

TOKYO TIER2 STATUS



T.KISHIMOTO (ICEPP)

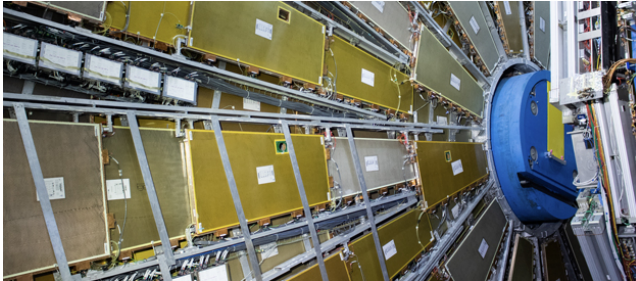
TOMOE KISHIMOTO,
ICEPP

2021/3/17

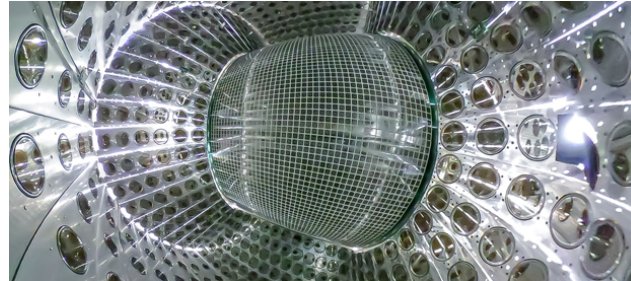
INTERNATIONAL CENTER FOR ELEMENTARY PARTICLE PHYSICS

- Main projects at ICEPP:

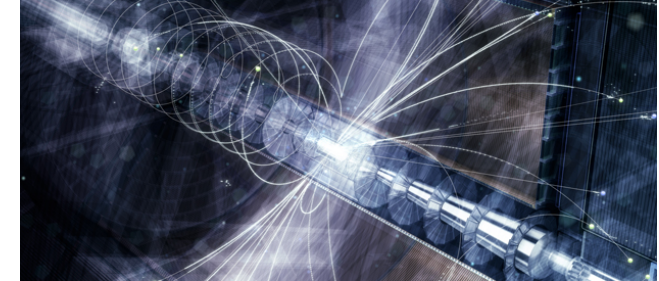
ATLAS experiment at LHC



MEG experiment at PSI
($\mu \rightarrow e\gamma$ rare decay)



ILC projects



- ATLAS Japan group
 - 17 institutes and ~ 150 members including students
 - Contributes to wide area of the experiment (e.g. muon triggers, silicon trackers, Tier2 operation)



