Siamese Network for Fake Item Detection

(Discussion Paper)

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Scenario

- **Goal**. Monitoring item authenticity in the supply chain for discovering fake/counterfeit products

- **Idea**. Developing a counterfeit detection system based on a deep learning approach

- **Solution**. Mapping item descriptors, i.e., identifiable features, in a low-dimensional space exploiting Siamese Neural Network

Problem Definition

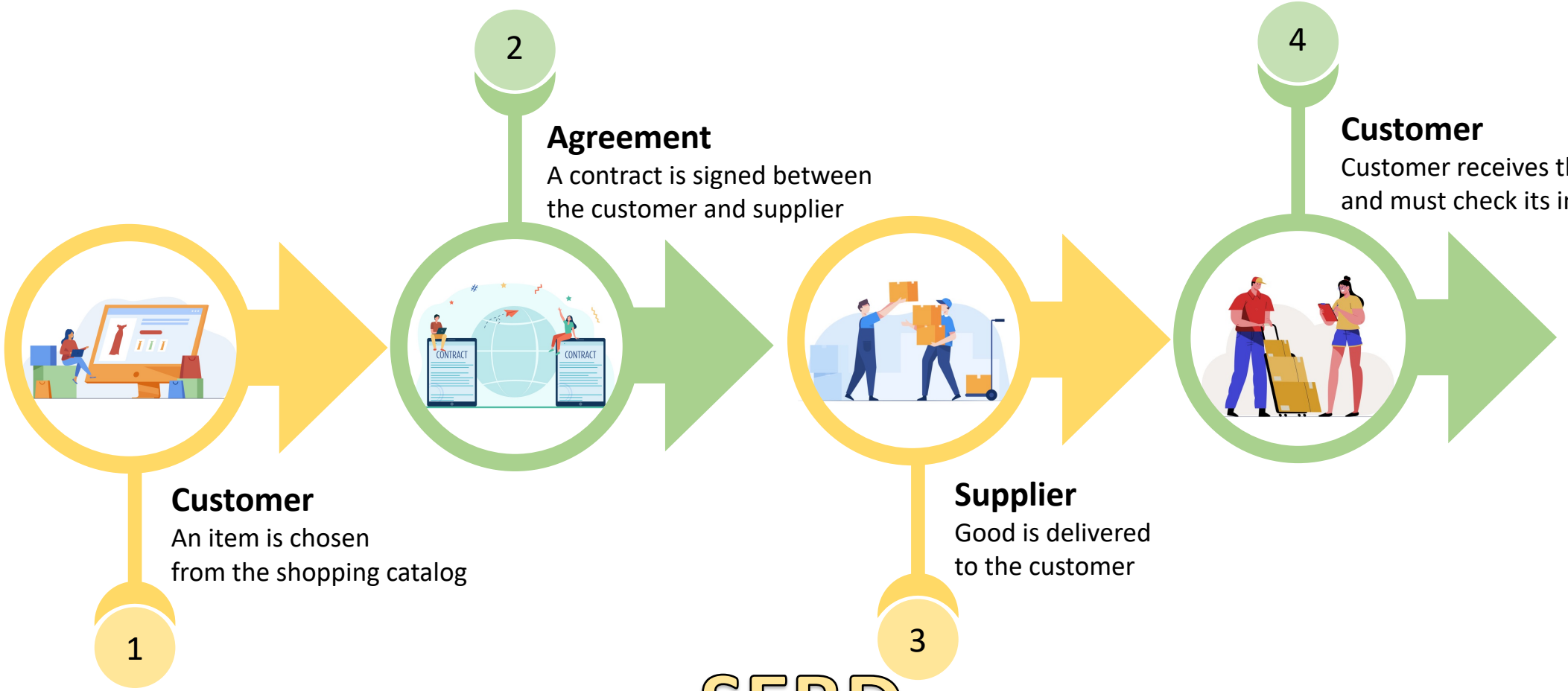

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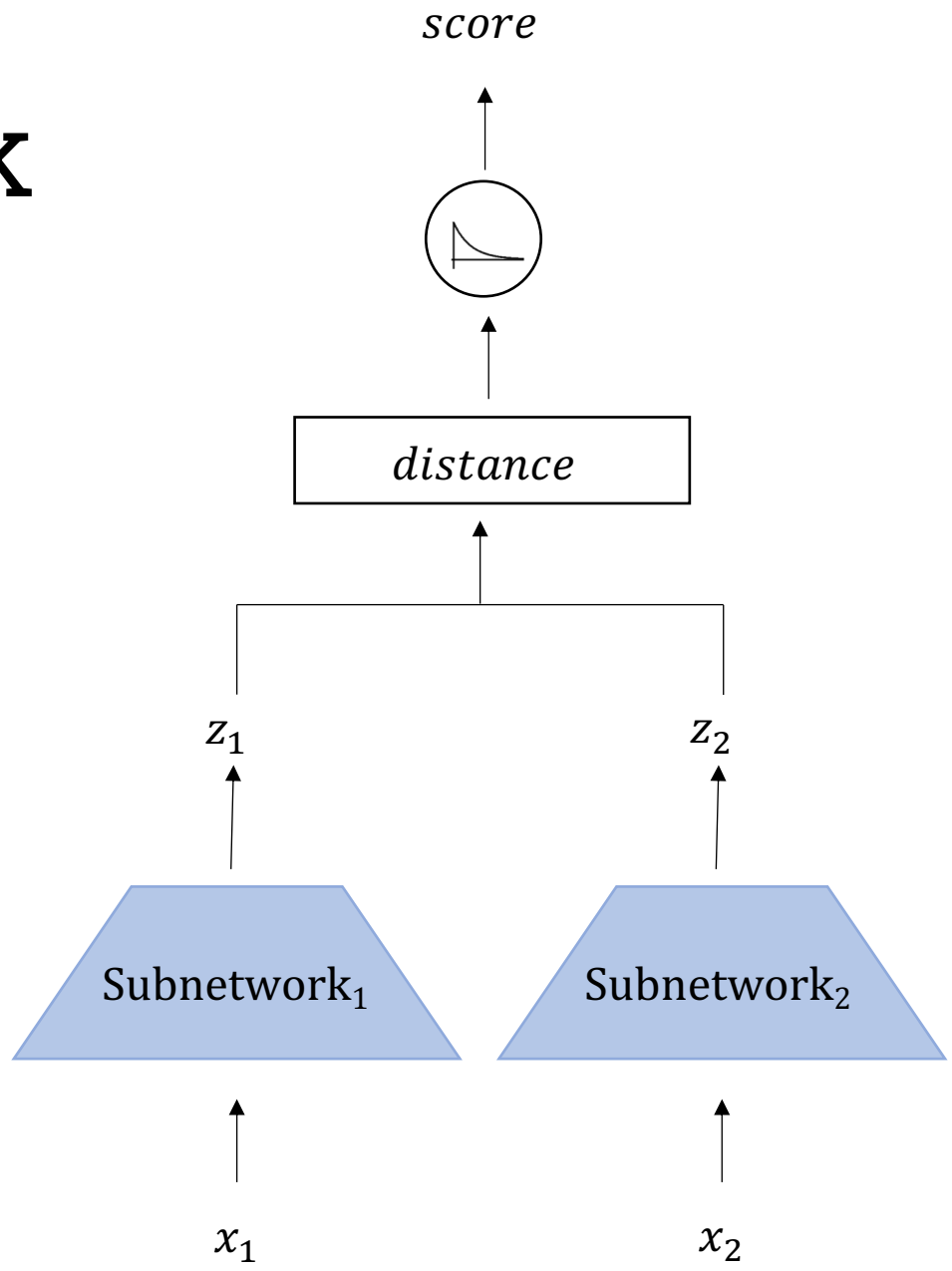
Image by pch.vector on Freepik

Methodology Overview

- A set of identifiable features, named **descriptors**, allow discovering alterations of the items
  - Features should be chosen based on the value of the exchange item
- A **Siamese Neural Network** is adopted for integrity check
  - Mapping the input (delivery and purchased item descriptors) into data points lying on a latent space
  - Identifying counterfeit items based on their generated embedding
    - Data that exhibit similar characteristics, i.e., original item, are in the same area w.r.t. data with different properties, i.e., counterfeit item

Siamese Neural Network

- Siamese Neural Network is composed of three modules:
  - **Subnetwork module** that maps a descriptor x into a low-dimensional space z
  - **Distance module** that outputs the Euclidean distance between two embeddings
  - **Exponential module** that applies a negative exponential function to provide a similarity score
- The subnetwork module exploits the ResNet architecture and a combination of Linear and Dropout layers



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Case Study

- Identify counterfeit signatures
- Dataset of handwritten signatures available on Kaggle
- 140 real signatures of 28 subjects
  - Each of them provides 5 signatures
- 140 corresponding fake signatures

