



Looking into Java ML/DL Libraries: Tribuo and DeepNetts

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AI for Enterprise Virtual
User Group | Jacksonville
Artificial Intelligence
Meetup

Use Hashtag:
#Tribuo
#DeepNetts

About me



Mani Sarkar

[More about me](#)

Freelance Software,
Data, ML Engineer

Java / JVM

Cloud / Infra /
DevOps

Polyglot developer

Java/JVM and
Developer
communities

Code quality, testing,
performance, DevOps,
deep affinity for
AI/ML/DL/NLP, NN...

Strengthening teams
and helping them
accelerate

JCP member, F/OSS projects:
@graalvm @truffleruby, W&B

Java Champion, Oracle Groundbreaker
Ambassador, Software Crafter, Blogger, Speaker

Get the slide deck (just now) at



<https://bit.ly/java-ml-dl-libs-tribuo-deepnetts>

Download the PDF for clickable links in the slides

Disclaimer

- Sharing my ideas, but *YMMV*
- Possibly missed one or more things or made mistakes, *I ask for forgiveness*
- Not clear for some, *my apologies*
- Lots of info and resources
- Lots of takeaway, please go home and do some more research
- These are my learnings and maybe guidelines but may not be a silver-bullet solution to your production or real-world problems
- Please contribute and share, please tweet!

Agenda

About Tribuo &
DeepNetts

Demo(s),
notebooks, code!

More fun with
Java and AI

Summary,
Resources, Q&A

About this talk:

Covering Tribuo &

DeepNetts

How to get started, use them in your apps?

A bit more on DeepNetts but will cover Tribuo equally well

Why Java Will Dominate the Future of Machine Learning, AI, and Big Data?

The image shows a presentation slide with a red and blue background. The slide title is "Machine Learning, AI and Big Data" and the subtitle is "Java based ML, AI and Big Data Framework". A list of features is shown under the heading "Smile". To the right of the slide, there is a logo for "ORACLE CODE" and a graphic of a document. Below the logo, the text "Live for the Code" is displayed. At the bottom right, a man is seen speaking at a podium. The Oracle logo is visible at the bottom left of the slide.

Machine Learning, AI and Big Data
Java based ML, AI and Big Data Framework

- Smile
 - The core machine learning mathematical functions (basic, special, kernel, distance, sorting, random number generators, optimization, linear algebra, statistical distributions, and hypothesis testing)
 - Data Parsers for delimited text, sparse matrix, microarray gene expression data.
 - Graph algorithms on adjacency list and matrix interpolation
 - NLP Natural Language Processing.
 - Swing-based data visualization library.


ORACLE
LIVE FOR THE CODE

Important
takeaway!

What the talk is not about?



~~Which one of the
library is better?~~



~~What are the pros
and cons, compare
and contrast?~~

Fun facts about the name “Tribuo”

pronounced

| trib-you-oh |

| to assign, apportion |

in latin, meaning

Fun facts about “DeepNetts”

High-school student learned
Deep Learning using DeepNetts!

DeepNetts is the successor
of the Neuroph framework!

Get Started

Fork/clone the repo

Watch and Star
the repo

```
git clone https://github.com/oracle/tribuo.git
```

```
git clone https://github.com/deepnetts/deepnetts-communityedition
```

Watch and Star
the repo

Maven

Tribuo

```
<dependency>
```

```
  <groupId>org.tribuo</groupId>
```

```
  <artifactId>tribuo-all</artifactId>
```

```
  <version>4.0.1</version>
```

```
  <type>pom</type>
```

```
</dependency>
```

DeepNetts

```
<dependency>
```

```
  <groupId>com.deepnetts</groupId>
```

```
  <artifactId>deepnetts-core</artifactId>
```

```
  <version>1.12</version>
```

```
</dependency>
```

Gradle

Tribuo

```
dependencies {  
  
    implementation ("org.tribuo:tribuo-all:4.0.1@pom") {  
  
        // --- for Groovy uncomment below line  
  
        // transitive = true  
  
        // --- for Kotlin uncomment below line  
  
        // isTransitive = true  
  
    }  
  
}
```

DeepNetts

```
dependencies {  
  
    implementation('com.deepnetts:deepnetts-core:1.12@pom') {  
  
        transitive = true  
  
    }  
  
}
```

Learn

Documentation

Tribuo

- Features
- Architecture
- Package overview
- Security considerations
- JavaDocs

DeepNetts

- About
 - Community Edition
 - Professional Edition
- Getting Started
- JavaDocs
- Blogs

Tutorial

Tribuo

- Classification
- Regression
- Clustering
- Anomaly detection
- Configuration

DeepNetts

- Blogs with tutorials
- Notebooks

FAQ: Frequently Asked Questions

Tribuo

- Project Overview
- General

or ask team at Oracle Labs (or Adam)

DeepNetts

- Frequently Asked Questions

or ask Zoran from DeepNetts

Features

Tribuo

Provenance

Cohesion

Interoperability

*A step towards
Explainability*

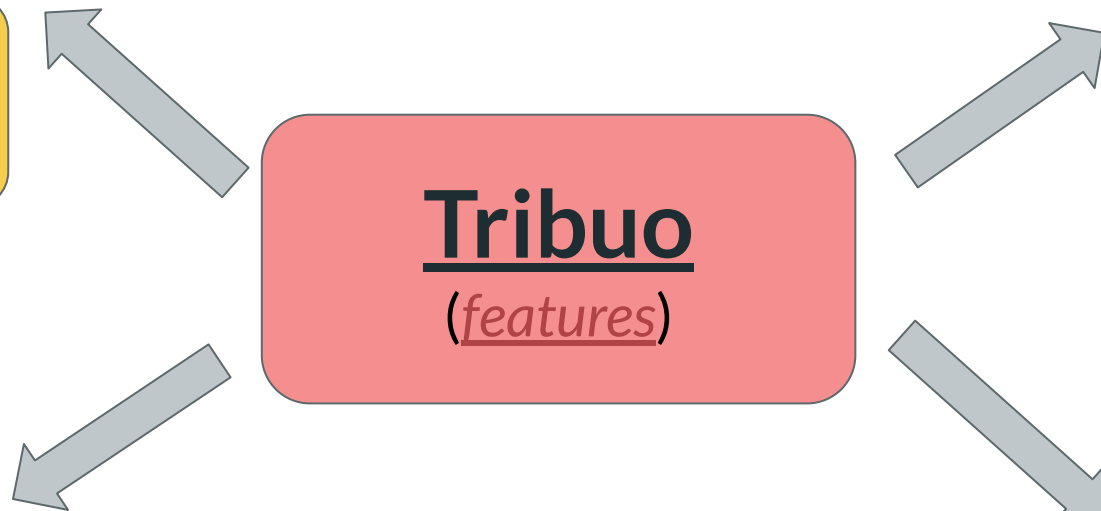
Tribuo
(features)

Fulcrum

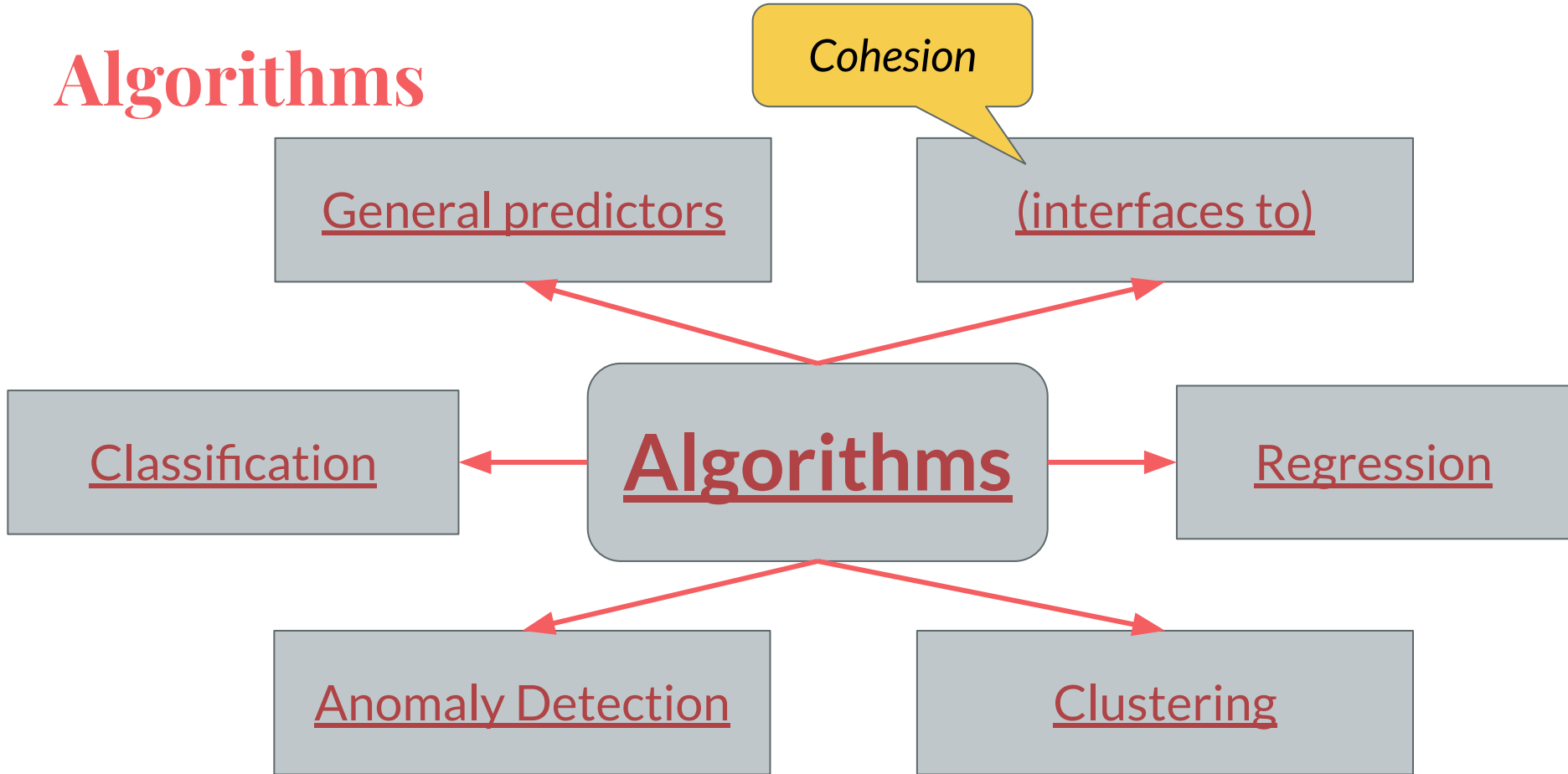
Type Safety
(strongly typed)

