# Teaching Machines to Recognise Emotions

When people talk about their feelings, they are communicating their subjective experience of an emotion. However, to study emotion objectively it is important to establish concrete relationships between what individuals report feeling and the measurable activity of their bodies and brains.

In psychology and neuroscience emotions are often understood as existing on a plane of **arousal** (how intensely an emotion is experienced) and **valence** (how positive or negative the experience is).[1]

This study, unlike many recent studies[2], aimed to develop digital models based on **physiological signals for** predicting levels of emotional arousal and valence on a **continuous** scale. It employed state-of-the-art **machine learning** techniques to find a relationship between these signals and individuals' emotional states.

## The Data:

The Database for Emotion Analysis using Physiological Signals (DEAP) was collected from 32 individuals as they watch 40 separate music videos.[3] It consists of:

- Electroencephalography (EEG) waves from 32 electrodes placed over different regions of the brain.
- Blood volume pressure (BVP) for heart rate information.
- Perspiration data.
- Breathing pattern.
- Subjective ratings for arousal and valence for each video as a continuous value between 1 and 9.

**Data Pre-processing and Feature Extraction:**
Raw waveforms underwent several transformations to extract features to be used by the learning algorithm. Statistical features such as mean and standard deviation were extracted as well as the strength of the signal at selected frequency bands (PSD).

The processed data was split into three different sets: Electroencephalograph (EEG), Peripheral signals (PER) and the two sets combined (EEG/PER).

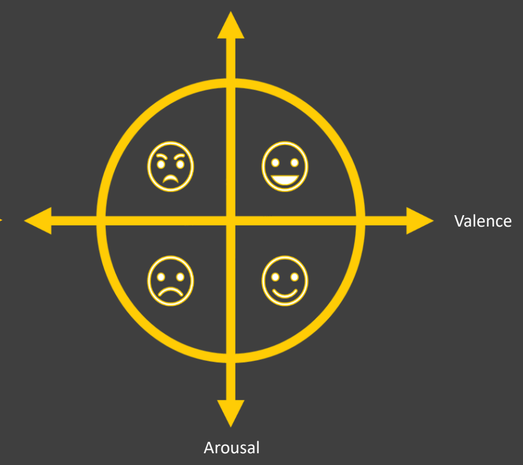
**Feature Selection:**
In any dataset, there will exist some features that do not contain useful information. This impairs the performance of the learned model and increases the time required to train it.

***Genetic Algorithms*** *(GAs), inspired by natural selection, were used to artificially evolve a good subset of features from a random population of individual subsets.[4] GAs utilise Darwinian ideas such as "gene-crossover", "mutation" and "selection-pressure" to efficiently find a good subset of features for training.*

**Prediction using Regression:**
Regression algorithms use statistical methods to attempt to measure the relationship between the values of one variable and the values of other corresponding variables in the data.

This study used a **Ridge Regression** algorithm to calculate the relationship that best maps the data to the arousal and valence ratings.

+/-

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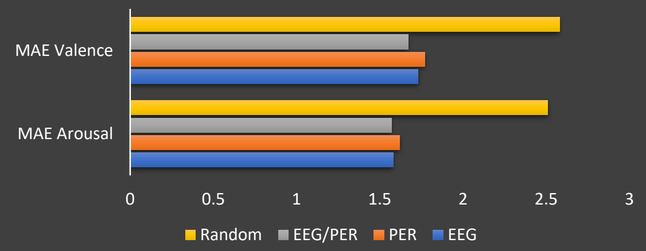
**The Results:**
The study resulted in significantly better accuracy in predicting emotional arousal and valence than our baseline of random guessing.

**Mean Absolute Error for Predicting Arousal and Valence (Lower is Better)**




These results are comparable to the those of similar studies in this area and add to the proof that EEG information and peripheral signals are both useful for predicting arousal and valence.

Going forward the aim is to continue minimising prediction error (MAE). Some proposed methods include:

- Constructing a bigger, more comprehensive dataset.
- Engineering of more features from the existing data.
- Investigating the applicability of **Neural Network** based regression methods.
- Exploring other feature selection methods.

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