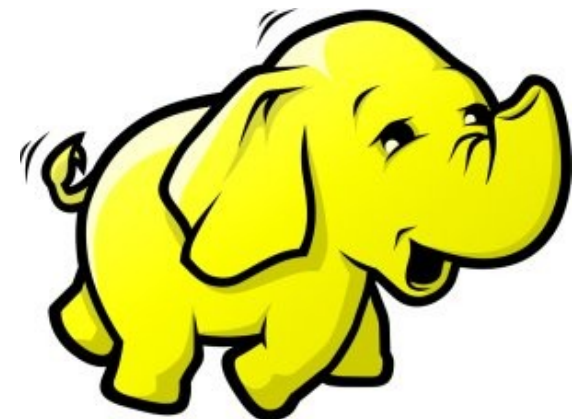




# Hadoop 簡介：源起與術語

*Introduction to Hadoop : History and Terminology*

**Jazz Wang**  
**Yao-Tsung Wang**  
**jazz@nchc.org.tw**



# *What is Hadoop ?*

用一句話解釋 **Hadoop** 是什麼??

*Hadoop is a **software platform** that lets one easily write and run applications that **process vast amounts of data.***

*Hadoop* 是一個讓使用者簡易撰寫並執行處理海量資料應用程式的軟體平台。

亦可以想像成一個處理海量資料的生產線，只須學會定義 **map** 跟 **reduce** 工作站該做哪些事情。

# *Features of Hadoop ...*

## **Hadoop 這套軟體的特色是 ...**

- **海量 Vast Amounts of Data**
  - 擁有儲存與處理大量資料的能力
  - Capability to **STORE** and **PROCESS** vast amounts of data.
- **經濟 Cost Efficiency**
  - 可以用在由一般 PC 所架設的叢集環境內
  - Based on large clusters built of **commodity hardware**.
- **效率 Parallel Performance**
  - 透過分散式檔案系統的幫助，以致得到快速的回應
  - With the help of HDFS, Hadoop **have better performance**.
- **可靠 Robustness**
  - 當某節點發生錯誤，能即時自動取得備份資料及佈署運算資源
  - Robustness to add and remove computing and storage resource without shutdown entire system.

# *Founder of Hadoop – Doug Cutting*

**Hadoop** 這套軟體的創辦人 **Doug Cutting**

Doug Cutting Talks About The Founding Of Hadoop

clouderahadoop

9 部影片

編輯訂閱項目

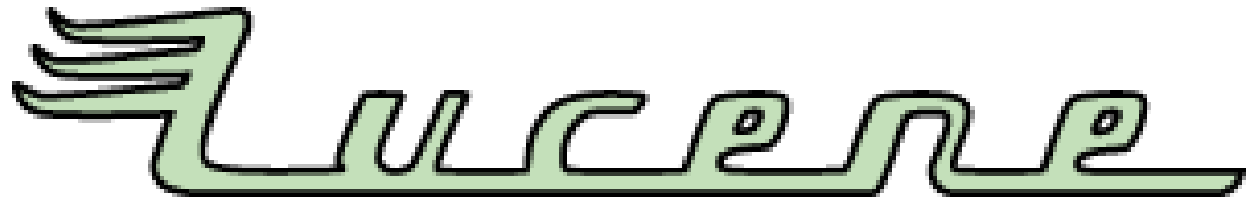


Doug Cutting Talks About The Founding Of Hadoop

<http://www.youtube.com/watch?v=qxC4urJOchs>

# History of Hadoop ... 2002~2004

## Hadoop 這套軟體的歷史源起 ... 2002~2004



- Lucene

- <http://lucene.apache.org/>
- 用 Java 設計的高效能文件索引引擎 API
- a high-performance, full-featured **text search engine library** written entirely in **Java**.
- 索引文件中的每一字，讓搜尋的效率比傳統逐字比較還要高的多
- Lucene create an **inverse index** of every word in different documents. It enhance performance of text searching.

