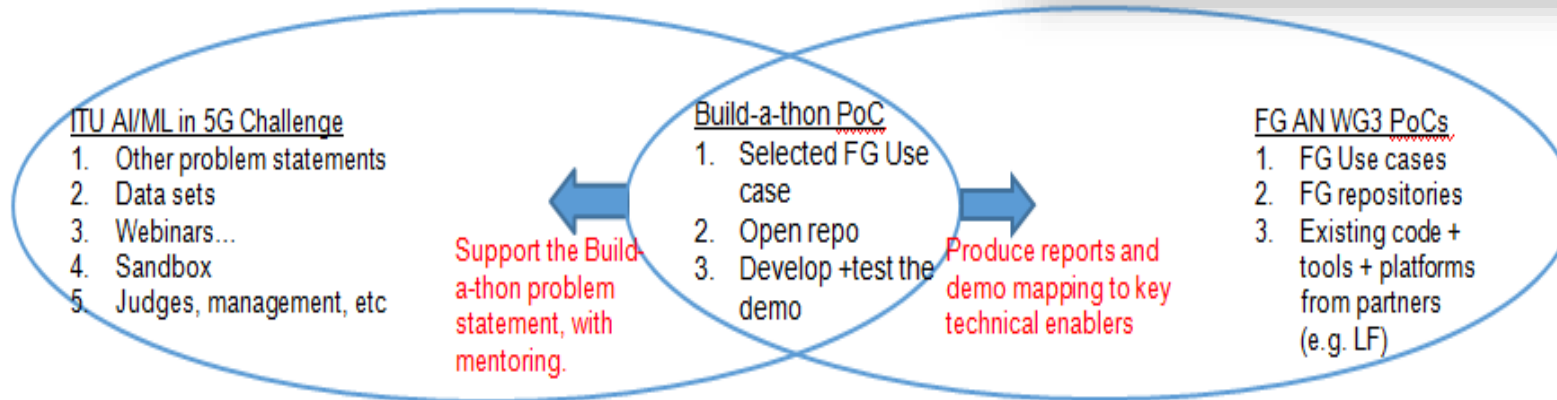
FG-AN: Build-a-thon (PoC) 2022

Create baseline representation of closed loops: "BYOC – Build your own closed loop"
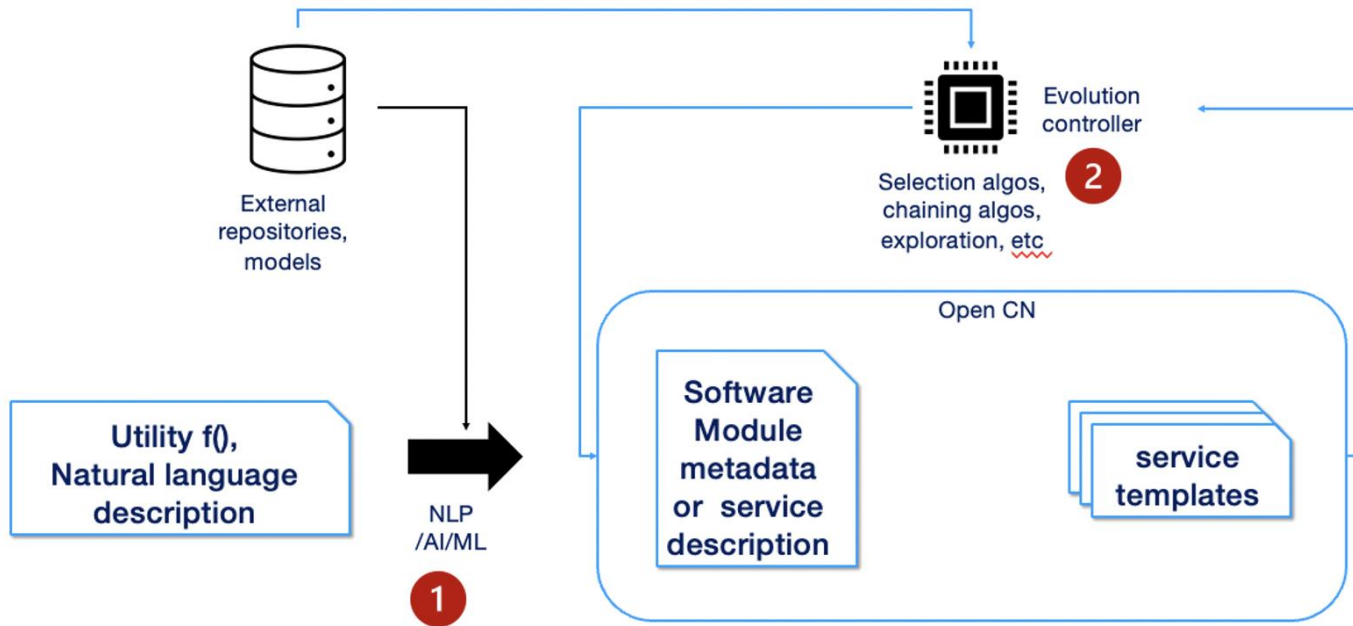
- collaboratively create a crowdsourced, baseline representation for AN closed loops (controllers), review and analyse them, and publish them in an open repository.

- trigger technical discussions on the standard format for representing closed loops (controllers) with FG AN members and other stakeholders.

