CZ/CE 4032, SC4020
Data Analytics & Mining

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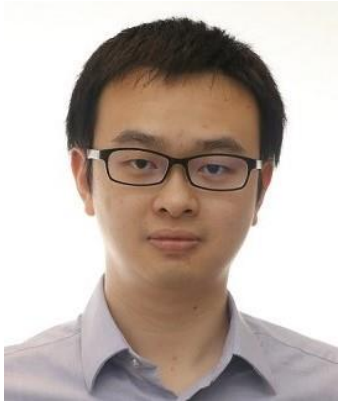
About me

- Instructor of the 1st half (Week1 – Week6):

A/Prof Lin Guosheng



  - Specialized in computer vision
  - Email or MS Teams: gslin@ntu.edu.sg
  - Homepage: https://guosheng.github.io/

- Q&A:
  - By emails or MS Teams messages
  - After each lecture or tutorial

- Instructor of the 2nd half (Week7-Week12):

Prof Cong Gao

- Homepage: https://personal.ntu.edu.sg/gaocong/
- Email: gaocong@ntu.edu.sg

Assessment

- Final exam (50%) + Assignments (50%)
  - Closed book exam
- Assignments
  - 2 group-based projects: (25% + 25%)
    - Project 1 will be announced in Week 2
    - Project 2 will be announced in the 2nd half

- Please start to form your group now
  - please edit the online form to create your group.
    - https://docs.google.com/spreadsheets/d/1YMiw326R1CJ_k_C9DklqqmhtLcQMhNEQ-0nQeKROs20/edit?usp=sharing
  - Each group is limited to 4 members.
    - The first person for each group in the form is the coordinator and contact person.
  - You can form a group of less than 4 members.
- Grouping will be finalized in week 3

Topics (Tentative)

- The 1st half (Week 1 to Week 6)
  - Introduction
  - Clustering – basic methods
  - Link analysis – PageRank
  - Graph neural network
  - Similarity search
  - Clustering – advanced methods
  - Graph community detection

- The 2nd half (Week 7 to Week 12)
  - Association Rule Mining
  - Classification
  - Recommendation Systems
  - Data Processing, Data Cleaning and integration
  - others

- Online materials:
  - CS246: Mining Massive Data Sets
    - https://web.stanford.edu/class/cs246/
    - Many slides used in this course are from CS246
  - CS224W: Machine Learning with Graphs
    - http://web.stanford.edu/class/cs224w/
  - Book: Mining of Massive Datasets
    - By Jure Leskovec, Anand Rajaraman, Jeff Ullman
    - http://www.mmds.org/

- What is data mining
  - Data mining is the process of extracting patterns/knowledge from data.

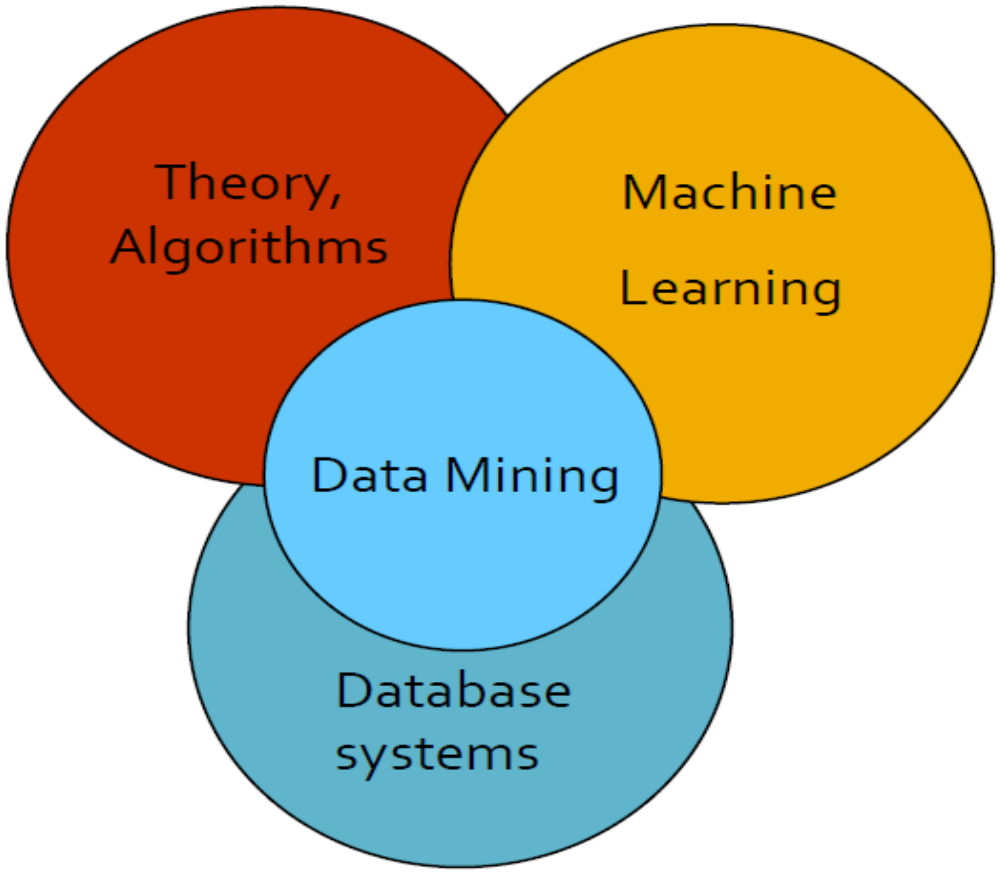
- Data needs to be
  - Stored (computer systems)
  - Managed (databases)
  - And **ANALYZED (this class)**

