THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

Introduction to Machine Learning

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Overview

- What is machine learning?
- Data mining, AI, Deep learning
- Applications

Age of Big Data

- We are collecting and storing data at unprecedented rate
  - Youtube, Facebook, news
  - Credit card transactions and Amazon purchases
  - Transportation data (Google Maps, Uber, Auckland Transport)
  - Gene expression data, protein interaction assays, chemistry pathways

Age of Big Data

- What can you do with this data?
  - Too much data to search through it manually?
- But there is valuable information in the data
  - How can we use it for fun, profit, and/or the greater good?
- Machine Learning and Data Mining are key tools we use to make sense of large data sets!

What is Machine Learning?

- "*Machine Learning is the field of study that gives the computer the ability to learn without being explicitly programmed.*" – Arthur Samuel (1959)

- "*A computer is said to learn from experience E with respect to some class of task T and performance measure P, if its performance at tasks in T, as measured by P, improved with experience E*" – Tom Mitchell

Arthur Samuel

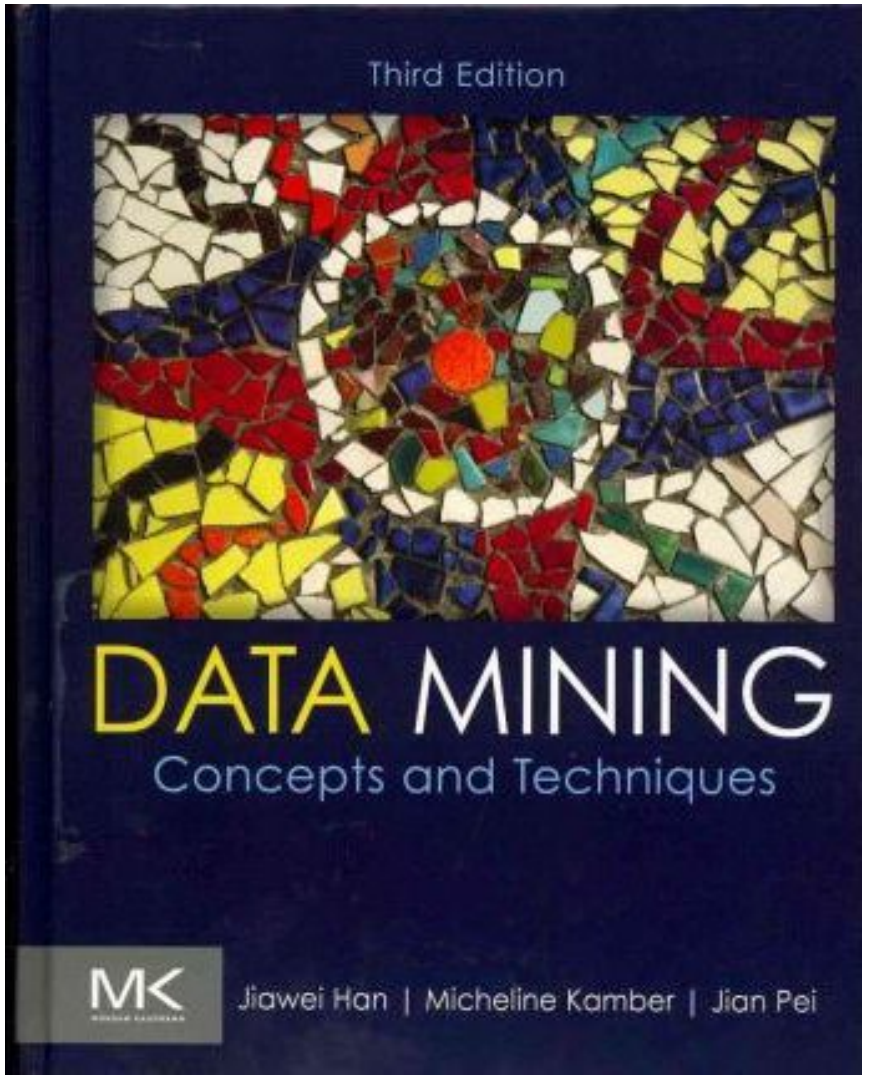
Example Problem – Self-Driving Cars

- *T*: Driving on public highway using vision sensors
- *P*: Average distance traveled before an error / crash
- *E*: A sequence of images and steering commands recorded while observing a human driver

