Microservices and DevOps

DevOps and Container Technology
Virtualization

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What is it?

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- **vir•tu•al (adj):**
  - **existing in essence or effect, though not in actual fact**

- Example
  - *ScummVM is a program which allows you to run certain classic graphical point-and-click adventure games, provided you already have their data files. The clever part about this: ScummVM just replaces the executables shipped with the games, allowing you to play them on systems for which they were never designed!*

A Physical Machine
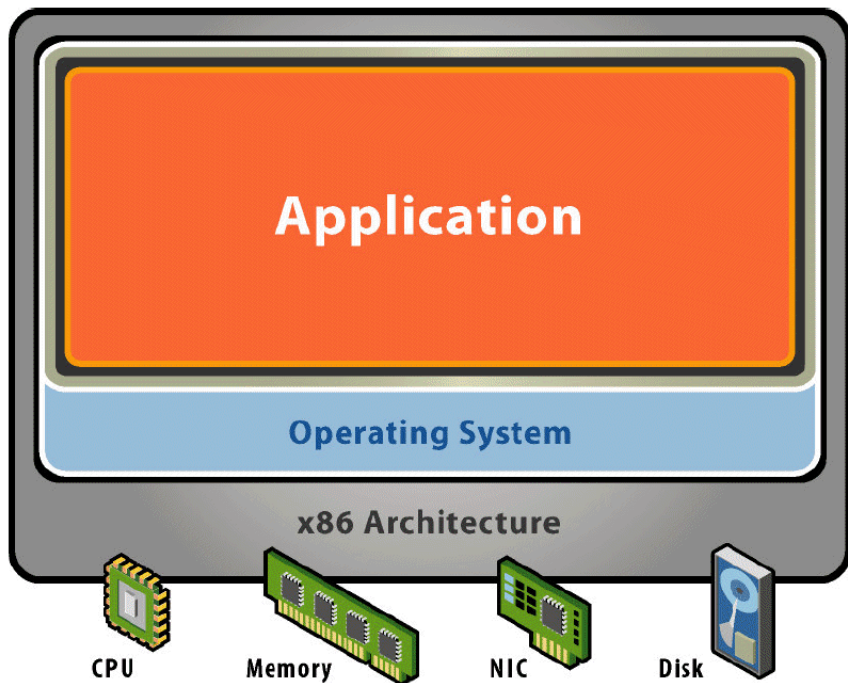
- Hardware
  - Processors, devices, memory, etc.

- Software
  - Built to the given hardware (**Instruction Set Architecture**, e.g. x86)
  - Built to given OS (**App. Programming Interface**, e.g. Win XP)
  - OS controls hardware

A Virtual Machine

- **Hardware Abstraction**
  - Virtual processor, memory, devices, etc.

- **Virtualization Software**
  - Indirection: Decouple hardware and OS
  - Multiplex physical hardware across guest VMs

Smith et al.

