

Top 200

DevOps

Engineer

Interview

Questions

& Answers

Knowledge Powerhouse

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DEDICATION

To our readers!

CONTENTS

**DevOps**

**1. What are the popularDevOps tools that you use?**

**2. What are the main benefits of DevOps?**

**3. What is the typical DevOps workflowyou use in your organization?**

**4. Howdo you take DevOps approachwithAmazonWeb Services?**

**5. Howwill you run a script automatically when a developercommits a change into GIT? 6. What are the main features of AWS OpsWorks Stacks?**

**7. Howdoes CloudFormationwork inAWS?**

**8. What is CICD inDevOps?**

**9. What are the best practices of Continuous Integration (CI)?**

**10. What are the benefits of Continuous Integration (CI)?**

**11. What are the options forsecurity in Jenkins?**

**12. What are the main benefits of Chef?**

**13. What is the architecture of Chef?**

**14. What is a Recipe inChef?**

**15. What are the main benefits of Ansible?**

**16. What are the main use cases of Ansible?**

**17. What is DockerHub?**

**18. What is yourfavorite scripting language forDevOps?**

**19. What is Multi-factor authentication?**

**20. What are the main benefits of Nagios?**

**21. What is State Stalking inNagios?**

**22. What are the main features of Nagios?**

**23. What is Puppet?**

**24. What is the architecture of Puppet?**

**25. What are the main use cases of Puppet Enterprise?**

**26. What is the use of Kubernetes?**

**27. What is the architecture of Kubernetes?**

**28. Howdoes Kubernetes provide high availability of applications in a Cluster? 29. Why AutomatedTesting is a mustrequirement forDevOps?**

**30. What is Chaos Monkey inDevOps?**

**31. Howdo you performTest Automation inDevOps?**

**32. What are the main services of AWS that you have used?**

**33. Why GITis considered betterthanCVS for version controlsystem? 34. What is the difference between a Container and a Virtual Machine? 35. What is Serverless architecture?**

**36. What are the main principles of DevOps?**

**37. Are youmore Dev ormore Ops?**

**38. What is a RESTservice?**

**39. What are the Three Ways of DevOps?**

**40. Howdo you apply DevOps principles to make systemSecure? 41. What is Self-testing Code?**

**42. What is a Deployment Pipeline?**

**43. What are the main features of DockerHub?**

**44. What are the security benefits of using Container based system? 45. Howmany heads can you create in a GITrepository?**

**46. What is a Passive check inNagios?**

**47. What is a Dockercontainer?**

**48. Howwill you remove an image fromDocker?**

**49. What are the common use cases of Docker?**

**50. Canwe lose our data when a DockerContainerexits?**

**DockerQuestions**

**51. What is Docker?**

**52. What is the difference betweenDockerimage andDockercontainer? 53. Howis a Dockercontainer different froma hypervisor?**

**54. Canwe write compose file in json file instead of yaml?**

**55. Canwe runmultiple apps on one serverwithDocker?**

**56. What are the main features of Docker-compose?**

**57. What is the most popular use of Docker?**

**58. What is the role of open source development in the popularity of Docker? 59. What is the difference betweenDockercommands: up,run and start? 60. What is Docker Swarm?**

**61. What are the features of Docker Swarm?**

**62. What is a DockerImage?**

**63. What is a DockerContainer?**

**64. What is DockerMachine?**

**65. Why do we use DockerMachine?**

**66. Howwill you create a ContainerinDocker?**

**67. Do you think Dockeris Application-centric orMachine-centric?**

**68. Canwe runmore than one process in a Dockercontainer?**

**69. What are the objects created by DockerCloud inAmazonWeb Services (AWS) EC2? 70. Howwill you take backup of Dockercontainer volumes inAWS S3? 71. What are the three main steps of DockerCompose?**

**72. What is Pluggable Storage Driver architecture inDocker based containers? 73. What are the main security concerns withDocker based containers? 74. Howcanwe check the status of a ContainerinDocker?**

**75. What are the main benefits of using Docker?**

**76. Howdoes Dockersimplify Software Development process?**

**77. What is the basic architecture behindDocker?**

**78. What are the populartasks that you can do withDockerCommand line tool? 79. What type of applications- Stateless or Stateful are more suitable forDockerContainer? 80. HowcanDockerrun on different Linux distributions?**

**81. Why do we use Docker on top of a virtual machine?**

**82. HowcanDockercontainershare resources?**

**83. What is the difference betweenAdd andCopy command in a Dockerfile? 84. What is DockerEntrypoint?**

**85. What is ONBUILD command inDocker?**

**86. What is Build cache inDocker?**

**87. What are the mostcommon instructions inDockerfile?**

**88. What is the purpose of EXPOSEcommand inDockerfile?**

**89. What are the different kinds of namespaces available in a Container?**

**90. Howwill youmonitorDockerin production?**

**91. What are the Cloud platforms that support Docker?**

**92. Howcanwe control the startup order of services inDockercompose?**

**93. Why Dockercompose does not wait for a containerto be ready before moving on to start next service in dependency order? 94. Howwill you customize Dockercompose file for differentenvironments?**

**CloudComputing Questions**

**95. What are the benefits of CloudComputing?**

**96. What is On-demand computing inCloudComputing?**

**97. What are the different layers of Cloud computing?**

**98. Whatresources are provided by Infrastructure as a Service (IAAS) provider?**

**99. What is the benefit of Platformas a Service?**

**100. What are the main advantages of PaaS?**

**101. What is the main disadvantage of PaaS?**

**102. What are the different deployment models inCloud computing?**

**103. What is the difference between Scalability andElasticity?**

**104. What is Software as a Service?**

**105. What are the different types of Datacenters inCloud computing?**

**106. Explain the various modes of Software as a Service (SaaS)cloud environment?**

**107. What are the important things to care about in Security in a cloud environment?**

**108. Why do we use API in cloud computing environment?**

**109. What are the different areas of Security Management in cloud?**

**110. What are the main cost factors ofcloud based data center?**

**111. Howcanwe measure the cloud-based services?**

**112. Howa traditional datacenteris different froma cloud environment?**

**113. Howwill you optimize availability of your application in a Cloud environment?**

**114. What are the requirements forimplementing IaaS strategy inCloud?**

**115. What is the scenario inwhich publiccloud is preferred over private cloud?**

**116. Do you think CloudComputing is a software application or a hardware service?**

**117. Why companies nowpreferCloudComputing architecture overClient ServerArchitecture? 118. What are the main characteristics of CloudComputing architecture?**

**119. Howdatabases inCloud computing are different fromtraditional databases?**

**120. What is Virtual Private Network (VPN)?**

**121. What are the main components of a VPN?**

**122. Howwill you secure the application data fortransport in a cloud environment?**

**123. What are the large-scale databases available inCloud?**

**124. What are the options for open source NoSQLdatabase in a Cloud environment?**

**125. What are the important points to consider before selecting cloud computing?**

**126. What is a SystemintegratorinCloud computing?**

**127. What is virtualization in cloud computing?**

**128. What is Eucalyptus in a cloud environment?**

**129. What are the main components of Eucalyptus cloud architecture?**

**130. What is Auto-scaling inCloud computing?**

**131. What are the benefits of Utility Computing model?**

**132. What is a HypervisorinCloudComputing?**

**133. What are the different types of HypervisorinCloudComputing?**

**134. Why Type-1 Hypervisor has better performance thanType-2 Hypervisor?**

**135. What is CaaS?**

**136. Howis Cloud computing different fromcomputing formobile devices?**

**137. Why automation of deployment is very important inCloud architecture?**

**138. What are the main components inAmazonCloud?**

**139. What are main components inGoogle Cloud?**

**140. What are the major offerings of Microsoft Azure Cloud?**

**141. What are the reasons of popularity of CloudComputing architecture?**

**142. What are the Machine Learning options fromGoogle Cloud?**

**143. Howwill you optimize the CloudComputing environment?**

**144. Do you think Regulations andLegal Compliance is an important aspect of CloudComputing? Unix Questions**

**145. Howwill you remove all files in current directory? Including the files that are two levels down in a sub-directory. 146. What is the difference between the –v and –x options inBash shellscripts?**

**147. What is a FilterinUnix command?**

**148. What is Kernel inUnix operating system?**

**149. What is a Shell inUnix OS?**

**150. What are the different shells inUnix that you knowabout?**

**151. What is the firstcharacter of the output in ls –lcommand ?**

**152. What is the difference betweenMulti-tasking andMulti-userenvironment?**

**153. What is an Inode inUnix?**

**154. What is the difference between absolute path and relative path inUnix file system? 155. What are the main responsibilities of a Unix Shell?**

**156. What is a Shell variable?**

**157. What are the important Shell variables that are initialized on starting a Shell?**

**158. Howwill you set the value of Environment variables inUnix?**

**159. What is the difference between a SystemCall and a library function?**

**160. What are the networking commands inUnix that you have used?**

**161. What is a Pipeline inUnix?**

**162. What is the use of tee command inUnix?**

**163. Howwill you count the number of lines andwords in a file inUnix?**

**164. What is Bash shell?**

**165. Howwill you search for a name inUnix files?**

**166. What are the popular options of grep command inUnix?**

**167. What is the difference betweenwhoami andwho amicommands inUnix?**

**168. What is a SuperuserinUnix?**

**169. Howwill you check the information about a process inUnix?**

**170. What is the use of more commandwith catcommand?**

**171. What are the File modes inUnix?**

**172. We wrote a shellscript inUnix but it is not doing anything. Whatcould be the reason?**

**177. What is the significance of 755 in chmod 755 command?**

**178. Howcanwe run a process in background inUnix? Howcanwe kill a process running in background? 179. Howwill you create a read only file inUnix?**

**180. Howdoes alias work inUnix?**

**181. Howcan you redirect I/OinUnix?**

**182. What are the main steps taken by a Unix Shell for processing a command?**

**183. What is a Sticky bit inUnix?**

**184. What are the different outputs fromKillcommand inUnix?**

**185. Howwill you customize yourenvironment inUnix?**

**186. What are the popularcommands for usermanagement inUnix?**

**187. Howwill you debug a shellscript inUnix?**

**188. What is the difference between a Zombie andOrphan process inUnix?**

**189. Howwill you check if a remote host is still alive?**

**190. Howwill you get the lastexecuted command inUnix?**

**191. What is the meaning of “2>&1” in a Unix shell?**

**192. Howwill you findwhich process is taking most CPUtime inUnix?**

**193. What is the difference between Soft link andHard link inUnix?**

**194. Howwill you findwhich processes are using a file?**

**195. What is the purpose of nohup inUnix?**

**196. Howwill you remove blank lines froma file inUnix?**

**197. Howwill you find the remote hosts that are connecting to yoursystemon a specific port inUnix? 198. What is xargs inUnix?**

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INTRODUCTION

DevOps is one ofthe most popular technology trends. Thereisa growing demand for DevOps Engineer job in technology companies.

This book contains popular technicalinterviewquestions thatan interviewerasks for DevOps Engineer position. The questionscover DevOps, Docker, CloudComputing and Unix areas.

Each question isaccompanied with an answer so that you can preparefor job interviewin short time.

We havecompiled this listafterattending dozens oftechnicalinterviews in top-notch companies like- Airbnb, Netflix, Amazon etc.

Often, these questionsand conceptsare used in our dailywork. But theseare most helpfulwhen an Interviewer is trying to test your deep knowledge ofDevOps.

Once you go through themin thefirst pass, mark the questions that you could notanswer by yourself. Then, in second pass go through only the difficult questions.

After going through this book 2-3 times, youwill be well prepared to faceatechnicalinterviewfora DevOps Engineer position.

DevOps Interview Questions

**DevOps**

**1. What are the popular DevOps tools that you use?**

We usefollowing tools for work inDevOps:

I. **Jenkins** : This is an open source automation server used as a continuous integration tool. We can build, deploy and run automated tests with Jenkins.

II. **GIT**:It isa version controltool used for tracking changes in filesand software.

III. **Docker**:This isa popular toolforcontainerization ofservices. It is very usefulinCloud based deployments. IV. **Nagios** :We use Nagios for monitoring ofIT infrastructure.

V. **Splunk** :This isa powerfultoolfor log search as wellas monitoring production systems.

VI. **Puppet** :We use Puppet to automate our DevOps work so that it is reusable.

**2. What are the main benefits of DevOps?**

DevOps isa very popular trend in Software Development. Some ofthe main benefits ofDevOpsareas follows:

I. **Release Velocity** : DevOps practices help in increasing the release velocity. We can release code to productionmore often and withmoreconfidence.

II. **Development Cycle** : With DevOps, the complete Development cycle from initial design to production deployment becomes shorter.

III. **Deployment Rollback** : In DevOps, we plan for any failure in deployment rollback due to a bug in code or issuein production. This givesconfidencein releasing feature without worrying about downtimefor rollback.

IV. **Defect Detection** : With DevOps approach, we can catch defects much earlier than releasing to production. It improves the quality ofthesoftware.

V. **Recovery fromFailure** :In case ofafailure, wecan recover very fast withDevOps process.

VI. **Collaboration** :WithDevOps,collaboration between developmentand operations professionals increases.

VII. **Performance-oriented** : With DevOps, organization follows performance-oriented culture in which teams become more productiveand moreinnovative.

**3. What is the typical DevOps workflow you use in your organization?** ThetypicalDevOps workflowin our organization isas follows:

I. We use Atlassian Jirafor writing requirementsand tracking tasks.

II. Based on theJiratasks, developerscheckin codeinto GIT version controlsystem.

III. Thecodechecked into GIT is built by usingApache Maven.

IV. The build process isautomated with Jenkins.

V. During the build process,automated tests run to validatethecodechecked in by developer. VI. Code built on Jenkins is sent to organization’s Artifactory.

VII. Jenkinsautomatically picks thelibraries fromArtifactory and deploys it to Production.

VIII. During Production deployment Docker imagesare used to deploy samecode onmultiple hosts. IX. Oncecodeis deployed to Production, we use Nagios to monitor the health of production servers. X. Splunk based alerts informus ofany issues orexceptions in production.

**4. How do you take DevOps approach with Amazon Web Services?**

AmazonWeb Services (AWS) provide many toolsand features to deploy and manageapplications inAWS.As per DevOps, wetreat infrastructureascode. We mainly usefollowing two services fromAWS for DevOps:

I. **CloudFormation** : We use AWS CloudFormation to create and deployAWS resources by using templates. We can describe our dependencies and pass special parameters in these templates. CloudFormation can read thesetemplatesand deploy theapplication and resources inAWS cloud.

II. **OpsWorks** :AWS provides another service called OpsWorks that is used for configuration management by utilizing Chef framework. We can automate server configuration, deployment and management by using OpsWorks. It helps inmanagingEC2 instances inAWS as wellasany on-premises servers.

**5. How will you run a script automatically when a developer commits a change into GIT?**

GIT provides thefeatureto executecustomscripts when certain event occurs inGIT. This featureiscalled hooks.

Wecanwritetwo types of hooks.

I. Client-side hooks

II. Server-side hooks

For this case, we can write a Client-side post-commit hook. This hook willexecute a customscript in which we can add the messageand codethat we want to run automaticallywith each commit.

