#### Section 3. Deploying and implementing a cloud solution

3.1 Deploying and implementing Compute Engine resources. Tasks include:

a. Launching a compute instance using Cloud Console and Cloud SDK (gcloud) (e.g., assign disks, availability policy, SSH keys)

* Command line: <https://cloud.google.com/sdk/gcloud/reference/compute/instances/create>
* Attach disk: <https://cloud.google.com/sdk/gcloud/reference/compute/instances/attach-disk>
* Live migration during maintenance events: <https://cloud.google.com/compute/docs/instances/live-migration>
* Set VM host maintenance policy: <https://cloud.google.com/compute/docs/instances/setting-instance-scheduling-options>
* About SSH connections: <https://cloud.google.com/compute/docs/instances/ssh>
* Create SSH keys: <https://cloud.google.com/compute/docs/connect/create-ssh-keys>
* Add SSH keys to VMs: <https://cloud.google.com/compute/docs/connect/add-ssh-keys>
* Youtube video that demonstrates SSH key creation and access: <https://www.youtube.com/watch?v=8QGpHQ2SyG8>

b. Creating an autoscaled managed instance group using an instance template

* Instance groups: <https://cloud.google.com/compute/docs/instance-groups/>
* Instance template: <https://cloud.google.com/compute/docs/instance-templates/>
* Create instance templates: <https://cloud.google.com/compute/docs/instance-templates/create-instance-templates>
* Basic scenarios for creating managed instance groups (MIGs): <https://cloud.google.com/compute/docs/instance-groups/creating-groups-of-managed-instances#create_managed_group>
* Create a MIG with VMs in multiple zones in a region: <https://cloud.google.com/compute/docs/instance-groups/distributing-instances-with-regional-instance-groups>
* Autoscaling groups of instances: <https://cloud.google.com/compute/docs/autoscaler/#managed_instance_groups>
* Setting up health checking and autohealing: <https://cloud.google.com/compute/docs/instance-groups/autohealing-instances-in-migs>
* Adding an instance group to a load balancer: <https://cloud.google.com/compute/docs/instance-groups/adding-an-instance-group-to-a-load-balancer>

c. Generating/uploading a custom SSH key for instances

* Choose an access method: <https://cloud.google.com/compute/docs/instances/access-overview>

d. Installing and configuring the Cloud Monitoring and Logging Agent

* Legacy method: Installing the Cloud Logging agent on individual VMs: <https://cloud.google.com/logging/docs/agent/logging/installation>
* Configuring the Logging Agent: <https://cloud.google.com/logging/docs/agent/logging/configuration>
* Legacy method: Installing the Cloud Monitoring agent on individual VMs: <https://cloud.google.com/monitoring/agent/monitoring/installation>
* Configuring the Cloud Monitoring agent: <https://cloud.google.com/monitoring/agent/monitoring/configuration>
* New method: Ops Agent overview: <https://cloud.google.com/stackdriver/docs/solutions/agents/ops-agent>
* Configuring the Ops Agent: <https://cloud.google.com/stackdriver/docs/solutions/agents/ops-agent/configuration>

e. Assessing compute quotas and requesting increases

* Resource quotas: <https://cloud.google.com/compute/quotas>
* Requesting an increase in quota: <https://cloud.google.com/compute/quotas#requesting_additional_quota>
* Compute Engine quotas: <https://cloud.google.com/compute/quotas>
* BigQuery quotas: <https://cloud.google.com/bigquery/quotas>

3.2 Deploying and implementing Google Kubernetes Engine resources. Tasks include:

**GKE How-to Guides**: <https://cloud.google.com/kubernetes-engine/docs/how-to>

a. Installing and configuring the command line interface (CLI) for Kubernetes (kubectl)

* Install kubectl and configure cluster access: <https://cloud.google.com/kubernetes-engine/docs/how-to/cluster-access-for-kubectl>
* kubectl syntax: <https://kubernetes.io/docs/reference/kubectl/cheatsheet/>

b. Deploying a Google Kubernetes Engine cluster with different configurations including AutoPilot, regional clusters, private clusters, etc.

