SPARK+AI SUMMIT 2019

# Leveraging NLP and Deep Learning for Document Recommendation in the Cloud

Guoqiong Song, Intel

#UnifiedAnalytics #SparkAISummit

# Agenda

- Job/Resume Search Challenges and Opportunity
- Analytics Zoo and BigDL Overview
- Resume Search Analytics Zoo Solution
- Takeaways

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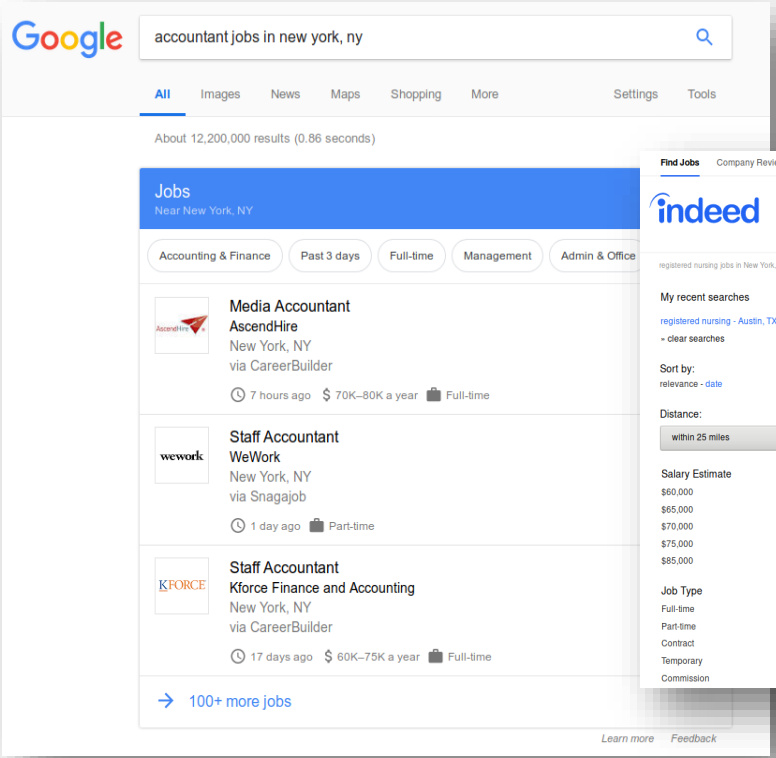
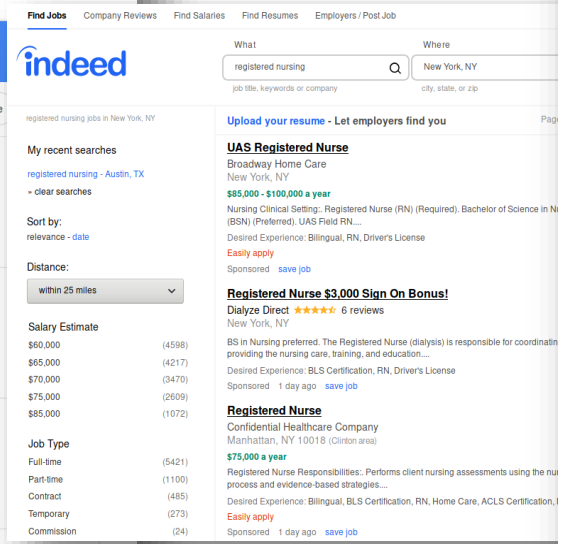
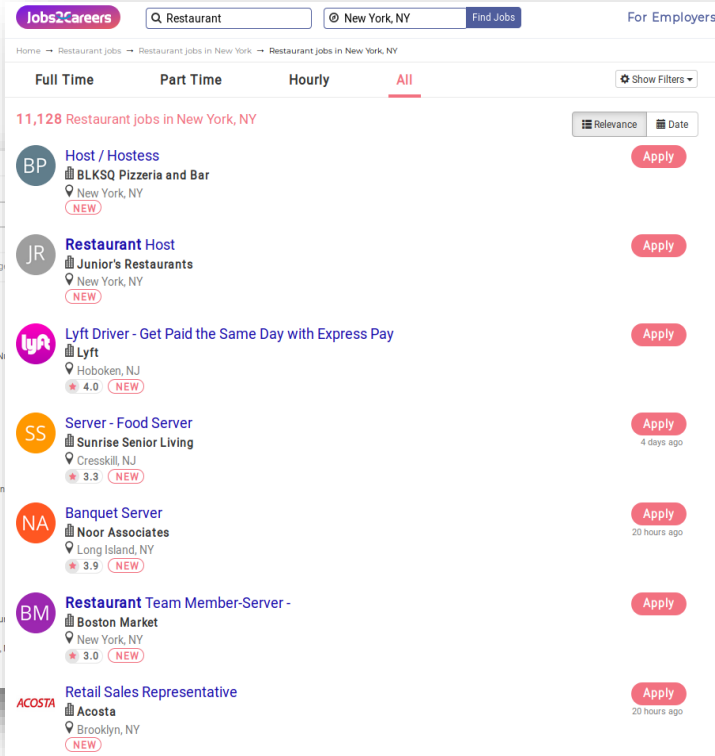
- **Job/Resume Search Challenges and Opportunity**
- **Analytics Zoo and BigDL Overview**
- **Resume Search Analytics Zoo Solution**
- **Takeaways**

