
University of Glasgow
FinTech Scotland
What's my next Investment?
Automated Recommendations for Investors
05-10-2023 – Scottish Fintech Festival 2023
UKRI
Engineering and Physical Sciences Research Council
WORLD CHANGING GLASGOW
A WORLD TOP 100 UNIVERSITY

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Agenda

- 9:30-9:35: **Introducing Financial Informatics at Glasgow**
- 9:35-9:50: **An Introduction to Financial Recommendation**
- 9:50-10:45: **Challenges and Solutions for Effective Financial Asset Recommendation**

- **Break**

- 11:00-11:30: **Hands-on Tutorial on Financial Asset Recommendation**
- 11:30-12:30: **Demonstrations, poster session and networking**

Financial Informatics @ Glasgow

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Dr. Richard McCreadie

University of Glasgow
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Financial Informatics

- Financial Informatics is a research theme hosted by the Information, Data and Analysis section
  - It represents a cross-cutting group of researchers in Computing Science working on the research and development of AI and Information Retrieval technologies applied to financial use-cases and data

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Financial Recommendation Systems

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We specialize in the development of sophisticated AI-powered services, which can collate, analyse and apply financial data in real-time

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Three Research Pillars

Collate Diverse Information from Multiple Modalities

- **Market Data** — Capture how traders value assets over time an in different market conditions
- **Asset Fundamentals** — Know your business, track company performance, scale and growth
- **First Party Statements** — How does a business view itself and its prospects?
- **News and Social Media** — How does the world view the business and its products? What impact do world events have
- **Customer Data** — Know your customer via their transactions, investments and situation data

Analyse to Build Models, Data Structures and Gain Insights

- **Event Detection** — Identify financially relevant events, whether within-company or from the wider world
- **Technical Analysis** — Convert financial time series to human understandable KPIs
- **Knowledge Graphs** — Model financial facts and their relation ships, as well as how they evolve over time
- **Financial Language Models** — Build adapters for large language models, enabling them to better handle financial terminology
- **Content Categorization** — Develop AI models to classify and tag financial documents

Apply our technologies to tackle real financial use-cases

- **Asset Recommender** — Suggest suitable personalized investments for customers and advisors
- **Portfolio Construction** — Build optimized portfolios for investors
- **Robo-Advisors** — Answer financial questions and provide advice
- **Automatic Trading** — Automatically manage investment portfolios in real-time
- **Sustainability Optimization** — Optimize back-end financial data services to reduce carbon costs

Current Areas of Interest and Projects

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- Ongoing Research
  - Knowledge Graph Construction and Smart Embeddings from News and Financial Reports
  - Real-time Identification of Impactful Financial Events
  - Answering Financial Questions using Generative Models
  - Search over Financial Corpora

- Projects

Enhancing Sustainability via Dynamic Optimization of Barclay's Data Services
BARCLAYS | 2023-2026
Automatic analysis of financial data access patterns for driving **infrastructure** and **service scalability** in cloud environments

FAR-AI
Engineering and Physical Sciences Research Council | 2023
Building a **financial asset recommendation platform** for the UK banking market

PPC-FI
Engineering and Physical Sciences Research Council
NATIONAL BANK OF GREECE | 2023
Developing **Personalized Portfolio Construction** and Optimisation algorithms for **Retail Customers**

INFINITECH
HORIZON 2020 | 2019-2023
Tailored **IoT** & **BigData** Sandboxes and Testbeds for Smart, Autonomous and Personalized Services in the European **Finance** and **Insurance** Services Ecosystem

IMX
THE DATA LAB | 2017
Investment Management eXtension
Leveraging **data mining** and **machine learning** to comparing **finance assets** with **model portfolios** for financial product construction