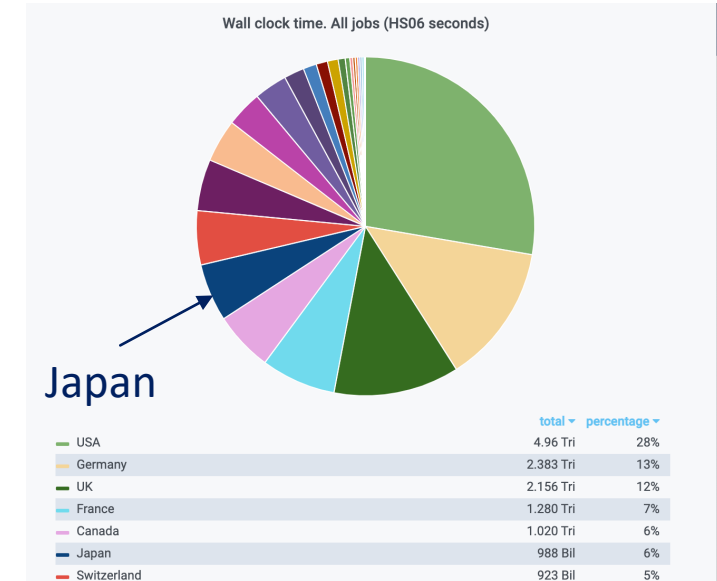
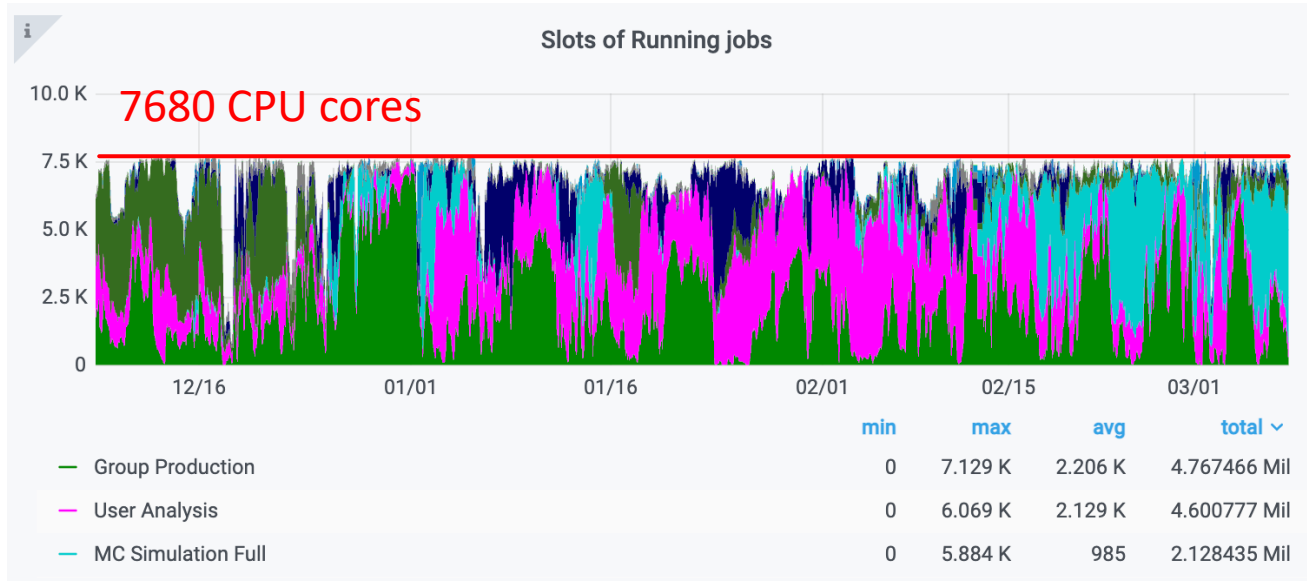
ICEPP REGIONAL ANALYSIS CENTER

- Hardware devices are leased and replaced every 3 years
 - Uniform architecture allows us to reduce operation cost
 - System is kept as powerful as possible to satisfy requirements of the experiment
 - 5th system is in operation since 2019:
 - ~ 10k CPU cores (3 GB memory per core) and 15 PB disk storage
 - 40 Gbps to NREN (SINET5)
- Operated by ICEPP staffs (~ 3 FTEs) + SEs from company (2 FTEs)
- Only ATLAS VO is supported
 - No other WLCG sites in ATLAS Japan group
- Grid middleware: ARC-CE + HTCondor and DPM
 - One of the biggest DPM sites in WLCG