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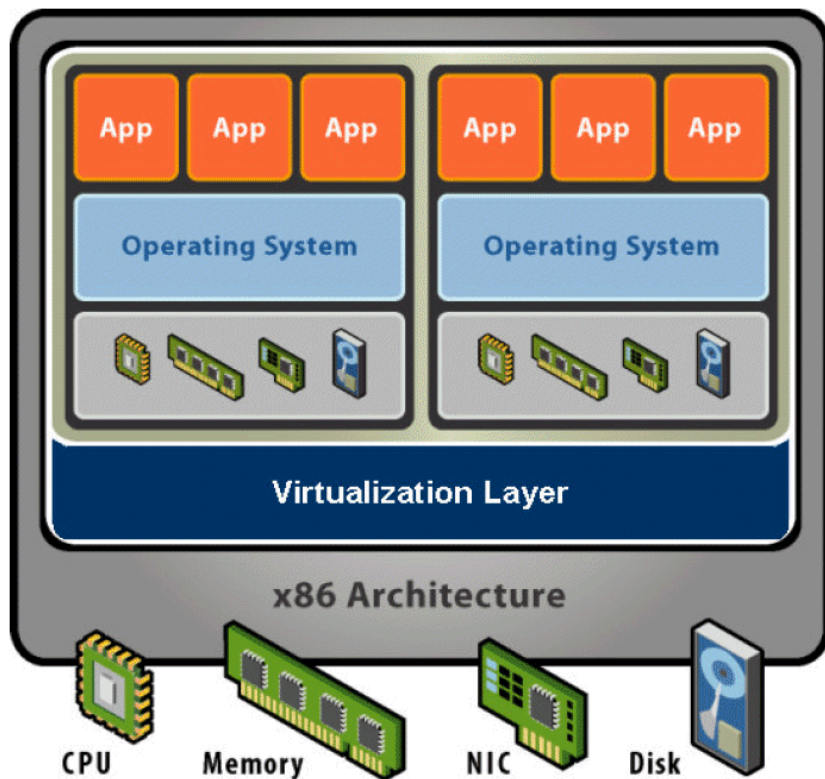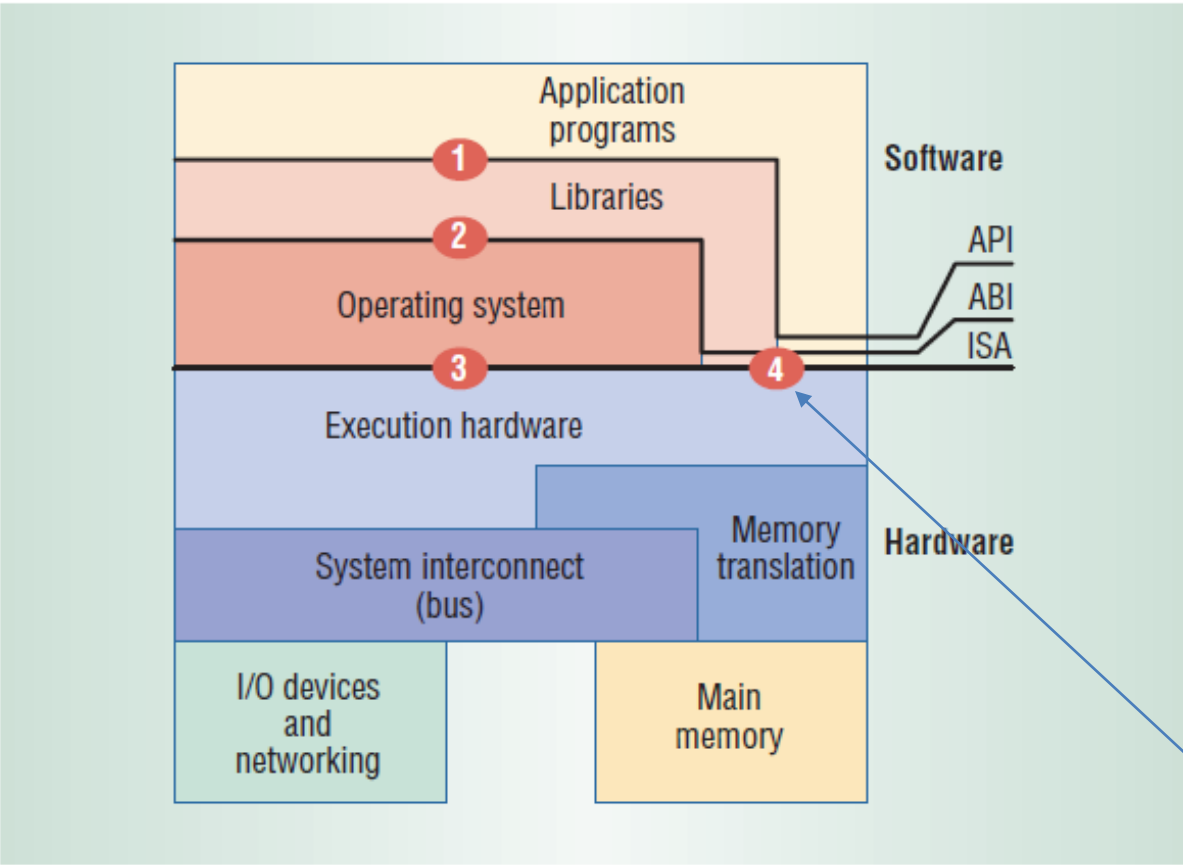
API: Library calls
Appl Progr Interface

ABI: OS calls
Appl Binary Interface

ISA: Machine Code

Kernel Mode

Why VMs?

- Many advantages (often business related)
  - Utilization of resources
    - VM1 that idles automatically free resources to VM2
      - Of course not the case for physical machines
  - Isolation
    - Crash, virus, in VM1 does not propagate to VM2
  - Encapsulation
    - A VM is a **file**: (OS ,Apps, Data, Config, run-time state)
    - Content distribution: Demos as snapshots
    - Snapshot provides recovery point
    - Migration to new physical machines by snapshot/restore
      - In e.g. server farms

Why VMs?

