

22RL-052: ML for IoT

2.9 year report

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Team



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PhD in Graph theory



Rafayel Mkrtchyan
Phd student, YSU

3 years of research
4 years of software
development
experience



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MS in CS, AUA

7 years of ML
engineering
experience



Ararat Saribekyan
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2 years of ML
engineering



Arthur Tumanyan
PhD student, YSU

20 years of software
development
experience



Armen Manukyan
Masters from ASDS,
YSU (2024+)



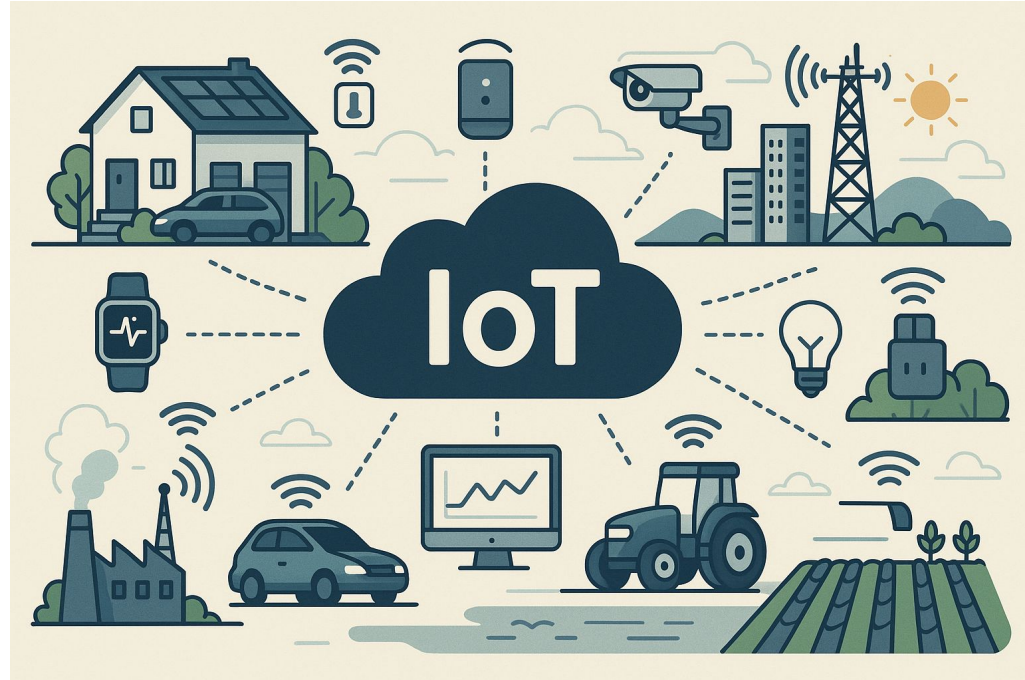
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B.Sc. in Physics, YSU
(2025+)

Medals at
international
olympiads

Internet of Things

A wide area of research

- Node placement
- Device localization
- Resource allocation
- Energy usage optimization
- Radio channel management
- Traffic prediction
- Security against attacks
- Robustness wrt failures



Simulated Data from Huawei

arXiv > cs > arXiv:2212.02159

Computer Science > Machine Learning

[Submitted on 5 Dec 2022]

WAIR-D: Wireless AI Research Dataset

Yourui Huangfu, Jian Wang, Shengchen Dai, Rong Li, Jun Wang, et al.

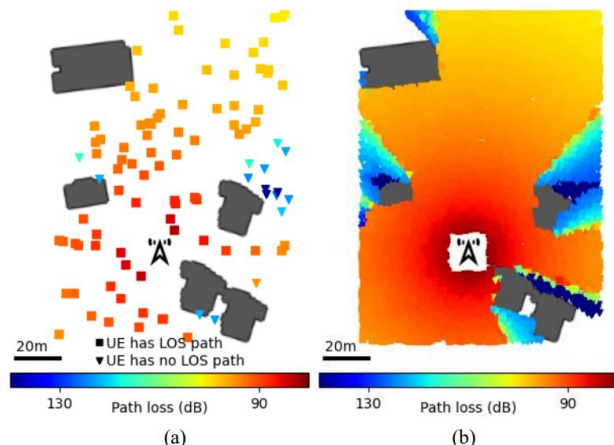


Figure 4. An example environment in Scenario 2, (a) shows 100 UEs among the totally 10,000 UEs, (b) shows all 10,000 UEs

