

EE 542 Review Session for Final Exam

during last Lecture on Nov.27, 2017

Exam Period:

2 pm – 4 pm (120 minutes)

Wednesday, Nov. 29, 2017

Exam Venue:

MHP 101 for all students

Format and Exam Rules :

- The final exam is **close-book and close-note**.
- No wireless phone or notebook computer are allowed.
- **Bring your own calculator and erasers.** No borrow from other students during the exam.
- The Format is **similar to Mid-Term Exam**, except there will be **4 problem-solving type** with numerical calculations

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Exam Format and Coverage:

- 7 problems to be solved in 120 minutes
- Prob.1 : 18% for mapping 18 key Terms
- Prob. 2: 10% for 10 multiple-choice questions.
- Remaining 5 Problems (72%) cover selected sections in 6 chapters 4, 6, 7, 8, 9, and 10
- The coverage: 14 Lectures 3, 4, 5, 8, 9, 14, 15, and 17, 18, 19, 20, 21, 22, and 23, including HW Sets 1, 2, 3 and 4.
- Note that Last two lectures 24 and 25 given on Nov.15 and Nov. 20 are excluded from the final exam.

Coverage in Six Chapters :

- All sections in Chapters 4 and 8 are fully covered.
- Chapters 1, 2, 3 and 5 are skipped.
- Coverage of Chapters 6 and 7 are given in the next slide
- Chapter 9 covers **only Sections 9.1 ~ 9.3**
- Chapter 10 only cover only **Sections 10.1 ~ 10.3**

Coverage in Chapters 6 and 7

- Chapter 6 deals with Machine Learning Algorithms.
- Sections 6.1, 6.2.1 (Regression), 6.2.3 (Bayesian Classifier), 6.3.1 (Clustering Methods), and entire Section 6.4 (ML Model Fitting) are included.
- Chapter 7 is devoted AI Machines and Deep Learning Networks .
- Sections 7.1 (AI Machines), 7.2.1 ~ 7.2.2 (AR, VR) 7.3.1 ~ 7.3.4 (ANNs), and 7.4 (CNN and RNN).
- Skip Section 7.5

Suggestions To Review:

- All lecture slides must be reviewed, some slides carry updated information from the book.
- Pay attentions to key concepts, models, abbreviated key terms, and tabulations which summarizes clouds, services, HW/SW, and programming tools.
- The exam format and problem style are similar to Mid-term exam. More computation problems are asked.
- Reading assignments were identified in the lectures. Those sections that you can skip are identified .

Preparation Suggestions:

- All 14 lecture slides must be reviewed including the project specification in Lecture 5.
- Read only selected sections in 6 Chapters (4 , 6 ~10).
- Skip reading the following sections in Chapters 6 and 7: Sections 6.2.2, 6.2.4, 6.3.2~6.3.4, 7.2.3, 7.3.5, and 7.5
- Review Homework Solutions. You should correct errors by comparing with handout solutions.
- No make-up exam, if you miss the exam. Arrive at the exam room 10 minutes early to get seated properly.
- No negotiation of grades after the final exam.

Reviews of Chapter 4

- **Chapter 4** is the main chapter for cloud architecture, all sections are **fully covered**. (Lectures 3 and 4)
- **AWS Architecture and Service Offerings**
- **Review of other Cloud Architectures:**
Google GAE, MS Azures, Salesforce clouds, IBM SmartCloud, HP Helion, SGI Cyclone, etc.
- **The Team Project running on AWS platform** will be covered. (Lec.5)

Some Representative Public Clouds

Table 4.1

Five public cloud platforms and their service offerings (2016)

Public Clouds	Platform Model(s)	Typical Service Offerings	Website and Coverage in Book
Amazon Web Service (AWS)	IaaS, PaaS	EC2, S3, SQS, EMR, VPC, EBS, SNS, CloudFront, etc.	http://aws.amazon.com/ , Section 4.3
Google App Engine	PaaS, SaaS	Gmail, Docs, GFS, BigTable, Chubby	https://developer.google.com , Section 4.4.1~2
Microsoft Azure	PaaS, SaaS	Live, SQL, Office 365, Dynamic CRM	http://www.windowsazure.com , Section 4.4.3
IBM SmartCloud	PaaS, SaaS, IaaS	Compute, Storage, Backup, Networking, Virtualization	http://www.ibm.com/cloud-computing , Section 4.5.2
SalesForce Clouds	SaaS, PaaS	CRM, Sales, Marketing, Apex, Visual force	https://salesforce.com , Section 4.5.1