~ 300 m²



STATUS IN ATLAS



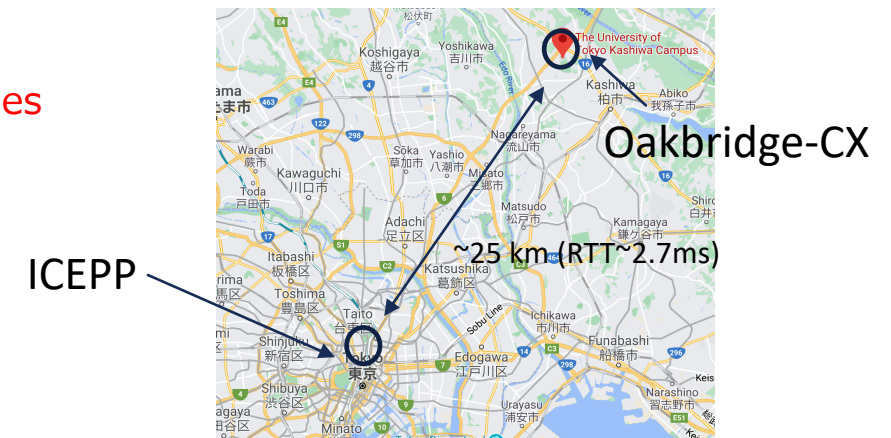
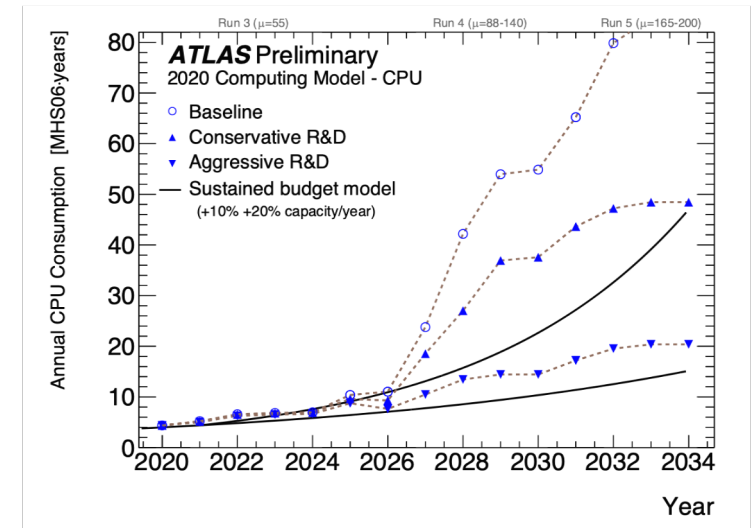
- CPUs are fully utilized by variety of job types (e.g. MC simulation, user analysis)
 - Contributes ~5% of all ATLAS Tier2s (wall clock time) ☺ (ATLAS Japan members / ATLAS all members ~ 5%)