- More advantages
  - Maintenance costs
    - Maintain 100 Linux-based web server machines versus a few big VM platforms
  - Legacy VMs
    - Run ancient apps (like DOS or Win98 programs)
  - Create once, run anywhere
    - No configuration issues
      - E.g. complex setup of app suite of database, servers, etc.

Types of VMs

- Smith & Nair 2005

- Two super classes
  - Process VM
  - System VM

- Both can be sub classed based upon supporting virtualization of *same* or *different* ISA (Instruction Set Architecture).
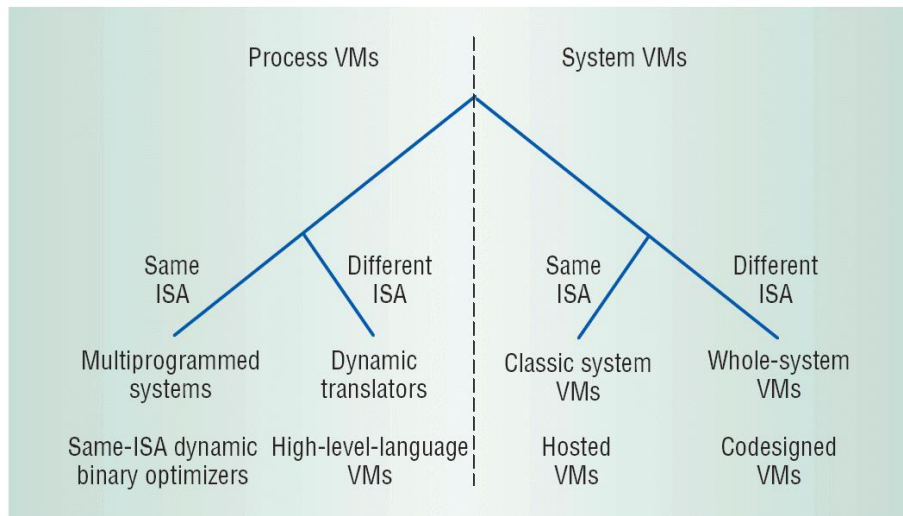
Process / System VM
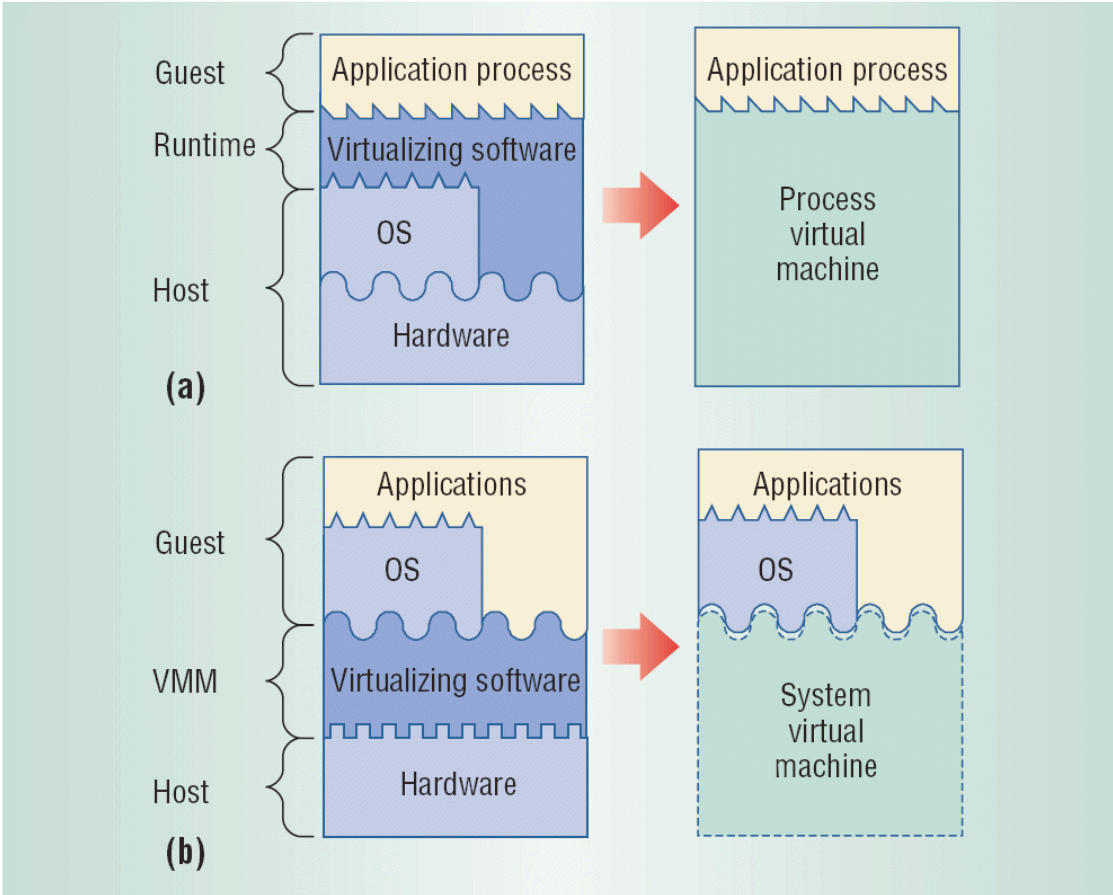
Process VM

