- **The screenshot of kubectl get nodes**

```
student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl get nodes
NAME                 STATUS   ROLES           AGE   VERSION
kind-control-plane   Ready    control-plane   23m   v1.29.2
kind-worker          Ready    <none>          23m   v1.29.2
kind-worker2         Ready    <none>          23m   v1.29.2
```

- **The screenshot of passing all the unit tests**

```
root@2bc177a89795:/go/src/app# go test -v ./...
?       my-scheduler-plugins/cmd/scheduler      [no test files]
=== RUN   TestCustomScheduler_PreFilter
=== RUN   TestCustomScheduler_PreFilter/pod_is_accepted
finish adding2024/06/13 10:58:29 Pod  is in Prefilter phase.
=== RUN   TestCustomScheduler_PreFilter/pod_is_just_accepted
finish adding2024/06/13 10:58:29 Pod  is in Prefilter phase.
=== RUN   TestCustomScheduler_PreFilter/pod_is_rejected
finish adding2024/06/13 10:58:29 Pod  is in Prefilter phase.
--- PASS: TestCustomScheduler_PreFilter (0.00s)
    --- PASS: TestCustomScheduler_PreFilter/pod_is_accepted (0.00s)
    --- PASS: TestCustomScheduler_PreFilter/pod_is_just_accepted (0.00s)
    --- PASS: TestCustomScheduler_PreFilter/pod_is_rejected (0.00s)
=== RUN   TestCustomScheduler_Score
=== RUN   TestCustomScheduler_Score/least_mode
2024/06/13 10:58:29 Custom scheduler runs with the mode: Least.
2024/06/13 10:58:29 Pod  is in Score phase. Calculate the score of Node m1.
2024/06/13 10:58:29 Pod  is in Score phase. Calculate the score of Node m2.
=== RUN   TestCustomScheduler_Score/most_mode
2024/06/13 10:58:29 Custom scheduler runs with the mode: Least.
2024/06/13 10:58:29 Pod  is in Score phase. Calculate the score of Node m1.
2024/06/13 10:58:29 Pod  is in Score phase. Calculate the score of Node m2.
--- PASS: TestCustomScheduler_Score (0.00s)
    --- PASS: TestCustomScheduler_Score/least_mode (0.00s)
    --- PASS: TestCustomScheduler_Score/most_mode (0.00s)
=== RUN   TestCustomScheduler_NormalizeScore
=== RUN   TestCustomScheduler_NormalizeScore/scores_in_range
=== RUN   TestCustomScheduler_NormalizeScore/scores_out_of_range
=== RUN   TestCustomScheduler_NormalizeScore/negative_score
--- PASS: TestCustomScheduler_NormalizeScore (0.00s)
    --- PASS: TestCustomScheduler_NormalizeScore/scores_in_range (0.00s)
    --- PASS: TestCustomScheduler_NormalizeScore/scores_out_of_range (0.00s)
    --- PASS: TestCustomScheduler_NormalizeScore/negative_score (0.00s)
PASS
ok      my-scheduler-plugins/pkg/plugins        0.035s
root@2bc177a89795:/go/src/app#
```

- **Explain the 3 scenarios you design to validate your implementation by describing the expected results and showing**

the screenshots of the results. You have to explain them during the demo.

- ○ **Scenario1: Prefilter**
- ○ Create pod

```
student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl create -f pod-scenario1.yaml
pod/nginx created
```