An Introduction to Financial Recommendation

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Investing for the Future

Problem and Challenges

Personal Investment Problem

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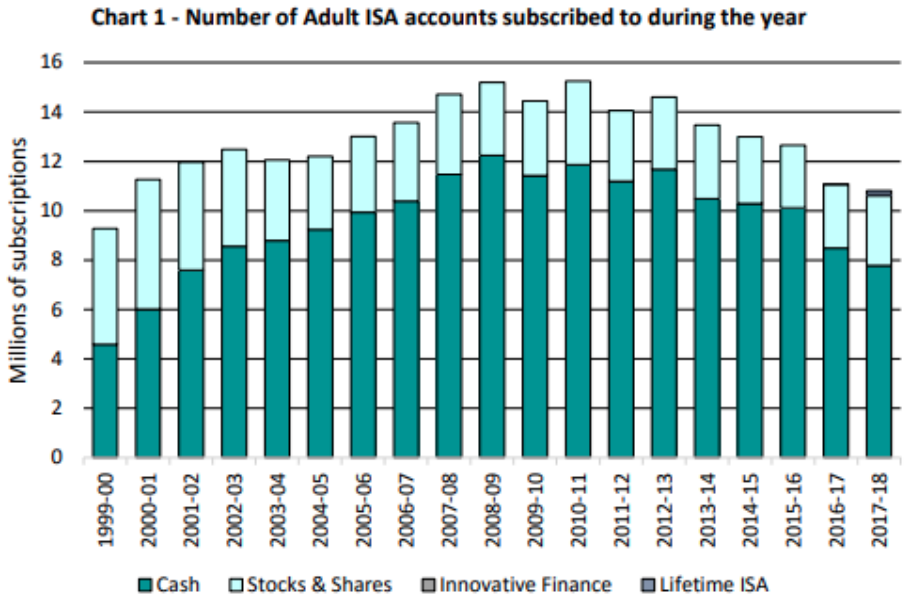
- We are currently living in a world where only a small fraction of the public sufficiently invest for the future
  - **35%** (18.4 million) of the UK adult population say they don't have a pension.
  - **43%** of the population admit they don't know how much they will need for retirement.

- One way to tackle this is to encourage people to invest spare cash rather than have it lie un-used in current accounts
  - But only around **4-5%** of adults in the UK have stocks and shares ISAs (one of the most cost-effective ways of doing this)



