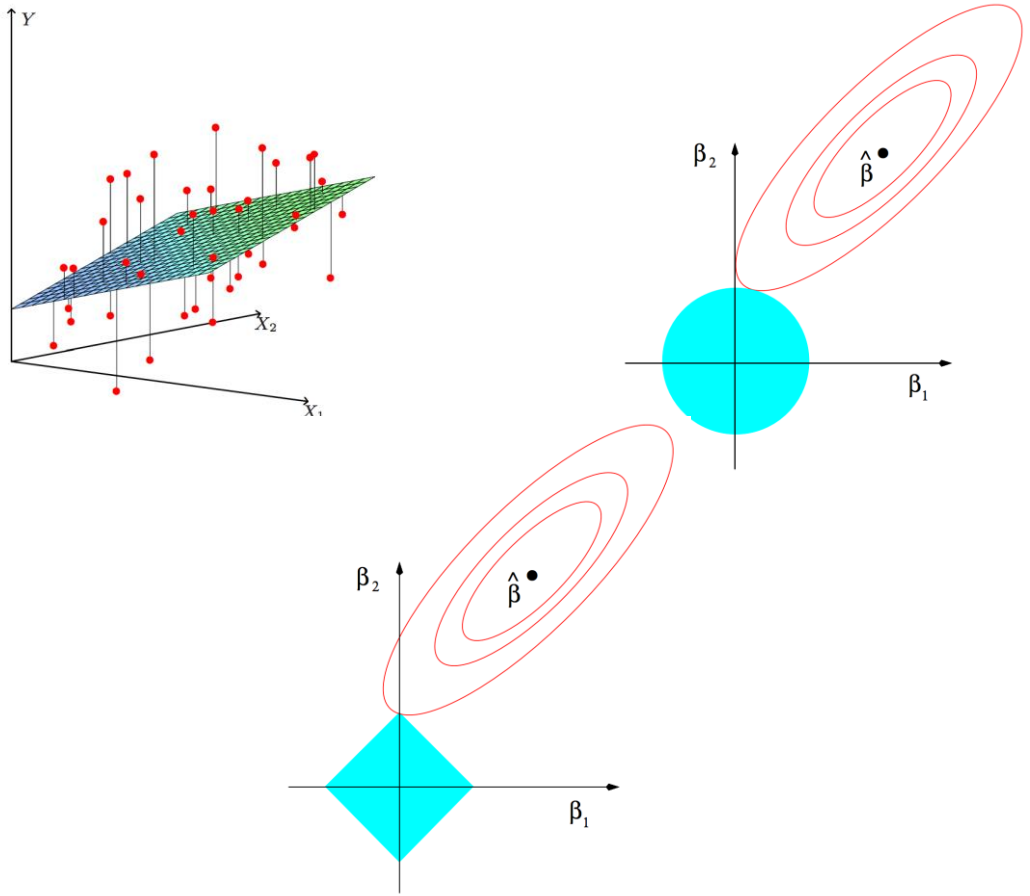
Accuracy, Speed and Interpretability

Generalized Linear Modelling in h2o4gpu

- Framework utilizes Proximal Graph Solver (POGS) from Stephen Boyd & Chris Fougner (Parameter Selection and Pre-Conditioning for a Graph Form Solver -- C. Fougner and S. Boyd)
  - A solver for convex optimization problems in *graph form* using Alternating Direction Method of Multipliers (ADMM)
- Solvers include Lasso, Ridge Regression, Logistic Regression, and Elastic Net Regularization
- Improvements to original implementation of POGS:
  - Full alpha search
  - Cross Validation
  - Early Stopping (RMSE for regression problems and Logloss for classification)
  - Various bug fixes from original implementation
  - Added Scikit learn “like” API
  - Supports multiple GPUS