○ Logs of my scheduler

```
student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl logs my-scheduler-69cfc986c7-jgxp8
2024/06/13 11:10:59 custom-scheduler starts!
I0613 11:10:59.732486       1 flags.go:64] FLAG: --allow-metric-labels="[]"
I0613 11:10:59.732523       1 flags.go:64] FLAG: --authentication-kubeconfig=""
I0613 11:10:59.732528       1 flags.go:64] FLAG: --authentication-skip-lookup="false"
I0613 11:10:59.732532       1 flags.go:64] FLAG: --authentication-token-webhook-cache-ttl="10s"
I0613 11:10:59.732538       1 flags.go:64] FLAG: --authentication-tolerate-lookup-failure="true"
I0613 11:10:59.732541       1 flags.go:64] FLAG: --authorization-always-allow-paths="[/healthz,/readyz,/livez]"
I0613 11:10:59.732549       1 flags.go:64] FLAG: --authorization-kubeconfig=""
I0613 11:10:59.732552       1 flags.go:64] FLAG: --authorization-webhook-cache-authorized-ttl="10s"
I0613 11:10:59.732557       1 flags.go:64] FLAG: --authorization-webhook-cache-unauthorized-ttl="10s"
I0613 11:10:59.732560       1 flags.go:64] FLAG: --bind-address="0.0.0.0"
I0613 11:10:59.732565       1 flags.go:64] FLAG: --cert-dir=""
I0613 11:10:59.732567       1 flags.go:64] FLAG: --client-ca-file=""
I0613 11:10:59.732570       1 flags.go:64] FLAG: --config="/etc/kubernetes/scheduler-config.yaml"
I0613 11:10:59.732576       1 flags.go:64] FLAG: --contention-profiling="true"
I0613 11:10:59.732580       1 flags.go:64] FLAG: --disabled-metrics="[]"
I0613 11:10:59.732584       1 flags.go:64] FLAG: --feature-gates=""
I0613 11:10:59.732590       1 flags.go:64] FLAG: --help="false"
I0613 11:10:59.732603       1 flags.go:64] FLAG: --http2-max-streams-per-connection="0"
I0613 11:10:59.732607       1 flags.go:64] FLAG: --kube-api-burst="100"
I0613 11:10:59.732611       1 flags.go:64] FLAG: --kube-api-content-type="application/vnd.kubernetes.protobuf"
I0613 11:10:59.732615       1 flags.go:64] FLAG: --kube-api-qps="50"
I0613 11:10:59.732622       1 flags.go:64] FLAG: --kubeconfig=""
I0613 11:10:59.732625       1 flags.go:64] FLAG: --leader-elect="true"
I0613 11:10:59.732629       1 flags.go:64] FLAG: --leader-elect-lease-duration="15s"
I0613 11:10:59.732633       1 flags.go:64] FLAG: --leader-elect-renew-deadline="10s"
I0613 11:10:59.732641       1 flags.go:64] FLAG: --leader-elect-resource-lock="leases"
I0613 11:10:59.732644       1 flags.go:64] FLAG: --leader-elect-resource-name="kube-scheduler"
I0613 11:10:59.732646       1 flags.go:64] FLAG: --leader-elect-resource-namespace="kube-system"
I0613 11:10:59.732649       1 flags.go:64] FLAG: --leader-elect-retry-period="2s"
I0613 11:10:59.732652       1 flags.go:64] FLAG: --lock-object-name="kube-scheduler"
I0613 11:10:59.732655       1 flags.go:64] FLAG: --lock-object-namespace="kube-system"
I0613 11:10:59.732663       1 flags.go:64] FLAG: --log-flush-frequency="5s"
I0613 11:10:59.732679       1 flags.go:64] FLAG: --logging-format="text"
I0613 11:10:59.732682       1 flags.go:64] FLAG: --master=""
I0613 11:10:59.732685       1 flags.go:64] FLAG: --permit-address-sharing="false"
I0613 11:10:59.732688       1 flags.go:64] FLAG: --permit-port-sharing="false"
I0613 11:10:59.732690       1 flags.go:64] FLAG: --pod-max-in-unschedulable-pods-duration="5m0s"
I0613 11:10:59.732695       1 flags.go:64] FLAG: --profiling="true"
I0613 11:10:59.732698       1 flags.go:64] FLAG: --requestheader-allowed-names="[]"
I0613 11:10:59.732853       1 flags.go:64] FLAG: --requestheader-client-ca-file=""
I0613 11:10:59.732856       1 flags.go:64] FLAG: --requestheader-extra-headers-prefix="[x-remote-extra-]"
I0613 11:10:59.732861       1 flags.go:64] FLAG: --requestheader-group-headers="[x-remote-group]"
I0613 11:10:59.732867       1 flags.go:64] FLAG: --requestheader-username-headers="[x-remote-user]"
I0613 11:10:59.732872       1 flags.go:64] FLAG: --secure-port="10259"
I0613 11:10:59.732878       1 flags.go:64] FLAG: --show-hidden-metrics-for-version=""
I0613 11:10:59.732885       1 flags.go:64] FLAG: --tls-cert-file=""
I0613 11:10:59.732888       1 flags.go:64] FLAG: --tls-cipher-suites="[]"
I0613 11:10:59.732893       1 flags.go:64] FLAG: --tls-min-version=""
I0613 11:10:59.732897       1 flags.go:64] FLAG: --tls-private-key-file=""
I0613 11:10:59.732901       1 flags.go:64] FLAG: --tls-sni-cert-key="[]"
I0613 11:10:59.732911       1 flags.go:64] FLAG: --v="2"
I0613 11:10:59.732915       1 flags.go:64] FLAG: --version="false"
I0613 11:10:59.732922       1 flags.go:64] FLAG: --vmodule=""
```