Challenges to Investment

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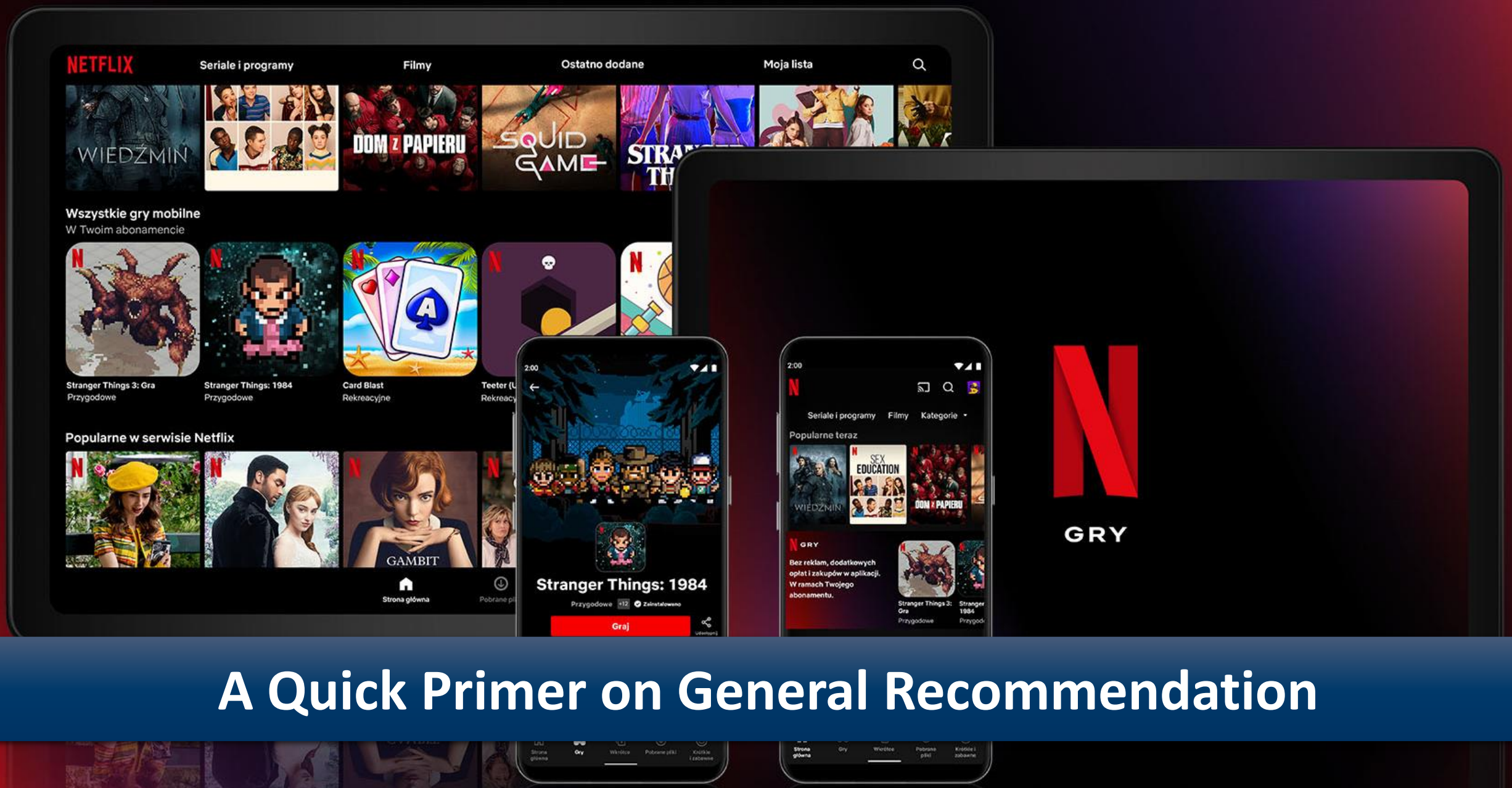
There are a wide array of reasons that people choose not to invest in financial assets even if they have the money to do so, including:

- **Complexity**: Finance is complicated, and many people are not sufficiently educated to understand the consequences of their decisions (…and the large volumes of financial jargon does not help!)
- **Time**: Investing successfully takes time and effort to research and understand the target markets, most people don't have the time for this
- **Risk**: There are a wide range of investment risks, and some of those are difficult to effectively quantify
- **Choice**: The range of possible investments is so large that choice paralysis is a barrier
- **Advice**: Its not clear to a new investor where the should go to get advice, and who they can trust

Investment Recommendation

- Given these problems, we cannot expect an average member of the public to become a savvy investor on their own
- They need a financial advisor to **analyze their position** and **recommend** **assets** to invest in personalized to them
  - Manage investment risk to the customer by identifying profitable assets that meet their risk profile
- … but expert financial advisor time is limited and expensive
  - Also, may only specialize in particular asset types or markets

Automated Recommenders can Fill this Gap!