# History of Hadoop ... 2002~2004

## Hadoop 這套軟體的歷史源起 ... 2002~2004

- Nutch



- <http://nutch.apache.org/>
- Nutch 是基於開放原始碼所開發的網站搜尋引擎
- Nutch is open source web-search software.
- 利用 Lucene 函式庫開發
- It builds on Lucene and Solr, adding web-specifics, such as a crawler, a link-graph database, parsers for HTML and other document formats, etc.



# Three Gifts from Google ....

## 來自 Google 的三個禮物 ....

- Nutch 後來遇到儲存大量網站資料的瓶頸
- Nutch encounter storage issue
- Google 在一些會議分享他們的三大關鍵技術
- Google shared their design of web-search engine
  - SOSP 2003 : “The Google File System”
  - <http://labs.google.com/papers/gfs.html>
  - OSDI 2004 : “MapReduce : Simplified Data Processing on Large Cluster”
  - <http://labs.google.com/papers/mapreduce.html>
  - OSDI 2006 : “Bigtable: A Distributed Storage System for Structured Data”
  - <http://labs.google.com/papers/bigtable-osdi06.pdf>



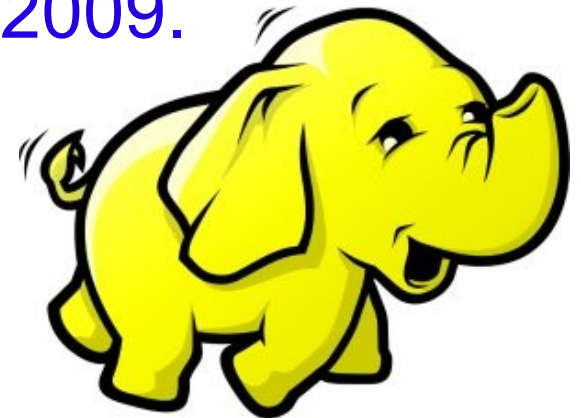
# ***History of Hadoop ... 2004 ~ Now***

## ***Hadoop 這套軟體的歷史源起 ... 2004 ~ Now***

- Dong Cutting reference from Google's publication
- Added DFS & MapReduce implement to Nutch
- According to **user feedback** on the mail list of Nutch ....
- Hadoop became separated project **since Nutch 0.8**
- Nutch DFS → Hadoop Distributed File System (HDFS)
- **Yahoo** hire Dong Cutting to build a team of web search engine at **year 2006**.
  - Only **14 team members** (engineers, clusters, users, etc.)
- Dong Cutting joined Cloudera at year 2009.

**YAHOO!**

 **cloudera**





# Who Use Hadoop ??

## 有哪些公司在用 **Hadoop** 這套軟體 ??

- **Yahoo** is the key contributor currently.
- **IBM** and **Google** teach Hadoop in universities ...
- [http://www.google.com/intl/en/press/pressrel/20071008\\_ibm\\_univ.html](http://www.google.com/intl/en/press/pressrel/20071008_ibm_univ.html)
- **The New York Times** used **100 Amazon EC2 instances** and a Hadoop application to process **4TB of raw image TIFF data** (stored in S3) into **11 million finished PDFs** in the space of **24 hours** at a computation cost of about **\$240** (not including bandwidth)
  - from <http://en.wikipedia.org/wiki/Hadoop>
- <http://wiki.apache.org/hadoop/AmazonEC2>
- <http://wiki.apache.org/hadoop/PoweredBy>
  - A9.com
  - ADSDAQ by Contextweb
  - EHarmony
  - Facebook
  - Fox Interactive Media
  - IBM
  - ImageShack
  - ISI
  - Joost
  - Last.fm
  - Powerset
  - The New York Times
  - Rackspace
  - Veoh
  - Metaweb

# Performance improvement of Hadoop

## Hadoop 過去幾年的效能改進 (from Yahoo)

年份	日期	節點數	耗時 ( 小時 )
2006	四月	188	47.9
2006	五月	500	42
2006	十一月	20	1.8
2006	十一月	100	3.3
2006	十一月	500	5.2
2006	十一月	900	7.8
2007	七月	20	1.2
2007	七月	100	1.3
2007	七月	500	2
2007	七月	900	2.5

Sort benchmark, every nodes with terabytes data.

