Technical Advisory Council Meeting

May 21, 2020

THE LINUX FOUNDATION

LF AI

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Recording of Calls

Reminder that TAC calls are recorded and available for viewing on the TAC Wiki

Reminder: LF AI Useful Links

Web site: lfai.foundation
Wiki: wiki.lfai.foundation
GitHub: github.com/lfai
Landscape: landscape.lfai.foundation or l.lfai.foundation
Mail Lists: https://lists.lfai.foundation

LF AI Logos: https://github.com/lfai/artwork/tree/master/lfai
LF AI Presentation Template:
https://drive.google.com/file/d/1eiDNJvXCqSZHT4Zk_-czASIz2GTBRZk2/view?usp=sharing

Events Page on LF AI Website: https://lfai.foundation/events/
Events Calendar on LF AI Wiki (subscribe available):
https://wiki.lfai.foundation/pages/viewpage.action?pageId=12091544
Event Wiki Pages: https://wiki.lfai.foundation/display/DL/LF+AI+Foundation+Events

Agenda

- Roll Call
- Approval of Minutes
- Guest Presentation: SnapML
- LF AI General Updates
- Upcoming TAC Meetings
- Open Discussion

TAC Voting Members

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Angel Project	Bruce Tao	brucetao@tencent.com
ONNX Project	*Jim Spohrer	spohrer@us.ibm.com

* TAC Chairperson

Approval of Minutes

- Draft minutes from the May 7th meeting of the TAC were previously distributed to the TAC members

- **Proposed Resolution:**
  - That the minutes of the May 7th meeting of the Technical Advisory Council of the LF AI Foundation are hereby approved

Guest Presentation:
Snap ML

Guest Presentation: Snap ML

Snap Machine Learning (Snap ML) is a library for training generalized linear models.

- **Presenter:** Haris Pozidis, HAP@zurich.ibm.com
- **GitHub:**
  - https://github.com/ibmsoe
  - https://github.com/ibmsoe/snap-ml

Snap ML: Optimized Machine Learning

Haris Pozidis, PhD
IBM Research - in collaboration with IBM Systems

https://www.zurich.ibm.com/snapml/

Snap ML: Optimizing Machine Learning

Design Objectives

- Accelerate & scale popular ML algorithms through system awareness, and HW/SW co-design
- Develop novel ML algorithms with best-in-class accuracy for business-focused applications

AI in Business – Challenges

Speed	Efficiency	Accuracy	Data Size
Train and re-train on new data online	Use resources judiciously	Make accurate decisions or predictions	Learn from all available data
Large parameter, model searches	Less resources means less $	Cost savings (e.g. card fraud), higher revenue (e.g. portfolio allocation)	More data, better models, higher accuracy
Make fast decisions	On-prem and in the cloud		Handle big data efficiently

Snap ML is:

- Fast
- Scalable
- Accurate
- Resource-efficient
- Consumable

Snap ML Library Overview

WMLCE 1.6.0 (4Q18)

- Linear Regression
- Logistic Regression
- SVM

WMLCE 1.6.1 (2Q19)

- Decision Trees
- Random Forest

WMLCE 1.6.2 (4Q19)

- Boosting Machine

WMLCE 1.8.0 (3Q20)

- Random Forest Inference
- Boosting Machine Inference

1.7.0 (Feb’20) includes CPU/GPU-accelerated Decision Tree and multi-GPU Random Forest

1.8.0 (3Q20): CPU-Accelerated Inference for SnapBoost & new SnapBoost version (better accuracy)

Core library written in C++/CUDA

Python wrappers for APIs

~16k lines of code

Snap ML is integrated in IBM Watson Machine Learning Community Edition (WMLCE)

Seven library releases in WMLCE since Jun’18

WMLCE 1.7.0 (Feb’20)

Model	CPU solver	GPU solver	Multi-node
Linear Regression			
Logistic Regression			
SVM			
Decision Tree			
Random Forest			2H’20
Boosting Machine			2H’20

Key Innovations

Distributed Training

Adaptive Distributed Newton (**ADN**) algorithm for scaling out GLMs across a cluster of CPUs/GPUs

ICML 2018
NeurIPS 2018

Multi-threaded Training

State-of-the-art solvers on multi-core, multi-socket CPUs.