*Type safety
of Java*

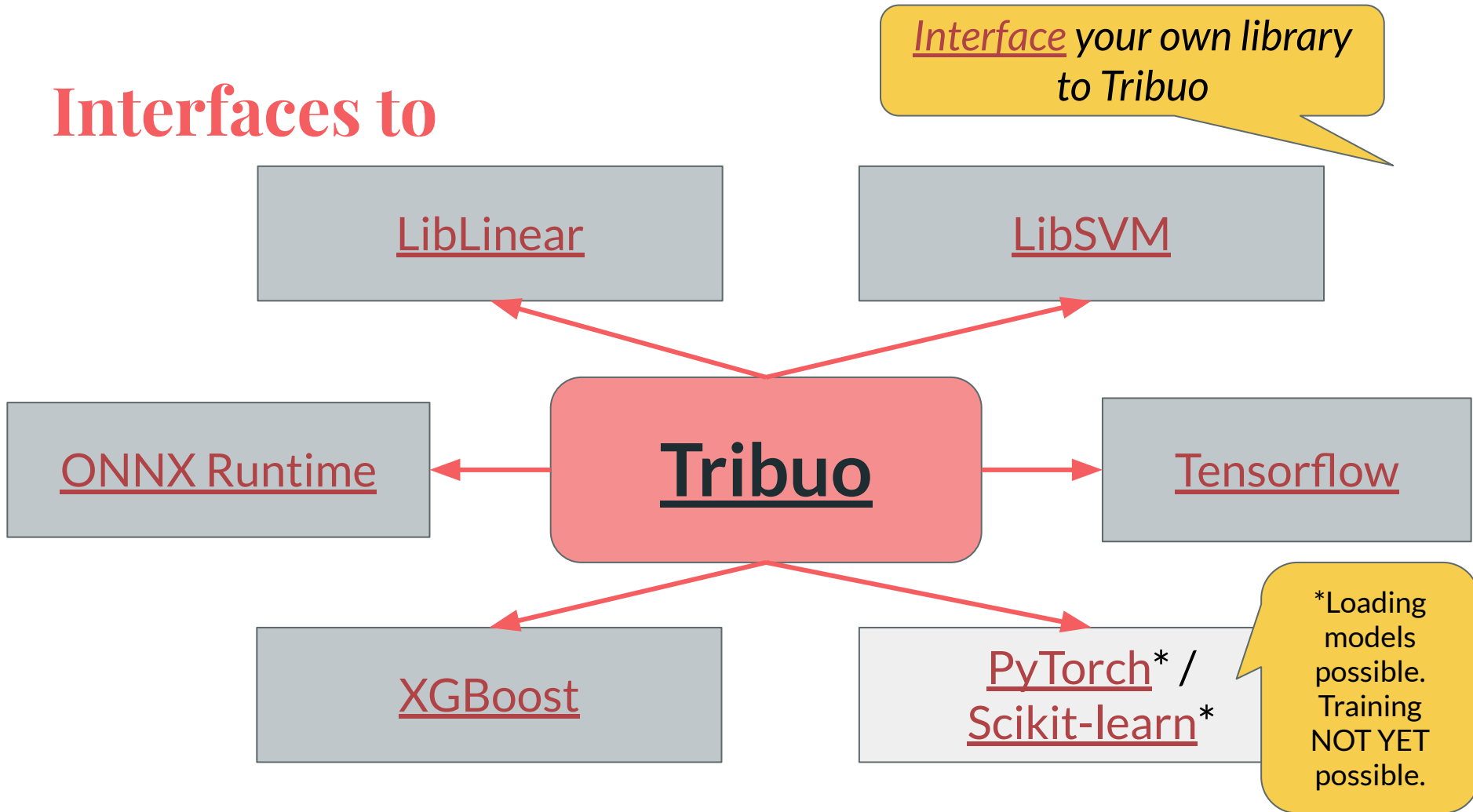
Algorithms



Algorithms



Interfaces to



DeepNetts

Monitor/Analyse via
IDE

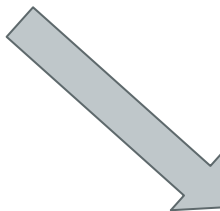
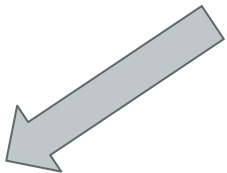
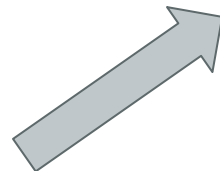
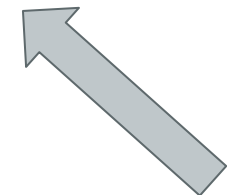
*User-friendly
approach*

Wizard-based
Expert System

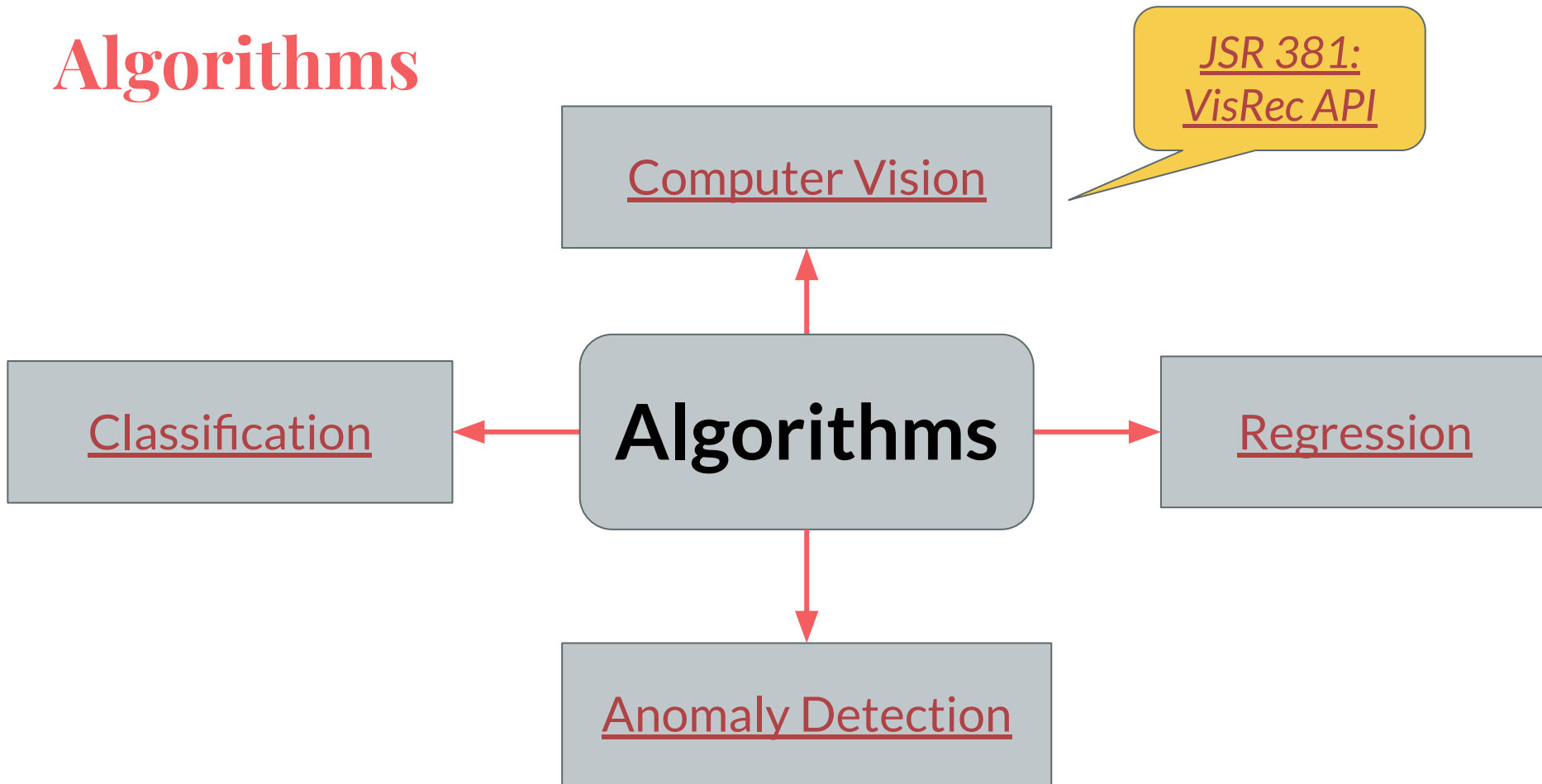
DeepNetts
(features)