- Site availability in last 6 months was > 98%
 - There was a planned power outage for building maintenance

SELECTED RECENT ACTIVITIES

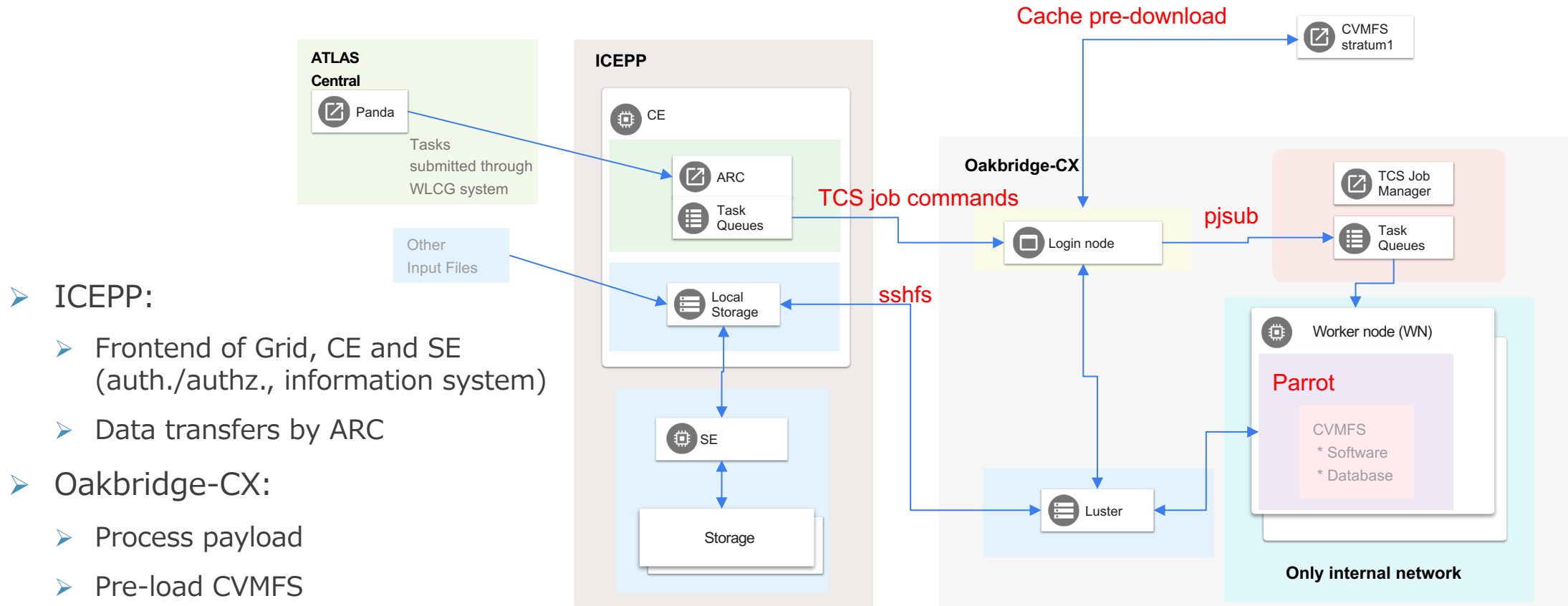
- Utilization of HPC resources
 - Related talk: CHEP 2019 [link](#)
- Data center operation using Machine learning
 - Related talk: CHEP 2019 [link](#)