# *Hadoop in production run ....*

## 商業運轉中的 **Hadoop** 應用 ....

- **February 19, 2008**
- **Yahoo! Launches World's Largest Hadoop Production Application**
- <http://developer.yahoo.net/blogs/hadoop/2008/02/yahoo-worlds-largest-production-hadoop.html>

Number of links between pages in the index	roughly 1 trillion links
Size of output	over 300 TB, compressed!
Number of cores used to run single Map-Reduce job	over 10,000
Raw disk used in the production cluster	over 5 Petabytes

# *Hadoop in production run ....*

## 商業運轉中的 **Hadoop** 應用 ....

- **September 30, 2008**
- **Scaling Hadoop to 4000 nodes at Yahoo!**
- [http://developer.yahoo.net/blogs/hadoop/2008/09/scaling\\_hadoop\\_to\\_4000\\_nodes\\_a.html](http://developer.yahoo.net/blogs/hadoop/2008/09/scaling_hadoop_to_4000_nodes_a.html)

<b>Total Nodes</b>	<b>4000</b>
<b>Total cores</b>	<b>30000</b>
<b>Data</b>	<b>16PB</b>

	<b>500-node cluster</b>		<b>4000-node cluster</b>	
	<b>write</b>	<b>read</b>	<b>write</b>	<b>read</b>
<b>number of files</b>	990	990	14,000	14,000
<b>file size (MB)</b>	320	320	360	360
<b>total MB processes</b>	316,800	316,800	5,040,000	5,040,000
<b>tasks per node</b>	2	2	4	4
<b>avg. throughput (MB/s)</b>	<b>5.8</b>	<b>18</b>	<b>40</b>	<b>66</b>

# Comparison between Google and Hadoop

## Google 與 Hadoop 的比較表

<b>Develop Group</b>	Google	Apache
<b>Sponsor</b>	Google	Yahoo, Amazon
<b>Algorithm Method</b>	MapReduce	MapReduce
<b>Resource</b>	open document	open source
<b>File System (MapReduce)</b>	GFS	HDFS
<b>Storage System (for structure data)</b>	big-table	HBase
<b>Search Engine</b>	Google	Nutch
<b>OS</b>	Linux	Linux / GPL

# Why should we learn Hadoop ?

## 為何需要學習 **Hadoop ??**

[Search Jobs](#) [Browse Jobs](#) [Local Jobs](#) [Salaries](#) [Employment Trends](#)

**simply**hired<sup>®</sup>

job search made simple

Employment Trends

Xen, Hyper-V, Hadoop

Tip: You can compare trends by separating them with commas.

Xen, Hyper-v, Hadoop Trends



### Xen, Hyper-v, Hadoop Job Trends

This graph displays the percentage of jobs with your search terms anywhere in the job listing. Since November 2008, the following has occurred:

- [Xen jobs](#) increased 141%
- [Hyper-v jobs](#) increased 551%
- [Hadoop jobs](#) did not change or there is no data available