* Standard cluster architecture: <https://cloud.google.com/kubernetes-engine/docs/concepts/cluster-architecture>
* Creating a zonal cluster: <https://cloud.google.com/kubernetes-engine/docs/how-to/creating-a-zonal-cluster>
* Creating a regional cluster: <https://cloud.google.com/kubernetes-engine/docs/how-to/creating-a-regional-cluster>
* Creating an Autopilot cluster: <https://cloud.google.com/kubernetes-engine/docs/how-to/creating-an-autopilot-cluster>
* Reduce costs with spot pods on GKE Autopilot: <https://medium.com/@krisztian.sala/reduce-costs-with-spot-pods-on-gke-autopilot-78ae87ffca1e>
* Suggested Lab: GKE Autopilot: Qwik Start: <https://partner.cloudskillsboost.google/focuses/22189?catalog_rank=%7B%22rank%22%3A1%2C%22num_filters%22%3A0%2C%22has_search%22%3Atrue%7D&parent=catalog&search_id=17892080>
* Creating a private cluster: <https://cloud.google.com/kubernetes-engine/docs/how-to/private-clusters>
* Suggested lab: Setting up a Private Kubernetes Cluster: <https://partner.cloudskillsboost.google/focuses/11641?catalog_rank=%7B%22rank%22%3A2%2C%22num_filters%22%3A0%2C%22has_search%22%3Atrue%7D&parent=catalog&search_id=17892027>
* GKE Services: <https://cloud.google.com/kubernetes-engine/docs/concepts/service>

c. Deploying a containerized application to Google Kubernetes Engine

* Overview of deploying workloads: <https://cloud.google.com/kubernetes-engine/docs/how-to/deploying-workloads-overview>
* Deploying a stateless Linux application: <https://cloud.google.com/kubernetes-engine/docs/how-to/stateless-apps>
* Deploying a stateful application: <https://cloud.google.com/kubernetes-engine/docs/how-to/stateful-apps>
* Stateful Set tutorial: <https://kubernetes.io/docs/tutorials/stateful-application/basic-stateful-set/>

d. Configuring Google Kubernetes Engine monitoring and logging

* Configuring Cloud Operations for GKE: <https://cloud.google.com/stackdriver/docs/solutions/gke/installing>
* Managing GKE logs: [https://cloud.google.com/stackdriver/docs/solutions/gke/managing-logs](https://cloud.google.com/stackdriver/docs/solutions/gke/managing-logs#:~:text=them%20to%20Logging.-,What%20logs%20are%20collected,log%2C%20and%20the%20Events%20log)
* Introducing Kubernetes control plane metrics in GKE (Blog Sep 8, 2022): <https://cloud.google.com/blog/products/containers-kubernetes/kubernetes-control-plane-metrics-are-generally-available>

3.3 Deploying and implementing Cloud Run and Cloud Functions resources. Tasks include, where applicable:

a. Deploying an application and updating scaling configuration, versions, and traffic splitting

* Cloud Run
  + Knative: <https://cloud.google.com/knative>
  + Deploying container images: <https://cloud.google.com/run/docs/deploying#command-line>
  + About container instance autoscaling: <https://cloud.google.com/run/docs/about-instance-autoscaling>
  + Versions (Managing Revisions): <https://cloud.google.com/run/docs/managing/revisions>
  + Traffic splitting: <https://cloud.google.com/run/docs/rollouts-rollbacks-traffic-migration>
  + Choosing between Cloud Run and Cloud Run for Anthos: <https://cloud.google.com/anthos/run/docs/choosing-a-platform>
  + Container Registry: <https://cloud.google.com/container-registry/docs>
  + Artifact Registry: <https://cloud.google.com/artifact-registry/docs/overview>
  + Rollbacks, gradual rollouts, and traffic migration: <https://cloud.google.com/run/docs/rollouts-rollbacks-traffic-migration>
  + Lab suggestion (this contains a series of labs): [https://partner.cloudskillsboost.google/quests/152](https://partner.cloudskillsboost.google/quests/152?catalog_rank=%7B%22rank%22%3A1%2C%22num_filters%22%3A0%2C%22has_search%22%3Atrue%7D&search_id=16956178)
  + Quickstarts: <https://cloud.google.com/run/docs/quickstarts>
* Cloud Functions
  + Deploying Cloud Functions: <https://cloud.google.com/functions/docs/deploying>
  + Using maximum instances: <https://cloud.google.com/functions/docs/configuring/max-instances#gcloud>
  + Using minimum instances: <https://cloud.google.com/functions/docs/configuring/min-instances>
  + Quickstart - Deploy Cloud Functions with version control: <https://cloud.google.com/source-repositories/docs/deploy-cloud-functions-version-control>
    - Note: There is no built in method of version control. Have to use something like a source code repository
  + Traffic splitting: not supported
  + Lab suggestion: [https://partner.cloudskillsboost.google/focuses/11542](https://partner.cloudskillsboost.google/focuses/11542?catalog_rank=%7B%22rank%22%3A13%2C%22num_filters%22%3A0%2C%22has_search%22%3Atrue%7D&parent=catalog&search_id=16956267)