UTILIZATION OF HPC RESOURCES

- High Luminosity LHC (HL-LHC) is planned to start in 2026
 - Peak luminosity x5
 - Current computing model cannot provide enough resources with flat budget
 - Integrating HPC resources should help cover the growing computing demands
- We are testing to integrate **Oakbridge-CX** system to ICEPP system
 - Operated by Information technology center of U-Tokyo
 - **No root privilege, no external network connectivity from/to computing nodes**
 - CPU: Intel Xeon Platinum 8280
 - Shared file system (Lustre)
 - FUJITSU Software Technical Computing Suite (TCS) for job management

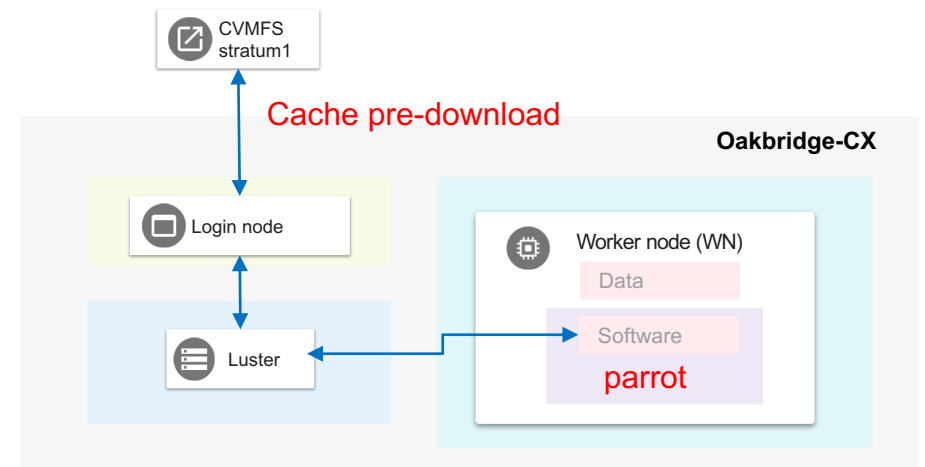


SYSTEM OVERVIEW

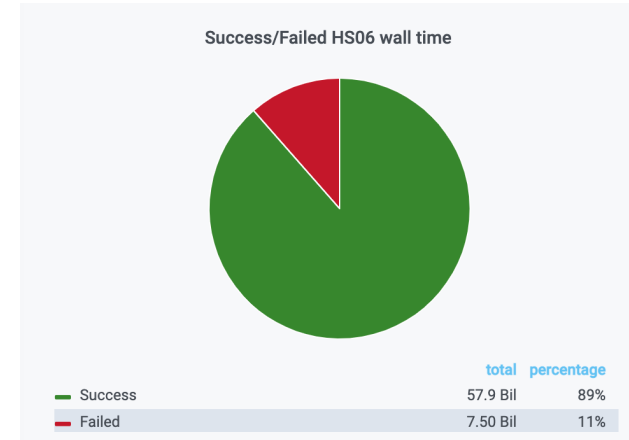
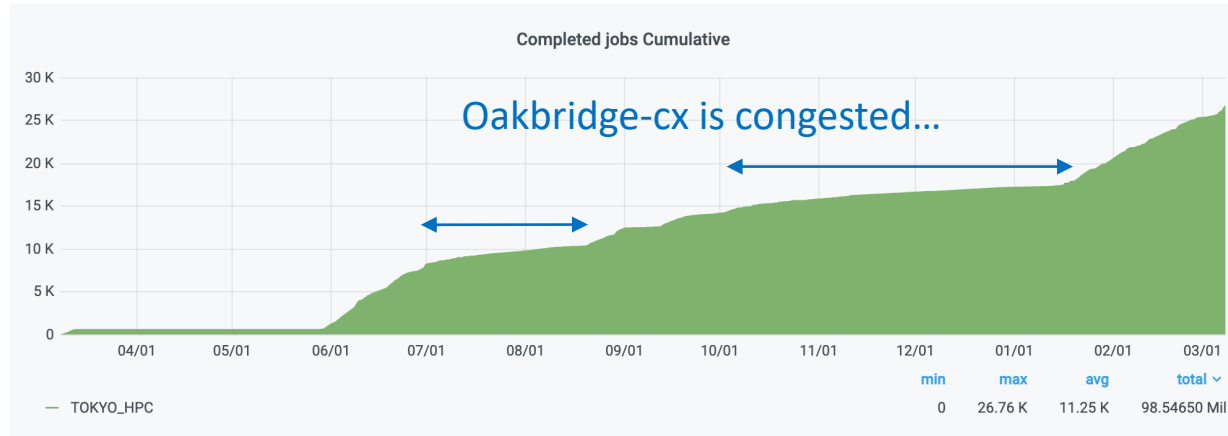


TECHNICAL WORKAROUND

- Input and output data transfers
 - ARC supports data transfers to/from shared file system with cache ☺
- Software deployment
 - CVMFS cache data are pre-downloaded to shared file system by `cvmfs_preload` command
 - Only software, which are assumed to be necessary to run simulation jobs, are selected
 - ~ 4TB data, need to update regularly
 - `parrot_run` in `cctools` allows us to run `cvmfs` client as user privilege
- Development of ARC plugins
 - ARC does not support TCS job scheduler natively
 - Developed plugin scripts to prepare job configuration file, submit jobs to TCS, monitor job status, and so on



COMPLETED JOBS BY HPC



- Only event generation and simulation jobs are processed because they are CPU intensive
- ~27k jobs have been processed so far, which is 1-2% of completed jobs by on-premise resources
- No dedicated resources for ATLAS:
 - Jobs are rarely processed based on fair-share when Oakbridge-CX is congested..
- Plan to migrate from “cvmfs_preload + parrot” to “singularity” for simplicity and performance