# Job search


Google
accountant jobs in new york, ny
All
Images
News
Maps
Shopping
More
Settings
Tools
About 12,200,000 results (0.86 seconds)
Jobs
Near New York, NY
Accounting & Finance
Past 3 days
Full-time
Management
Admin & Office
Media Accountant
AscendHire
New York, NY
via CareerBuilder
7 hours ago
70K–80K a year
Full-time
Staff Accountant
WeWork
New York, NY
via Snagajob
1 day ago
Part-time
Staff Accountant
Kforce Finance and Accounting
New York, NY
via CareerBuilder
17 days ago
60K–75K a year
Full-time
100+ more jobs
Learn more
Feedback


Find Jobs
Company Reviews
Find Salaries
Find Resumes
Employers / Post Job
indeed
What
registered nursing
Where
New York, NY
My recent searches
registered nursing - Austin, TX
clear searches
Sort by:
relevance - date
Distance:
within 25 miles
Salary Estimate
$60,000 (4598)
$65,000 (4217)
$70,000 (3470)
$75,000 (2609)
$85,000 (1072)
Job Type
Full-time (5421)
Part-time (1100)
Contract (485)
Temporary (273)
Commission (24)
Upload your resume - Let employers find you
UAS Registered Nurse
Broadway Home Care
New York, NY
$85,000 - $100,000 a year
Easily apply
Registered Nurse $3,000 Sign On Bonus!
Dialyze Direct
6 reviews
New York, NY
Registered Nurse
Confidential Healthcare Company
Manhattan, NY 10018
$75,000 a year
Easily apply


Restaurant
New York, NY
Find Jobs
For Employers
Full Time
Part Time
Hourly
All
Show Filters
11,128 Restaurant jobs in New York, NY
Relevance
Date
Host / Hostess
BLKSQ Pizzeria and Bar
New York, NY
Restaurant Host
Junior's Restaurants
New York, NY
Lyft Driver - Get Paid the Same Day with Express Pay
Lyft
Hoboken, NJ
Server - Food Server
Sunrise Senior Living
Cresskill, NJ
Banquet Server
Noor Associates
Long Island, NY
Restaurant Team Member-Server -
Boston Market
New York, NY
Retail Sales Representative
Acosta
Brooklyn, NY
Apply

# Personalize Results Value

## Job Seekers

Find the right job faster

Resume

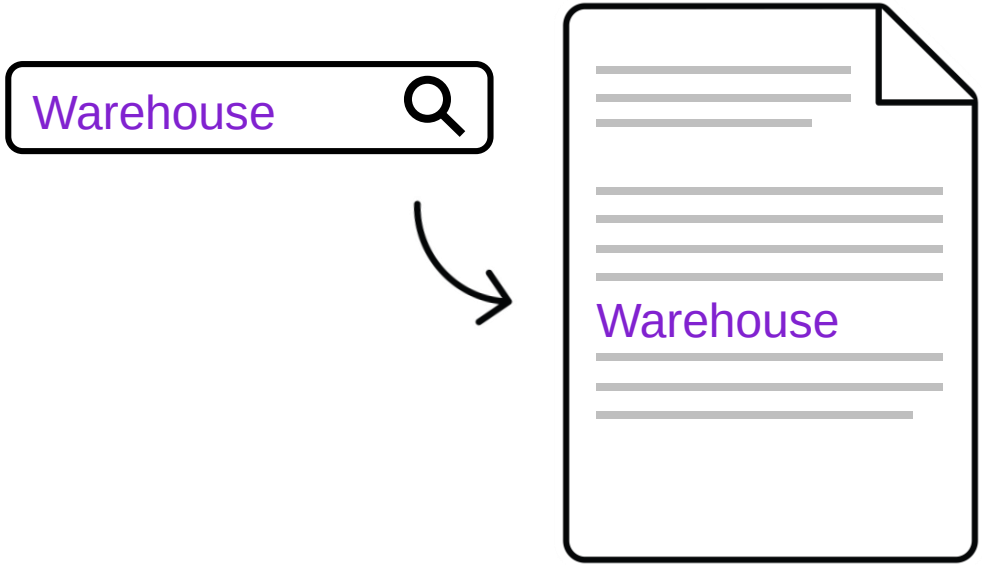
## Employers

Find the right person

Job description

# Traditional Information Retrieval Sufferings

Solution challenges: stemming, synonyms, ontologies, sensitivity



# Stemming

Accountant =!= Accounting

# Stemming Solution

Accountant =!= Accounting

Account~~ant~~ = Account~~ing~~

# Stemming Sufferings

Accountant =!= Accounting

---

Accountant = Accounting

---

Accountant = Accounting = Account Representative

# Synonyms

Registered Nurse =!= RN

# Synonyms Solution

| | | |
|---|---|---|
| Registered Nurse | =!= | RN |
| Registered Nurse | = | RN → registered nurse |

# Synonym Sufferings

| | | |
|---|---|---|
| Registered Nurse | =!= | RN |
| Registered Nurse | = | RN → registered nurse |

. . .