- The **process VM** puts the virtualization border line at the *process* line.
  - A application process/program executes in a
    - Logical address space (assigned/handled by the OS)
    - Using user-level instructions and registers (CPU user-mode)
    - Only do IO using OS calls or High-Level Library(HHL) calls
- Thus a process VM becomes a ***virtual OS*** in which a process may execute.
- Example: *Different ISA Process VM*
  - JavaVM defines its own ISA (stack-based) as well as normal OS operations

- The **system VM** sets the virtualization border at the system or hardware line
  - A system/OS executes in a
    - Physical memory space
    - Using the full ISA of the underlying machine
    - Interact directly with IO
- Thus a system VM becomes a ***virtual machine*** in which a system as a whole may execute
- Example: *Same ISA System VM*
  - VMWare: Executes Guest OS that is running on the x86 ISA.

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- OS-Layer Virtualization (Sahoo, 2010), or
- *Operating System Level* virtualization
  – Merkel (2014)

- Ex:
  – *Docker*

VMs vs. Containers

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- From Docker

Traditional VMMs
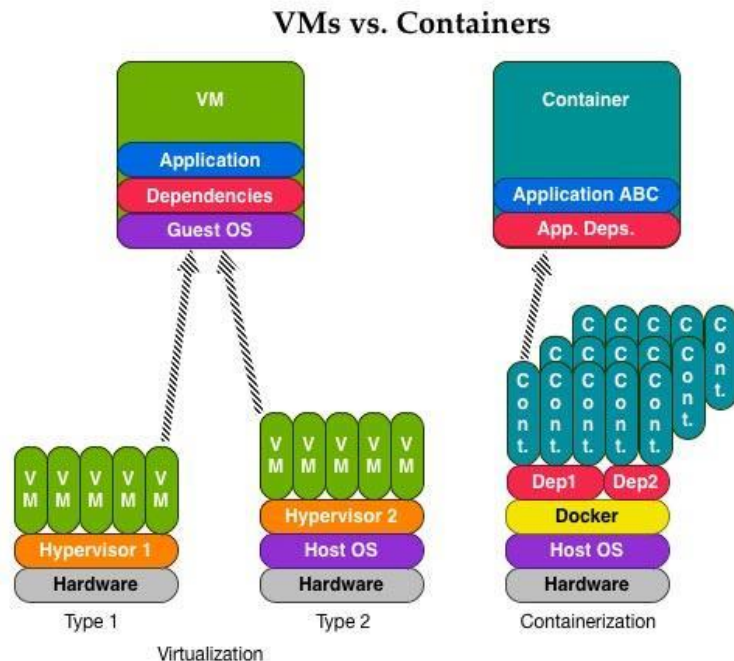
Docker
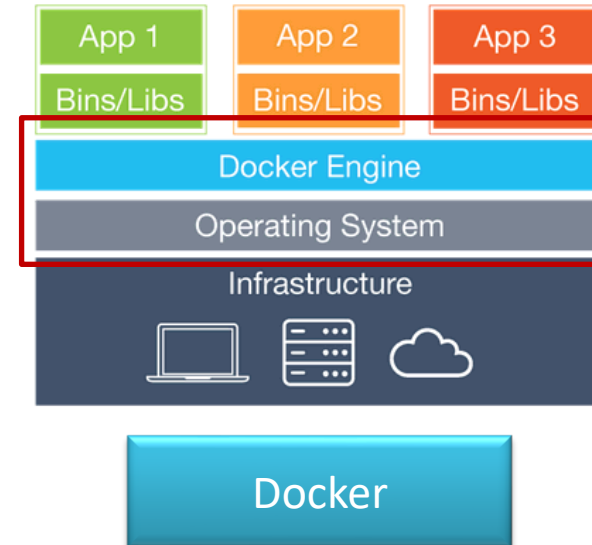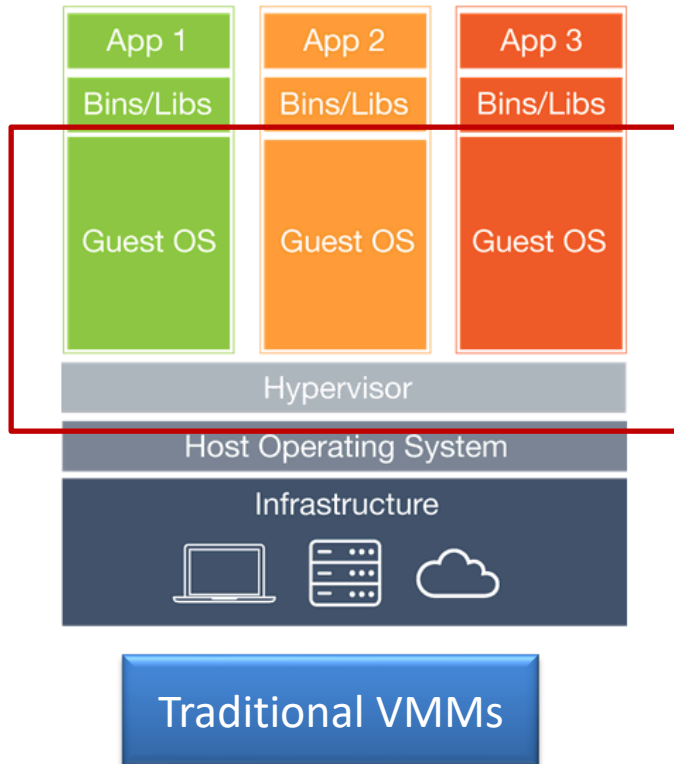
Classic Versus Hosted VMs