**6. What are the main features of AWS OpsWorks Stacks?** Some ofthe main features ofAWS OpsWorks Stacksareas follows:

I. **Server Suppo** rt:AWS OpsWorks Stacks we can automate operational tasks on any server inAWS as well as our own datacenter.

II. **Scalable Automation** : We get automated scaling support withAWS OpsWorks Stacks. Each new instance inAWS can read configuration fromOpsWorks. It can even respond to systemevents in same way as other instances do.

III. **Dashboard** :Wecan create dashboards inOpsWorks to display thestatus ofallthestacks inAWS. IV. **Configuration as Code** :AWS OpsWorks Stacks are built on the principle of“Configuration as Code”. We can define and maintain configurations like application source code. Same configuration can be replicated on multipleserversand environments.

V. **Application Support** :OpsQorks supportsalmostall kinds ofapplications. So it is universalin nature.

**7. How does CloudFormation work in AWS?**

AWS CloudFormation is used for deployingAWS resources.

In CloudFormation, we have to first create a template for a resource. Atemplate is a simple text file that contains information

aboutastack onAWS. Astack isacollection ofAWS resourced that we want to deploy together in anAWS asa group.

Once the template is ready and submitted toAWS, CloudFormationwillcreate all the resources in the template. This helps in automation of building newenvironments inAWS.

**8. What is CICD in DevOps?**

CICDstands for Continuous Integration and Continuous Delivery. Thesearetwo differentconcepts thatarecomplementary to each other.

**Continuous Integration (CI)** : In CI all the developer work is merged to main branch several times a day. This helps in reducing integration problems.

In CI we try to minimize the duration for which a branch remains checked out. Adeveloper gets early feedback on the new codeadded to main repository by usingCI.

**Continuous Delivery (CD)** : In CD, a software teamplans to deliver software in short cycles. They performdevelopment, testing and releasein such ashort timethat incrementalchangescan beeasily delivered to production.

InCD,asa DevOps wecreatearepeatable deployment process thatcan help achievethe objective ofContinuous Delivery. **9. What are the best practices of Continuous Integration (CI)?**

Some ofthe best practices ofContinuous Integration (CI)areas follows:

I. **BuildAutomation** : In CI, we create such a build environment that even with one command build can be triggered. Thisautomation is doneallthe way up to deployment to Production environment.

II. **MainCode Repository** : In CI, we maintain a main branch in code repository that stores all the Production ready code. This is the branch that wecan deploy to Production any time.

III. **Self-testing build** :Every build inCI should beself-tested. It means with every build thereisaset oftests that runs to ensurethatchangesare of high quality.

IV. **Every day commits to baseline** : Developers will commit all of theirs changes to baseline everyday. This ensures that thereis no big pileup ofcode waiting for integrationwith the main repository foralong time. V. **Build every commit to baseline** :WithAutomated Continuous Integration, every timeacommit is madeinto baseline,a build is triggered. This helps in confirming thatevery changeintegratescorrectly.

VI. **Fast Build Process** : One of the requirements of CI is to keep the build process fast so that we can quickly identify any problem.

VII. **Production like environment testing** :In CI, we maintain a production like environmentalso known as pre production or staging environment, which is very close to Production environment. We performtesting in this environment to check forany integration issues.

VIII. **Publish BuildResults** : We publish build results on a common site so that everyone can see these and take correctiveactions.

IX. **Deployment Automation** :The deployment process isautomated to theextent that in a build process wecan add the step of deploying the code to a test environment. On this test environment all the stakeholders can accessand test thelatest delivery.

**10. What are the benefits of Continuous Integration (CI)?** The benefits ofContinuous Integration (CI)areas follows:

I. CI makes thecurrent build constantly availablefor testing, demo and release purpose.

II. WithCI, developers write modularcodethat works wellwith frequentcodecheck-ins.

III. In case ofa unittest failure or bug, developercan easily revert back to the bug-freestate ofthecode. IV. Thereis drasticreduction in chaos on release daywithCI practices.

V. WithCI, wecan detect Integration issues much earlier in the process.

VI. Automated testing is one very usefulsideeffect ofimplementingCI.

VII. All the stakeholders including business partners can see the small changes deployed into pre-production environment. This providesearly feedback on thechanges to software.

VIII. Automated CI and testing generates metrics like code-coverage, code complexity that help in improving the development process.

**11. What are the options for security in Jenkins?**

In Jenkins, it is very important to make the systemsecure by setting user authentication and authorization. To do this we have to do following:

I. First we have to set up the Security Realm. We can integrate Jenkins with LDAP server to create user authentication.

II. Second part is to set theauthorization for users. This determines which user hasaccess to what resources. In Jenkins some ofthe options to setup security areas follows:

I. Wecan useJenkins’ ownUser Database.

II. Wecan use LDAP plugin to integrateJenkins withLDAP server.

III. Wecan also setup Matrix based security on Jenkins.

**12. What are the main benefits of Chef?**

Chefisan automation toolfor keeping infrastructureascode. It has many benefits. Some oftheseareas follows: I. **CloudDeployment** :Wecan use Chefto performautomated deployment inCloud environment. II. **Multi-cloud support** :WithChefwecan even use multiplecloud providers for our infrastructure. III. **HybridDeployment** :Chefsupports bothCloud based as wellas datacenter-based infrastructure.

IV. **HighAvailability** : With Chefautomation, we can create high availability environment. In case of hardware failure, Chefcanmaintain or start newservers in automated way to maintain highly availableenvironment.

**13. What is the architecture of Chef?**

Chefiscomposed ofmany components like ChefServer, Clientetc. Some ofthe main components inChefareas follows:

I. **Client** :Thesearethe nodes or individual users thatcommunicate withChefserver.

II. **Chef Manage** :This is the web consolethat is used for interactingwithChefServer.

III. **Load Balancer**:All the Chef server API requests are routed through Load Balancer. It is implemented in Nginx.

IV. **Bookshelf** : This is the component that stores cookbooks. All the cookbooks are stored in a repository. It is separatestoragefromthe Chefserver.

V. **PostgreSQL**:This is the datarepository for Chefserver.

VI. **Chef Server**: This is the hub for configuration data. All the cookbooks and policies are stored in it. It can scaleto thesize ofany enterprise.

**14. What is a Recipe in Chef?**

In any organization, Recipeis the most fundamentalconfiguration element.

It is written inRuby language. It isacollection ofresources defined by using patterns.

ARecipeis stored in a Cookbook and itmay have dependency on other Recipe.

Wecan tagRecipeto createsome kind of grouping.

We haveto add a Recipein run-list before using it by chef-client.

Italways maintains theexecution order specified in run-list.

**15. What are the main benefits of Ansible?**

Ansible is a powerful tool for ITAutomation for large scale and complex deployments. It increases the productivity of team.

Some ofthe main benefits ofAnsibleareas follows:

I. **Productivity** :It helps in delivering and deployingwith speed. It increases productivity in an organization.

II. **Automation** : Ansible provides very good options for automation. With automation, people can focus on delivering smartsolutions.

III. **Large-scale** :Ansiblecan be used in smallas wellas very large-scale organizations.

IV. **Simple DevOps** : WithAnsible, we can write automation in a human-readable language. This simplifies the task ofDevOps.

**16. What are the main use cases of Ansible?**

Some ofthe popular usecases ofAnsibleareas follows:

I. **AppDeployment** :WithAnsible, wecan deploy apps in areliableand repeatable way.

II. **ConfigurationManagement** :Ansible supports the automation ofconfiguration management across multiple environments.

III. **Continuous Delivery** :Wecan release updates with zero downtime withAnsible.

IV. **Security** :Wecan implementcomplex security policies withAnsible.

V. **Compliance** : Ansible helps in verifying and organization’s systems in comparison with the rules and regulations.

VI. **Provisioning** :Wecan provide newsystemsand resources to other users withAnsible. VII. **Orchestration** :Ansiblecan be used in orchestration ofcomplex deployment in asimple way.

**17. What is Docker Hub?**

Docker Hub isacloud-based registry. Wecan use Docker Hub to link coderepositories. Wecan even build imagesand store theminDocker Hub. Italso provides links to Docker Cloud to deploy theimages to our hosts.

Docker Hub isacentralrepository forcontainer image discovery, distribution, change management, workflowautomation and teamcollaboration.

**18. What is your favorite scripting language for DevOps?**

In DevOps, we use different scripting languages for different purposes. There is no single language that can work in all the scenarios. Some ofthe popular scripting languages that we useareas follows:

I. **Bash** :OnUnix based systems we use Bash shellscripting forautomating tasks.

II. **Python** :Forcomplicated programming and large modules we use Python. Wecan easily usea wide variety of standard libraries with Python.

III. **Groovy** : This is a Java based scripting language. We need JVM installed in an environment to use Groovy. It is very powerfuland it provides very powerfulfeatures.

IV. **Perl** :This isanother languagethat is very usefulfor text parsing. We useit inweb applications.

**19. What is Multi-factor authentication?**

In security implementation, we use Multi-factor authentication (MFA). In MFA, a user is authenticated by multiple means before giving access to aresource or service. It is different fromsimple user/password based authentication.

The most popular implementation of MFA is Two-factor authentication. In most of the organizations, we use username/password and anRSAtoken as two factors forauthentication.

WithMFA, thesystembecomes moresecureand itcannot beeasily hacked.

**20. What are the main benefits of Nagios?**

Nagios is open sourcesoftwareto monitor systems, networksand infrastructure. The main benefits ofNagiosareas follows:

I. **Monitor** : DevOps can configure Nagios to monitor IT infrastructure components, system metrics and network protocols.

II. **Alert** :Nagios willsend alerts when acriticalcomponent in infrastructurefails.

III. **Response** :DevOpsacknowledgesalertsand takescorrectiveactions.

IV. **Report** :PeriodicallyNagioscan publish/send reports on outages,eventsand SLAsetc. V. Maintenance:Duringmaintenance windows, wecan also disablealerts.

VI. **Planning** :Based on past data, Nagios helps in infrastructure planning and upgrades.

**21. What is State Stalking in Nagios?**

State Stalking is a very useful feature. Though all the users do not use it all the time, it is very helpful when we want to investigatean issue.

In State Stalking, we can enable stalking on a host. Nagios willmonitor the state of the host very carefully and it will log any changes in thestate.

By this wecan identifywhatchanges might becausing an issue on the host.

**22. What are the main features of Nagios?**

Some ofthe main features ofNagiosareas follows:

I. **Visibility** :Nagios providesacentralized viewoftheentireIT infrastructure.

II. **Monitoring** :Wecanmonitorallthe mission criticalinfrastructurecomponents withNagios.

III. **Proactive Planning** :WithCapacity Planning and Trendingwecan proactively plan to scale up or scale down theinfrastructure.

IV. **Extendable** :Nagios isextendableto athird party tools inAPIs.

V. **Multi-tenant** :Nagios supports multi-tenantsarchitecture.

**23. What is Puppet?**

Puppet Enterprise is a DevOps software platformthat is used for automation of infrastructure operations. It runs on Unix as

wellas onWindows.

Wecan definesystemconfiguration by using Puppet’s language or RubyDSL.

Thesystemconfiguration described in Puppet’s languagecan be distributed to atargetsystemby usingRESTAPIcalls.

**24. What is the architecture of Puppet?**

Puppet is Open Source software. It is based on Client-server architecture. It is a Model Driven system. The client is also called Agent. And server iscalled Master.

It has following architecturalcomponents:

I. **Configuration Language** : Puppet provides a language that is used to configure Resources. We have to specifywhat Action has to beapplied to whichResource.

TheAction has threeitems foreachResource:type, titleand list ofattributes ofaresource. Puppetcodeis written inManifests files.

II. **Resource Abstraction** : We can create Resource Abstraction in Puppet so that we can configure resources on different platforms. Puppet agent uses a Facter for passing the information of an environment to Puppet server. In Facter we haveinformation about IP, hostname, OS etc oftheenvironment.

III. **Transaction** : In Puppet, Agent sends Facter to Master server. Master sends back the catalog to Client. Agentappliesany configuration changes to system. Onceallchangesareapplied, theresult is sent to Server.

**25. What are the main use cases of Puppet Enterprise?**

Wecan use Puppet Enterprisefor following scenarios:

I. **Node Management** :Wecanmanagealarge number of nodes with Puppet.

II. **Code Management** :With Puppet wecan defineInfrastructureascode. Wecan review, deploy, and test the environmentconfiguration for Development, Testing and Production environments.

III. **Reporting & Visualization** : Puppet provides Graphical tools to visualize and see the exact status of infrastructureconfiguration.

IV. **Provisioning Automation** : With Puppet we can automate deployment and creation of new servers and resources. So usersand businesscan get their infrastructurerequirementscompleted very fast with Puppet. V. **Orchestration** : For a large Cluster of nodes, we can orchestrate the complete process by using Puppet. It can followthe order inwhichwe want to deploy theinfrastructureenvironments.

VI. **Automation of Configuration** : With Configuration automation, the chances of manual errors are reduced. The process becomes morereliable with this.

**26. What is the use of Kubernetes?**

We use Kubernetes forautomation oflarge-scale deployment ofContainerized applications.

It isan open sourcesystembased on concepts similar to Google’s deployment process ofmillions ofcontainers. Itcan be used on cloud, on-premise datacenterand hybrid infrastructure.

In Kubernetes we can create a cluster ofservers that are connected to work as a single unit. We can deploy a containerized application to alltheservers in acluster withoutspecifying the machine name.

We haveto packageapplications in such a way that they do not depend on aspecific host.

**27. What is the architecture of Kubernetes?**

Thearchitecture ofKubernetesconsists offollowing components:

**Master**:Thereisa master nodethat is responsiblefor managing thecluster. Master performs following functions in acluster. I. SchedulingApplications

II. Maintaining desired state ofapplications

III. Scaling applications

IV. Applying updates to applications

**Nodes** :ANode inKubernetes is responsible for running an application. The Node can be a VirtualMachine or a Computer in the cluster. There is software called Kubelet on each node. This software is used for managing the node and communicating with the Master nodein cluster.

There is a Kubernetes API that is used by Nodes to communicate with the Master. When we deploy an application on Kubernetes, werequest Master to startapplication containers onNodes.

**28. How does Kubernetes provide high availability of applications in a Cluster?**

In a Kubernetes cluster, there is a Deployment Controller. This controller monitors the instances created by Kubernetes in a cluster. Oncea node or the machine hosting the node goes down, Deployment Controller willreplacethe node.

It isaself-healingmechanisminKubernetes to provide high availability ofapplications.

Therefore in Kubernetes cluster, Kubernetes Deployment Controller is responsible for starting the instances as well as replacing theinstances in case ofafailure.

**29. Why Automated Testing is a must requirement for DevOps?** In DevOps approach we release software with high frequency to production. We have to run tests to gain confidence on the quality ofsoftware deliverables.

Running tests manually is a time taking process. Therefore, we first prepare automation tests and then deliver software. This ensures that wecatch any defectsearly in our process.

**30. What is Chaos Monkey in DevOps?**

Chaos Monkey is a concept made popular by Netflix. In Chaos Monkey, we intentionally try to shut down the services or createfailures. By failing one or moreservices, wetest thereliability and recoverymechanismofthe Production architecture.