Image source: https://www.forbes.com/

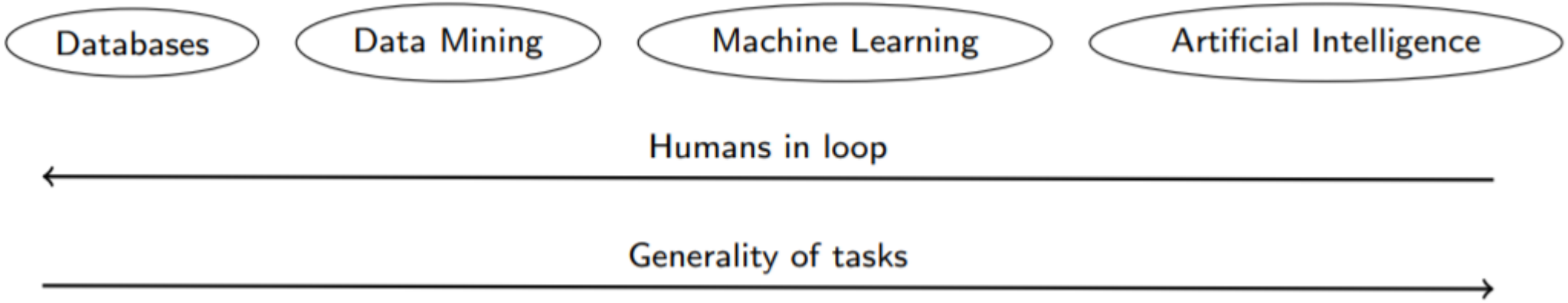
Data Mining

- "*Data mining refers to extracting or mining knowledge from large amounts of data*" – Jiawei Han



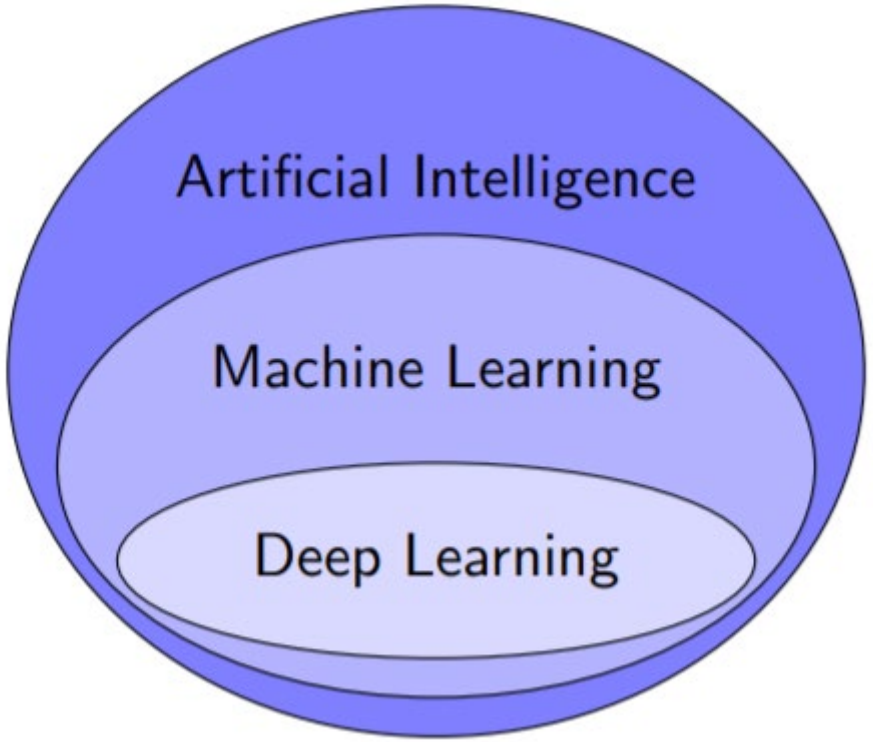
Machine Learning vs. Data Mining

- Data Mining and Machine Learning are very similar:
  - Data Mining often viewed as closer to databases
  - Machine Learning often viewed as closer to AI
- Both are similar to statistics, but more emphasis on
  - Large data sets and computation
  - Predictions (instead of descriptions)
  - Flexible models (that work on many problems)



