

IT4371: Distributed Systems

Spring 2016

Overview and Introduction

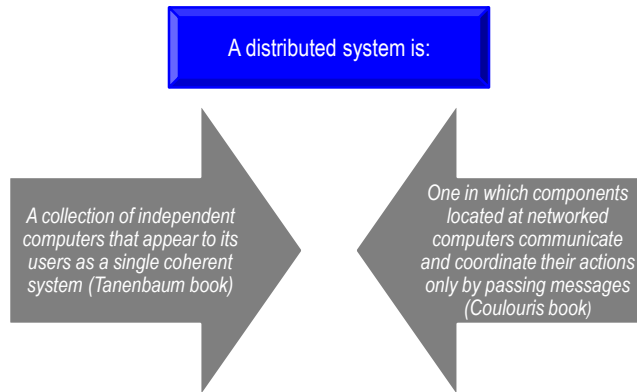
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Why should you Study Distributed Systems?

Application Domain	Associated Networked Application
<i>Finance and commerce</i>	eCommerce e.g. Amazon and eBay, PayPal, online banking and trading
<i>The information society</i>	Web information and search engines, ebooks, Wikipedia; social networking: Facebook and MySpace.
<i>Creative industries and entertainment</i>	online gaming, music and film in the home, user-generated content, e.g. YouTube, Flickr
<i>Healthcare</i>	health informatics, on line patient records, monitoring patients
<i>Education</i>	e-learning, virtual learning environments; distance learning
<i>Transport and logistics</i>	GPS in route finding systems, map services: Google Maps, Google Earth
<i>Science</i>	The Grid as an enabling technology for collaboration between scientists
<i>Environmental management</i>	sensor technology to monitor earthquakes, floods or tsunamis

Definition of a Distributed System



Why Distributed Systems?

Scale

- Processing
- Data

Diversity in Application Domains

Collaboration

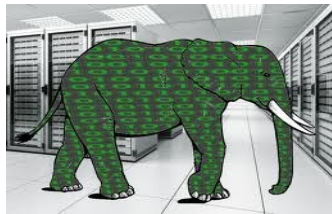
Cost

Why Distributed Systems?

A. *Big data* continues to grow:

- In mid-2010, the information universe carried 1.2 zettabytes and 2020 predictions expect nearly 44 times more at 35 zettabytes coming our way.

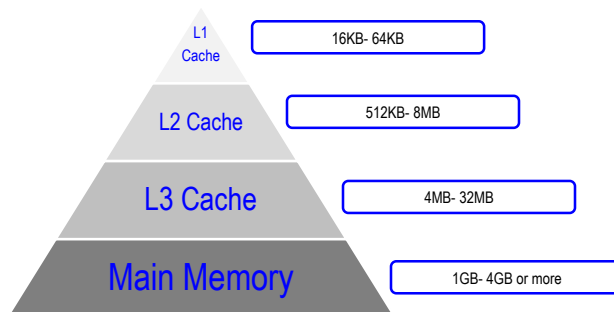
B. Applications are becoming *data-intensive*.



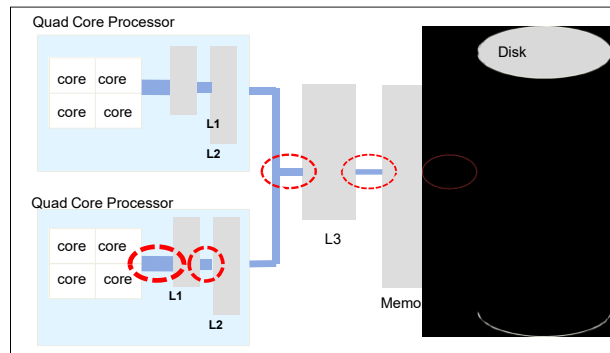
Why Distributed Systems?