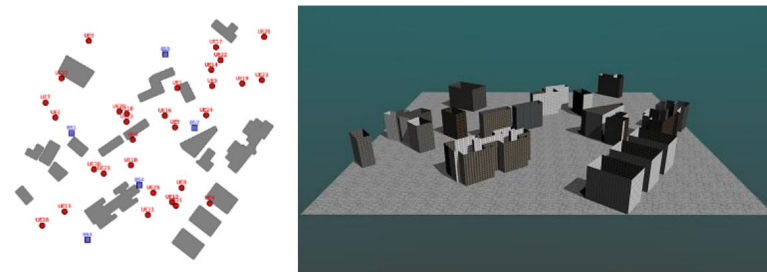


Figure 1 An example environment with buildings and BS(blue)/UE(red) positions in top view (left), the same buildings in bird-eye view (right)

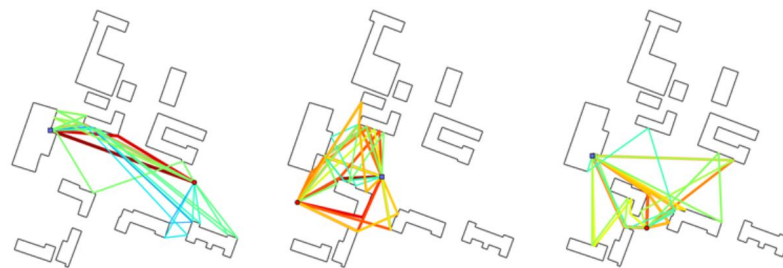
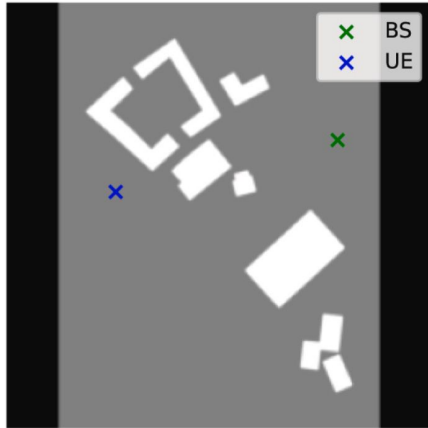


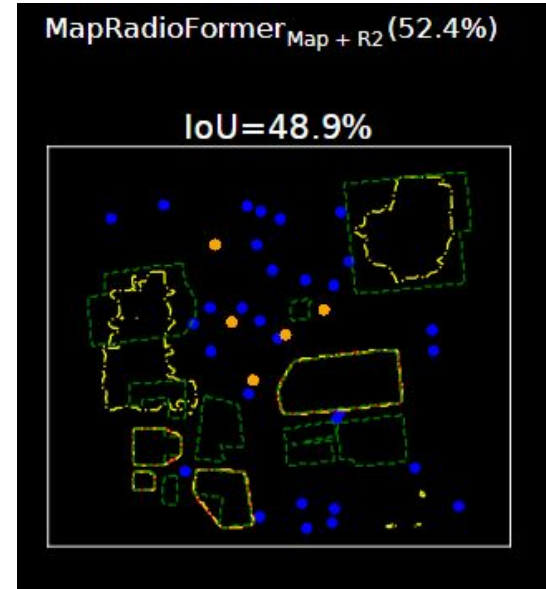
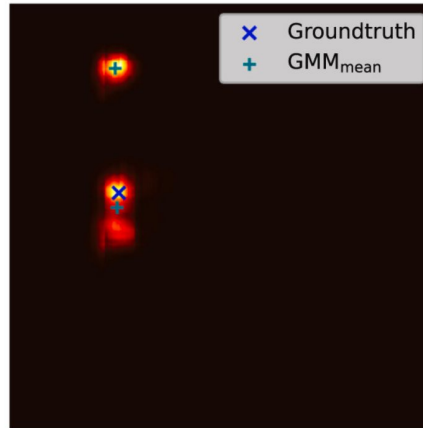
Figure 2 Visualization of simulated radio propagation paths for three radio links in an environment (darker and thicker lines indicate stronger radio propagation paths)