MLSys 2018
NeurIPS 2019

GPU Acceleration

Twice-parallel, asynchronous stochastic coordinate descent (**TPA-SCD**) for training linear models on GPUs.

Duality-gap based heterogenous learning (**DuHL**) for when the dataset does not fit in GPU memory.

NIPS 2017, FGCS 2018

Tree Ensembles

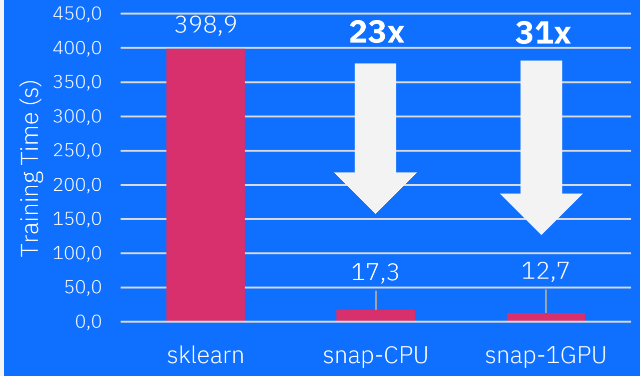
Memory-efficient breadth-first search algorithm for training of decision trees, random forests and gradient boosting machines.

New boosting algorithm based on stochastic selection of base learner.

MLSys 2019

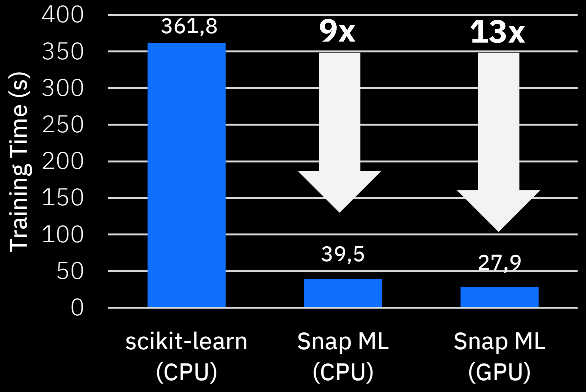
Fast: Seamless acceleration of scikit-learn applications

Logistic Regression (Kaggle #1 most used)



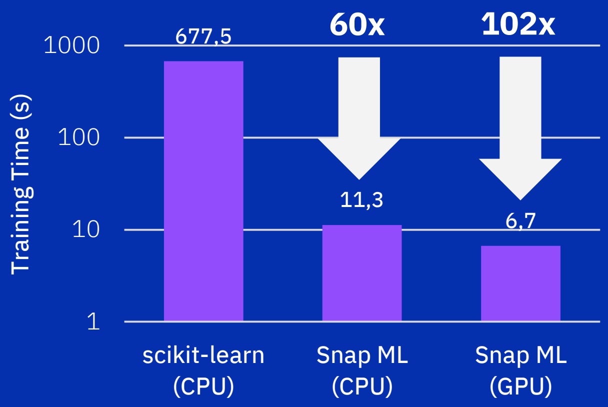
Dataset: criteo-kaggle
Machine: 1x AC922
scikit-learn loss: 0.4558
Snap ML loss: 0.4558

Random Forest (Kaggle #2 most used)



