

Evaluation

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Current state

- Microservice System in Kubernetes deployed
- Scaling through the Horizontal Pod Autoscaler
- Metrics through Prometheus/Grafana

Events in the Kubernetes Dashboard

Name	Min Replicas	Max Replicas	Reference	Created ↑	
inventory	1	7	Deployment / inventory	3 hours ago	⋮

Events ▲

Message	Source	Sub-object	Count	First Seen	Last Seen
New size: 4; reason: external metric xtraffix(&LabelSelector(MatchLabels:map[string]string{type:prometheus,MatchExpressions:[LabelSelectorRequirement({})]) above target	horizontal-pod-autoscaler	-	7	an hour ago	5 minutes ago
Scaled up replica set inventory-5646fb4fc8 to 4	deployment-controller	-	7	an hour ago	5 minutes ago
New size: 1; reason: All metrics below target	horizontal-pod-autoscaler	-	6	an hour ago	48 minutes ago
Scaled down replica set inventory-5646fb4fc8 to 1	deployment-controller	-	6	an hour ago	48 minutes ago
New size: 7; reason: external metric xtraffix(&LabelSelector(MatchLabels:map[string]string{type:prometheus,MatchExpressions:[LabelSelectorRequirement({})]) above target	horizontal-pod-autoscaler	-	5	an hour ago	12 minutes ago
Scaled up replica set inventory-5646fb4fc8 to 7	deployment-controller	-	5	an hour ago	12 minutes ago
New size: 2; reason: All metrics below target	horizontal-pod-autoscaler	-	2	an hour ago	12 minutes ago
Scaled down replica set inventory-5646fb4fc8 to 2	deployment-controller	-	2	an hour ago	12 minutes ago
New size: 2; reason: external metric xtraffix(&LabelSelector(MatchLabels:map[string]string{type:prometheus,MatchExpressions:[LabelSelectorRequirement({})]) above target	horizontal-pod-autoscaler	-	2	an hour ago	36 minutes ago
Scaled up replica set inventory-5646fb4fc8 to 2	deployment-controller	-	2	an hour ago	36 minutes ago