Data Mining ≈ Knowledge Discovery in Data (KDD) ≈ Big Data ≈ Data Science ≈ Machine Learning

Part of Artificial Intelligence

Slides from CS246: Mining Massive Data Sets

Relationship with other subjects:



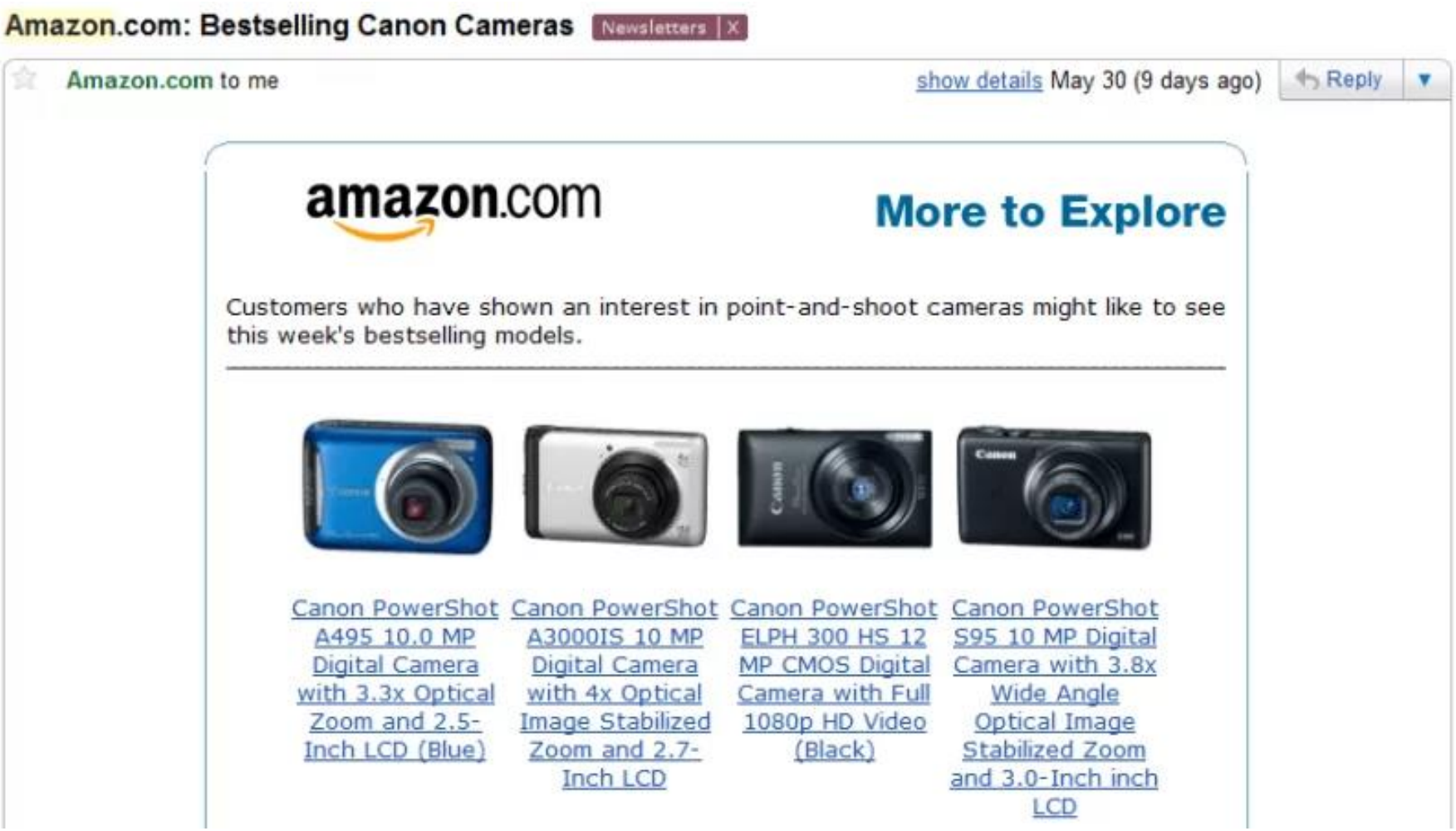
Also highly related to

1. Computer vision
   (image/video data)

2. Natural language process
   (text data)

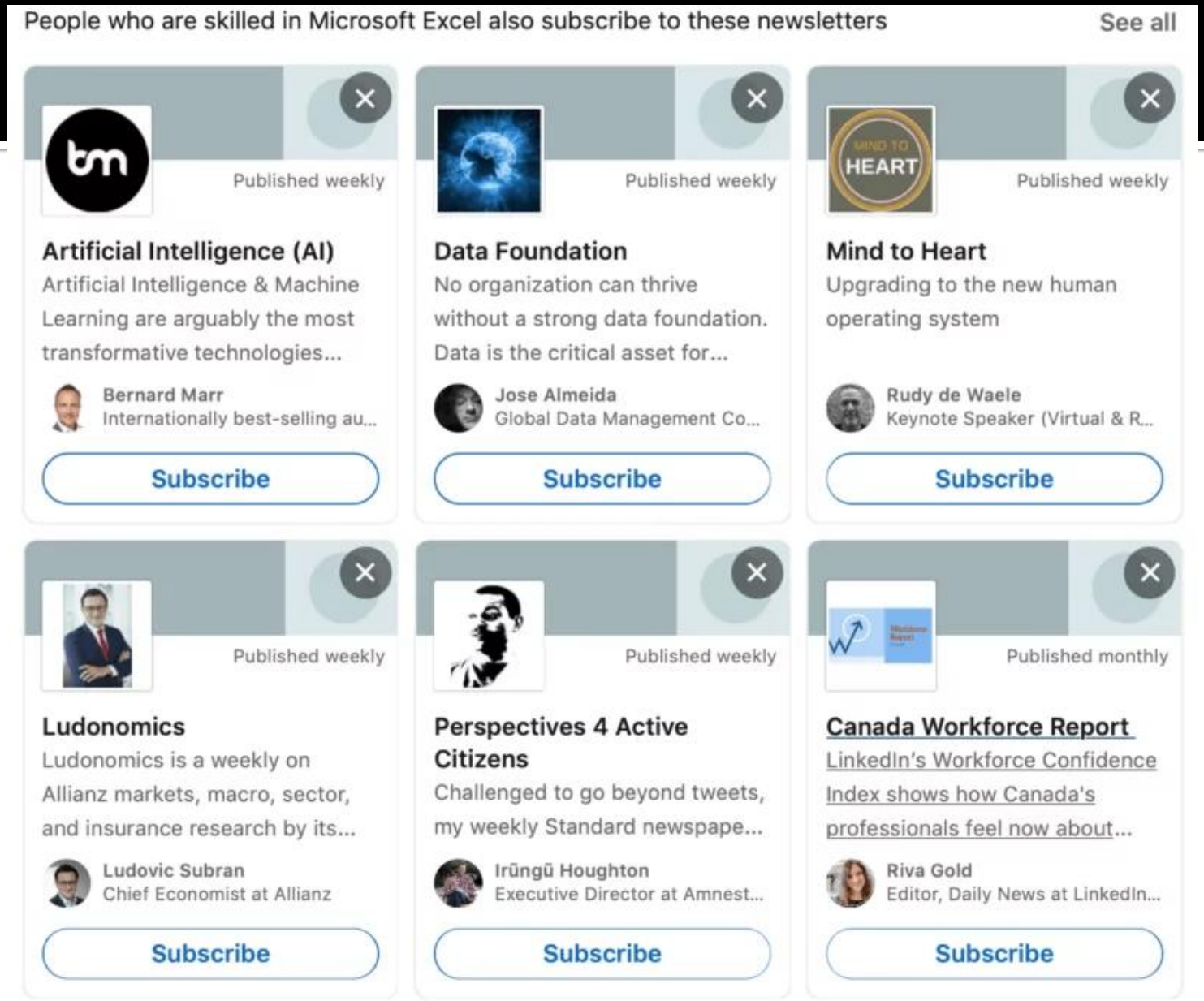
3. Deep learning or
deep neural networks