Dataset: SUSY
Machine: x86, V100
scikit-learn acc: 0.7848
Snap ML acc: 0.7945

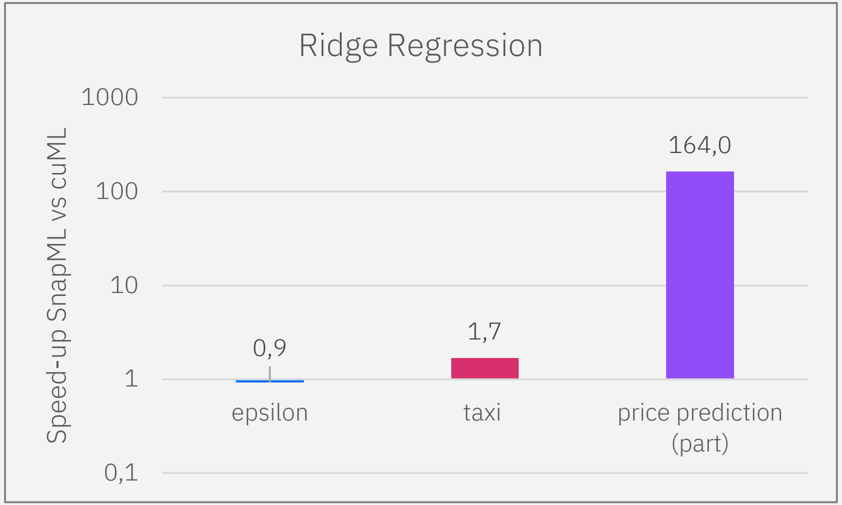
Decision Tree (Kaggle #2 most used)

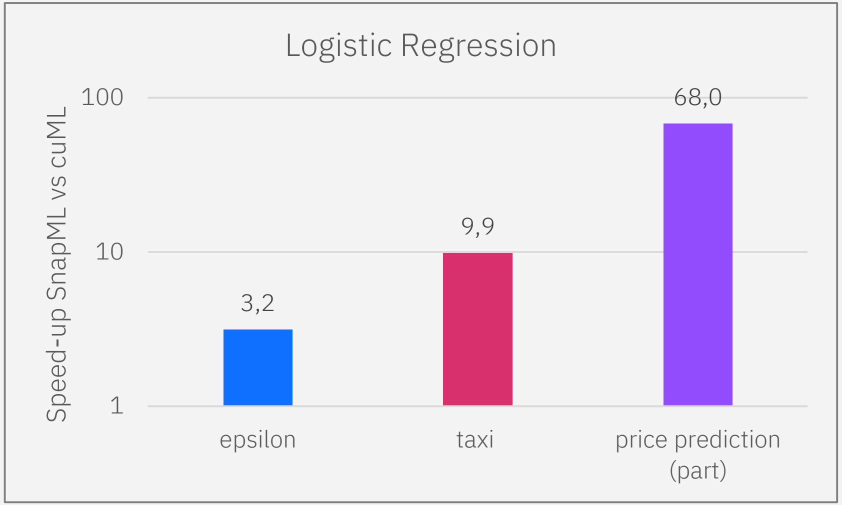


Dataset: higgs
Machine: x86, V100
scikit-learn acc: 0.7030
Snap ML acc: 0.7030

Snap ML vs. Nvidia RAPIDS (cuML)

SnapML speedup vs. RAPIDS/cuML: Ridge/Logistic Regression

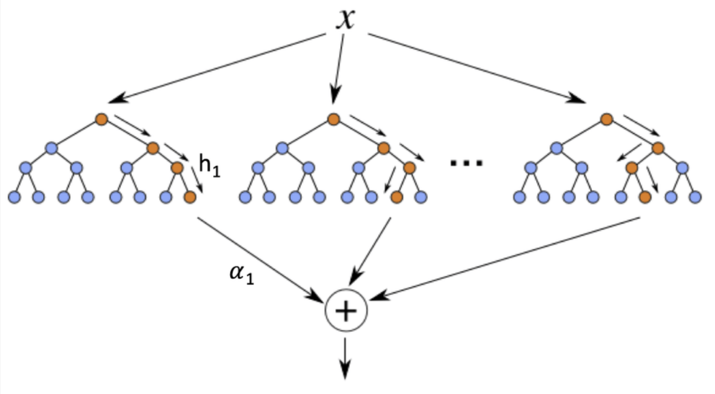




HW: Intel® Xeon® Gold 6150 CPU, 36 cores, 502 GB RAM, 1x Tesla V100 GPU, 16GB RAM
SW: Ubuntu 18.04.3, CUDA 10.1.243
Frameworks: cuml- 0.10.0, numpy- 1.17.3, scikit-learn- 0.21.3, WML-CE 1.6.2, pai4sk 1.5.0
Results are averages over best 5 out of 10 runs