Compute, Storage, Database and Networking Services in The AWS Cloud in 2015

Category	Offering	Service Modules or Short Description
Compute	EC2	Virtual Servers in the AWS Cloud
	Lambda	Run Code in Response to Events
	EC2 Container Service	Run and Manage Docker Containers
Storage & Content Delivery	S3	Scalable Storage in the AWS Cloud
	Elastic File System	Fully Management File System for EC2 (Preview)
	Storage Gateway	Integrate On-Premises IT Facilities with Cloud Storage
	Glacier	Archive Storage in the Cloud
Database	CloudFront	Global Content Delivery Network
	RDS	MySQL, Postgres, Oracle, SQL Server, and Amazon
	DynamicDB	Predictable and Scalable NoSQL Data Store
	ElastiCache	In-Memory Cache
Networking	Redshift	Managed Petabyte-Scale Warehouse Service
	VPC	Virtual Private Cloud as Isolated Cloud Resources
	Direct Connect	Dedicated Network Connection to AWS
	Route 53	Scalable DNS and Domain Name Registration

Application, Mobile and Analytics Services in the AWS Cloud

Category	Offering	Service Modules or Short Description
Application Services	SQS	Message Queue Services
	SWF	Workflow for Coordinating App Components
	AppStream	Low Latency Application Streaming
	Elastic Transcoder	Easy-To-Use Scalable Media Transcoding
	SES	Email Sending Service
	CloudSearch	Managed Search Service
	API Gateway	Build, Deploy and Manage APIs
Mobile Services	Cognito	User Identity and App Data Synchronization
	Device Farm	Test Android and iOS apps on Mobile Devices
	Mobile Analytics	Collect, View and Export App Analytics
	SNS	Simple Push Notification Service
Analytics Services	EMR	Managed Elastic Hadoop Framework
	Kinesis	Real-Time Processing of Streaming Big Data
	Data Pipeline	Orchestration for Data-Driven Workflows
	Machine Learning	Build Smart Applications Quickly and Easily

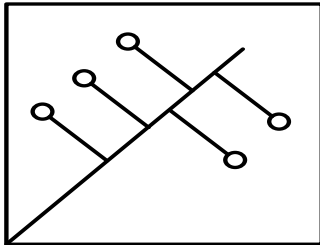
Administraion, Security, Enterprise and Deployment Services in the AWS Cloud

Category	Offering	Service Modules or Short Description
Administration & Security	Directory Service	Managed Directory in the AWS Cloud
	Identity/Access Manager	Access Control and Key Management
	Trusted Advisor	AWS Cloud Optimization Expert
	Cloud Trail	User Activity and Change Tracking
	Configuration	Resource Configurations and Inventory
	CloudWatch	Resource and Application Monitory
	Service Catalog	Personalized Catalog of AWS Resources
Enterprises Applications	Workplaces	Destops in the AWS Cloud
	WorkDocs	Secure Enterprise Storage and Sharing Service
	WorkMail	Secure Email and Calendaring Service
Deployment and Management	Elastic Beanstalk	AWS Application Containers
	OpsWorks	DevOps Application Managemnt Service
	CloudFormation	Templated AWS Resource Creation
	CodeEeploy	Automated Deployments
	CodeCommit	Managed Git Repositories
	Code Pipeline	Continuous Delivery of Codes

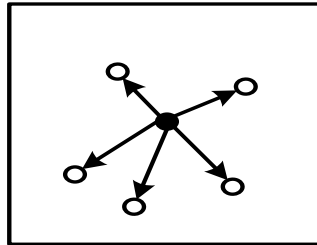
Review of Chapter 6

- Chapter 6 deals with Machine Learning Algorithms.
- Sections 6.1 covers Machine Learning categories
- Supervized learning in 6.2.1 (Regression), 6.2.3 (Bayesian Classifier),
- Sections 6.2.2, 6.2.4, 6.3.2, 6.3.3, 6.3.4 are skipped, No need to read them.
- Section 6.3.1 (Clustering Methods) for Unsupervised learning
- Entire Section 6.4 (ML Model Fitting) is included.