Simulated Data from Huawei

Device Localization using RF signals

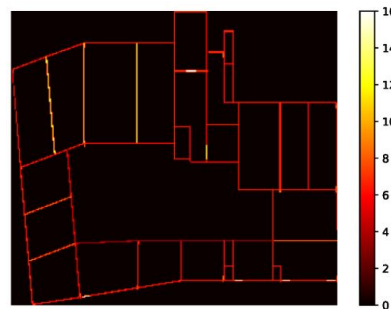


Map Refinement using RF signals

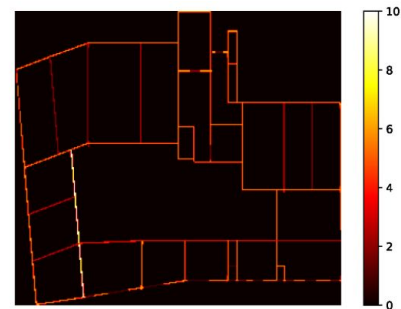


Indoor Simulated Data: Radio Mapping

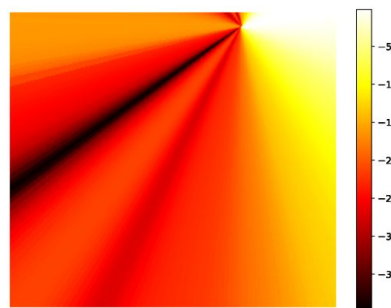
- ICASSP'25 Challenge
 - 8th place
- MLSP'25 Challenge
 - 5th place
 - Presented at MLSP