- Collate the learnings from this exercise

- Produce reference implementations of parser, "AN orchestrator" and "openCN" [FGAN-O-013-R1] and Evolution controller [FGAN-I-198].

FG-AN-usecase-029: China Unicom

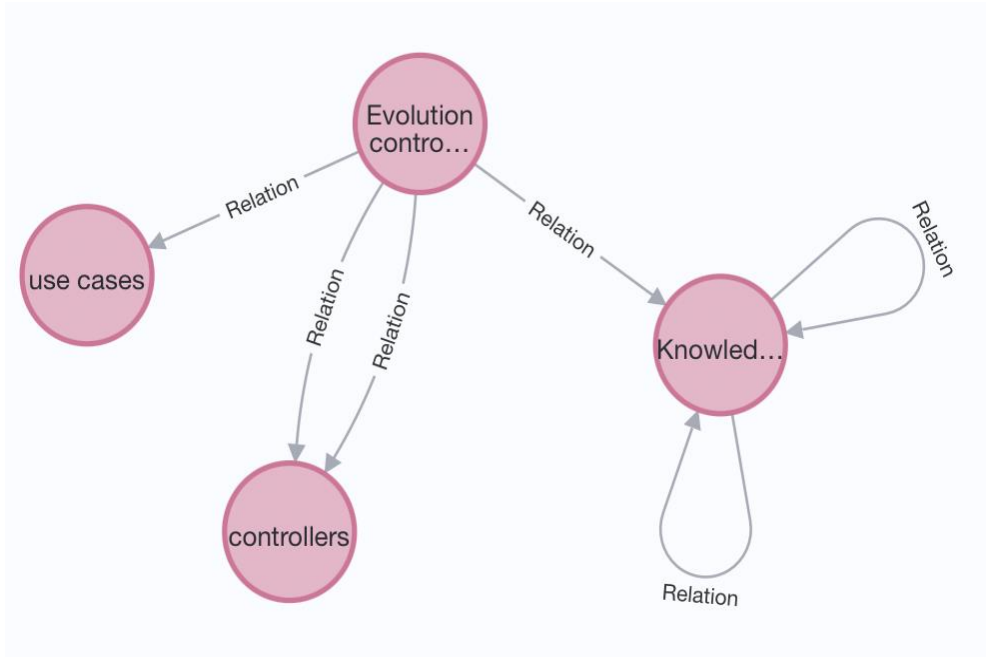***Graph below is generated from* [notebook](#)