Type Safety
(Java-based library)

Neural Networks:
first class citizen

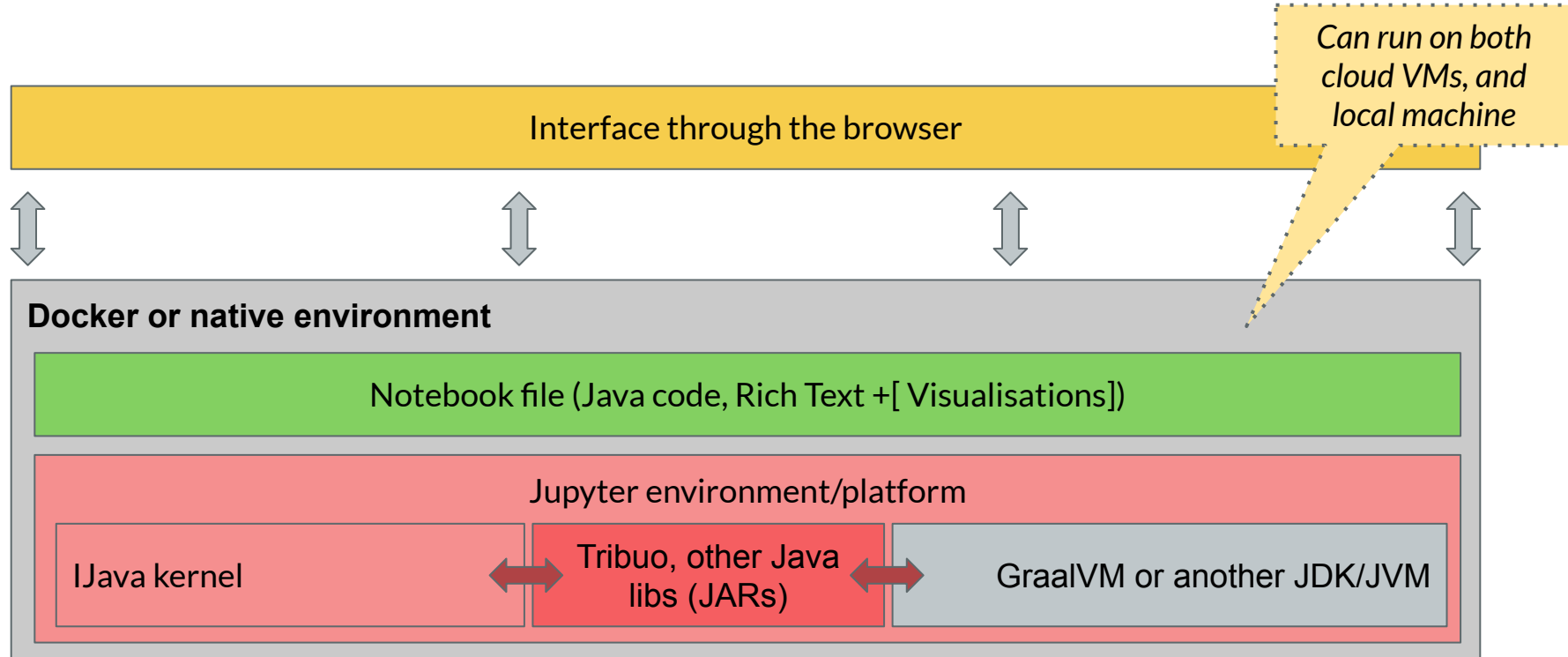


Algorithms

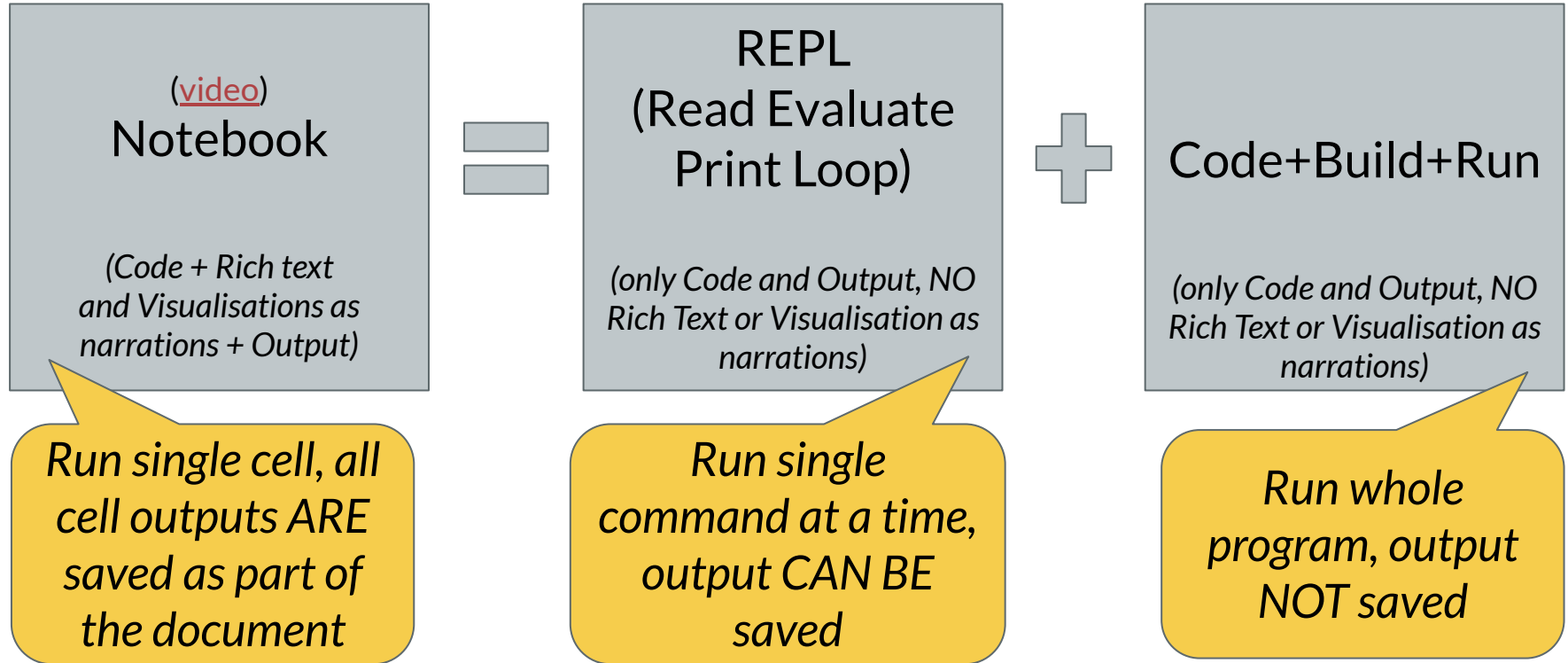


Demo: Tribuo & DeepNetts

A bit more about the demo environment



What is a “notebook”? Best of both worlds!



Demo: Tribuo

About the demo

- **Code on GitHub (example):**

<https://github.com/neomatrix369/awesome-ai-ml-dl/tree/master/examples/tribuo>
(follow steps in the README)

- **Classification notebook on GitHub:**

<https://github.com/oracle/tribuo/blob/main/tutorials/irises-tribuo-v4.ipynb>

- **Other Notebooks on GitHub:**

<https://github.com/oracle/tribuo/blob/main/tutorials/>

- **Tribuo docker image:**

<https://hub.docker.com/r/neomatrix369/tribuo>



irises-tribuo-v4.ipynb

+ ✂ 📄 📌 ▶ ■ ↺ ⏭ Markdown ⌚ git

Java ○

Classification Tutorial

This tutorial will show how to use Tribuo's classification models to predict Iris species using Fisher's well known Irises dataset (it's 2020 and we're still using a dataset from 1936 in demos, but not to worry we'll use MNIST from the 90s next time). We'll focus on a simple logistic regression, and investigate the provenance and metadata that Tribuo stores inside each model.

