Advanced VMWare Workstation

0.1 Different ways of viewing virtual machine

0.1.1 Appliance view

We can use appliance view if we want to connect to virtual appliance using its web interface. It is possible that we are using VMWare workstation to virtualize not a desktop OS but some server/appliance which does not have GUI/Terminal interface. Such appliances usually provide a web interface using which we can manage them remotely. For such use cases VMWare workstation supports appliance view. In this case instead console view of guest we can use appliance view, where we get button for connecting to guest using browser. VMWare automatically detects IP address of guests for such connections.

Install IIS server on Windows XP guest using "Control Panel → Add / Remove Software → Add / Remove Windows Components". Remove files from "`C:\Inetpub\wwwroot`" and create some "index.htm" (not .html) file with some text message. Now try to open http://localhost/ in guest. Now find IP address of guest and open http://<guest_IP>/ in host. Now configure appliance view for guest and try to use VMWare appliance view to access guest web interface. Note that we need not inform VMWare workstation about Guests IP, it detects that automatically.

0.1.2 Unity

VMWare workstation supports Unity features for guests. To understand this click on the 'Unity' button in toolbar while guest is selected. VMWare workstation window will get minimized and you will get menu to run programs inside VM on Desktop. When we run programs in unity mode they will appear as normal applications inside host, completely hiding the fact that they are running in guest OS. We can use '`Ctrl + Shift + U`' shortcut key to again get Unity menu option on Desktop from which we can launch other guest applications.

To exit unity view. Click on 'Exit Unity' button shown on guest tab in VMWare workstation window.

0.1.3 Quick switch and Full screen modes

Try quick switch and full screen modes for virtual machines from toolbar. In quick switch mode the virtual machine console occupies full screen and a tool bar is shown on top to switch between various virtual machines. In full

screen mode entire screen is occupied by single virtual machine, no toolbar is displayed to switch between virtual machines.

To exit these modes we can use the 'restore' button shown on auto-hide toolbar which scrolls from top of window or we can use shortcuts '`F11`' to toggle Quick view or '`Ctrl + Alt + Enter`' to toggle full screen view.

0.2 Managing virtual machines

0.2.1 Restart / Poweroff virtual machine

Try reset or poweroff options for virtual machines. These cause virtual machine to restart / poweroff as actual physical machines do when we press reset / poweroff but on cabinet/keyboard.

0.2.2 Suspend

We can suspend virtual machine using 'Suspend' option. This will save state of virtual machine (entire RAM contents and device status) in a file. Later on we can resume the virtual machine using this status file. Note that virtual machine will not realize that it was suspended or restored. Also this is not hibernate. For hibernate we need support from OS and hardware. For suspend to work we do not need support from guest OS or hardware.

If some network communication is going on (which usually have read/write timeouts), then those connections may close if we suspend virtual machines for long time. Try suspending virtual machine to a file and restoring it back. You can also suspend guest, restart host and restore guest. This way we can restart host machine without affecting guest machines state.

0.2.3 Snapshots

Snapshots are like time-machines for virtual machines or save / restore option that we get in single player games. We can save the current state of virtual machine using snapshot. This is different then suspend as the virtual machine keeps running. Later we can again restore virtual machine to any one of the snapshots stage.

This option can be very useful for organizing lab exercises with the help of VMs. Instructor can prepare virtual machine for exercise and create a snapshot. Now students can do the lab and work on the virtual machine. After students leave the instructor can restore virtual machine to original state using snapshot. In fact multiple snapshots for different labs can be created.

Take a snapshot of virtual machine. Now create a new file/folder on Desktop and take another snapshot. Switch between these two snapshots few times to understand snapshots properly. Note that you can branch from single snapshot in multiple directions. Hence snapshots need not be in linear chain, they can also be in tree fashion. Snapshots are get stored in diff format in host machine making it very efficient to keep multiple snapshots without occupying large space.

0.2.4 Record/Replay

Choose 'record' option from menu "VM → Replay". Assume recording as taking snapshot of VM automatically every few milliseconds. Hence when we record a virtual machine we can go back to any instant of that virtual machine during replay. We can even save snapshots of instants that we go to using replay to start working from those points again. Try Record / Replay feature provided by VMWare workstation to understand what kind of power / security problems record / replay feature can provide.

Assume we are playing chess against a computer program. Even if the program does not allows us to go back and change our moves, using record / replay option of VMs we can go back in time and change our moves so that we can win against the program. This wont work against web based games or multi-player LAN games. (Why?)

