Machine learning & deep learning basics

Lecture 1

Changho Suh

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1. Logistics

2. Machine learning & optimization

Logistics

Instructor and TAs

- **Instructor**
  Changho Suh
  N1-912, 042-350-7429
  chsuh@kaist.ac.kr
  http://csuh.kaist.ac.kr

- **TAs**

Jaewoong Cho
KAIST N1-920
042-350-7529
cjw2525@kaist.ac.kr

Moonseok Choi
KAIST N1-920
042-350-7529
ms.choi@kaist.ac.kr

Minguen Kang
KAIST N26-210
042-350-8037
minkang23@kaist.ac.kr

Geewon Suh
KAIST N1-920
042-350-7529
gwsuh91@kaist.ac.kr

Kiwon Lee
KAIST N26-210
042-350-8037
kaiser5072@kaist.ac.kr

Junhyung Ahn
KAIST N1-920
042-350-7529
tonyahn96@kaist.ac.kr

Soobin Um
KAIST N1-920
042-350-7529
sum@kaist.ac.kr

Dongjin Seo
KAIST N1-920
042-350-7529
dongjin.seo@kaist.ac.kr

6 week course

Weeks 1/2 (Days 1 ~ 10):

Lectures & practice sessions

Weeks 3/4/5/6 (Days 11 ~ 30):

Project!

Weeks 1/2

1. Machine learning & deep learning basics
2. Advanced techniques
3. CNN
4. RNN
5. Small-data technique I: Random Forests
6. Dimensionality reduction & clustering
7. Autoencoder & matrix completion
8. Generative models: GANs & RBMs
9. Small-data technique II: Semi-supervised learning etc.
10. Reinforcement learning

Weeks 3/4/5/6

Project!

Group A

수강생	부서/주제
김규진	파워트레인열유동해석팀 HEV 엔진 성능특성 **예측**
김영광	상용전자제어개발3팀 수소전기차 주행상황 **분류** 및 연료전지 **최적화**
김진하	엔진성능시험1팀 DPF 파손 방지를 위한 제어 로직 **최적화**
김치환	내비게이션개발팀 두개의 다른 DB를 매칭시켜주는 알고리즘
김형주	안전성능선행개발팀 수동운전자 모델링
박상천	강판재료개발팀 HE (수소최성) **예측**
박장호	공력개발팀 차량 압력분포 및 유동장 **예측**

Group B

양두희	차량컨셉개발팀 감가속도 활용한 서브마린 발생 판단
어희재	인포테인먼트기획팀 맛집 **추천**
위경수	샤시제어개발팀 댐퍼 누유 **인지**
이성욱	안전시스템제어설계팀 실내 승객 클래스 **판단**
정진영	엔진선행개발팀 파워트레인 유입 공기량 **예측**
조수호	전자전력제어개발 12V 배터리 충방전 **예측**
주기형	전동화PT성능기술개발팀 주행패턴 **개인화**
최현우	인포테인먼트기획팀 음악청취이력 기반 **추천**

TA assignment

Group A

수강생	조교
김규진	**강민근**/최문석/서동진
김영광	**강민근**/최문석/서동진
김진하	강민근/**최문석**/서동진
김치환	강민근/**최문석**/서동진
김형주	강민근/최문석/**서동진**
박상천	**이기원**/서기원/음수빈
박장호	**이기원**/서기원/음수빈

Group B

양두희	이기원/**서기원**/음수빈
어희재	이기원/**서기원**/음수빈
위경수	이기원/서기원/**음수빈**
이성욱	**조제웅**/안준형
정진영	**조제웅**/안준형
조수호	조제웅/**안준형**
주기형	강민근/최문석/**서동진**
최현우	조제웅/**안준형**

Week 3: Communication

Oct. 11: 대체공휴일

Oct. 12: Proposal rehearsal with TAs
Revise proposals

Oct. 13: Proposal presentation I (Group A)
Set up action items

Oct. 14: Proposal presentation II (Group B)
Set up action items

Oct. 15: Checkpoint 1
Set up action items

Week 4: Model setup

Oct. 18: Reinforcement learning (대체공휴일로 연기된 강좌 진행)

Oct. 19: Checkpoint 2

Set up action items

Oct. 20: Project 수행

Oct. 21: Checkpoint 3

Set up action items

Oct. 22: Checkpoint 4

Set up action items

Week 5: Improve model performance

Oct. 25: Checkpoint 5

Set up action items

Oct. 26: Project 수행

Oct. 27: Checkpoint 6

Set up action items

Oct. 28: Project 수행

Oct. 29: Checkpoint 7

Set up action items

Week 6: Wrap-up & final presentation

Nov. 1: Checkpoint 8

Set up action items

Nov. 2: Project 수행

Nov. 3: Checkpoint 9

Set up action items

Nov. 4: Project 수행

Nov. 5: Checkpoint 10

Final presentation preparation

Nov. 8: Final presentation I (Group A)

Nov. 9: Final presentation II (Group B)

How lectures proceed: Week 1

Day 1: Machine learning and deep learning basics

Lecture 1: 9:00 am ~ 10:00 am

Lecture 2: 10:10 am ~ 11:10 am

Lecture 3: 11:20 pm ~ 12:30 pm

PS 1: 1:30 pm ~ 2:30 pm

PS 2: 2:40 pm ~ 3:40 pm

PS 3: 3:50 pm ~ 5:00 pm

Same format for Days 2 ~ 10.