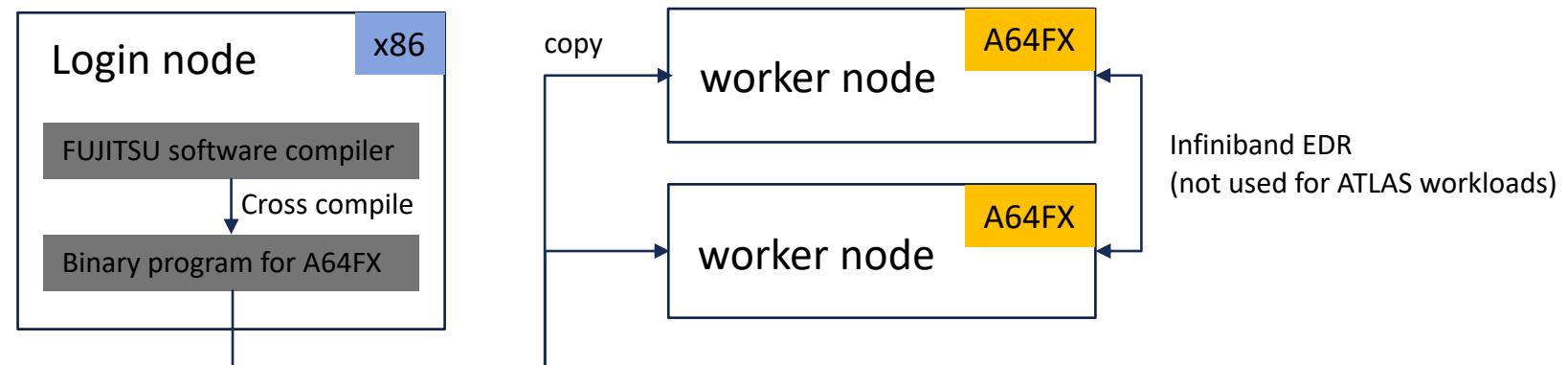
ARM PROCESSOR

- Fugaku is the leading HPC in TOP500 and Green500
- We have procured PTIMEHPC FX700 to evaluate performances and power consumption
 - A64FX x2 (96 cores)
 - Need to compile ATLAS software by FUJITSU software compiler to maximize performance
- Studies are ongoing...

FX700



Test system



DATA CENTER OPERATION USING ML

- Machine learnings have been proven to be successful in many applications
 - It is also promising for data center operation
- Motivation:
 - “text logs” produced by services provide useful information for understanding the status of service
 - However, it is time-consuming tasks for site administrators to monitor and analyse such logs everyday
→ Developing a support framework to detect anomaly logs automatically
- Why ML?
 - Log analysis using scripts do not scale for complex logs and difficult to set criteria for all suspicious logs
 - “Unsupervised” ML is used because it is difficult to collect a large amount of anomaly logs
 - Idea of anomaly detection: **preprocessing** → **word embedding** → **clustering**
 - Real DPM logs at Tokyo Tier2 site are used to evaluate ML performance

PREPROCESSING

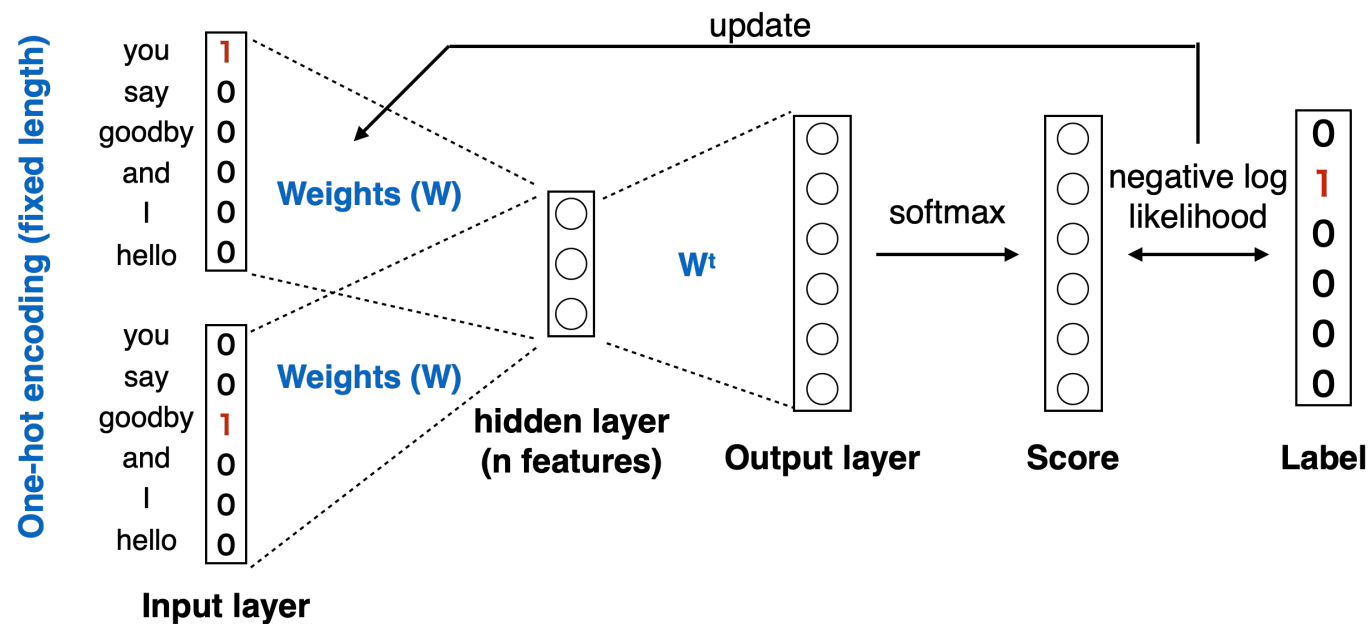
- Service logs are aggregated using “logwatch” everyday
 - Need to make dedicated scripts for each service
 - For DPM, logwatch outputs “Error counts : Error message” format as follows