0.2.5 Encryption

To use encryption Virtual machine should be switched off. We can enable encryption using "Settings → Options → Encrypt". Once encryption is enabled a lock icon appears for virtual machine in Workstation. Also whenever we want to power on encrypted virtual machine we have to supply the password. We can still use snapshots on encrypted virtual machines. Record / Replay / ACE / Linked clone etc. features get disabled or limited once we use encryption. Encryption would take long time, so there is no point trying it in lab on VM you are working on. Try these feature after normal lab hours.

0.2.6 Shared folders

We can use shared folders feature in VMWare workstation to share files between host and guest. Guest sees the files using HGFS (Host Guest File system) when we use shared folders. The shared folders option is available in "VM → Settings → Options → Shared folders". As per manual the feature works on Linux (Kernel > 2.6) and Solaris too. But in labs it seems to work only in Windows without any kind of configuration / tweaking. Hence for

labs try the feature for Windows Guest. How to use shared folders with Linux guests needs to be determined.

0.3 Devices

0.3.1 Connecting USB devices (pen drive) to guest

To connect pen drive to host machine, use "VM → Removable Devices → <Device Name> → Connect (Disconnect from Host)" option to connect device to VM. Use the device in VM. Now use "VM → Removable Devices → <Device Name> → Disconnect (Connect to Host)" option to connect device back to host.

0.3.2 Adding harddisk

We can add harddisk to a VM by editing settings of Virtual Machine and choose "Add" and then "Hard disk" option. Add a harddisk to system when the VM is on and when VM is off. You will notice only SCSI disks can be added when VM is on. Understand concept of independent disks both persistent and non-persistent properly.

0.3.3 Adding CD/DVD drive

Try adding one more CD/DVD drive to VM. Again when VM is running SCSI drive will get added and when system is off IDE drive will get added.

0.4 Automation

0.4.1 Configuration files

VMware stores guest configuration in '`.vmx`' files. The Guest disk images are stored in '`.vmdk`' files. When we suspend guest '`.vmem`' file is created to store the contents of guest's RAM. Go to VMWare guest storage folder and open '`.vmx`' files in wordpad. Suspend guest and see that '`.vmem`' files get created and that its size is equal to RAM allotted to guest OS. '`.log`' file is used to store logs of Workstation activity. '`.nvram`' files store bios state of VM. '`.vmsd`' stores metadata and information about snapshots centrally. '`.vmsn`' is used to store running state of VM when snapshot is taken.

Please refer to VMWare manual - Table 4.1 on more details of files used by VMWare workstation and their significance.

Once we know how to write configuration files we can write programs which can create / modify these configuration files and hence effectively create / modify VMs.

0.4.2 Commands

Open cmd and go to folder "C:\Program Files\VMware\VMware Workstation". Stop all VMs from VMWare workstation and try these commands.

```
vmrun.exe start "H:\vmware_workstation_vms\windows_xp\Windows_XP.vmx"
vmrun.exe list
vmrun.exe stop "H:\vmware_workstation_vms\windows_xp\Windows_XP.vmx"
```

Type '`vmrun`' and press enter to see complete set of operations that can be performed by vmrun. You can use "`dir *.exe /w`" command to look at executables other then vmrun in same folder and try what they are for as well.

0.4.3 Scripting

VMWare supports scripting in various methods like VMcom, VMPerl, VIX etc. Explanation / Practice of these scripting languages / techniques is outside the scope of this course. Interested students can go to VMWare website and look for resources related to Scripting VMs.

0.5 Lab tasks

1. Try poweroff, reset and suspend options on VM.
2. Try appliance view for Windows XP guest and try to open IIS home page of guest in browser.
3. Try quick switch and full screen options. Toggle between these modes using short-cut keys.
4. Try unity option and start few guests applications to appear as if they are running in host.
5. Take snapshots in manner such that we get tree like structure in snapshot manager with more than one snapshots branching from same base snapshot.

6. Mention security problems that arise due to snapshot option provided by VMWare workstation. How can application writers try to circumvent the security problems created by snapshots? Can applications detect that snapshot was created if VM does not have network interface? If yes, how?

7. Try record / replay features of VMWare workstation. Play freecell or hearts. Go back in time to win the game / improve score.

8. Mention things that can now be done using record / replay feature that were not possible earlier with same applications when using physical machine.

9. Mention security problems that arise due to record / replay features of VM. Do not mention problems that are also due to snapshot features, possibly mentioned as answers to question 6. Mention problems that are caused only due to record / replay feature and in general are not affected by snapshot feature.

