CC Week 10

Virtual machine (VM) migration refers to the process of moving a virtual machine from one physical host or computing environment to another. This relocation can occur within the same physical infrastructure or across different infrastructure platforms, such as from an on-premises data center to a cloud environment, or between different cloud providers.

- Processor state, storage, memory and network connection are moved from one host to another host

Why to migrate VMs?
– Distribute VM load efficiently across servers in a cloud
– System maintenance

Types:

Cold or non live Migration: In this method, the VM is powered off before the migration process begins. This method typically involves some downtime as the VM is unavailable during the migration process.

Warm Migration: Warm migration involves migrating a VM while it's still running, but with minimal disruption to its operation. This is achieved by temporarily pausing the VM, transferring its disk state to the destination host, and then resuming its operation on the new host.

Hot or **Live Migration**: Live migration, also known as hot migration, allows for seamless migration of a VM while it's still running and serving requests.

Storage Migration: Sometimes it's not necessary to move the entire VM; instead, you may want to migrate only its storage to a different storage system or location.

Cloud Migration: If you're moving VMs to or between cloud environments, you can use cloud-specific migration tools and services provided by the cloud providers.

Hot migration/ Live VM :

Approaches: pre-copy and post-copy

What to migrate?

- CPU and ram contents
- disk content
- network : IP address, mac address, network packets
- i/o devices

Memory Migration:

1. **Push**:
    - Memory pages are sent from the running VM to the new destination over the network.
    - If any pages change during the transfer, they're sent again to keep things consistent.
    - The VM keeps running during this process.
2. **Stop-and-Copy**:
    - The running VM is temporarily paused.
    - Its memory is copied over to the new location.
    - Once copied, the VM starts running again on the new host.
    - This method involves downtime while the VM is stopped.
3. **Pull**:
    - The new VM starts up on the destination.
    - When it needs a memory page that hasn't been copied yet, it fetches it from the original VM over the network.
    - This allows the VM to start quickly but might cause delays as it fetches pages as needed.

For the pure stop-and-copy method:

- simple but downtime and migration time increase with the VM's memory size.
- If the VM is serving live services, the downtime might not be acceptable.

dirty pages: memory pages that have been modified after they were ast copied.

Pre-Copy Live Memory Migration:

1. **Pre-Copy Phase**: Similar to pre-copy live migration, memory is iteratively copied over several rounds while the VM continues running.

2. **Pre-Copy Termination Phase**: Stops the pre-copy phase based on specified thresholds: exceeding a certain number of rounds, total memory transmitted, or a drop in the number of dirtied pages.
3. **Stop-and-Copy Phase**: Similar to pre-copy migration, VM execution is paused at the source, remaining dirty pages and CPU state are copied to the destination, and then VM execution resumes.

Post-Copy Live Memory Migration:

1. **Stop Phase**: The source VM is stopped, and the CPU state is copied to the destination VM.
2. **Restart Phase**: The destination VM is restarted.
3. **On-demand Copy**: VM memory is copied as needed when the VM tries to access memory pages that haven't been copied yet

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QUESTION 1:

Post-copy and Pre-copy migration approaches are employed in :

a. Live Migration process

b. Non-live Migration process

c. Hybrid Migration process

d. None of these

Correct Answer: a

Detailed Solution: Both Post-copy and Pre-copy are approaches for the live migration process.

QUESTION 2:

Kubernetes operates at the hardware level.

a. True

b. False

Correct Answer: b

Detailed Solution: Kubernetes operates at the container level. (Slide 96)

QUESTION 3:

What is(are) the key advantage(s) of Docker?

a. Facilitating microservices

b. Modeling networks.

c. Packaging software

d. None of these

Correct Answer: a,b,c

Detailed Solution: Facilitating microservices, packaging software, and modeling networks for initiating multiple isolated containers on a single machine, are the key advantages of Docker. (slide - 73)

QUESTION 5:

In Docker utility, _____ is a collection of filesystem layers and some metadata that, if taken together, can be spun up as Docker containers.

a. Operating System

b. Microservice

c. Virtual Machine

d. Image

Correct Answer: d

Detailed Solution: In Docker utility, an image is a collection of filesystem layers and some metadata which if taken together, can be spun up as Docker containers. (slide - 77)

QUESTION 6:

Containers are similar to VMs but they have unrelaxed isolation properties to share the operating system among the applications.

a. True

b. False

Correct Answer: b

Detailed Solution: Containers are similar to VMs but they have relaxed isolation properties to share operating systems among the applications. Therefore, containers are considered lightweight.

QUESTION 8:

Private Docker registry is a service that stores Docker images.

a. True

b. False

Correct Answer: a

Detailed Solution: Private Docker registry is a service that stores Docker images.

Moreover, Docker on the host machine is split into two parts- a daemon with RESTful API and a client who talks with the daemon.