- **Hosted**

- VMWare Player (free) / Workstation Pro
  - Ordinary application in Linux/Windows

- **Classic (Bare metal)**

- VMWare ESXi (free of charge!)
  - Runs on the bare machine using a minimal Linux core

Examples

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Packages for Students

- For my course, I hand out a dedicated VM
  - Faster 'get going'
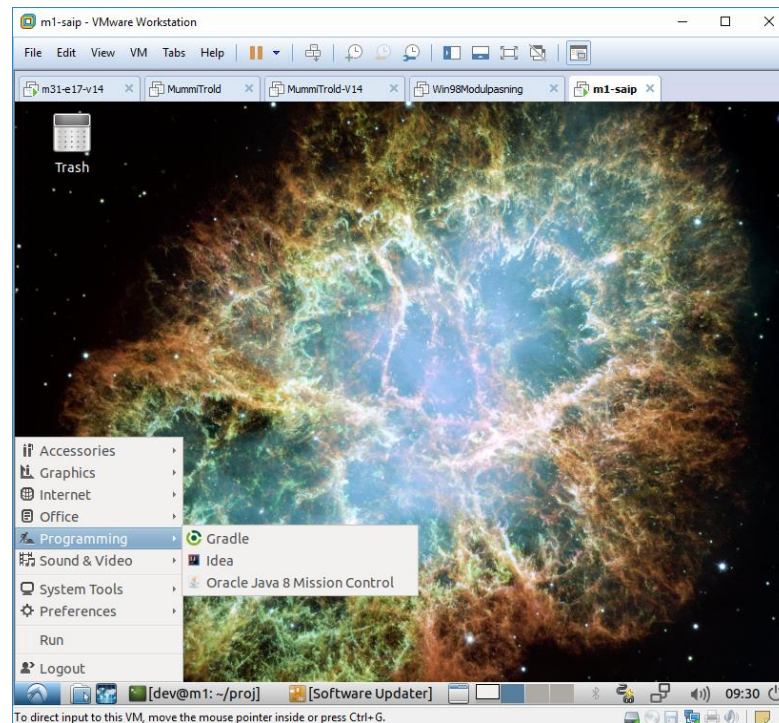
Avoid Poluted Machine

