

Table of Contents

Preface	1
Chapter 1: Introducing Hybrid Clouds	7
 Understanding hybrid clouds	7
What is cloud computing?	8
Software as a Service	8
Platform as a Service	9
Infrastructure as a Service	9
Characteristics of a cloud	11
Types of cloud	11
Private cloud	11
Public cloud	12
Technologies used by cloud providers	13
 Introducing hybrid cloud	14
Hybrid cloud architecture	15
Hybrid cloud using OpenStack and AWS/Azure/GCP	16
What qualifies as a hybrid cloud?	18
Cloud bursting in a hybrid cloud	19
Advantages of using hybrid cloud	20
Cost savings	20
Flexibility	20
Speed	21
Portability	21
Security	21
Factors to consider before moving to a hybrid cloud	21
Understanding DevOps methodology	22
Collaboration	25
Automation	25
Continuous integration	25
Continuous testing	25
 Summary	26
Chapter 2: Exploring AWS Cloud	27
 Introducing AWS Cloud	27
Amazon Web Service features	28
Creating an AWS account	30
Amazon EC2	33
AMI	34
EC2 instance types	34
EC2 instance IP addressing	35
EC2 instance security groups	35
Launching an EC2 instance from the web console	36

Amazon EBS	42
Creating an AWS EBS volume	43
Snapshot of EBS volumes	45
Amazon S3	46
S3 bucket properties	47
Creating an S3 bucket using the AWS console	47
Uploading/downloading files to and from an S3 bucket	51
Using the AWS command-line interface	51
Using HTTP GET method or wget	51
Using AWS S3 API	51
Using the AWS console	52
Amazon VPC	52
Creating an AWS VPC	54
VPC configurations	56
Scenario 1 – VPC with public subnet only	56
Scenario 2 – VPC with public and private subnet	57
Scenario 3 – VPC with public and private subnet and VPN connectivity	59
Scenario 4 – VPC with private subnet only and VPN connectivity	61
VPC peering	62
Summary	62
Chapter 3: Exploring OpenStack Private Cloud	63
 Introducing OpenStack	63
OpenStack architecture	64
Installing OpenStack	68
NOVA – OpenStack Compute Service	70
Neutron – OpenStack Networking Service	72
Tenant networks	73
Provider networks	74
Glance – OpenStack Imaging Service	75
Cinder – OpenStack Block Storage Service	77
Keystone – OpenStack Identity Service	78
Horizon – OpenStack Dashboard Service	83
Heat – OpenStack Orchestration Service	84
Ironic – OpenStack bare metal provisioning	86
OpenStack workflow – launching a new virtual machine	87
Summary	89
Chapter 4: Developing AWS Cloud Applications	91
 Technical requirements	91
 AWS – Software Development Kit (SDK)	92
 Setting up an AWS development environment on Visual Studio	92
 Setting up a Unix development environment for Python	93
 Developing Amazon S3 applications – Windows	94
Creating an S3 bucket	94
Listing S3 buckets	97
Uploading files to the S3 bucket	98
Downloading files from the S3 bucket	100

Listing files in an S3 bucket	101
Deleting a file in an S3 bucket	101
Developing AWS S3 applications – Unix	102
Creating a bucket	102
Uploading files to S3	102
Listing S3 buckets	103
Downloading files from the S3 bucket	103
Deleting objects/files from a bucket	104
Deleting a bucket	104
Developing Amazon EC2 applications – Windows	105
Launching an EC2 instance	105
Checking the state of your EC2 instance	106
Connecting to the instance	107
Terminating the EC2 instance	107
Developing Amazon EC2 applications – Unix	108
Launching an EC2 instance in Python	108
Listing EC2 instances in Python	108
Terminating an EC2 instance in Python	109
Developing Amazon RDS applications – Windows	110
DB Instance and instance classes	110
Creating an RDS instance	111
Listing the RDS database instances	112
Connecting to the database instance	113
Deleting the RDS database instance	113
Developing Amazon RDS applications – Unix	114
Creating an RDS instance	114
Listing the database instances	115
Connecting to the database instance	115
Deleting the RDS database instance	116
Developing Amazon SNS applications – Windows	116
Creating a topic	117
Subscribing to a topic	118
Publishing messages	118
Deleting the topic	119
Developing Amazon SNS applications – Unix	119
Creating a topic	119
Subscribing to a topic	120
Publishing a message	120
Deleting a topic	121
Developing Amazon SQS applications – Windows	121
Creating an SQS queue	122
Listing the available queues	123
Sending a message to the queue	124
Receiving a message from the queue	124

Deleting a message from the queue	125
Developing Amazon SQS applications – Unix	126
Creating an SQS queue	126
Sending a message to the queue	126
Receiving a message from the queue	127
Deleting messages from the queue	128
Amazon CloudFormation service	129
How CloudFormation works	129
A CloudFormation template	129
Executing the CloudFormation template	132
Summary	133
Chapter 5: Developing OpenStack Applications	135
 Technical requirements	135
 Introduction to OpenStack SDK	136
Go	136
Java	136
JavaScript	136
.NET	137
PHP	137
Ruby	137
C	137
C++	138
Perl	138
Python	138
 Creating an application development environment for OpenStack	138
 Writing your first OpenStack application	139
 Developing OpenStack image service applications	140
Listing images	140
Downloading a VM image	141
Uploading an image	142
Deleting the image	143
 Developing OpenStack compute applications	143
Listing nova networks	143
Creating an SSH key-pair	144
Launching a VM	144
Starting a VM	145
Stopping a VM	146
Rebooting a VM	146
Pausing a VM	146
Unpausing a VM	147
Creating an image from a VM	147
IP address	147
Adding a fixed IP address	148
Removing a fixed IP address	148