AI and Deep Learning

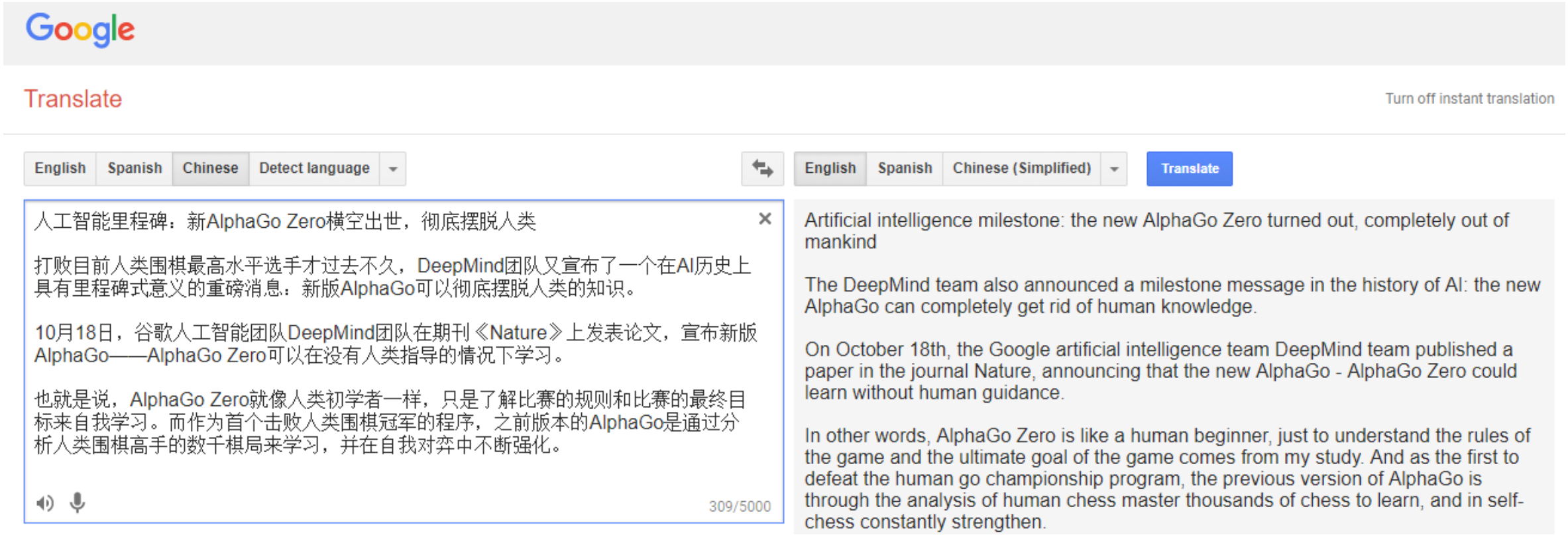
- Traditionally, we've viewed ML as a subset of AI
- Deep learning is a subclass of machine learning