Setup

You'll need to get a copy of the irises dataset.

```
wget https://archive.ics.uci.edu/ml/machine-learning-databases/iris/bezdekIris.data
```

It's Java, so first we load in the necessary Tribuo jars. Here we're using the classification experiments jar, along with the json interop jar to read and write the provenance information.

```
[1]: %jars ./tribuo-classification-experiments-4.0.1-jar-with-dependencies.jar
    %jars ./tribuo-json-4.0.1-jar-with-dependencies.jar
```

```
[2]: import java.nio.file.Paths;
    import java.nio.file.Files;
```



(Demo)

Tribuo Classification Tutorial

See my previous talk

Tribuo: an introduction to a Java ML Library
(for slides and video)

Tribuo Regression Tutorial

See my previous talk

"nn" things every Java Developer should
know about AI/ML/DL

(for slides and video)

Demo: DeepNetts

About the demo

- **Code on GitHub (example):**

<https://github.com/neomatrix369/awesome-ai-ml-dl/tree/master/examples/deepnetts> (follow steps in the README)

- **Regression notebook on GitHub:**

<https://github.com/deepnetts/deepnetts-communityedition/blob/community-visrec/notebooks/regression.ipynb>

- **Other Notebooks on GitHub:**

<https://github.com/deepnetts/deepnetts-communityedition/tree/community-visrec/notebooks>

- **DeepNetts docker image:**

<https://hub.docker.com/r/neomatrix369/deepnetts>

Regression Tutorial

This notebook is an exact copy of the example provided by **DeepNetts** at <https://github.com/deepnetts/deepnetts-communityedition/blob/community-visrec/deepnetts-examples/src/main/java/deepnetts/examples/LinearRegression.java>

We need to load the `deepnetts-core` jar and other dependencies (via Maven pom invocations) before we get started. The `deepnetts-examples-n.nn.jar` (for e.g. `deepnetts-examples-1.11.jar`) is a result of building the `deepnetts-community` project and copying the `jar` from the `target` folder into the `notebooks` folder.

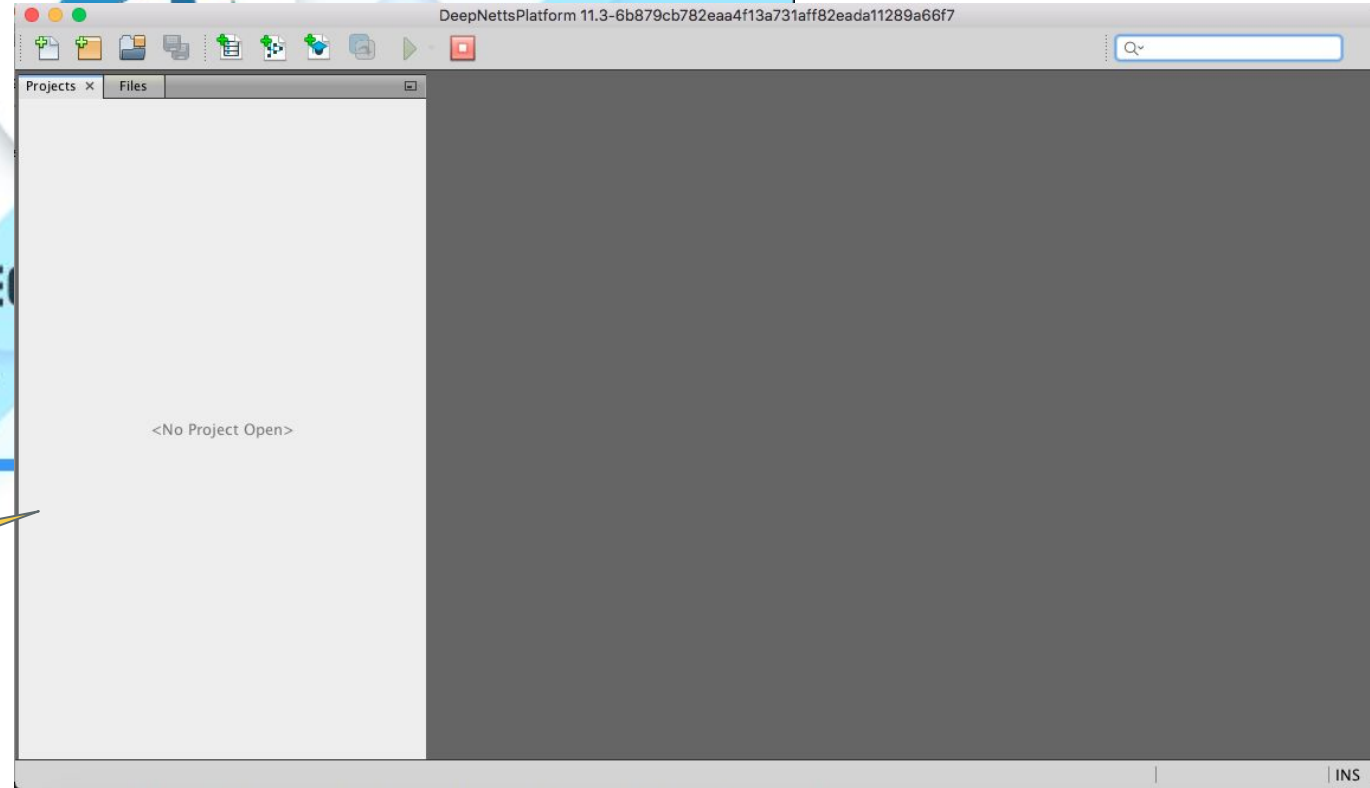
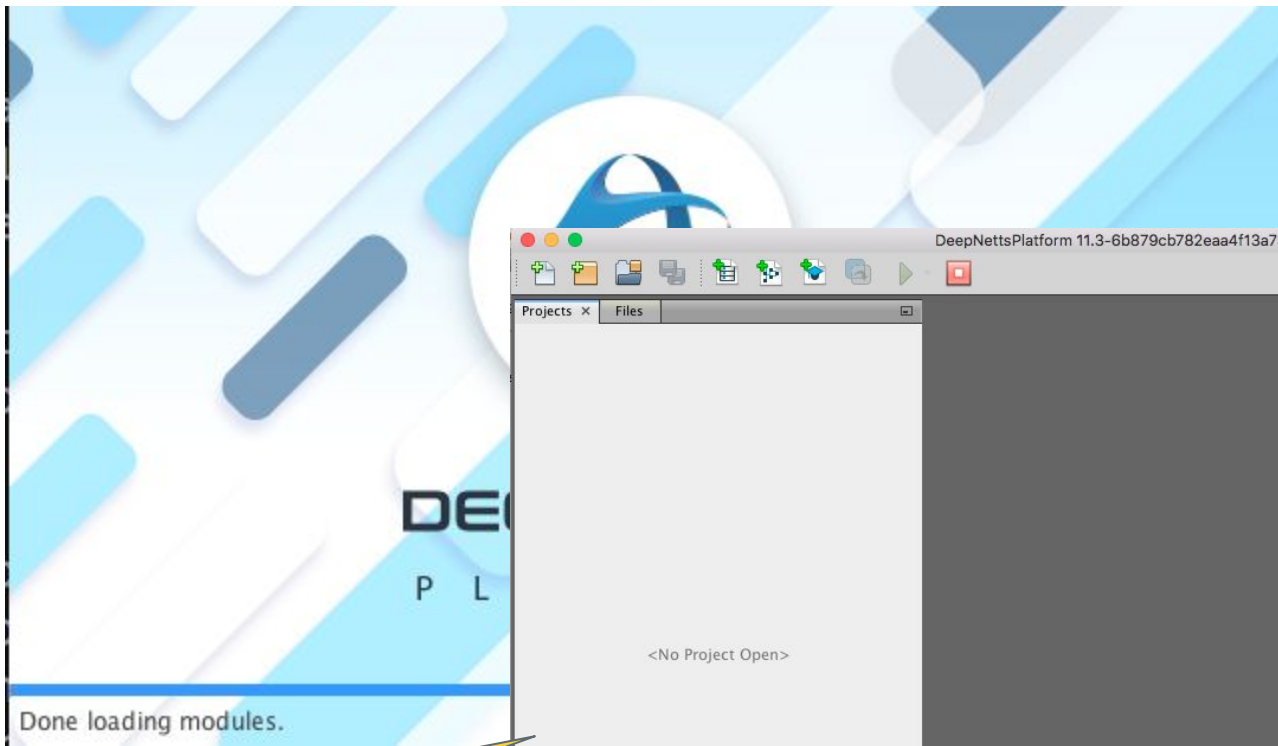
```
In [1]: %jars ./deepnetts-examples-1.11.jar
```

```
In [2]: %%loadFromPOM
```

```
<properties>
  <deepnetts.version>1.12</deepnetts.version>
  <visrec.version>1.0.1</visrec.version>
</properties>

<dependency>
  <groupId>javax.visrec</groupId>
  <artifactId>visrec-api</artifactId>
  <version>1.0.1</version>
</dependency>
<dependency>
  <groupId>javax.visrec</groupId>
```

(Demo)



Wizard-driven
IDE in action
(youtube)

Done loading modules.

