Understanding affective behaviour from physiological signals: Feature learning versus pattern mining

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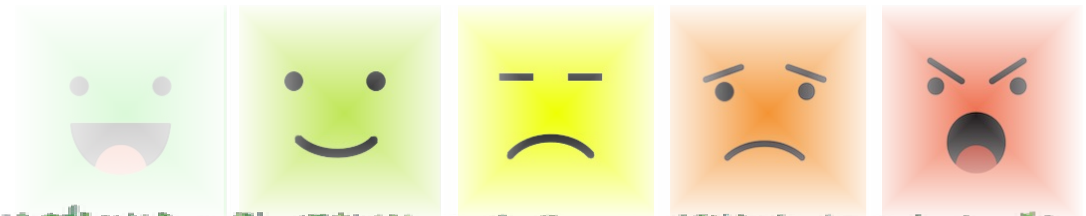
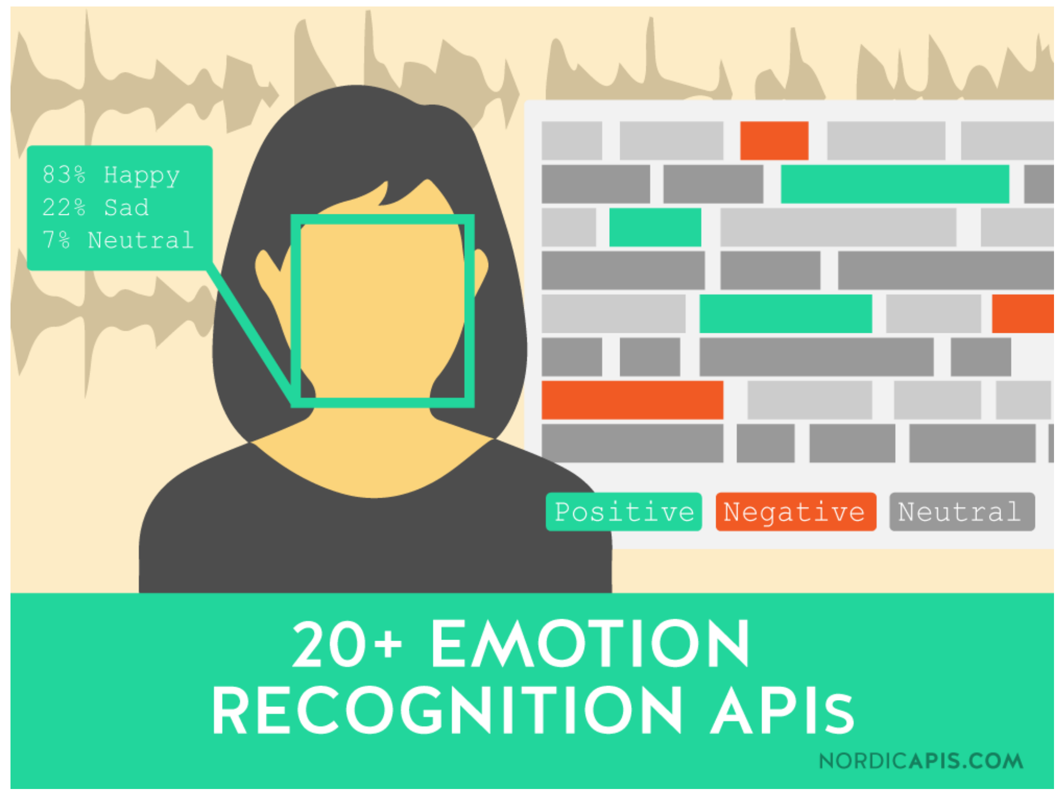


Introduction

- ☺ Monitoring emotions is important in the care of mental disease and behavioural health changes (i.e. health therapies based on behavioural change)

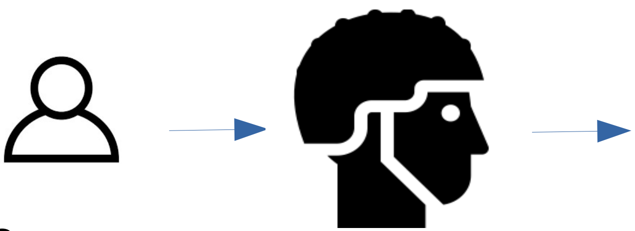
- ☺ Emotions recognition coming from sensors is not an easy task.