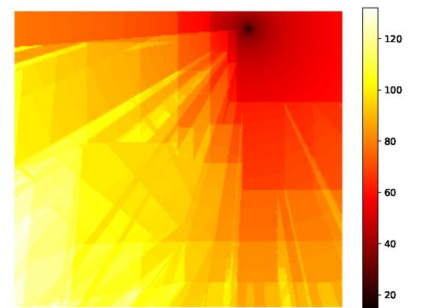
(a) Reflectance



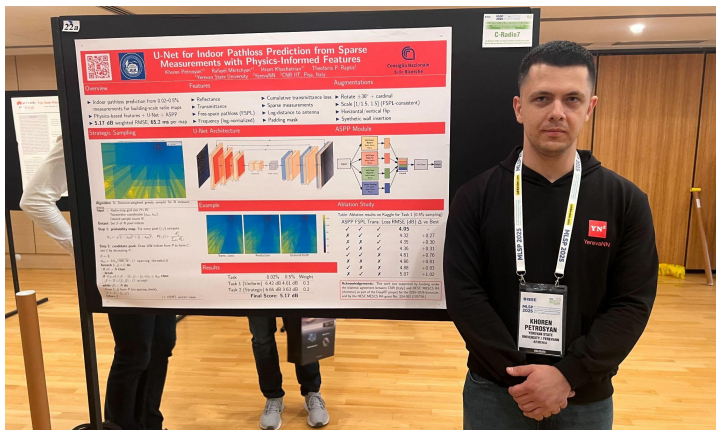
(b) Transmittance



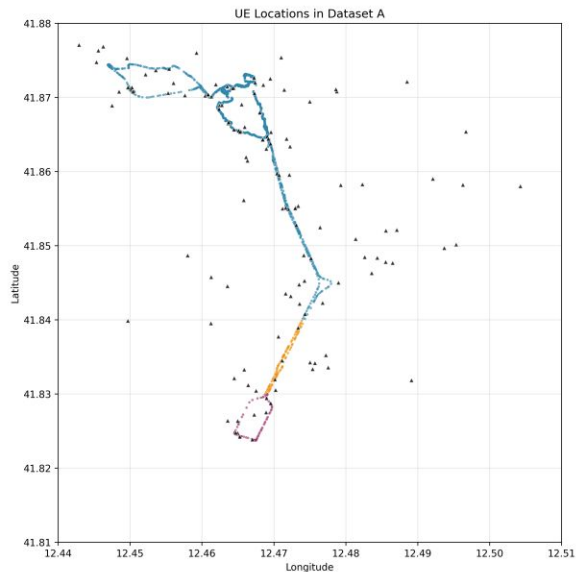
(d) Radiation pattern



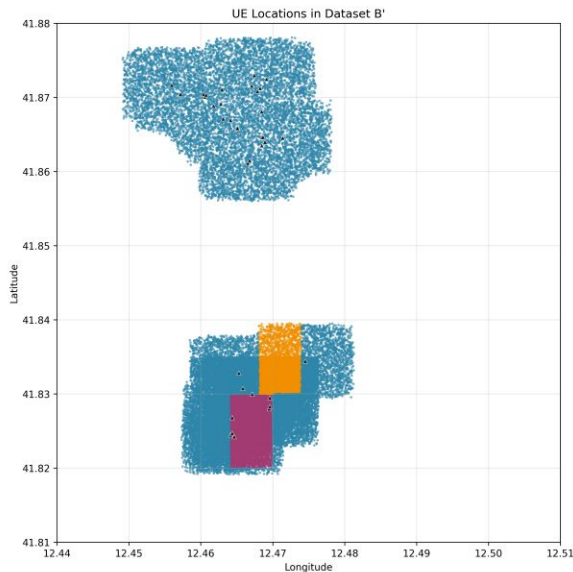
(e) Target