C. Individual computers have limited resources compared to scale of current day problems & application domains:

1. Caches and Memory:



Blade Performance

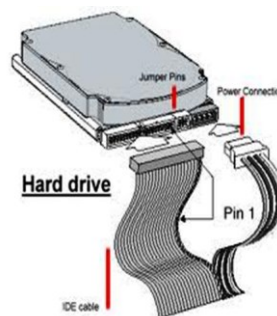


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Why Distributed Systems?

2. Hard Disk Drive:

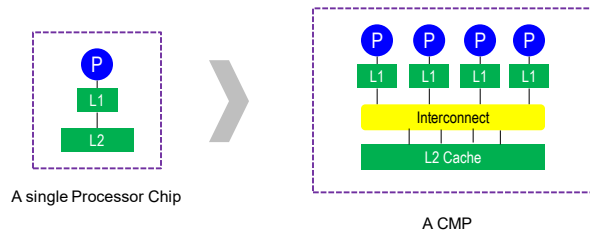
- Limited capacity
- Limited number of channels
- Limited bandwidth



Why Distributed Systems?

3. Processor:

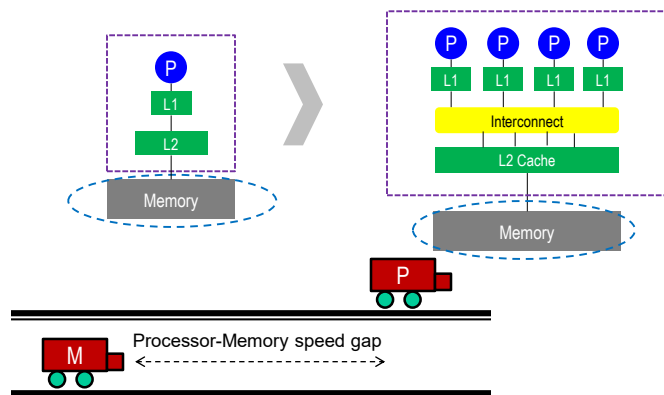
- The number of transistors that can be integrated on a single die has continued to grow at Moore's pace.
- Chip Multiprocessors (CMPs) are now available



Why Distributed Systems?

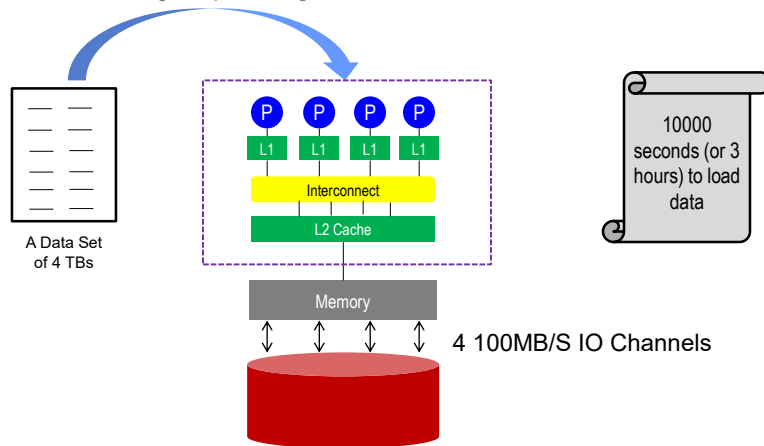
3. Processor (cont'd):

- Up until a few years ago, CPU speed grew at the rate of 55% annually, while the memory speed grew at the rate of only 7% [HP report].