# Ontologies

Dishwasher =!= Back of House

# Ontologies Solution

Dishwasher =!= Back of House

Dishwasher Back of House

Restaurant = Restaurant

# Ontologies Sufferings

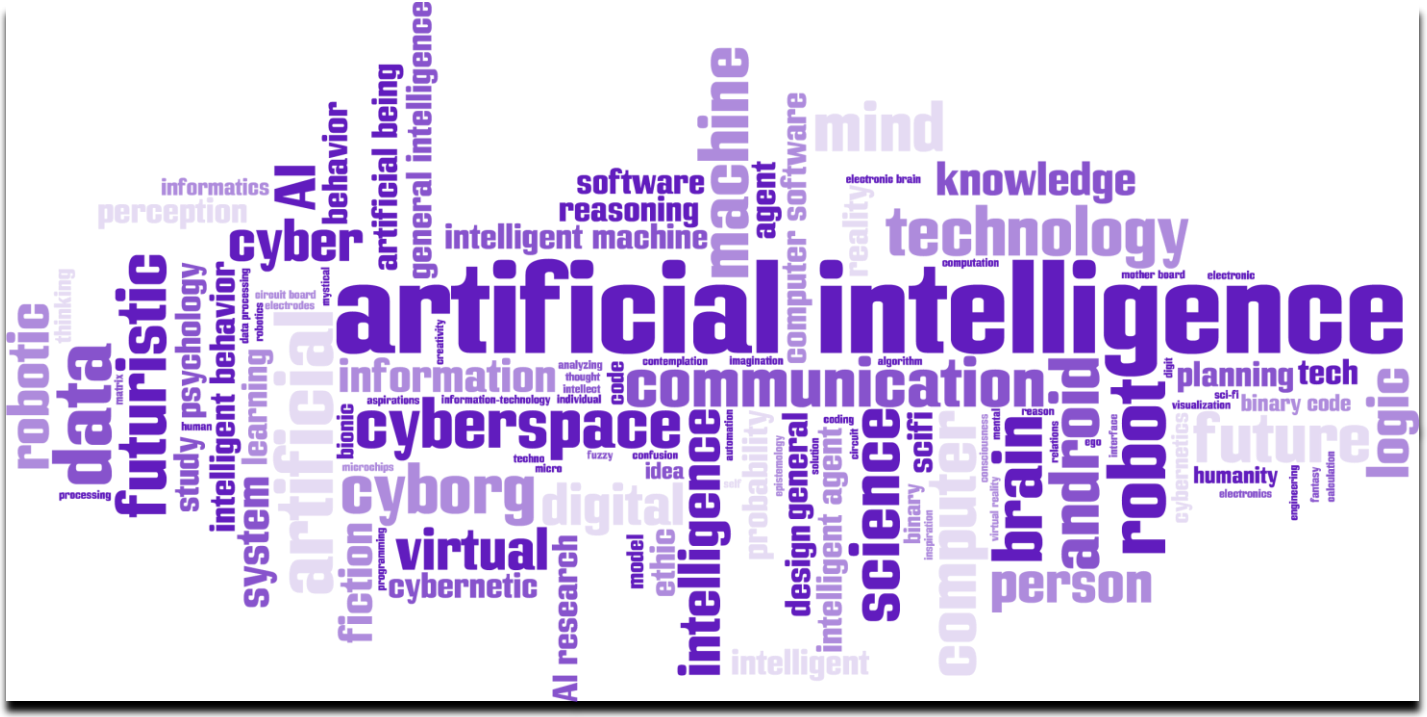
Dishwasher =!= Back of House

Dishwasher Back of House

Restaurant = Restaurant

. . .

# Specificity Suffering



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- **Analytics Zoo and BigDL Overview**
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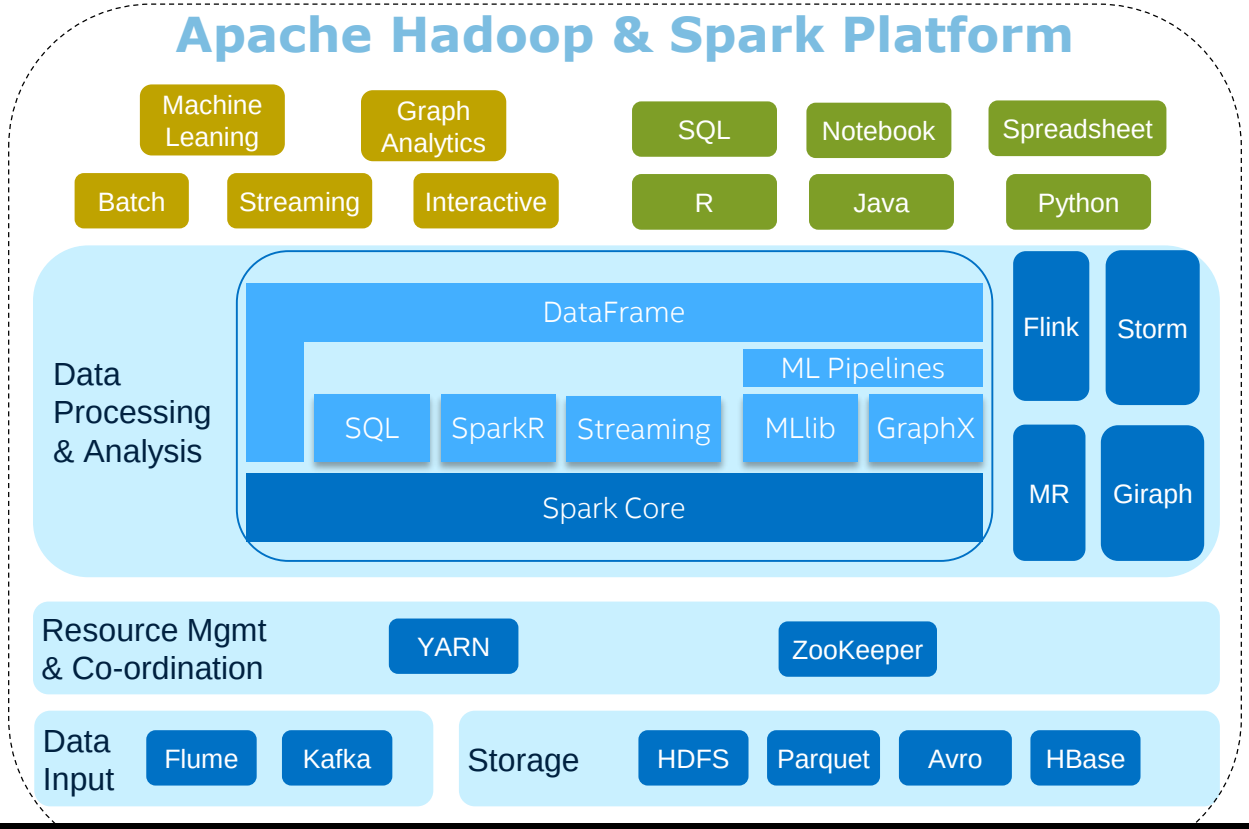
# AI on Spark