. . . .

```
I0613 11:11:43.892088      1 log.go:194] Pod nginx is in Prefilter phase.
I0613 11:11:43.892708      1 schedule_one.go:867] "Unable to schedule pod; no fit; waiting" pod="default/nginx" err="0/3 nodes are available: Pods' total number in group is less than min available number. preemption:
0/3 nodes are available: 3 No preemption victims found for incoming pod.."
```

- ○ kubectl get po -o wide

```
student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl get po -o wide
NAME                              READY   STATUS    RESTARTS   AGE     IP           NODE          NOMINATED NODE   READINESS GATES
my-scheduler-69cfc986c7-jgxp8     1/1     Running   0          4m51s   10.244.1.2   kind-worker2  <none>           <none>
nginx                             0/1     Pending   0          4m7s    <none>       <none>        <none>           <none>
```

Nginx is pending because total number of pods in group is less than

minimum available number

- ○ **Scenario2: Least mode**
- ○ Create pod

```
● student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl create -f pod-scenario23.yaml
pod/nginx2 created
pod/nginx3 created
```

Pod-scenario2 and pod-scenario3 and pod-scenario23 are having the

same content, in report I will use pod-scenario23 to demonstrate

- ○ Logs of my scheduler

```
● student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl logs my-scheduler-69cfc986c7-jgxp8
2024/06/13 11:10:59 custom-scheduler starts!
I0613 11:10:59.732486      1 flags.go:64] FLAG: --allow-metric-labels="[]"
I0613 11:10:59.732523      1 flags.go:64] FLAG: --authentication-kubeconfig=""
I0613 11:10:59.732528      1 flags.go:64] FLAG: --authentication-skip-lookup="false"
I0613 11:10:59.732532      1 flags.go:64] FLAG: --authentication-token-webhook-cache-ttl="10s"
I0613 11:10:59.732538      1 flags.go:64] FLAG: --authentication-tolerate-lookup-failure="true"
I0613 11:10:59.732541      1 flags.go:64] FLAG: --authorization-always-allow-paths="[/healthz,/readyz,/livez]"
I0613 11:10:59.732549      1 flags.go:64] FLAG: --authorization-kubeconfig=""
```

. . . .

```
I0613 11:17:00.971416      1 log.go:194] Pod nginx2 is in Prefilter phase.
I0613 11:17:00.972106      1 log.go:194] Pod nginx2 is in Score phase. Calculate the score of Node kind-worker.
I0613 11:17:00.972132      1 log.go:194] Pod nginx2 is in Score phase. Calculate the score of Node kind-worker2.
I0613 11:17:00.978328      1 schedule_one.go:252] "Successfully bound pod to node" pod="default/nginx2" node="kind-worker" evaluatedNodes=3 feasibleNodes=2
I0613 11:17:01.027079      1 log.go:194] Pod nginx3 is in Prefilter phase.
I0613 11:17:01.027325      1 log.go:194] Pod nginx3 is in Score phase. Calculate the score of Node kind-worker2.
I0613 11:17:01.027340      1 log.go:194] Pod nginx3 is in Score phase. Calculate the score of Node kind-worker.
I0613 11:17:01.031714      1 schedule_one.go:252] "Successfully bound pod to node" pod="default/nginx3" node="kind-worker" evaluatedNodes=3 feasibleNodes=2
```

- ○ kubectl get po -o wide

```
student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl get po -o wide
NAME                              READY   STATUS    RESTARTS   AGE     IP           NODE          NOMINATED NODE   READINESS GATES
my-scheduler-69cfc986c7-jgxp8     1/1     Running   0          7m47s   10.244.1.2   kind-worker2  <none>           <none>
nginx                             0/1     Pending   0          7m3s    <none>       <none>        <none>           <none>
nginx2                            1/1     Running   0          106s    10.244.2.2   kind-worker   <none>           <none>
nginx3                            1/1     Running   0          105s    10.244.2.3   kind-worker   <none>           <none>
```