Application: recommender system



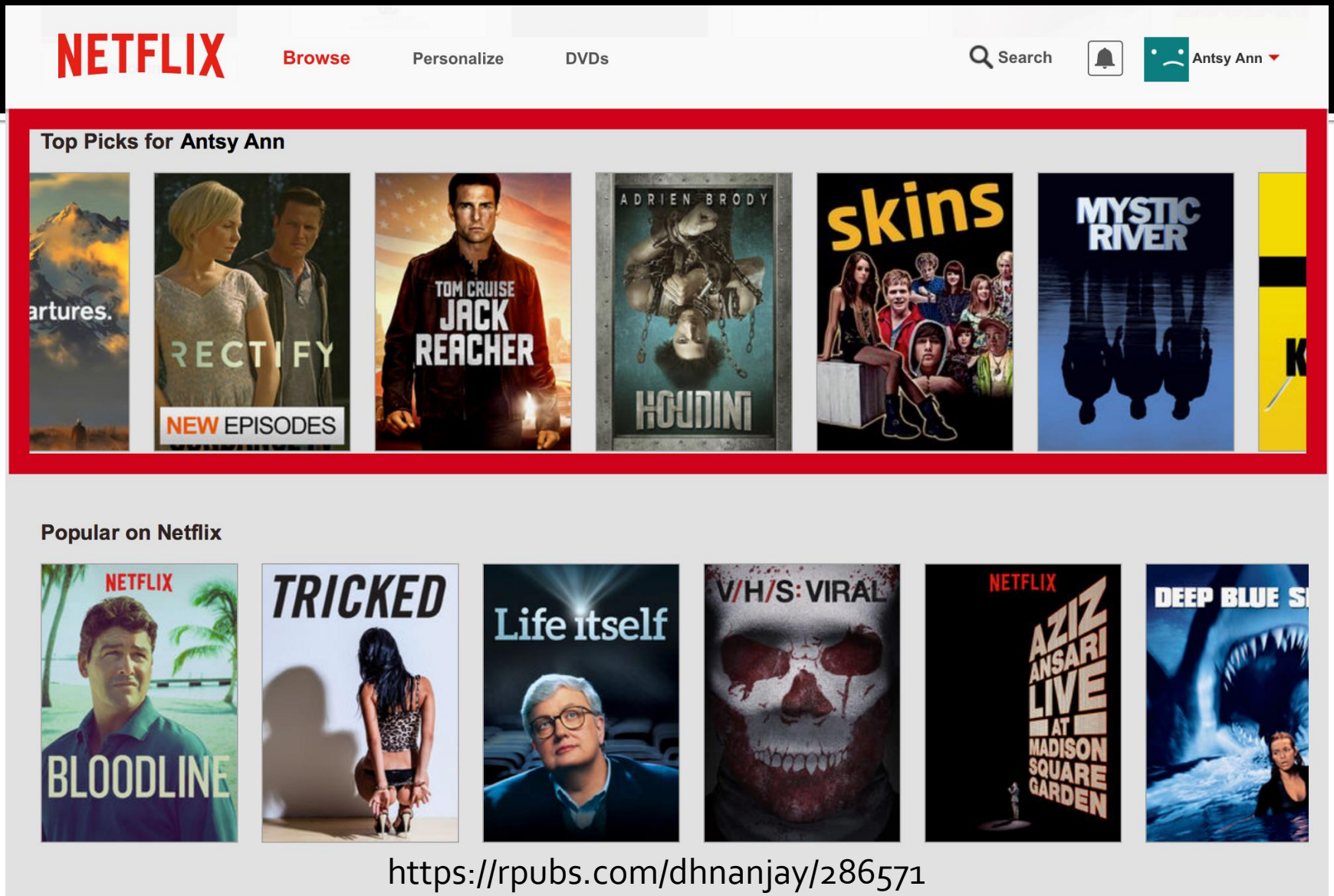
Amazon.com

https://research.aimultiple.com/recommendation-system/



Linkedin

https://research.aimultiple.com/recommendation-system/

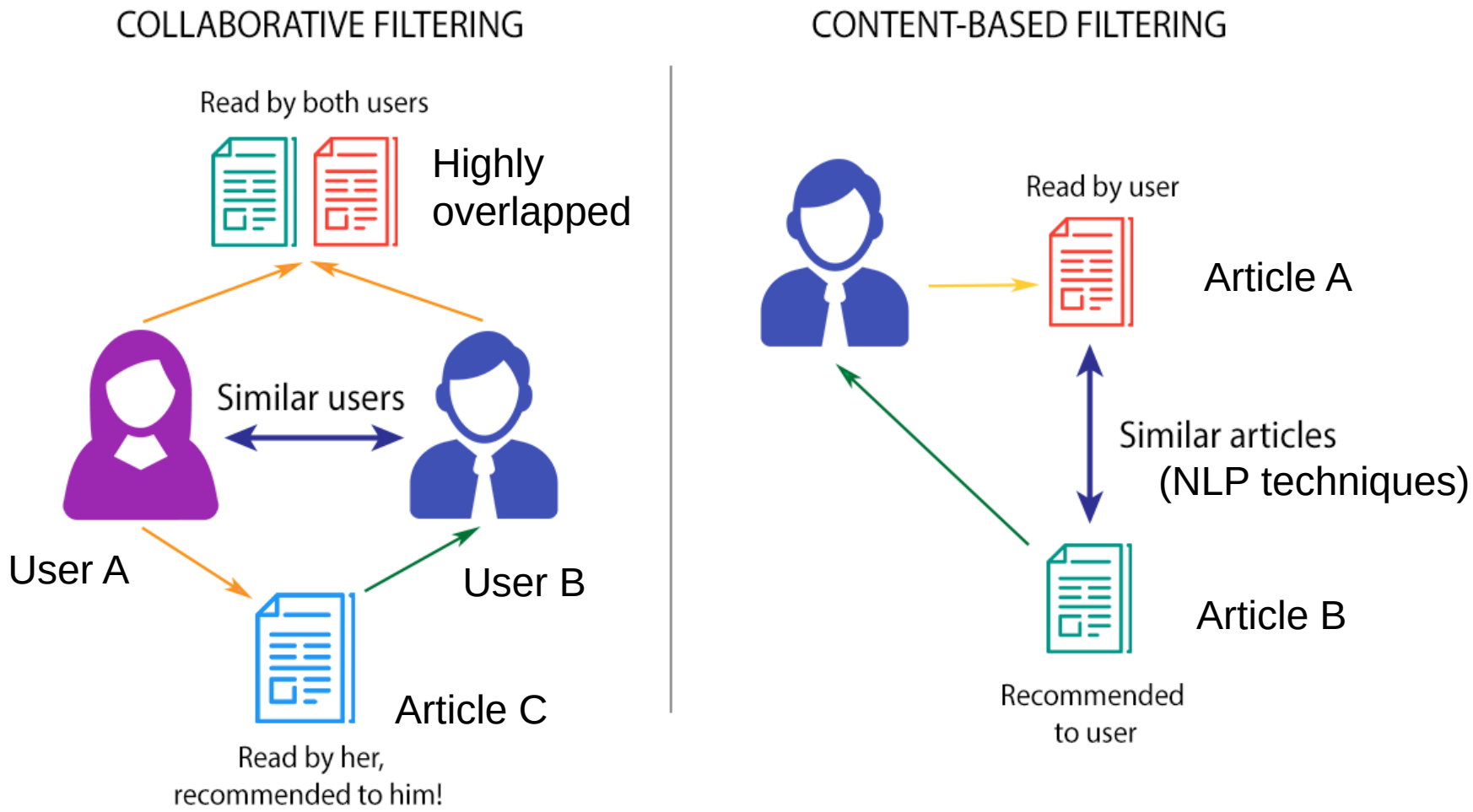


https://rpubs.com/dhnanjay/286571

Netflix Prize (2006): recommendation competition

https://www.thrillist.com/entertainment/nation/the-netflix-prize

Recommender system



Focus on the similarity between users

Focus on the similarity between items

https://towardsdatascience.com/brief-on-recommender-systems-b86a1068a4dd

A simple example for collaborative filtering.
Can be formulated as a missing value prediction problem:

	Movie A	Movie B	Movie C	Movie D
User 1	5	4	1	1
User 2	2	3	2	4
User 3	2	4	?	1
User 4	2	3	1	?