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Events in the CLI

```
trod@trodspec -  
File Edit View Search Terminal Tabs Help  
trod@trodspec: ~/Documents/hpa_config/hpa_test x trod@trodspec: ~/Documents/kubernetes-event-exporte... x trod@trodspec: ~/Documents/hpa_config/hpa_test x trod@trodspec: ~  
55m Normal Killing pod/inventory-5646fb4fc8-wp9zt Stopping container inventory  
54m Normal Scheduled pod/inventory-5646fb4fc8-zj5pd Successfully assigned default/inventory-5646fb4fc8-zj5pd to minikube  
54m Normal Pulling pod/inventory-5646fb4fc8-zj5pd Pulling image "t2project/inventory:main"  
54m Normal Pulled pod/inventory-5646fb4fc8-zj5pd Successfully pulled image "t2project/inventory:main" in 4.258249339s  
54m Normal Created pod/inventory-5646fb4fc8-zj5pd Created container inventory  
54m Normal Started pod/inventory-5646fb4fc8-zj5pd Started container inventory  
49m Normal Killing pod/inventory-5646fb4fc8-zj5pd Stopping container inventory  
13m Normal Scheduled pod/inventory-5646fb4fc8-zlldf Successfully assigned default/inventory-5646fb4fc8-zlldf to minikube  
13m Normal Pulling pod/inventory-5646fb4fc8-zlldf Pulling image "t2project/inventory:main"  
13m Normal Pulled pod/inventory-5646fb4fc8-zlldf Successfully pulled image "t2project/inventory:main" in 1.322963424s  
13m Normal Created pod/inventory-5646fb4fc8-zlldf Created container inventory  
13m Normal Started pod/inventory-5646fb4fc8-zlldf Started container inventory  
7n54s Normal Killing pod/inventory-5646fb4fc8-zlldf Stopping container inventory  
60m Normal SuccessfulCreate replicaset/inventory-5646fb4fc8 Created pod: inventory-5646fb4fc8-lpnzb  
60m Normal SuccessfulCreate replicaset/inventory-5646fb4fc8 Created pod: inventory-5646fb4fc8-jrnhd  
55m Normal SuccessfulDelete replicaset/inventory-5646fb4fc8 Deleted pod: inventory-5646fb4fc8-jrnhd  
49m Normal SuccessfulDelete replicaset/inventory-5646fb4fc8 Deleted pod: inventory-5646fb4fc8-7k856  
37m Normal SuccessfulCreate replicaset/inventory-5646fb4fc8 Created pod: inventory-5646fb4fc8-qphl4  
29m Normal SuccessfulCreate replicaset/inventory-5646fb4fc8 Created pod: inventory-5646fb4fc8-l2sv8  
29m Normal SuccessfulCreate replicaset/inventory-5646fb4fc8 Created pod: inventory-5646fb4fc8-vxc2b  
20m Normal SuccessfulCreate replicaset/inventory-5646fb4fc8 Created pod: inventory-5646fb4fc8-5xg4k  
20m Normal SuccessfulCreate replicaset/inventory-5646fb4fc8 Created pod: inventory-5646fb4fc8-ho1vw  
20m Normal SuccessfulCreate replicaset/inventory-5646fb4fc8 Created pod: inventory-5646fb4fc8-7tcs9  
14m Normal SuccessfulDelete replicaset/inventory-5646fb4fc8 Deleted pod: inventory-5646fb4fc8-5xg4k  
7n54s Normal SuccessfulDelete replicaset/inventory-5646fb4fc8 Deleted pod: inventory-5646fb4fc8-zlldf  
6n39s Normal SuccessfulRescale horizontalpodautoscaler/inventory New size: 4; reason: external metric xtrafficx(8LabelSelector[MatchLabels:map[string]string{type: prometheus,},MatchExpressio  
ns:[]LabelSelectorRequirement{,}) above target  
6n39s Normal ScalingReplicaSet deployment/inventory Scaled up replica set inventory-5646fb4fc8 to 4  
49m Normal SuccessfulRescale horizontalpodautoscaler/inventory New size: 1; reason: All metrics below target  
49m Normal ScalingReplicaSet deployment/inventory Scaled down replica set inventory-5646fb4fc8 to 1  
49m Normal SuccessfulRescale horizontalpodautoscaler/inventory New size: 7; reason: external metric xtrafficx(8LabelSelector[MatchLabels:map[string]string{type: prometheus,},MatchExpressio  
ns:[]LabelSelectorRequirement{,}) above target  
13m Normal ScalingReplicaSet deployment/inventory Scaled up replica set inventory-5646fb4fc8 to 7  
13m Normal SuccessfulRescale horizontalpodautoscaler/inventory New size: 2; reason: All metrics below target  
13m Normal ScalingReplicaSet deployment/inventory Scaled down replica set inventory-5646fb4fc8 to 2  
13m Normal SuccessfulRescale horizontalpodautoscaler/inventory New size: 2; reason: external metric xtrafficx(8LabelSelector[MatchLabels:map[string]string{type: prometheus,},MatchExpressio  
ns:[]LabelSelectorRequirement{,}) above target  
37m Normal ScalingReplicaSet deployment/inventory Scaled up replica set inventory-5646fb4fc8 to 2  
6n54s Normal SuccessfulRescale horizontalpodautoscaler/inventory New size: 3; reason: All metrics below target  
6n54s Normal ScalingReplicaSet deployment/inventory Scaled down replica set inventory-5646fb4fc8 to 3  
7n54s Normal SuccessfulRescale horizontalpodautoscaler/inventory New size: 4; reason: All metrics below target  
7n54s Normal ScalingReplicaSet deployment/inventory Scaled down replica set inventory-5646fb4fc8 to 4  
25m Normal Scheduled pod/utbackend-cff658987-wmbnk Successfully assigned default/utbackend-cff658987-wmbnk to minikube  
25m Normal Pulling pod/utbackend-cff658987-wmbnk Pulling image "t2project/utbackend:main"  
25m Normal Pulled pod/utbackend-cff658987-wmbnk Successfully pulled image "t2project/utbackend:main" in 1.404289691s  
25m Normal Created pod/utbackend-cff658987-wmbnk Created container utbackend  
25m Normal Started pod/utbackend-cff658987-wmbnk Started container utbackend  
25m Normal SuccessfulCreate replicaset/utbackend-cff658987 Created pod: utbackend-cff658987-wmbnk  
25m Normal SuccessfulRescale horizontalpodautoscaler/utbackend New size: 2; reason: external metric xcpx(8LabelSelector[MatchLabels:map[string]string{type: prometheus,},MatchExpressions:[  
]LabelSelectorRequirement{,}) above target  
25m Normal ScalingReplicaSet deployment/utbackend Scaled up replica set utbackend-cff658987 to 2  
trod@trodspec: $
```

