BOOSTING JIRA CLOUD APP DEVELOPMENT WITH APACHE IGNITE

Created by Peter Gagarinov and Ilya Roublev

March 2, 2021

OVERVIEW

- What is JIRA app?
- Alliedium AIssistant backend design paradigms, requirements to the underlying database
- The legacy backend architecture vs the current backend architecture
- PostgresSQL + Celery vs Apache Ignite + Ray Server as both the database and computing grid: cons and pros for our use case

WHY JIRA?

- Profitable for plugin developers: license cost depends on number of all users even if they do not use the plugin
- Very popular — millions of users around the globe

ALLIEDIUM AISSISTANT[1]: ABOUT THE PROJECT

- Makes the project management easier via automating the ticket assignment, labeling, ranking by priority
- Uses ML to infer rules from existing Jira tickets

ALLIEDIUM AISSISTANT BACKEND DESIGN PARADIGMS

- SaaS built using microservice architecture
- Container orchestration
- Cloud-based fail-safe distributed architecture
- Scalable key-value database with SQL layer
- Multitenancy
- Background task manager
- Internal ML engine as a service
- Should support both cloud and on-premise deployment

DATABASE REQUIREMENTS

- integrates with Java natively
- highly available and horizontally scalable
- fault-tolerant and distributed
- supports distributed ACID transactions
- provides both persistent and in-memory storage
- supports SQL for distributed data

DATABASE REQUIREMENTS (CONTINUED...)

- supports user-defined distributed jobs
- provides automatic failover (jobs and db connections)
- provides Transparent Data Encryption for safety reasons
- supports native configurations for deployment in Kubernetes
- free and open-source

INITIAL TECHNOLOGY STACK

- Spring Boot as a web framework
- PostgreSQL as a database
- Hibernate as an ORM tool
- Celery + RabbitMQ as a computing grid[2]
- Scikit-Learn as an ML framework (runs inside Celery)[3]

CURRENT TECHNOLOGY STACK

- Spring Boot as a web framework
- Apache Ignite as a distributed database, no ORM is used
- Celery + RabbitMQ → Apache Ignite + Ray Serve[4][5][6]
- Scikit-Learn + PyTorch[7][8]


Amazon cloud
SageMaker
Deep Learning Container
Deep Learning Container
Deep Learning Container
Amazon cloud/on premise
Spring Boot Web Server
Apache Ignite
Ray Serve
Spring Boot Web Server
Apache Ignite
Apache Ignite
Ray Serve
Ray Serve
Load Balancer
Spring Boot Web Server
Apache Ignite
Kubernetes
Jira cloud
JIRA instance
JIRA instance
JIRA instance
User

POSTGRESQL: GOOD

- Easy to deploy[9]
- Easy to integrate with Atlassian Connect Spring Boot[10]
- Easy to version track schema changes and perform data migrations[11][12]
- supports most of the major features of ANSI SQL:2016 (starting with PostgreSQL 12) [13] [14]
- Full support for ACID transactions

POSTGRESQL: NOT SO GOOD

- Not horizontally scalable (unless some PostgreSQL-derivative database is used) [15] [16] [17] [18]
- Requires more efforts for mapping objects to tables
- Key-value API needs to be imitated via

```
select value from some_table where key = some_key
```

- Transparent Data Encryption is available only via an unofficial patch[19][20]
- In-memory tables: approximation only (RAM disk, UNLOGGED)[21][22][23][24]

APACHE IGNITE AS A DATABASE: GOOD

- Thick client for Java providing a full set of APIs
- Both key-value and SQL API
- Distributed
- Native persistence
- Full support for distributed ACID transactions[25]
- Built-in Transparent Data Encryption
- In-memory caches
- Good integration with Kubernetes
- Automatic connection failover for both thick and thin clients

APACHE IGNITE AS A DATABASE: NOT SO GOOD

- No open-source schema version tracking and data migration tools
- Database backup/restore is difficult[26][27]
- Still supports only a subset of ANSI SQL:1999 (e.g. no foreign keys)[28]
- SQL transactions are still in beta[29]
- Doesn't play nicely with Spring Boot DevTools[30][31][32]
- Requires network isolation for development purposes[33]
- Python thin client doesn't yet support transactions[34]
- Using the thick client API[35] from Python requires Py4J Python-Java bridge[36]
- Has the legacy Spring 4 as a dependency even though Spring 5 has been around for quite a while[37]

CELERY: GOOD

- Python-based — easier to integrate with Python-based ML frameworks
- "At Least Once" delivery guarantee for Celery message queues (implemented via RabbitMQ)[38]

CELERY: NOT SO GOOD

- Requires a separate message broker (RabbitMQ) for submitting tasks[39]
- Requires a separate results backend for large results[39]
- No out-of-the-box pure Java API[40]
- If not run inside K8s a special care is needed for RabbitMQ auto-failover implementation[41]
- Automatic connection failover is available only inside Kubernetes