## 1. Data Explore

資訊大爆炸

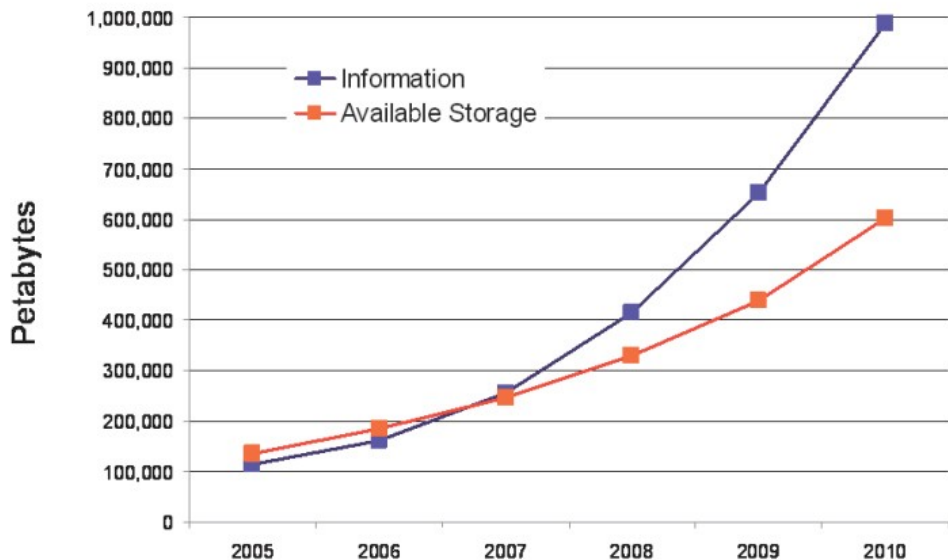
## 2. Data Mining Tool

方便作資料探勘的工作

## 3. Looking for Jobs

好找工作 !!

# Information Versus Available Storage



Source: <http://www.emc.com/collateral/analyst-reports/expanding-digital-idc-white-paper.pdf>

Source: IDC, 2007

# 2007 Data Explore

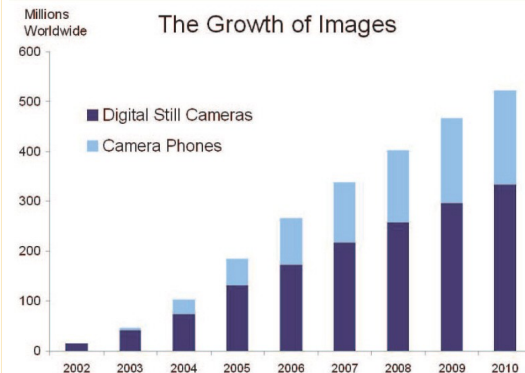
- Top 1 : Human Genomics – 7000 PB / Year
- Top 2 : Digital Photos – 1000 PB+/ Year
- Top 3 : E-mail (no Spam) – 300 PB+ / Year

The Worldwide Growth of eMail

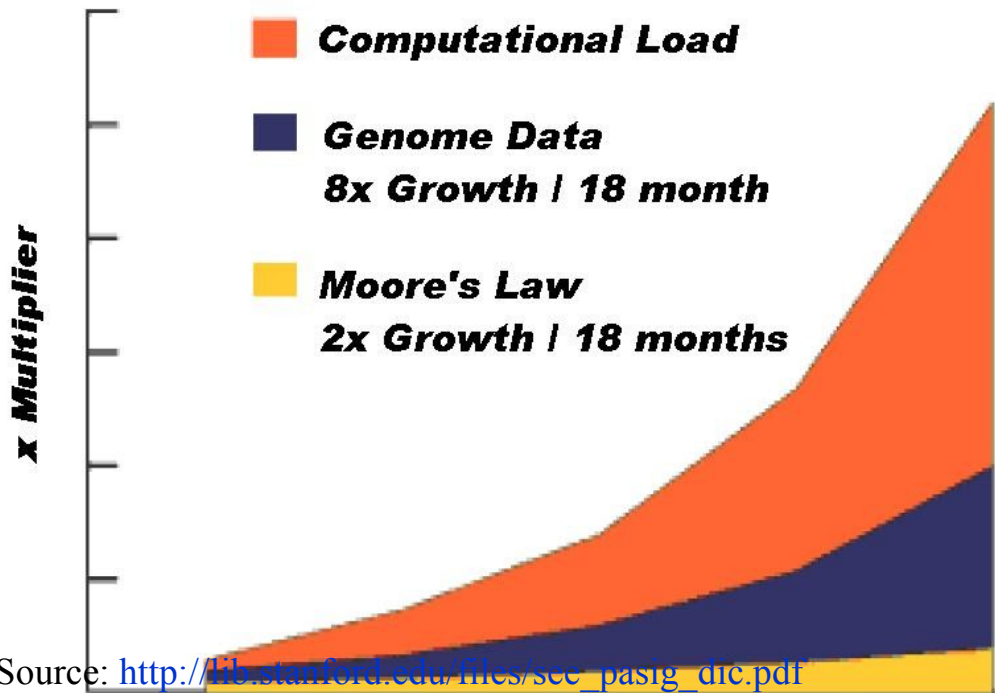


Source: IDC, 2007

The Growth of Images



Source: IDC, 2007



Source: [http://lib.stanford.edu/files/sec\\_pasig\\_idc.pdf](http://lib.stanford.edu/files/sec_pasig_idc.pdf)

