FFmpeg-MR

Distributed Video Transcoding using MapReduce

Background: Video Transcoding Problem

(Compression)

- What is it?
- Why do we need to do it?
  - *Performance*
  - *Compression/File Size*
  - *Quality*
- Why is it more important now than it ever has been?

Background: MapReduce

- What?!
  - **Map** and **Reduce**
  - Influence from Functional Programming (although not quite the same!)
    - Google popularised it in 2004 for querying **large data sets** on **clusters** of computers
- Other uses?
  - Video Transcoding?
- The ‘Cloud’

Project:
MapReduce based Audio and Video Transcoding

- Feasibility study
  - Can we use MapReduce for more than just large data processing?
  - Is video transcoding a good candidate for MapReduce?
    - Is the performance increase close to being linear w.r.t the number of nodes?
    - Is the problem easily split up into units of work?
    - Can the ***Reduce*** function be used effectively?

High-level solution walkthrough

Input Demux **Map** **Reduce** *Merge*

Sort

Input

Demux

Map

Sort

Reduce

Merge

Input

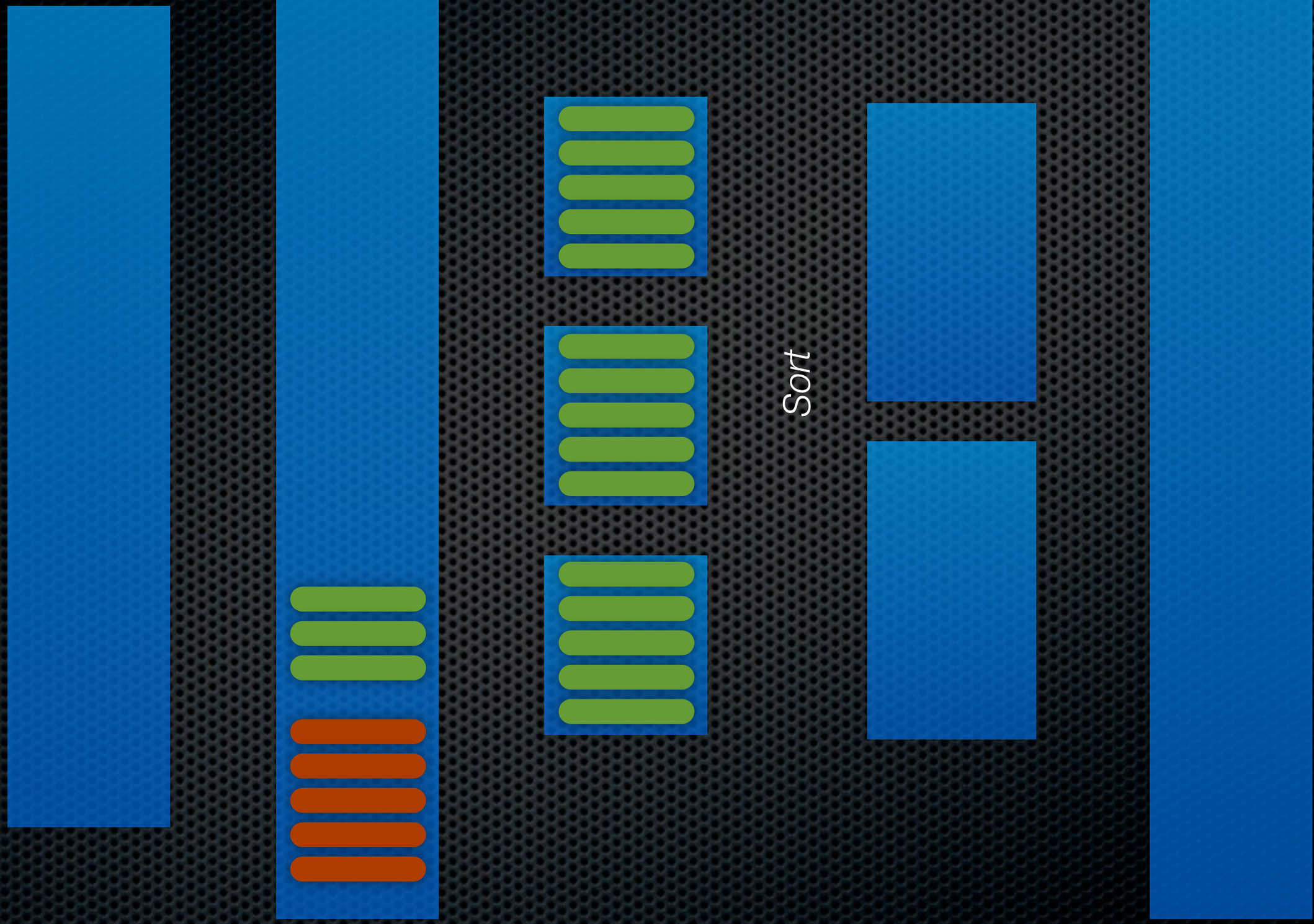
Demux

Map

Sort

Reduce

Merge



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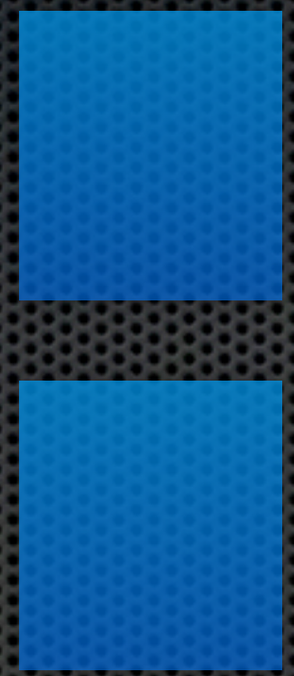

So

Low Level Implementation Summary

- MapReduce is only a ***programming paradigm***.

- Apache **Hadoop** = open source implementation of MapReduce.
  - Manages the assignment of the *Map*, *Sort* and *Reduce* tasks.
  - Manages the replication and distribution of the data (if you want it to).

Low Level Implementation Summary

- FFmpeg libav* libraries are used for working with the video files (hence the project name).
  - Good performance, codec support and quality.
- But:
  - FFmpeg = **C**.
  - Hadoop = **Java**.
- So there is a layer of custom JNI (Java Native Interface) in between that deals with this conversion. *This does have some performance trade offs.*

Project Analysis

- **Performance Tests**
  - Time taken as number of nodes increases on various different size files, compared to on single machine FFmpeg run.
- **File Size/Compression Comparison Test**
  - Compared to input, and a control FFmpeg run.
- **Objective Quality Tests**
  - PSNR (peak signal to noise ratio) compared to input, and a control FFmpeg run.
  - SSIM (structural similarity index) compared to input, and a control FFmpeg run.
- **Subjective User Study Quality Tests**
  - Can users tell the difference between the distributed output, and one generated by FFmpeg on a single machine?

Progress and Conclusion

- Demux and (Map) implementation are feature complete.
- Reduce ongoing.
- (Testing on Amazon EMR (Elastic MapReduce) works well.)

- Solution looks to be technically feasible.
- Analysis will reveal if performance and compression is good in the coming weeks.

Questions?

http://www.flickr.com/photos/ryanhadley/3369519392/

A take-off of xkcd's Compiling (http://xkcd.com/303).