Adding a floating IP address	149
Removing a floating IP address	149
Security groups	149
Adding a security group to a VM	150
Removing a security group from a VM	150
Listing security groups	151
Flavors	151
Listing flavors	151
Creating a flavor	151
Deleting a flavor	152
Developing OpenStack networking applications	152
Networks	153
Creating a network/subnet	153
Listing networks	153
Listing subnets	154
Listing ports	154
Listing routers	154
Listing network agents	154
Deleting a network	155
Creating a security group	155
Developing OpenStack Identity Service applications	156
User management	156
Creating a user	156
Deleting a user	157
Updating a user	157
Finding a user	157
Roles	157
Creating a role	158
Updating a role	158
Deleting a role	158
Projects	159
Creating a project	159
Updating a project	159
Deleting a project	159
Developing block storage applications	160
Volumes	160
Creating a volume	160
Deleting a volume	161
Volume snapshots	161
Creating a snapshot	162
Deleting a snapshot	162
Developing HEAT orchestration templates	163
Summary	166
Chapter 6: Cloud Migration	167
Choosing the right cloud provider	167
Setting up a hybrid cloud environment	168

Cloud migration	170
Application migration strategies	171
Rehosting	172
Replatforming	172
Repurchasing	173
Refactoring	173
Retiring	173
AWS migration tools	173
AWS Migration Hub	173
AWS Application Discovery Service	174
AWS Server Migration Service	174
AWS Database Migration Service	174
AWS S3 Transfer Acceleration	174
AWS Snowball	175
AWS Snowmobile	175
AWS Direct Connect	175
AWS Kinesis Firehouse	175
Migrating a VM to AWS	176
Migrating from AWS to OpenStack	179
Benefits of cloud migration	181
Risks of cloud migration	181
Cost benefits of cloud migration	182
Summary	183
Chapter 7: Hybrid Cloud Best Practices	185
 Hybrid cloud strategy best practices	186
Pluggable architecture	186
AWS root account	187
Security group rules	187
Data backup	187
High availability	188
Cloud monitoring	189
Cloud automation	190
Cloud orchestration	190
Co-locating data and application tiers	191
Scaling	191
Vertical scaling	191
Horizontal scaling	192
Legacy applications	193
Resource utilization and costs	193
Centralized cloud management	194
Designing for failure	194
Caching	194
Retry operation	194
Limiting requests	195
Error reporting	195
Application decoupling	195

Continuous delivery and integration	196
Deploying the application at multiple locations	197
Developing the application locally or in the cloud	198
Summary	198
Chapter 8: Monitoring and Troubleshooting Hybrid Cloud	199
Troubleshooting OpenStack	200
Linux troubleshooting and monitoring tools	200
Troubleshooting the OpenStack Identity service	204
Authentication issues	204
Keystone service issues	205
Keystone database issues	205
Troubleshooting the OpenStack Image service	206
Glance service issues	207
Glance database issues	208
Troubleshooting the Networking service	208
IP address allocation to the VM	209
Unable to ping to VM	209
VM cannot reach the external network	210
Troubleshooting the Compute service	212
Database issues	214
Instance issues	214
Volume issues	216
Troubleshooting the Block Storage service	216
Common issues	217
Troubleshooting the Object Storage service	218
Swift authentication	219
Troubleshooting the Orchestration service	221
Service errors	221
Stack errors	223
Troubleshooting AWS	224
AWS Direct Connect	224
EC2 instance issues	225
Instance connection issues	225
Empty console output	225
SSH key issues	226
EBS volume issues	227
Volume stuck in Attaching state	227
Volume in Error state	227
Volume snapshot in Pending state	227
S3 object store issues	228
Troubleshooting OpenVPN issues	228
OpenVPN log files	228
VPN connection issues	228
Authentication issues	230
Starting and stopping OpenVPN	230
Summary	231

Chapter 9: Hybrid Cloud Security	233
Hybrid cloud security threats	233
Lack of encryption	234
User symmetric key encryption	234
Encrypting data before uploading to the cloud	235
Protecting data at rest and in transit with a cloud access security broker	235
Using a reliable VPN connection	236
Using SSH	236
Key management	236
Lack of compliance	236
Lack of data backup and replication	237
Unsecure application APIs	239
Denial of service attacks	240
Data leaks	241
Virtualization software security	241
Virtual machine security	242
Patch management	243
Intrusion detection and prevention	244
Identity access management	245
Developing secure applications	247
Data manipulation	247
Coding practices	247
User input validation	248
Security testing	248
Summary	249
Other Books You May Enjoy	251
Index	255