b. Deploying an application that receives Google Cloud events (e.g., Pub/Sub events, Cloud Storage object change notification events)

* Cloud Function:
  + Google Cloud Pub/Sub Triggers: <https://cloud.google.com/functions/docs/calling/pubsub>
  + Cloud Pub/Sub Tutorial: <https://cloud.google.com/functions/docs/tutorials/pubsub>
  + Google Cloud Storage Triggers: <https://cloud.google.com/functions/docs/calling/storage>
* Cloud Run:
  + Triggering from Pub/Sub push: <https://cloud.google.com/run/docs/triggering/pubsub-push>
  + Cloud Storage (+ other types of events): <https://cloud.google.com/eventarc/docs/creating-triggers>

3.4 Deploying and implementing data solutions. Tasks include:

a. Initializing data systems with products (e.g., Cloud SQL, Firestore, BigQuery, Cloud Spanner, Pub/Sub, Cloud Bigtable, Dataproc, Dataflow, Cloud Storage)

* Discussed all but Dataproc, Dataflow and BigQuery in other sections
* Dataproc: <https://medium.com/google-cloud/all-you-need-to-know-about-google-cloud-dataproc-23fe91369678>
* Lab - Dataproc: Qwik Start - Command Line: <https://partner.cloudskillsboost.google/focuses/13315?catalog_rank=%7B%22rank%22%3A6%2C%22num_filters%22%3A0%2C%22has_search%22%3Atrue%7D&parent=catalog&search_id=16889185> v
* Dataflow: [https://cloud.google.com/blog/topics/developers-practitioners/dataflow-backbone-data-analytics](https://cloud.google.com/blog/topics/developers-practitioners/dataflow-backbone-data-analytics?utm_source=ext&utm_medium=partner&utm_campaign=CDR_pve_gcp_gcpsketchnote_&utm_content=-)
* Lab - Dataflow: Qwik Start - Python: <https://partner.cloudskillsboost.google/focuses/13312?catalog_rank=%7B%22rank%22%3A6%2C%22num_filters%22%3A0%2C%22has_search%22%3Atrue%7D&parent=catalog&search_id=16889189>
* Query BIG with BigQuery: https://cloud.google.com/blog/topics/developers-practitioners/query-big-bigquery-cheat-sheet
* BigQuery - estimate query costs: <https://cloud.google.com/bigquery/docs/estimate-costs#estimate_query_costs>
* Using the bq command-line tool: <https://cloud.google.com/bigquery/docs/bq-command-line-tool>

b. Loading data (e.g., command line upload, API transfer, import/export, load data from Cloud Storage, streaming data to Pub/Sub)