Itchecks whether ourapplicationsand deployment havesurvivalstrategy built into it or not.

**31. How do you perform Test Automation in DevOps?**

We use Jenkins to create automated flows to runAutomation tests. The first part oftestautomation is to develop test strategy and testcases. Onceautomation testcasesareready foran application, we haveto plug theseinto eachBuild run. In eachBuild werunUnit tests, Integration testsand Functionaltests.

With a Jenkins job, we can automate all these tasks. Once all the automated tests pass, we consider the build as green. This helps in deploymentand release processes to build confidence on theapplication software.

**32. What are the main services of AWS that you have used?** We usefollowingmain services ofAWS in ourenvironment:

I. **EC2** : This is the Elastic Compute Cloud by Amazon. It is used to for providing computing capability to a system. We can use it in places of our standalone servers. We can deploy different kinds ofapplications on EC2.

II. **S3** :We use S3 inAmazon for our storage needs.

III. **DynamoDB** :We use DynamoDBinAWS for storing datainNoSQL databaseform.

IV. **AmazonCloudWatch** :We use CloudWatch to monitor ourapplication inCloud.

V. **Amazon SNS** : We use Simple Notification Service to inform users about any issues in Production environment.

**33. Why GIT is considered better than CVS for version control system?** GIT is a distributed system. In GIT, any person can create its own branch and start checking in the code. Once the code is tested, it is merged into mainGIT repo. IN between, Dev, QAand productcan validatetheimplementation ofthatcode.

InCVS, thereisacentralized systemthatmaintainsallthecommitsand changes.

GIT is open sourcesoftwareand thereare plenty ofextensions inGIT for use by our teams.

**34. What is the difference between a Container and a Virtual Machine?** We need to select anOperating System(OS) to get a specific VirtualMachine (VM). VM provides fullOS to an application for running in a virtualized environment.

AContainer uses APIs ofanOperating System(OS) to provideruntimeenvironment to an application. AContainer is very lightweight in comparisonwith a VM.

VMprovides higher level ofsecurity compared to a Container.

AContainer just provides the APIs thatarerequired by theapplication.

**35. What is Serverless architecture?**

Serverless Architectureisatermthat refers to following:

I. AnApplication that depends on athird-party service.

II. AnApplication inwhichCodeis run on ephemeralcontainers.

InAWS, Lambdaisa popular serviceto implement Serverlessarchitecture.

Anotherconcept in ServerlessArchitectureis to treatcodeasaservice or Function asa Service(FAAS). Wejust writecode thatcan berun on any environment or server without the need ofspecifyingwhich server should be used to run thiscode.

**36. What are the main principles of DevOps?**

DevOps is different fromTechnicalOperations. It has followingmain principles:

I. **Incremental** : In DevOps we aim to incrementally release software to production. We do releases to productionmore often thanWaterfallapproach of onelargerelease.

II. **Automated** :To enable useto makereleases more often, weautomatethe operations fromCode Check in to deployment in Production.

III. **Collaborative** :DevOps is not only responsibility ofOperations team. It is a collaborative effort ofDev, QA, Releaseand DevOps teams.

IV. **Iterative** :DevOps is based on Iterative principle of using a process that is repeatable. But with each iteration weaimto makethe process moreefficientand better.

V. **Self-Service** : In DevOps, we automate things and give self-service options to other teams so that they are

empowered to deliver the work in their domain.

**37. Are you more Dev or more Ops?**

This is a tricky question. DevOps is a new concept and in any organization the maturity of DevOps varies from highly Operations oriented to highlyDevOps oriented. In some projects teams are verymature and practice DevOps in it true form. In some projects, teams relymore onOperations team.

Asa DevOps person I givefirst priority to the needs ofan organization and project. Atsometimes I may haveto performalot of operations work. But with each iteration, Iaimto bringDevOpschanges incrementally to an organization.

Over time, organization/projectstarts seeing results ofDevOps practicesand embraces it fully.

**38. What is a REST service?**

REST is also known as Representational State Transfer. A REST service is a simple software functionality that is available over HTTP protocol. It isalightweightservicethat is widely available dueto the popularity ofHTTP protocol.

Sine REST is lightweight; it has very good performance in a software system. It is also one of the foundations for creating highly scalablesystems that provideaserviceto large number ofclients.

Another key feature of a REST service is that as long as the interface is kept same, we can change the underlying implementation. E.g. Clients of REST service can keep calling the same service while we change the implementation fromphp to Java.

**39. What are the Three Ways of DevOps?**

Three Ways ofDevOps refers to three basic principles ofDevOpsculture. Theseareas follows:

I. **The First Way: Systems Thinking** :In this principle weseethe DevOpsasaflowofwork fromleft to right. This is the time taken fromCode check in to the feature being released to End customer. In DevOps culture wetry to identify the bottlenecks in this.

II. **The Second Way: Feedback Loops** : Whenever there is an issue in production it is a feedback about the whole development and deployment process. We try to make the feedback loop more efficient so that teams can get the feedback much faster. It is a way ofcatching defect much earlier in process than it being reported by customer.

III. **The ThirdWay: Continuous Learning** :We make use offirstand second way principles to keep onmaking improvements in the overall process. This is thethird principleinwhich over thetime we makethe processand our operations highly efficient,automated and error free by continuously improving them.

**40. How do you apply DevOps principles to make system Secure?** Security of a system is one of the most important goals for an organization. We use following ways to apply DevOps to security.

I. **Automated Security Testing** : We automate and integrate Security testing techniques for Software Penetration testing and Fuzztesting in software development process.

II. **Early Security Checks** : We ensure that teams know about the security concerns at the beginning of a project, rather than at the end of delivery. It is achieved by conducting Security trainings and knowledge sharing sessions.

III. **Standard Process** : At DevOps we try to follow standard deployment and development process that has already gone through security audits. This helps in minimizing the introduction of any new security loopholes dueto changein thestandard process.

**41. What is Self-testing Code?**

Self-testing Code is an important feature ofDevOps culture. InDevOps culture, development teammembers are expected to write self-testing code. It means we have to write code along with the tests that can test this code. Once the test passes, we feelconfident to releasethecode.

Ifwe getan issuein production, wefirst writean automation test to validatethat theissue happens in current release. Oncethe issue in release code is fixed, we run the same test to validate that the defect is not there. With each release we keep running thesetests so that theissue does notappearanymore.

One ofthetechniques ofwriting Self-testing codeis Test DrivenDevelopment (TDD).

**42. What is a Deployment Pipeline?**

ADeployment Pipeline is an important concept in Continuous Delivery. In Deployment Pipeline we break the build process into distinctstages. In each stage we get thefeedback to move onto the nextstage.

It isacollaborativeeffort between various groups involved in delivering software development.

Often thefirststageinDeployment Pipelineiscompiling thecodeand converting into binaries.

After that we run the automated tests. Depending on the scenario, there are stages like performance testing, security check, usability testing etcin a Deployment Pipeline.

InDevOps, ouraimis to automateall thestages ofDeployment Pipeline. With asmooth runningDeployment Pipeline, wecan achievethe goal ofContinuous Delivery.

**43. What are the main features of Docker Hub?**

Docker Hub provides followingmain features:

I. **Image Repositories** : In Docker Hub we can push, pull, find and manage Docker Images. It is a big library that has images fromcommunity, officialas wellas privatesources.

II. **Automated Builds** : We can use Docker Hub to create new images by making changes to source coderepository oftheimage.

III. **Webhooks** : With Webhooks inDocker Hub we can trigger actions that can create and build new images by pushing achangeto repository.

IV. **Github/Bitbucket integration** :Docker Hub also provides integrationwithGithub and Bitbucketsystems.

**44. What are the security benefits of using Container based system?** Some ofthe main security benefits of using a Container based systemareas follows:

I. **Segregation** : In a Container based system we segregate the applications on different containers. Each applicationmay berunning on same host but in aseparatecontainer. Each application hasaccess to ports, files and other resources thatare provided to it by thecontainer.

II. **Transient** :In a Container based system, each application isconsidered asa transient system. It is better than astaticsystemthat has fixed environment which can beexposed overtime.

**III. Control:** We use repeatable scripts to create the containers. This provides us tight control over the software application that we want to deploy and run. It also reduces the risk of unwanted changes in setup that can causesecurity loopholes.

**IV. Security Patch:** In a Container based system; we can deploy security patches on multiple containers in a uniformway. Also it iseasier to patch a Container with an application update.

**45. How many heads can you create in a GIT repository?**

Therecan beany number of heads in a GIT repository.

By default thereis one head known as HEADin each repository inGIT.

**46. What is a Passive check in Nagios?**

In Nagios, we can monitor hosts and services by active checks. In addition, Nagios also supports Passive checks that are initiated by externalapplications.

Theresults ofPassivechecksaresubmitted to Nagios. Therearetwo main usecases ofPassivechecks:

I. We use Passivechecks to monitorasynchronous services that do not give positiveresult withActivechecksat regular intervals oftime.

II. Wecan use Passivechecks to monitor services orapplications thatarelocated behind afirewall. **47. What is a Docker container?**

ADocker Container isalightweight systemthatcan berun on a Linux operating systemora virtualmachine. It isa package of an application and related dependencies thatcan berun independently.

Since Docker Container is very lightweight, multiplecontainerscan berun simultaneously on asingleserver or virtualmachine.

With a Docker Container we can create an isolated systemwith restricted services and processes. AContainer has private viewofthe operating system. It has its own process IDspace, filesystem,and network interface.

Multiple Docker Containerscan sharesame Kernel.

**48. How will you remove an image from Docker?**

Wecan use docker rmicommand to deletean imagefromour localsystem.

Exactcommand is:

%docker rmi<ImageId>

Ifwe want to find IDs ofallthe Docker images in our localsystem, wecan user docker imagescommand. %docker images

Ifwe want to removea dockercontainer thenwe use docker rmcommand.

%docker rm<Container Id>

**49. What are the common use cases of Docker?**

Some ofthecommon usecases ofDockerareas follows:

I. **Setting up Development Environment** : We can use Docker to set the development environment with the applications onwhich ourcodeis dependent.

II. **Testing Automation Setup** : Docker can also help in creating the TestingAutomation setup. We can setup differentservicesand apps withDocker to createtheautomation-testing environment.

III. **Production Deployment** : Docker also helps in implementing the Production deployment for an application. We can use it to create the exact environment and process that will be used for doing the production deployment.

**50. Can we lose our data when a Docker Container exits?**

ADocker Container has its own file-system. In an application running on Docker Container we can write to this file-system. When the container exits, data written to file-systemstill remains. When we restart the container, same data can be accessed again.

Onlywhenwe deletethecontainer, related data will be deleted.

**Docker Questions**

**51. What is Docker?**

Docker is Open Sourcesoftware. It provides theautomation ofLinux application deployment in asoftwarecontainer. Wecan do operating systemlevel virtualization onLinuxwithDocker.

Docker can package software in a complete file system that contains software code, runtime environment, system tools, & libraries thatarerequired to installand run thesoftware on aserver.

**52. What is the difference between Docker image and Docker container?**

Dockercontainer is simply an instance ofDocker image.

ADocker imageisan immutablefile, which isasnapshot ofcontainer. Wecreatean image with **build** command. Whenwe userun command,an Image will produceacontainer.

In programming language,an Imageisa Classand a Container isan instance oftheclass.

**53. How is a Docker container different from a hypervisor?**

In a Hypervisorenvironment wefirstcreatea VirtualMachineand then installanOperating Systemon it.After that we deploy theapplication. The virtualmachine may also beinstalled on different hardwareconfigurations.

In a Docker environment, we just deploy the application in Docker. There is no OS layer in this environment. We specify libraries,and rest ofthe kernelis provided byDockerengine.

In a way, Dockercontainerand hypervisorarecomplementary to each other.

**54. Can we write compose file in json file instead of yaml?**

Yes. Yamlformat isasuperset ofjson format. Thereforeany json fileisalso a valid Yamlfile.

Ifwe useajson filethenwe haveto specify in dockercommand that weare using ajson fileas follows:

%docker-compose-f docker-compose.json up

**55. Can we run multiple apps on one server with Docker?**

Yes, theoreticallywe can runmultiples apps on one Docker server. But in practice, it is better to run different components on separatecontainers.

With this we getcleanerenvironmentand itcan be used for multiple uses.

**56. What are the main features of Docker-compose?**

Some ofthe main features ofDocker-composeareas follows:

I. **Multiple environments on same Host** : We can use it to create multiple environments on the same host server.

II. **Preserve Volume Data on Container Creation** : Docker compose also preserves the volume data when wecreateacontainer.

III. **Recreate the changedContainers** :Wecan also usecomposeto recreatethechanged containers. IV. **Variables in Compose file** : Docker compose also supports variables in compose file. In this way we can create variations of ourcontainers.

**57. What is the most popular use of Docker?**

The most popular use ofDocker is in build pipeline. With the use ofDocker it is much easier to automate the development to deployment process in build pipeline.

We use Docker for thecomplete build flowfromdevelopment work, test run and deployment to production environment.

**58. What is the role of open source development in the popularity of Docker?**

Since Linuxwasan open source operating system, it opened newopportunities for developers who want to contributeto open sourcesystems.

One ofthe very good outcomes of open sourcesoftwareis Docker. It has very powerfulfeatures. Docker has wideacceptance dueto its usability as wellas its open sourceapproach ofintegratingwith differentsystems.

**59. What is the difference between Docker commands: up, run and start?** We have up and startcommands in docker-compose. Therun command is in docker.

a. **Up** : We use this command to build, create, start or restart all the services in a docker-compose.yml file. It also attaches to containers foraservice.

Thiscommand can also start linked services.

b. **Run** : We use this command for adhoc requests. It just starts the service that we specifically want to start. We generally useit run specifictests orany administrativetasks.

c. **Start** : This command is used to start the container that were previously created but are not currently running. Thiscommand does notcreate newcontainers.

**60. What is Docker Swarm?**

Docker Swarm is used to create a cluster environment. It can turn a group of Docker engines into a Single virtual Docker Engine. Thiscreatesasystemwith pooled resources. Wecan use Docker Swarmto scale ourapplication.

**61. What are the features of Docker Swarm?**

Some ofthe key features ofDocker Swarmareas follows:

I. **Compatible** :Docker Swarmiscompatible with standard Docker API.

II. **High Scalability** : Swarmcan scale up to as much as 1000 nodes and 50000 containers. There is almost no performance degradation at this scaleinDocker Swarm.

III. **Networking** :Swarmcomes with support for Docker Networking.

IV. **High Availability** : We can create a highly available system with Docker Swarm. It allows use to create multiple master nodes so that in case ofafailure,another nodecan take over.

V. **Node Discovery** : In Docker Swarm, we can add more nodes and the new nodes can be found with any discovery servicelikeetcd orzookeeperetc.

**62. What is a Docker Image?**

Docker Image is the blue print that is used to create a Docker Container. Whenever we want to run a container we have to specify theimagethat we want to run.

Thereare manyDocker imagesavailable onlinefor standard software. Wecan usetheseimages directly fromthesource.