MATCH (n) where 'usecase_029" in labels(n) return n
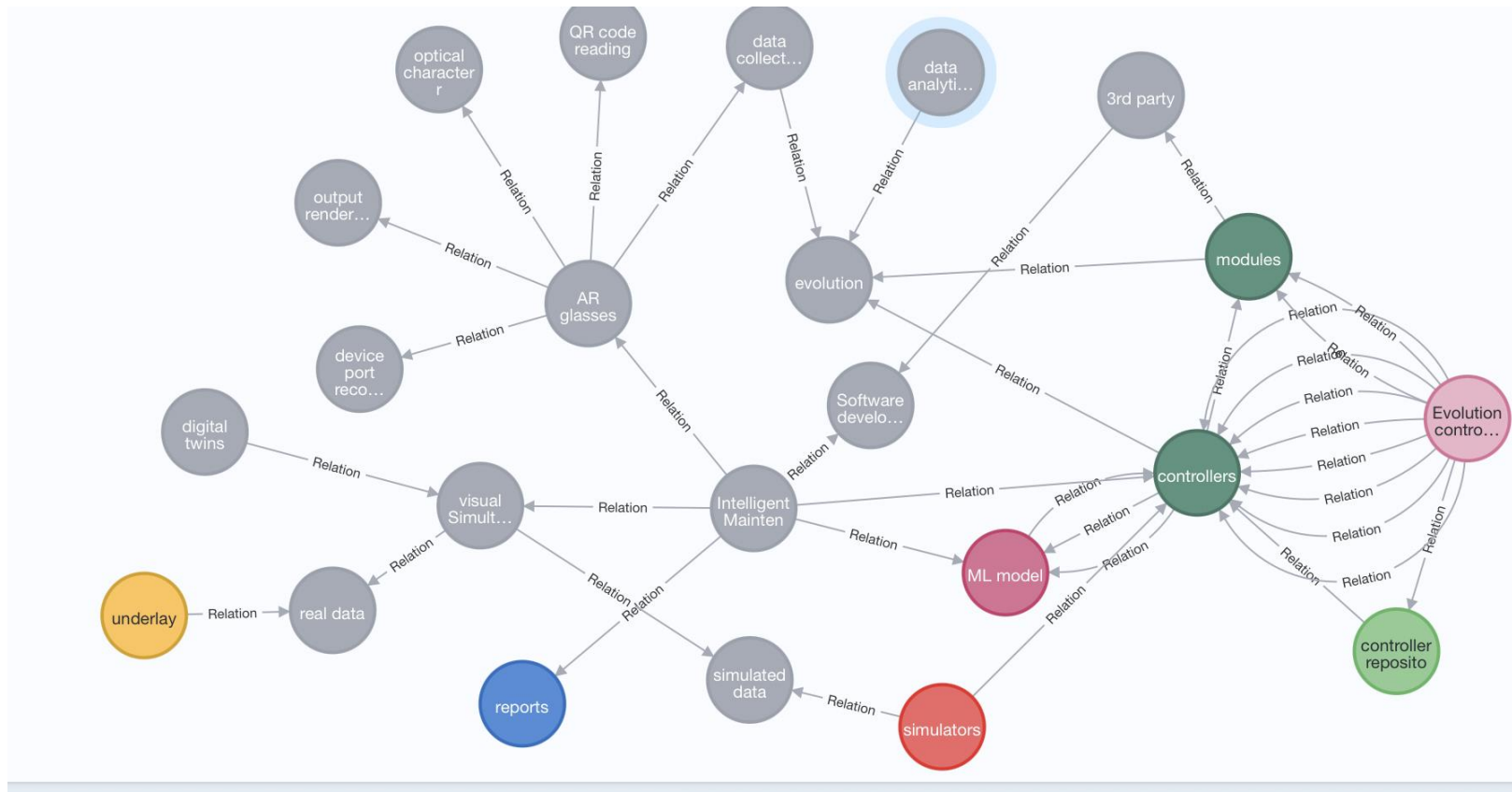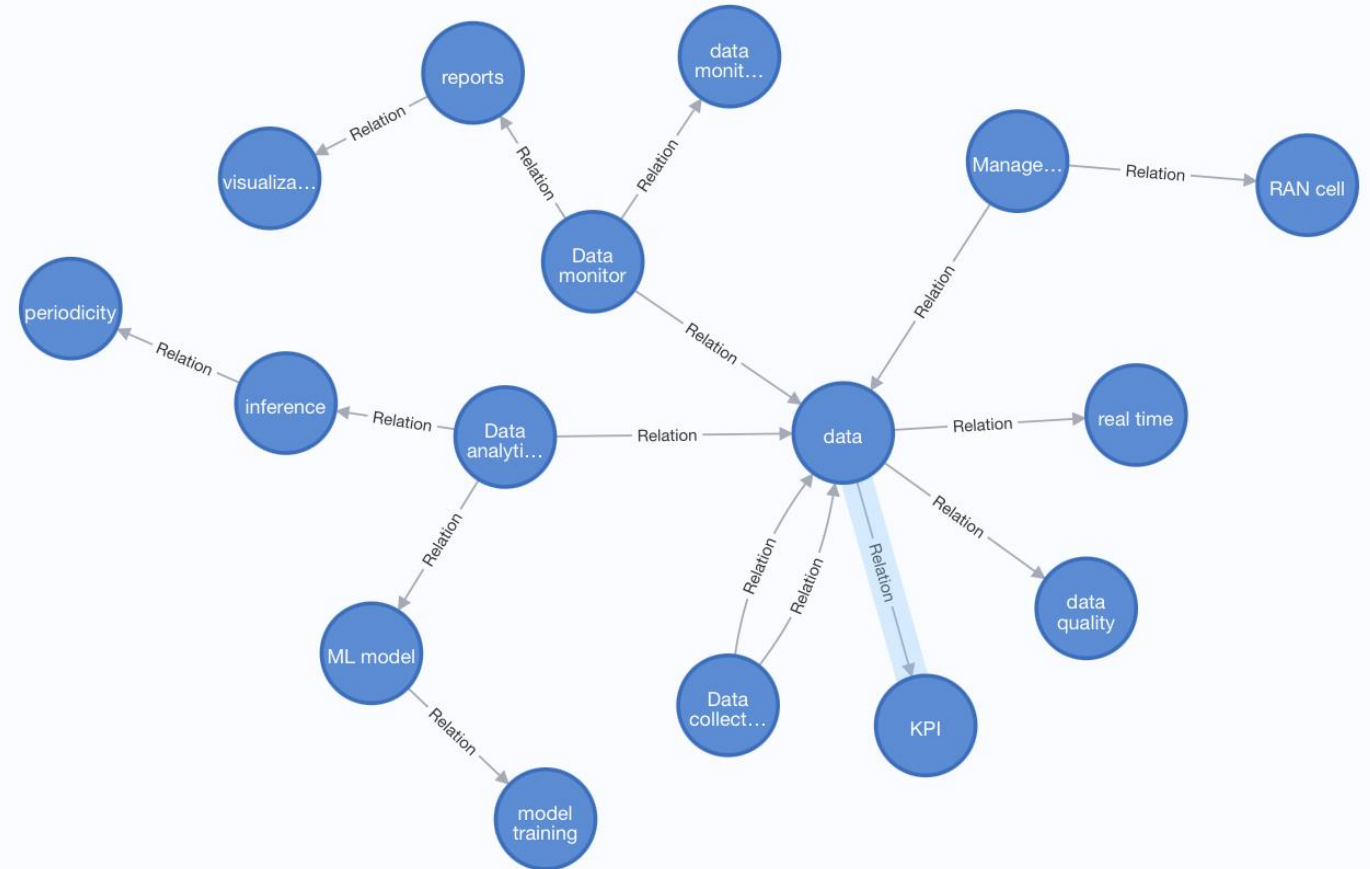