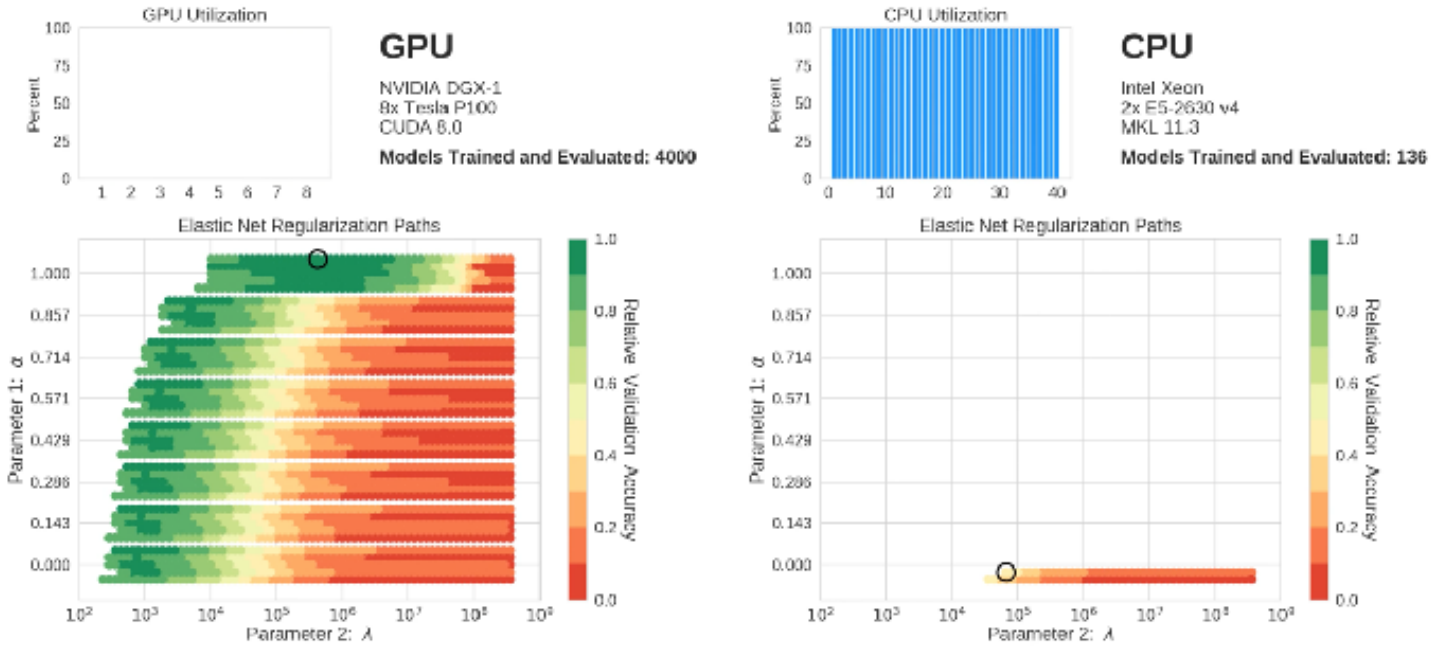


Hastie, Tibshirani, Friedman. Elements of Statistical Learning

Hastie, Tibshirani, Wainwright. Statistical Learning with Sparsity

YouTube

H2O.ai Machine Learning – Generalized Linear Modeling

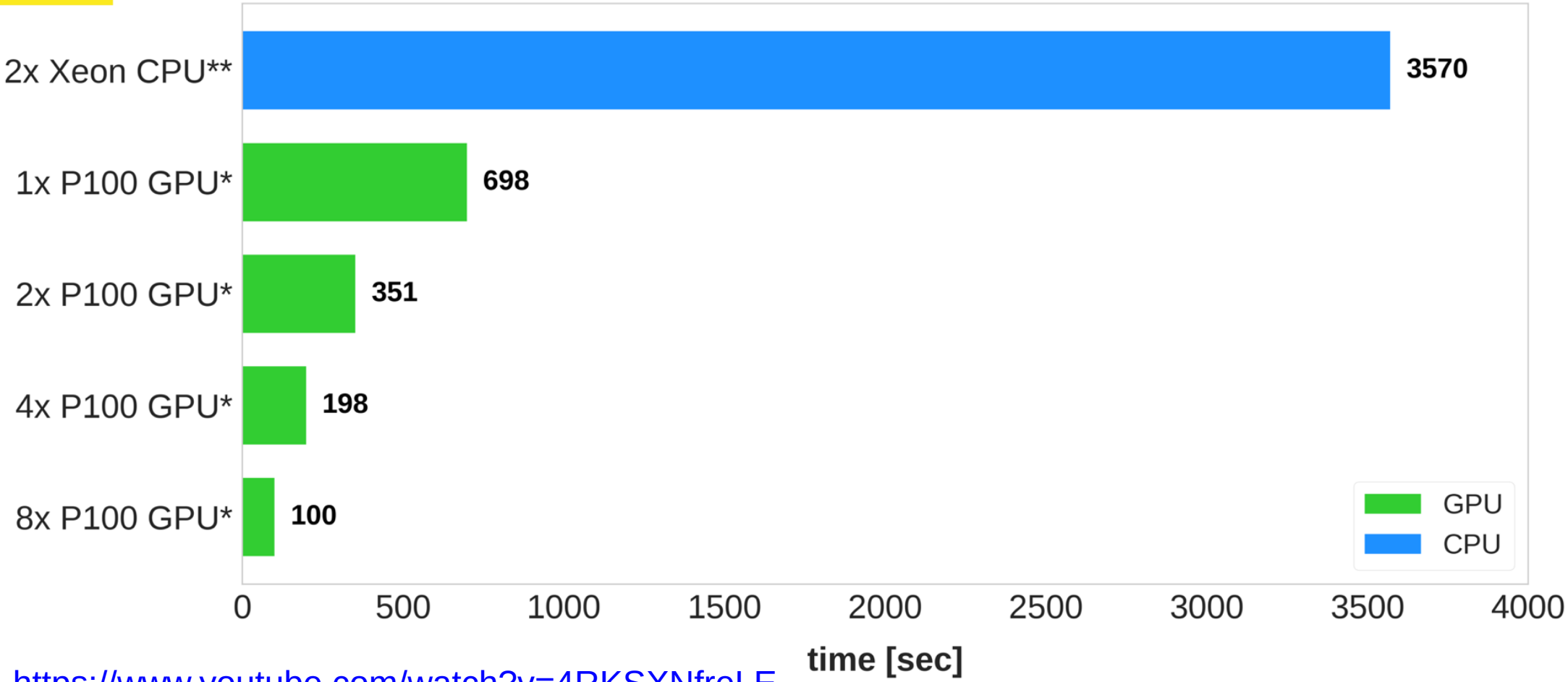


U.S. Census dataset (predict Income): 45k rows, 10k cols