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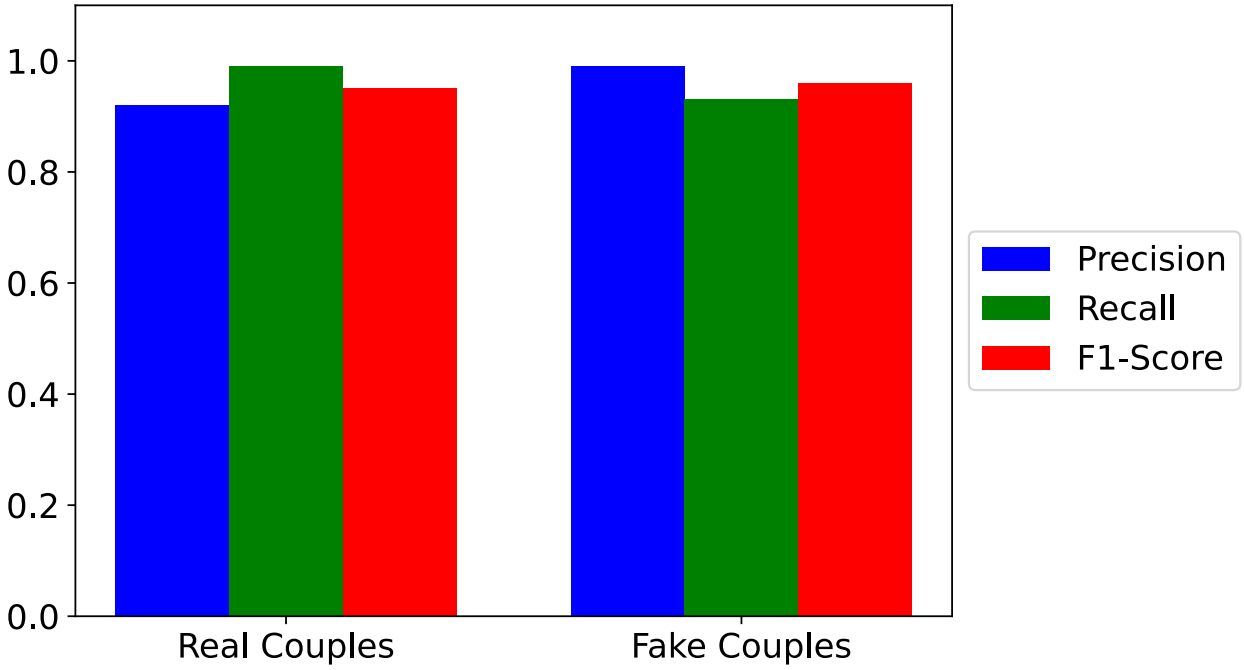
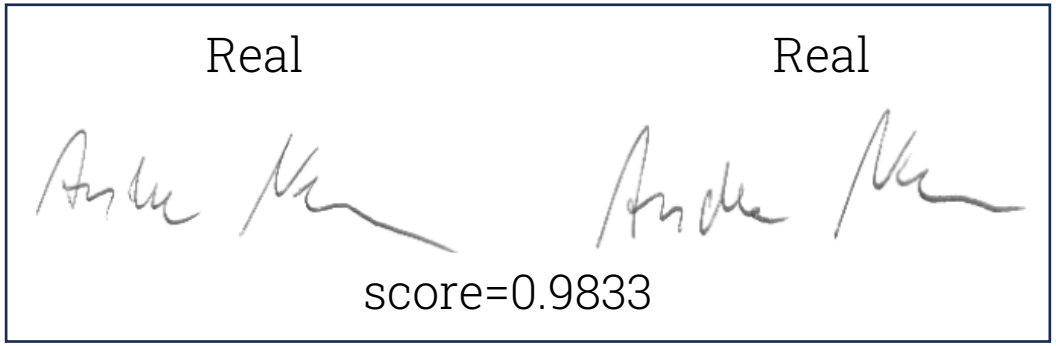
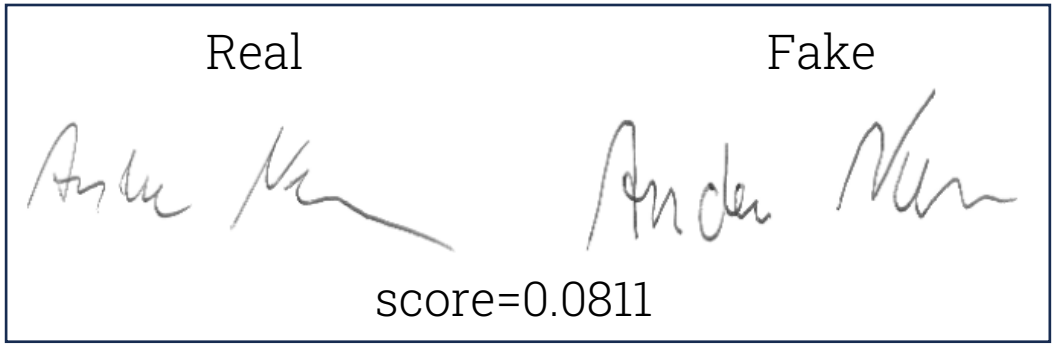
Case Study

- We generated both the signature couples (real, real) and (real, fake).
  - Couples of real signatures have been tagged with label 1
  - Couples of fake signatures with label 0
- Final dataset of 1400 tuples, equally partitioned

Experiments







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Conclusion and Future Works

- A Siamese Neural Network using two sub-networks to validate the product authenticity is proposed
- Preliminary results on a public dataset prove the effectiveness of the proposed model
- As future works, we plan to consider sets of feature descriptors depending on the item price and explore more sophisticated ways to strengthen security on multiple levels

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Thank you for your attention!
Questions?

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