FG-AN-usecase-006: China Telecom
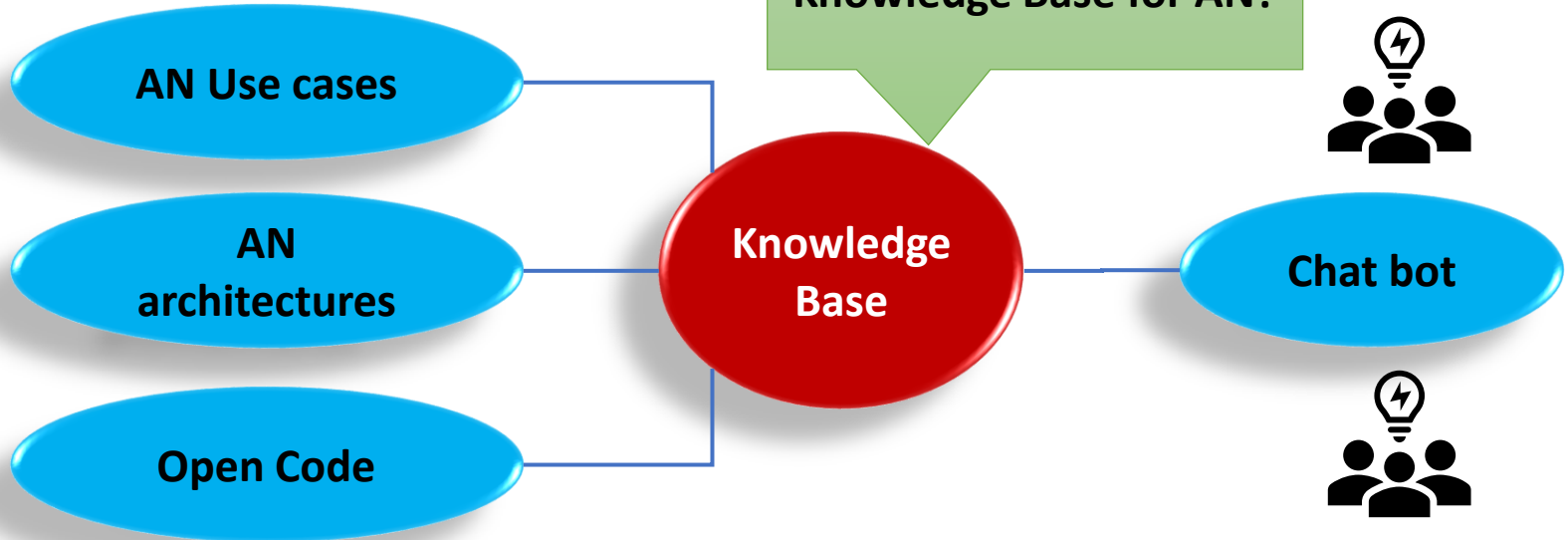
MATCH (n) where 'usecase_006_cat1' in labels(n) return n

