The screenshot of `kubectl get nodes`

```
student@ds-student17:~/NTHU-Scheduler-Plugin$ kubectl get nodes
NAME                STATUS    ROLES           AGE    VERSION
kind-control-plane  Ready     control-plane   23d    v1.29.2
kind-worker         Ready     <none>          23d    v1.29.2
kind-worker2        Ready     <none>          23d    v1.29.2
```

The screenshot of passing all the unit tests

```
root@30ca7b00b4d9:/go/src/app# go test -v ./...
?       my-scheduler-plugins/cmd/scheduler      [no test files]
=== RUN   TestCustomScheduler_PreFilter
=== RUN   TestCustomScheduler_PreFilter/pod_is_accepted
finish adding2024/06/15 06:52:34 Pod  is in Prefilter phase.
=== RUN   TestCustomScheduler_PreFilter/pod_is_just_accepted
finish adding2024/06/15 06:52:34 Pod  is in Prefilter phase.
=== RUN   TestCustomScheduler_PreFilter/pod_is_rejected
finish adding2024/06/15 06:52:34 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
2024/06/15 06:52:34 Custom scheduler runs with the mode: Least.
2024/06/15 06:52:34 Pod  is in Score phase. Calculate the score of Node m1.
2024/06/15 06:52:34 Node m1 remain memory 100
2024/06/15 06:52:34 Pod  is in Score phase. Calculate the score of Node m2.
2024/06/15 06:52:34 Node m2 remain memory 200
=== RUN   TestCustomScheduler_Score/most_mode
2024/06/15 06:52:34 Custom scheduler runs with the mode: Least.
2024/06/15 06:52:34 Pod  is in Score phase. Calculate the score of Node m1.
2024/06/15 06:52:34 Node m1 remain memory 100
2024/06/15 06:52:34 Pod  is in Score phase. Calculate the score of Node m2.
2024/06/15 06:52:34 Node m2 remain memory 200
--- 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        0.034s
```

Explain the 3 scenarios designing to validate your implementation

1. validate preFilter

- pod spec: testPrefilter.yaml
- 共有三個 pod
  - 同屬一個 Group: GP
  - GP 的 minAvailable: 3
- expected result: 到了第三個 pod 被 create 才會被 schedule
- screenshots of result
  - 共有三個 pod，只有 test-prefilter-3 是 Running 狀態

```
student@ds-student17:~/NTHU-Scheduler-Plugin$ kubectl get pod
NAME                              READY   STATUS    RESTARTS   AGE
my-scheduler-69cfc986c7-m54pd     1/1     Running   0          2m51s
test-prefilter-1                  0/1     Pending   0          1s
test-prefilter-2                  0/1     Pending   0          1s
test-prefilter-3                  1/1     Running   0          1s
```

  - log 中顯示確實只有 test-prefilter-3 被 schdeule

```
I0615 07:31:25.202079       1 named_certificates.go:53] "Loaded SNI cert" index=0 certName="self-signed loopback" certDetail="\"apiserver-loopback-client@
1718436685\" [serving] validServingFor=[apiserver-loopback-client] issuer)\"apiserver-loopback-client-ca@1718436684\" (2024-06-15 06:31:24 +0000 UTC to 20
25-06-15 06:31:24 +0000 UTC (now=2024-06-15 07:31:25.202061113 +0000 UTC))"
I0615 07:34:12.103853       1 log.go:194] Pod test-prefilter-1 is in Prefilter phase.
I0615 07:34:12.105146       1 schedule_one.go:867] "Unable to schedule pod; no fit; waiting" pod="default/test-prefilter-1" err="0/3 nodes are available:
unschedulable. preemption: 0/3 nodes are available: 3 No preemption victims found for incoming pod.."
I0615 07:34:12.151021       1 log.go:194] Pod test-prefilter-2 is in Prefilter phase.
I0615 07:34:12.151328       1 schedule_one.go:867] "Unable to schedule pod; no fit; waiting" pod="default/test-prefilter-2" err="0/3 nodes are available:
unschedulable. preemption: 0/3 nodes are available: 3 No preemption victims found for incoming pod.."
I0615 07:34:12.206337       1 log.go:194] Pod test-prefilter-3 is in Prefilter phase.
I0615 07:34:12.207000       1 log.go:194] Pod test-prefilter-3 is in Score phase. Calculate the score of Node kind-worker.
I0615 07:34:12.207016       1 log.go:194] Node kind-worker remain memory 1324290048
I0615 07:34:12.207023       1 log.go:194] Pod test-prefilter-3 is in Score phase. Calculate the score of Node kind-worker2.
I0615 07:34:12.207027       1 log.go:194] Node kind-worker2 remain memory 1861160960
I0615 07:34:12.211919       1 schedule_one.go:252] "Successfully bound pod to node" pod="default/test-prefilter-3" node="kind-worker" evaluatedNodes=3 fea
sibleNodes=2
```

