DRIVES

Development and Research on Innovative Vocational Education Skills

U3 DEEP LEARNING AND NEURAL NETWORKS

U3.E6 ADVANCED ARCHITECTURES

Artificial Intelligence Technician

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LEARNING OBJECTIVES

The student is able to

AIT.U3.E6.PC1	Know that there are other artificial neural networks architectures.
AIT.U3.E6.PC2	Understand the most commonly used advanced architectures and their particularities.
AIT.U3.E6.PC3	Explore and understand some examples of the application of advanced ANN architectures.

STOCHASTIC NEURAL NETWORKS

In contrast to **deterministic networks**, which represent **mappings** from a set of **inputs** to a set of **outputs**, **stochastic networks** represent **mappings** from a set of **inputs** to a set of **probability distributions** over the set of **outputs**.

Applications:

- Risk management;
- Oncology;
- Bioinformatics.

GENERATIVE ADVERSARIAL NETWORKS (GAN)

“Generative modeling” is an area of machine learning that deals with models of distributions P(X), defined over data points X in some potentially high-dimensional space X.

For example, we might create generative models for images that are a popular kind of data. Each “data point” (image) has thousands or millions of dimensions (pixels), and the generative model’s job is to somehow capture the dependencies between pixels. Nearby pixels have similar color and are organized into objects.

GENERATIVE ADVERSARIAL NETWORKS (GAN)

Learns to generate new data with the same statistics as the training set, is based on game theory and can generate realistic high-resolution images. GAN are great learning in situations where there are many possible correct answers. For example, GAN can turn a photo of a horse into a photo of a zebra, after studying a collection of these photos. Can generate images of high subjective perceptual quality.

Applications:

- Fashion, Art and Advertising;
- Science;
- Video games;
- Concerns about malicious applications;
- Transfer learning;
- Miscellaneous applications.

VARIATIONAL AUTOENCODERS (VAE)

VAE was perhaps the first model that employed a recognition model, marry graphical models and deep learning. The generative model is a Bayesian network.

Limitations:

- The improvements obtained using deep models are limited because these type of models with several layers of dependent stochastic variables are difficult to train.
- One of the main limitations of VAE is that latent sample representations are in dependent and identically distributed.

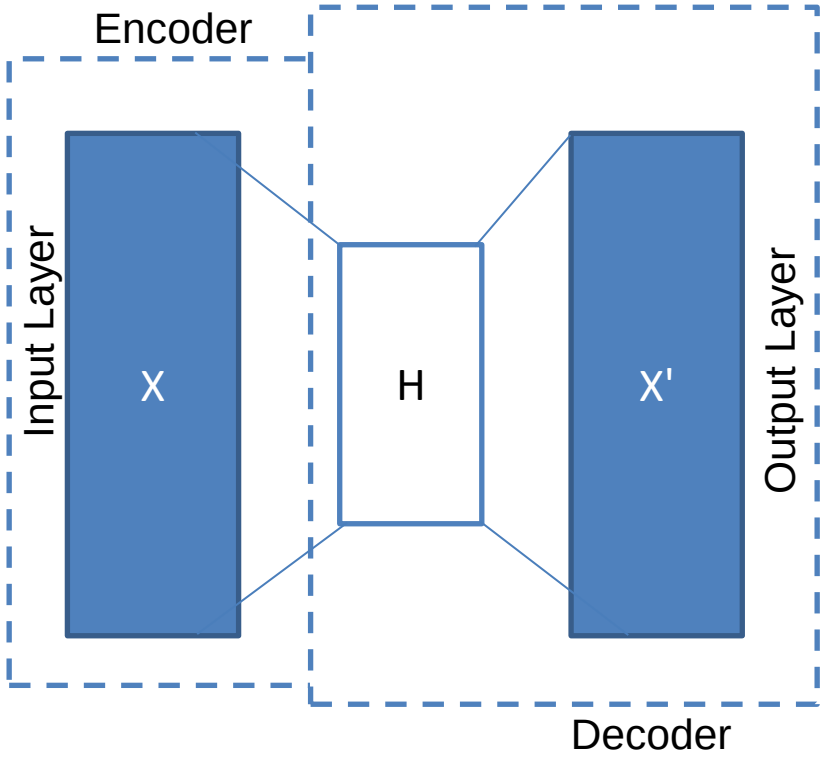
VARIATIONAL AUTOENCODERS (VAE)

To generate significant latent representations of integrated data, Variational AutoEncoders provide an unsupervised methodology. Variational autoencoders are generative models based on layered neural networks.

VAE can be viewed as two coupled, but independently parameterized models: the encoder or recognition model, and the decoder or generative model:

- **Encoder (**maps the high dimensional input data into a latent variable embedding that has lower dimensions than the input);
- **Decoder (**try to reconstruct the input data from the embedding).