Events in the CLI

```
trod@trodspsc: ~  
File Edit View Search Terminal Tabs Help  
trod@trodspsc: ~/Documents/hpa_config/hpa_test x trod@trodspsc: ~/Documents/kubernetes-event-exporte... x trod@trodspsc: ~/Documents/hpa_config/hpa_test x trod@trodspsc: ~  
trod@trodspsc:~$ kubectl get events --field-selector reason=SuccessfulRescale  
LAST SEEN   TYPE      REASON              OBJECT                                          MESSAGE  
13m         Normal    SuccessfulRescale    horizontalpodautoscaler/inventory             New size: 4; reason: external metric xtrafficx(&LabelSelector{MatchLabels:map[string]string{type: prometheus,},MatchExpression  
s:[[]LabelSelectorRequirement{[]}) above target  
55m         Normal    SuccessfulRescale    horizontalpodautoscaler/inventory             New size: 1; reason: All metrics below target  
3m17s       Normal    SuccessfulRescale    horizontalpodautoscaler/inventory             New size: 7; reason: external metric xtrafficx(&LabelSelector{MatchLabels:map[string]string{type: prometheus,},MatchExpression  
s:[[]LabelSelectorRequirement{[]}) above target  
20m         Normal    SuccessfulRescale    horizontalpodautoscaler/inventory             New size: 2; reason: All metrics below target  
44m         Normal    SuccessfulRescale    horizontalpodautoscaler/inventory             New size: 2; reason: external metric xtrafficx(&LabelSelector{MatchLabels:map[string]string{type: prometheus,},MatchExpression  
s:[[]LabelSelectorRequirement{[]}) above target  
13m         Normal    SuccessfulRescale    horizontalpodautoscaler/inventory             New size: 3; reason: All metrics below target  
14m         Normal    SuccessfulRescale    horizontalpodautoscaler/inventory             New size: 4; reason: All metrics below target  
32m         Normal    SuccessfulRescale    horizontalpodautoscaler/uibackend             New size: 2; reason: external metric xcpux(&LabelSelector{MatchLabels:map[string]string{type: prometheus,},MatchExpressions:[]  
LabelSelectorRequirement{[]}) above target  
2m3s        Normal    SuccessfulRescale    horizontalpodautoscaler/uibackend             New size: 1; reason: All metrics below target  
trod@trodspsc:~$
```

Procedure

Receiving Events

1. Convert to a nicer format
2. Extract information
 - a. Metric
 - b. Scaling type
 - c. Replica size

Relation of Events

Relation of Events:

- Scaling type
- Time interval
- Metric type
- Derivation

Performance Problems

- Classify load
- Collect metrics
- Analyse for performance problems

Create Issues

Error in the HPA:

- Metric not available

Adaption not successful:

- Scaling till maxReplica

Performance Problem:

- Reporting the problem type

Evaluation Questions:

1. Which are the biggest challenges developers face when trying to understand/verify the autoscaling behavior of a microservice system?
2. Please order the following points by how much they challenge developers, when trying to understand/verify the autoscaling behavior of a microservice system?
 1. High effort to provide information for analysis
 2. Information is scattered through too many tools/dashboards
 3. There are too many autoscaling decisions taken to keep an overview

Evaluation Questions:

3. Which of the problems from question 1 and 2 are solved by the system proposed in this bachelor thesis?
4. Which of the problems from question 1 and 2 are reduced by the system in this bachelor thesis? If yes, how much are they reduced? (1-5) (1, not very much, 5, very much)
5. Are there features missing that you would need to better understand/verify the autoscaling behavior of a microservice system?
6. Would you use a completely implemented version of the tool proposed in this bachelor thesis?