Epsilon: 300,000 rows x 2,000 columns
Taxi: 1,600,000 rows x 606 columns
Price Pred.: 175,000 x 5074 columns

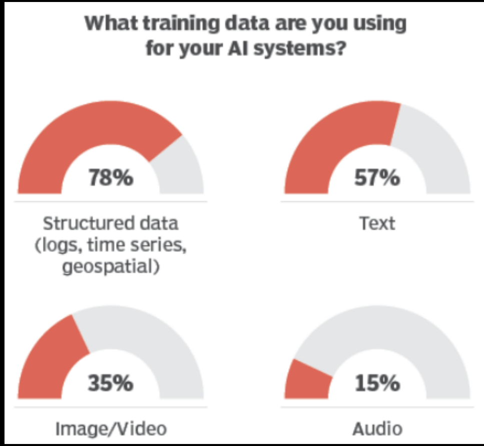
Gradient Boosting



GB models comprise an ensemble of decision trees, similar to a random forest (RF).

Deep neural networks achieve state-of-the-art accuracy on image, audio and NLP tasks.

However, on structured datasets GB usually out-performs all other models in terms of accuracy.



Majority of data in business is **Structured data**

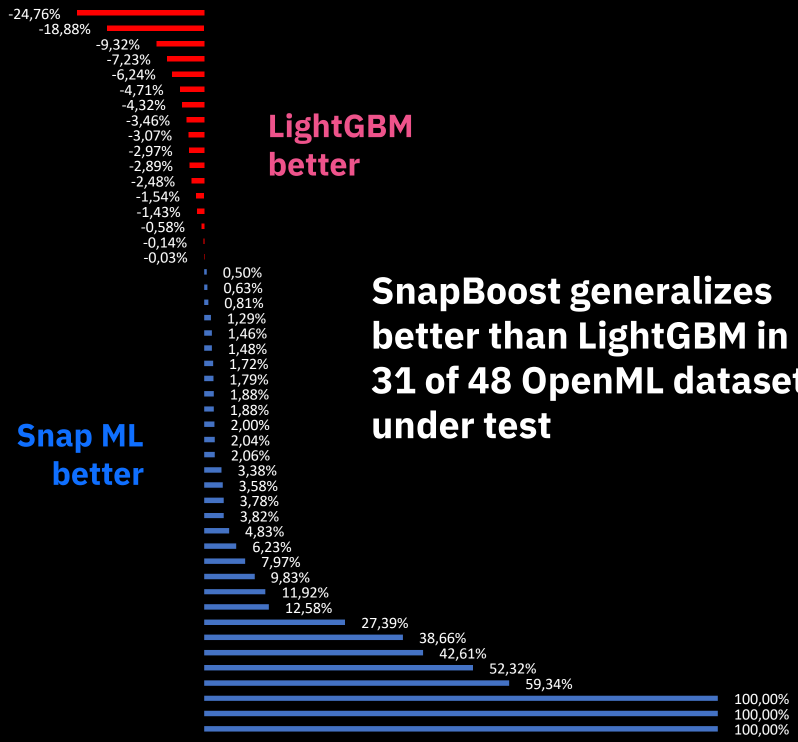
Source: The State of AI in the Enterprise, O'Reilly, 2019

Main GB libraries are XGBoost, LightGBM, and CatBoost.

Snap ML Gradient Boosting Machine (SnapBoost) targets **high accuracy** by a stochastic combination of base learners.