MATCH (n) where 'usecase_006_cat2' in labels(n) return n

Call for collaboration: Build-a-thon

FGAN-O-030/LS11
LS on ITU FG AN Build-a-thon 2023

Can we create a Knowledge Base for AN?

AN Use cases

AN architectures

Open Code

Knowledge Base

Chat bot

Contributors and participants and Students

Scan me!

- ITU is conducting Autonomous Network Build-a-thon
- A chatbot is trained to assist contributors and participants

https://github.com/vrra/FGAN-Build-a-thon

ITU Events

Focus Group on Autonomous Networks BUILD-A-THON

Workshop 4.0

Friday, 29 September 2023
12:00 - 16:30 Geneva (CEST)

itu.int/en/ITU-T/focusgroups/an/

ITU provides State-of the art compute platform for Challenge participants

I. Free GPU access

II. Jupyter Notebooks

III. Python IDE

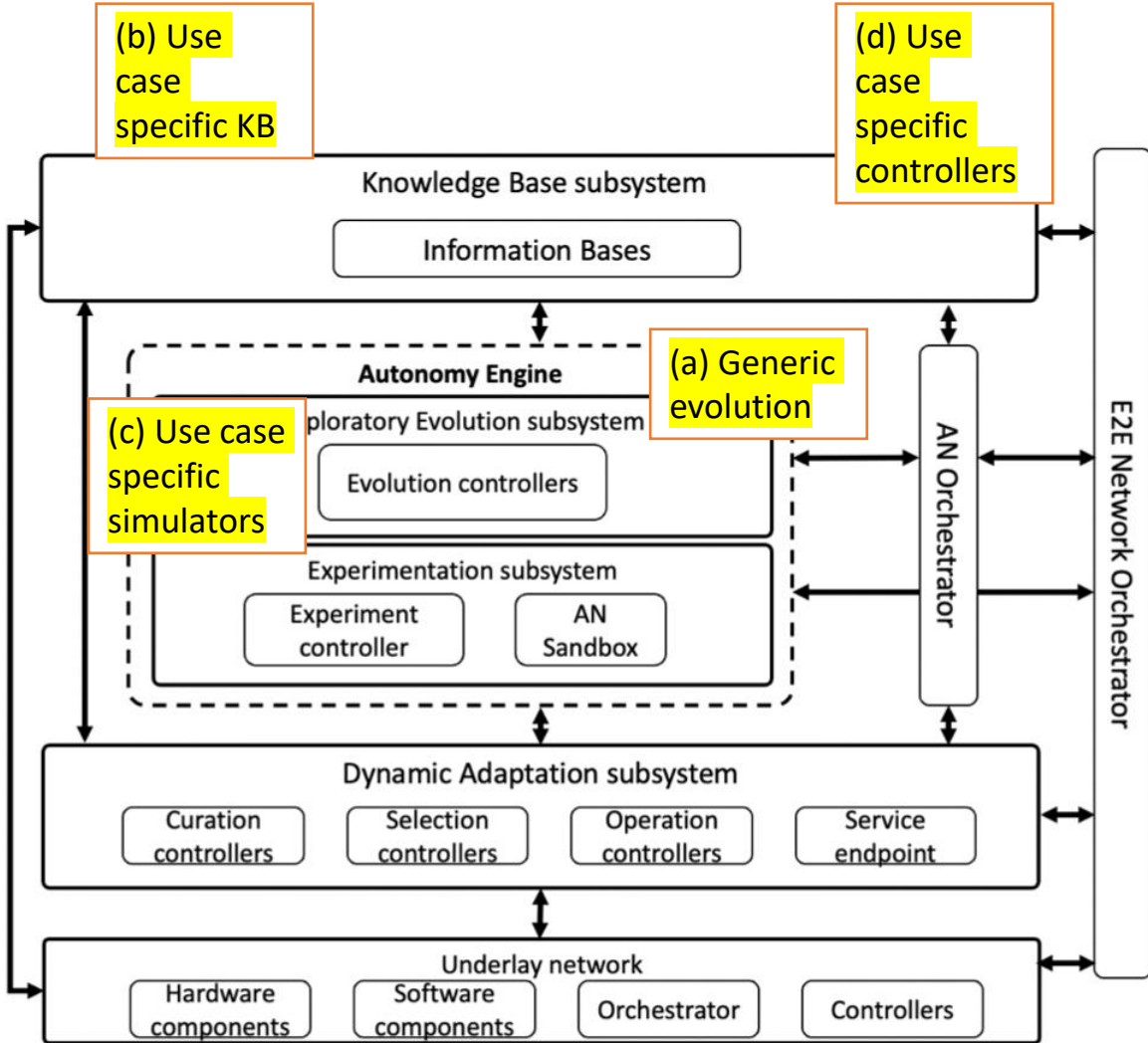| Main Motivations	Level the playing field
	Common reference solutions based on standards
	Encourage collaboration and quality submissions.
	Create a Sandbox of cross-domain knowledge

Internet

Server

Problem statement for 2023?

Figure 5: High-Level Framework for Autonomous Network

Problem statement options:
1) What is the End goal? Concepts that we would like to prove:
   a) It is possible to plugin different evolution mechanisms as a service with clear but limited interfaces
   b) It is possible to interoperate with different knowledge bases with clear but limited interfaces
   c) It is possible to host experimentation in a Sandbox as a service with clear but limited interfaces
   d) It is possible to interoperate with different closed and open loops and openCN repo with clear but limited interfaces.

2) Demos that you would like to see:
   a) **Homework**: Demo of basic framework (KB, Autonomy Engine) which can be used by various participants - by June 2023
      i. Reuse the code from 2022 (Digital twins, Innovnet, FUT Minna, etc)
   b) **Challenge**: Demo of various participants using the framework for different use cases – by Dec 2023

Expectations (at use case level) from the participant

1. Text Input of use case:
   A. Type the use case in Slack (or a github form) in English
   B. Graph based design is made automatically using NLP methods (or try existing pipeline tools such as Argilla)

2. Click and submit the use case for Integration into the openCN
   A. Evolution at **use case level**: The generated graph based design is "integrated" into the overall "openCN".
      1. Immediately after submission, the graphs just co-exist as disjoint
      2. A periodic or async trigger for "property prediction" and "link prediction" is done, so that disjoint graphs may be included in the predictions.
   B. Validation at use case level: Such integrations are validated
      1. By domain experts OR
      2. By automated scripts
      3. This feedback is then fed back to the prediction algos in 2.A.2 and the participant.
3. Click and Generate use case doc from the predicted subgraph
4. Submit the doc to FG AN.

"Ninja" Extensions – for module level

1. GUI based Input of controller modules:
   A. Generated from graph nodes (?)
   B. Input as code from github by participants

2. Click and Integrate controller modules into KB
   A. Evolution at **module level**: The generated or input components are "integrated" into the overall "openKB".
      1. Make sure the modules are packaged as containers with exposed APIs.
      2. pipelines of modules is made by stringing together the containers.
   B. Validation at pipeline level: Such integrations are validated:
      1. By domain experts
      2. By automated scripts and simulators in Sandbox.
3. Click and Generate the experimentation report
4. Submit the report to FG AN.

Expectations (at use case level) from the participant

1. <mark>Text Input of use case:</mark>
   - A. Type the use case in Slack (or a github form) in English
   - B. Graph based design is made automatically using NLP methods (or try existing pipeline tools such as Argilla)

2. <mark>Click and submit the use case for Integration into the openCN</mark>
   - A. Evolution at **use case level**: The generated graph based design is "integrated" into the overall "openCN".
     1. Immediately after submission, the graphs just co-exist as disjoint
     2. A periodic or async trigger for "property prediction" and "link prediction" is done, so that disjoint graphs may be included in the predictions.
   - B. Validation at use case level: Such integrations are validated
     1. By domain experts OR
     2. By automated scripts
     3. This feedback is then fed back to the prediction algos in 2.A.2 and the participant.

