View Source: Design Patterns in the Wild

Map/Reduce

Ashwin J Mathew Spring 2008
School of Information, UC Berkeley

Today

- Functional programming fun with Map/Reduce
- Map/Reduce as a distributed programming pattern, implemented in Apache Hadoop

The Problem

- Reduce algorithm implementation complexity
  - Apply a function to every item of a collection
  - Reduce a collection to a single value, or smaller set of values
- Duplicated iteration code
  - Potentially inefficient
  - Error-prone: index variables are globals in Javascript
  - Hard to refactor nested loops

Why Map/Reduce?

```
for (i=0;i<a.length;i++)
    a[i] = a[i] ^ 2;

for (i=0;i<a.length;i++)
    sum += a[i];
```

```
a = a.map(function(x) {
        return x^2} );

sum = a.reduce(
    function(x,y) {
        return x+y});
```

Hide your loops!

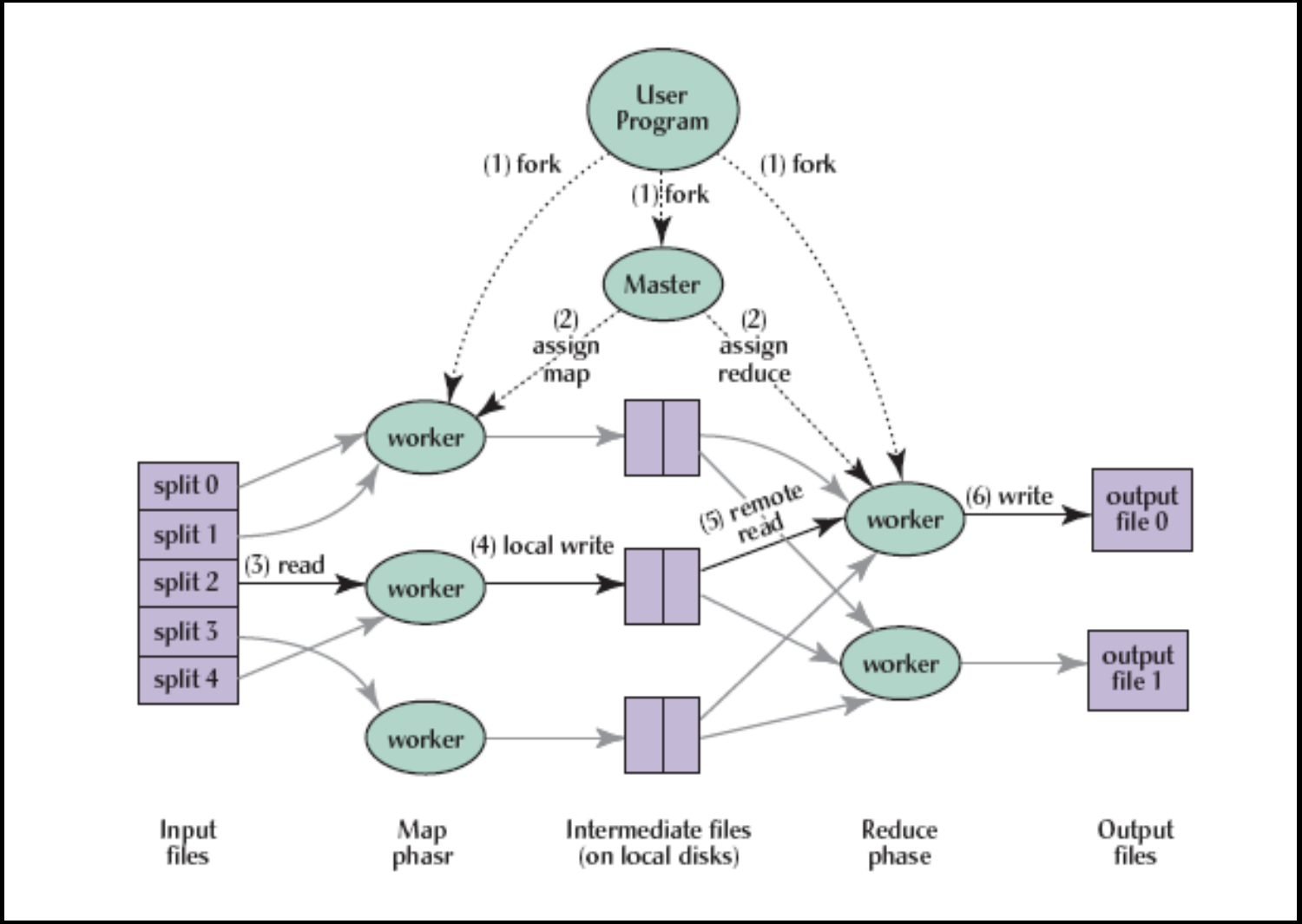
Ashwin J Mathew Spring 2008
School of Information, UC Berkeley

Potential

By abstracting away the very concept of looping, you can implement looping any way you want, including implementing it in a way that scales nicely with extra hardware.

- Joel Spolsky

Distributed Map/Reduce



From MapReduce: Simplified Data Processing on Large Clusters by Dean and Ghemawat

Ashwin J Mathew Spring 2008
School of Information, UC Berkeley

Introducing Apache Hadoop

- Originally part of the Apache Lucene search engine project
- Distributed Map/Reduce engine
- Used for distributed indexing by Apache Nutch web search engine

Benefits + Considerations

- Simpler, smaller map/reduce job implementations
- More complex, distributed map/reduce engine
- Scales based on hardware and map/reduce engine implementation
- Limited network capacity -> Locality of data
- Anticipate slow and failed workers

Yahoo's Hadoop Clusters

- We have ~10,000 machines running Hadoop
- Our largest cluster is currently 2000 nodes
- 1 petabyte of user data (compressed, unreplicated)
- We run roughly 10,000 research jobs / week

Presentation to Berkeley RAD Lab by O'Malley and Baldeschwieler