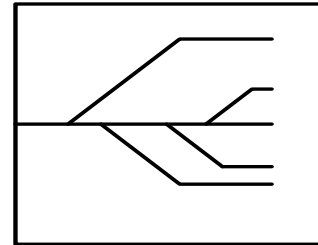
12 Machine Learning Methods (In class, we have only covered (a, e, f, h, i) in details)



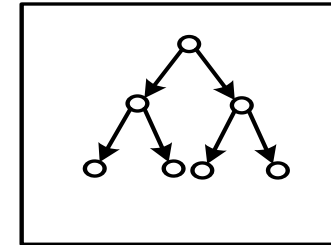
(a) Regression Algorithm



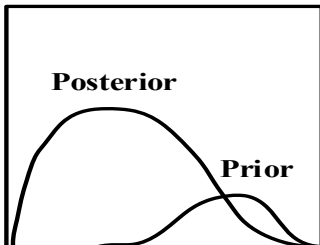
(b) Instance-based Algorithm



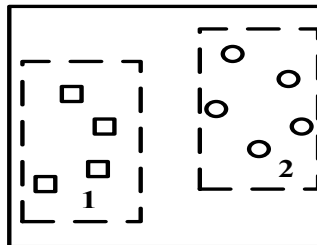
(c) Regularization Algorithm



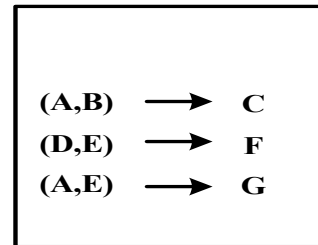
(d) Decision Tree Algorithm



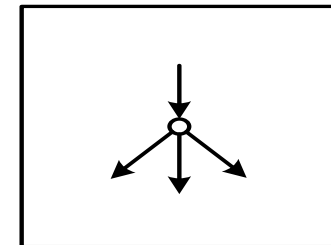
(e) Bayesian Algorithms



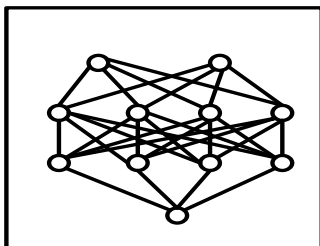
(f) Clustering Algorithms



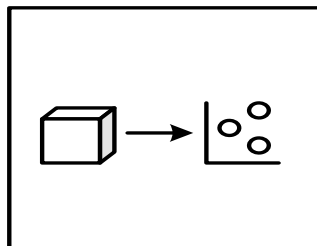
(g) Association Rule Learning Algorithms



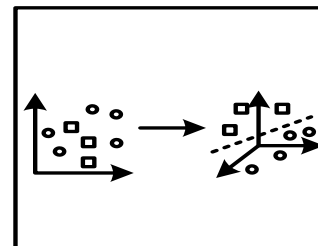
(h) Artificial Neural Network Algorithms



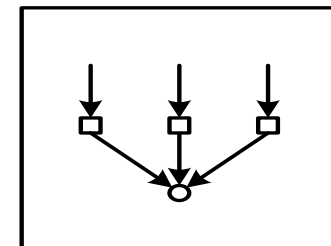
(i) Deep Learning Algorithms



(j) Dimensional Reduction Algorithms



(k) Support Vector Machine Algorithms



(l) Ensemble Algorithms

Coverage Review of Chapter 7

- Chapter 7 is devoted AI Machines and Deep Learning Networks .
- Sections 7.1 (AI Machines) entirely included
- Sections 7.2.1 ~ 7.2.2 (AR, VR) are included
- Skip Section 7.2.3 on blockchains
- Sections 7.3.1 ~ 7.3.4 cover ANNs, included
- Skip Section 7.3.5 on Back Propagation
- Entire Section 7.4 covers CNN and RNN, included.
- Skip the entire Section 7.5

Example 7.2 : Convolution and pooling for Convolutional Neural Networks

CNN has been widely used in digital image processing with the rapid development of CNN. For example, using this DeepID convolutional neural network, the recognition rate of the human face can reach a maximum of 99.15% of the correct rate. This technique can play an important role in the search for missing people and the prevention of terrorist crime. Fig. 7.14 shows CNN used. If the given input image as shows in Fig. 7.15(a), the image size is 8x6. We adopt the size of convolution kernels is 3x3 and the size of one feature graph in convolutional layer 1 is $((8-3)+1) \times ((6-3)+1) = 6 \times 4$. Assuming we use 3 filters, the corresponding weight matrices are:

$$w_1 = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 1 \end{bmatrix}, w_2 = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}, w_3 = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