3. <mark>Click and Generate use case doc</mark> from the predicted subgraph
4. <mark>Submit the doc</mark> to FG AN.

Parse the sentence
Make graph

Traverse the graph
Make graph analytics

Interact with human expert

Generate text from Graph

For each step,
Make small jupyter notebooks

Make videos/podcast for explaining the notebook usage.
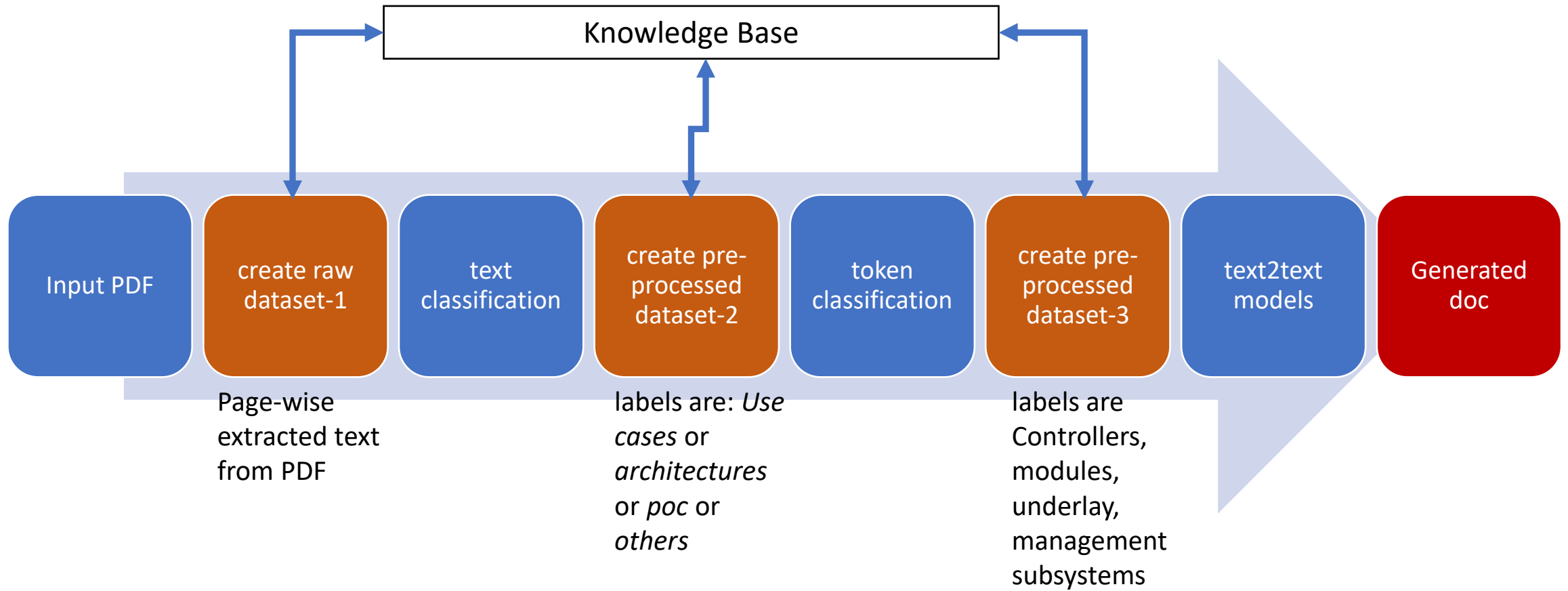
Participants' view: Toolsets and notebooks and workflows
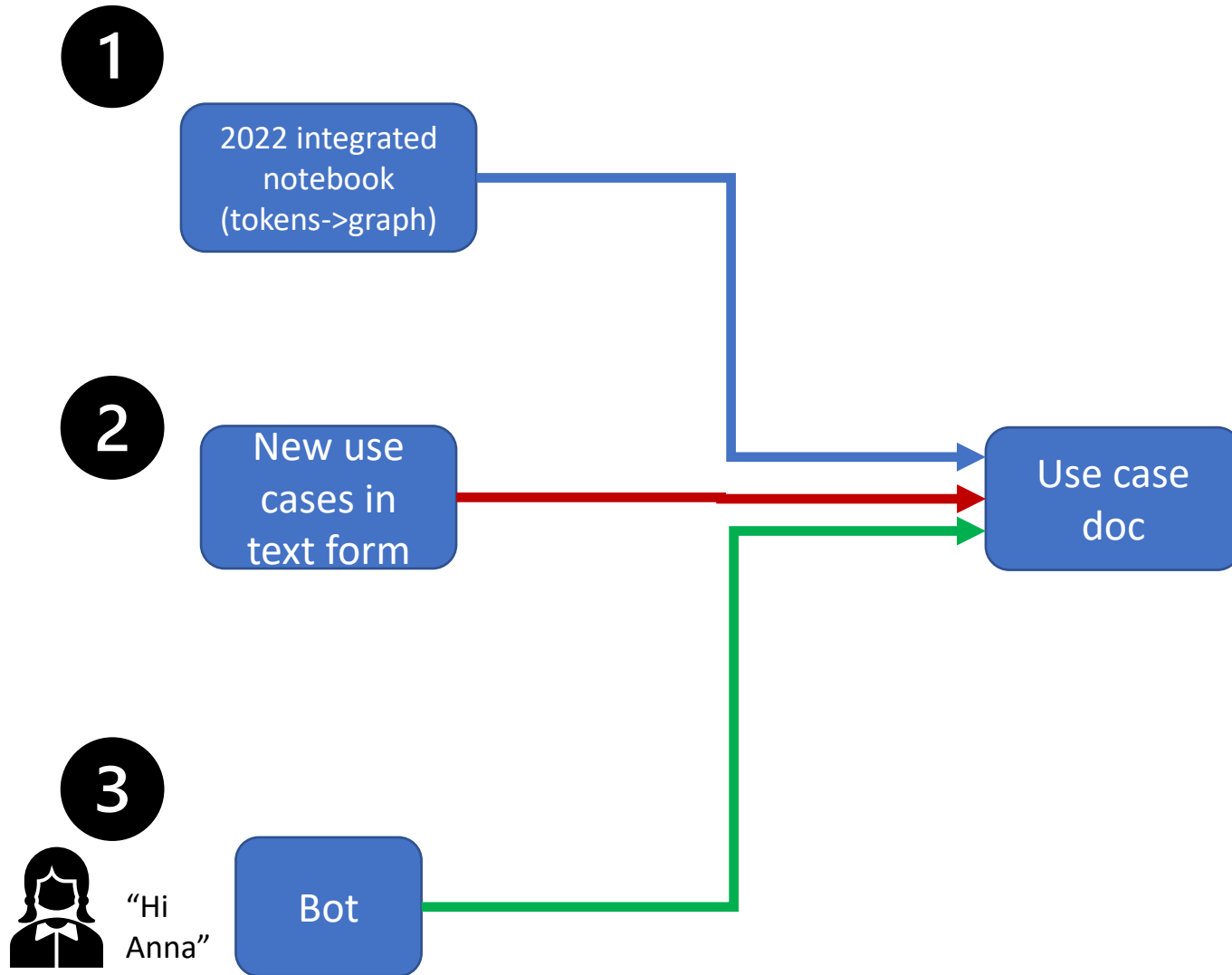
Mentors' view: Toolsets and notebooks and workflows