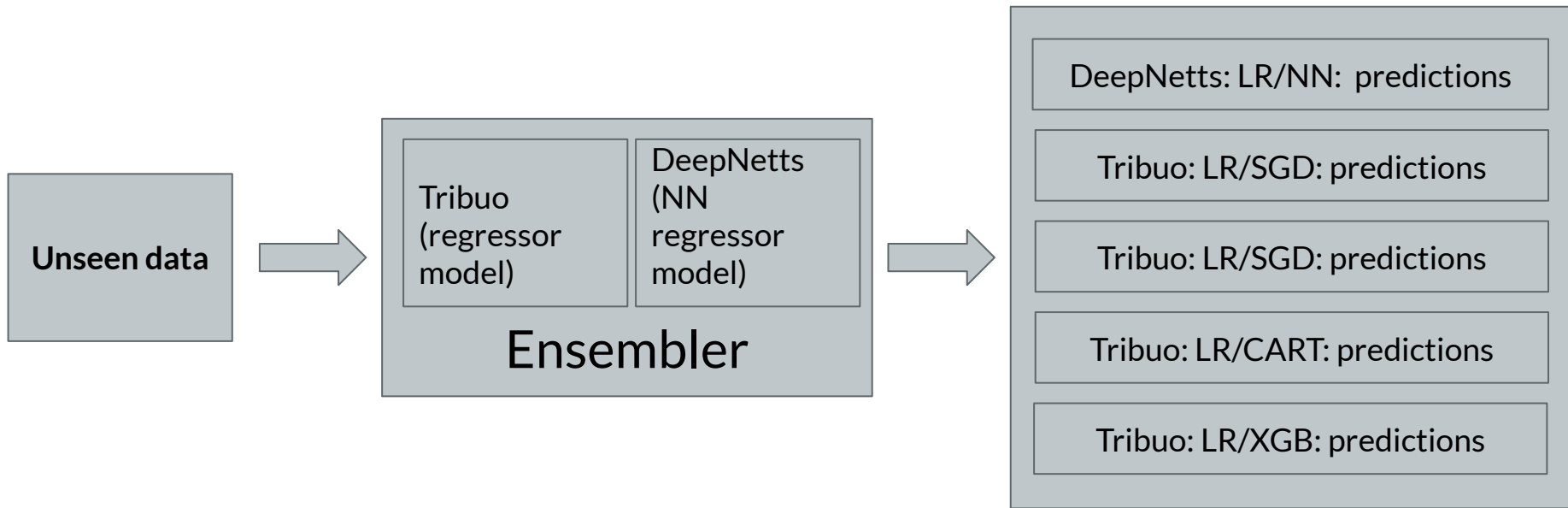
Demo: Ensemble the predictions

About the demo: Ensemble the predictions

- **Code on GitHub (example):**

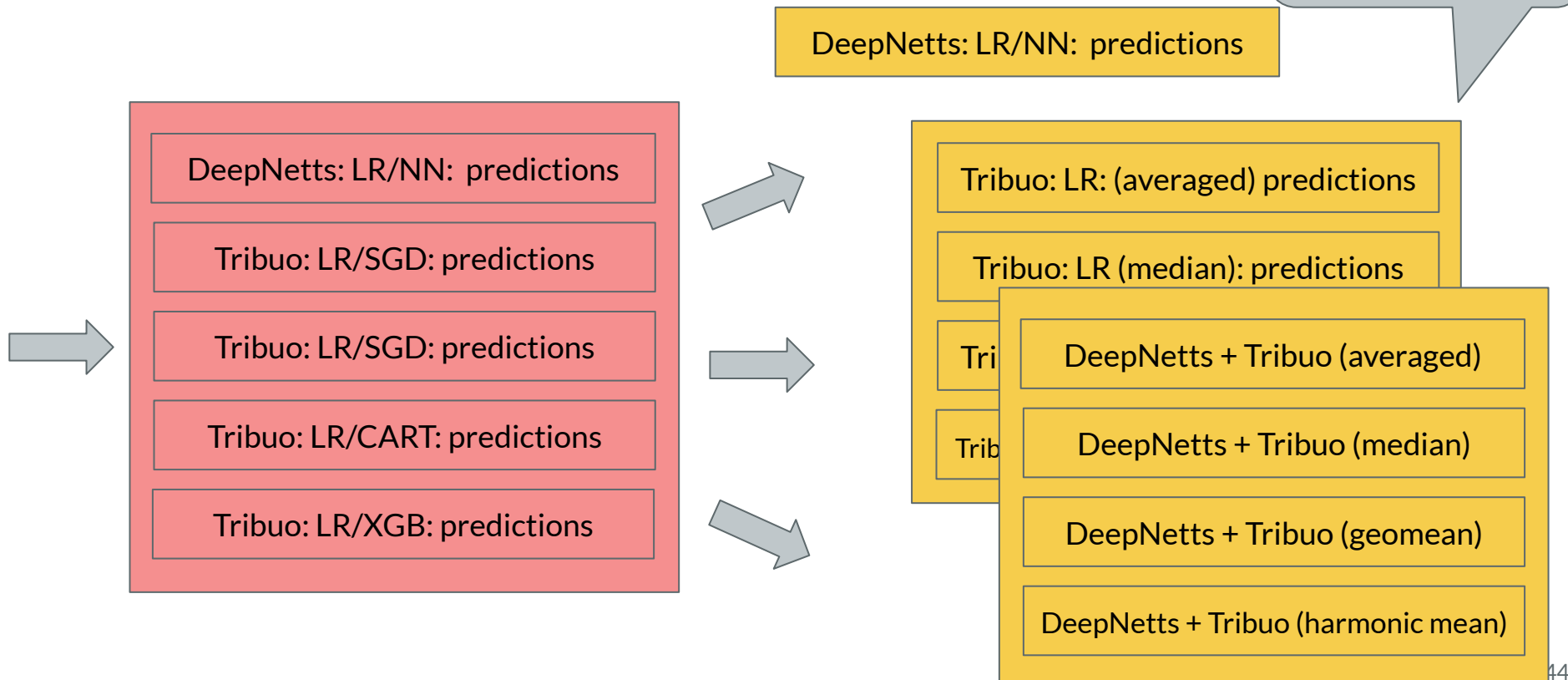
<https://github.com/neomatrix369/awesome-ai-ml-dl/tree/master/examples/ensembler>
(follow steps in the README)

About the demo: Ensemble the predictions



About the demo: Ensemble

And many such combinations





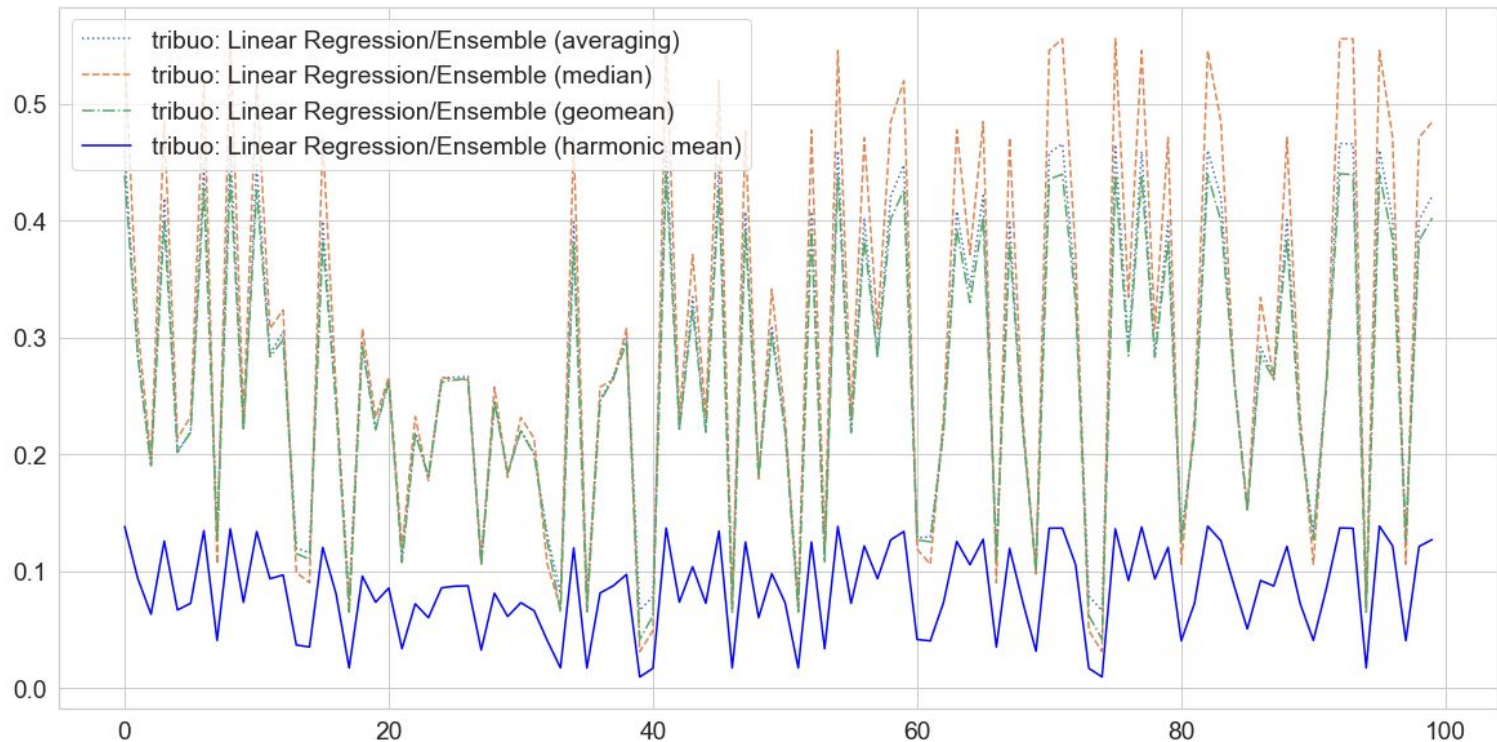
File Edit View Run Kernel Tabs Settings Help