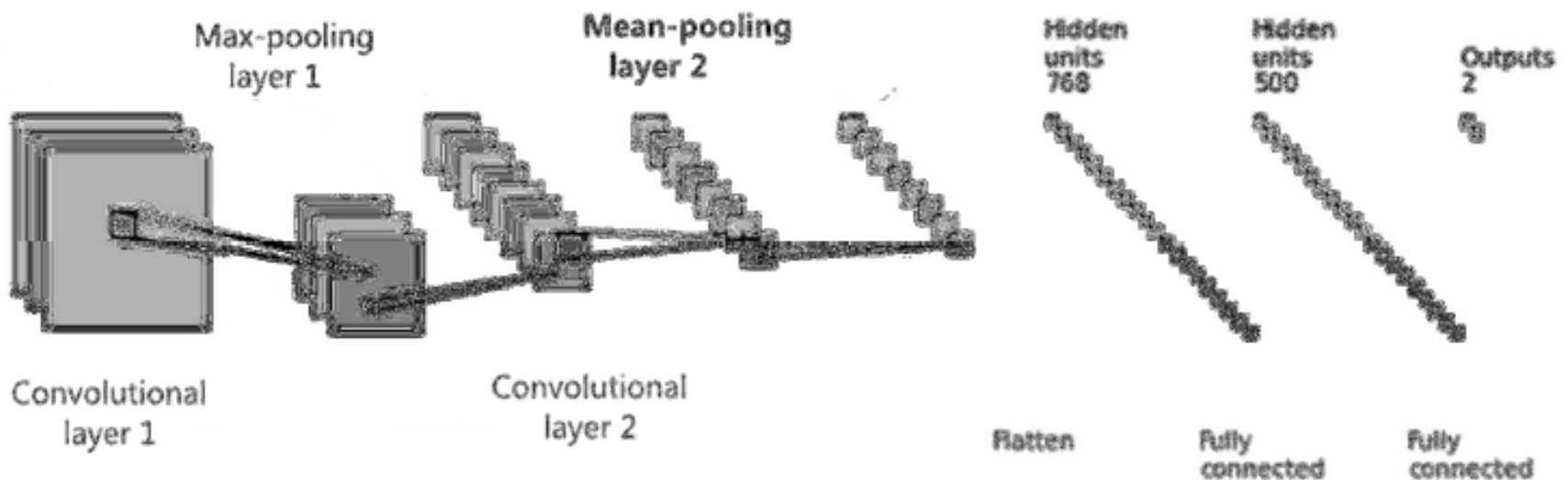


Figure 7.14 Schematic diagrams of Convolutional Neural Network

If the given input image as shows in Fig. 7.15(a), the image size is 8x6. We adopt the size of convolution kernels is 3x3 and the size of one feature graph in convolutional layer 1 is $((8-3)+1) \times ((6-3)+1) = 6 \times 4$. Assuming we use 3 filters, the corresponding weight matrices are:

$$w_1 = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 1 \end{bmatrix}, w_2 = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}, w_3 = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

4	3	1	6	8	0	0	0
0	0	0	5	3	2	1	0
0	0	0	4	5	7	9	1
0	0	0	0	0	0	0	0
1	2	6	2	1	6	3	1
0	0	0	0	0	0	1	1