Nginx2 and nginx3 are bind to kind-worker in least mode, because

kind-worker has less allocatable memory than kind-worker2

```
Name:                   kind-worker
Roles:                  <none>
Labels:                 beta.kubernetes.io/arch=amd64
                        beta.kubernetes.io/os=linux
                        kubernetes.io/arch=amd64
                        kubernetes.io/hostname=kind-worker
                        kubernetes.io/os=linux
Annotations:            kubeadm.alpha.kubernetes.io/cri-socket: unix:///run/(
                        node.alpha.kubernetes.io/ttl: 0
                        volumes.kubernetes.io/controller-managed-attach-deta(
CreationTimestamp:      Thu, 13 Jun 2024 11:03:28 +0000
Taints:                 <none>
Unschedulable:          false
Lease:
  HolderIdentity:       kind-worker
  AcquireTime:          <unset>
  RenewTime:            Thu, 13 Jun 2024 11:03:59 +0000
Conditions:
  Type            Status  LastHeartbeatTime                      LastTransiti
  ----            ------  -----------------                      ------------
  MemoryPressure  False   Thu, 13 Jun 2024 11:03:32 +0000        Thu, 13 Jun
  DiskPressure    False   Thu, 13 Jun 2024 11:03:32 +0000        Thu, 13 Jun
  PIDPressure     False   Thu, 13 Jun 2024 11:03:32 +0000        Thu, 13 Jun
  Ready           True    Thu, 13 Jun 2024 11:03:32 +0000        Thu, 13 Jun
Addresses:
  InternalIP:   172.19.0.3
  Hostname:     kind-worker
Capacity:
  cpu:                  6
  ephemeral-storage:    50620216Ki
  hugepages-2Mi:        0
  memory:               6063024Ki
  pods:                 110
Allocatable:
  cpu:                  6
  ephemeral-storage:    50620216Ki
  hugepages-2Mi:        0
  memory:               1344432Ki
  pods:                 110
```

```
Name:              kind-worker2
Roles:             <none>
Labels:            beta.kubernetes.io/arch=amd64
                   beta.kubernetes.io/os=linux
                   kubernetes.io/arch=amd64
                   kubernetes.io/hostname=kind-worker2
                   kubernetes.io/os=linux
Annotations:       kubeadm.alpha.kubernetes.io/cri-socket: unix:///run/containerd/containerd.sock
                   node.alpha.kubernetes.io/ttl: 0
                   volumes.kubernetes.io/controller-managed-attach-detach: true
CreationTimestamp: Thu, 13 Jun 2024 11:03:21 +0000
Taints:            <none>
Unschedulable:     false
Lease:
  HolderIdentity:  kind-worker2
  AcquireTime:     <unset>
  RenewTime:       Thu, 13 Jun 2024 11:03:53 +0000
Conditions:
  Type             Status  LastHeartbeatTime                  LastTransitionTime                 Reas
  ----             ------  -----------------                  ------------------                 ----
  MemoryPressure   False   Thu, 13 Jun 2024 11:03:26 +0000    Thu, 13 Jun 2024 11:03:21 +0000    Kube
  DiskPressure     False   Thu, 13 Jun 2024 11:03:26 +0000    Thu, 13 Jun 2024 11:03:21 +0000    Kube
  PIDPressure      False   Thu, 13 Jun 2024 11:03:26 +0000    Thu, 13 Jun 2024 11:03:21 +0000    Kube
  Ready            True    Thu, 13 Jun 2024 11:03:26 +0000    Thu, 13 Jun 2024 11:03:26 +0000    Kube
Addresses:
  InternalIP:  172.19.0.4
  Hostname:    kind-worker2
Capacity:
  cpu:                6
  ephemeral-storage:  50620216Ki
  hugepages-2Mi:      0
  memory:             6063024Ki
  pods:               110
Allocatable:
  cpu:                6
  ephemeral-storage:  50620216Ki
  hugepages-2Mi:      0
  memory:             1868720Ki
  pods:               110
```

- ○ **Scenario3: Most mode**
- ○ First make remove, change values.yaml to Most, then build and deploy the custom scheduler again
- ○ Delete pods and create pod

```
▶ student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl delete pod nginx2
pod "nginx2" deleted
▶ student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl delete pod nginx3
pod "nginx3" deleted
▶ student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl get po -o wide
NAME                              READY   STATUS    RESTARTS   AGE     IP            NODE           NOMINATED NODE   READINESS GATES
my-scheduler-69cfc986c7-jgxp8     1/1     Running   0          9m21s   10.244.1.2    kind-worker2   <none>           <none>
nginx                             1/1     Running   0          8m37s   10.244.2.4    kind-worker    <none>           <none>
▶ student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl create -f pod-scenario23.yaml
pod/nginx2 created
pod/nginx3 created
```