Distributed, High-Performance
Deep Learning Framework
for Apache Spark
https://github.com/intel-analytics/bigdl

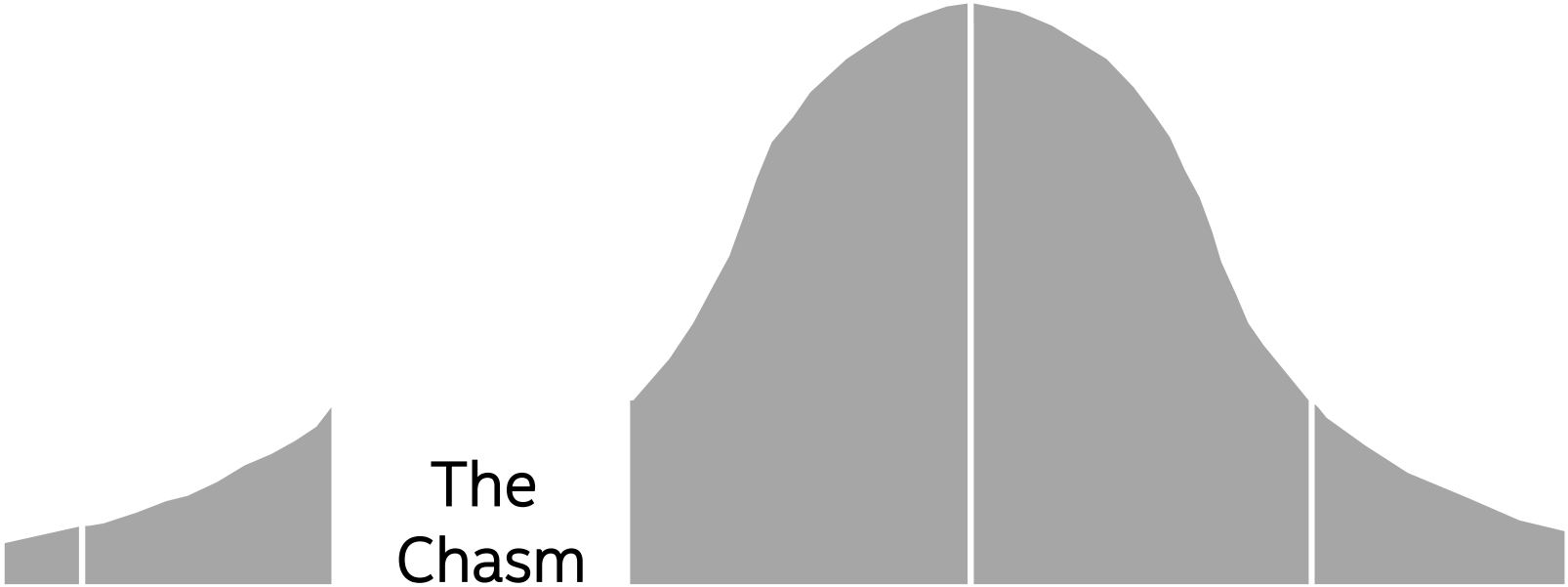

Distributed TensoRflow, Keras and BigDL on Spark
Reference Use Cases, AI Models,
High-level APIs, Feature Engineering, etc.
https://github.com/intel-analytics/analytics-zoo

**Unifying Analytics + AI on Apache Spark**

# Unified Big Data Analytics Platform



# Chasm b/w Deep Learning and Big Data Communities




Deep learning experts

Average users (big data users, data scientists, analysts, etc.)

# Bridging the Chasm

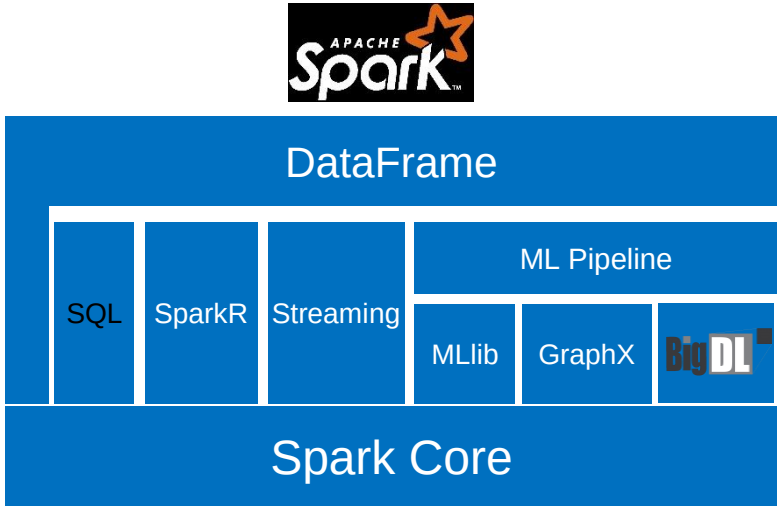
## Make deep learning more accessible to big data and data science communities

- **Continue the use of familiar SW tools and HW infrastructure to build deep learning applications**
- **Analyze "big data" using deep learning on the same Hadoop/Spark cluster where the data are stored**
- **Add deep learning functionalities to large-scale big data programs and/or workflow**
- **Leverage existing Hadoop/Spark clusters to run deep learning applications**
  - **Shared, monitored and managed with other workloads (*e.g., ETL, data warehouse, feature engineering, traditional ML, graph analytics, etc.*) in a dynamic and elastic fashion**