The standard set ofDocker Images is stored inDocker Hub Registry. We can download these fromthis location and use it in ourenvironment.

Wecan also create our ownDocker Image with thesoftwarethat we want to run asacontainer.

**63. What is a Docker Container?**

ADocker Container isalightweight systemthatcan berun on a Linux operating systemora virtualmachine. It isa package of an application and related dependencies thatcan berun independently.

Since Docker Container is very lightweight, multiplecontainerscan berun simultaneously on asingleserver or virtualmachine.

With a Docker Container we can create an isolated systemwith restricted services and processes. AContainer has private viewofthe operating system. It has its own process IDspace, filesystem,and network interface.

Multiple Docker Containerscan sharesame Kernel.

**64. What is Docker Machine?**

Wecan use Docker Machineto installDocker Engine on virtual hosts. Italso providescommands to manage virtual hosts. Some ofthe popular Docker machinecommandsenable us to start, stop, inspectand restarta managed host. Docker Machine providesa Command LineInterface(CLI), which is very usefulinmanagingmultiple hosts.

**65. Why do we use Docker Machine?**

Therearetwo main uses ofDocker Machine:

I. **Old Desktop** : If we have an old desktop and we want to run Docker then we use Docker Machine to run Docker. It is likeinstalling a virtualmachine on an old hardwaresystemto runDockerengine.

II. **Remote Hosts** : Docker Machine is also used to provision Docker hosts on remote systems. By using Docker Machine you can installDocker Engine on remote hostsand configureclients on them.

**66. How will you create a Container in Docker?**

To create a Container in Docker we have to create a Docker Image. We can also use an existing Image fromDocker Hub Registry.

Wecan run an Imageto createthecontainer.

**67. Do you think Docker is Application-centric or Machine-centric?**

Docker is anApplication-centric solution. It is optimized for deployment ofan application. It does not replace a machine by creating a virtualmachine. Rather, it focuses on providing ease of usefeatures to run an application.

**68. Can we run more than one process in a Docker container?** Yes, a Docker Container can provide process management that can be used to run multiple processes. There are process supervisors likerunit, s6, daemontoolsetcthatcan be used to fork additional processes in a Dockercontainer.

**69. What are the objects created by Docker Cloud in Amazon Web Services (AWS) EC2?**

Docker Cloud creates following objects inAWS EC2 instance:

I. **VPC** : Docker Cloud creates a Virtual Private Cloud with the tag name dc-vpc. It also creates Class Less Inter-DomainRouting (CIDR) with therange of 10.78.0.0/16 .

II. **Subnet** : Docker Cloud creates a subnet in each Availability Zone (AZ). In Docker Cloud, each subnet is tagged with dc-subnet.

III. **Internet Gateway** : Docker Cloud also creates an internet gateway with name dc-gateway and attaches it to the VPC created earlier.

IV. **Routing Table** :Docker Cloud also creates a routing table named dc-route-table inVirtual Private Cloud. In this RoutingTable Docker Cloud associates thesubnet with theInternet Gateway.

**70. How will you take backup of Docker container volumes in AWS S3?** Wecan usea utility named Dockup provided byDocker Cloud to take backup ofDockercontainer volumes in S3.

**71. What are the three main steps of Docker Compose?**

Three main steps ofDocker Composeareas follows:

I. **Environment** :Wefirst definetheenvironment of ourapplicationwith a Dockerfile. Itcan be used to recreate theenvironmentatalater point oftime.

II. **Services** : Then we define the services that make our app in docker-compose.yml. By using this file we can define howtheseservicescan berun together in an environment.

III. **Run** : The last step is to run the Docker Container. We use docker-compose up to start and run the application.

**72. What is Pluggable Storage Driver architecture in Docker based containers?**

Docker storage driver is by default based on a Linux file system. But Docker storage driver also has provision to plug in any other storage driver thatcan be used for ourenvironment.

In Pluggable Storage Driver architecture, we can use multiple kinds of file systems in our Docker Container. In Docker info command wecan seethe Storage Driver that is set on a Docker daemon.

Wecan even plug in shared storagesystems with the Pluggable Storage Driverarchitecture.

**73. What are the main security concerns with Docker based containers?** Docker based containers havefollowing security concerns:

I. **Kernel Sharing** :In acontainer-based system, multiplecontainers sharesame Kernel. If onecontainercauses Kernel to go down, it will take down all the containers. In a virtualmachine environment we do not have this issue.

II. **Container Leakage** : If a malicious user gains access to one container, it can try to access the other containers on the same host. If a container has security vulnerabilities it can allow the user to access other containers on same hostmachine.

III. **Denial of Service** : If one container occupies the resources ofa Kernel then other containers willstarve for resources. Itcan createa Denial ofServiceattack likesituation.

IV. **Tampered Images** : Sometimes a container image can be tampered. This can lead to further security concerns. An attacker can try to run a tampered image to exploit the vulnerabilities in host machines and othercontainers.

V. **Secret Sharing** :Generally one container can access other services. To access a service it requires a Key or Secret. Amalicious user can gain access to this secret. Since multiple containers share the secret, it may lead to further security concerns.

**74. How can we check the status of a Container in Docker?**

Wecan use docker ps –acommand to get thelist ofallthecontainers inDocker. Thiscommand also returns thestatus ofthesecontainers. **75. What are the main benefits of using Docker?**

Docker isa very powerfultool. Some ofthe main benefits of usingDockerareas follows:

I. **Utilize Developer Skills** :WithDocker we maximizethe use ofDeveloper skills. WithDocker thereis less need of build or releaseengineers. Same Developercan createsoftwareand wrap it in onesinglefile.

II. **StandardApplication Image** :Docker based systemallows us to bundletheapplication softwareand Operating systemfiles in a single Application Imagethatcan be deployed independently.

III. **Uniformdeployment** :WithDocker wecan create one package of our softwareand deploy it on different platforms seamlessl y .

**76. How does Docker simplify Software Development process?**

Prior to Docker, Developers would develop softwareand pass it to QAfor testing and then it is sent to Build &Releaseteamfor deployment.

InDocker workflow, Developer buildsan Imageafter developing and testing thesoftware. This Imageis shipped to Registry. FromRegistry it is availablefor deployment to any system. The development process is simpler sincesteps for QAand Deploymentetctake place beforetheImage is built. So Developer gets thefeedback early.

**77. What is the basic architecture behind Docker?**

Docker is built on clientserver model. Docker server is used to run theimages. We use Dockerclient to communicate withDocker server. Clients tellDocker server viacommands what to do.

Additionally thereisa Registry thatstores Docker Images. Docker Servercan directly contact Registry to download images.

**78. What are the popular tasks that you can do with Docker Command line tool?**

Docker Command Line(DCL) toolis implemented inGo language. Itcan compileand run onmost ofthecommon operating systems. Some of thetasks that wecan do withDocker Command Linetoolareas follows:

I. Wecan download images fromRegistrywithDCL.

II. Wecan start, stop or terminateacontainer on a Docker server byDCL.

III. Wecan retrieve Docker Logs via DCL.

IV. Wecan build a Container Image withDCL.

**79. What type of applications- Stateless or Stateful are more suitable for Docker Container?**

It is preferableto create Statelessapplication for Docker Container. Wecan createacontainer out of ourapplication and take out theconfigurable state parameters fromapplication. Nowwecan run samecontainer in Production as wellas QAenvironments with different parameters. This helps in reusing thesameImagein differentscenarios. Also astatelessapplication is much easier to scale withDocker Containers than astateful application.

**80. How can Docker run on different Linux distributions?**

Docker directlyworks withLinux kernellevellibraries. In everyLinux distribution, the Kernelis same. Dockercontainers sharesame kernelas the host kernel.

Sinceallthe distributions sharethesame Kernel, thecontainercan run on any ofthese distributions.

**81. Why do we use Docker on top of a virtual machine?**

Generallywe use Docker on top ofa virtualmachineto ensureisolation oftheapplication. On a virtualmachine wecan get theadvantage of security provided by hypervisor. Wecan implement differentsecurity levels on a virtualmachine. And Dockercanmake use ofthis to run the application at differentsecurity levels.

**82. How can Docker container share resources?**

Wecan runmultiple Dockercontainers on same host. Thesecontainerscan share Kernelresources. Each container runs on its ownOperating Systemand it has its own user-spaceand libraries.

So in a wayDockercontainer does notshareresources within its own namespace. But theresources thatare not in isolated namespaceareshared between containers. Thesearethe Kernelresources of hostmachinethat havejust onecopy.

So in the back-end thereis sameset ofresources that Docker Containers share.

**83. What is the difference between Add and Copy command in a Dockerfile?**

BothAdd and Copy commands ofDockerfilecan copy newfiles fromasourcelocation to a destination inContainer’s file path. They behavealmostsame.

The main difference between thesetwo is that Add command can also read thefiles froma URL.

As per Docker documentation, Copy command is preferable. Since Copy only supportscopying localfiles to a Container, it is preferred over Add command.

**84. What is Docker Entrypoint?**

We use Docker Entrypoint to set thestarting point foracommand in a Docker Image.

Wecan usetheentrypointasacommand for running an Imagein thecontainer.

E.g. Wecan definefollowing entrypoint in docker fileand run itas following command:

ENTRYPOINT [“mycmd”]

%docker runmycmd

**85. What is ONBUILD command in Docker?**

We use ONBUILDcommand inDocker to run theinstructions that haveto executeafter thecompletion ofcurrent Dockerfile build. It is used to build a hierarchy ofimages that haveto be build after the parent imageis built.

ADocker build willexecutefirst ONBUILDcommand and then it willexecuteany othercommand inChild Dockerfile. **86. What is Build cache in Docker?**

Whenwe build an Image, Docker will processeach lineinDockerfile. It willexecutethecommands on each linein the order that is mentioned in thefile.

Butateach line, beforerunning any command, Docker willcheck ifthereisalready an existing imagein itscachethatcan bereused rather than creating a newimage.

This method of using cacheinDocker iscalled Build cacheinDocker.

Wecan also specify the option –no-cache=trueto let Docker knowthat we do not want to usecachefor Images. With this option, Docker will createall newimages.

**87. What are the most common instructions in Dockerfile?**

Some ofthecommon instructions inDockerfileareas follows:

I. **FROM** :We use FROMto set the baseimagefor subsequent instructions. In every valid Dockerfile, FROMis thefirst instruction.

II. **LABEL**:We use LABEL to organize our imagesas per project, module, licensing etc. Wecan also use LABEL to help in automation.

InLABELwespecify a key value pair thatcan belater used for programmatically handling the Dockerfile.

III. **RUN** :We use RUN command to executeany instructions in a newlayer on top ofthecurrent image. With eachRUN command weadd something on top oftheimageand useit in subsequentsteps inDockerfile.

IV. **CMD** :We use CMDcommand to provide default values ofan executing container. In a Dockerfile, ifweinclude multiple CMD commands, then only thelast instruction is used.

**88. What is the purpose of EXPOSE command in Dockerfile?**

We use EXPOSE command to informDocker that Container willlisten on aspecific network port during runtime. But these ports onContainer may not beaccessibleto the host. Wecan use –p to publish arange of ports fromContainer.

**89. What are the different kinds of namespaces available in a Container?**

In a Container we havean isolated environment with namespaceforeach resourcethata kernel provides. Thereare mainly six types of namespaces in a Container.

I. **UTS Namespace** :UTS stands for UnixTimesharing System. InUTS namespaceevery container gets its own hostnameand domain name.

II. **Mount Namespace** :This namespace provides its own filesystemwithin acontainer. With this namespace we get root like/ in the filesystemonwhich rest ofthefilestructureis based.

III. **PID Namespace** :This namespacecontainsallthe processes that runwithin a Container. Wecan run pscommand to seethe processes thatarerunningwithin a Dockercontainer.

IV. **IPCNamespace** :IPC stands for Inter Process Communication. This namespacecovers shared memory, semaphores, named pipesetcresources thatareshared by processes. Theitems in this namespace do notcross thecontainer boundary.

V. **UserNamespace** :This namespacecontains the usersand groups thatare defined within acontainer.

VI. **Network Namespace** :With this namespace,container provides its own network resources like- ports, devicesetc. With this namespace, Dockercreatesan independent network stack within each container.

**90. How will you monitor Docker in production?**

Docker provides tools like docker statsand dockerevents to monitor Docker in production.

Wecan get reports on importantstatistics with thesecommands.

**Dockerstats** :Whenwecall docker stats with acontainer id, we get the CPU, memory usageetc ofacontainer. It is similar to top command in Linux.

**Dockerevents** :Dockereventsareacommand to seethestreamofactivities thatare going on inDocker daemon. Some ofthecommonDockereventsare:attach,commit, die, detach, rename, destroy etc.

Wecan also use various options to limit or filter theevents that weareinterested in.

**91. What are the Cloud platforms that support Docker?**

Some ofthe popularcloud platforms thatsupport Dockerare:

I. AmazonAWS

II. Google Cloud Platform

III. Microsoft Azure

IV. IBMBluemix

**92. How can we control the startup order of services in Docker compose?**

InDockercompose wecan usethe depends\_on option to controlthestartup order ofservices.

With compose, theservices willstart in the dependency order. Dependenciescan be defined in the options like- depends\_on, links, volumes\_from, network\_modeetc.

But Docker does not wait for untilacontainer is ready.

**93. Why Docker compose does not wait for a container to be ready before moving on to start next service in dependency order?**

The problemwithwaiting foracontainer to beready is that in a Distributed system, someservices or hosts may become unavailablesometimes. Similarly during startup also someservices may also be down.

Therefore, we haveto build resiliency in ourapplication. So thateven ifsomeservicesare downwecan continue our work or wait for theservice to becomeavailableagain.

Wecan use wait-for-it or dockerizetools for building this kind ofresiliency.

**94. How will you customize Docker compose file for different**

**environments?**

InDockercomposetherearetwo files docker-compose.ymland docker-compose.override.yml. Wespecify our baseconfiguration in docker compose.ymlfile. Forany environmentspecificcustomizationwe use docker-compose.override.ymlfile.

Wecan specify aservicein both thefiles. Dockercompose willmergethesefiles based on following rules:

For single value options, newvaluereplaces the old value.

For multi-value options,compose willconcatenatethe both set of values.

Wecan also useextends field to extend aserviceconfiguration to multipleenvironments. With extends,child servicescan usethecommon configuration defined by parentservice.

**Cloud Computing Questions**

**95. What are the benefits of Cloud Computing?**

Therearetenmain benefits ofCloud Computing:

I. **Flexibility** :The businesses that havefluctuating bandwidth demands need theflexibility ofCloud Computing. If you need high bandwidth, you can scale up yourcloud capacity. When you do not need high bandwidth, you can justscale down. Thereis no need to betied into an inflexiblefixed capacity infrastructure.

II. **DisasterRecovery** :Cloud Computing provides robust backup and recovery solutions thatare hosted in cloud. Dueto this there is no need to spend extraresources on homegrown disaster recovery. Italso saves timein setting up disaster recovery. III. **Automatic Software Updates** :Most ofthe Cloud providers giveautomaticsoftware updates. This reduces theextratask of installing newsoftware version and alwayscatching up with thelatestsoftwareinstalls.