- ☺ The performance of Deep Learning is being compared with Time-Interval Related Pattern (TIRP) mining.



Source: Nordic APIs

Deap dataset



32 persons

40 sensors

EEG (32)
electrooculography (2),
electromyography (2),
galvanic skin response,
respiration belt,
plethysmography and
temperature

40 musical videos
of 63 seconds

Labels:
(self-reported states)

Valence: 1-9
Arousal: 1-9
Dominance: 1-9
Liking: 1-9
Familiarity: 1-5

Binarized labels:
(0-low, 1-hight)

Valence: 0,1
Arousal: 0,1
Dominance: 0,1
Liking: 0,1
Familiarity: 0,1

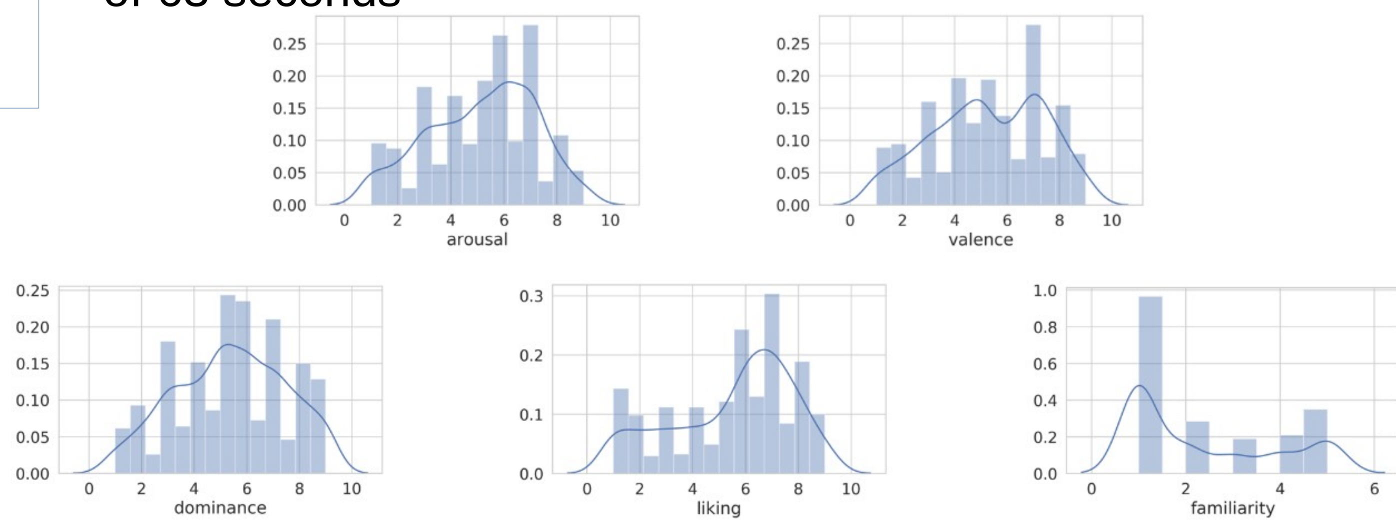


Fig. 2: Class distribution.