A Quick Primer on General Recommendation

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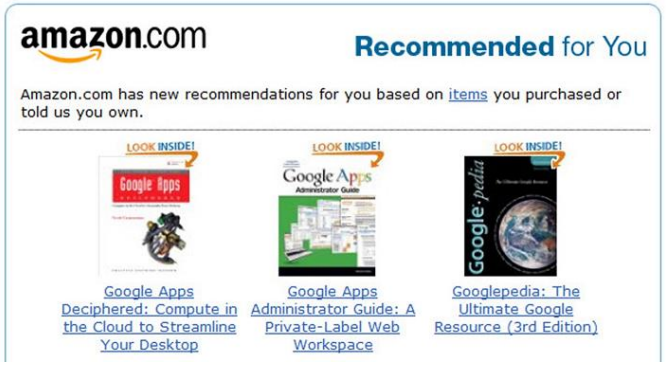
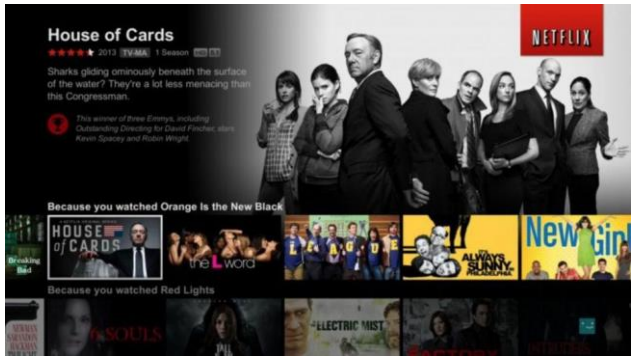
Recommendation

- There are many cases where we want to provide or suggest things to people (online)
  - We refer to this as Recommendation
  - We want to recommend items to users
- Recommendation is Big Business
  - Netflix thinks it's algorithm is worth a lot of money: $1 billion per year

Books



Movies



Hotels

The Netflix Recommender System: Algorithms, Business Value, and Innovation. Gomez-Uribe and Hunt. ACM TMIS 2016.

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Recommendation Signals

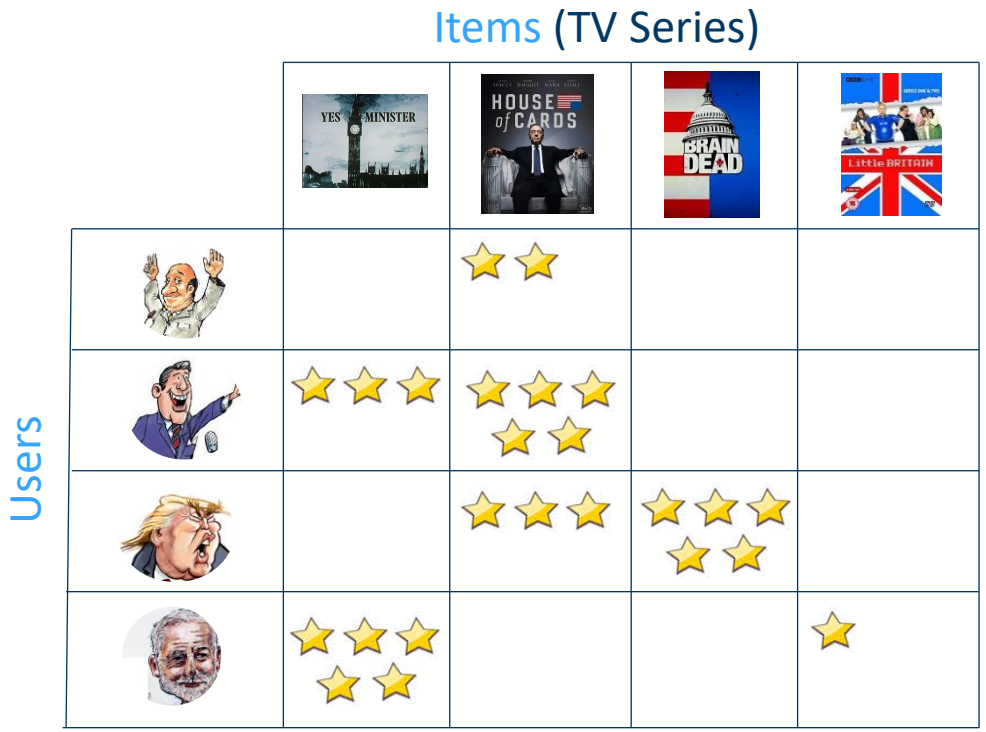
- To perform recommendation, we need to know something about the preferences of the user
  - Platforms that make use of recommendation put a lot of effort into collecting data on what you like