IV. **LowCapital Expenditure** :InCloud computing the modelis Pay as youGo. This means thereis very less upfrontcapital expenditure. Thereisa variable payment that is based on the usage.

V. **Collaboration:** In acloud environment,applicationscan beshared between teams. This increasescollaboration and communication among teammembers.

VI. **Remote Work:** Cloud solutions provideflexibility ofworking remotely. Thereis no on site work. Onecan justconnect from anywhereand start working.

VII. **Security:** Cloud computing solutionsare moresecurethan regular onsite work. Datastored in localserversand computers is proneto security attacks. InCloud Computing, thereare very fewlooseends. Cloud providers giveasecure working environment to its users.

VIII. **Document Control:** Oncethe documentsarestored in acommon repository, it increases the visibility and transparency among companiesand theirclients. Sincethereis oneshared copy, therearefewerchances of discrepancies.

IX. **Competitive Pricing:** InCloud computing thereare multiple players, so they keep competing among themselvesand provide very good pricing. Thiscomes outmuch cheapercompared to other options.

X. **Environment Friendly:** Cloud computing saves preciousenvironmentalresourcesalso. By not blocking theresourcesand bandwidth.

**96. What is On-demand computing in Cloud Computing?**

On-demand Computing is thelatestmodelin enterprisesystems. It is related to Cloud computing. Itmeans IT resourcescan be provided on demand by a Cloud provider.

In an enterprisesystemdemand forcomputing resources varies fromtimeto time. In such ascenario, On-demand computingmakes surethat serversand IT resourcesare provisioned to handletheincrease/decreasein demand.

Acloud provider maintainsa poll ofresources. The pool ofresourcescontains networks, servers, storage,applicationsand services. This poolcan

servethe varying demand ofresourcesand computing by variousenterpriseclients.

Thereare many concepts like- grid computing, utility computing,autonomiccomputing etc. thataresimilar to on-demand computing. This is the most popular trend in computingmodelas of now.

**97. What are the different layers of Cloud computing?**

Three main layers ofCloud computing areas follows:

I. **Infrastructure as a Service (IAAS):** IAAS providers givelow-levelabstractions of physical devices. AmazonWeb Services (AWS) isan example ofIAAS. AWS provides EC2 forcomputing, S3 buckets for storageetc. Mainly theresources in this layer are hardwarelike memory, processor speed, network bandwidth etc.

II. **Platformas a Service (PAAS):** PAAS providers offer managed services like Rails, Django etc. One good example ofPAAS is Google App Engineer. Thesearetheenvironments inwhich developerscan develop sophisticated software with ease.

Developers just focus on developing software, whereas scaling and performanceis handled by PAAS provider.

III. **Software as a Service (SAAS)** :SAAS provider offeran actualworking softwareapplication to clients. Salesforceand Github aretwo good examples ofSAAS. They hidethe underlying details ofthesoftwareand just providean interfaceto work on the system. Behind thescenes the version ofSoftwarecan beeasily changed.

**98. What resources are provided by Infrastructure as a Service (IAAS) provider?**

An IAAS providercan give physical, virtual or both kinds ofresources. Theseresourcesare used to build cloud. IAAS provider handles thecomplexity ofmaintaining and deploying theseservices.

IAAS provideralso handles security and backup recovery for theseservices. The main resources in IAAS areservers, storage, routers, switches and other related hardwareetc.

**99. What is the benefit of Platform as a Service?**

Platformasaservice(PaaS) isa kind ofcloud computing service. APaaS provider offersa platformonwhich clientscan develop, run and manageapplications without the need of building theinfrastructure.

In PAAS clients savetime by notcreating and managing infrastructureenvironmentassociated with theapp that theywant to develop. **100. What are the main advantages of PaaS?**

Theadvantages ofPaaS are:

I. Itallows development work on higher level programmingwith very lesscomplexity.

II. Teamscan focus on just the development oftheapplication thatmakes theapplication very effective.

III. Maintenanceand enhancement oftheapplication is much easier.

IV. It is suitablefor situations inwhichmultiple developers work on asingle project butare notco-located.

**101. What is the main disadvantage of PaaS?**

Biggest disadvantage ofPaaS is thata developercan only usethetools that PaaS provider makesavailable. Adevelopercannot usethefullrange ofconventionaltools.

Some PaaS providers lock in theclients in their platform. Thisalso decreases theflexibility ofclients using PaaS.

**102. What are the different deployment models in Cloud computing?** Cloud computing supports following deploymentmodels:

**I. Private Cloud:** Somecompanies build their privatecloud. Aprivatecloud isafully functional platformthat is owned, operated and used by only one organization.

Primary reason for privatecloud is security. Many companies feelsecurein privatecloud. The other reasons for building privatecloud arestrategic decisions orcontrol of operations.

Thereisalso aconcept ofVirtualPrivate Cloud (VPC). InVPC, privatecloud is builtand operated by a hosting company. But it isexclusively used by one organization.

**II. Public Cloud:** Therearecloud platforms by somecompanies thatare open for general publicas wellas big companies for useand deployment. E.g. Google Apps, AmazonWeb Servicesetc.

The publiccloud providers focus on layersand application like- cloud application, infrastructure managementetc. In this model resourcesareshared among different organizations.

**III. HybridCloud:** Thecombination of publicand privatecloud is known as Hybrid cloud. Thisapproach provides benefits of both theapproaches- privateand publiccloud. So it is very robust platform.

Aclient gets functionalitiesand features of both thecloud platforms. By usingHybrid cloud an organization can createits own cloud as wellas they can pass thecontrol oftheircloud to another third party.

**103. What is the difference between Scalability and Elasticity?**

Scalability is theability ofasystemto handletheincreased load on itscurrent hardwareand softwareresources. In a highly scalablesystemit is possibleto increasethe workload without increasing theresourcecapacity. Scalability supportsany sudden surgein the demand/traffic with currentset ofresources.

Elasticity is theability ofasystemto increasethe workload by increasing the hardware/softwareresources dynamically. Highly elasticsystemscan

handletheincreased demand and traffic by dynamically commission and decommission resources. Elasticity isan importantcharacteristic ofCloud Computing applications. Elasticitymeans howwell yourarchitectureisadaptableto workload in realtime.

E.g. Ifin asystem, oneservercan handle 100 users, 2 serverscan handle 200 usersand 10 serverscan handle 1000 users. But in caseforadding everyXusers, if you need 2Xtheamount ofservers, then it is notascalable design.

Letsay, you havejust one user login every hour on your site. Your oneservercan handlethis load. But, ifsuddenly, 1000 users login at once,can your systemquickly start newweb servers on thefly to handlethis load? Your design iselasticifitcan handlesuch sudden increasein trafficso quickly.

**104. What is Software as a Service?**

Softwareas Serviceisacategory ofcloud computing inwhich Softwareiscentrally hosted and it is licensed on asubscription basis. It isalso known as On-demand software. Generally,clientsaccess thesoftware by using athin-client likea web browser.

Many applications like Google docs, Microsoft officeetc. provide SaaS modelfor their software.

The benefit ofSaaS is thataclientcan add more users on thefly based on itscurrent needs. And client does not need to install or maintain any software on its premises to usethis software.

**105. What are the different types of Datacenters in Cloud computing?** Cloud computing consists of different types ofDatacenters linked in a grid structure. The main types ofDatacenters inCloud computing are:

**I. ContainerizedDatacenter**

As the namesuggests,containerized datacenter provides high level ofcustomization foran organization. Thesearetraditional kind of datacenters. Wecan choosethe different types ofservers, memory, network and other infrastructureresources in this datacenter. Also we haveto plan temperaturecontrol, network managementand power management in this kind of datacenter.

**II. Low-Density Datacenters**

In a Low-density datacenter, we get high level of performance. In such a datacenter ifweincreasethe density ofservers, theissue with powercomes. With high density ofservers, thearea gets heated. In such ascenario,effective heatand power management is done. To reach high level of performance, we haveto optimizethe number ofservers’ in the datacenter.

**106. Explain the various modes of Software as a Service (SaaS) cloud environment?**

Softwareasa Service(SaaS) is used to offer different kinds ofsoftwareapplications in a Cloud environment. Generally theseare offered on subscription basis. Differentmodes ofSaaS are:

I. **Simple multi-tenancy** :In this setup,each client gets its own resources. Theseresourcesare notshared with otherclients. It is moresecure option, sincethereis no sharing ofresources. But itan inefficient option, sinceforeach clientmore money is needed to scaleit with therising demands. Also it takes timeto scale up theapplication in this mode.

II. **Fine grainmulti-tenancy** :In this mode, thefeature provided to each client is same. Theresourcesareshared amongmultiple clients. It isan efficientmode ofcloud service, inwhich datais kept privateamong differentclients butcomputing resourcesare shared. Also it iseasierand quicker to scale up the SaaS implementation for differentclients.

**107. What are the important things to care about in Security in a cloud environment?**

In acloud-computing environment, security is one ofthe most importantaspects.

With growing concern of hacking,every organizationwants to makeits softwaresystemand datasecure. Sincein acloud computing environment, Softwareand hardwareis not on the premises ofan organization, it becomes moreimportant to implement the bestsecurity practices.

Organizations haveto keep their Data mostsecure during thetransfer between two locations. Also they haveto keep datasecure when it is stored atalocation. Hackerscan hack into application or they can getan unauthorized copy ofthe data. So it becomes important to encrypt the data during transitas wellas during rest to protect it fromunwanted hackers.

**108. Why do we use API in cloud computing environment?**

Application Programming Interfaces (API) is used in cloud computing environment foraccessingmany services. APIsare very easy to use. They providea quick option to create differentset ofapplications in cloud environment.

AnAPI providesasimpleinterfacethatcan be used inmultiplescenarios.

Thereare different types ofclients forcloud computingAPIs. It iseasier to serve different needs ofmultipleclients withAPIs in cloud computing environment.

**109. What are the different areas of Security Management in cloud?** Differentareas ofSecuritymanagement in cloud areas follows:

I. **Identity Management** :Thisaspectcreates different level of users, rolesand theircredentials to access theservices in cloud.

II. **Access Control** :In thisarea, wecreate multiplelevels of permissionsand accessareas thatcan be given to a user or rolefor accessing aservicein cloud environment.

III. **Authentication** :In thisarea, wecheck thecredentials ofa userand confirmthat it is thecorrect user. Generally this is done by user password and multi-factorauthentication like-verification by a one-time usecode on cell phone.

IV. **Authorization** :In thisaspect, wecheck for the permissions thatare given to a user or role. Ifa user isauthorized to accessa service, they areallowed to useit in thecloud environment.

**110. What are the main cost factors of cloud based data center?** Costs in a Cloud based datacenterare different fromatraditional datacenter. Main cost factors ofcloud based datacenterareas follows:

I. **Laborcost** :We need skilled staffthatcanwork with thecloud-based datacenter that we haveselected for our operation. Since cloud is nota very old technology, itmay get difficult to get therightskill peoplefor handling cloud based datacenter.

II. **Powercost** :In somecloud operations, powercostsare borne by theclient. Sinceit isa variablecost, itcan increase with the increasein scaleand usage.

III. **Computing cost** :The biggestcost inCloud environment is thecost that we pay to Cloud provider for giving uscomputing resources. Thiscost is much highercompared to thelabor or powercosts.

**111. How can we measure the cloud-based services?**

In acloud-computing environment we pay for theservices that we use. So main criteriato measureacloud based serviceits usage. Forcomputing resource we measure by usagein terms oftimeand the power ofcomputing resource.

Forastorageresource we measure by usagein terms of bytes (giga bytes)and bandwidth used in datatransfer.

Another importantaspect ofmeasuring acloud serviceis itsavailability. Acloud provider has to specify theservicelevelagreement (SLA) for the timefor which service will beavailablein cloud.

**112. How a traditional datacenter is different from a cloud environment?**

In atraditional datacenter thecost ofincreasing thescale ofcomputing environment is much higher than a Cloud computing environment. Also in a traditional datacenter, thereare notmuch benefits ofscaling down the operationwhen demand decreases. Since most oftheexpenditureis in capitalspent of buying serversetc., scaling down justsaves powercost, which is very lesscompared to other fixed costs.

Also in a Cloud environment thereis no need to higheralarge number of operations staffto maintain the datacenter. Cloud provider takescare of maintaining and upgrading theresources inCloud environment.

With atraditional datacenter, peoplecost is very high since we haveto hirealarge number oftechnical operation peoplefor in-house datacenter.

**113. How will you optimize availability of your application in a Cloud environment?**

In a Cloud environment, it is important to optimizetheavailability ofan application by implementing disaster recovery strategy. For disaster recoverywecreatea backup application in another location ofcloud environment. In case ofcompletefailureata datacenter we usethe disaster recovery siteto run theapplication.

Anotheraspect ofcloud environment is thatservers often fail or go down. In such ascenario it is important to implement theapplication in such a way that wejust killtheslowserverand restartanother server to handlethetrafficseamlessly.

**114. What are the requirements for implementing IaaS strategy in Cloud?** Main requirements to implement IAAS areas follows:

I. **Operating System(OS):** We need anOS to support hypervisor in IaaS. Wecan use open source OS like Linux for this purpose.

II. **Networking** :We haveto defineand implement networking topology for IaaS implementation. Wecan use public or private network for this.

III. **CloudModel** :We haveto select therightcloud modelfor implementing IaaS strategy. Itcan be SaaS, PaaS or CaaS.

**115. What is the scenario in which public cloud is preferred over private cloud?**

In astartup mode oftenwe want to test our idea. In such ascenario itmakes senseto setup application in publiccloud. It is much fasterand cheaper to use publiccloud over privatecloud.

Remember security isa majorconcern in publiccloud. But with timeand changes in technology,even publiccloud is very secure.

**116. Do you think Cloud Computing is a software application or a hardware service?**

Cloud Computing is neitherasoftwareapplication nora hardwareservice. Cloud computing isasystemarchitecturethatcan be used to implement softwareas wellas hardwarestrategy ofan organization.

Cloud Computing isa highly scalable, highly availableand costeffectivesolution for softwareand hardware needs ofan application.

Cloud Computing provides greatease of usein running thesoftwarein cloud environment. It isalso very fast to implementcompared with any other traditionalstrategy.

**117. Why companies now prefer Cloud Computing architecture over Client Server Architecture?**

InClient Serverarchitecturethereis oneto onecommunication between clientand server. Server is often at in-house datacenterand clientcan access sameserver fromanywhere. Ifclient isataremotelocation, thecommunication can have high latency.

InCloud Computing therecan be multipleservers in thecloud. There will bea Cloud controller that directs therequests to rightserver node. In such ascenario clientscan accesscloud-based servicefromany location and they can be directed to the one nearest to them.

Another reason for Cloud computing architectureis high availability. Sincethereare multipleservers behind thecloud,even if oneserver is down, another servercan servetheclients seamlessly.

**118. What are the main characteristics of Cloud Computing architecture?** Main characteristics ofCloud Computing architectureareas follows:

I. **Elasticity** :InCloud Computing systemis highly elasticin thesensethat itcan easily adapt itselfto increase or decreasein load. Thereis no need to take urgentactions when thereis surgein trafficrequests.

