Notes on the Cloud Landscape – CSE 40822 – Cloud Computing
Prof. Douglas Thain, University of Notre Dame, January 2016

Caution: These are high level notes that I use to organize my lectures. You may find them useful for reviewing main points, but they aren’t a substitute for participating in class.

References:

• Daniel Reed and Jack Dongarra, “Exascale Computing and Big Data” Communications of the ACM, Volume 58, Number 7, DOI:10.1145/2699414
  http://cacm.acm.org/magazines/2015/7/188732-exascale-computing-and-big-data/fulltext

The term “cloud” is very broad and encompasses a wide variety of computing techniques. Some of them have been around for a long time (e.g. distributed computing) while others are relatively new (pay-as-you-go).

Some key aspects of cloud computing:
(but not everything called “cloud” has all of these)

  Centralized Data Center
  Pay-as-You-Go
  Interoperability
  Services, not Programs
  Resource Virtualization
  Distributed/Parallel Computing

A Brief History of Computing

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainframes</td>
<td>Centralized</td>
<td>(MULTICS-Utility Computing)</td>
</tr>
<tr>
<td>Minicomputers</td>
<td>In Between</td>
<td>(VAX/VMS + Terminals)</td>
</tr>
<tr>
<td>Personal Computers</td>
<td>Distributed</td>
<td>(IBM PCs)</td>
</tr>
<tr>
<td>Networks of Workstations</td>
<td>In Between</td>
<td>(Sun + NFS, PCs + Novell)</td>
</tr>
<tr>
<td>Internet and Peer to Peer</td>
<td>Distributed</td>
<td></td>
</tr>
<tr>
<td>Grid Computing</td>
<td>Distributed Data Centers</td>
<td></td>
</tr>
<tr>
<td>Cloud Computing</td>
<td>Centralized</td>
<td></td>
</tr>
</tbody>
</table>

Many aspects of computing writ large can be seen as pendulum that swing from one extreme to another with both technology and society. Centralization/Distribution is one of these pendulums.
Cloud Architecture Layers
- Physical Resources
- Virtualized Resources
- Cloud Software (Middleware, Operating System)
- Applications
- Web Interface
- End User

(Note the comparison of architectures in the Reed paper!)

Layers of Service Delivery
- IaaS – e.g. Intel Machines
- PaaS – e.g. Linux Maciness
- SaaS – e.g. Hadoop Installation

How does this change things for IT and business as a whole?

- Provision Business Functions
- Replicate Configurations Accurately
- High Throughput Computing
- Match Resources to Load (Friendster vs Facebook)
- Data Analytics - Compute Close to Data
- Store Configurations
- Backup, Reliability, Availability
- Software Development for Services

Cloud and related terms:

- Cloud - Clients access big remote services.
- Grid - Multiple sites interoperating.
- Cluster - Everything in one room.
- Parallel - Everything on one backplane.
- Multithreaded - Everything on one chip.
- Exascale – High performance computing >= 1 Exa-Flop per Second
- Big Data – Volume, Variety, Velocity.

Cloud on the Hype Cycle

Notice “hybrid clouds” in the trough of disillusionment!