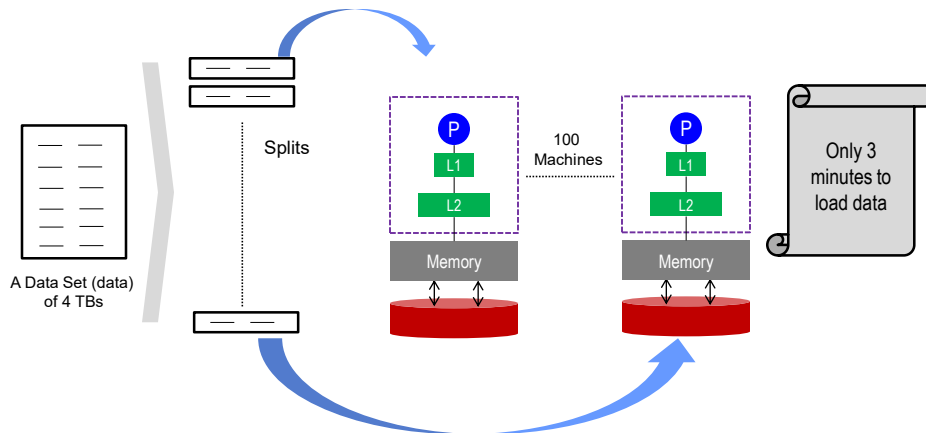


Why Distributed Systems?

- Even if 100s or 1000s of cores are placed on a CMP, it is a challenge to deliver input data to these cores fast enough for processing.



Why Distributed Systems?



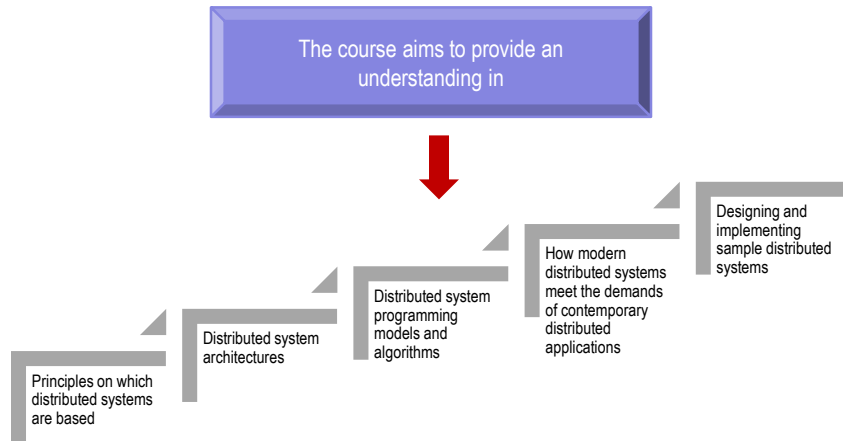
Requirements

- But this requires:
 - A way to express the problem as parallel processes and execute them on different machines ([Programming Models and Concurrency](#)).
 - A way for processes on different machines to exchange information ([Communication](#)).
 - A way for processes to cooperate, synchronize with one another and agree on shared values ([Synchronization](#)).
 - A way to enhance reliability and improve performance ([Consistency and Replication](#)).

Requirements

- But this requires (*Cont.*):
 - A way to recover from partial failures ([Fault Tolerance](#)).
 - A way to secure communication and ensure that a process gets only those access rights it is entitled to ([Security](#)).

Course Objectives



Obligatory Assessments

- **Obligatory** project : for group of students (max. 3 students/group)
 - 4 topics
- Final exam (70%)

Assignment Register Links

- Project (Obligatory)
- Register Deadline: before 12 PM, Feb 18, 2016
- Link: <https://goo.gl/bWjDtS>
- Defense: on 14th and 15th week

Text Books

□ The primary textbooks for this course are:

1. Andrew S. Tannenbaum and Maarten Van Steen, *Distributed Systems: Principles and Paradigms*, 2nd E, Pearson, 2007.
2. George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, *Distributed Systems: Concepts and Design*, 5th E, Addison Wesley, 2011
3. James E. Smith, and Ravi Nair, *Virtual Machines: Versatile Platforms for Systems and Processes*, 1st E, Morgan Kaufmann, 2005.

□ Reference Book:

4. Tom white, *Hadoop: The Definitive Guide*, 2nd E, O'Reilly Media, 2011

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Q&A