* Cloud Storage - data transfer options: <https://cloud.google.com/architecture/migration-to-google-cloud-transferring-your-large-datasets#transfer-options>
* How long will it take to transfer data? <https://cloud.google.com/architecture/migration-to-google-cloud-transferring-your-large-datasets#time>
* Cloud Storage - command line upload: <https://cloud.google.com/storage/docs/uploading-objects#prereq-cli>
* Cloud Storage - command line download: <https://cloud.google.com/storage/docs/downloading-objects>
* Gsutil copy syntax: <https://cloud.google.com/storage/docs/gsutil/commands/cp#description>
* Creating and managing data transfers programmatically: <https://cloud.google.com/storage-transfer/docs/create-manage-transfer-program>
* Storage Transfer Service: <https://cloud.google.com/storage-transfer/docs/overview>
* Transfer appliance: <https://cloud.google.com/transfer-appliance/docs/4.0/overview>
* Transfer appliance Youtube video: <https://www.youtube.com/watch?v=4g2ntSRU2pI>
* Create and manage data transfers with gcloud (Cloud Storage): <https://cloud.google.com/storage-transfer/docs/create-manage-transfer-gcloud>
* Cloud SQL - Export and import using CSV files: [https://cloud.google.com/sql/docs/mysql/import-export/import-export-csv](https://cloud.google.com/sql/docs/mysql/import-export/import-export-csv#rest-v1_1)
* Cloud SQL - Best practices for importing and exporting dat: <https://cloud.google.com/sql/docs/mysql/import-export/>
* Firestore in Datastore mode: <https://cloud.google.com/datastore/docs/export-import-entities>
* Publish and receive messages in Pub/Sub by using the gcloud CLI: <https://cloud.google.com/pubsub/docs/publish-receive-messages-gcloud>
* Stream messages from Pub/Sub by using Dataflow: <https://cloud.google.com/pubsub/docs/stream-messages-dataflow>
* Pub/Sub - Using client libraries: <https://cloud.google.com/pubsub/docs/publish-receive-messages-client-library>
* Pub/Sub - gcloud cli: <https://cloud.google.com/pubsub/docs/publish-receive-messages-gcloud>

3.5 Deploying and implementing networking resources. Tasks include:

a. Creating a VPC with subnets (e.g., custom-mode VPC, shared VPC)

* Start at this homepage: [https://cloud.google.com/vpc/docs/overview](https://cloud.google.com/vpc/docs/overview?hl=en)
  + It contains a lot of subtopics (firewall rules, etc.), some of which are listed here, but don’t limit your study to the links below.. Please read through all the links in the site.
  + VPC Network overview: <https://cloud.google.com/vpc/docs/vpc?hl=en>
  + For practice - Quickstart: Create and modify Virtual Private Cloud (VPC) networks <https://cloud.google.com/vpc/docs/create-modify-vpc-networks?hl=en>
    - You will need your own Google Cloud account for this

b. Launching a Compute Engine instance with custom network configuration (e.g., internal-only IP address, Google private access, static external and private IP address, network tags)

* Reserving a static external IP address: <https://cloud.google.com/compute/docs/ip-addresses/reserve-static-external-ip-address#staticnetworkaddress>
* Assign a static external IP address to a new VM instance: <https://cloud.google.com/compute/docs/ip-addresses/reserve-static-external-ip-address#assign_new_instance>
* Reserving a static internal IP address: <https://cloud.google.com/compute/docs/ip-addresses/reserve-static-internal-ip-address>
* Create a VM instance with a specific internal IP address: <https://cloud.google.com/compute/docs/ip-addresses/reserve-static-internal-ip-address#create_a_vm_instance_with_a_specific_internal_ip_address>
* Create a VM with no external IP address
  + <https://cloud.google.com/sdk/gcloud/reference/compute/instances/create>
    - Look at the “--no-address” flag
* Configuring Private Google Access: <https://cloud.google.com/vpc/docs/configure-private-google-access>
  + Enabling: <https://cloud.google.com/vpc/docs/configure-private-google-access#config-pga>
* Configuring network tags: <https://cloud.google.com/vpc/docs/add-remove-network-tags>
* Adding, viewing, and removing tags: <https://cloud.google.com/vpc/docs/add-remove-network-tags#adding_viewing_and_removing_tags>
* Lab suggestion - Configuring Private Google Access and Cloud NAT: <https://www.cloudskillsboost.google/focuses/4362?parent=catalog>

c. Creating ingress and egress firewall rules for a VPC (e.g., IP subnets, network tags, service accounts)