# BigDL

## Bringing Deep Learning To Big Data Platform

- Distributed deep learning framework for Apache Spark*
- Make deep learning more accessible to big data users and data scientists
  - Write deep learning applications as ***standard Spark programs***
  - Run on existing Spark/Hadoop clusters (***no changes needed***)
- Feature parity with popular deep learning frameworks
  - E.g., Caffe, Torch, Tensorflow, etc.
- High performance (on CPU)
  - Powered by Intel MKL and multi-threaded programming
- Efficient scale-out
  - Leveraging Spark for distributed training & inference




https://github.com/intel-analytics/BigDL

https://bigdl-project.github.io/

# BigDL Run as Standard Spark Programs

## Standard Spark jobs

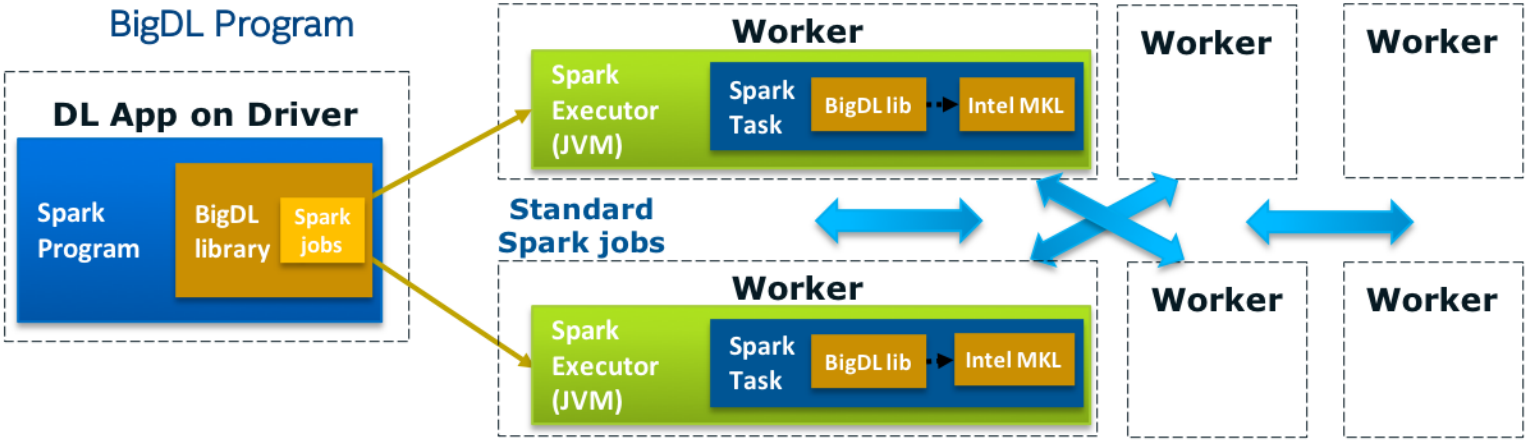
- No changes to the Spark or Hadoop clusters needed

## Iterative

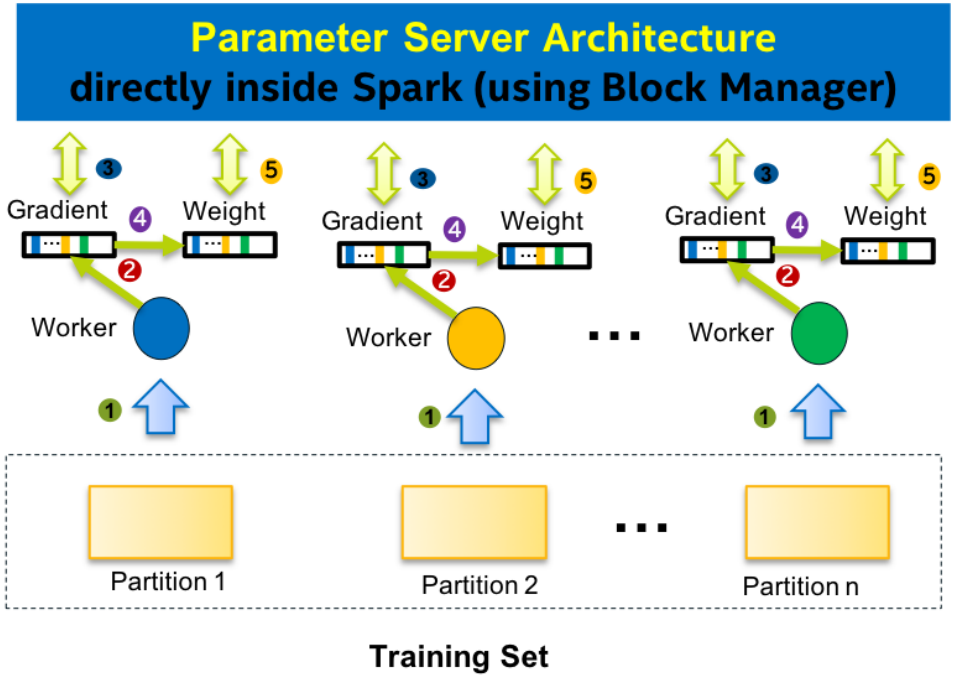
- Each iteration of the training runs as a Spark job

## Data parallel

- Each Spark task runs the same model on a subset of the data (batch)