2. validate Most mode

- pod spec: testMost.yaml
- 共有兩個 pod
  - 同屬一個 Group: GM
  - GP 的 minAvailable: 1
- expected result: pod 會被安排在剩餘最多 memory 空間的 node 上
- screenshots of result
  - 共有兩個 pod

```
student@ds-student17:~/NTHU-Scheduler-Plugin$ kubectl get po -o wide
NAME                              READY   STATUS    RESTARTS   AGE   IP            NODE          NOMINATED NODE   READINESS GATES
my-scheduler-69cfc986c7-7x6js     1/1     Running   0          10s   10.244.1.36   kind-worker   <none>           <none>
test-most-1                       1/1     Running   0          5s    10.244.2.29   kind-worker2  <none>           <none>
test-most-2                       1/1     Running   0          5s    10.244.1.37   kind-worker   <none>           <none>
```

  - log 中顯示

- mode: Most

```
I0615 07:43:30.831622      1 flags.go:64] FLAG: --vmodule=""
I0615 07:43:30.831626      1 flags.go:64] FLAG: --write-config-to=""
I0615 07:43:31.237608      1 serving.go:348] Generated self-signed cert in-memory
I0615 07:43:31.238404      1 configfile.go:59] "KubeSchedulerConfiguration v1beta3 is deprecated in v1.26, will be removed in v1.29"
W0615 07:43:31.240448      1 client_config.go:618] Neither --kubeconfig nor --master was specified.  Using the inClusterConfig.  This might not work.
I0615 07:43:31.671444      1 requestheader_controller.go:244] Loaded a new request header values for RequestHeaderAuthRequestController
I0615 07:43:31.677460      1 log.go:194] Custom scheduler runs with the mode: Most.
I0615 07:43:31.679735      1 configfile.go:105] "Using component config" config=<
```

- 在 create pod test-most-1 時，kind-worker2 比 kind-worker 的剩餘 memory 還多，所以部屬在 kind-worker2 上

- 在 create pod test-most-2 時，kind-worker 比 kind-worker2 的剩餘 memory 還多，所以部屬在 kind-worker 上

```
25-06-15 06:48:42 +0000 UTC (now=2024-06-15 07:48:42.927748735 +0000 UTC))
I0615 07:48:45.481900      1 log.go:194] Pod test-most-1 is in Prefilter phase.
I0615 07:48:45.483072      1 log.go:194] Pod test-most-1 is in Score phase. Calculate the score of Node kind-worker.
I0615 07:48:45.483107      1 log.go:194] Node kind-worker remain memory 1324290048
I0615 07:48:45.483130      1 log.go:194] Pod test-most-1 is in Score phase. Calculate the score of Node kind-worker2.
I0615 07:48:45.483135      1 log.go:194] Node kind-worker2 remain memory 1861160960
I0615 07:48:45.492471      1 schedule_one.go:252] "Successfully bound pod to node" pod="default/test-most-1" node="kind-worker2" evaluatedNodes=3 feasibl
eNodes=2
I0615 07:48:45.540130      1 log.go:194] Pod test-most-2 is in Prefilter phase.
I0615 07:48:45.541024      1 log.go:194] Pod test-most-2 is in Score phase. Calculate the score of Node kind-worker.
I0615 07:48:45.541087      1 log.go:194] Node kind-worker remain memory 1324290048
I0615 07:48:45.541168      1 log.go:194] Pod test-most-2 is in Score phase. Calculate the score of Node kind-worker2.
I0615 07:48:45.541197      1 log.go:194] Node kind-worker2 remain memory 812584960
I0615 07:48:45.549538      1 schedule_one.go:252] "Successfully bound pod to node" pod="default/test-most-2" node="kind-worker" evaluatedNodes=3 feasible
```