Error counts	Error message
336780 time(s)	globus-gridftp-server : dmlite DmStatus : Info: [#00.000002] DPM_LFN not found
333902 time(s)	xrootd : dmlite DmStatus : Info: [#00.000002] replica DPM_LFN not found
333900 time(s)	globus-gridftp-server : dmlite DmException : DmException(..):[#00.000002] Error when issuing request to ' http://lcg-se01.icepp.jp:1094/domehead/command/dome_getstatinfo '. Status 404. DavixError: 'HTTP NUMBER : File not found '. Response (NUMBER bytes): 'File not found on rfn: DPM_LFN err: NUMBER what: '[#00.000002] replica DPM_LFN not found'
...	...

- Meaningless words are replaced with common words
 - e.g 0xabcd (memory address) → NUMBER

WORD EMBEDDING

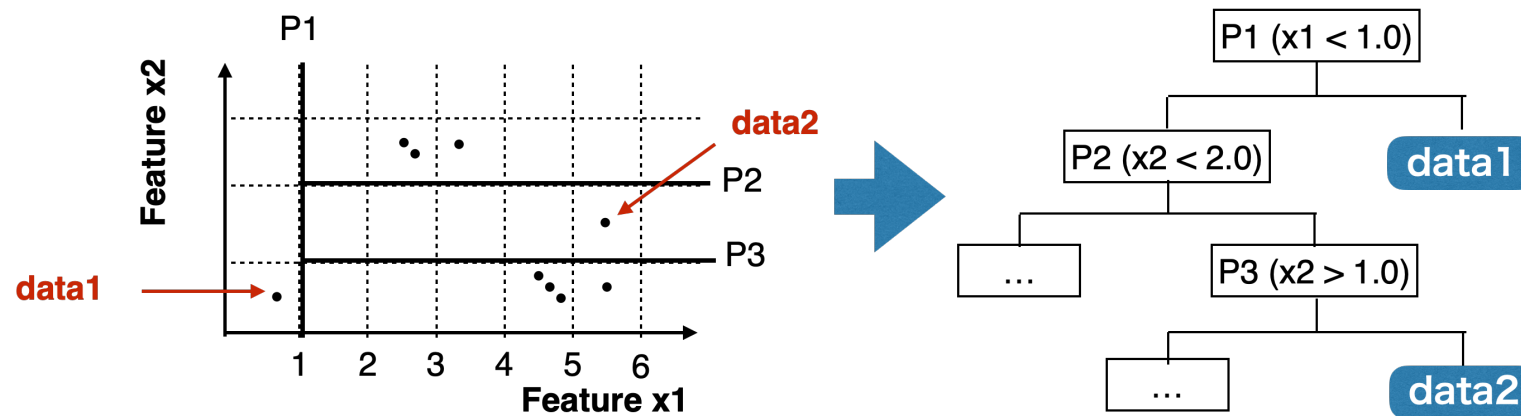
- Texts are converted to feature vectors using word embedding technique
 - Doc2vec algorithm ([link](#)) is used in this study
 - Use a neural network that predict a target word from context
 - You ○○ goodbye and I say hello → what is ○○ ?



- Weights (W) represents word vectors
- For paragraph, additional matrix is defined for paragraph-id, which represents paragraph vectors

CLUSTERING

- Clustering n-dimensional feature vectors
 - IsolationForest algorithm ([link](#)) is used
 - Decision trees are defined with random feature and value
 - Anomaly data tend to result in small number of partitions