II. **Self-service provisioning** :InCloud environment userscan provision newresources on their own by justcalling some APIs. Thereis no need to fillformsand orderactual hardwarefromvendors.

III. **Automated de-provisioning** :In case demand/load decreases,extraresourcescan beautomatically shut down inCloud computing environment.

IV. **Standard Interface** :Therearestandard interfaces to start, stop, suspend or removean instanceinCloud environment. Most of theservicesareaccessible via publicand standard APIs inCloud computing.

V. **Usage basedBilling** :In a Cloud environment, usersarecharged for their usage ofresources. They can forecast their billand costs based on the growth they areexpecting in their load.

**119. How databases in Cloud computing are different from traditional databases?**

In a Cloud environment,companies often use different kind of datato store. Thereare datalikeemail, images, video, pdf, graph etc. in a Cloud environment. To storethis data oftenNoSQL databasesare used.

ANoSQL databaselike MongoDBprovides storageand retrieval of datathatcannot bestored efficiently in atraditionalRDBMS. Databaselike Neo4J provides features to store graph datalike Facebook, LinkedIn etc. in acloud environment.

Hadoop like database help in storingBigData based information. Itcan handle very large-scaleinformation that is generated in alarge-scale environment.

**120. What is Virtual Private Network (VPN)?**

In a Cloud environment, wecan createa virtual private network (VPM) thatcan besolely used by only oneclient. This isasecure network in which datatransfer between servers ofsame VPN is very secure.

By usingVPN,an organization uses the public network in a private manner. It increases the privacy ofan organization’s datatransfer in acloud environment.

**121. What are the main components of a VPN?**

VirtualPrivate Network (VPN)consists offollowingmain components:

I. **Network Access Server(NAS):** ANAS server is responsiblefor setting up tunnels in a VPN that isaccesses remotely. It maintains thesetunnels thatconnectclients to VPN.

II. **Firewall** :It is thesoftwarethatcreates barrier betweenVPN and public network. It protects the VPN frommaliciousactivity that can be donefromthe outside network.

III. **AAAServer**:This isan authentication and authorization server thatcontrols theaccessand usage ofVPN. Foreach request to use VPN, AAAserverchecks the user forcorrect permissions.

IV. **Encryption** :In a VPN,encryption algorithms protect theimportant private datafrommalicious users.

**122. How will you secure the application data for transport in a cloud environment?**

With ease of useinCloud environmentcomes theimportantaspect of keeping datasecure. Many organizations have datathat is transferred from their traditional datacenter to Cloud datacenter.

During thetransit of datait is important to keep itsecure. Once ofthe best way to secure datais by usingHTTPS protocol over Secure Socket Layer (SSL).

Another important point is to keep the dataalwaysencrypted. This protects datafrombeing accessed by any unauthorized user during transit.

**123. What are the large-scale databases available in Cloud?**

InCloud computing scaleis notalimit. So thereare very large-scale databasesavailablefromcloud providers. Some oftheseare:

I. **AmazonDynamoDB** :AmazonWeb Services (AWS) providesa NoSQLweb servicecalled DynamoDBthat provides highly availableand partition tolerant databasesystem. It hasa multi-master design. It uses synchronous replication across multiple datacenters. Wecan easily integrateit withMapReduceand Elastic MapReduce ofAWS.

II. **Google Bigtable** :This isa very large-scale high performancecloud based database option fromGoogle. It isavailable onGoogle Cloud. Itcan bescaled to peta bytes. It isa Google proprietary implementation. InBigtable, two arbitrary string values, rowkey and column key,and timestamp are mapped to an arbitrary bytearray. InBigtable MapReducealgorithmis used for modifying and generating the data.

III. **Microsoft Azure SQLDatabase** :Microsoft Azure providescloud based SQL databasethatcan bescaled very easily for increased demand. It has very good security featuresand itcan beeven used to build multi-tenantapps to service multiple customers in cloud.

**124. What are the options for open source NoSQL database in a Cloud environment?**

Most ofthecloud-computing providers support Open Source NoSQL databases. Some ofthese databasesare:

I. **Apache CouchDB** :It isa document based NoSQL databasefromApache Open Source. It iscompatible withCouch Replication Protocol. Itcan communicatein nativeJSON and can store binary data verywell.

II. **HBase** :It isa NoSQL databasefor use withHadoop based software. It isalso availableas Open SourcefromApache. It isa scalableand distributed BigData database.

III. **MongoDB** :It isan open source databasesystemthat offersaflexible data modelthatcan be used to store various kinds of data. It provides high performanceand always-on userexperience.

**125. What are the important points to consider before selecting cloud computing?**

Cloud computing isa very good option foran organization to scaleand outsourceits software/hardware needs. But beforeselecting acloud provider it is important to consider following points:

I. **Security** :One ofthe most important points is security ofthe data. Weshould ask thecloud providerabout the options to keep datasecurein cloud during transitand at rest.

II. **Data Integrity** :Another important point is to maintain theintegrity of datain cloud. It isessentialto keep dataaccurateand completein cloud environment.

III. **Data Loss** :In acloud environment, therearechances of dataloss. So weshould knowthe provisions to minimizethe dataloss. It can be done by keeping backup of datain cloud. Also thereshould bereliable datarecovery options in case of dataloss.

IV. **Compliance** :While using acloud environment one must beaware oftherulesand regulations that haveto befollowed to usethe cloud. Therecomplianceissues with storing data ofa user in an external provider’s location/servers.

V. **Business Continuity** :In case ofany disaster, it is important to create businesscontinuity plans so that wecan provide uninterrupted serviceto ourend users.

VI. **Availability** :Another important point is theavailability of dataand services in acloud-computing environment. It is very important to provide high availability fora good customerexperience.

VII. **Storage Cost** :Since datais stored in cloud, itmay be very cheap to storethe data. But therealcostcan comein transfer of data whenwe haveto pay by bandwidth usage. So storagecost of datain cloud should also includetheaccesscost of datatransfer.

VIII. **Computing Cost** :One ofthe highestcosts ofcloud iscomputing cost. Itcan be very high cost with theincrease ofscale. So cloud computing options should be wisely considered in conjunctionwith computing costcharged for them.

**126. What is a System integrator in Cloud computing?**

Often an organization does not knowallthe optionsavailablein a Cloud computing environment. Herecomes therole ofa SystemIntegrator (SI) who specializes in implementingCloud computing environment.

SIcreates thestrategy ofcloud setup. It designs thecloud platformfor the use ofitsclient. Itcreates thecloud architecturefor the business need of client.

SI oversees the overallimplementation ofcloud strategy and plan. Italso guides theclient whilechoosing theright options in cloud computing platform.

**127. What is virtualization in cloud computing?**

Virtualization is thecore ofcloud computing platform. In cloud wecan createa virtual version of hardware, storageand operating systemthatcan be used to deploy theapplication.

Acloud provider gives options to create virtualmachines in cloud thatcan be used by itsclients. These virtualmachinesare much cheaper than buying afewhigh end computingmachines.

In cloud wecan use multiplecheap virtualmachines to implementaresilientsoftwaresystemthatcan bescaled very easily in quick time. Whereas

buying an actual high-end machineto scalethesystemis very costly and timetaking.

**128. What is Eucalyptus in a cloud environment?**

Eucalyptus isan open sourcesoftwareto build privateand hybrid cloud inAmazonWeb Services (AWS).

Itstands for Elastic UtilityComputingArchitecturefor LinkingYour Programs To UsefulSystems.

Wecan create our own datacenter in a privatecloud by usingEucalyptus. Itmakes use of pooling thecomputing and storageresources to scale up the operations.

InEucalyptus, wecreateimages ofsoftwareapplications. Theseimagesare deployed to createinstances. Theseinstancesare used forcomputing needs.

AEucalyptus instancecan have both publicand privateip addresses.

**129. What are the main components of Eucalyptus cloud architecture?** The main components ofEucalyptuscloud architectureareas follows:

I. **CloudController(CLC)** :This is thecontroller thatmanages virtualresources likeservers, network and storage. It isat the highest levelin hierarchy. It isaJava programwithweb interfacefor outside world. Itcan do resourcescheduling as wellas systemaccounting. Thereis only one CLC percloud. Itcan handleauthentication,accounting, reporting and quota management in cloud.

II. **Walrus** :This isanother Java programinEucalyptus that isequivalent to AWS S3 storage. It provides persistentstorage. Italso contains images, volumesand snapshots similar to AWS. Thereis only one Walrus in acloud.

III. **ClusterController(CC)** :It isa C programthat is thefrontend fora Eucalyptuscloud cluster. Itcan communicate with Storage controllerand Nodecontroller. Itmanages theinstanceexecution in cloud.

IV. **Storage Controller(SC)** :It isaJava programequivalent to EBS inAWS. Itcan interface withCluster Controllerand Node Controller to manage persistent data via Walrus.

V. **Node Controller(NC)** :It isa C programthatcan hosta virtualmachineinstance. It isat thelowest levelinEucalyptuscloud. It downloads images fromWalrusand createsan instanceforcomputing requirements in cloud.

VI. **VMWare Broker**:It isan optionalcomponent inEucalyptus. It provides AWS compatibleinterfaceto VMWareenvironment. **130. What is Auto-scaling in Cloud computing?**

AmazonWeb Services (AWS) providesan important featurecalled Auto-scaling in thecloud. WithAuto-scaling setup wecan automatically

provision and start newinstances inAWS cloud withoutany human intervention.

Auto-scaling is triggered based on load and other metrics.

Letsay iftheload reachesathreshold wecan setup auto-scaling to kick in and starta newserver to handleadditionalload.

**131. What are the benefits of Utility Computing model?**

Utility computing isacloud service modelinwhich provider givescomputing resources to users for using on need basis. Some ofthe main benefits ofUtility computing are:

I. **Pay per use** :Sincea user pays for only usage, thecost ofUtility computing is pay per use. We pay for the number ofservers of instances that we usein cloud.

II. **Easy to Scale** :It iseasier to scale up the operations inUtility computing. Thereis no need to plan for timeconsuming and costly hardware purchase.

III. **Maintenance** :InUtility computingmaintenance ofservers is done by cloud provider. So a usercan focus on itscore business. It need notspend timeand resources onmaintenance ofservers in cloud.

Utility computing isalso known as On-demand computing.

**132. What is a Hypervisor in Cloud Computing?**

Hypervisor isalso known as virtualmachine monitor (VMM). It isacomputer software/hardwarethatcan createand run virtualmachines. Hypervisor runs on a hostmachine. Each virtualmachineiscalled Guestmachine.

Hypervisor derives its namefromtermsupervisor, which isatraditional namefor the kernel ofan operating system. Hypervisor providesa virtual operating platformto the guest operating system. Itmanages theexecution of guest OS.

**133. What are the different types of Hypervisor in Cloud Computing?** Hypervisorscomein two main types:

I. **Type-1, native or bare-metal hypervisors** :Type 1 hypervisor runs directly on the hardware of hostmachine. Itcontrols the guest operating systemfromhostmachine. It isalso called bare metal hypervisor or native hypervisor.

Examples ofType-1 are:Xen, Oracle VMServer for SPARC, Oracle VMServer for x86, the CitrixXenServer, Microsoft Hyper-Vand VMware ESX/ESXi.

II. **Type-2, hosted hypervisors:** Type 2 hypervisor runs likearegularcomputer programon an operating system. The guest operating systemruns likea process on the hostmachine. Itcreatesan abstract guest operating systemdifferent fromthe host operating system.

Examples ofType-2 are:VMware Workstation, VMware Player, VirtualBox, Parallels Desktop for Macand QEMUare examples oftype-2 hypervisors.

**134. Why Type-1 Hypervisor has better performance than Type-2 Hypervisor?**

Type-1 Hypervisor has better performancethanType-2 hypervisor because Type-1 hypervisor skips the host operating systemand it runs directly on host hardware. So itcan utilizealltheresources of hostmachine.

In cloud computingType-1 hypervisorsare more popular since Cloud servers may need to runmultiple operating systemimages.

**135. What is CaaS?**

CaaS isalso known as Communication asa Service. It isavailableinTelecomdomain. One oftheexamples for CaaS is Voice Over IP (VoIP). CaaS offers business features like desktop callcontrol, unified messaging,and fax via desktop.

CaaS also provides services for CallCenterautomation like- IVR, ACD,callrecording, multimediarouting and screen sharing.

**136. How is Cloud computing different from computing for mobile devices?**

Since Mobile devicesare getting connected to theInternet in large numbers, we often use Cloud computing for Mobile devices.

Inmobileapplications, therecan besudden increasein trafficas wellas usage. Even someapplications become viral very soon. This leads to very high load on application.

In such ascenario, itmakes senseto use Cloud Computing for mobile devices.

Also mobile devices keep changing over time, it requires standard interfaces ofcloud computing for handlingmultiple mobile devices.

**137. Why automation of deployment is very important in Cloud**

**architecture?**

One ofthe main reasons for selectingCloud architectureis scalability ofthesystem. In case of heavy load, we haveto scale up thesystemso that thereis no performance degradation.

Whilescaling up thesystemwe haveto start newinstances. To provision newinstances we haveto deploy ourapplication on them. In such ascenario, ifwe want to savetime, itmakes senseto automatethe deployment process. Another termfor this is Auto-scaling. With afully automated deployment process wecan start newinstances based on automated triggers thatareraised by load reaching athreshold.

**138. What are the main components in Amazon Cloud?**

Amazon providesa widerange of products inAmazonWeb Services for implementingCloud computing architecture. InAWS some ofthe main componentsareas follows:

I. **AmazonEC2** :This is used forcreating instancesand getting computing power to run applications inAWS. II. **Amazon S3** :This isa Simple Storage ServicefromAWS to storefilesand mediain cloud.

III. **AmazonDynamoDB** :It is the databasesolution byAWS in cloud. Itcan store very large-scale datato meet needs ofeven BigDatacomputing.

IV. **AmazonRoute53** :This isacloud based DomainName System(DNS) servicefromAWS.

V. **AmazonElastic LoadBalancing (ELB):** Thiscomponentcan be used to load balancethe various nodes inAWS cloud. VI. **AmazonCodeDeploy** :This service provides featureto automatethecode deployment to any instanceinAWS.

**139. What are main components in Google Cloud?**

Googleisa newercloud alternativethanAmazon. But Google provides many additionalfeatures thanAWS. Some ofthe main components of Google Cloud areas follows:

I. **Compute Engine** :Thiscomponent providescomputing power to Google Cloud users.

II. **Cloud Storage** :As the namesuggests this isacloud storagesolution fromGooglefor storing largefiles forapplication use or just serving over theInternet.

III. **CloudBigtable** :It isa Google proprietary databasefromGoogleinCloud. Nowuserscan usethis unique databaseforcreating theirapplications.

IV. **CloudLoadBalancing** :This isacloud-based load balancing servicefromGoogle.

V. **BigQuery** :It isa data-warehousesolution fromGoogleinCloud to performdataanalytics oflargescale.

VI. **CloudMachine Learning Platform**:It isa powerfulcloud based machinelearning product fromGoogleto performmachine learningwithAPIs like- Job Search, Text Analysis, SpeechRecognition, Dynamictranslation etc.