Accuracy vs. LightGBM

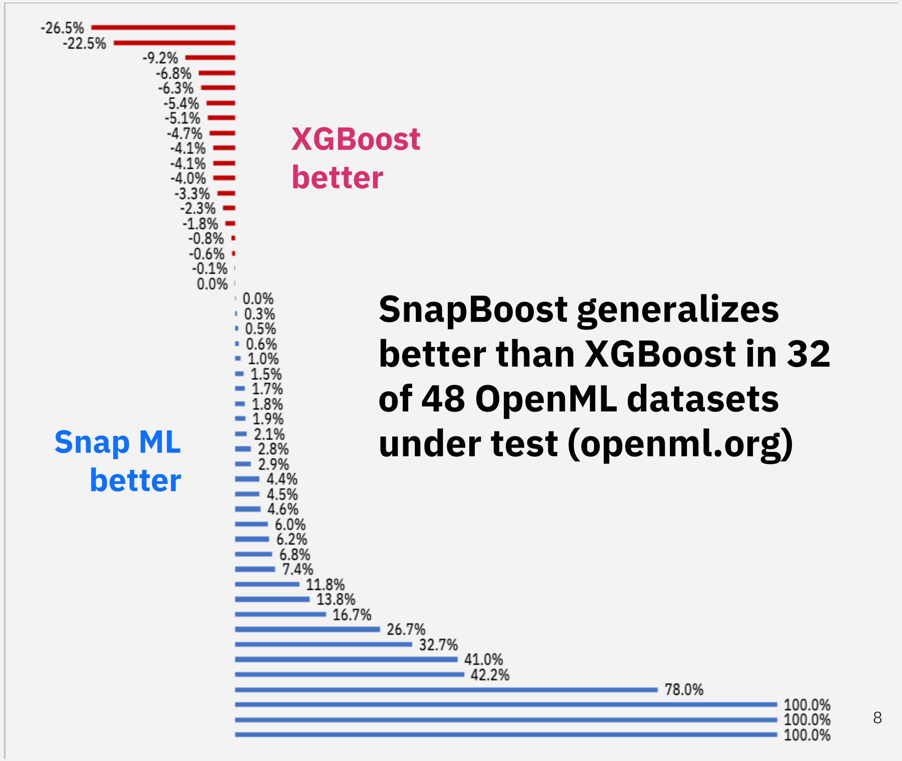
Relative Improvement in Test Loss (vs. LightGBM)



SnapBoost generalizes better than LightGBM in 31 of 48 OpenML datasets under test

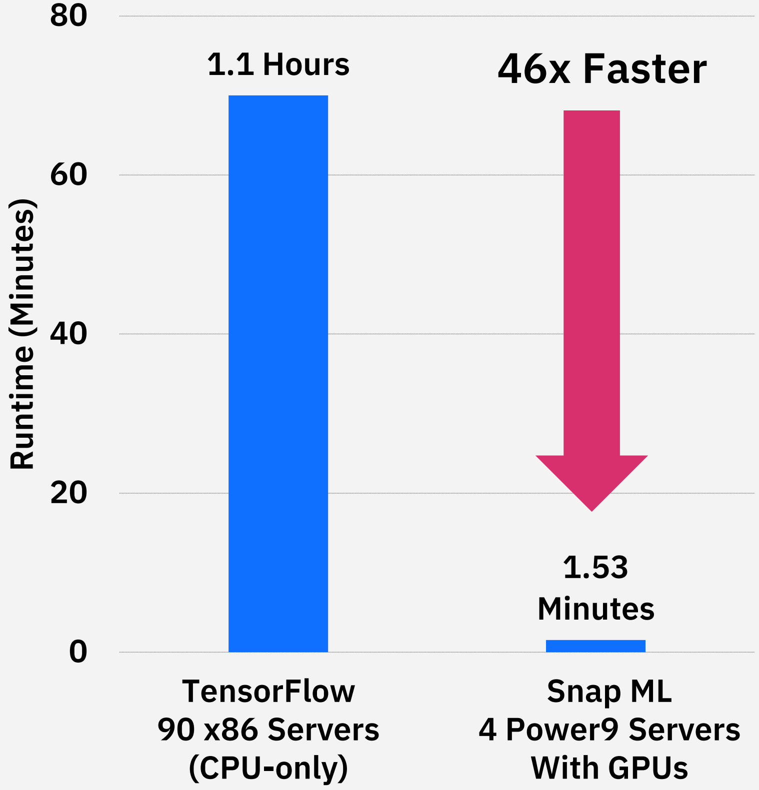
Accuracy vs. XGBoost

Relative Improvement in Test Loss (vs. XGBoost)



SnapBoost generalizes better than XGBoost in 32 of 48 OpenML datasets under test (openml.org)

Scalable: Handling Terabyte-scale Datasets



For huge data-sets that do not fit into CPU memory, scikit-learn cannot be used for training.