01_ComparingResults.ipynb x 02_EnsembleTribuoResults x 03_EnsembleTribuoDeepN x

Markdown git

Python 3

[128]: <matplotlib.legend.Legend at 0x12c53b4a8>



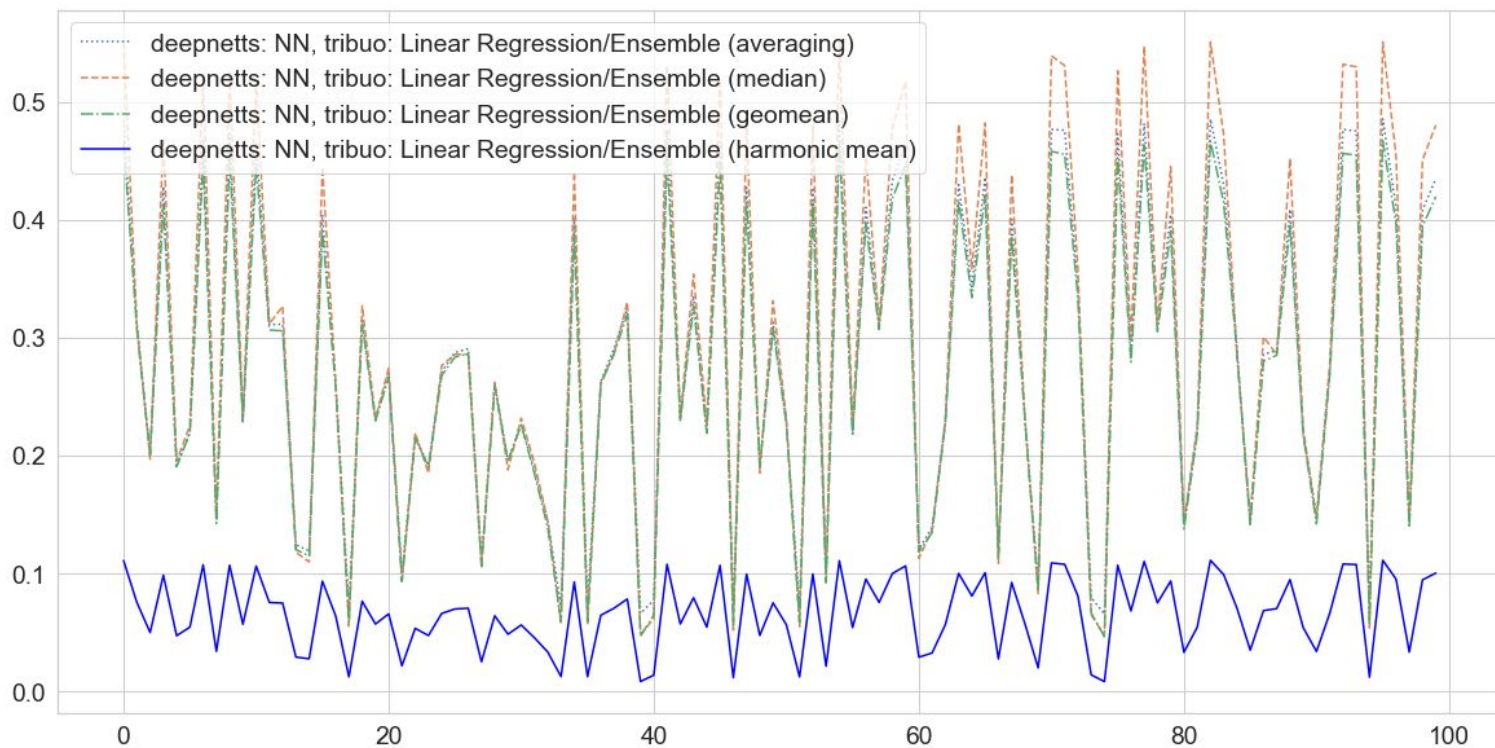


File Edit View Run Kernel Tabs Settings Help

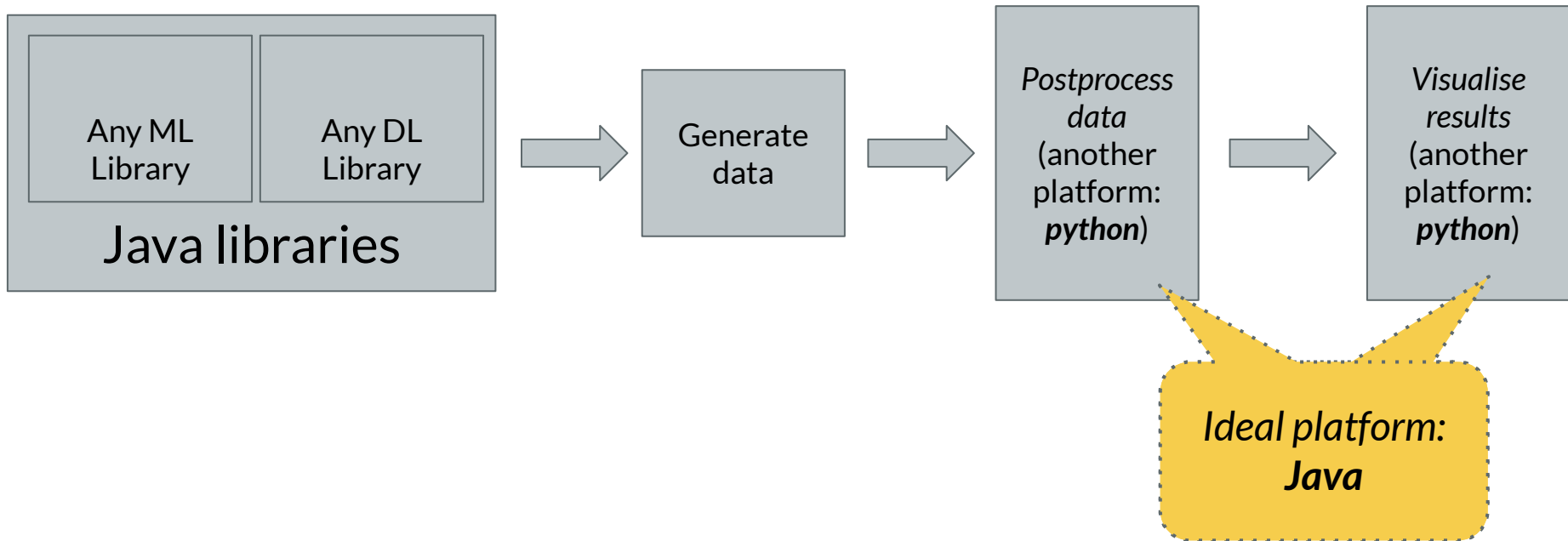
01_ComparingResults.ipyn X 02_EnsembleTribuoResults X 03_EnsembleTribuoDeepN X

Markdown git

Python 3



Ensemble: Workflow



(Demo)

(Demo: try yourself)

As Java CLI app

non-GUI mode...

Tribuo examples: as a Java CLI app

DeepNetts examples: as a Java CLI app

Go to the above links and please perform the steps mentioned there.

You should see outputs like these.

- *Build and run JAR from CLI*
- *Build and run GraalVM native-image from CLI*



Performant native-image

Super-fast,
small-footprint

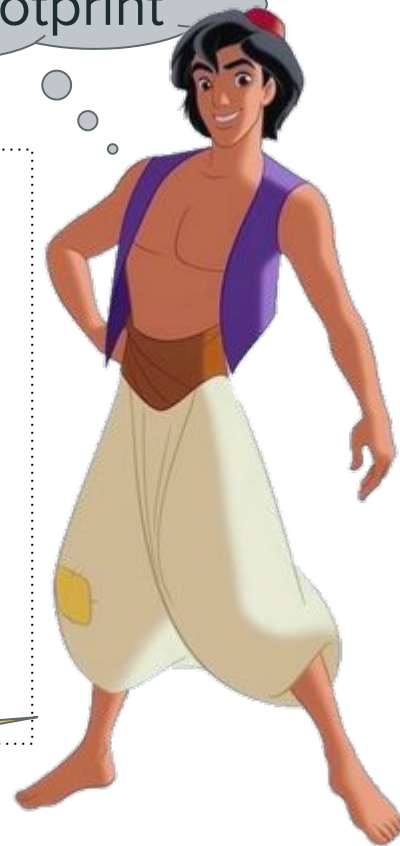
Go to these links:

[Tribuo examples: as a Java CLI app](#)

[DeepNetts examples: as a Java CLI app](#)

And please perform the steps mentioned there.
Look for the `--pgo` and `--compress` options.

