High Speed Video and Image Processing with Java and Hadoop

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Growing Volumes of Video and Image Data

- Drones
- Courtesy: c-span.org
- Surveillance cameras
- Stock images
- Corporate archives
- License plates
Some Challenges

• Large volumes of data (addressing scale)

• Diversity in types of video/image processing

• Moving video data across the network (out of the scope of this presentation)
Addressing Scale

Video and Image Processing

• Face recognition
• License plate identification
• Fingerprint matching
• Optical character recognition

Input

Identified faces, license plate text, matching timestamps, etc

Input

Identified faces, timestamps, individual frames

6x compute power
Scale-out Capability of Apache Hadoop

18x compute power on Oracle Big Data Appliance
Multimedia Analytics Framework

• Enables processing of video and image data in Hadoop

• Leverages Hadoop parallelism for high speed processing
  – Ships with OpenCV (www.opencv.org)
  – Integrate third party software into framework

• Massive storage and InfiniBand network of Oracle Big Data Appliance enables processing and management of petabytes of multimedia data
Multimedia Analysis Framework

How it Works

- **Input**: JSON or CSV or image with labels, timestamp in video
- **Split**: HDFS
- **Process**: Output

![Diagram showing the process flow from input to output through split and process stages, with HDFS as output]

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Framework Runs a MapReduce Job

- Submitted as a Hadoop job

$ hadoop jar ordhadoop-multimedia-analytics.jar -conf vprocess.xml vinput voutput

- Map tasks on each node decode segment of video/image and call processFrame()
Multimedia Analytics Framework

Benefits

• Faster video processing
  – Processing massive video/image volumes ideal for Hadoop architecture

• Extensible framework
  – Use with a variety of third party video/image processing engines

• Use framework without specialized Hadoop skills
  – Gain Hadoop scalability without Hadoop-specific management and programming skills

• Integrate video/image processing with Big Data applications
Integrate with Video/Image Processing Technology

Display/visualize

Oracle Analytics products

Hadoop APIs for data ingest

Partner module

Hadoop platform

Partner

Oracle
Extensibility

Address diversity in video/image processing requirements
Extensibility: Implement \texttt{processFrame()} \\

\textbf{Input: } (key, value (frame from video or image)) \\
\textbf{Output: } (key, value) \quad \text{Defined by implementation} \\
Implement reduce task: For example, group by output key \\

\begin{verbatim}
@Override
    public void processFrame(Text key, OrdImageWritable value)

@Override
    public Text getKey()

@Override
    public OrdImageWritable getValue()
\end{verbatim}
Part of Oracle Big Data Cloud Service

Big Data Cloud Service
(Includes Big Data Spatial and Graph, Multimedia Analytics Framework)
Building Applications
License Plate Recognition
Integrate with Video/Image Processing Technology

Display/visualize

Oracle Analytics products

Hadoop platform

Hadoop APIs for data ingest

License plate recognition

Oracle

Partner
Number Plate Demonstration Overview

Captured Images: Number Plates

Big Data Lite VM with Oracle Spatial & Graph & license plate recognition

11G Database: Number plate fact & customer fact data to ‘Detect & Act’ on fines

Oracle SQL Developer: DB Queries

Send Email to recipient if ‘number plate matches fine’

Exploration (Citizen Data Science) via Big Data Discovery
Displaying output part-m-00000
hdfs://bigdatalite.localdomain:8020/user/oracle/
  IMG_3755.JPG,1HJ4PR,92.253906

Script Complete.
hdfs://bigdatalite.localdomain:8020/user/oracle/
  IMG_3755.JPG,1HJ4PR,92.253906

hdfs://bigdatalite.localdomain:8020/user/oracle/
  IMG_3715.JPG,ZHT855,89.887215
  IMG_3715.JPG,ZHT855,81.972366
  IMG_3715.JPG,ZHT855,78.273483
  IMG_3715.JPG,ZHT855,76.112907
  IMG_3715.JPG,ZHT855,74.122231

hdfs://bigdatalite.localdomain:8020/user/oracle/
  IMG_3757.JPG,IAV8QN,90.788933
  IMG_3757.JPG,IAV88N,84.348106
  IMG_3757.JPG,IAV8N,79.394325
  IMG_3757.JPG,IAV8GN,79.057892
  IMG_3757.JPG,IAV8OM,78.712296

hdfs://bigdatalite.localdomain:8020/user/oracle/
  IMG_3756.JPG,FLL3SN,90.684166
  IMG_3756.JPG,FLL3SM,80.185354
  IMG_3756.JPG,FLL3S,76.768189

hdfs://bigdatalite.localdomain:8020/user/oracle/
  IMG_3758.JPG,ZTY885,87.072441
  IMG_3758.JPG,ZTY885,84.029678
  IMG_3758.JPG,ZTY85,78.346504
  IMG_3758.JPG,ZTY85S,76.793304
  IMG_3758.JPG,ZTY85S,76.443649

hdfs://bigdatalite.localdomain:8020/user/oracle/
  IMG_3759.JPG,W0T981,90.763484
Optical Character Recognition

With Apache Tesseract
Implement OCR processing in `processFrame()`

Input:  (key, value (frame from video or image))

Output: (key, value)  Output value image overlaid with recognized text

```java
@Override
public void processFrame(Text key, OrdImageWritable value) {

<call Tesseract APIs>
ocrString = instance.doOCR()
```

Details in https://blogs.oracle.com/bigdataspatialgraph/entry/using_oracle_big_data_spatial
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BY WILLIAM MARSH RICE
IN FREEDOM FOR RESEARCH
TO SOBER FEARLESS PURSUIT

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Partnership with Griaule
Griaule Biometrics S/A

- Specialized in software for large scale biometric identification systems (Big Data Biometrics)
- Provides technology for Systems Integrators who provide solutions to the end customer
- 15 years researching biometrics, with over 20 certifications (FBI, NIST, FVC, etc.)
- Largest ABIS in the world using fingerprint as primary technology for deduplication
- Multimodal fingerprint, face and voice technologies
Identification Uses

- Recognize people amid crowds
- Facial aging and weight changes
- Over 20 FBI certifications in biometrics
- Most precise finger print algorithm in the world since the FVC2006
Architecture

- Easily integrated
- Plan to integrate with all Griaule’s identification systems (facial, voice, fingerprint and more)
- Full access to Griaule’s intelligence systems
Implement Griaule processing in `processFrame()`

Input: (key, value (frame from video or image))

Output: (key, value)   Output value face with green or yellow bounding box

@Override
    public void processFrame(Text key, OrdImageWritable value) {

Demo

"What's Brightest in America"

Griaule face recognition with Multimedia Analytics framework in Oracle Big Data Spatial and Graph
Roadmap

• Real-time analysis of streaming video

• Spark streaming integration
Summary

• Multimedia Analytics Frameworks enables fast video and image processing in Hadoop

• Extensibility API for third party software integration enables many different types of processing

• Video and image data can be analyzed along side other Big Data types
Integrated Cloud
Applications & Platform Services