Autoencoders learn how to compress the representation (embedding/code) of the input data by reconstructing it on the output of the network.



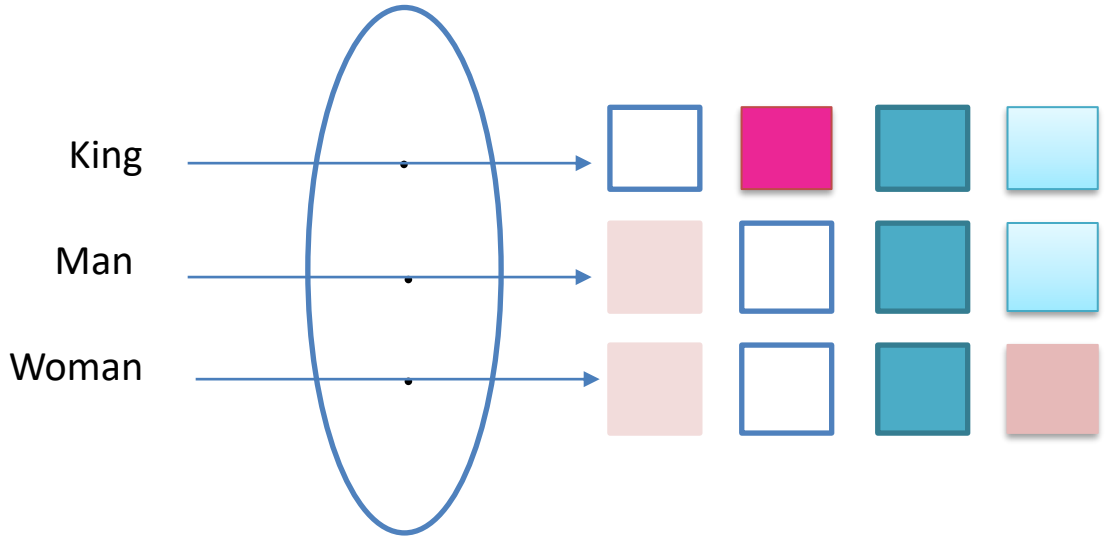
APPLICATION

- Variational autoencoder architectures in integrative data analyses such learning representations and analyzing transcriptomic cancer data.
- Data integration
- VAEs also generated complicated data such as handwritten digits, faces, house numbers, physical models of scenes, segmentation, and predicting the future from static images.

Variational Autoencoders (VAEs) have emerged as one of the most popular approaches to unsupervised learning ofcomplicated distributions.

WORD2VEC

Word2Vec is a technique for natural language processing published in 2013. It is a family of model architectures and optimizations that can be used to learn word embeddings from large data sets.



Genes, code, likes, playlists, social media graphs, and other verbal or symbolic series are examples of the applications of Word2Vec.

Word2Vec have some real-time applications:

- *Dependency parser* to generate better and accurate dependency relationship between words at the time of parsing.
- *Name entity recognition* to finding out the similarity. All similar entities will be joined and consequently, will achieve better results.
- *Sentiment analysis*, to preserve semantic similarity that helps us to understand which phrases or words people use to express their opinions. From this, it's possible to generate good insights and accuracy by using word2vec concepts in sentiment analysis. For example, an application can be built to predict a person's name by using their writing style.

APPLICATION

- *Document classification* with high accuracy and using simple statistics.
- *Word clustering* is the central product. All words with a similar meaning are clustered together. For example, Google uses word2vec and deep learning to improve its *machine translation product.*

REINFORCEMENT LEARNING (RL)

RL is a term for a class of strategies where the method aims to improve by active contact with the world to optimize any idea of incremental reward. RL is also called adaptive (or approximate) dynamic programming, and has emerged as a powerful tool for solving complex sequential decision-making problems in control theory.

To maximize the rewards and minimize the punishments, RL study how agents had to behave. This is an optimization problem, is the ability to learn to obtain the things that are needed or wanted and to avoid those that are harmful or undesirable.

This type of learning can be applied to autonomous devices due to their flexibility in their environment.

- Variational Autoencoders (VAEs) have emerged as one of the most popular approaches to unsupervised learning of complicated distributions.
- RL has emerged as a powerful tool for solving complex sequential decision making problems in control theory.
- Word2Vec can be used to learn word embeddings from large data sets.
- GAN are great learning in situations where there are many possible correct answers.
- Stochastic Networks represent mappings from a set of inputs to a set of probability distributions over the set of outputs.

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DRIVES

Development and Research on Innovative Vocational Education Skills

Thank you for your attention

DRIVES project is project under **The Blueprint for Sectoral Cooperation on Skills in Automotive Sector**, as part of New Skills Agenda.

The aim of the Blueprint is **to support an overall sectoral strategy and to develop concrete actions to address short and medium term skills needs.**

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