- *Build profile-guided optimised native-images*
 - *Build compressed native-images*



Deploy on the Cloud

Please feedback
after trying out.

Go to these links:

[Run Tribuo notebooks on the Cloud](#)

[Run DeepNetts notebooks on the Cloud](#)

And please perform the steps mentioned there.

- *Use docker to create containers for local and cloud usage*
- *Use terraform to create and destroy cloud instances*



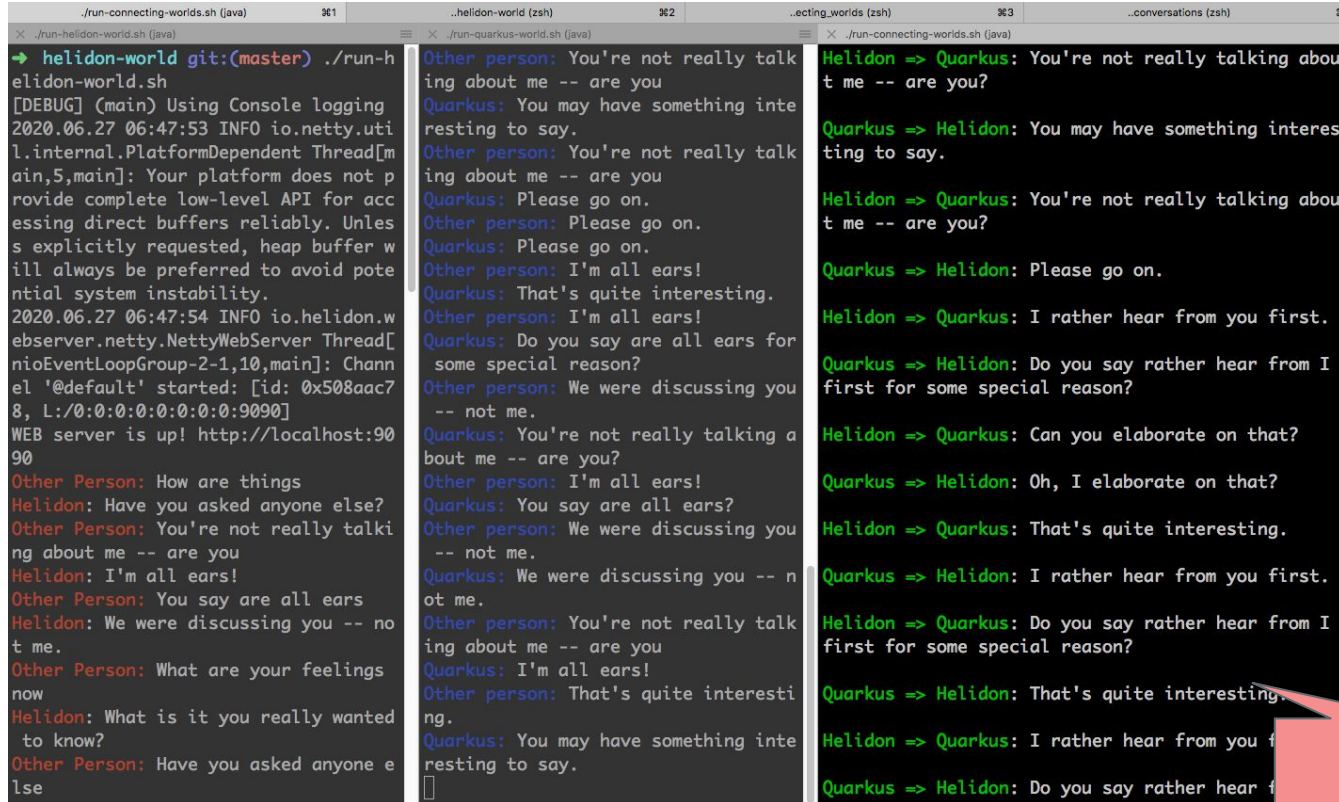
Making chatbot have a conversation

- Github repo:
<https://github.com/neomatrix369/chatbot-conversations>
- Questions
 - Is this a real conversation?
 - Would this pass the Turing test?
 - What is good about this example/demo?
- Puzzles to solve
 - What are the different things that can be improved?
 - What new ideas come to mind when you see this?



[Video](#)
(Chatbots demo)

Making chatbot have a conversation



The screenshot displays a terminal window with four tabs: `./run-connecting-worlds.sh (java)`, `./helidon-world (zsh)`, `./connecting-worlds (zsh)`, and `./conversations (zsh)`. The `./helidon-world (zsh)` tab is active, showing a Java application running with console logging. The application is a chatbot that responds to user input. The conversation is as follows:

```
helidon-world git:(master) ./run-helidon-world.sh
[DEBUG] (main) Using Console logging
2020.06.27 06:47:53 INFO io.netty.util.internal.PlatformDependent Thread[m
ain,5,main]: Your platform does not p
rovide complete low-level API for acc
essing direct buffers reliably. Unles
s explicitly requested, heap buffer w
ill always be preferred to avoid pote
ntial system instability.
2020.06.27 06:47:54 INFO io.helidon.w
ebserver.netty.NettyWebServer Thread[
nioEventLoopGroup-2-1,10,main]: Chann
el 'default' started: [id: 0x508aac7
8, L:/0:0:0:0:0:0:0:0:9090]
WEB server is up! http://localhost:90
90
Other Person: How are things
Helidon: Have you asked anyone else?
Other Person: You're not really talki
ng about me -- are you
Helidon: I'm all ears!
Other Person: You say are all ears
Helidon: We were discussing you -- no
t me.
Other Person: What are your feelings
now
Helidon: What is it you really wanted
to know?
Other Person: Have you asked anyone e
lse
```

[Video](#)
(Chatbots demo)

Release & License

Tribuo library

Latest Release

tag/v4.0.2

Apache 2.0

*Developer and
community friendly
License*

DeepNetts library

Latest Release

v1.12

GPL 3.0 with
CPE

Open Source License

Community

Community: Tribuo

- [Oracle Labs](#)
- [Oracle Labs: Machine Learning Research Group](#)
- Discussion List: [Archive](#) | [Subscribe](#)
- [Issues](#) | [Pull Requests](#) on GitHub
- [Contribution Guidelines](#)
- [Security Reporting Guidelines](#)

Community: DeepNetts

- Checkout details about [community edition](#)
- [Free DeepNetts Professional Edition developer license](#) available, [see here and download](#)

READY TO GET STARTED?

Yes! Download for free

I have a question!

Summary

- Built on good foundation
- Focus is on user-friendliness and end-goal
 - Focus on provenance
 - IDE to monitor and analyse processes, also Wizard driven approach
- Runtime performance compared to other options
- How to deploy on Docker or in the cloud?

Summary

- Open Source and community friendly licenses
- **Ensemble:** combined benefits of the two can be better than their individual differences
- We just scraped the surface, lots of resources to learn from and neat documentation to get started with

Resources

Resources

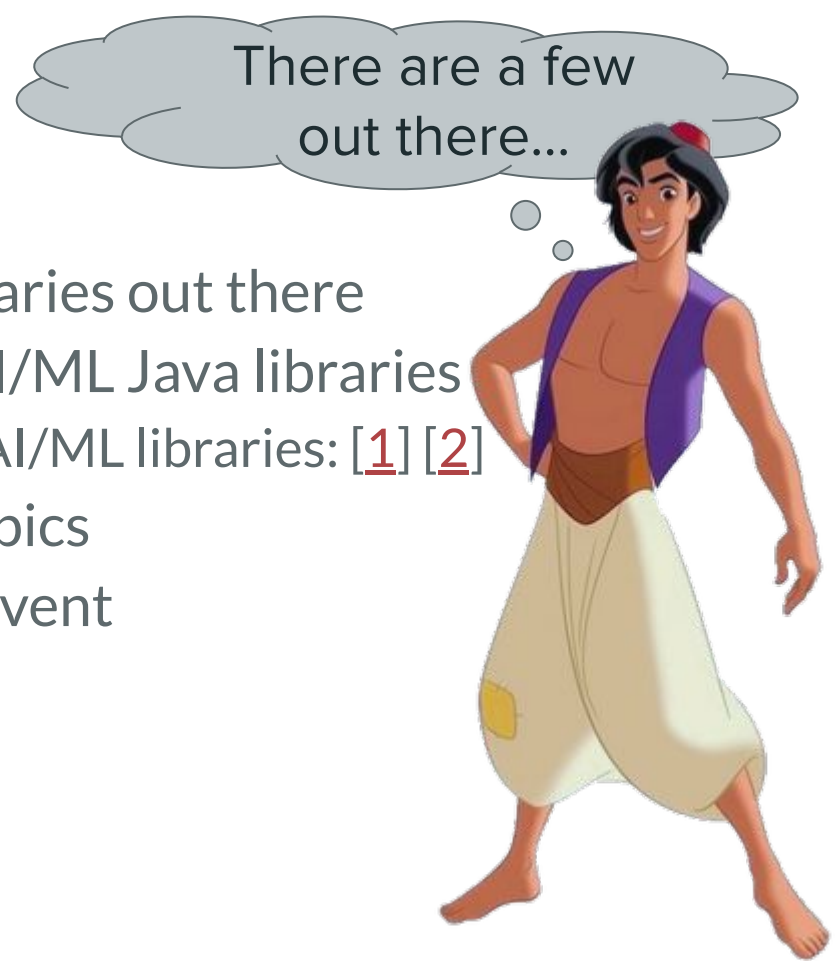
- See the Resources sections of these links <https://bit.ly/intro-to-tribuo-slides> and <https://bit.ly/gba-apac-tour-2020-slides> for more resources on **Tribuo**
- Twitter: [@oraclelabs](https://twitter.com/oraclelabs) with #tribuo