Parameters: 5-fold cross-validation, $\alpha = \{\frac{i}{7}, i = 0 \ldots 7\}$, full λ-search

https://www.youtube.com/watch?v=LrC3mBNG7WU

H2O.ai Machine Learning – Generalized Linear Modeling

Time to Train and Evaluate 4000 Models



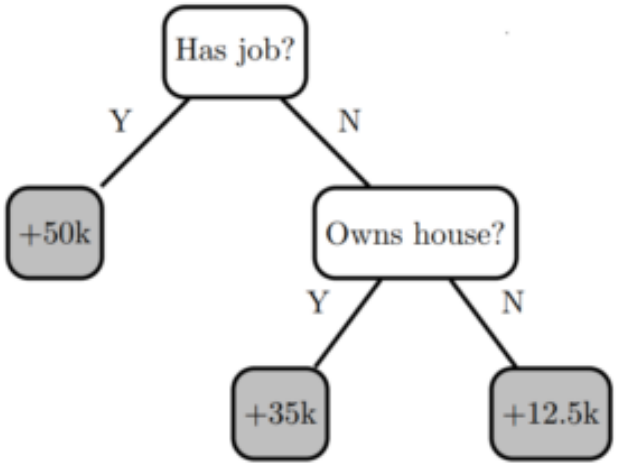
https://www.youtube.com/watch?v=4RKSXNfreLE