VII. **Cloud IAM** :This isan Identity and Access management toolfromGoogleto help administrators run thesecurity and authorization/authentication policies ofan organization.

**140. What are the major offerings of Microsoft Azure Cloud?** Microsoft isarelatively newentrant to Cloud computingwithAzurecloud offering. Some ofthe main products ofMicrosoftcloud areas follows:

I. **Azure Container Service** :This isacloud computing servicefromMicrosoft to run and manage Docker based containers. II. **StorSimple** :It isa Storagesolution fromMicrosoft for Azurecloud.

III. **App Service** :By usingApp Services, userscan create Apps for mobile devicesas wellas websites.

IV. **SQLDatabase** :It isa Cloud based SQL databasefromMicrosoft.

V. **DocumentDB** :This isa NoSQL databasein cloud byMicrosoft.

VI. **Azure Bot Service** :Wecan use Azure Bot Serviceto createserverless bots thatcan bescaled up on demand. VII. **Azure IoTHub** :It isasolution for Internet ofThings services in cloud byMicrosoft.

**141. What are the reasons of popularity of Cloud Computing**

**architecture?**

These days Cloud Computing is one ofthe most favoritearchitectureamong organizations for their systems. Following aresome ofthereasons for popularity ofCloud Computing architecture:

I. **IoT**:With theInternet ofThings, thereare many types ofmachines joining theInternetand creating various types ofinteractions. In such ascenario, Cloud Computing serves wellto providescalableinterfaces to communicate between the machines in IoT.

II. **Big Data** :Another major trend in today’scomputing is BigData. WithBigDatathereis very largeamount of user /machine data that is generated. Using in-housesolution to handle BigDatais very costly and capitalintensive. InCloud Computingwecan handle BigData very easily since we do not haveto worry aboutcapitalcosts.

III. **Mobile Devices** :Alarge number of usersare going to Mobilecomputing. With a mobile device userscan accessaservicefrom any location. To handle wide-variety ofmobile devices, standard interfaces ofCloud Computing are very useful.

IV. **Viral Content** :With growth ofSocialMedia,contentand mediais getting virali.e. It takes very short timeto increasethetraffic exponentially on aserver. In such ascenario Auto-scaling ofCloud Computing architecturecan handlesuch spikes very easily.

**142. What are the Machine Learning options from Google Cloud?** Google providesa very rich library ofMachine Learning options inGoogle Cloud. Some ofthese APIare:

I. **Google CloudML**:This isa general purpose Machine LearningAPI in cloud. Wecan use pre-trained models or generate new models for machinelearningwith this option.

II. **Google Cloud Jobs API** :It isanAPI to link Job Seekers withOpportunities. It is mainly for job search based on skills, demand and location.

III. **Google Natural Language API** :This APIcan do textanalysis of naturallanguagecontent. Wecan useit foranalyzing the content of blogs, websites, booksetc.

IV. **Google Cloud SpeechAPI** :It isa SpeechRecognitionAPI fromGoogleto handlespoken text. Itcan recognize morethan 80 languagesand their related variants. Itcan even transcribethe user speech into written text.

V. **Google CloudTranslate API** :This APIcan translatecontent fromonelanguageto another languagein cloud.

VI. **Google CloudVisionAPI** :It isa powerfulAPI for Imageanalysis. Itcan recognizefacesand objects in an image. Itcan even categorizeimages inmultiplerelevantcategories with asimple RESTAPIcall.

**143. How will you optimize the Cloud Computing environment?**

In a Cloud Computing environment we pay by usage. In such ascenario our usagecostsare much higher. To optimizethe Cloud Computing environment we haveto keep a balance between our usagecostsand usage.

Ifweare paying forcomputing instances wecan choose options like LambdainAWS, which isa much cheaper options forcomputing in cloud. In case ofStorage, ifthe datato bestored is not going to beaccesses frequentlywecan go for Glacier option inAWS.

Similarlywhenwe pay for bandwidth usage, itmakes senseto implementacaching strategy so that we useless bandwidth for thecontent that is accessed very frequently.

It isachallenging task foran architect in cloud to match the optionsavailablein cloud with the budget thatan organization has to run its applications.

Optimizations likeserver-lesscomputing, load balancing,and storageselection can help in keeping the Cloud computing costs lowwith no degradation inUserexperience.

**144. Do you think Regulations and Legal Compliance is an important aspect of Cloud Computing?**

Yes, inCloud Computingweare using resources thatare owned by the Cloud provider. Dueto this our dataresides on theservers thatcan be shared by other users ofCloud.

Thereareregulationsand laws for handling user data. We haveto ensurethat theseregulationsare met whileselecting and implementing a Cloud computing strategy.

Similarly, ifwearein acontract with aclient to providecertain Service LevelAgreement (SLA) performance, we haveto implement thecloud solution in such a way that thereis no breach ofSLAagreement dueto Cloud provider’s failures.

For security therearelaws that haveto befollowed irrespective ofCloud or Co-located Datacenter. This is in theinterest of ourend-customeras wellas for the benefit of businesscontinuity.

WithCloud computing architecture we haveto do due diligencein selecting Security and Encryption options inCloud.

**Unix Questions**

**145. How will you remove all files in current directory? Including the files that are two levels down in a sub-directory.**

InUnixwe havermcommand to removefilesand sub-directories. With rmcommand we have –r option thatstands for recursive. The –r option can deleteallfiles in a directory recursively.

Itmeans ifwe ourcurrent directory structureisas follows:

My\_dir

->Level\_1\_dir

-> Level\_1\_dir ->Level\_2\_dir

-> Level\_1\_dir ->Level\_2\_dir->a.txt

With rm–r \* command wecan deletethefilea.txtas wellas sub-directories Level\_1\_dirand Level\_2\_dir.

**Command:**

rm– r \*

Theasterisk (\*) isa wild card character thatstands forallthefiles with any name.

**146. What is the difference between the –v and –x options in Bash shell scripts?**

In a BASHUnix shellwecan specify the options –v and –x on top ofascriptas follows:

#!/bin/bash -x –v

With –x optionBASHshellwillecho thecommands likefor, select,caseetc.after substituting theargumentsand variables. So it will bean expanded formofthecommand thatshowsalltheactions ofthescript. It is very usefulfor debugging ashellscript.

With –v optionBASHshellwillecho every command beforesubstituting the values ofargumentsand variables. In –v optionUnixwill printeach lineas it reads.

In –v option, Ifwerun thescript, theshell prints theentirefileand then executes. Ifwerun thescript interactively, itshowseach command after pressing enter.

**147. What is a Filter in Unix command?**

InUnix thereare many Filtercommands like- cat,awk, grep, head, tailcutetc.

AFilter isasoftware programthat takesan inputand producesan output,and itcan be used in astreamoperation. E.g.cut -d :-f 2 /etc/passwd | grep abc

Wecanmix and matchmultiplefilters to createacomplex command thatcan solvea problem.

Awk and Sed arecomplex filters that providefully programmablefeatures.

EvenDatascientists use Unix filters to get the overviewof datastored in thefiles.

**148. What is Kernel in Unix operating system?**

Kernelis thecentralcorecomponent ofa Unix operating system(OS).

AKernelis the main component thatcan controleverythingwithinUnixOS.

It is thefirst programthat is loaded on startup ofUnixOS. Onceit is loaded it willmanagetherest ofthestartup process. Kernelmanages memory, scheduling as wellascommunicationwith peripherals like printers, keyboardsetc. But Kernel does not directly interact with a user. Fora newtask, Kernelwillspawn ashelland user willwork in ashell. Kernel provides many systemcalls. Asoftware programinteracts withKernel by using systemcalls. Kernel hasa protected memory areathatcannot be overwritten accidentally by any process.

**149. What is a Shell in Unix OS?**

ShellinUnix isa user interfacethat is used by a user to access Unix services.

Generally a Unix Shellisacommand lineinterface(CLI) inwhich usersentercommands by typing or uploading afile. We usea Shellto run differentcommandsand programs onUnix operating system.

AShellalso hasacommand interpreter thatcan take ourcommandsand send theseto beexecuted byUnix operating system. Some ofthe popular Shells onUnix are:Korn shell, BASH, C shelletc.

**150. What are the different shells in Unix that you know about?** Unix has many flavors ofShell. Some oftheseareas follows:

Bourneshell:We usesh for Bourneshell.

Bourne Again shell:We use bash to run this shell.

Korn shell:Wecan use ksh to for Korn shell.

Z shell:Thecommand to usethis iszsh

C shell:We usecsh to runC shell.

Enhanced C shell:tcsh is thecommand forenhanced C shell.

**151. What is the first character of the output in ls –l command ?** We usels -lcommand to list thefilesand directories in a directory. With -l optionwe get long listing format.

In this format thefirstcharacter identifies theentry type. Theentry typecan be one ofthefollowing:

b Block specialfile

c Character specialfile

d Directory

l Symboliclink

s Socket link

p FIFO

- Regular file

In generalwesee d for directory and - foraregular file.

**152. What is the difference between Multi-tasking and Multi-user environment?**

In a Multi-tasking environment, same usercan submitmorethan onetasksand operating systemwillexecutethemat thesametime. In a Multi-userenvironment, morethan one usercan interact with the operating systemat thesametime. 3. What is Command Substitution inUnix?

Command substitution isa mechanismbywhich Shell passes the output ofacommand asan argument to anothercommand. Wecan even useit to seta variable or usean argument list in afor loop.

E.g. rm`cat files\_to\_delete`

In thisexamplefiles\_to\_deleteisafilecontaining thelist offiles to be deleted.catcommand outputs this fileand gives the output to rmcommand. rmcommand deletes thefiles.

In generalCommand Substitution is represented by back quotes `.

**153. What is an Inode in Unix?**

An Inodeisa Data StructureinUnix that denotesafile ora directory on filesystem. Itcontains information about filelike- location offile on the disk,access mode, ownership, filetypeetc.

Each Inode hasa number that is used in theindex table. Unix kernel uses Inode number to access thecontents ofan Inode. Wecan usels -icommand to get theinode number ofafile.

**154. What is the difference between absolute path and relative path in Unix file system?**

Absolute path is thecomplete path ofafile or directory fromtheroot directory. In generalroot directory is represented by /symbol. Ifwearein a directory and want to knowtheabsolute path, wecan use pwd command.

Relative path is the path relativethecurrent location in directory.

E.g. In a directory structure/var/user/kevin/mailifwearein kevin directory then pwd command will give absolute path as /var/user/kevin. Absolute path ofmailfolder is /var/user/kevin/mail. For mailfolder ./mailis therelative path ofmail directory fromkevin folder.

**155. What are the main responsibilities of a Unix Shell?**

Some ofthe main responsibilities ofa Unix Shellareas follows:

1. ProgramExecution:Ashellis responsibleforexecuting thecommandsand script files inUnix. Usercan either interactively enter thecommands inCommand LineInterfacecalled terminal or they can run ascript filecontaining a program.

2. Environment Setup:Ashellcan definetheenvironment fora user. Wecan setmany environment variables in ashelland usethe value ofthese variables in our program.

3. Interpreter:Ashellactsasan interpreter for our scripts. It hasa built in programming languagethatcan be used to implement thelogic.

4. Pipeline:Ashellalso can hookup a pipeline ofcommands. Whenwerunmultiplecommands separated by | pipecharacter, theshelltakes the output ofacommand and passes it to next onein the pipeline.

5. I/O Redirection:Shellisalso responsiblefor taking input fromcommand lineinterface(CLI)and sending the output back to CLI. We use >, <, >> characters for this purpose.

**156. What is a Shell variable?**

AUnix Shell variableisan internal variablethatashellmaintains. It is localto that Shell. It is notmadeavailableto the parentshell orchild shell. We generally uselowercase names for shell variables inC shell.

Wecan set the value ofashell variable by setcommand.

E.g. %setmax\_threads=10

To deletea Shell variable wecan use unsetcommand.

To usea Shell variablein ascript we use $ sign in front ofthe variable name.

E.g.echo $max\_threads

**157. What are the important Shell variables that are initialized on starting a Shell?**

Therearefollowing important Shell variables thatareautomatically initialized when a Shellstarts:

user:

term:

home:

path:

These Shell variables take values fromenvironment variables.

Ifwechangethe value ofthese Shell variables then thecorresponding environment variable valueisalso changed.

**158. How will you set the value of Environment variables in Unix?** Wecan use'setenv' command to set the value ofenvironment variables.

E.g. %setenv [Name] [value]

%setenvMAX\_TIME 10

To print the value ofenvironment variable wecan use'printenv' command.

E.g. %printenvMAX\_TIME

Ifwejust use printenv then it listsalltheenvironment variablesand their values.

To unset or deletean environment variable we use unsetenv command.

E.g. %unsetenvMAX\_TIME

To usean environment variablein acommand we usethe prefix $ with the name of variable.

What is thespecialruleabout Shelland Environment variableinBourne Shell?

InBourne Shell, thereis notmuch difference between Shell variableand Environment variable.

Once westarta Bourne Shell, it gets the value ofenvironment variablesand definesacorresponding Shell variable. Fromthat time onwards the shell only refers to Shell variable. But ifachangeis madeto a Shell variable, thenwe haveto explicitly export it to environmentso that other shell orchild processescan useit.

Also for Shell variables we usesetand unsetcommands.

**159. What is the difference between a System Call and a library function?**

Systemcallsarelow-level kernelcalls. Theseare handled by the kernel. Systemcallsareimplemented in kernel ofUnix. An application has to executespecial hardwareand systemdependent instruction to run a Systemcall.

Alibrary function isalso alowlevelcall but it is implemented in user space. Alibrary callisaregular function callwhosecoderesides in ashared library.

**160. What are the networking commands in Unix that you have used?** Some ofthe popular networking commands inUnix that we useareas follows:

I. **ping** :We usethiscommand to test thereachability ofa host on an Internet Protocol(IP) network.

II. **telnet** :This isanother usefulcommand to accessanother machine on the network. This iscommand uses Telnet protocol.

III. **tracert** :This is short for Traceroute. It isa diagnosticcommand to display therouteand transit delays of packetsacross Internet Protocol.

IV. **ftp** :We useftp commands to transfer files over the network. ftp uses File Transfer Protocol.

V. **su** :This unix command is used to executecommands with the privileges ofanother user. It isalso known as switch user, substitute user.

VI. **ssh** :This isasecurecommand that is preferred over Telnet forconnecting to another machine. Itcreatesasecurechannel overan unsecured network. It usescryptographic protocolto makethecommunication secure.

**161. What is a Pipeline in Unix?**

APipelineinUnix isachain ofcommands thatareconnected through astreamin such a way that output of onecommand becomes input for anothercommand.

E.g. ls –l| grep “abc”| wc –l

In theaboveexample we havecreated pipeline ofthreecommands ls, grep and wc.

First ls –lcommand isexecuted and gives thelist offiles in a directory. Then grep command searches forany line withword “abc”in it. Finallywc –lcommand counts the number oflines thatarereturned by grep command.

In generala Pipelineis uni-directional. The dataflows fromleft to right direction.

**162. What is the use of tee command in Unix?**

We useteecommand in ashellto read theinput by user (standard input)and writeit to screen (standard output)as wellas to afile.