APACHE IGNITE AS A COMPUTING GRID: GOOD

- Native Java API for messages and distributed computing tasks
- Built-in distributed basic ML models
- Automatic connection failover for both thick and thin clients

APACHE IGNITE AS A COMPUTING GRID: NOT SO GOOD

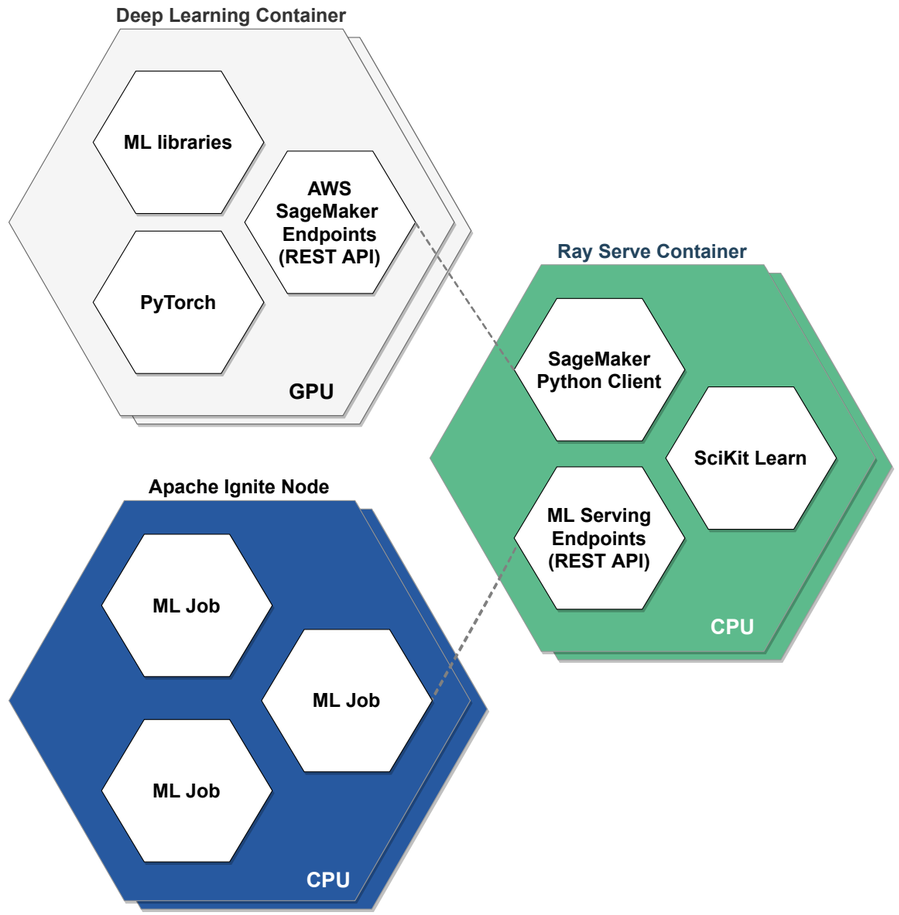
- Weaker delivery guarantees — not suitable for important messages (in finance e.g.)[42]
- Python thin client doesn't support neither message nor computing API[34][43]
- Using the thick client API from Python requires Py4J Python-Java bridge[36]

POSTGRESQL → APACHE IGNITE: MIGRATION DIFFICULTIES

- If Celery is kept, Py4J bridge is required for communication between Celery and Apache Ignite (because we need transactions)
- Apache Ignite cache imitating `atlassian_host` table needs to be created prior to starting Atlassian Connect Spring Boot[44]
- Integration with Spring 5 requires a special care (by putting dependencies on Spring prior to Apache Ignite dependencies)
- Fields having non-SQL datatypes (custom class-valued fields) need to be stored as XML (via `Binarylizable`[45] and `QueryEntity`[46]) to be readable in SQL client tools such as DBeaver and DataGrip
- Still not possible to get the list of all atomics names inside the cluster[47]

CELERY + RABBITMQ → APACHE IGNITE: MIGRATION DIFFICULTIES

- Still need a place to run Python-based ML calculations, that is why Ray Serve
- More care on the front-end is required due to no delivery guarantees


Deep Learning Container
ML libraries
AWS SageMaker Endpoints (REST API)
PyTorch
GPU
Ray Serve Container
SageMaker Python Client
SciKit Learn
ML Serving Endpoints (REST API)
CPU
Apache Ignite Node
ML Job
ML Job
ML Job
CPU

QUESTIONS?