Fill in missing value (User 4, Movie D) in the table

A simple example for collaborative filtering

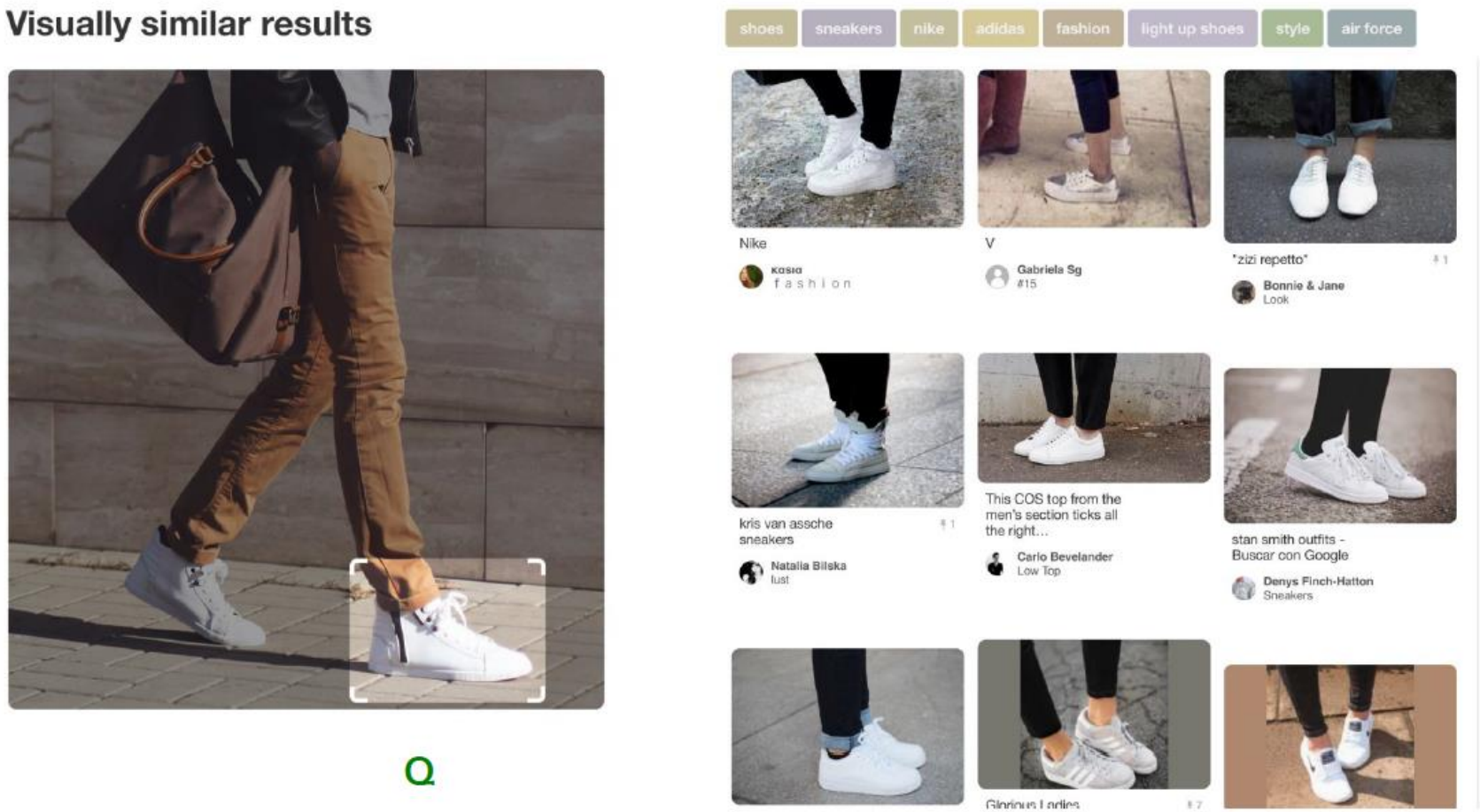
	Movie A	Movie B	Movie C	Movie D
User 1	5	4	1	1
User 2	2	3	2	4
User 3	2	4	?	1
User 4	2	3	1	?

Predict the missing value (User 4, Movie D) in the table

Collaborative filtering:
User 4 is similar to user 2, so we can predict 4 for (User 4, Movie D)

Un-personalized prediction (prior):
Use the average score as the prediction: (1+4+1)/3 = 2