- When you use platforms like Amazon and Netflix you reveal a lot of information about your preferences (signals):
  - Explicit
    - Did you rate an item?
      - Most shopping platforms will send you a reminder email if you don't!
      - Streaming sites like Netflix ask you to rate a film/series after watching it
  - Implicit
    - Where you shown/recommended something but passed over it?
    - Time spent on an item's page
    - Shopping/navigation history

Recommendation systems: Principles, methods and evaluation. Isinkaye et al. EI Journal 2015.

The User-Item Matrix

- These signals are often represented by a user-item matrix
  - Columns are our items (books/movies/hotels)
  - Rows are our users (what do they like?)
- The cells of the matrix contain the signals that the platform has for that user and item pair
  - Lets assume explicit ratings
  - E.g. Star rating (1-5)



The Recommendation Problem

- This matrix is sparse
  - There are lots of items that users have not rated
- Recommendation can be viewed as the task of predicting these missing ratings

Items (TV Series)

Users

				
	?	★★	?	?
	★★★	★★★★★	?	?
	?	★★★	★★★★★	?
	★★★★★	?	?	★

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Approach Timeline

Time

Item Hierarchy	➢ Encode expert knowledge about items ➢ "You bought a paint brush, hence you will also need paint"
Attribute-based	➢ Match attribute patterns in items you rated to find new items you might like ➢ "You like movies staring Clint Eastwood, hence you might like Dirty Harry"
User-User Similarity	➢ Group users by similarities in their ratings, similar users will like the same things ➢ "People like you bought the Avengers film, hence you will like it too"
Item-Item Similarity	➢ Group items by their inherent similarity (item-type dependant) ➢ "You like Godfather so you will like Scarface"
Social Graph Similarity	➢ Recommend items that your friends like ➢ "Your friends like Star Wars, so you will too"
Model-Based	➢ Lets try and learn from the data how to match users to items ➢ "Recommend items the machine-learned model says to because its smarter than you"

Collaborative Filtering Using Data Mining and Analysis. Vishal Bhatnagar. Book 2016.

Model Based Solutions (AI)

- Model based solutions are based on **Machine learning**
  - The process of teaching a computer by example how to do a task automatically
  - Involves having the computer learn a function by example that takes in data and outputs some meaningful labels or scores

- The function we want to machine learn in a recommendation setting is an estimator for user satisfaction in an item given information about the user
  - This might be predicting a rating or estimating more granular score for the item