Resources

- [DeepNetts website](#)
- [Blogs](#)
- [Download](#)
- [API Docs](#)
- Editions: [Professional](#) | [Community](#)
- [FAQ](#)
- [YouTube Channel](#)
- [GitHub \(community version\)](#)
- [Twitter: @deepnetts](#)

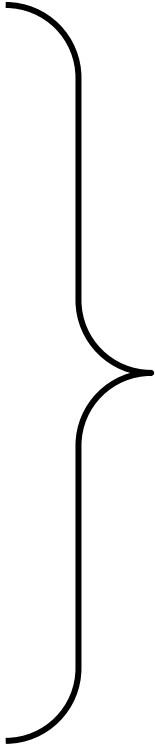
Other libraries

- There are a few AI/ML Java libraries out there
- Eyal's recent presentation on AI/ML Java libraries
- DeepNetts: Zoran's blog posts on AI/ML libraries: [[1](#)] [[2](#)]
- My Previous talks on related topics
- Other AI/ML Java talks at this event



Learning websites

- Awesome AI/ML/DL
- Better NLP
- Awesome Graal
- Virgilio | GitHub
- MadeWithML



All you need to know, pick and choose, make your own collections / checklists / playlists of resources to study and practice from.

Java AI/ML/DL Resources

- Java on Awesome AI/ML/DL
- Awesome AI/ML/DL
- Tribuo | GitHub
- Awesome Graal
- Awesome Java | Awesome JVM

More resources

See Appendix section

Thank you!

You



And organisers of this
meetup: *Eyal, Vivian,*
Zoran and team

Use Hashtag:
#Tribuo
#DeepNetts

Special Thanks

**Eyal and
Zoran**

Zoran, nice
library, thanks for
the **Free** version!

Eyal, great work
with all the
unconferences and
meetups!

Use Hashtag:
#Tribuo
#DeepNetts

Citation

The respective authors and creators are, and remain the true owners of the images and other artifacts used in this presentation.

Thank you for your creations!

Questions & feedback

Use Hashtag:
#Tribuo
#DeepNetts

Please share your questions
and feedback at

@theNeomatrix369

or on the video stream

Social media links

- twitter: [@theNeomatrix369](#)
- medium: <https://medium.com/@neomatrix369>
- github: <https://github.com/neomatrix369/>
- linkedin:
<https://uk.linkedin.com/pub/mani-sarkar/71/a77/39b>
- slideshare: <https://www.slideshare.net/neomatrix369/>
- youtube: [My Channel](#) | [Videos playlist](#)

Use Hashtag:
#Tribuo
#DeepNetts

Keep in mind...



It's your turn next to share and inspire!!!

Appendix

Freebies!

Get \$500 worth of free cloud
credits on Oracle Cloud

People doing some great work with AI & Java

Eyal Wirsansky, Zoran Sevarac,
Suyash Joshi, Adam Pocock,
Frank Greco, Johan Vos and
many others...

(please share more names and examples with me so I can add them here)

Accelerated Processing

Java on the GPU by Mitia

Plenty of resources on  **NVIDIA**.

Nvidia's [Developer site](#) | [Community](#) | [Research](#) | [Blog site](#)

Parallel processing

GNU
Parallel

<https://www.gnu.org/software/parallel/>

Parallel / Async
programming

[Talk by Venkat Subramanian](#)

ASYNC
Reactive programming

<https://community.oracle.com/docs/DOC-1006738>

Java and AI/ML/DL

Machine Learning Best Practices

o

Top 5 machine learning libraries for Java

o

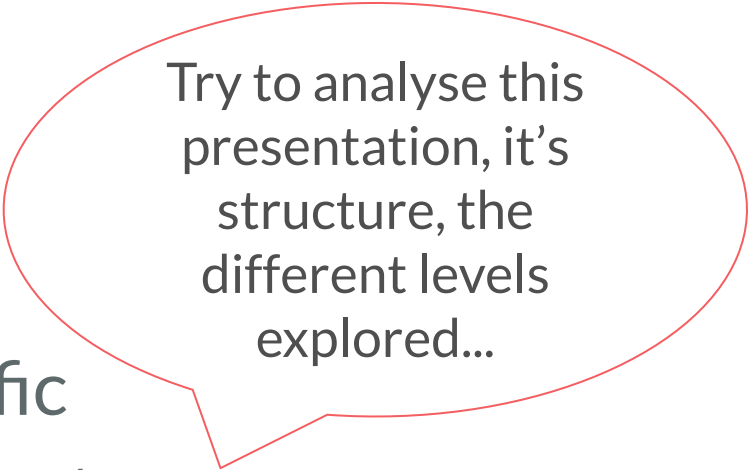
10 Popular Java Machine Learning Tools & Libraries

o

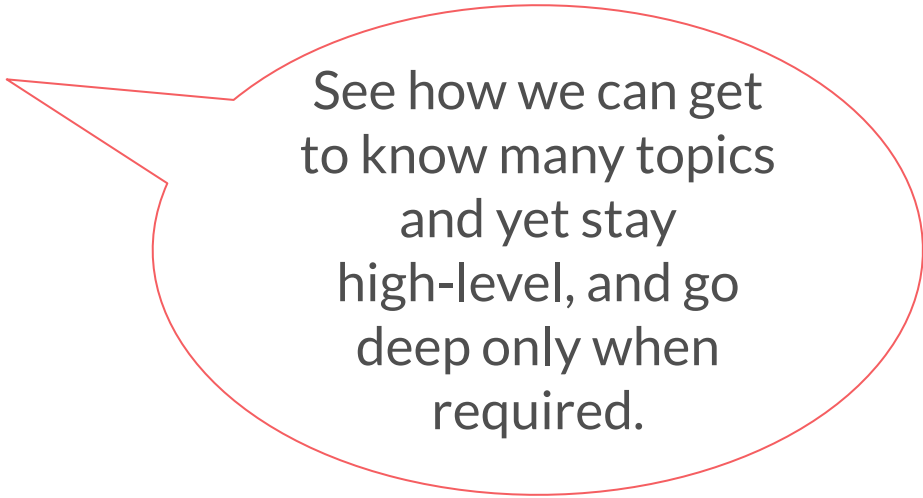
What are machine learning libraries in Java?

Levels of abstractions

- Higher to lower
 - From generic to more specific
- Always know the level of abstract
 - when reading
 - when writing
 - when speaking



Try to analyse this presentation, it's structure, the different levels explored...



See how we can get to know many topics and yet stay high-level, and go deep only when required.

Book references

- How to think like a Scientist!
- Deep work book
- Getting Things Done: Book | Free Resources

Previous talks

- I recently gave a talk: "nn" things every Java Developer should know about AI/ML/DL
- Tribuo: an introduction to a Java ML Library
- NLP Profiler: A simple profiler, to profile textual datasets
- From backend development to machine learning
- "nn" things every Java developer should know about AI/ML/DL (jOnConf)
- Naturally, getting productive, my journey with Grakn and Graql
- Do we know our data as well as our tools?
- Java N.n: What to know? How to learn?
- Some of my other talks can be found here and here (and others on Slideshare)

Create something simple from scratch

- even if it's as simple or silly idea - like the demos i have shown
- *(it can also be putting existing components together from scratch)*
- this can have a massive impact on us and our communities

Learning by example

DL4J example

- Github
- Blog post

NLP examples

- Example 1
 - Github
 - Blog post
- Example 2
 - Blog post
- Example 3
 - Blog post
- Better NLP

Jupyter Notebook example

- Example 1
 - Github
 - Blog: Exploring NLP concepts using Apache OpenNLP inside a Jupyter notebook
- Example 2
 - Blog post
- Example 3
 - Github
 - Blog post

Apache Zeppelin example

- Github
- Blog posts
 - Apache Zeppelin: stairway to notes* haven!
 - Running Apache Zeppelin on Oracle Cloud Infrastructure

grql-to-english, english-to-grql example

- Presentation
- Github

grCuda example

- Blog posts

- [grCUDA: A Polyglot Language Binding for CUDA in GraalVM.](#)
NVIDIA Developer Blog, November 2019.
- [grCUDA: A Polyglot Language Binding.](#) Presentation at Oracle
CodeOne 2019, September 2019.
- [Simplifying GPU Access.](#) Presentation at NVIDIA GTC 2020, March
2020
- [Optimizing Machine Learning Performance at Netsuite with](#)
GraalVM and NVIDIA GPUs

- [Github](#)

graalPython examples

- Blog posts
 - [Introduction to the Python implementation for GraalVM](#)
 - [Moving from Jython to GraalVM](#)
 - [Running Python on GraalVM](#)
- [Github](#)