Instead, one must turn to distributed frameworks like TensorFlow or Spark MLlib

Snap ML applications can be seamlessly distributed across a cluster **without any code change**

Dataset: Criteo Terabyte Click Logs (http://labs.criteo.com/2013/12/download-terabyte-click-logs/)
4 billion training examples, 1 million features
Model: Logistic Regression: TensorFlow vs Snap ML
Test LogLoss: 0.1293 (Google using Tensorflow), 0.1292 (Snap ML)
Platform: 89 CPU-only machines in Google using Tensorflow versus 4 AC922 servers (each 2 Power9 CPUs + 4 V100 GPUs) for Snap ML
Google data from this Google blog

Consumable: RandomForest API

sklearn RandomForest API

```
from sklearn.ensemble import RandomForestClassifier
as SklearnForest

rf = SklearnForest(random_state=random_state,
                   max_depth=max_depth,
                   n_estimators=n_estimators,
                   n_jobs=num_threads,
                   max_features='sqrt')

# Train
rf.fit(X_train, y_train)

# Inference
pred_test = rf.predict(X_test)
```

SnapML RandomForest API

```
from snap_ml import RandomForestClassifier
as SnapForest

rf = SnapForest(random_state=random_state,
                max_depth=max_depth,
                n_estimators=n_estimators,
                n_jobs=num_threads,
                max_features='sqrt',
                use_histograms=True,
                use_gpu=True,
                gpu_ids=[0])

# Train
rf.fit(X_train, y_train)

# Inference
pred_test = rf.predict(X_test)
```

SnapBoost API

XGBoost sklearn API

```
from xgboost import XGBClassifier

booster = XGBClassifier(n_estimators=1000,
                        max_depth=8,
                        learning_rate=0.01
                        tree_method = 'gpu_hist',
                        n_jobs=8)

# Train
booster.fit(X_train, y_train)

# Inference
yhat_test = booster.predict(X_test, output_margin=True)
```

SnapBoost API

```
from snap_ml import BoostingMachine

booster = BoostingMachine(objective='logloss',
                          num_round=1000,
                          min_max_depth=8,
                          max_max_depth=8,
                          learning_rate=0.01,
                          use_gpu=True,
                          n_threads=8)

# Train
booster.fit(X_train, y_train)

# Inference
yhat_test = booster.predict(X_test)
```


Reuse additional functionalities of scikit-learn (pre-processing, filtering, feature engineering, train/test splitting)

Snap ML Evolution

1.5.2
06/18
- GLMs: Logistic regression, SVM, linear regression
- Local (single-node), MPI, Spark Python APIs
- Multi-GPU training, multi-threaded CPU training

1.5.3
09/18
- GLMs: sparse linear models
- Multiclass classification
- Visualization extensions

1.5.4
11/18
- CPU performance optimizations
- Fast (multi-threaded) inference
- Fast SVM Light data loader

1.6.0
03/19
- Decision Tree: CPU single-node
- Random Forest: CPU single-node
- cuDF integration for fast pre-processing