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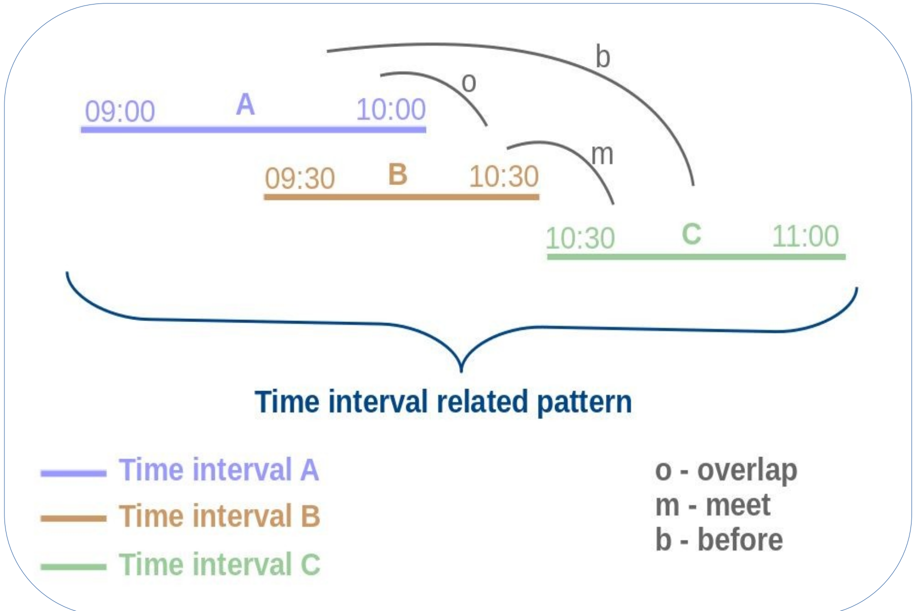
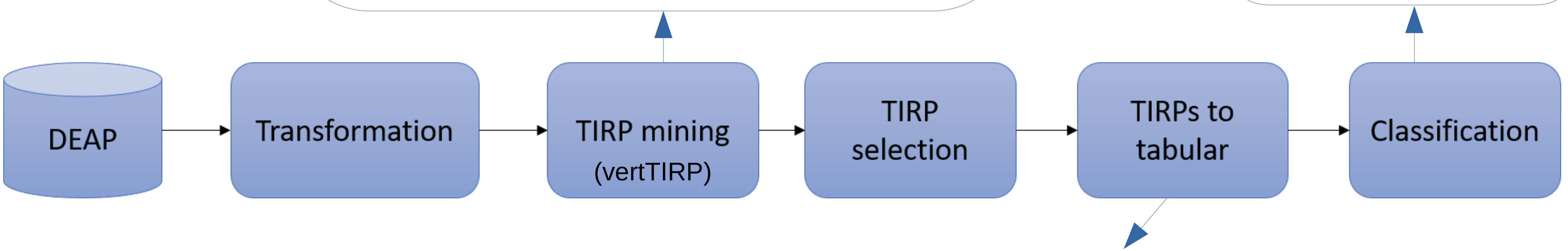
Method: 1-TIRP mining