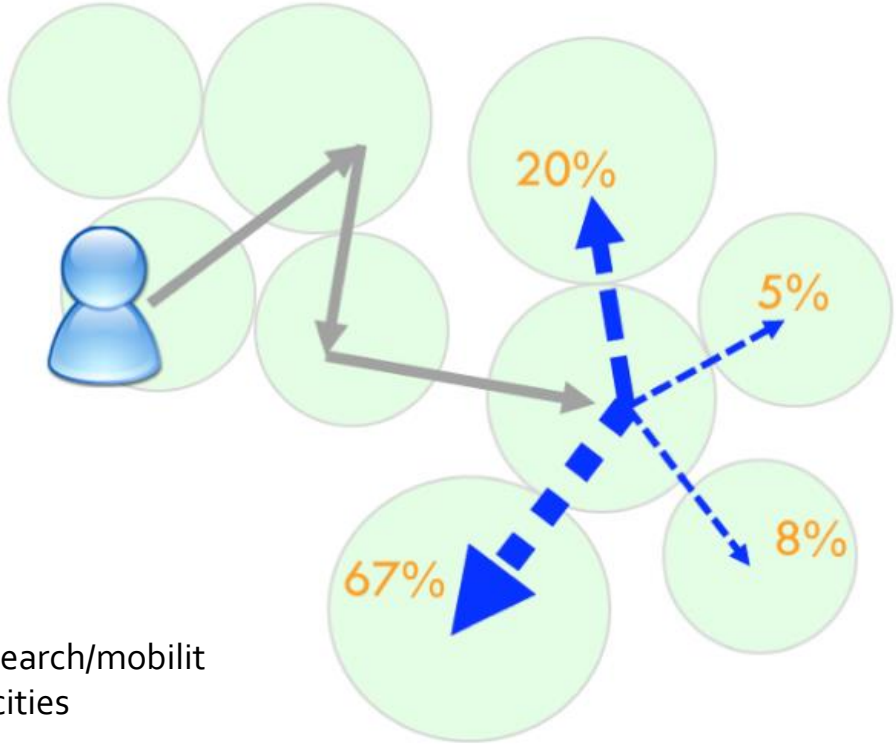
Application: information retrieval



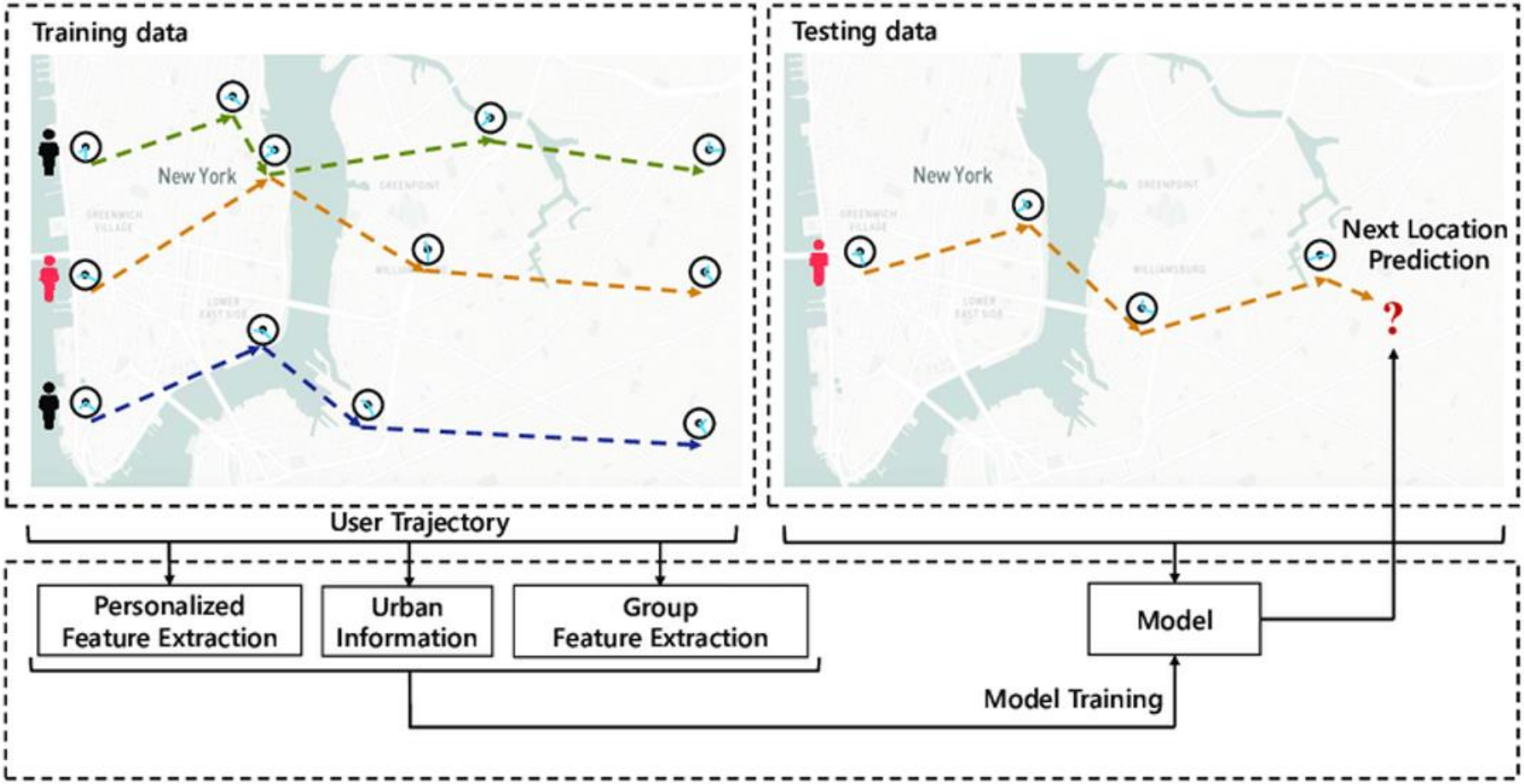
Source: FRSFN: A semantic fusion network for practical fashion retrieval

Application

- Urban computing, smart city
  - Next location prediction/ future position prediction
    - Spatial-temporal trajectory data (e.g., GPS data + time)
    - Predict traffic congestion, improve traffic management