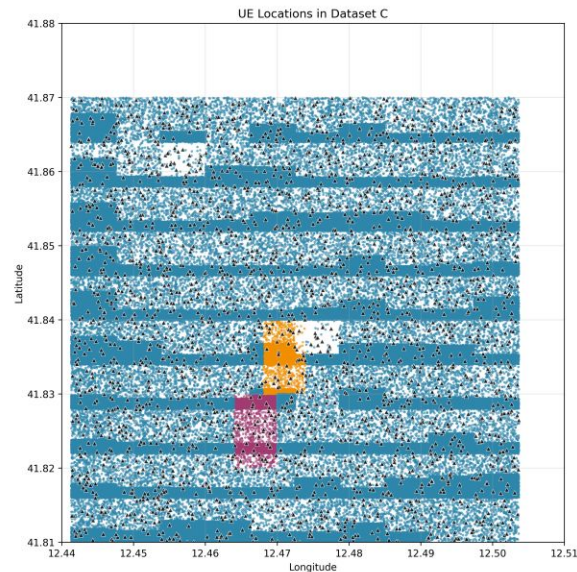
Real Data from Rome + our own Simulations



(a) Dataset A (Real-world data)



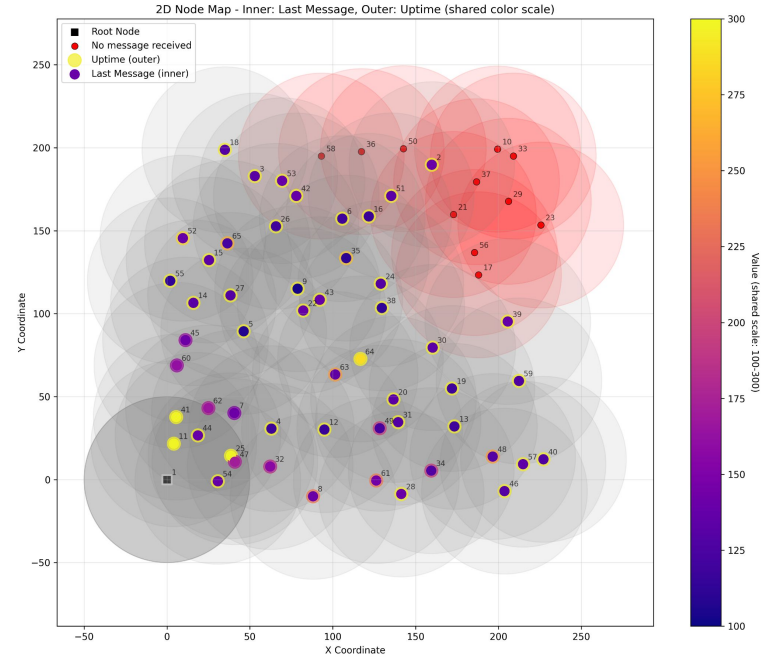
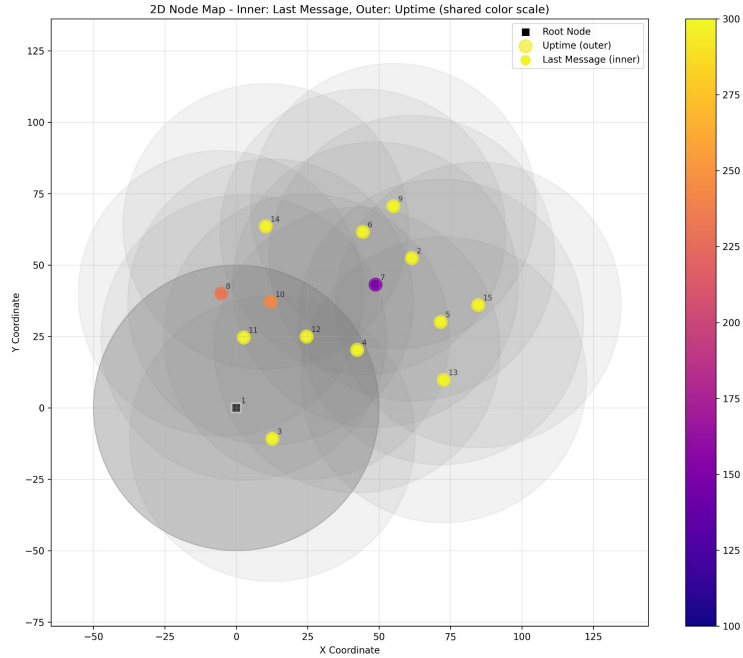
(b) Dataset B' (Real BSs, simulated signals)