(a) Input image

5	13	14	17	22	8
0	5	3	7	4	2
7	8	12	19	18	15
0	0	0	0	1	1

(b) After first convolution

-5	3	4	7	12	8
-10	-5	-7	-3	-6	-8
-3	-2	2	9	8	5
-10	-10	-10	-10	-9	-9

(c) After deviation

0	3	4	7	12	8
0	0	0	0	0	0
0	0	2	9	8	5
0	0	0	0	0	0

(d) Feature map at layer 1

0	0	3	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

(e) After second convolution

0	0	3	0	0	0
0	0	0	0	0	0
0	0	1	0	0	0
0	0	0	0	0	0

(f) After another convolution

1			2			3		
3	7	12	0	3	0	0	3	0
0	9	8	0	0	0	0	1	0

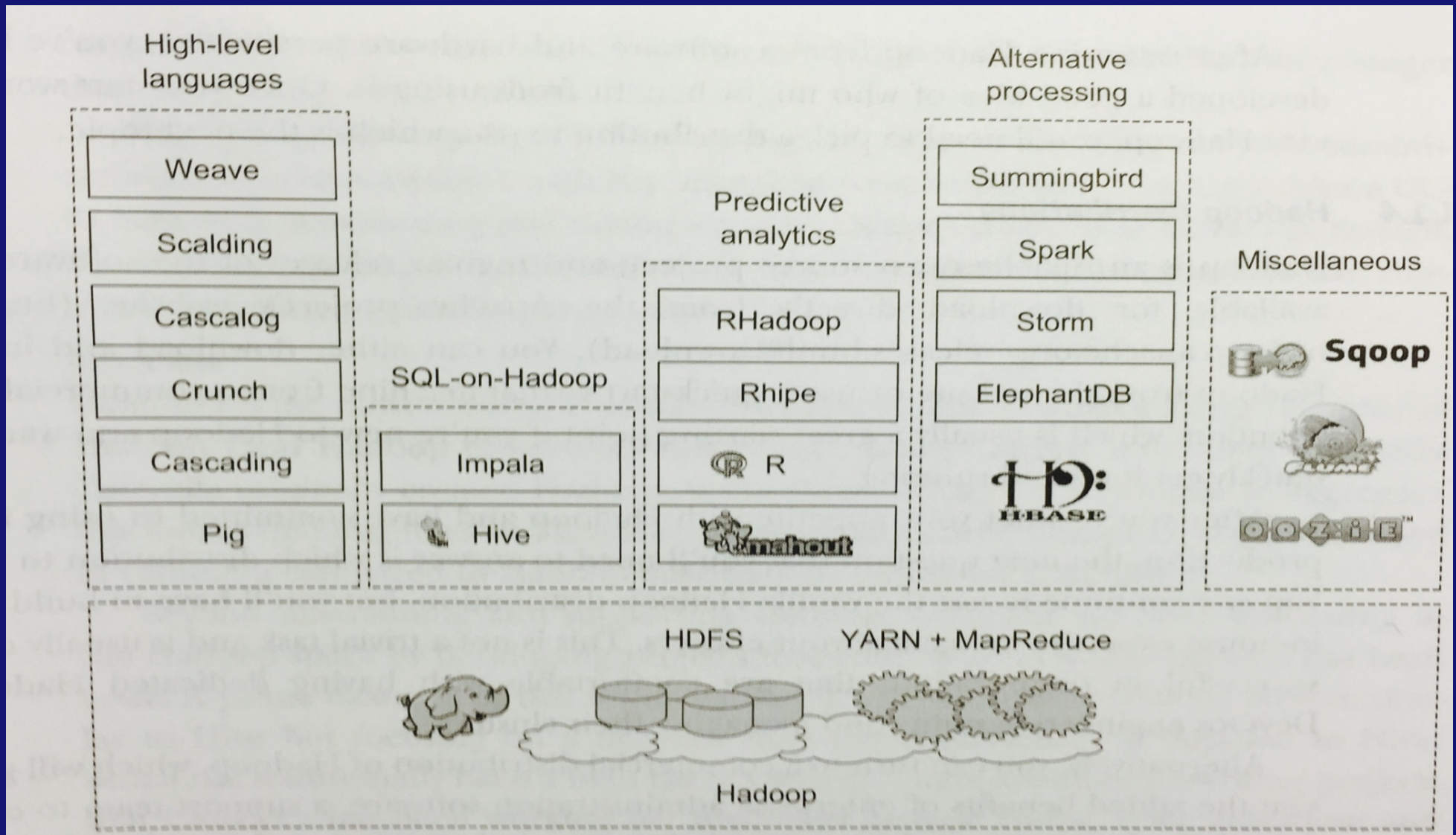
(g) Feature map after maximum polling

Figure 7.15: Successive Convolutional and Pooling steps in building a CNN

Review of Chapter 8

- Chap. 9 is entirely covered in the Final Exam
- **MapReduce Computing Paradigm** is the main thing
- Relationship Between **Google MapReduce** and **Hadoop MapReduce**
- **HDFS** using **<Key, Value>** pairs over distributed disks on servers
- **YARN** for Resources Scheduling in Hadoop
- **Spark Improvements** over Hadoop
- **RDD and Spark Program Modules**