Source: https://kdd.isti.cnr.it/research/mobility-data-mining-science-cities



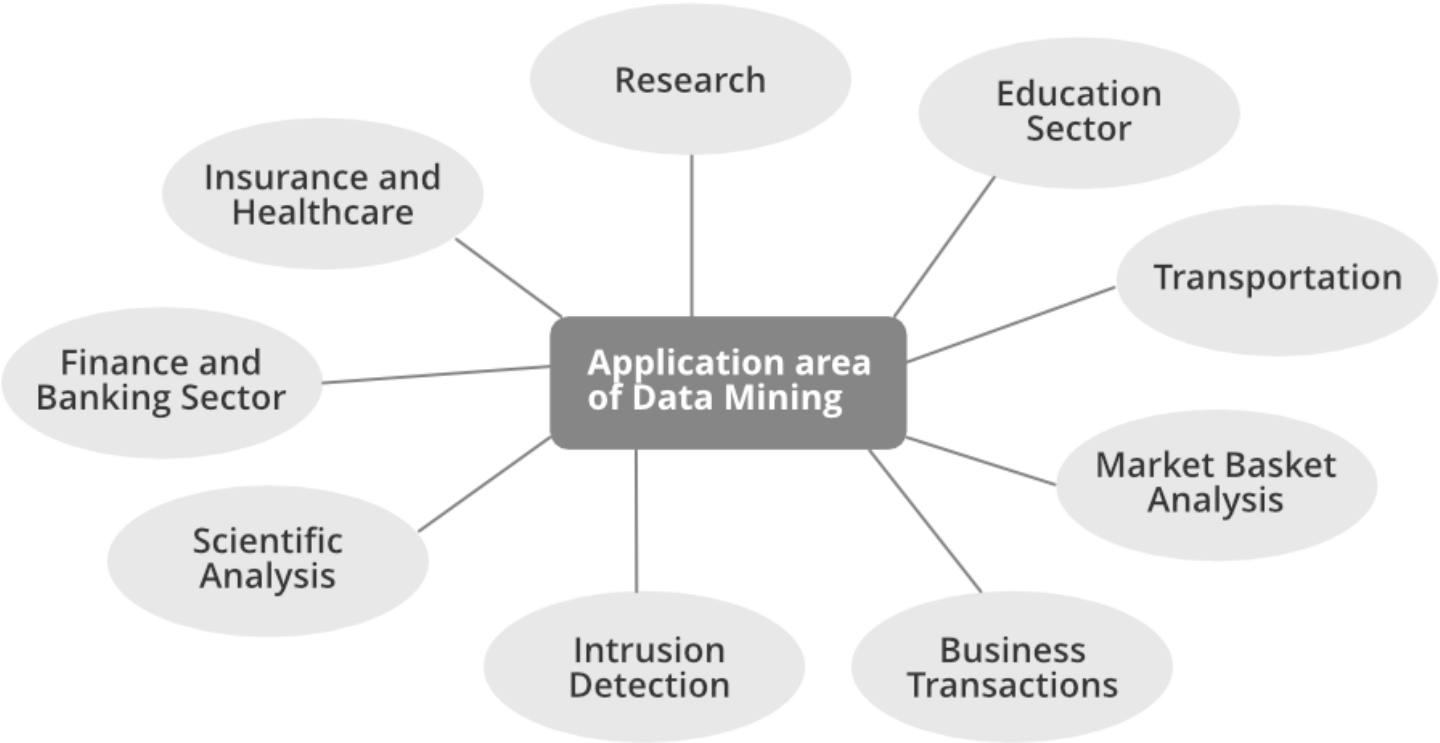
Source: PG2Net: Personalized and Group Preferences Guided Network for Next Place Prediction

Application

- Urban computing, smart city
  - Urban planning
    - Choose the address for a hospital/bus stop?
- Social computing

  Analyse human behavior based on social data
    - Examples of social data: social media, blogs, social networks
    - Social media platforms: Twitter, Facebook, etc.
  - Social Media Analysis
    - Understand user behavior and activities
  - Social Network Analysis
    - Community detection

Many other applications



https://www.geeksforgeeks.org/applications-of-data-mining/

Conferences and Journals

Where you can find various research topics and research papers on data mining

- KDD Conferences
  - ACM SIGKDD Int. Conf. on Knowledge Discovery in Databases and Data Mining (KDD)
  - SIAM Data Mining Conf. (SDM)
  - (IEEE) Int. Conf. on Data Mining (ICDM)
  - European Conf. on Machine Learning and Principles and practices of Knowledge Discovery and Data Mining (ECML-PKDD)
  - Pacific-Asia Conf. on Knowledge Discovery and Data Mining (PAKDD)
  - Int. Conf. on Web Search and Data Mining (WSDM)
- Other related conferences
  - DB conferences: ACM SIGMOD, VLDB, ICDE, EDBT, ICDT, ...
  - Web and IR conferences: WWW, SIGIR, WSDM
  - ML conferences: ICML, NeurIPS
  - CV conferences: CVPR, ICCV
  - NLP conferences: ACL
- Journals
  - Data Mining and Knowledge Discovery (DAMI or DMKD)
  - IEEE Trans. On Knowledge and Data Eng. (TKDE)
  - KDD Explorations
  - ACM Trans. on KDD