(c) Dataset C (Simulated BSs, simulated signals)

- Can simulated data improve the performance of ML models *on real data*?!
 - **Short answer: Yes!** Long answer: not yet to the level of practical applicability.

IoT Network Simulations: a Dataset of 10K Simulations



Automation pipeline developed by Aram Dovlatyan

Real Data Collection from an Apple Orchard in Armenia



Moisture (%) for node 30C922EFA128



N (mg/kg) for node 30C922EFA128

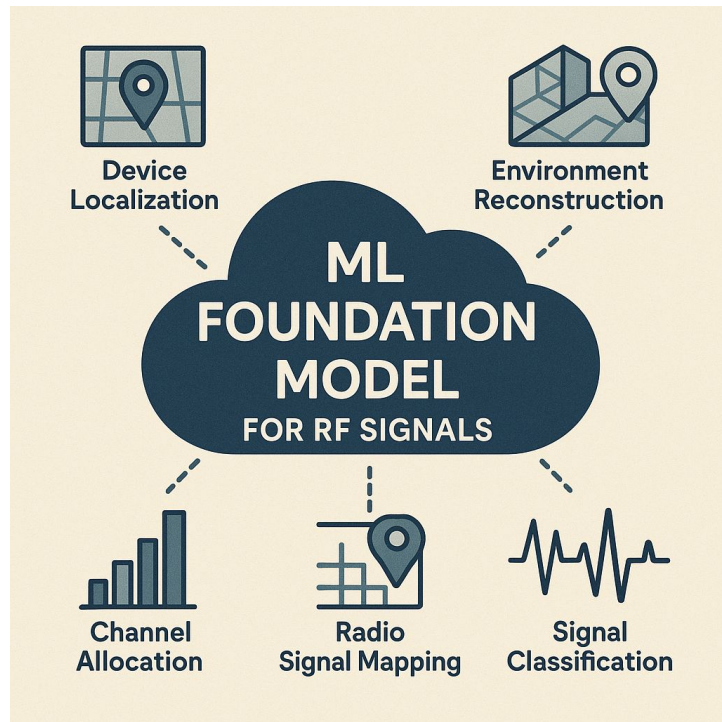


Conferences and Publications

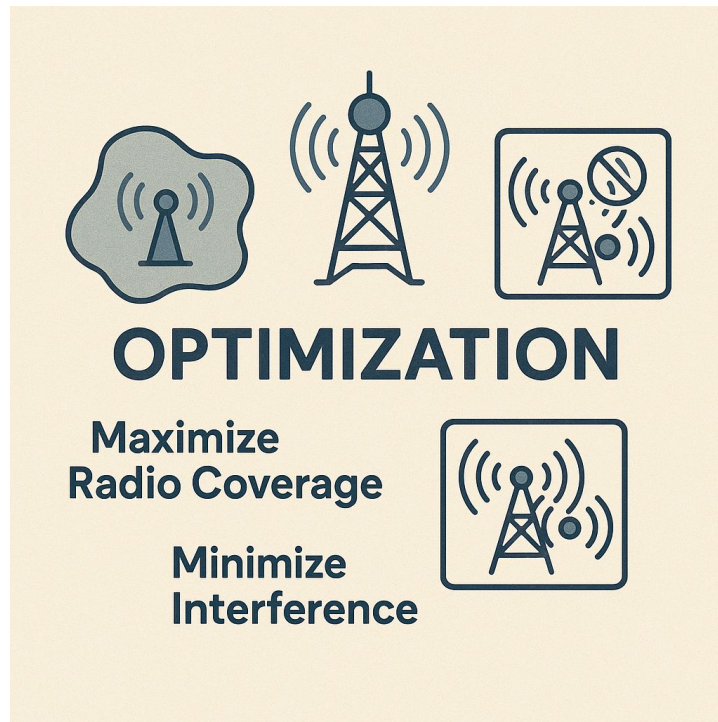
	Conferences	Journal papers
Device Localization (Synthetic Data, NLOS)	✓ IEEE BDS'23	✗ Q1 #1, ✓ Q1 #26/236
Map Refinement with RF Data	✓ IEEE IWCMC'24	✗ Q1 #1, ⚠ Resubmission Q1 #77/382
Indoor Radio Map Prediction	✗ ICASSP'25 (8th place)	✓ Q2
Indoor Radio Map Prediction w/ Sparse Map	✓ MLSP'25 (5th place)	work-in-progress
Synthetic-to-real Transfer for Localization	✗ GlobeCom'25	⚠ Major revision Q1 #1
Cooja Network Simulations	✓ IEEE SDS'24	⚠ Under review Q2
Data Collection from an Apple Orchard	✓ IEEE DCOSS-IoT'23	work-in-progress
Position paper: ML for Wireless / RF	✓ IEEE MeditCom'24	✗ Q1 #4, ✗ Q1 #9

Future work

Foundation Model for Radio Signals



Optimization of IoT / Radio Networks



More Grants

-  Horizon Europe grant
 - Large consortium with 18 partners
 - Eur 200,000 for Yerevan State University
 -  “Travel grant” from Germany
 - Eur 40,000
 - Got rejected after 9 months of review
 -  Armenian-Italian travel grant
 -  Applied to a NATO SPS Grant
 - Eur 110,000 for 3 years
- Some AI-related Horizon grants do not allow partners from Armenia !

GPU Resources in Armenia

Current Resources @ YSU

- 8 x NVIDIA A100s (Sep 2023)
 - 40GB memory per GPU
 - 256 CPU threads, 1TB RAM
- 8 x NVIDIA H100s (Oct 2024)
 - 80GB memory per GPU
 - 224 CPU threads, 2TB RAM
- Users
 - ML Group
 - Computational Material Science Group
 - ASDS students
 - Few more researchers
 - Rafayel Petrosyan's Group



Usage Last 30 days



Usage Last 7 days



Job wait time on YSU GPUs (last 7 days)

Job Wait Time (In Hours)



Upcoming Solution: 64 H100s!

- Science Committee allocated ~\$8.5M
 - Supercomputer + data center @ YSU
- 8 nodes, 64 H100s in total
- 1792 CPU threads
- 16TB total RAM
- 600TB+ Storage
- Infiniband network
- **We need a strong system administrator for this!**