Hadoop Programming and Extensions



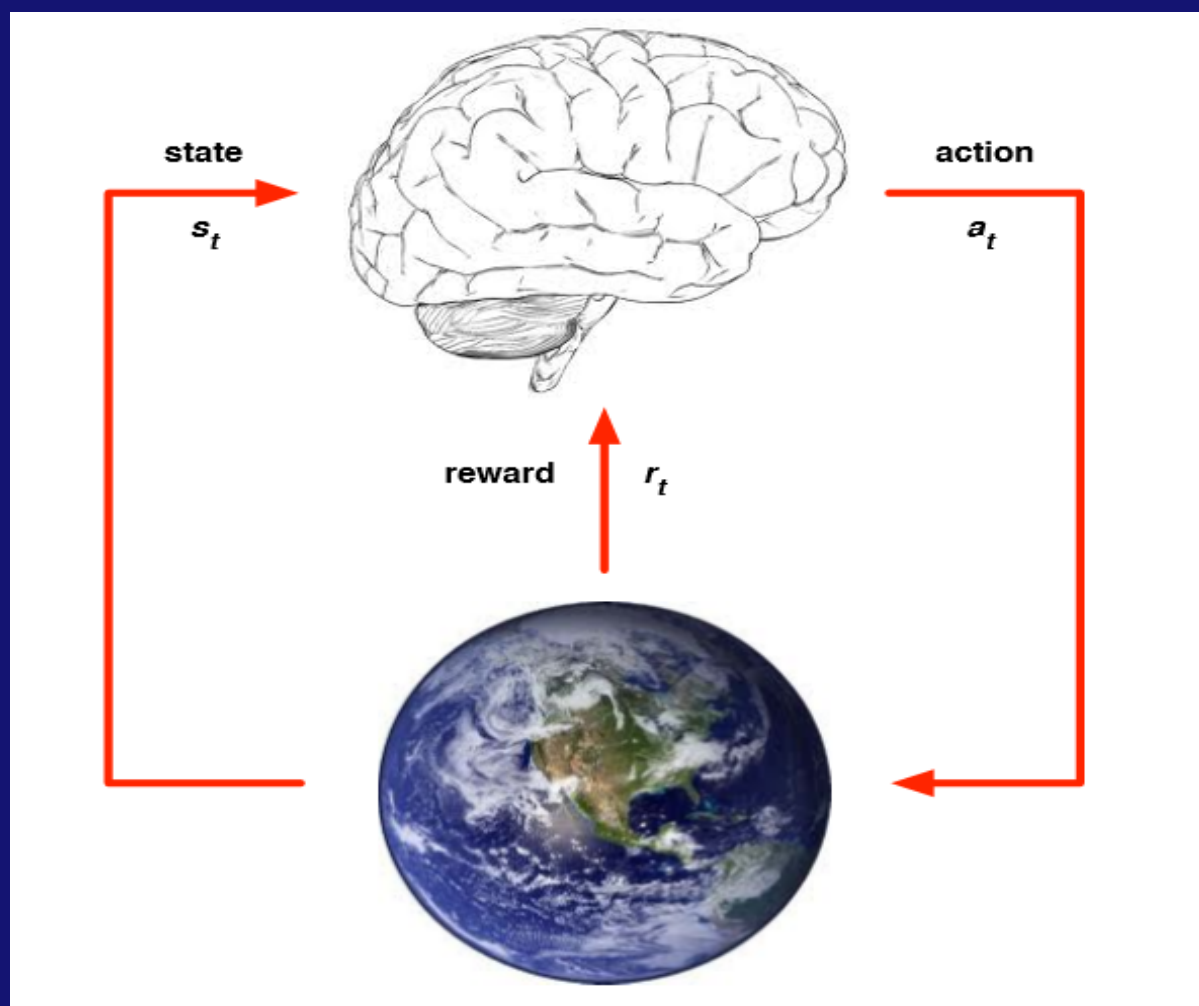
Core Concepts of Spark

- Spark's programming abstraction is enabled by **RDD (Resilient Distributed Datasets)**, defined by many APIs for manipulating large collection of data items.
- **Spark SQL** deal with structured data.
- **Spark Streaming** handles live streams of data.
- **Mllib library** contains common machine learning functionality.
- **GraphX** for manipulating social network graphs.
- Spark's **Cluster Manager** can run with
 - Hadoop **YARN**
 - Apache **Mesos**
 - Spark's own **Standalone Scheduler**.

