INTRODUCTION TO CLOUD COMPUTING

CIT 3400

LECTURE 3

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LECTURER COMPUTER SCIENCE

CLOUD COMPUTING CHARACTERISTICS

- So what are its characteristics?
  - Described as: On-demand computing, pay as you go, software as a service, utility computing
  - Usually costs, but cost-effective
  - Virtualization
  - Scalable (expand on current hardware)
  - Elastic (dynamically add hardware as needed)
  - Distributed and highly parallel approach
  - Emphasizes availability
  - Replication, replication, replication …

VIRTUALIZATION

- What is virtualization? Read: KVM paper
  - Software implementation of a computer that executes programs like a physical machine
  - Installation of one machine runs on another
  - All software runs on a server within virtual machine
  - AMD-Virtualization and Intel Virtualization Technologies (IVT) extensions made it possible
- Why is it useful?
  - ***Abstracts hardware so software stacks can be deployed without tied to specific physical server***

VIRTUALIZATION

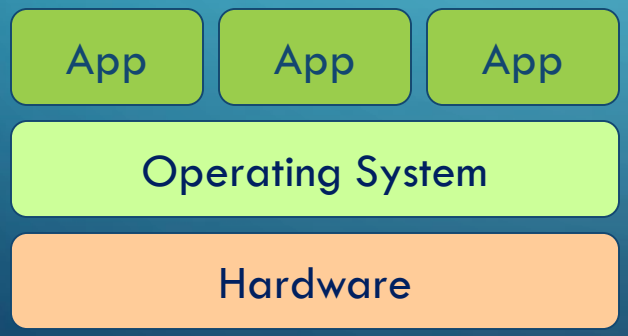
- Can
  - Share computer among multiple users
  - Run applications and different operating systems on same machine
  - Isolate users from each other and control program
  - Emulate software and/or hardware for the guest os
- Full virtualization
  - First appeared in 1967 with IBM CP-40 system
  - **Complete** installation of one machine runs on another
  - emulate entire system

VIRTUALIZATION

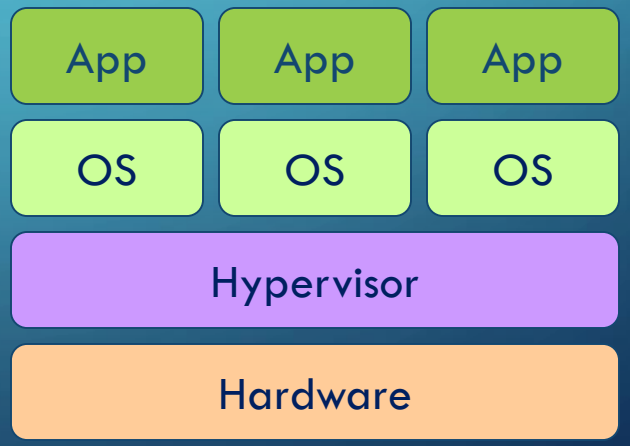
- **Virtual Machine VM**
  - isolated guest OS installation within a normal host OS
  - Runs on top of the OS of the server machine
  - Object of deployment
- **Virtual Machine Image –**
  - Static data containing software (OS, apps, data files) the VM will run once started
  - Used to create VM instance
  - Typically stored on disk
- **Virtual Machine Instance –**
  - Running virtual machine
  - Started from image, runs OS and processes, computes, etc.
  - dynamic object you can interact with
  - snapshot of a VM at a given time

VIRTUALIZATION

- Hypervisor – Virtual Machine Manager VMM
  - One level higher than supervisory program
  - Installed directly on server hardware or run within an OS
- Easily create copies of existing environments
  - Can exist on same servers or different machines
  - Single server multiple OS instances, minimize CPU idle time



Traditional Stack



Virtualized Stack

VIRTUALIZATION

- Application needs a VM on which to run in a cloud
- Application will be associated with that VM
- Entire user interface resides in single window
  - Provide all facilities of OS inside a browser
- Program must continue running even as number of users grows
- Communication model is many-to-many

VIRTUALIZATION

- **Virtual Appliance** – pre-configured virtual machine that includes software partially or fully configured to perform a specific task
- Built to host a single application
- VMs are **deployed** – copy image from Appliance Library to machine (hypervisor) with specific Virtual Appliance configuration

PARAVIRTUALIZATION

- Full virtualization may not be efficient
- Paravirtualization instead
  - Doesn't emulate entire system like in full (e.g. BIOS, drive)
  - uses resources efficiently
  - OS adjusted to work in virtual machine
  - Better performance, only emulate some elements

FULL VS PARA?

- Seems like full virtualization is still dominant
- If guest OS is same as host OS, can share the kernel
- Windows runs unmodified as a guest OS, but paravirtualization open-source drivers are being developed

AMAZON

- Amazon Machine Images (AMI) use 2 types of virtualization:
  - Paravirtual PV
    - PV guests can run on host hardware that does not have explicit support for virtualization.
    - Can't take advantage of special hardware extensions such as enhanced networking or GPU processing
  - Hardware Virtual Machine HVM
    - Presents vm with fully virtualized set of hardware
    - No modification of the guest operating system
    - Guest os runs as if it were on the bare-metal hardware

AMAZON

- Only Linux AMIs can us PV
  - Used to have better performance than HVM but no longer true
- Linux and Windows AMIs can use HVM
  - Same as if OS run on a bare metal machine
  - Take advantage of hardware extension to provide fast access to underlying hardware on host

AMAZON

- Micro instance doesn't imply more paravirtualization

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SCALABLE

- Use what you need
  - Hardware, platform (OS), software
- Cloud computing is not one-size-fits-all
- Company has a temporary surge in business, use cloud instead of invest in new computing equipment

(*because of virtualization*)