REFERENCES

[1] Alliedium AIssistant Jira App, ver. 1.2, 2020

[2] Johansson Lovisa, Running Celery with RabbitMQ, www.cloudampq.com, 2019

[3] scikit-learn: Machine Learning in Python, scikit-learn.org, ver. 0.24, 2020

[4] Ray Serve: Scalable and Programmable Serving, docs.ray.io, ver. 1.2.0, 2021

[5] Mo Simon, Machine Learning Serving is Broken: And How Ray Serve Can Fix it, medium.com, 2020

[6] Oakes Edward, The Simplest Way to Serve your NLP Model in Production with Pure Python, medium.com, 2020

[7] How would you compare Scikit-learn with PyTorch?, www.quora.com, 2020

[8] K Dhiraj, Why PyTorch Is the Deep Learning Framework of the Future, medium.com, 2019

[9] Chiniara Dan, Installing PostgreSQL for Mac, Linux, and Windows, medium.com, 2019

REFERENCES

[10] Atlassian Connect Spring Boot, bitbucket.org, ver. 2.1.2, 2020

[11] Oliveira Junior, The best and easy way to handle database migrations (version control), medium.com, 2019

[12] Gopal Vineet, Move fast and migrate things: how we automated migrations in Postgres, medium.com, 2019

[13] PostgreSQL: Appendix D. SQL Conformance, www.postgresql.org, ver. 13.2, 2021

[14] PostgreSQL vs SQL Standard, wiki.postgresql.org, 2020

[15] Kuizinas Gajus, Lessons learned scaling PostgreSQL database to 1.2bn records/month: Choosing where to host the database, materialising data and using database as a job queue, medium.com, 2019

[16] Slot Marco, Why the RDBMS is the future of distributed databases, ft. Postgres and Citus, www.citiusdata.com, 2018

REFERENCES

[17] Knoldus Inc., Want to know about Greenplum?, medium.com, 2020

[18] TimescaleDB 2.0: A multi-node, petabyte-scale, completely free relational database for time-series, blog.timescale.com, 2020

[19] Chen Neil, Rise and Fall for an expected feature in PostgreSQL — Transparent Data Encryption, highgo.ca, 2020

[20] PostgreSQL Transparent Data Encryption, www.cybertec-postgresql.com, 2021

[21] Huang Cary, Approaches to Achieve in-Memory Table Storage with PostgreSQL Pluggable API, highgo.ca, 2020

[22] Westermann Daniel, Can I put my temporary tablespaces on a RAM disk with PostgreSQL?, blog.dbi-services.com, 2020

[23] PostgreSQL: 22.6. Tablespaces, www.postgresql.org, ver. 13.2, 2021

[24] Ringer Craig, Putting a PostgreSQL tablespace on a ramdisk risks ALL your data, 2014

REFERENCES

[25] Apache Ignite: ACID Transactions with Apache Ignite, ignite.apache.org, ver. 2.9.1, 2020

[26] Apache Ignite: Cluster Snapshots: Current Limitations, ignite.apache.org, ver. 2.9.1, 2020

[27] Ignite in-memory + other SQL store without fully loading all data into Ignite, Apache Ignite Users, 2020

[28] SQL Conformance, ignite.apache.org, ver. 2.9.1, 2020

[29] Apache Ignite: SQL Transactions, ignite.apache.org, ver. 2.9.1, 2020

[30] Using Spring Boot: 8. Developer Tools, 8.2.7. Known Limitations, docs.spring.io, ver. 2.4.3, 2021

[31] ClassCastException while fetching data from IgniteCache (with custom persistent store), Apache Ignite Users, 2016

REFERENCES

[32] Spring Session and Dev Tools Cause ClassCastException, github.com/spring-projects/spring-boot, 2017

[33] Bhuiyan Shamim, A Simple Checklist for Apache Ignite Beginners (5. Ghost Nodes), dzone.com, 2019

[34] Apache Ignite: Thin Clients Overview, ignite.apache.org, ver. 2.9.1, 2020

[35] Kulichenko Valentin, Apache Ignite: Client Connectors Variety, dzone.com, 2020

[36] Py4J — A Bridge between Python and Java, py4j.org, ver. 0.10.9.2, 2021

[37] MavenRepository: Ignite Spring, ver. 2.9.1, 2020

[38] RabbitMQ: Reliability Guide, Acknowledgements and Confirms, ver. 3.8.13, 2021

[39] First Steps with Celery: Configuration, docs.celeryproject.org, ver. 5.0.5, 2020

[40] Celery: Message Protocol, docs.celeryproject.org, ver. 5.0.5, 2020

REFERENCES

[41] Paudice Genny, High availability with RabbitMQ, blexin.com, 2019

[42] Messaging Reliability, Apache Ignite Users, 2016

[43] Apache Ignite: Python Thin Client, ignite.apache.org, ver. 2.9.1, 2020

[44] Gagarinov Peter & Roublev Ilya, Boosting Jira Cloud app development with Apache Ignite, medium.com, 2020

[45] Apache Ignite JavaDoc: Interface Binarylizable, ignite.apache.org, ver. 2.9.1, 2020

[46] Apache Ignite: SQL API, Query Entities, ignite.apache.org, ver. 2.9.1, 2020

[47] Unable to query system cache through Visor console, Apache Ignite Users, 2017