Table of Contents

Preface xi

1. Introduction 1
Velocity 2
The Value of Immutability 3
Declarative Configuration 4
Self-Healing Systems 4
Scaling Your Service and Your Teams 5
Decoupling 5
Easy Scaling for Applications and Clusters 6
Scaling Development Teams with Microservices 6
Separation of Concerns for Consistency and Scaling 7
Abstracting Your Infrastructure 9
Efficiency 10
Summary 11

2. Creating and Running Containers 13
Container Images 14
The Docker Image Format 14
Building Application Images with Docker 16
Dockerfiles 16
Image Security 16
Optimizing Image Sizes 17
Storing Images in a Remote Registry 18
The Docker Container Runtime 19
Running Containers with Docker 19
Exploring the kuard Application 19
Limiting Resource Usage 19

Cleanup 20
Summary 21

3. Deploying a Kubernetes Cluster. 23
Installing Kubernetes on a Public Cloud Provider 23
Google Container Service 24
Installing Kubernetes with Azure Container Service 24
Installing Kubernetes on Amazon Web Services 25
Installing Kubernetes Locally Using minikube 25
Running Kubernetes on Raspberry Pi 26
The Kubernetes Client 26
Checking Cluster Status 26
Listing Kubernetes Worker Nodes 27
Cluster Components 29
Kubernetes Proxy 29
Kubernetes DNS 30
Kubernetes UI 30
Summary 31

4. Common kubectl Commands. 33
Namespaces 33
Contexts 33
Viewing Kubernetes API Objects 34
Creating, Updating, and Destroying Kubernetes Objects 35
Labeling and Annotating Objects 35
Debugging Commands 36
Summary 36

5. Pods. 37
Pods in Kubernetes 38
Thinking with Pods 38
The Pod Manifest 39
Creating a Pod 40
Creating a Pod Manifest 40
Running Pods 41
Listing Pods 41
Pod Details 42
Deleting a Pod 43
Accessing Your Pod 43
Using Port Forwarding 44
Getting More Info with Logs 44
Running Commands in Your Container with exec 44

Copying Files to and from Containers 45
Health Checks 45
Liveness Probe 46
Readiness Probe 47
Types of Health Checks 47
Resource Management 47
Resource Requests: Minimum Required Resources 48
Capping Resource Usage with Limits 50
Persisting Data with Volumes 50
Using Volumes with Pods 51
Different Ways of Using Volumes with Pods 51
Persisting Data Using Remote Disks 52
Putting It All Together 53
Summary 54

6. Labels and Annotations. 55
Labels 55
Applying Labels 56
Modifying Labels 58
Label Selectors 58
Label Selectors in API Objects 60
Annotations 61
Defining Annotations 62
Cleanup 62
Summary 63

7. Service Discovery. 65
What Is Service Discovery? 65
The Service Object 66
Service DNS 67
Readiness Checks 68
Looking Beyond the Cluster 69
Cloud Integration 70
Advanced Details 71
Endpoints 72
Manual Service Discovery 73
kube-proxy and Cluster IPs 74
Cluster IP Environment Variables 74
Cleanup 75
Summary 75

8. ReplicaSets. 77
Reconciliation Loops 78
Relating Pods and ReplicaSets 78
Adopting Existing Containers 79
Quarantining Containers 79
Designing with ReplicaSets 79
ReplicaSet Spec 80
Pod Templates 80
Labels 81
Creating a ReplicaSet 81
Inspecting a ReplicaSet 82
Finding a ReplicaSet from a Pod 82
Finding a Set of Pods for a ReplicaSet 82
Scaling ReplicaSets 83
Imperative Scaling with kubectl Scale 83
Declaratively Scaling with kubectl apply 83
Autoscaling a ReplicaSet 84
Deleting ReplicaSets 85
Summary 86

9. DaemonSets. 87
DaemonSet Scheduler 88
Creating DaemonSets 88
Limiting DaemonSets to Specific Nodes 90
Adding Labels to Nodes 90
Node Selectors 91
Updating a DaemonSet 92
Updating a DaemonSet by Deleting Individual Pods 92
Rolling Update of a DaemonSet 93
Deleting a DaemonSet 94
Summary 94

10. Jobs. 95
The Job Object 95
Job Patterns 96
One Shot 96
Parallelism 100
Work Queues 102
Summary 106

11. ConfigMaps and Secrets. 107
ConfigMaps 107

Creating ConfigMaps 107
Using a ConfigMap 108
Secrets 111
Creating Secrets 112
Consuming Secrets 113
Private Docker Registries 114
Naming Constraints 115
Managing ConfigMaps and Secrets 116
Listing 116
Creating 117
Updating 117
Summary 119

12. Deployments. 121
Your First Deployment 122
Deployment Internals 122
Creating Deployments 123
Managing Deployments 125
Updating Deployments 125
Scaling a Deployment 125
Updating a Container Image 126
Rollout History 127
Deployment Strategies 130
Recreate Strategy 130
RollingUpdate Strategy 130
Slowing Rollouts to Ensure Service Health 134
Deleting a Deployment 135
Summary 136

13. Integrating Storage Solutions and Kubernetes. 137
Importing External Services 138
Services Without Selectors 139
Limitations of External Services: Health Checking 141
Running Reliable Singletons 141
Running a MySQL Singleton 142
Dynamic Volume Provisioning 145
Kubernetes-Native Storage with StatefulSets 146
Properties of StatefulSets 146
Manually Replicated MongoDB with StatefulSets 147
Automating MongoDB Cluster Creation 149
Persistent Volumes and StatefulSets 152
One Final Thing: Readiness Probes 153

Summary 153

14. Deploying Real-World Applications. 155
Parse 155
Prerequisites 155
Building the parse-server 156
Deploying the parse-server 156
Testing Parse 157
Ghost 157
Configuring Ghost 158
Redis 161
Configuring Redis 161
Creating a Redis Service 163
Deploying Redis 163
Playing with Our Redis Cluster 165
Summary 165

A. Building a Raspberry Pi Kubernetes Cluster. 167

Index. 175