3. validate Least mode

- pod spec: testLeast.yaml
- 共有三個 pod
  - 同屬一個 Group: GL
  - GP 的 minAvailable: 1
- expected result: pod 會被安排在剩餘最少 memory 空間的 node 上
- screenshots of result
  - 共有三個 pod

```
student@ds-student17:~/NTHU-Scheduler-Plugin$ kubectl get po -o wide
NAME                          READY   STATUS    RESTARTS   AGE   IP            NODE          NOMINATED NODE   READINESS GATES
my-scheduler-69cfc986c7-dxd27 1/1     Running   0          27s   10.244.1.39   kind-worker   <none>           <none>
test-least-1                  1/1     Running   0          8s    10.244.1.40   kind-worker   <none>           <none>
test-least-2                  1/1     Running   0          8s    10.244.1.41   kind-worker   <none>           <none>
test-least-3                  1/1     Running   0          8s    10.244.1.42   kind-worker   <none>           <none>
student@ds-student17:~/NTHU-Scheduler-Plugin$
```

  - log 中顯示
    - mode: Least

```
I0615 07:54:41.953751      1 flags.go:64] FLAG: --write-config-to=""
I0615 07:54:42.362652      1 serving.go:348] Generated self-signed cert in-memory
I0615 07:54:42.363843      1 configfile.go:59] "KubeSchedulerConfiguration v1beta3 is deprecated in v1.26, will be removed in v1.29"
W0615 07:54:42.363958      1 client_config.go:618] Neither --kubeconfig nor --master was specified.  Using the inClusterConfig.  This might not work.
I0615 07:54:42.707652      1 requestheader_controller.go:244] Loaded a new request header values for RequestHeaderAuthRequestController
I0615 07:54:42.714705      1 log.go:194] Custom scheduler runs with the mode: Least.
I0615 07:54:42.717387      1 configfile.go:105] "Using component config" config=<
```

    - 在 create pod test-least-1 時，kind-worker 比 kind-worker2 的剩餘 memory 還少，所以部屬在 kind-worker2 上

    - 在 create pod test-least-2 時，kind-worker 比 kind-worker2 的剩餘 memory 還少，所以部屬在 kind-worker2 上

    - 在 create pod test-least-3 時，kind-worker 比 kind-worker2 的剩餘 memory 還少，所以部屬在 kind-worker2 上

```
25-00-13 00.34.42 +0000 UTC (now=2024-06-13 07.54.42.823923578 +0000 UTC))
I0615 07:55:00.565588       1 log.go:194] Pod test-least-1 is in Prefilter phase.
I0615 07:55:00.566403       1 log.go:194] Pod test-least-1 is in Score phase. Calculate the score of Node kind-worker2.
I0615 07:55:00.566427       1 log.go:194] Node kind-worker2 remain memory 1861160960
I0615 07:55:00.566482       1 log.go:194] Pod test-least-1 is in Score phase. Calculate the score of Node kind-worker.
I0615 07:55:00.566495       1 log.go:194] Node kind-worker remain memory 1324290048
I0615 07:55:00.573204       1 schedule_one.go:252] "Successfully bound pod to node" pod="default/test-least-1" node="kind-worker" evaluatedNodes=3 feasibl
eNodes=2
I0615 07:55:00.617837       1 log.go:194] Pod test-least-2 is in Prefilter phase.
I0615 07:55:00.618096       1 log.go:194] Pod test-least-2 is in Score phase. Calculate the score of Node kind-worker.
I0615 07:55:00.618108       1 log.go:194] Node kind-worker remain memory 1219432448
I0615 07:55:00.618116       1 log.go:194] Pod test-least-2 is in Score phase. Calculate the score of Node kind-worker2.
I0615 07:55:00.618119       1 log.go:194] Node kind-worker2 remain memory 1861160960
I0615 07:55:00.623065       1 schedule_one.go:252] "Successfully bound pod to node" pod="default/test-least-2" node="kind-worker" evaluatedNodes=3 feasibl
eNodes=2
I0615 07:55:00.682651       1 log.go:194] Pod test-least-3 is in Prefilter phase.
I0615 07:55:00.683196       1 log.go:194] Pod test-least-3 is in Score phase. Calculate the score of Node kind-worker2.
I0615 07:55:00.683209       1 log.go:194] Node kind-worker2 remain memory 1861160960
I0615 07:55:00.683222       1 log.go:194] Pod test-least-3 is in Score phase. Calculate the score of Node kind-worker.
I0615 07:55:00.683226       1 log.go:194] Node kind-worker remain memory 1114574848
I0615 07:55:00.688006       1 schedule_one.go:252] "Successfully bound pod to node" pod="default/test-least-3" node="kind-worker" evaluatedNodes=3 feasibl
eNodes=2
```