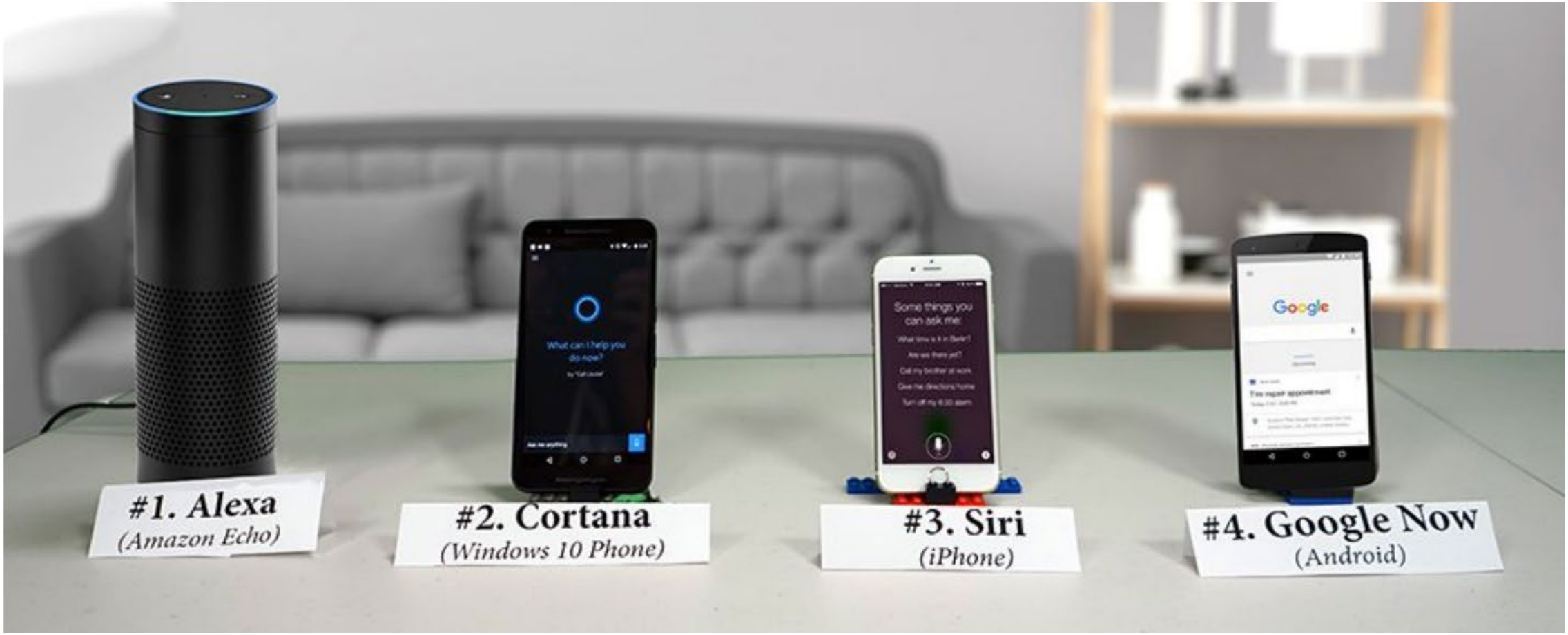
Applications

- Machine translation
- Speech recognition
- Face recognition
- Image generation
- Artistic style transfer
- Recommendations
- Object detection
- Optical character recognition
- Sports analytics
- Medical imaging
- Self-driving cars
- Image annotation
- Discovering new cancer subtypes
- Protein folding prediction
- Drug discovery
- Chess / Go / Starcraft / ...

Machine translation



Speech recognition



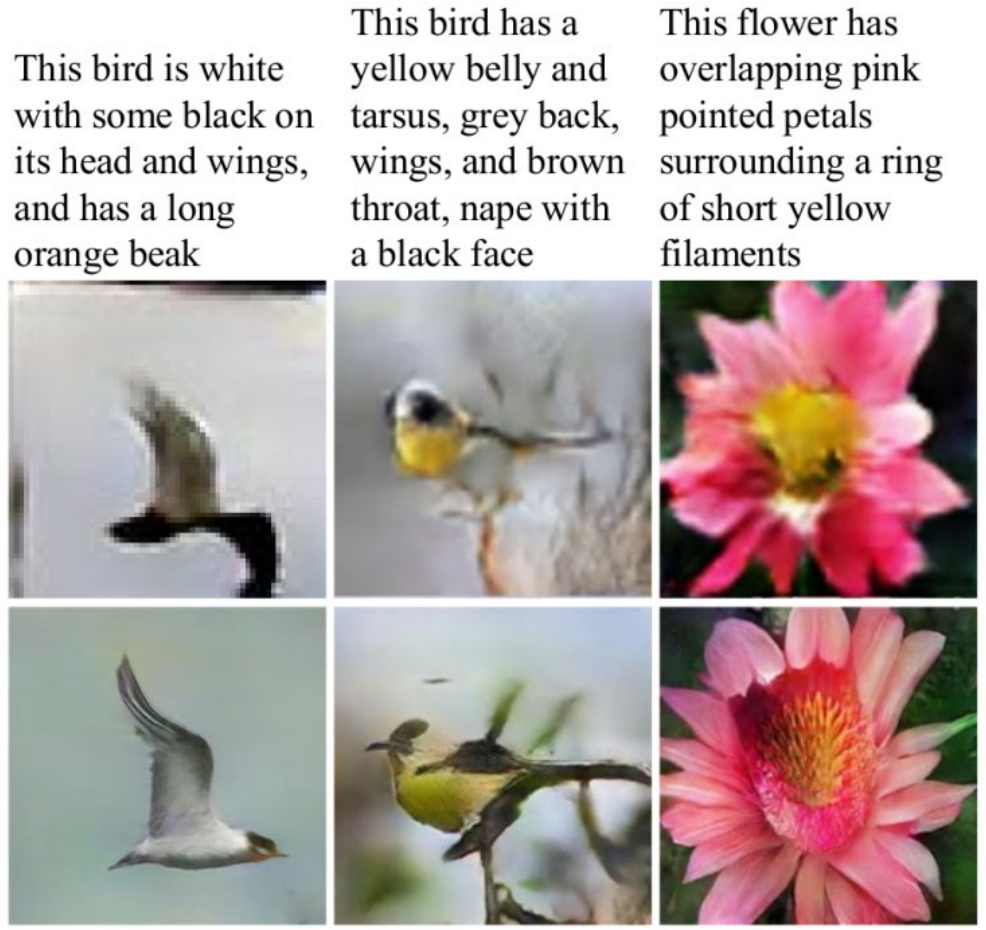
[Examples from Stanford CS221]