1.6.1
06/19
- Deep integration with Spark for Data Movement

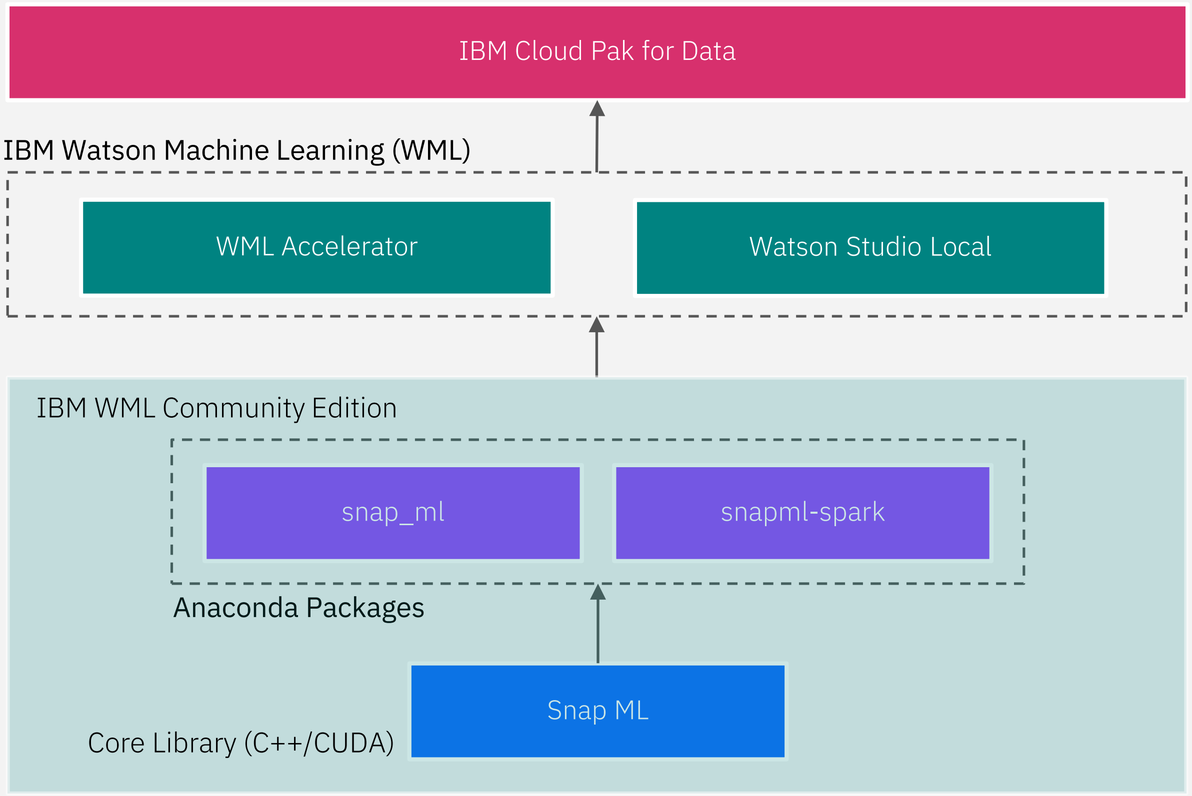
1.6.2
10/19
- Boosting Machine Tech Preview (CPU/GPU solvers)
- Sample weighting for imbalanced datasets (Decision Tree, Random Forest)

1.7.0
02/20
- Multithreaded tree-based models
- GPU-accelerated tree-based models
- Multi-GPU Random Forest

Roadmap

- Improved Boosting Machine (2Q20)
- Accelerated Inference for tree ensembles (2Q20)
- Distributed (multi-node) versions of Random Forest and Boosting Machine (2H20)
- Sparse data support for tree models (2H20)
- Spark integration of distributed tree-ensemble models (2021)