Wecan useteecommand to split the output ofa programso that it is visible on command lineinterface(CLI)as wellas stored on afilefor later use.

Syntax is tee[-a] [-i] [file …]

**163. How will you count the number of lines and words in a file in Unix?**

Wecan use wc(word count)command forcounting the number oflinesand words in afile. The wccommand provides very good options for collecting statistics ofafile. Some ofthese optionsare:

l:This option gives linecount

m:This option givescharactercount

c:This option gives bytecount

w:This option gives word count

L:This option gives thelength ofthelongest line

In case we give morethan onefilesas input to wccommand then it gives statistics for individualfilesas wellas thetotalstatistics forallfiles.

**164. What is Bash shell?**

Bash stands for Bourne Again Shell. It is freesoftware written to replace Bourneshell.

Wecan seefollowing linein shellscripts for Bash shell.

#!/bin/bash

InBashwe use ~/.profileat login to setenvironment variables.

InBashwecan executecommands in batchmode orconcurrentmode.

In batchmodecommandsareseparated by semicolon.

%command1;command2

In concurrentmode weseparatecommands by&symbol.

%command1 &command2

**165. How will you search for a name in Unix files?**

Wecan use grep command to search fora name orany text in a Unix file.

Grep stands for Globally search a Regular Expression and Print.

Grep command can search foratext in onefileas wellas multiplefiles.

Wecan also specify thetext to besearched in regularexpression pattern.

%grep ^z \*.txt

Abovecommand searches for lines startingwith letterzin allthe.txt files in current directory.

**166. What are the popular options of grep command in Unix?** InUnix, grep is one ofthe very usefulcommands. It provides many useful options. Some ofthe popular optionsare:

%grep –i :This option ignorescase while doing search.

%grep –x :This option is used to search exact word in afile.

%grep –v:We usethis option to find thelines that do not havethetext wearesearching.

%grep –A10:This option displays 10 linesafter the match is found.

%grep –c:Wecan useit to count the number ofmatching lines.

**167. What is the difference between whoami and who am i commands in Unix?**

Both thecommands whoamiand who amiare used to get the user information inUnix.

Whenwelogin as root user on the network, then bothwhoamiand who amicommands willshowthe useras root. But when any other user letsay john logs in remotely and runs su –root, whoamiwillshowroot, but who amiwillshowthe original user john.

**168. What is a Superuser in Unix?**

Superuser isaspecial useraccount. It is used for Unix systemadministration. This usercan accessallfiles on thefilesystem. Also Superusercan also run any command on asystem.

Generally Superuser permission is given to root user.

Most ofthe users work on their own useraccounts. But when they need to run someadditionalcommands, they can usesu to switch to Superuser account.

It isa best practiceto not use Superuseraccount for regular operations.

**169. How will you check the information about a process in Unix?** Wecan use pscommand to check thestatus ofa process inUnix. It is short for Process Status.

On running pscommand we get thelist of processes thatareexecuting in the Unix environment.

Generallywe use ps –efcommand. In thisestands forevery processand fstands for fullformat.

Thiscommand gives us id ofthe process. Wecan usethis id to killthe process.

**170. What is the use of more command with cat command?**

We generally usecatcommand to display thecontents ofafile.

Ifafileis very big then thecontents ofthefile will not fit in screen, thereforescreenwillscrollforward and in theend wejustseethelast page of information fromafile.

Withmorecommand wecan pausethescrolling of datafromafilein display. Ifwe usecatcommand withmorethenwejustseethefirst page ofa filefirst. On pressing enter button, morecommand will keep changing the page. In this way it iseasier to viewinformation in afile.

When using thecatcommand to display filecontents, large datathat does not fit on thescreenwould scroll offwithout pausing, therefore making it difficult to view. On the other hand, using the morecommand is moreappropriatein such case becauseit will display filecontents onescreen page atatime.

**171. What are the File modes in Unix?**

InUnix, therearethree main permissions fora File.

I. r = Itmeansa usercan read thefile

II. w= Itmeans thata usercanwriteto this file

III. x = Itmeans thea usercan executeafilelikeashellscript

Further therearethree permission sets.

I. Owner:User who created thefile

II. Group:Thisapplies to user ofa group to which owner belongs

III. Other:This is rest ofthe users inUnix system

With thecombination ofthesethreesets permissions offileinUnix arespecified.

E.g. Ifafile has permissions –rwxr-xr-- , itmeans that owner has read, write,executeaccess. Group has read and executeaccess. Others have just read access. So the owner oradmin has to specifically grantaccess to Others to executethefile.

**172. We wrote a shell script in Unix but it is not doing anything. What could be the reason?**

After writing ashellscript we haveto giveitexecute permission so that itcan berun inUnix shell.

Wecan usechmod command to changethe permission ofafileinUnix. In generalwe usechmod +x to giveexecute permission to users for executing theshellscript.

E.g.chmod +x abc.txt will giveexecute permission to users forexecuting thefileabc.txt.

With chmod command wecan also specify to which user/group the permission should be granted. The optionsare:

173. u is the owner user

174. g is the owner group

175. o is others

176. aisall users

**177. What is the significance of 755 in chmod 755 command?**

We usechmod command to changethe permissions ofafileinUnix. In thiscommand wecan pass thefile permissions in theformofathree-digit number.

In this number 755, first digit 7 is the permissions given to owner, second digit 5 is the permissions of group and third digit 5 is the permissions of all others.

Also the numbers 7 and 5 are madefromfollowing rules:

4 = read permission

2 = write permission

1 = execute permission

So 7 = 4 + 2 + 1 = Read + Write + Execute permission

5 = 4 + 1 = Read + Execute permission

In outexample 755 means, owner has read, writeand execute permissions. Group and others haveread and execute permissions.

**178. How can we run a process in background in Unix? How can we kill a process running in background?**

InUnix shellwecan usesymbol&to run acommand in background.

E.g. %ls –lrt&

Once we use &option it runs the process in background and prints the process ID. Wecannot down this process IDfor using it in killcommand. Wecan also use ps –efcommand to get the process IDof processes running in background.

Once we knowthe process IDofa process wecan killit by following command:

%kill-9 processId

**179. How will you create a read only file in Unix?**

Wecan createafile withVieditor,cat orany othercommand. Oncethefileiscreated we haveto giveread only permissions to file. To changefile permission to read onlywe usefollowing command:

%chmod 400 filename

**180. How does alias work in Unix?**

We usealias inUnix to giveashort nameto along command. Wecan even useit to combine multiplecommandsand giveashortconvenient name.

E.g.aliasc=’clear’

With thisalias wejust need to typecfor running clearcommand.

In bashwestorealias in .bash\_profilefile.

To get thelist ofallactivealias in ashellwecan run thealiascommand withoutany argument on command line.

%alias

alias h='history'

alias ki='kill-9'

alias l='last'

**181. How can you redirect I/O in Unix?**

InUnixwecan redirect the output ofcommand or operation to afileinstead ofcommand lineinterface(CLI). For this wesueredirection pointers.

Thesearesymbols > and >>.

Ifwe want to writethe output ofls –lrtcommand to afile we usefollowing:

%ls –lrt > fileList.txt

Ifwe want to copy onefileto another file we usefollowing:

%catsrcFile > copyFile

Ifwe want to append thecontents of onefileat theend ofanother file we usefollowing:

%catsrcFile >> appendToFile

**182. What are the main steps taken by a Unix Shell for processing a command?**

AUnix Shelltakes followingmain steps to processacommand:

I. **Parse** :Firststep is to parsethecommand or set ofcommands given in a Command LineInterface(CLI). In this step multiple consecutivespacesarereplaced by singlespace. Multiplecommands thatare delimited by asymbolare divided into multiple individualactions.

II. **Variable** :In nextstep Shellidentifies the variables mentioned in commands. Generally anyword prefixed by $ sign isa variable.

III. **Command Substitution** :In this step, Shellexecutes thecommands thataresurrounded by back quotesand replaces thatsection with the output fromthecommand.

IV. **WildCard** :Oncethesestepsare done, Shellreplaces the Wild card characters likeasterisk \* with therelevantsubstitution. V. **Execute** :Finally, Shellexecutesallthecommandsand follows thesequenceinwhichCommandsare given inCLI.

**183. What is a Sticky bit in Unix?**

ASticky bit isafile/directory permission featureinUnix.

Sometimes whenwe give write permission to another user then that usercan deletethefile without the owner knowing about it. To preventsuch an accidental deletion offile we usesticky bit.

Whenwe mark afile/directorywith asticky bit, no user other than owner offile/directory gets the privilegeto deleteafile/directory.

To set thesticky bit we usefollowing command:

%chmod +t filename

Whenwe do ls forafile or directory, theentries with sticky bitarelisted with letter t in theend of permissions. E.g. %ls –lrt

-rwxrwxrwt 5 abcabc 4096 Jan 1 10:10 abc.txt

To removethesticky bit we usefollowing command:

%chmod –t filename

**184. What are the different outputs from Kill command in Unix?** Killcommand inUnix can return following outputs:

I. 0:Itmeans Killcommand was successful

II. -1:Whenwe get -1 fromKillcommand itshows that there was someerror. In addition to -1 we get EPERMor ESRCHin output. EPERMdenotes thatsystemdoes not permit the process to be killed.

ESRCHdenotes that process with PIDmentioned inKillcommand does notexistanymore. Or dueto security restrictions we cannotaccess that process.

**185. How will you customize your environment in Unix?**

InUnix,almostallthe popular shells provide options to customizetheenvironment by using environment variables. To makethesecustomizations permanent wecanwritetheseto specialfiles thatarespecificto a user in ashell.

Once we write ourcustomizations to thesefiles, we keep on getting samecustomizationwhenwe open a newshellwith same useraccount. Thespecialfiles for storing customization information for differentshellsat login timeare:

I. C shell:/etc/.login or ~/.cshrc

II. TC shell:/etc/.login or ~/.tshrc

III. Korn shell:~etc/ksh.kshrc

IV. Bash:~/.bash\_profile

**186. What are the popular commands for user management in Unix?** InUnixwe usefollowing commands for User Management:

I. **id** :Thiscommand gives theactive user id with login and groups to which user belongs.

II. **who** :Thiscommand gives the user that iscurrently logged on system. Italso gives thetime oflogin.

III. **last** : Thiscommand shows the previous logins to thesystemin achronological order.

IV. **adduser**: We usethiscommand to add a newuser.

V. **groupadd** :We usethiscommand to add a newgroup in thesystem.

VI. **usermod** :We user usermod command to add/removea user to a group inUnix.

**187. How will you debug a shell script in Unix?**

Ashellscript isa programthatcan beexecuted inUnix shell. Sometimesashellscript does not work as intended. To debug and find the problem in shellscript wecan usethe options provided by shellto debug thescript.

In bash shellthereare x and v options thatcan be used whilerunning ascript.

%bash –xv <scriptName>

With option v alltheinput linesare printed by shell. With option x allthesimplecommandsare printed in expanded format. Wecan seeallthe arguments passed to acommand with –x option.

**188. What is the difference between a Zombie and Orphan process in Unix?**

Zombieisa defunctchild process inUnix thatstill hasentry in process table.

Sometimesachild process is terminated inUnix, but the parent process stillwaits on it.

AZombie process is different fromanOrphan process. An orphan process isachild process whose parent process had died. Oncea process is orphan it isadopted by init process. So effectively it is notan orphan.

Thereforeifa processexits withoutcleaning itschild processes, they do not become Zombie. Instead init processadopts thesechild processes. Zombie processesarethe ones thatare not yetadopted by init process.

**189. How will you check if a remote host is still alive?**

Wecan use one ofthe networking commands inUnix. It iscalled ping. With ping command wecan ping aremote host.

Ping utility sends packets in an IP network with ICMP protocol. Oncethe packet goes fromsourceto destination and comes back it records the time.

Wecan even specify the number of packets we want to send so that wecollectmorestatistics to confirmtheresult. %pingwww.google.com

Another option is to usetelnet to remote host to check its status.

**190. How will you get the last executed command in Unix?**

Wecan use history command to get thelistcommands that wereexecuted inUnix. Since weare only interested in thelastexecuted command we haveto usetailto get thelastentry.

Exactcommand would beas follows:

%history | tail-2

**191. What is the meaning of “2>&1” in a Unix shell?**

InUnix shellfile descriptor 1 is for standard output.

File description 2 is for standard error.

Wecan use“2>&1”in acommand so thatalltheerrors fromstandard error go to standard output.

%cat file 2>&1

**192. How will you find which process is taking most CPU time in Unix?**

InUnix, wecan usetop command to list the CPUtimeand memory used by various processes. Thetop command lists the process IDsand CPU time, memory etc used by top most processes.

Top command keeps refreshing thescreen ataspecified interval. So wecan see over thetime which process isalwaysappearing on thetop most rowin theresult oftop command.

This is the process that isconsumingmost CPUtime.

**193. What is the difference between Soft link and Hard link in Unix?**

Asoft link isa pointer to afile, directory ora programlocated in a different location. Ahard link can point to a programorafile but not to a directory.

Ifwe move, delete or renameafile, thesoft link will be broken. Buta hard link stillremainsafter moving thefile/program. We usethecommand ln –s forcreating asoft link. Buta hard link can becreated by ln command without –s option.

**194. How will you find which processes are using a file?**

Wecan uselsofcommand to find thelist ofProcess IDs ofthe processes thatareaccessing afileinUnix.

Lsofstands for List Open Files.

Samplecommand is:

%lsof/var

It willlist the processes thatareaccessing /var directory in current unix system.

Wecan use options –i, -n and –P for different uses.

%lsof –iwill only list IP sockets.

**195. What is the purpose of nohup in Unix?**

InUnix, nohup command can be used to run acommand in background. But it is different from&option to run a process in background. Nohup stands for No Hangup. Anohup process does notstop even ifthe Unix user thatstarted the process has logged out fromthesystem. But the process started with option&willstop when the user thatstarted the process logs off.

**196. How will you remove blank lines from a file in Unix?**

Wecan use grep command for this option. Grep command gives –v option to excludelines that do notmatch a pattern. In an empty linethereis nothing fromstart to end. InGrep command, ^ denotes thatstart oflineand $ denotes theend ofline. %grep –v ‘^$’ lists thelines thatareempty fromstart to theend.

Once we get this result, wecan use > operator to writethe output to a newfile. So exactcommand will be:

%grep –v ‘^$’ file1.txt > file2.txt

**197. How will you find the remote hosts that are connecting to your system on a specific port in Unix?**

Wecan use netstatcommand for this purpose. Netstatcommand lists thestatisticsabout network connections. Wecan grep for the port inwhich weareinterested.

Exactcommand will be:

%netstst –a| grep “port number”

**198. What is xargs in Unix?**

We use xargscommand to build and executecommands that takeinput fromstandard input. It is generally used in chaining ofcommands. Xargs breaks thelist ofarguments into smallsub lists thatcan be handled by acommand.

Following isasamplecommand:

%find /path -typef-print | xargs rm

Theabovecommand uses find to get thelist ofallfiles in /path directory. Then xargscommand passes this list to rmcommand so that they can be deleted.

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Thanks!!!