# Distributed Training in BigDL




Peer-2-Peer All-Reduce Synchronization

# Analytics Zoo

## Unified Analytics + AI Platform for Big Data

### Distributed TensorFlow, Keras and BigDL on Spark

| | |
|---|---|
| **Reference Use Cases** | • Anomaly detection, sentiment analysis, fraud detection, image generation, chatbot, etc. |
| **Built-In Deep Learning Models** | • Image classification, object detection, text classification, text matching, recommendations, sequence-to-sequence, anomaly detection, etc. |
| **Feature Engineering** | Feature transformations for<br>• Image, text, 3D imaging, time series, speech, etc. |
| **High-Level Pipeline APIs** | • Distributed TensorFlow and Keras on Spark<br>• Native support for transfer learning, Spark DataFrame and ML Pipelines<br>• Model serving API for model serving/inference pipelines |
| **Backbends** | Spark, TensorFlow, Keras, BigDL, OpenVINO, MKL-DNN, etc. |

https://github.com/intel-analytics/analytics-zoo/ https://analytics-zoo.github.io/

# Analytics Zoo

**Build end-to-end deep learning applications for big data**

- Distributed *TensorFlow* on Spark
- *Keras*-style APIs (with autograd & transfer learning support)
- *nnframes*: native DL support for Spark DataFrames and ML Pipelines
- Built-in *feature engineering* operations for data preprocessing

**Productionize deep learning applications for big data at scale**

- *Model serving* APIs (w/ OpenVINO support)
- Support Web Services, Spark, Storm, Flink, Kafka, etc.

**Out-of-the-box solutions**

- Built-in deep learning *models* and reference *use cases*

# What Can you do with Analytic Zoo?

Anomaly Detection

- Using LSTM network to detect anomalies in time series data

Fraud Detection

- Using feed-forward neural network to detect frauds in credit card transaction data

Recommendation

- Use Analytics Zoo Recommendation API (i.e., Neural Collaborative Filtering, Wide and Deep Learning) for recommendations on data with explicit feedback.

Sentiment Analysis

- Sentiment analysis using neural network models (e.g. CNN, LSTM, GRU, Bi-LSTM)

Variational Autoencoder (VAE)

- Use VAE to generate faces and digital numbers

https://github.com/intel-analytics/analytics-zoo/tree/master/apps

# Building and Deploying with BigDL/Analytics Zoo


http://software.intel.com/bigdl/build

*Not a Full List*

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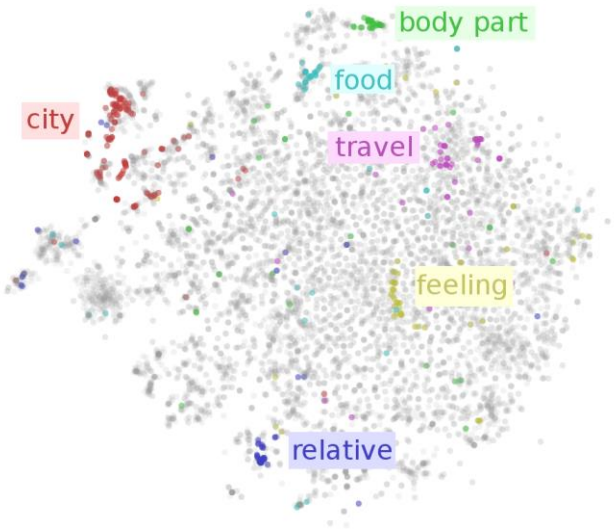
# Word Embeddings and GloVe Vectors

- **Words or phrases from the vocabulary are mapped to vectors of real numbers.**
- **Global log-bilinear regression model for the unsupervised learning algorithm.**
- **Training is performed on aggregated global word-word co-occurrence statistics from a Wikipedia.**
- **Vector representations showcase meaningful linear substructures of the word vector space.**