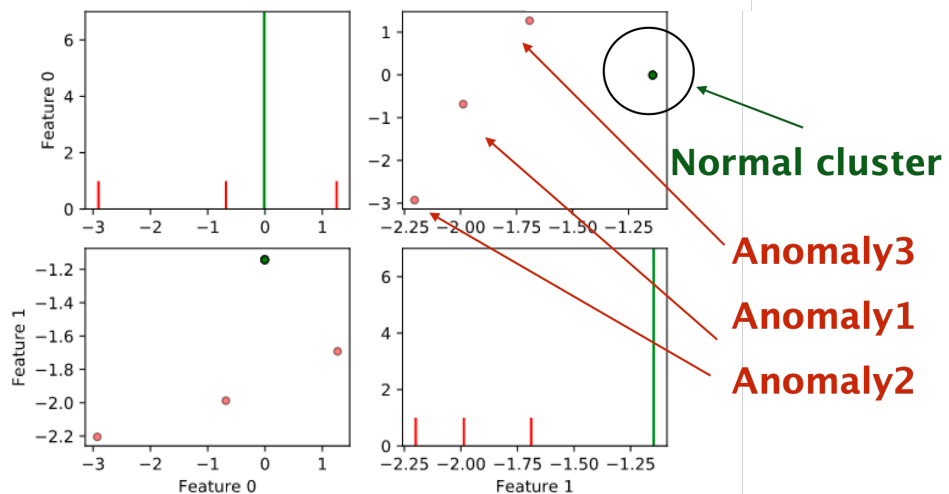
- 1 partition for data1
- 3 partitions for data2
- data1 is likely to be anomaly

- No need to define the number of clusters as a hyper parameter

SIMPLE TEST USING DUMMY DATA

- Simple dummy data (sshd log) are defined to check the idea

Label	Text logs	# of samples
Normal	Users logging in through sshd: root: 2001:2f8:102d:589:2:1:2:1 : 288 times	7
Anomaly1	Users logging in through sshd: root: 2001:2f8:102d:589:2:1:2:1 : 300 times	1
Anomaly2	Users logging in through sshd: root: 2001:2f8:102d:589:2:1:2:1 : 1000 times	1
Anomaly3	Users logging in through sshd: root: 2001:2f8:102d:589:2:1:2:1 : 288 times 2001:2f8:102d:589:2:1:2:2 : 10 times	1



- Converted to two-dimensional vectors
- Anomaly logs are detected as outliers as expected using clustering algorithm

DPM LOGS

- Use DPM logs from May 29th 2019 to Aug 31th 2019 at Tokyo Tier2
 - Logs are aggregated everyday using logwatch → 1 day = 1 sample

Date	# of samples	
May 29 – Aug 7	71	Tuning data
Aug8 – Aug 31	23	Validation data

- Hyper parameters of doc2vec and IsolationForest are tuned using tuning data
 - There were 7 days operational issues in this tuning data period → labeled as anomaly
 - E.g. configuration of quota was wrong, then data transfers failed

Suspicious DPM log

```
dmlite DmException : DmException(..):[#00.000028] Error when issuing request to 'http://lcg-  
se01.icepp.jp:1094/domehead/command/dome_put'. Status 507. DavixError: 'HTTP NUMBER : Insufficient Storage '. Response (NUMBER  
bytes): 'Unable to complete put for DPM_LFN - quotatoken 'ATLASGROUPDISK' has insufficient free space. minfreespace_bytes: NUMBER
```


RESULTS USING DPM LOGS

➤ Tuning data:

Accuracy of anomaly detection	Accuracy of normal detection
6 / 7 = 0.86	62 / 64 = 0.97

→ reasonable accuracies are achieved for pre-labeled anomalies

➤ Validation data:

- 4 days (Aug 24, 27, 28, 29) are detected as anomaly
- DPM was upgraded on Aug 27, DPM showed new type of logs after upgrade
→ Aug 27, 28, 29 are detected as anomaly as expected 😊
- Cannot understand clear reason for Aug 24 (false alert)

➤ Discussion

- Unsupervised ML is used, but data labeling is still required to evaluate performance
- ML model is tuned for specific service and condition, challenging to build general model

SUMMARY

- ICEPP regional analysis center is in operation stable
 - Contributes to ~5% of ATLAS all Tier2 sites
- Several R&Ds are ongoing
 - Oakbridge-CX is integrated to ICEPP to process ATLAS production jobs
 - ML is promising approach to automate data center operation