QUESTION 9:

Docker builds offer enhanced reproducibility and replicability compared to conventional software development approaches.

a. True

b. False

Correct Answer: a

Detailed Solution: Docker builds are more reproducible and and replicable than traditional software building methods. This makes implementing CD much easier. (Slide - 76)

VM Migration – Analysis

- Let T_{mig} be the total migration time.
- Let T_{down} be the total down time.
- For non-live migration of a single VM the migration time T_{mig} can be calculated as follows:

$$T_{mig} = V_m / R .$$

where, V_m is the size i.e. memory of the VM and R is the transmission rate.

- In non-live migration, down time is same as the migration time because the services of the VM is suspended during the entire migration process.

$$T_{down} = T_{mig}$$

Note: Transmission rate remains fixed for the entire duration of migration.

QUESTION 10:

Given the VM memory size of 1024 GB and the transmission rate of 16 MB/sec
What are the total migration time and downtime for non-live VM migration? Choose the most appropriate option.

a. 20 hours, 25 hours
b. 18 hours,18 hours
c. 16 hours, 16 hours
d. 24 hours,20 hours

$\frac{1024\ GB}{16\ MB}\ sec$

Correct Answer: b
Detailed Solution: Total Migration time = VM memory size/ transmission rate
=(1024x2^30)/(16x2^20)=65536 secs= 18 hours.
For non-live migration, overall migration time is the same as overall downtime.

- V_m : the memory of a VM.
- V_{th} : threshold for stopping the iterations.
- n_{max} : maximum number of iterations.
- r = (P*D)/R.

  where P is page size and D is the dirtying rate, R is the transmission rate.

Estimated number of rounds(n):

- $n = \min(\lceil log_r \frac{V_{th}}{V_m} \rceil, n_{max})$

QUESTION 1:

VM migration is the process of moving running applications or VMs from one physical host to another host.

a. True
b. False

Correct Answer: a

Detailed Solution: VM migration is a process to move running applications or VMs from one physical host/server to another host. So option (a) is correct.

QUESTION 3:

With Docker, the resource management effort is separated from the configuration effort.

a. True
b. False

QUESTION 4:

In Docker utility, ---------- is a collection of filesystem layers and some metadata which, if taken together, can be spun up as Docker containers.

a. Operating System
b. Microservice
c. Virtual Machine
d. Image

Correct Answer: d

Detailed Solution: In Docker utility, an image is a collection of filesystem layers and some metadata which if taken together, they can be spun up as Docker containers.

QUESTION 5:

What is(are) the reason(s) to opt for VM migration in the cloud computing paradigm?

a. No particular reason; depends on the will of the end client/user.
b. To remove a physical machine from service
c. To save power consumption
d. To relieve the load on the congested hosts.

Correct Answer: b,d

Detailed Solution: We should opt for VM migration either in order to remove a physical machine from service or to relieve the load on the congested hosts and/or both.

QUESTION 7:

Post-copy and Pre-copy migration approaches are followed in :

a. Live Migration process
b. Non-live Migration process
c. Hybrid Migration process
d. None of these

Correct Answer: a

Detailed Solution: Both Post-copy and Pre-copy are approaches for live migration process.

QUESTION 8:

Which of the following is (are) true in the case of Docker architecture?

Statement-1: Private Docker registry is a service that stores Docker images.
Statement-2: Docker on the host machine is split into two parts- a daemon with a RESTful API and a client who talks with the daemon.

a. Only Statement-1 is true
b. Only Statement-2 is true
c. Both Statement-1 and 2 are true
d. Neither Statement 1 nor 2 is true

Correct Answer: c
Detailed Solution: Private Docker registry is a service that stores Docker images.
Moreover, Docker on the host machine is split into two parts- a daemon with RESTful API and a client who talks with the daemon.

QUESTION 5:

A Kubernetes cluster consists of set of worker machines , called _____ .

a. Pods
b. Nodes
c. Control plane
d. Centers

Correct Answer: b

Detailed Solution: A Kubernetes cluster consists of set of worker machines , called nodes.

MCQ/MSQ Question

QUESTION 1:

In the containers terminology

Statement 1: ps : List all containers (incl. stopped)

Statement 2: rm : Delete a container

Which of the above statements are True?

a. I only
b. II only
c. I and II
d. None

Correct Answer: b

Detailed Solution: In containers terminology ps : List all running containers (ps -a : List all containers (incl. stopped)) therefore statement 1 is false only statement 2 is true.

QUESTION 2:

Docker provides application level virtualization.

a. True
b. False

Correct Answer: a

Detailed Solution: One of the reasons why docker is needed for applications is that it provides application level virtualization.

QUESTION 3:

In the image terminologies rmi is used to?

a. Delete a local image
b. List all local images
c. Delete a container
d. Download image from repository

Correct Answer: a

Detailed Solution: In image terminology rmi is used to delete a local image.

QUESTION 6:

__ is an Interface between sensor resources and the cloud fabric.

a. Sensor network proxy
b. Sensor-Cloud proxy
c. None

Correct Answer: b