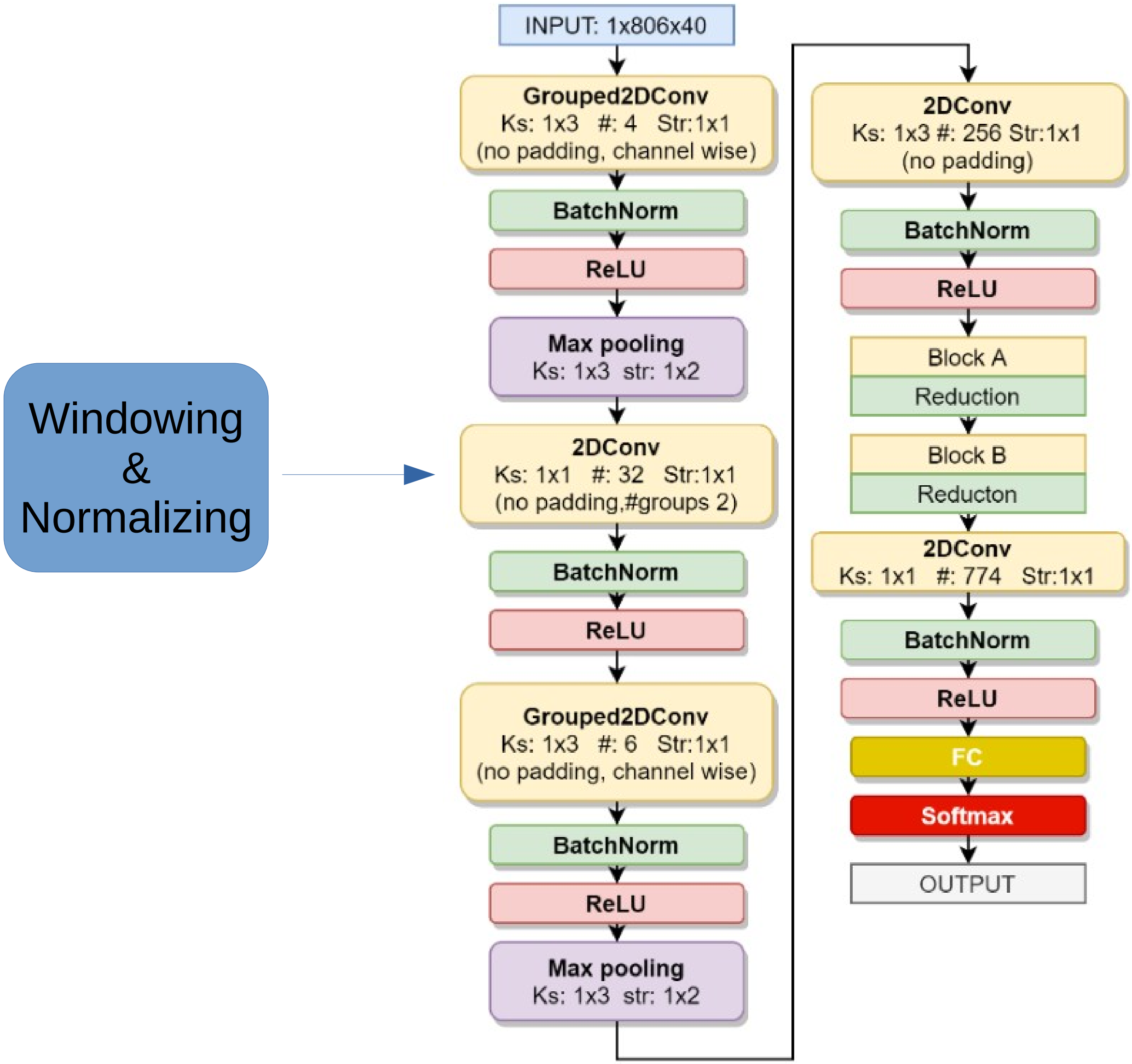


- K-Nearest Neighbors,
- Support Vector Classifier,
- Gaussian Process,
- Decision Tree,
- Random Forest,
- Neural Nets,
- Ada Boost
- Naive Bayes



Patient	sequence (video)	<ABC,obm>.d	<ABC,obm>.hs	<AG,bm>.d	<AG,bm>.hs	...	class
1	1	7200	1	6300	1		0
1	3	7200	1	7200	2		1
...	...	...	...	4200	1		...
1	s_n^1	7500	5	5000	2		
2	1	2280	2	0	0		0
...	...	...	...	7200	1		...
D	s_n^D	6000	3	0	0		0

Method: 2-NetEegChan



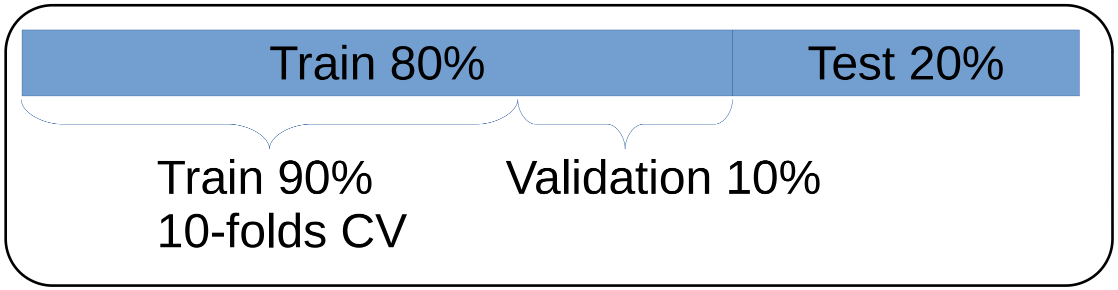
Schema of NetEegChan architecture. Blocks A and B are ResNet-Inception based blocks. **Str** is the stride, **Ks** kernel size and, # the number of kernels.