GPU Resources in Armenia



8 A100s + 8 H100s @ YSU



64 H100s @ YSU

GPU Resources in Armenia



8 A100s + 8 H100s @ YSU



64 H100s @ YSU

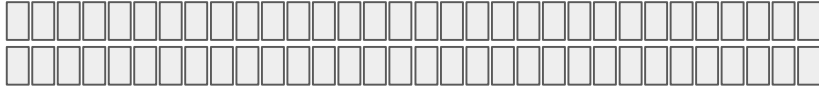


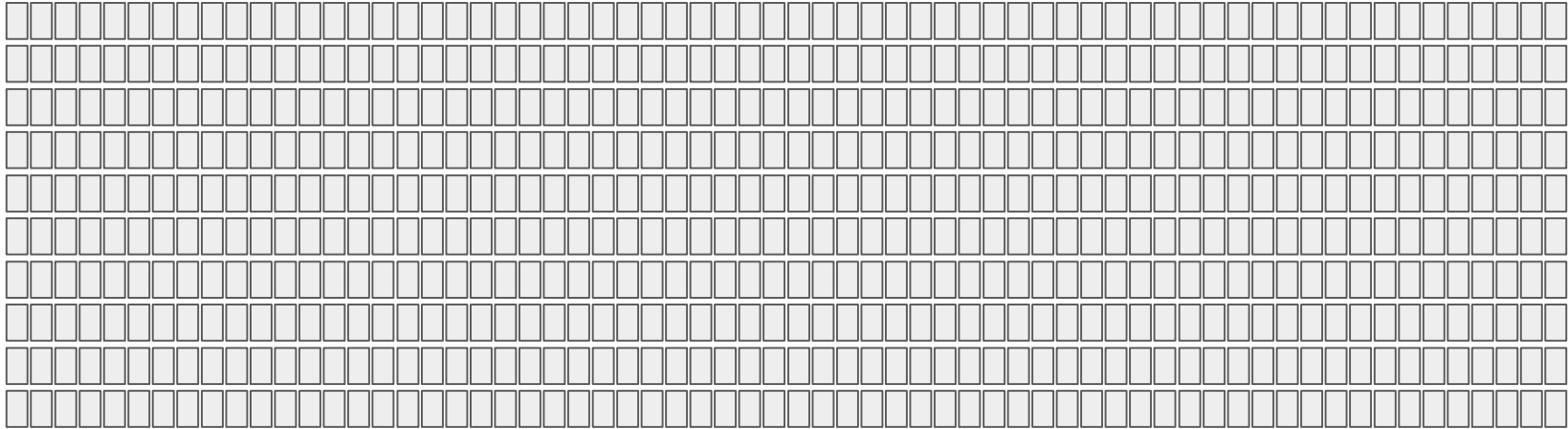
512 B300s @ Eleveight.ai

GPU Resources in Armenia

 8 A100s + 8 H100s @ YSU

 64 H100s @ YSU

 512 B300s @ Eleveight.ai



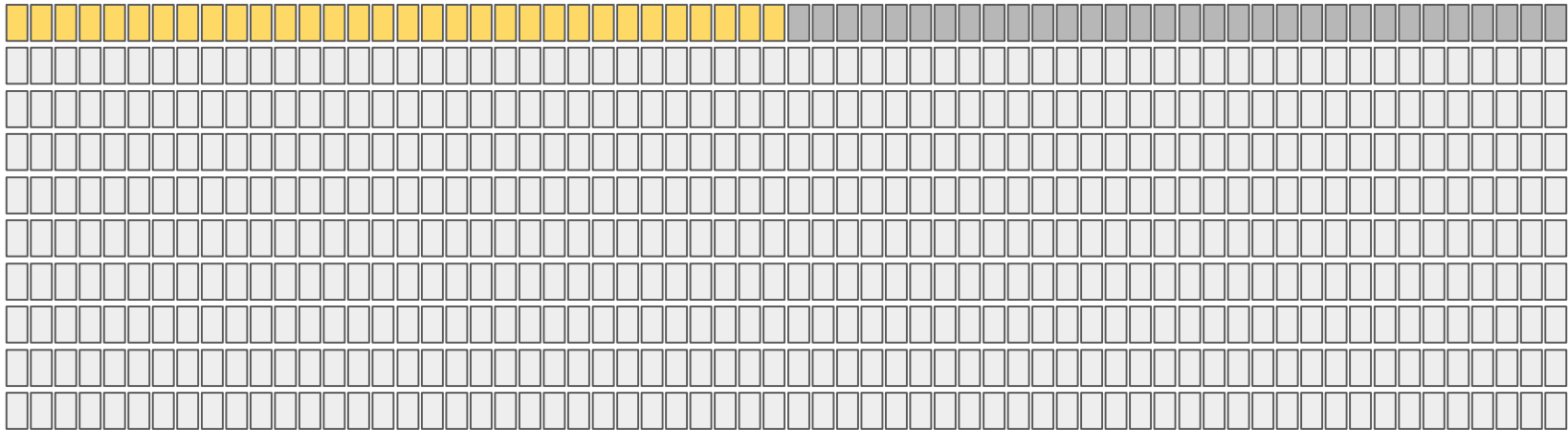
5120 B200s @ Firebird.ai

GPU Resources in Armenia

8 A100s + 8 H100s @ YSU

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5120 B200s @ Firebird.ai

Call To Action



8 A100s + 8 H100s @ YSU



64 H100s @ YSU



512 B300s @ Eleveight.ai



Let's design ambitious research projects
that can leverage large number of GPUs

5120 B200s @ Firebird.ai

Call To Action



8 A100s + 8 H100s @ YSU



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Let's design ambitious research projects
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Thank you!

5120 B200s @ Firebird.ai