* VPC firewall rules overview: <https://cloud.google.com/vpc/docs/firewalls>
* Using firewall rules: <https://cloud.google.com/vpc/docs/using-firewalls>
* Configure firewall rules for common use cases: <https://cloud.google.com/vpc/docs/using-firewalls#rules-for-common-use-cases>

d. Creating a VPN between a Google VPC and an external network using Cloud VPN

* Cloud VPN overview: <https://cloud.google.com/network-connectivity/docs/vpn/concepts/overview>
* Suggested lab - Building a High-throughput VPN: <https://partner.cloudskillsboost.google/focuses/11624?catalog_rank=%7B%22rank%22%3A1%2C%22num_filters%22%3A0%2C%22has_search%22%3Atrue%7D&parent=catalog&search_id=16888907>

e. Creating a load balancer to distribute application network traffic to an application (e.g., Global HTTP(S) load balancer, Global SSL Proxy load balancer, Global TCP Proxy load balancer, regional network load balancer, regional internal load balancer)

* Discussed load balancing in another section
* Suggested lab: <https://www.cloudskillsboost.google/focuses/12007?parent=catalog>
* Another lab - Internal Load Balancer: <https://www.cloudskillsboost.google/focuses/1910?catalog_rank=%7B%22rank%22%3A10%2C%22num_filters%22%3A0%2C%22has_search%22%3Atrue%7D&parent=catalog&search_id=16888929>
* Another lab - Creating Cross-region Load Balancing: <https://www.cloudskillsboost.google/focuses/642?catalog_rank=%7B%22rank%22%3A11%2C%22num_filters%22%3A0%2C%22has_search%22%3Atrue%7D&parent=catalog&search_id=16888943>
* You need your own GC account for this, but it’s nice in that it discusses the different parts, e,.g., forwarding rule, target proxy, etc.
  + Setting up a global external HTTP(S) load balancer with a Compute Engine backend (need your own GC account): <https://cloud.google.com/load-balancing/docs/https/setup-global-ext-https-compute>

3.6 Deploying a solution using Cloud Marketplace. Tasks include:

a. Browsing the Cloud Marketplace catalog and viewing solution details

* Lab- Provision Services with Google Cloud Marketplace: <https://www.cloudskillsboost.google/focuses/565?catalog_rank=%7B%22rank%22%3A1%2C%22num_filters%22%3A0%2C%22has_search%22%3Atrue%7D&parent=catalog&search_id=16888961>

b. Deploying a Cloud Marketplace solution

* GKE: Deploying an application from Cloud Marketplace: <https://cloud.google.com/kubernetes-engine/docs/how-to/deploying-marketplace-app>

3.7 Implementing resources via infrastructure as code. Tasks include:

a. Building infrastructure via Cloud Foundation Toolkit templates and implementing best practices

* Cloud Foundation Toolkit: <https://cloud.google.com/foundation-toolkit>
* Example templates from the Cloud Foundation Toolkit: <https://cloud.google.com/deployment-manager/docs/reference/cloud-foundation-toolkit>
* Rapid cloud foundation buildout and workload deployment using Terraform: <https://cloud.google.com/blog/products/devops-sre/using-the-cloud-foundation-toolkit-with-terraform>
* Terraform with Google Cloud: <https://cloud.google.com/docs/terraform>
* Getting started with Terraform - lab HTTPS Content-Based Load Balancer with Terraform: <https://www.cloudskillsboost.google/focuses/1206?parent=catalog>

b. Installing and configuring Config Connector in Google Kubernetes Engine to create, update, delete, and secure resources

* Config Connector overview: <https://cloud.google.com/config-connector/docs/overview>
* YouTube video: <https://www.youtube.com/watch?v=3lAOr2XdAh4>
* Choosing an installation type: <https://cloud.google.com/config-connector/docs/concepts/installation-types>
* Getting Started w/ config connector: <https://cloud.google.com/config-connector/docs/how-to/getting-started>