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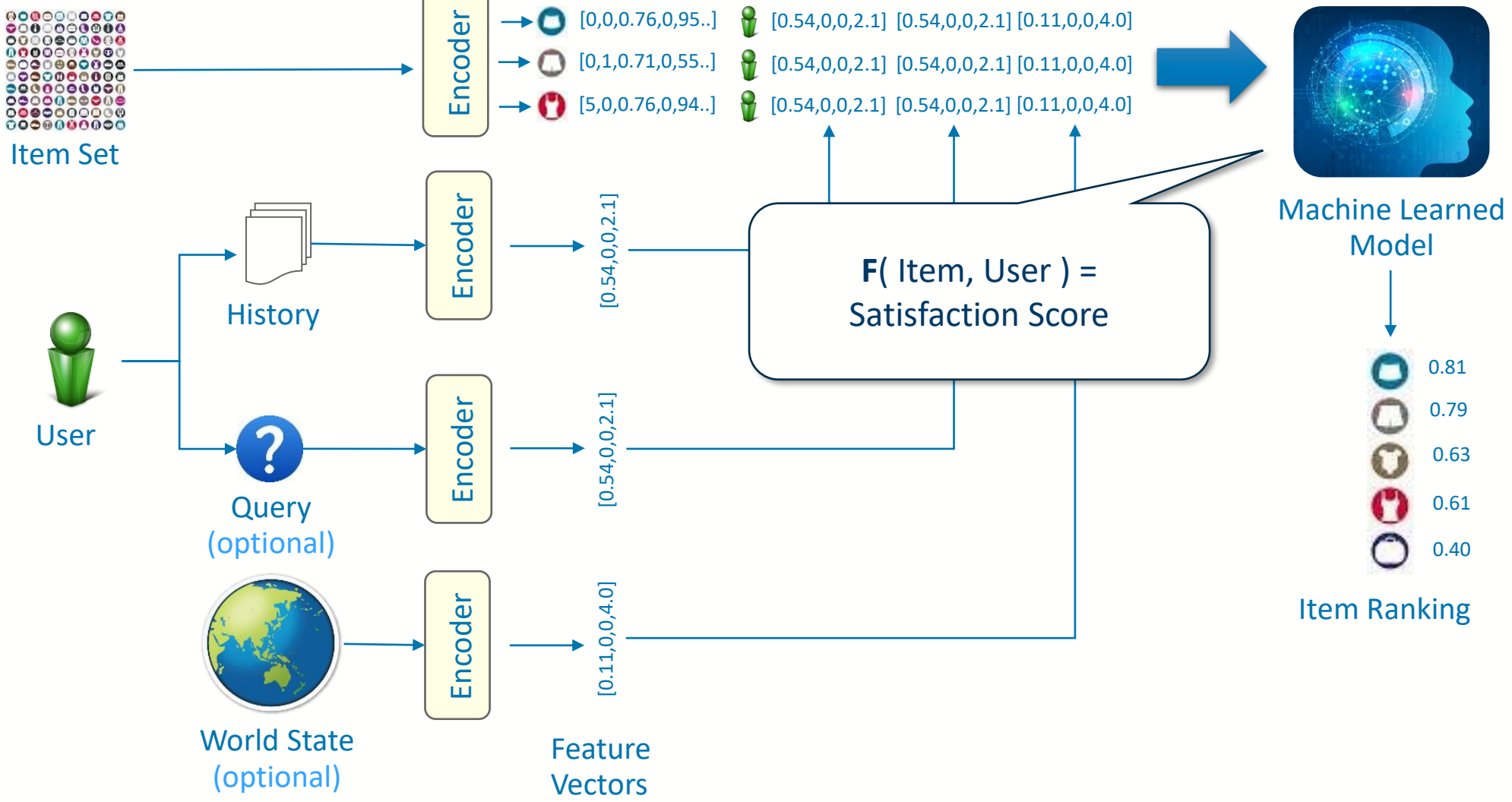
Example: Regression-Based Recommendation



Financial Recommendation

Robo-Advisors

- Robo-advisors are computer programs that can analyse customer and market data and provide financial advice
  - First devised around 13 years ago, they are becoming increasingly common, with companies like Betterment, Wealthfront, and Personal Capital managing an estimated $25 billion worth of assets (2017)
  - In 2018, they were estimated to manage around $200 billion worth of assets worldwide

- Financial Recommendation systems can drive robo-advisors (but not all robo-advisors are financial recommendation systems)

What are our Items? (Financial Assets)

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Stocks / Shares

- Fractional ownership in a company, which usually comes with some voting rights and potentially dividends (pay-outs when the company does well)

Who are our Users?