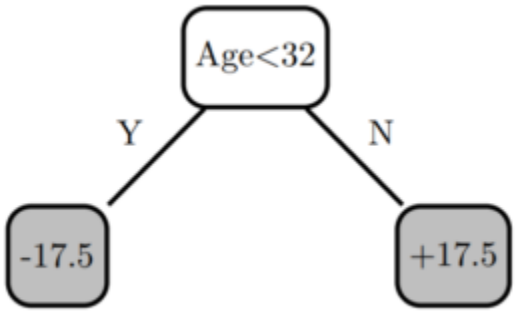
http://github.com/h2oai/perf/

*NVIDIA DGX-1, **Dual Intel Xeon E5-2630 v4
U.S. Census dataset (predict Income): 45k rows, 10k cols
Elastic Net Model Parameters: 5-fold cross-validation, $\alpha = \{\frac{i}{7}, i = 0 \ldots 7\}$, full λ-search

Gradient Boosting Machines in H2O4gpu

- Based upon XGBoost
- Raw floating point data -> Binned into Quantiles
- Quantiles are stored as compressed instead of floats
- Compressed Quantiles are efficiently transferred to GPU
- Sparsity is handled directly with highly GPU efficiency
- Multi-GPU by sharding rows using NVIDIA NCCL AllReduce