○ Logs of my scheduler

```
student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl logs my-scheduler-69cfc986c7-jgxp8
2024/06/13 11:10:59 custom-scheduler starts!
I0613 11:10:59.732486       1 flags.go:64] FLAG: --allow-metric-labels="[]"
I0613 11:10:59.732523       1 flags.go:64] FLAG: --authentication-kubeconfig=""
I0613 11:10:59.732528       1 flags.go:64] FLAG: --authentication-skip-lookup="false"
I0613 11:10:59.732532       1 flags.go:64] FLAG: --authentication-token-webhook-cache-ttl="10s"
I0613 11:10:59.732538       1 flags.go:64] FLAG: --authentication-tolerate-lookup-failure="true"
I0613 11:10:59.732541       1 flags.go:64] FLAG: --authorization-always-allow-paths="[/healthz,/readyz,/livez]"
I0613 11:10:59.732549       1 flags.go:64] FLAG: --authorization-kubeconfig=""
I0613 11:10:59.732552       1 flags.go:64] FLAG: --authorization-webhook-cache-authorized-ttl="10s"
I0613 11:10:59.732557       1 flags.go:64] FLAG: --authorization-webhook-cache-unauthorized-ttl="10s"
```

. . . .

```
I0613 11:24:45.585080       1 tlsconfig.go:200] "Loaded serving cert" certName="Generated self signed cert" certDetail="\"localhost@1718277884\" [serving] validS
ost-ca@1718277884\" (2024-06-13 10:24:44 +0000 UTC to 2025-06-13 10:24:44 +0000 UTC (now=2024-06-13 11:24:45.585067021 +0000 UTC))"
I0613 11:24:45.585434       1 named_certificates.go:53] "Loaded SNI cert" index=0 certName="self-signed loopback" certDetail="\"apiserver-loopback-client@1718277
t] issuer=\"apiserver-loopback-client-ca@1718277885\" (2024-06-13 10:24:44 +0000 UTC to 2025-06-13 10:24:44 +0000 UTC (now=2024-06-13 11:24:45.58542113 +0000 UTC
I0613 11:24:58.113778       1 log.go:194] Pod nginx2 is in Prefilter phase.
I0613 11:24:58.114280       1 log.go:194] Pod nginx2 is in Score phase. Calculate the score of Node kind-worker.
I0613 11:24:58.114298       1 log.go:194] Pod nginx2 is in Score phase. Calculate the score of Node kind-worker2.
I0613 11:24:58.121923       1 schedule_one.go:252] "Successfully bound pod to node" pod="default/nginx2" node="kind-worker2" evaluatedNodes=3 feasibleNodes=2
I0613 11:24:58.159490       1 log.go:194] Pod nginx3 is in Prefilter phase.
I0613 11:24:58.159894       1 log.go:194] Pod nginx3 is in Score phase. Calculate the score of Node kind-worker.
I0613 11:24:58.160086       1 log.go:194] Pod nginx3 is in Score phase. Calculate the score of Node kind-worker2.
I0613 11:24:58.165532       1 schedule_one.go:252] "Successfully bound pod to node" pod="default/nginx3" node="kind-worker2" evaluatedNodes=3 feasibleNodes=2
```

○ kubectl get po -o wide

```
student@ds-student7:~/NTHU-Scheduler-Plugin$ kubectl get po -o wide
NAME                            READY   STATUS    RESTARTS   AGE   IP           NODE          NOMINATED NODE   READINESS GATES
my-scheduler-69cfc986c7-7l56l   1/1     Running   0          41s   10.244.1.3   kind-worker2  <none>           <none>
nginx                           1/1     Running   0          13m   10.244.2.4   kind-worker   <none>           <none>
nginx2                          1/1     Running   0          26s   10.244.1.5   kind-worker2  <none>           <none>
nginx3                          1/1     Running   0          26s   10.244.1.4   kind-worker2  <none>           <none>
```

Nginx2 and nginx3 are bind to kind-worker2 in most mode, because kind-worker has less allocatable memory than kind-worker2