Snap ML Integration at IBM



Goal: Much broader reach and adoption through community channels

Where to get / How to try Snap ML

Available through IBM Watson ML Community Edition

- Free to download from
  https://developer.ibm.com/linuxonpower/deep-learning-powerai/releases/
- Runs in Power and x86 platforms
- Delivery through Conda packaging (“`conda install pai4sk`”)
- Documentation: https://ibmsoe.github.io/snap-ml-doc/index.html
- Examples: https://ibmsoe.github.io/snap-ml-doc/v1.6.0/tutorials.html
- Video: https://developer.ibm.com/videos/train-logistic-regression-and-random-forest-models-for-credit-default-prediction-using-snap-machine-learning/
- Blogs and articles:
  https://medium.com/@sumitg_16893/snap-ml-2x-faster-machine-learning-than-scikit-learn-c3529a1a6172
  https://www.ibm.com/blogs/systems/power-snapml-watson-machine-learning/
  https://developer.ibm.com/linuxonpower/2018/12/02/running-snapml-applications-with-ibm-powerai-enterprise-1-1-2/
  https://developer.ibm.com/series/snapml-on-powerai/
  https://developer.ibm.com/blogs/snap-ml-use-cases-blog/
  https://developer.ibm.com/linuxonpower/2020/03/26/benchmarking-linear-models-of-machine-learning-ml-frameworks-snap-ml-versus-cuml/

Questions/Discussion

LF AI General Updates

Project Updates

Upcoming Releases

For links to details on upcoming releases for LF AI hosted projects visit the Technical Project Releases wiki

Project releases will be announced via a blog post and promoted on LF AI Twitter and/or LinkedIn social channels

If you are an LF AI hosted project and would like LF AI to promote your release, reach out to pr@lfai.foundation to coordinate in advance (min 2 wks) of your expected release date. Please reach out for more details and/or questions.

Outreach Committee

LF AI PR/Comms

- Please follow LF AI on Twitter & LinkedIn and help amplify news via your social networks - Please retweet and share!
  - Also watch for news updates via the tac-general mail list
  - View recent announcement on the LF AI Blog

- Open call to publish project/committee updates or other relevant content on the LF AI Blog

- To discuss more details on participation or upcoming announcements, please email pr@lfai.foundation

Events

- Upcoming Events
  - Visit the LF AI Events Calendar or the LF AI 2020 Events wiki for a list of all events
  - To participate visit the LF AI 2020 Events wiki page or email info@lfai.foundation

- Please consider holding virtual events
  - To discuss participation, please email events@lfai.foundation

Call to Participate in Ongoing Efforts

Trusted AI

- **Leadership:**
  Animesh Singh (IBM), Souad Ouali (Orange), and Jeff Cao (Tencent)
- **Goal:** Create policies, guidelines, tooling and use cases by industry
- **Github:**
  https://github.com/lfai/trusted-ai
- **Wiki:**
  https://wiki.lfai.foundation/display/DL/Trusted+AI+Committee
- **To participate:**
  https://lists.lfai.foundation/g/trustedai-committee/
- **Next call:** Bi-weekly on Thursdays at 7am PT, subscribe to group calendar on wiki
  https://wiki.lfai.foundation/pages/viewpage.action?pageId=12091895

ML Workflow & Interop

- **Leadership:**
  Huang “Howard” Zhipeng (Huawei)
- **Goal:**
  Define an ML Workflow and promote cross project integration
- **Wiki:**
  https://wiki.lfai.foundation/display/DL/ML+Workflow+Committee
- **To participate:**
  https://lists.lfai.foundation/g/mlworkflow-committee
- **Next call:** Every 4 weeks on Thursdays at 7:00 am PT, subscribe to group calendar on wiki
  https://wiki.lfai.foundation/pages/viewpage.action?pageId=18481242

Upcoming TAC Meetings

Upcoming TAC Meetings

- **June 4:** AI for People Presentation
  - https://www.aiforpeople.org/

- **June 21:** TBD

TAC Meeting Details

- To subscribe to the TAC Group Calendar, visit the wiki: https://wiki.lfai.foundation/x/XQB2
- Join from PC, Mac, Linux, iOS or Android: https://zoom.us/j/430697670
- Or iPhone one-tap:
  - US: +16465588656,,430697670# or +16699006833,,430697670#
- Or Telephone:
  - Dial(for higher quality, dial a number based on your current location):
  - US: +1 646 558 8656 or +1 669 900 6833 or +1 855 880 1246 (Toll Free) or +1 877 369 0926 (Toll Free)
- Meeting ID: 430 697 670
- International numbers available: https://zoom.us/u/achYtcw7uN

Open Discussion

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