Autonomous driving

[Examples from Stanford CS221]

Image Generation

- Text → Image

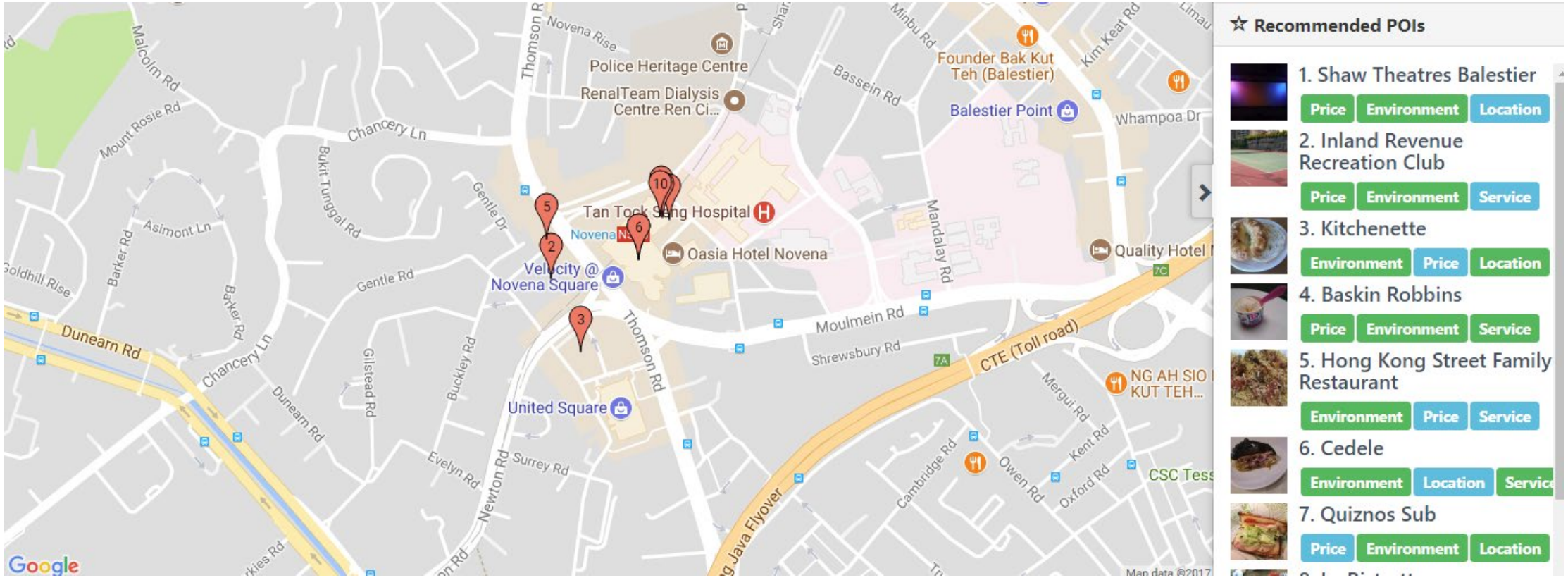


[Examples from Stanford CS221]

Artistic style transfer

Recommendation

- Recommend venues based on user's interests



Resources

- “Machine Learning” – Tom Mitchell
- “Data Mining: Concepts and Techniques” – Jiawei Han, Micheline Kamber, Jian Pei
- “Pattern Recognition and Machine Learning” – Christopher Bishop
- “Data Mining: Practical Machine Learning Tools and Techniques” – Ian Witten, Eibe Frank, Mark Hall, Christopher Pal