Particle Physics Large Hadron Collider (15PB)	Human Genomics (7000PB) 1GB / person 200PB+ captured 200% CAGR	World Wide Web (~1PB)	Wikipedia (10GB) 100% CAGR
Annual Email Traffic, no spam (300PB+)	Internet Archive (1PB+)	Estimated On-line RAM in Google (8PB)	Personal Digital Photos (1000PB+) 100% CAGR
200 of London's Traffic Cams (8TB/day)	2004 Walmart Transaction DB (500TB)	Typical Oil Company (350TB+)	Merck Bio Research DB (1.5TB/qtr)
UPMC Hospitals Imaging Data (500TB/yr)	MIT Babytalk Speech Experiment (1.4PB)	Terashake Earthquake Model of LA Basin (1PB)	One Day of Instant Messaging in 2002 (750GB)
Total digital data to be created this year <b>270,000PB</b> (IDC)			

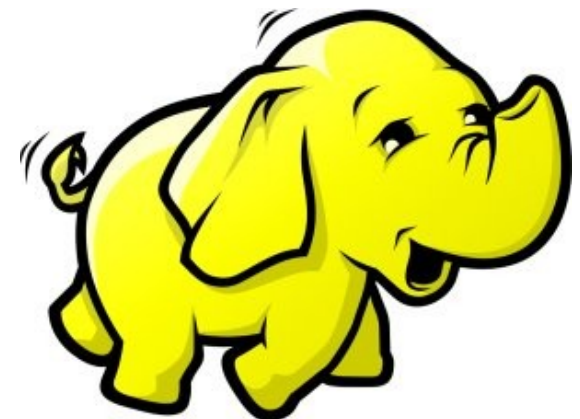
Phillip B. Gibbons, Data-Intensive Computing Symposium



# Hadoop 專業術語

*Introduction to Hadoop Terminology*

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# Two Key Elements of Operating System

## 作業系統兩大關鍵組成元素

Scheduler  
程序排程



File System  
檔案系統



# Terminologies of Hadoop

## Hadoop 文件中的專業術語

- Job
  - 任務
- Task
  - 小工作
- JobTracker
  - 任務分派者
- TaskTracker
  - 小工作的執行者
- Client
  - 發起任務的客戶端
- Map
  - 應對
- Reduce
  - 總和



- Namenode
  - 名稱節點
- Datanode
  - 資料節點
- Namespace
  - 名稱空間
- Replication
  - 副本
- Blocks
  - 檔案區塊 (64M)
- Metadata
  - 屬性資料



# *Two Key Roles of HDFS*

## **HDFS** 軟體架構的兩種關鍵角色

### 名稱節點 **NameNode**

- **Master Node**
- **Manage NameSpace of HDFS**
- **Control Permission of Read and Write**
- **Define the policy of Replication**
- **Audit and Record the NameSpace**
- **Single Point of Failure**

### 資料節點 **DataNode**

- **Worker Nodes**
- **Perform operation of Read and Write**
- **Execute the request of Replication**
- **Multiple Nodes**