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Professional Investors

- Experienced
- Large investor >£100k
- Likely has preferences on where to invest
- May have an investment strategy
- May be able to predict how long they can invest for
- We likely have some history about their past investments

Retail Investors

- Inexperienced
- Small Investor <£100k
- Usually has no idea of what they could invest in
- Will not have an investment strategy
- May have significant uncertainty on how long they can invest for
- Usually a cold-start user with no prior investments

Example: Regression-Based Recommendation

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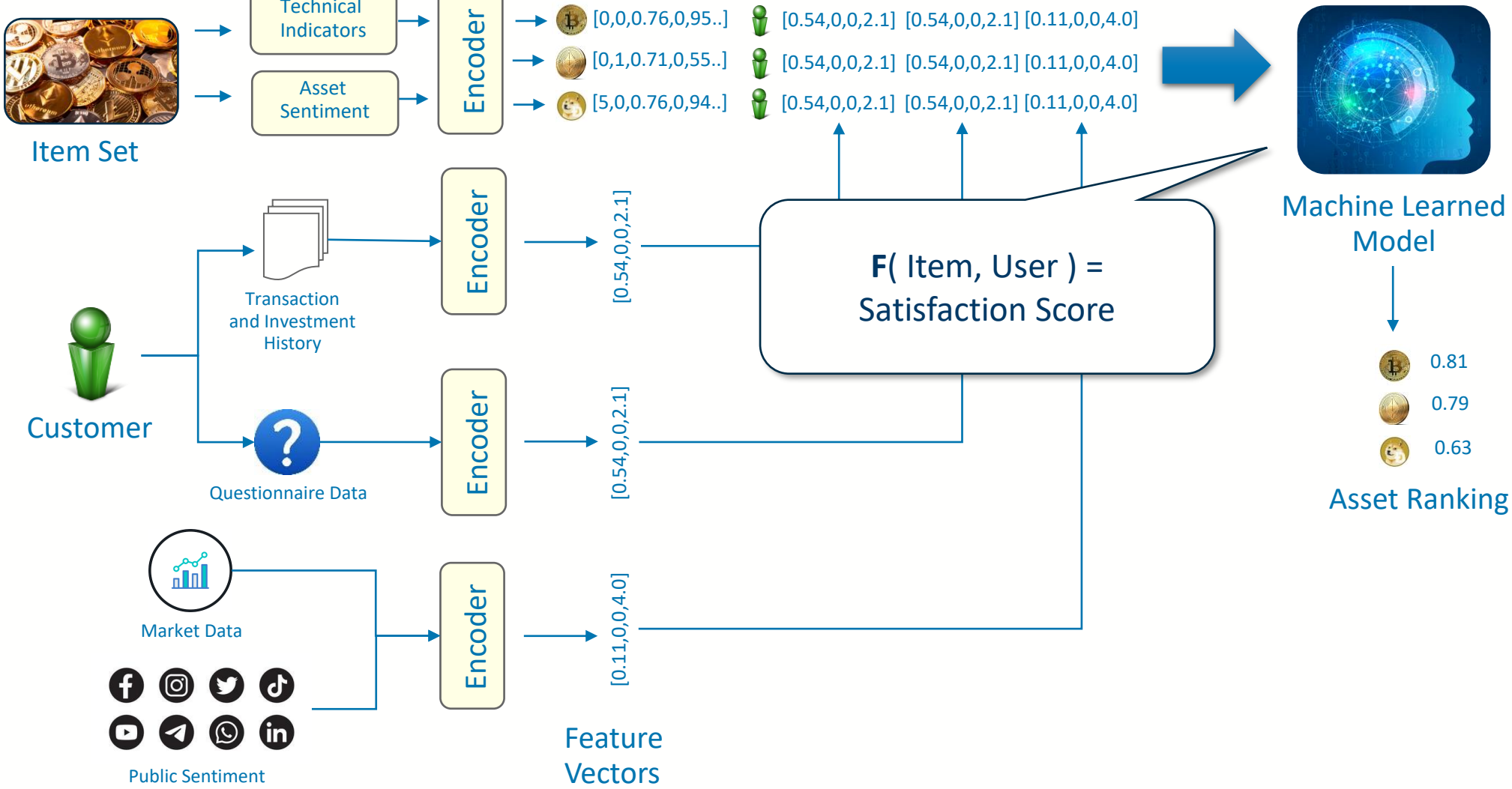

Questions?

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