- The last couple of years I have removed code development from my laptop completely...
  - I *only* develop using my M1, M17, ... Virtual linux machines on my VMWare Workstation or on my ESXi hypervisors
    - One machine per course
      - Easier to switch
    - No *polution* of my laptop

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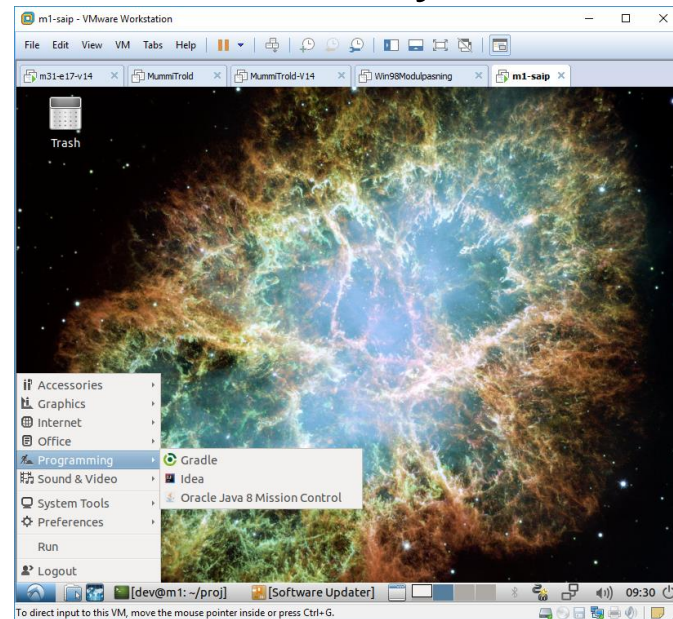
Moving Production

- Crunch3 machine was the production machine to do *awesome* stuff in another course I am running
  - It runs on my local ESXI
  - But, but – our students could not see it!
- Moved to the AUIT vSphere infrastructure
  - VMWare converter…
- Crunch3 is highly disk IO sensitive
  - Staff moved it 'as we spoke' to a pure SSD hypervisor

Keep Legacy Running

- Magnus wants to play *Titan Quest*
  - On his new MSI Windows 10 gaming laptop
  - Titan Quest does *not* run on Win10
  - Solution: Win XP SP3 installed on VMWare Player
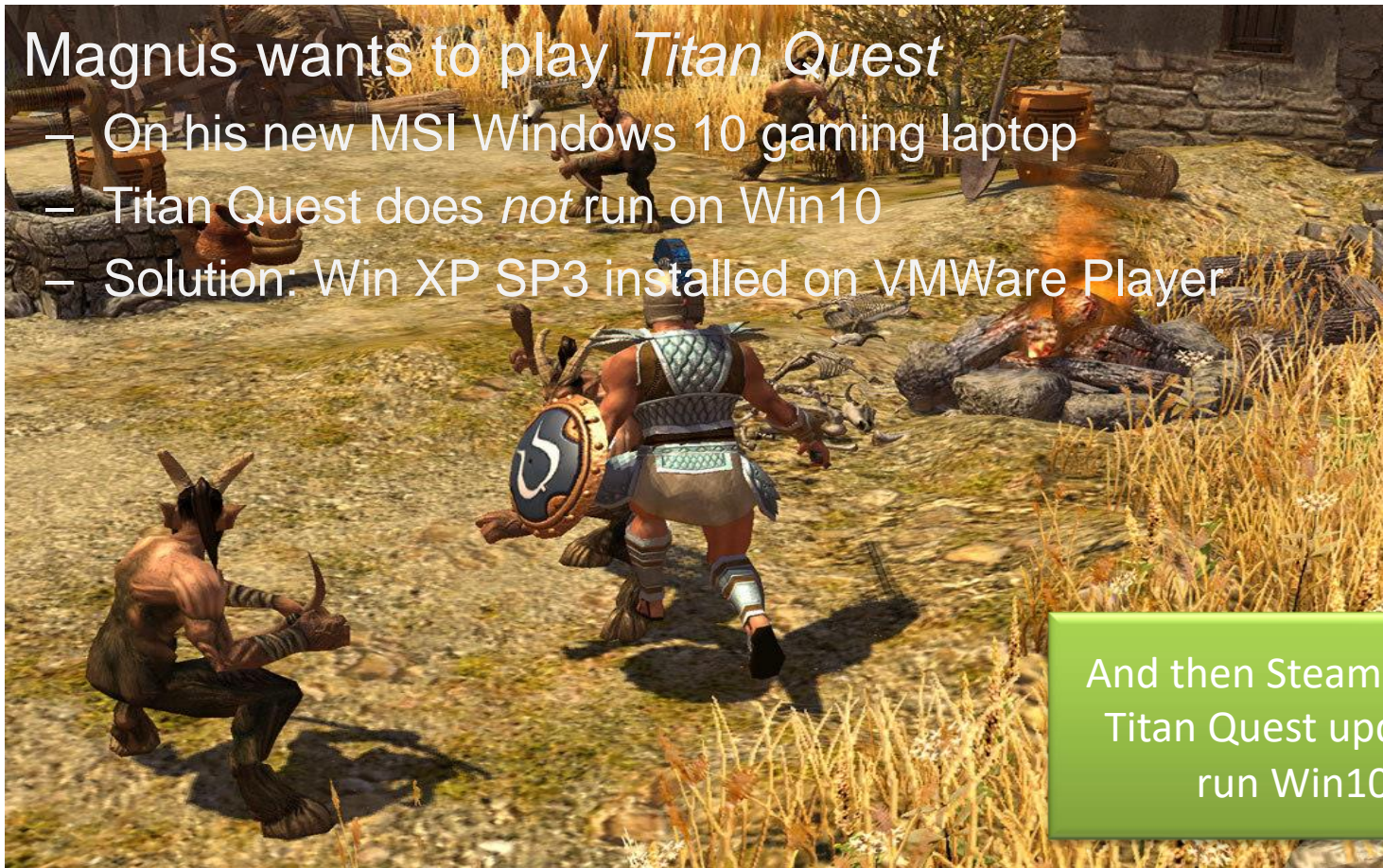
And then Steam released Titan Quest updated to run Win10 ☺