1

2022 integrated notebook (tokens->graph) → Argilla APIs → Shared Argilla server (tokens) → GUI → Labelling (manual or model based)

Text2Text models

neo4j APIs

2

Use case doc → Tarek's notebook (doc -> tokens) → Argilla APIs

Mentor's notebook (doc -> tokens) → Argilla APIs

Generated text

neo4j ("rich" or "decorated" graph)

Text2Text models
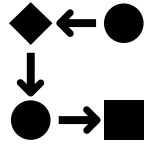
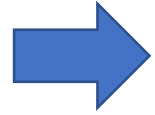**3**

"Hi Anna" ← Bot ← Use case doc
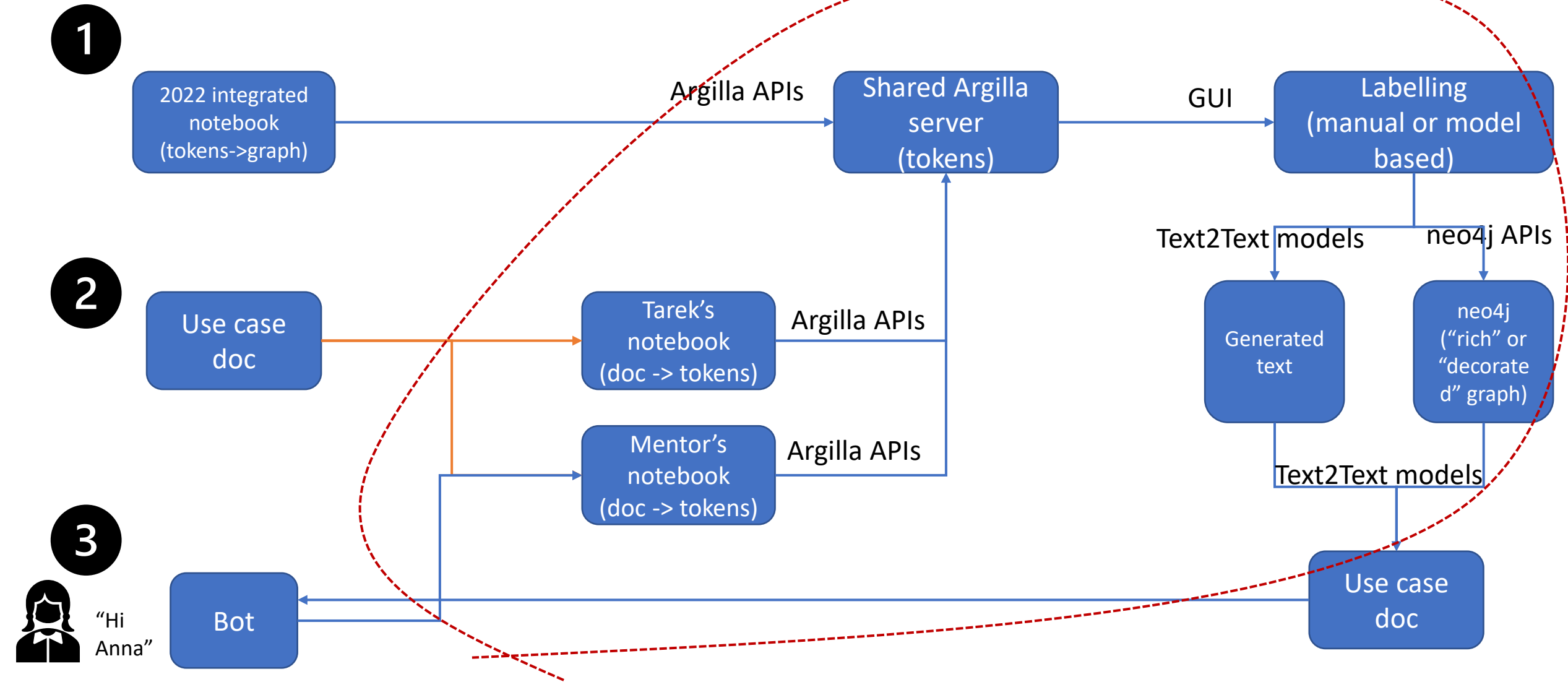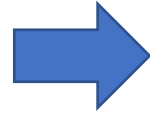
A sample pipeline (1)
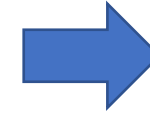
A sample pipeline (2)
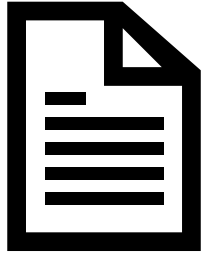
Github issue form → Github Actions → Upload dataset (argilla on HF spaces) → push dataset to on HF hub