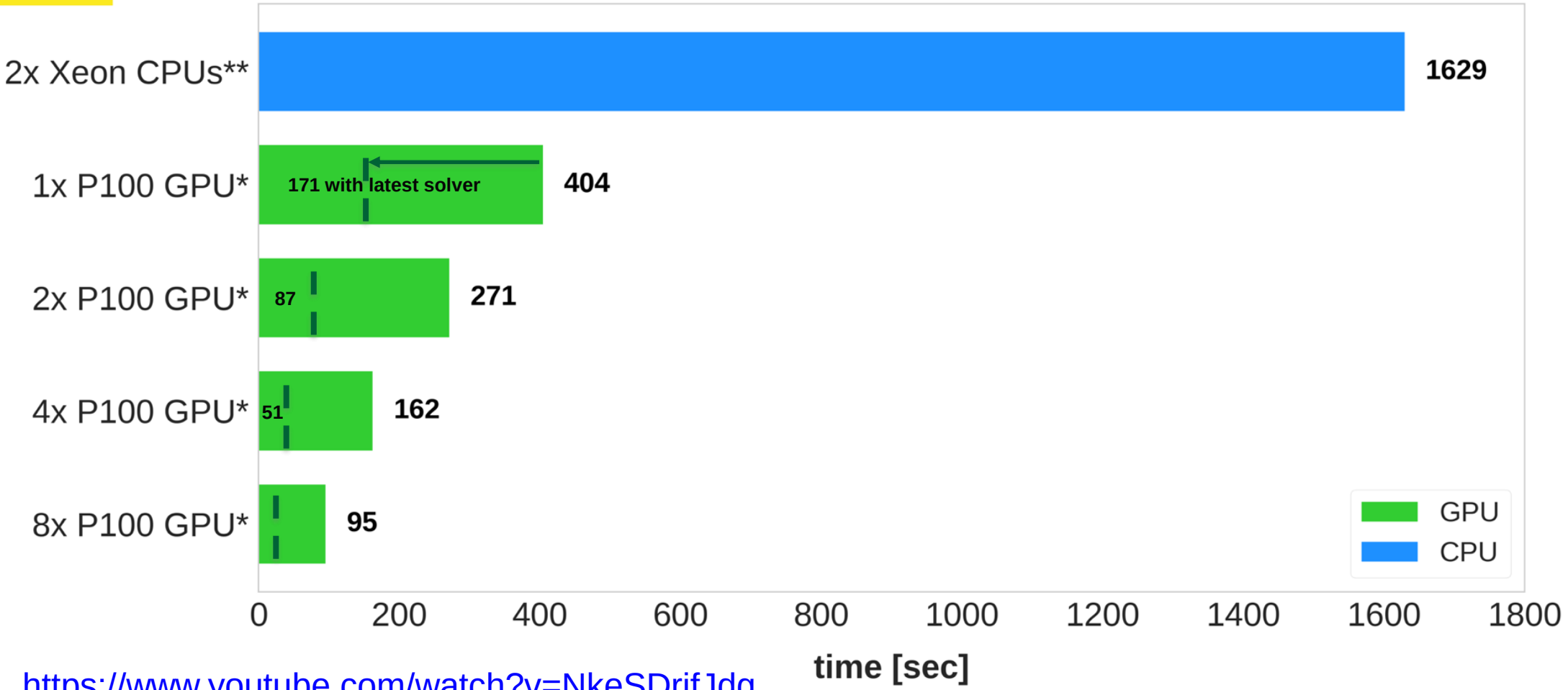




https://github.com/h2oai/h2o4gpu/blob/master/examples/py/xgboost_simple_demo.ipynb