# *Two Key Roles of Job Scheduler*

## *程序排程的兩種關鍵角色*

### *JobTracker*

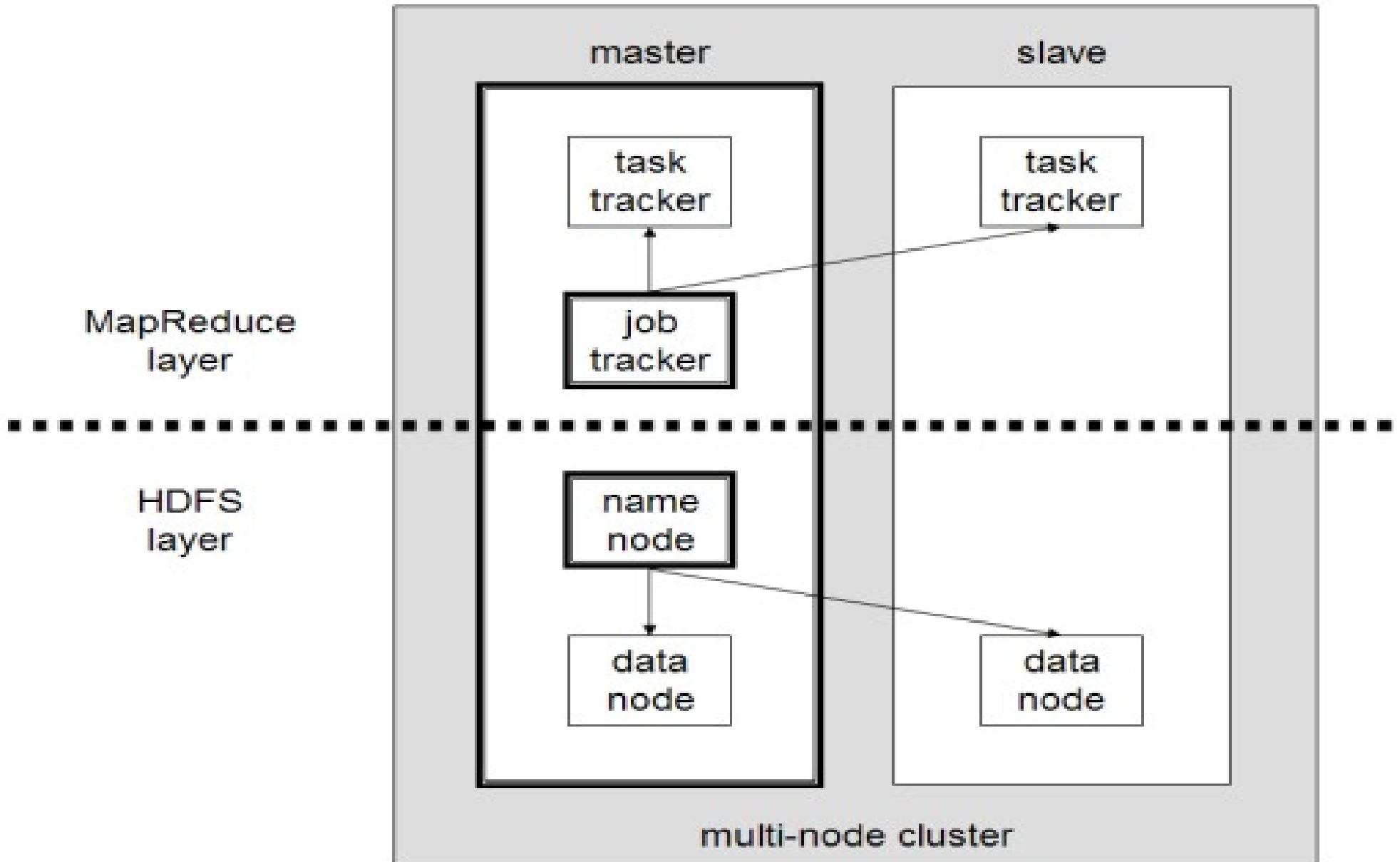
- **Master Node**
- **Receive Jobs from Hadoop Clients**
- **Assigned Tasks to TaskTrackers**
- **Define Job Queuing Policy, Priority and Error Handling**
- **Single Point of Failure**

### *TaskTracker*

- **Worker Nodes**
- **Excute Mapper and Reducer Tasks**
- **Save Results and report task status**
- **Multiple Nodes**