Review of Chapter 9

- TensorFlow Key Concepts
- Tensors, Variables, and Key Operators
- Google DeepMind Projects
- Reinforcement Learning in AlphaGo
- Sections 9.4 is skipped

Reinforcement Learning

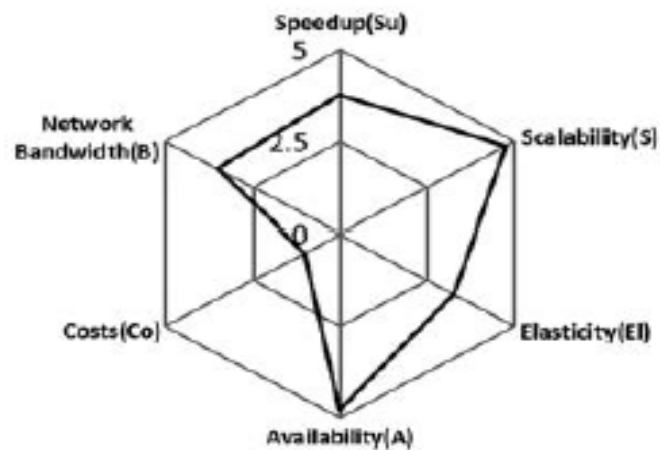


- ▶ At each step t the agent:
 - ▶ Receives state s_t
 - ▶ Receives scalar reward r_t
 - ▶ Executes action a_t
- ▶ The environment:
 - ▶ Receives action a_t
 - ▶ Emits state s_t
 - ▶ Emits scalar reward r_t

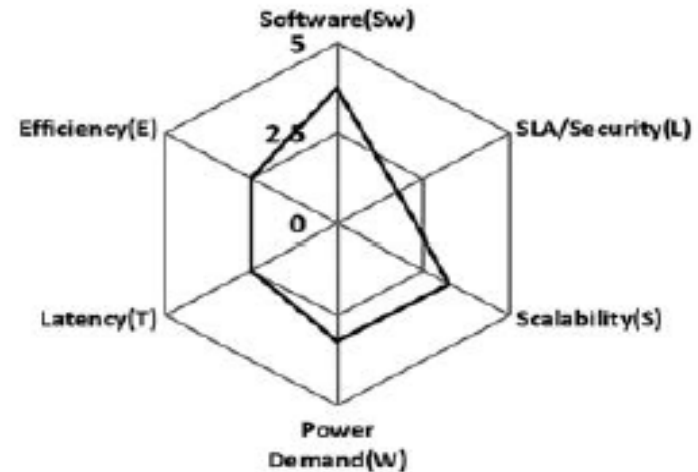
Review of Chapter 10

- Only **Section 10.1.1, 10.2 and 10.3** are included in Final Exam
- **Cloud Performance and QoS**
- **Cloud Performance Metrics and Benchmarks**
- **Analysis of some reported Benchmark Results**
- **Sections 10.4 and 10.5 are skipped**

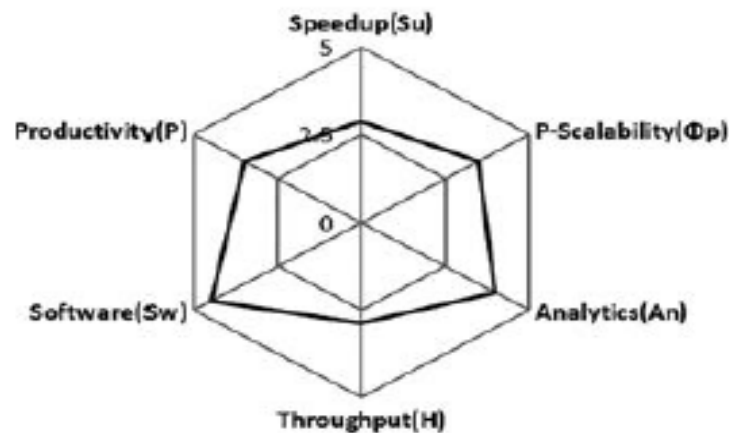
Review of Chapter 10 (Continued)



(a) IaaS (Amazon EC2)



(b) PaaS (Google App Engine)



(c) SaaS (Salesforce)

Figure 10.4

Performance maps of various clouds, where data points are extracted from reported Amazon EC2, Google App Engine, and Salesforce clouds. (Courtesy of Hwang et al., "Cloud Performance Modeling with Benchmark Evaluation of Elastic Scaling Strategies," *IEEE Transactions on Parallel and Distributed Systems*, January 2016.)