H2O.ai Machine Learning – Gradient Boosting Machine

Time to Train 16 H2O XGBoost Models

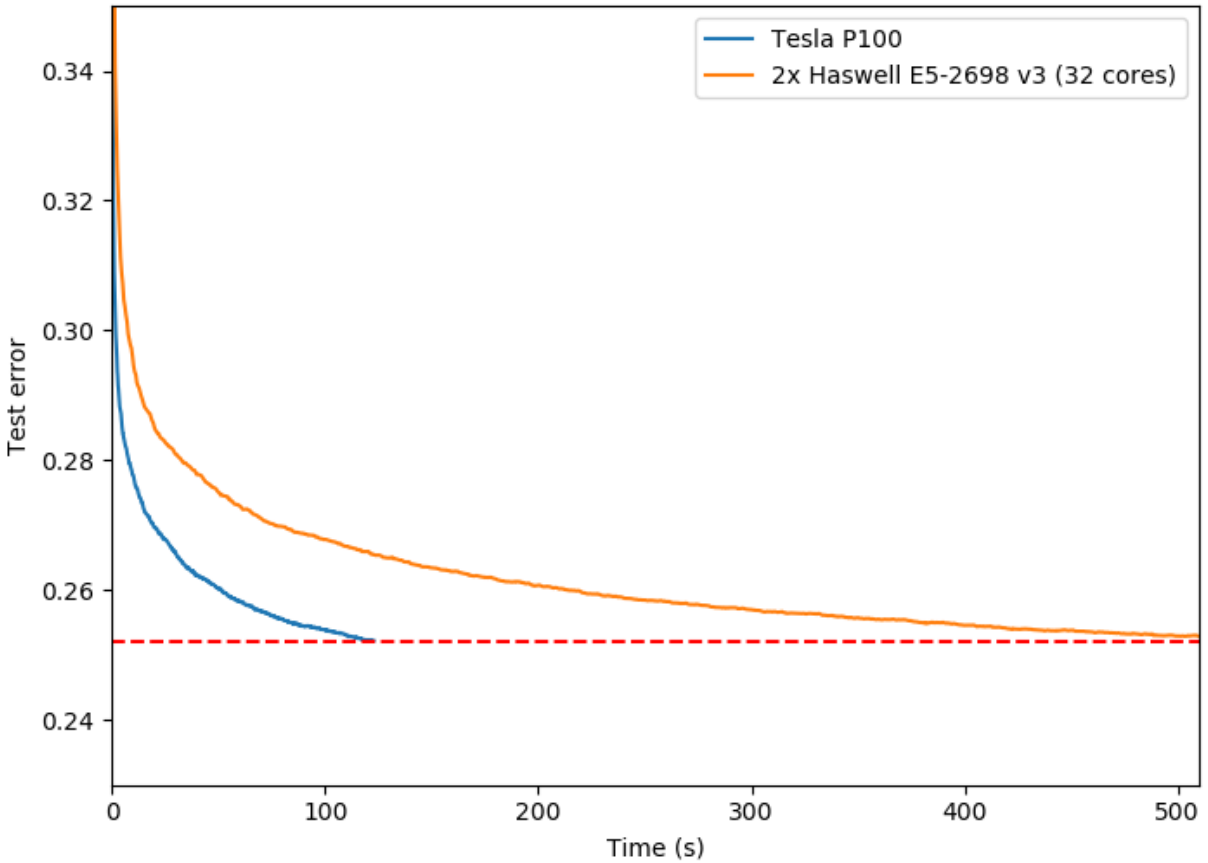


https://www.youtube.com/watch?v=NkeSDrifJdg

*NVIDIA DGX-1, **Dual Intel Xeon E5-2630 v4

http://github.com/h2oai/perf/ Higgs dataset (binary classification): 1M rows, 29 cols; max_depth: {6,8,10,12}, sample_rate: {0.7,0.8,0.9,1.0}

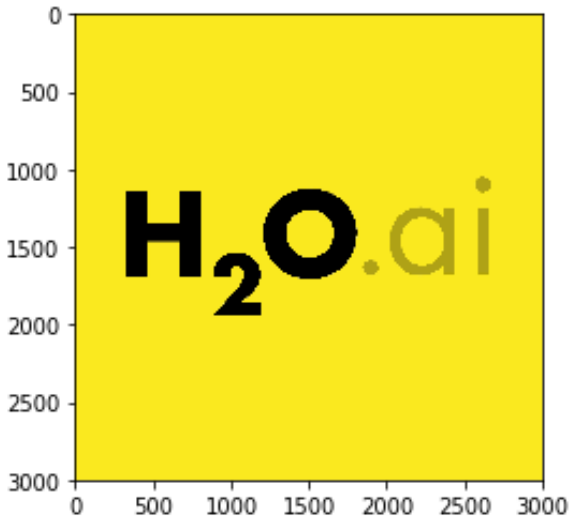
CPU vs. GPU on Higgs (Classification)

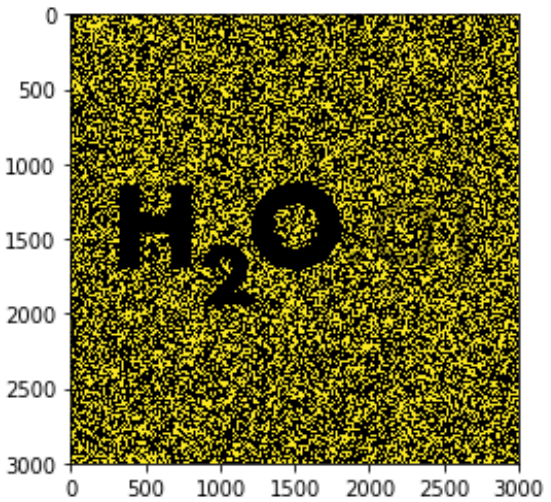


K-Means on H2O4gpu

- Based upon NVIDIA prototype of K-Means algorithm in CUDA
- Improvements to original implementation:
  - Significantly faster than scikit-learn implementation (50x)
  - Significantly faster than other GPU implementations (https://github.com/src-d/kmcuda) (5x-10x)
  - Various bug fixes
  - Supports multiple GPUs