30 lectures & 30 PSs

References

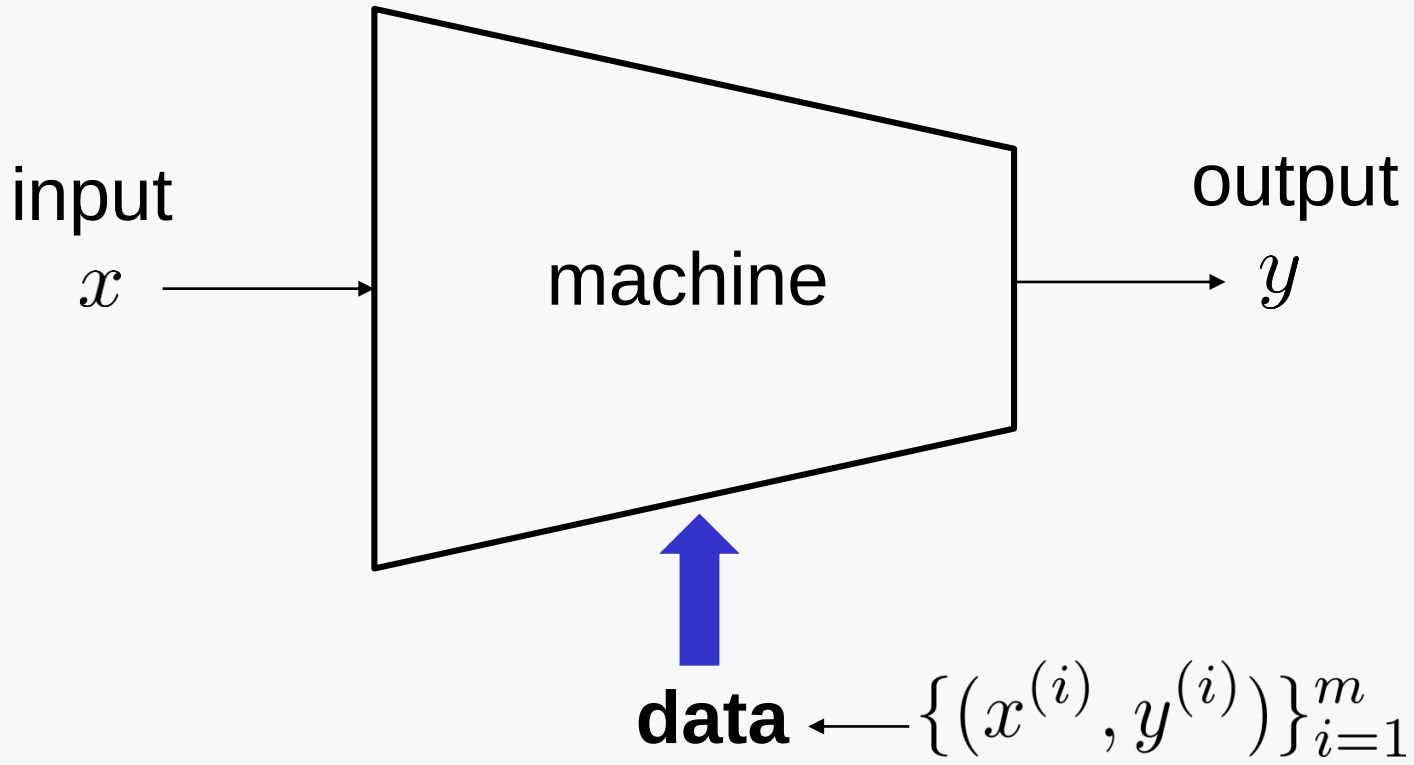
1. Lecture Slides (LS)