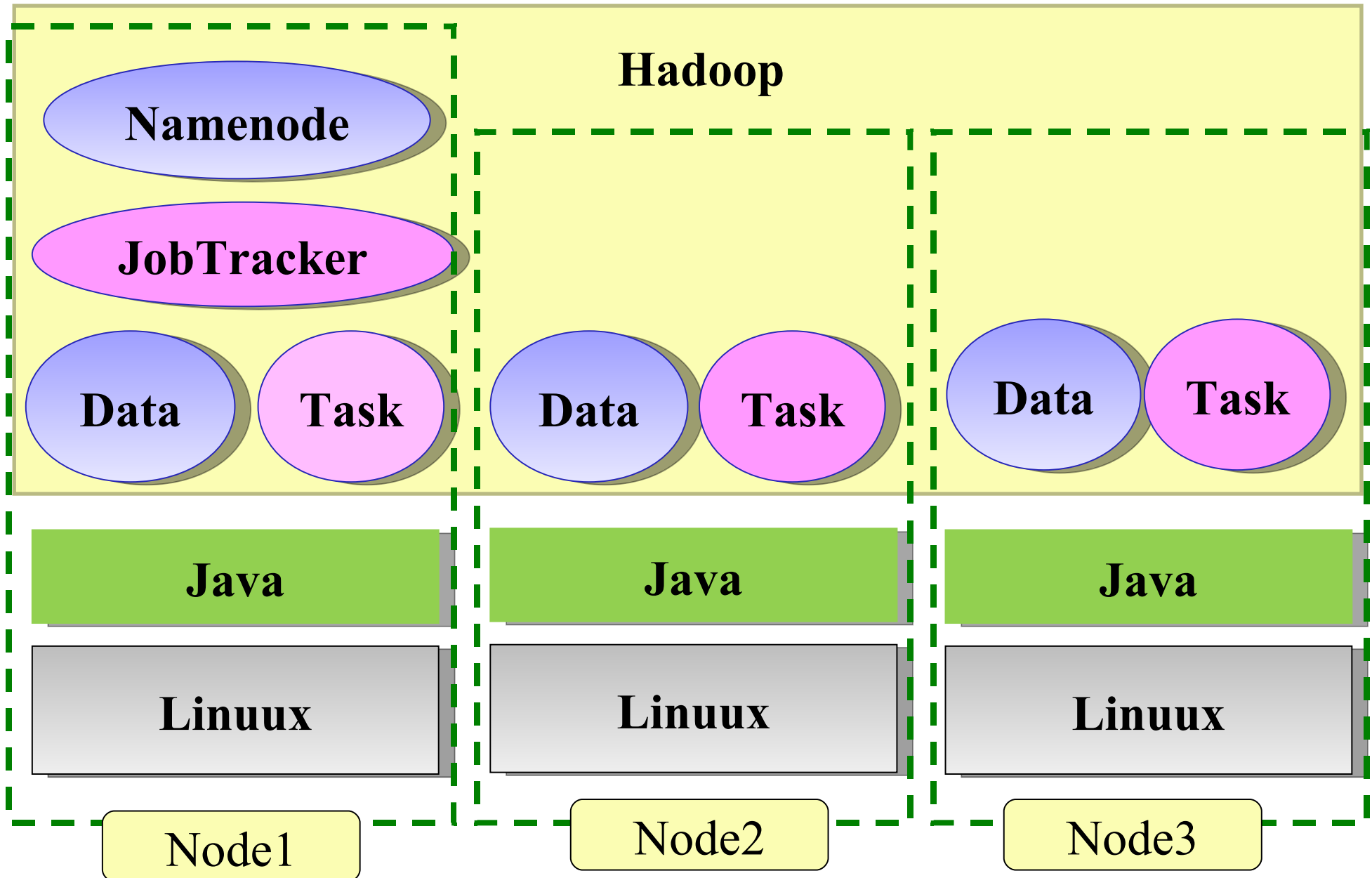
# *Different Roles of Hadoop Architecture*