https://github.com/vrra/FGAN-Build-a-thon/blob/main/.github/ISSUE_TEMPLATE/submit-usecase-2023.yml

https://github.com/vrra/FGAN-Build-a-thon/blob/main/.github/workflows/sample-1.yml

https://github.com/vrra/FGAN-Build-a-thon/blob/main/PythonScripts2023/PushRecordToArgilla-HF.py

Available under: https://huggingface.co/datasets/vishnuramov/ITU-T-Build-a-thon

🧊 **Dataset card**   ▷≣ Files   🤚 Community   ⚙ Settings

👁 **Dataset Preview** | Size: 15.9 kB | | </> API | | ⊞ Go to dataset viewer |

text (string)	inputs (dict)	prediction (null)	prediction_agent (null)	annotation (null)
"Debido a que las suscripciones móviles…	{ "text": "Debido a que las suscripciones…	null	null	null
"standortübergreifende Impact und Root Cause…	{ "text": "standortübergreifend…	null	null	null
"從4/5G綜合網管收集實時數據，然後根據數據監控網元，…	{ "text": "從4/5G綜合網管收集實時數據，然後根據數…	null	null	null

Programming Tasks

1) Dataset creation
    1) HF dataset

2) Select base model
    1) Llama
    2) Mistral

3) Fine-tuning
    1) Low Rank Adaptation (LoRA) approaches
    2) Reinforcement learning from human feedback (**RLHF**) approaches

4) Saving the fine tuned model
    1) Saving, reloading

The WINEST blueprint for Build-a-thon collaboration

ITU FG ML5G Student projects
- More than 3 contributions from WINEST

ITU News Magazine for ML in 5G
- Article highlighting the research projects in Nigeria.

ITU RG13 AFR 7th workshop
- "Use cases and solutions for migrating to IMT-2020 networks in emerging markets"

ITU RG13 AFR 8th workshop
- "An in-depth study of existing standards related to autonomous networks"

ITU FG AN Build-a-thon
- 2021: 1st Position, Network resource allocation for emergency management based on closed-loop analysis
- 2022: 3rd Position, Baseline representation of AN controllers

Step-1: Form a team of scholars and students

⬇

Step-2: Weekly meetings brainstorming the relevant problem statements

⬇

Step-3: Wider consultation in ITU meetings and submissions

Success

- A paper based on Build-a-thon 2021, titled "Network resource allocation for emergency management based on closed-loop analysis" is published on ITU Journal on Future and Evolving Technologies. It is a collaborative paper with 22 authors, distributed across 6 countries. https://www.itu.int/pub/S-JNL-VOL3.ISSUE2-2022-A16

- In 2023, "Graph based PoC on closed loops" is published in the ITU J-FET (ITU Journal on Future and Evolving Technologies, Volume 4, Issue 3, September 2023). 9 countries 14 different entities including academia, industry and startups. https://www.itu.int/pub/S-JNL-VOL4.ISSUE3-2023-A37

- Build-a-thon 2021 reports from FG AN teams are available in [FGAN-I-183], [FGAN-I-166], [FGAN-I-163-R2], [FGAN-I-187] and [FGAN-I-151-R1].

- Build-a-thon 2022 reports from FG AN teams are available in FGAN-I-289-R7.

- In addition to certificates from ITU, the top team from 2021 FG AN Build-a-thon was presented with a prize courtesy Rakuten Mobile.

- The top team from 2022 Build-a-thon was presented with a prize money of CHF 1000 courtesy of ITU. NOTE- the 2022 Challenge playoffs includes 4 teams from FG AN Build-a-thon.

- Discussions with open source and other partners (e.g. FGAN-I-233, FGAN-I-228-R1, FGAN-I-224 and other LS)