2. Practice Session:

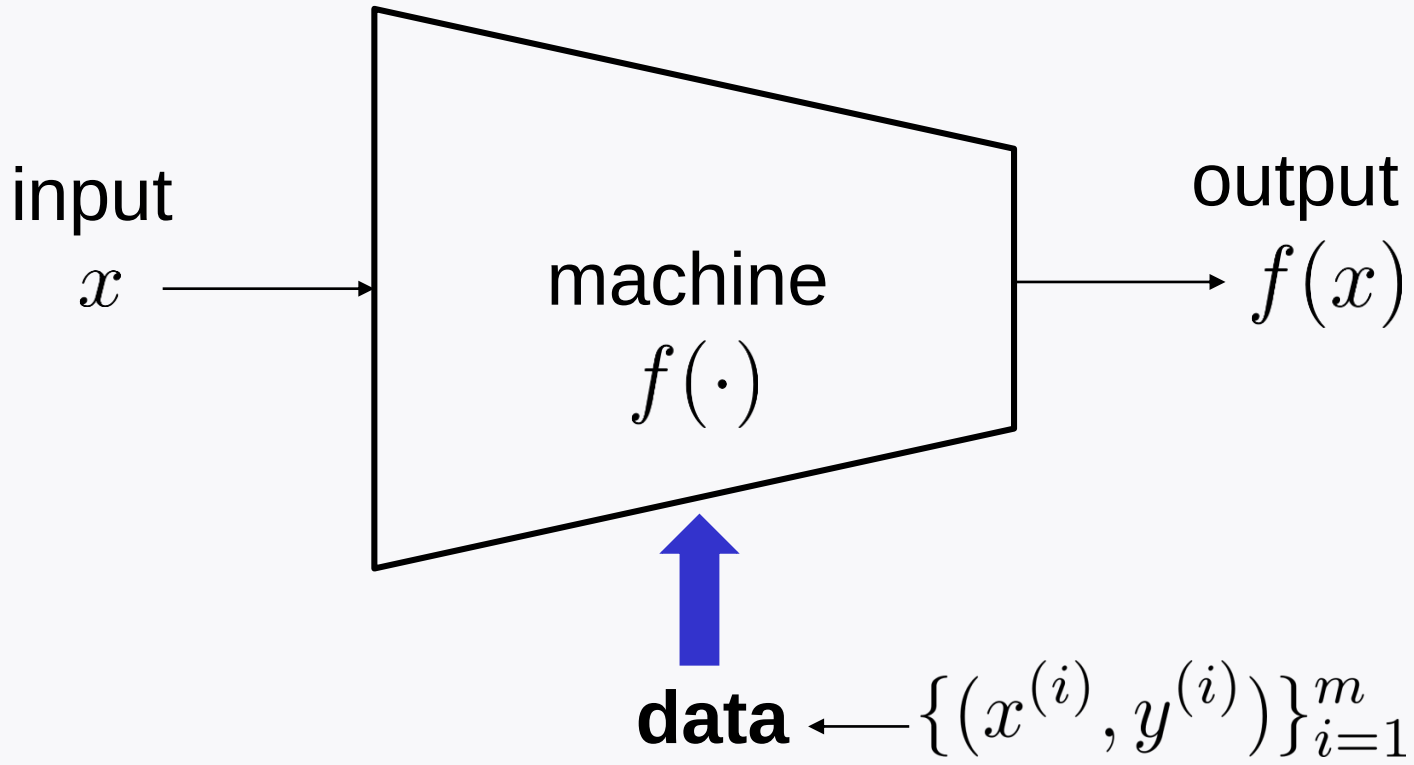
   Slides & python code

Machine learning and optimization

Machine learning



Machine learning



Design an interested function using $\{(x^{(i)}, y^{(i)})\}_{i=1}^{m}$

Training via optimization!

$$\min_{f} \sum_{i=1}^{m} \ell(y^{(i)}, f(x^{(i)}))$$

Note: Function optimization!

Parameterization

$$\min_{w} \sum_{i=1}^{m} \ell(y^{(i)}, f_w(x^{(i)}))$$

Three prominent problems depending on a choice of function class & loss function:

1. Least Squares

2. Logistic regression

3. Deep learning

Least Squares

$$\min_{w} \sum_{i=1}^{m} \ell(y^{(i)}, f_w(x^{(i)}))$$

Employ: Perceptron w/o activation

$$f_w(x) = w^T x$$

A squared-error loss:

$$\ell(y, \hat{y}) = \|y - \hat{y}\|^2$$

Has the closed form solution.

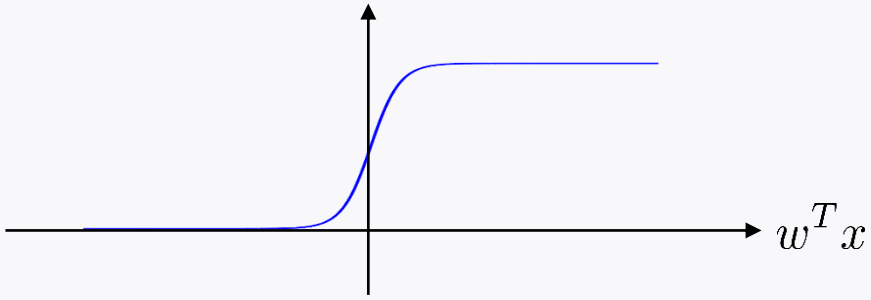
But performance is not that great.

Logistic regression

$$\min_{w} \sum_{i=1}^{m} \ell(y^{(i)}, f_w(x^{(i)}))$$

Employ: Perceptron w/ the logistic function

$$f_w(x) = \frac{1}{1+e^{-w^T x}}$$



Cross Entropy (CE) loss:

$$\ell(y, \hat{y}) = -y \log \hat{y} - (1-y) \log(1-\hat{y})$$

CE is the optimal loss function in a certain sense.

How to train LR?

Gradient descent!

Look ahead

Will study: Gradient descent.

Then move onto deep learning.