10. Why cant we go back using snapshot or record feature of VM in LAN games or Web based games?

11. What is one thing that definitely changes when we suspend and later resume VM? Can you capitalize on this information to solve problems asked in problem 6.

12. Try "Capture Screen" and "Capture Movie" options from VM menu.

13. Explain what happens when we use "Capture Screen" and "Capture Movie" option. Please mention advantages and disadvantages / security problems caused by these capture problems.

14. Answer these questions without actually trying them on VMWare workstation. Answer these with your understanding of how VMWare workstation and Operating Systems work.

    (a) If we enable "Capture Movie" option on Windows guest and some user uses "Remote Desktop" to connect to this Guest. Then what will get captured in the movie?

    (b) If we take snapshot of guest and then power it off. Now we map the guest disk on host OS and copy few files (say hostfile.txt) to this disk. Now we power on the guest and work (create delete files / folders) on it for few minutes. Now if we try to restore to the snapshot that we had created in beginning what will happen?

i. Will we get the machine in same state as it was when we took snapshot and file hostfile.txt will disappear?

ii. Will we get the machine in almost same state as before, only hostfile.txt would be extra?

iii. The above steps are not possible. Either VMWare wont allow them or they will lead to snapshot / VM corruption.

Mention reasons?

(c) What happens to running guests if we hibernate host OS and restore it back? Will they get corrupted or things would be fine? Can applications running in guest realize / test, if host machine gets hibernated?

15. Try to close tab off running VM to get options

    (a) Suspend

    (b) Power off

    (c) Run in background

    Explain 'Run in background' option. How do we get the virtual machines which are running in background back as tab in VMWare workstation? Will these VMs running in background continue to work if user logs off and another user logs in? What is necessary for VMs to be able to run in background even after user logs off?

16. Try connecting pen drive to guest OS.

17. Open '`.vmx`' configuration files for Virtual machines in wordpad and see how configuration options get saved in '`.vmx` files. Poweroff virtual machine and close VMWare workstation. Now change its MAC address in configuration file. Again start VMWare workstation and boot the VM. Check MAC address of virtual network adapter using Guest OS and verify that MAC address actually got changed.

18. Create clone of Windows VM.

19. How is clone different from snapshot? Are these two different names of same feature? If not, what are major differences between clone and snapshot? Can snapshots be converted to clones, if necessary? If yes, how? Can clones be converted to snap shots, if required? If yes, how?

20. Why is clone option even provided? Cant we just copy the VM folder and start both copies of VM at same time, as any way for cloning also we need to power off VM? What is the problem with copying approach?

21. How can we transfer files between guest and host OS if guest VM does not have network interface without powering off/suspending guest OS? Suggest at least two different methods?

22. Why only SCSI disks / devices can be added when VM is running and IDE hard-disks / devices are added only if VM is powered off?

23. We need to configure a Linux guest such that all files in drive (say D:) get deleted automatically when guest is powered off. (The files should remain if guest reboots, but after poweroff the files should get deleted). Is this configuration possible using VMWare workstation? If yes, how? Can we achieve same without using virtualization?

24. Connect two VMs in such a way so that they can only connect to each other and to host over network. These VMs should not be accessible from other machines in LAN. (Hint: Have a look at Virtual Network Editor, its shortcut is available in start-menu)

25. Configure VM such that no other machine in LAN can initiate connection towards VM. However this VM should be able to connect to other machines in LAN. Also the outgoing packets of this VM should go with IP address of host machine so that other machines in the network are not aware of presence of VM and it looks as if host machine initiated connection. (Hint: Have a look at Virtual Network Editor, its shortcut is available in start-menu)

26. How did you solve problems 24 and 25. Mention briefly.

27. What security problems can arise due to freedom of changing MAC addresses of virtual machines? Are these problems present without virtual machines using normal single host only OS?

28. Create shortcut / file on Desktop that allow starting and stopping a VM when we double click it. (Hint you can use batch files).

29. As part of lab queries responses mention how did you solve problem 28. Mention code / scripts used.

30. Learn about teams on your own. Write about advantages / use of teams as part of responses to lab queries.

0.6 Extra

Due to timing limitations features like ACE, supported by VMWare workstation are not being covered as part of labs. Scripting is also not being covered. Enthusiastic students can refer to VMWare workstation manual or use on-line documentation from Official VMWare website or other sources to learn about these features and try them.

0.7 References

VMWare workstation manual and VMWare official website both contain very in-depth information and tutorials on how to use advanced features of VMWare workstation. One can refer to both of these sources to understand techniques covered in this lab and to learn extra about VMWare Workstation.