## **Hadoop** 軟體架構中的不同角色



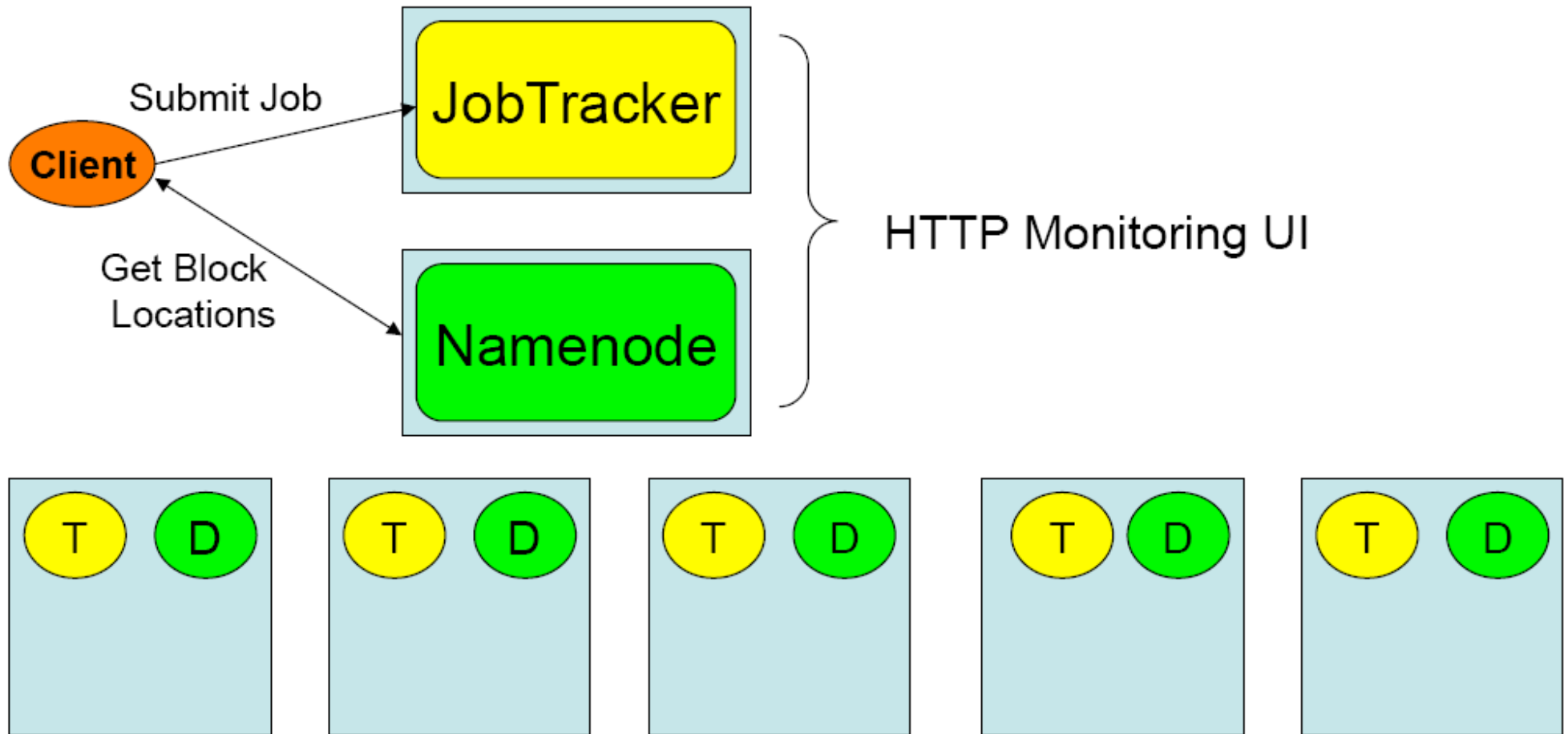
# Distributed Operating System of Hadoop

**Hadoop** 建構成一個分散式作業系統



# About Hadoop Client ...

## 不在雲裡的 **Hadoop Client**



# What we learn today ?

## WHAT

**Hadoop 是運算海量資料的軟體平台 !!**

hadoop is a software platform to process vast amount of data!!

## WHO

始祖是 Doug Cutting，Apache 社群支持，Yahoo 贊助  
From Doug Cutting to Apache Community, Yahoo and more !

## WHEN

**Hadoop 是 2004 年從 Nutch 分裂出來的專案 !!**

Hadoop became separate project since year 2004 !!

## WHY

資料大爆炸、資料探勘、找工作  
***Data Explore, Data Mining, Jobs !!***

## HOW

**採用自由軟體也能打造私有雲端**

Install on large clusters built of commodity hardware !!





## **Questions?**

***Slides - <http://trac.nchc.org.tw/cloud>***

***Jazz Wang***  
***Yao-Tsung Wang***  
***jazz@nchc.org.tw***



Powered by **DRBL**