K-Means

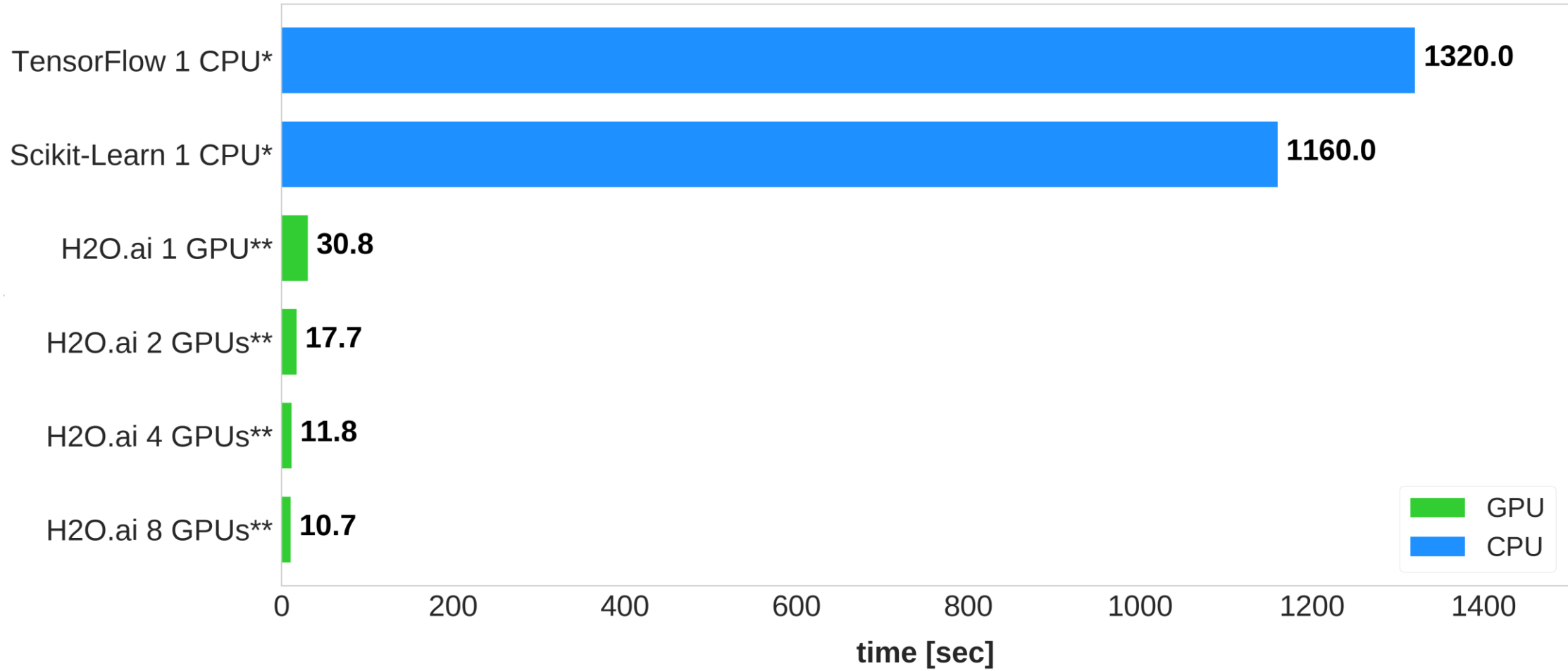




https://github.com/h2oai/h2o4gpu/blob/master/examples/py/demos/H2O4GPU_KMeans_Images.ipynb

H2O.ai Machine Learning – k-Means Clustering

Time to run 1000 Lloyds iterations for k=1000 clusters



Kaggle Homesite Home Insurance Claims Predictions Dataset (261k rows, 298 cols)
k-Means Clustering (Lloyds), random initialization, 1000 centroids, 1000 iterations
Hardware: *Intel i7 5820k (6-core), **NVIDIA Tesla P100 (DGX-1)

http://github.com/h2oai/perf/