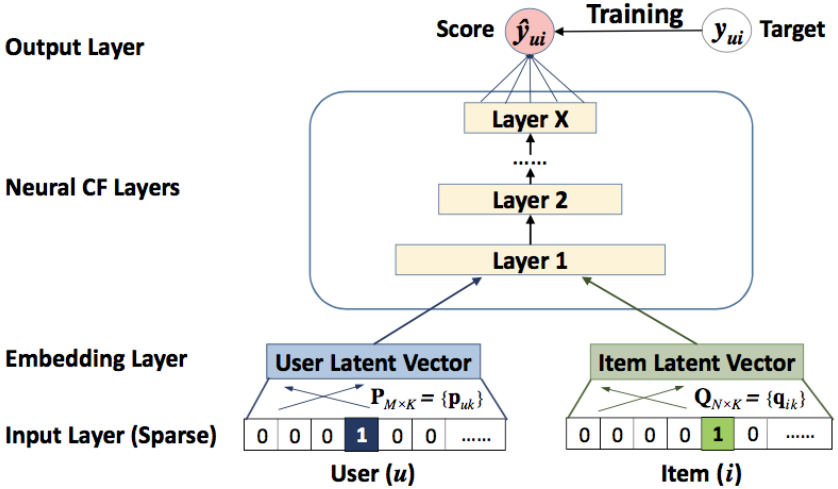





https://nlp.stanford.edu/projects/glove/

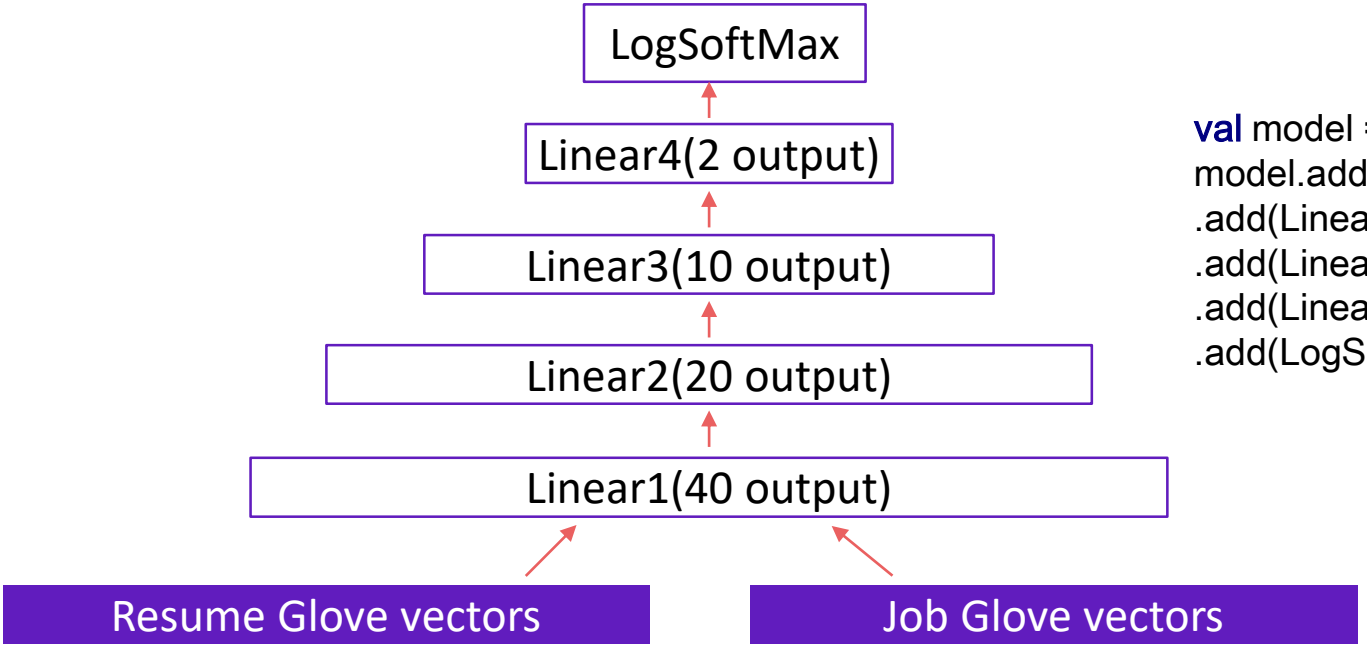
# Analytics Zoo Recommender Model

- Neural collaborative filtering, Wide and Deep
- Answer the question using classification methodologies
- Implicit feedback and explicit feedback
- APIs
  - recommendForUser
  - recommendForItem
  - predictUserItemPair