Keep Legacy Running
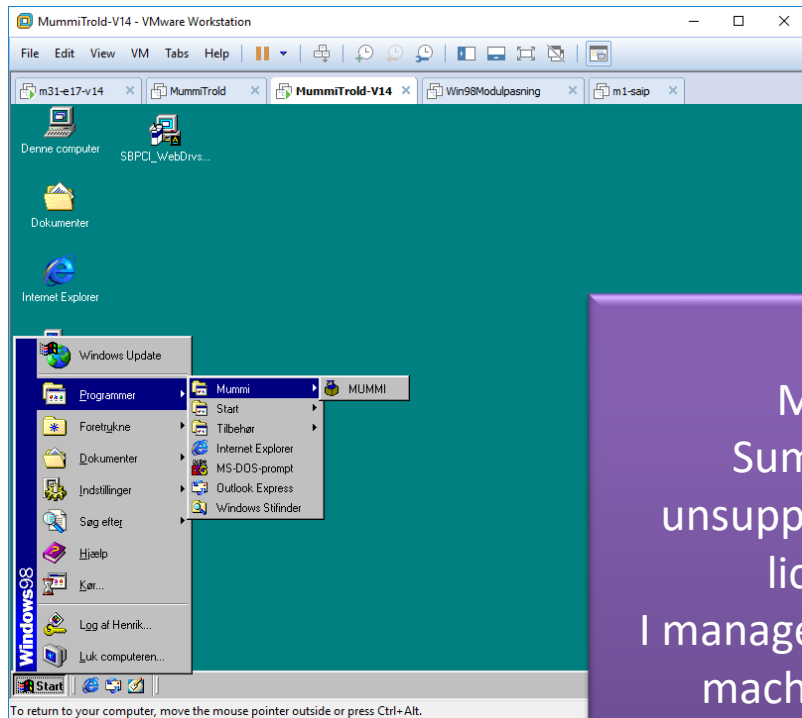
My company's accounting system, SummaSummerum, is a legacy system, unsupported and cannot be reinstalled due to license server has been shut down.
I managed to pull license files from my company machine, and "save it" in a VM. It is called "TheArk" ☺

