CS408 Fall 2018
Machine Learning: When and how (not) to use it

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Today's Lecture

- When to use ML for your CS408 project

  - When your system must behave intelligently in **new situations**

- When not to use ML for your CS408 project

  - When you don't have **enough good** data

- How to use ML well for your CS408 project

  - Know your data, users, and solution limitations

  - Start simple

  - Keep ethics in mind

When to use AI (not necessarily ML) for your CS408 project

- When your system must interact with people

- When your system models, predicts, or mimics people's behavior

- When your system must predict and act in situations that people cannot

  - Situations could be dangerous

  - There may be privacy issues

  - There are too much complex data to process

  - Using a person would be too costly

When it would be good to use ML for your CS408 project

- When your system must **replicate or improve expert behavior**

- When your system must **personalize to users**

- When your system must **improve with more usage**

- When your system must **generalize to new versions of the same problem**

- When you have **an enormous amount of data**

- When you expect to have **unpredictable inputs and contexts**

Example CS408 Projects

- **"Easy Checkout"** 이미지 인식을 통한 자동 체크아웃 시스템(마트 등)
- **"Smart Umpire"** 아마추어 야구팀을 위한 심판 앱(스트라이크/볼 판정, 세이프/아웃 판정)
- **"Faced"** 공공장소에 설치된 TV 채널 자동 조정 시스템(공간 내 사람들의 표정 인식을 통해 관심 측정)
- **"Multi-language messenger"** 다중 언어 번역 메신저
- **"BubblePop"** 뉴스 균형 소비 서비스 (페이스북 뉴스피드에 뉴스 링크 등장 시 다른 시각의 뉴스를 같이 제공)
- **"너의세끼"** 사용자 상태 반영한 음식 추천
- **"Let's eat out"** 음식 공유를 위한 사용자 매칭

Example CS408 Projects

- **"Easy Checkout"** Automatic check-out system (e.g., at a supermarket) through image recognition

- **"Smart Umpire"** Umpire app for amateur baseball teams (ruling strike/ball, safe/out)

- **"Faced"** Automatic TV channel control system for public systems (measuring interest through facial emotion recognition)

- **"Multi-language messenger"** Messenger with multi-language translation

- **"BubblePop"** Balanced news provider service (providing news articles from a different perspective along with Facebook newsfeed articles)

- **"너의세끼"** Food recommendation system tailored to current user state

- **"Let's eat out"** Matching users for sharing food

Making these projects "intelligent"

- "Easy Checkout" Automatic check-out system (e.g., at a supermarket) through **image recognition**

- "**Smart** Umpire" Umpire app for amateur baseball teams (**ruling** strike/ball, safe/out)

- "Faced" Automatic TV channel control system for public systems (measuring interest through **facial emotion recognition**)

- "Multi-language messenger" Messenger with multi-language **translation**

- "BubblePop" Balanced news provider service (**recommending** news articles from a **different perspective** along with Facebook newsfeed articles)

- "Your Three Meals" Food **recommendation** system tailored to current **user state**

- "Let's eat out" **Matching users** for sharing food

Making these projects "intelligent"

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- "BubblePop" Balanced news provider service (**recommending** news articles from a **different perspective** along with Facebook newsfeed articles)

- "Your Three Meals" Food **recommendation** system tailored to current **user state**

- "Let's eat out" **Matching users** for sharing food

**To make it "intelligent"
it is not always necessary
to use machine learning**

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

When to use ML: you don't know
all possible inputs in advance

Are these inputs predictable?

- "Easy Checkout" — image, weight, volume, temperature, etc. of objects
- "Smart Umpire" — audio, video, tactile input of ball / player
- "Faced" — interest level for each channel
- "Multi-language messenger" — text messages
- "BubblePop" — news articles
- "Your Three Meals" — user state
- "Let's eat out" — users and their availability, food preferences

Would it be possible to limit inputs to be predictable?