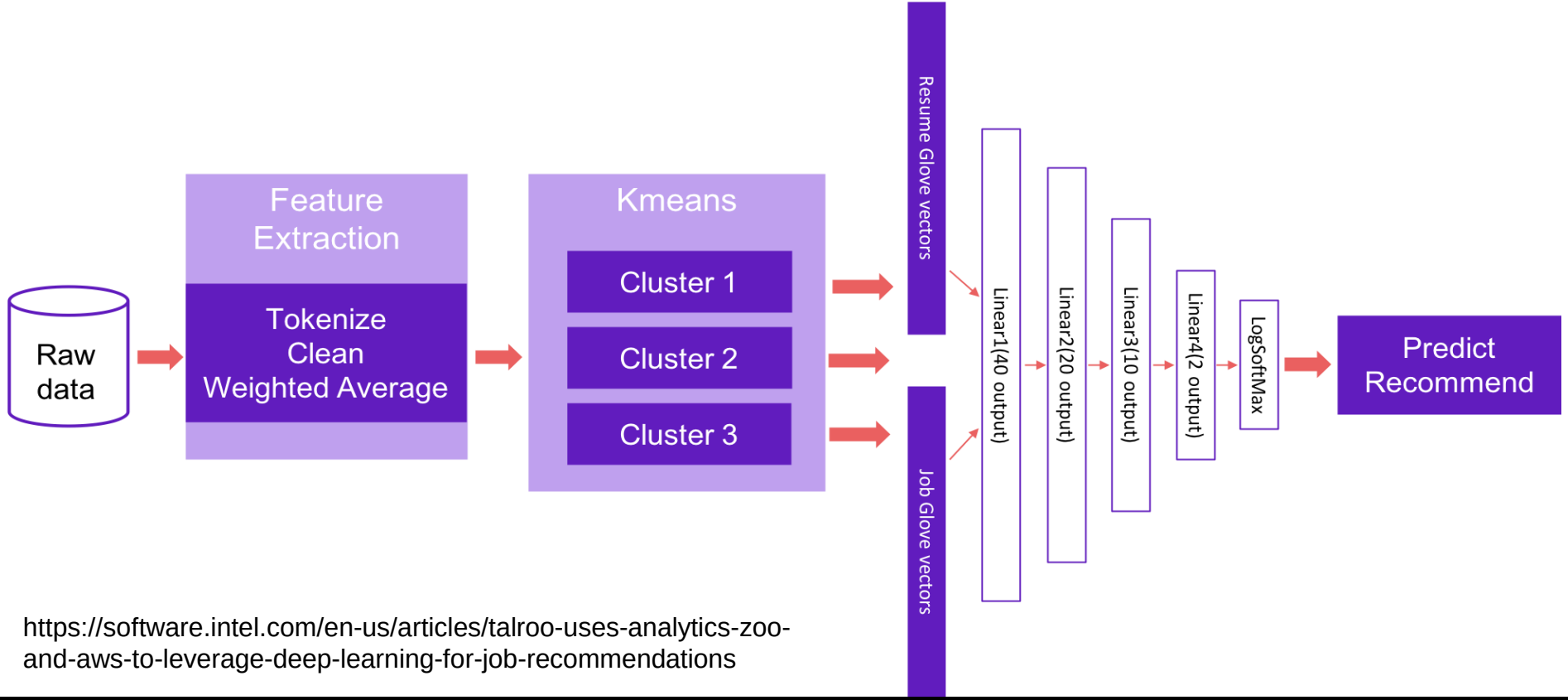

He, 2015

# Recommender model



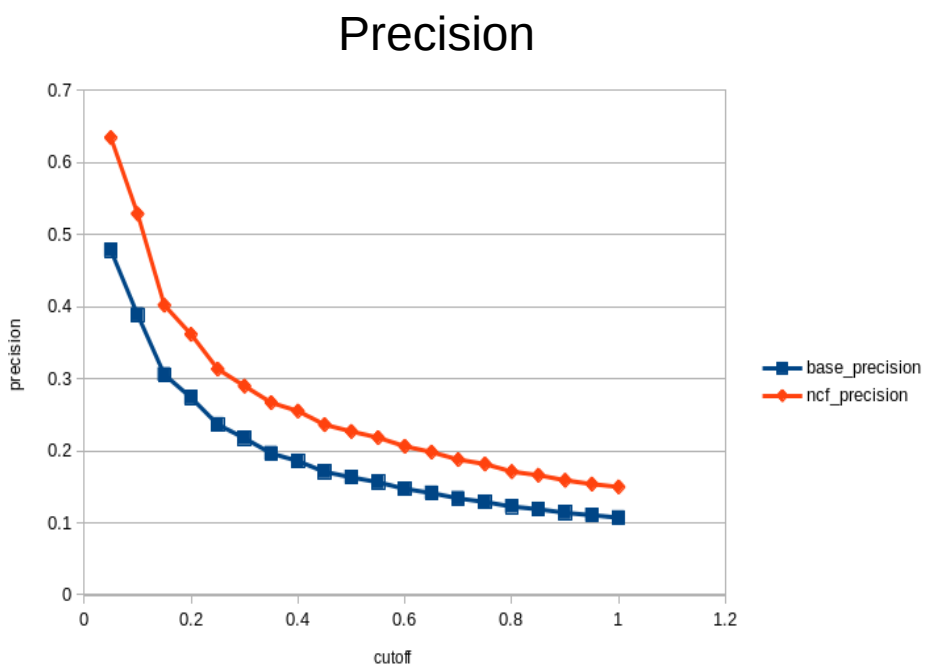

```
val model = Sequential[Float]()
model.add(Linear(100, 40)).add(ReLU())
.add(Linear(40, 20)).add(ReLU())
.add(Linear(20, 10)).add(ReLU())
.add(Linear(10, 2)).add(ReLU())
.add(LogSoftMax())
```

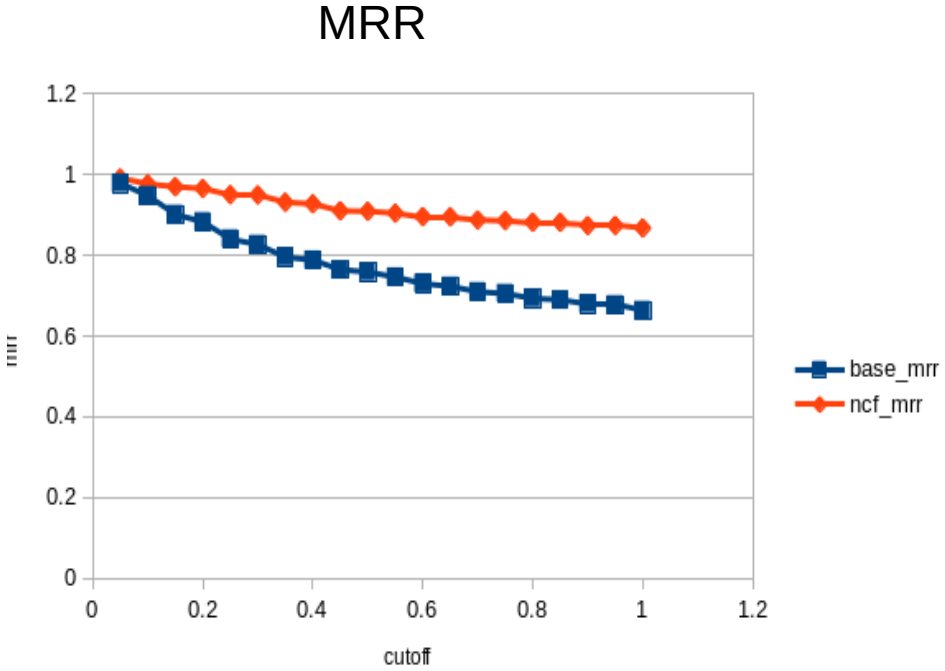
# End to End Flow




https://software.intel.com/en-us/articles/talroo-uses-analytics-zoo-and-aws-to-leverage-deep-learning-for-job-recommendations

# Evaluation Results



# Takeaways

- Analytics Zoo/BigDL integrates well into existing AWS Databricks Spark ETL and machine learning platform
- Analytics Zoo/BigDL scales with our data and business
- Jobs and resumes can be effectively modeled and processed through embeddings
- Ensembling multiple models and glove embedding feature embedding proved to be very effective for rich content
- More information available at https://analytics-zoo.github.io/

# ANALYTICS ZOO

## Unified Analytics + AI Platform

Distributed TensorFlow, Keras and BigDL on Apache Spark

https://github.com/intel-analytics/analytics-zoo

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