My 'Private Cloud' ☺

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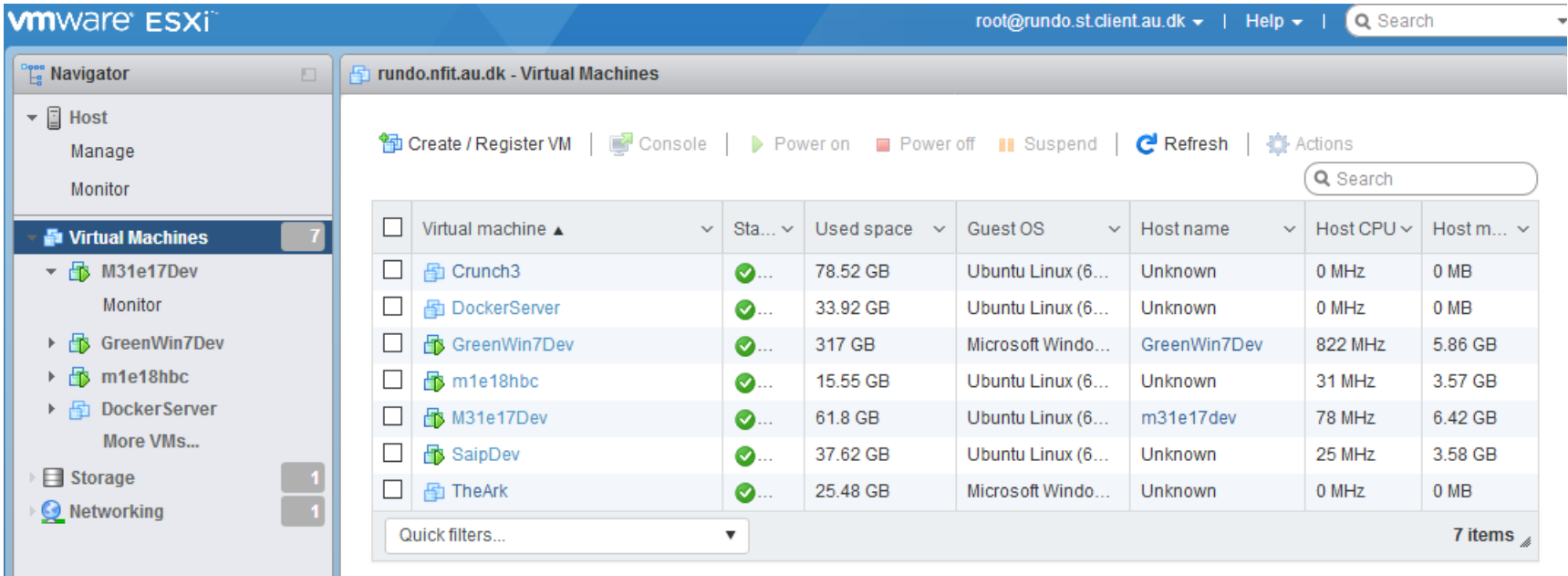
VMWare ESXi

- (Linux based) Minimal OS
  - My 'Rundo' runs from the USB stick
  - … and drivers were hell ☹

- Run Mgt application from its web server


```
VMware ESX Server 3i 3.5.0 build-110271

HP ProLiant BL25p G2

Dual-Core AMD Opteron(tm) Processor 2210 HE
2 GB Memory

Download tools to manage this host from:
http://████████████/ (STATIC)



<F2> Customize System                    <F12> Shut Down/Restart
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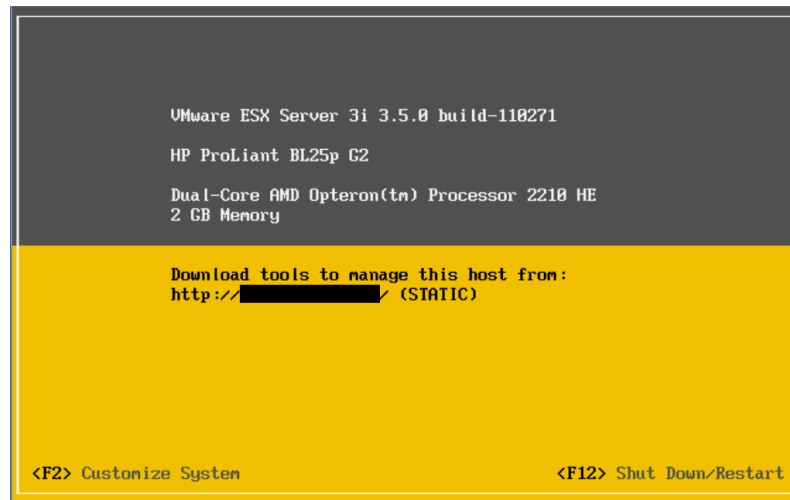
A Small VMM

- Remote client to access the VMM

A Much Bigger VMM

Amazon EC2 Dashboard

DigitalOcean Dashboard