- "Easy Checkout" — "scan" objects in exact lighting, direction, location, etc.
- "Smart Umpire" — use sensors for strike/ball; safe/out?
- "Faced" — measure interest through buttons (physical or phone app)
- "Multi-language messenger" — allow only pre-specified messages
- "BubblePop" — use pre-specified media sources (e.g., Chosun Ilbo vs. Hankyoreh)
- "Your Three Meals" — use pre-specified user states
- "Let's eat out" — use pre-specified list of user preferences and availability

Practical/Usable to limit inputs to be predictable?

- "Easy Checkout" — images of objects in different lighting, distance to camera, direction, etc.

- "Smart Umpire" — use sensors for strike/ball; safe/out?

- "Faced" — measure interest through user pose and eyegaze tracking

- "Multi-language messenger" — allow only pre-specified messages

- "BubblePop" — use pre-specified media sources (e.g., Chosun Ilbo vs. Hankyoreh)

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- "Let's eat out" — use pre-specified list of user preferences and availability

Limiting inputs to be predictable causing inaccurate predictions?

- "Easy Checkout" — images of objects in different lighting, distance to camera, direction, etc.

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When not to use ML

- **Problem:** When it is not an appropriate AI/ML problem (hard enough, not too hard; define-able)

- **Data:** When there are not enough/no data

- When you don't expect new, unexpected situations

- **Method:** When the technology isn't there yet (we don't have time to develop a whole new chatbot; must use existing models & algorithms)

Problem, Data, Method

	Problem	Data	Method
Easy Checkout			
Smart Umpire			
Faced			
Multi-lang Msg			
BubblePop			
ThreeMeals			
Let's Eat Out			

Problem, Data, Method

	Problem	Data	Method
Easy Checkout	Hard/Classification	Hard to get real data	CNN — computation heavy!
Smart Umpire	Hard/Classification	Hard to get real data	CNN — computation heavy!
Faced	Well-defined/ Regression	Medium — doable	Simple classifier will probably work
Multi-lang Msg	Well-defined/Sequence-to-sequence	Hard to be general	Sequence-to-sequence; research mode
BubblePop	Hard/Classification	Possible	Classifier (RNN variant)
ThreeMeals	Well-defined/ Regression?	Hard to define; hard to get real data	Simple classifier will probably work
Let's Eat Out	Too easy?/Ranking	Hard to define; hard to get real data	Simple classifier will probably work

How to use ML: Know Thy Data

- Easy Checkout

  - If you are going to use it in Korea, get data from Korean supermarkets!

  - If you are going to use it at Emart, get data from Emart

  - If you know (100% sure) that your data can be generalized to another situation, you can use data from a different situation (e.g., "eye gaze information from female users is same with male users)

How to use ML: Know Thy Users

- BubblePop

  - If your users are Korean university students, get their needs and data

  - Get them to participate in user studies

  - Even if you are a Korean university student, you are not your user

How to use ML: Know your technology

- Classifiers & Regression (Ranking)

  - Start with easy ones: naive bayes, logistic regression

  - Try more accurate ones: SVM, random forest

  - Go with deep neural network only when you have data & computation: MLP, CNN, RNN-variantjs

- Representation (Feature) learning

  - Try hand-crafted features, but if they don't work, go with NN-based solutions — autoencoders, CNN, etc.

How to use ML: Don't Overdo It

- Multi-language messenger

  - You don't have time to build a machine translation system

  - You can use Google (or some other) machine translation API

  - It's difficult enough to do it for a restricted set of languages and vocabulary

  - Concentrate instead on user needs

How to use ML: Think Ethics and Privacy

- Let's Eat Out

  - If you are collecting data from users having meals, that is private information

  - If you are collecting location information, that is very private, sensitive information

  - If you are collecting video, that is even more! In all cases, you must let your users know

  - Anonymize, but know that even anonymity (not revealing names) may not be 100% foolproof

Summary

- When to use ML for your CS408 project

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- How to use ML well for your CS408 project

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