Transfer learning is applied when the NetEegChan is trained using different labelling from a different class.

It is trained six times in the following order:

1) Valence
2) Arousal
3) Dominance
4) Liking
5) Familiarity

Experimental setup

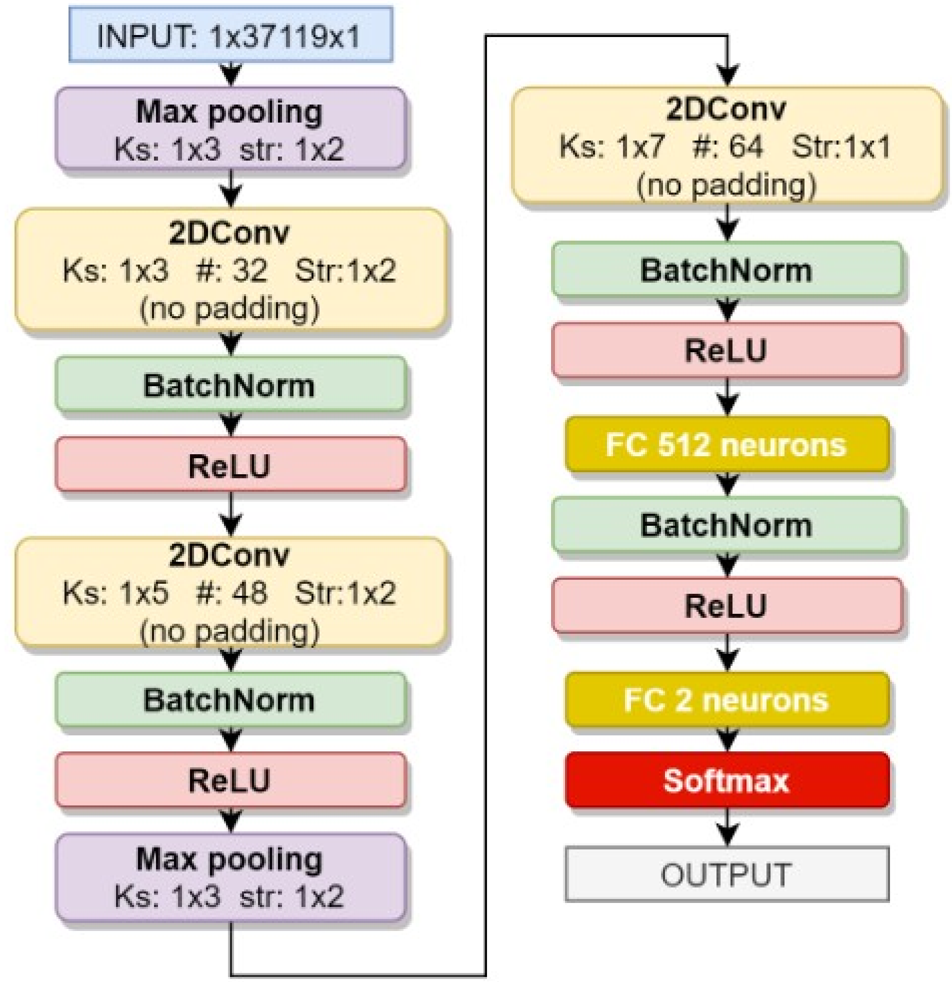


Experimental scenarios:

1) Pattern mining-VertTIRP.

2) Feature learning-NetEegChan.

3) Pattern mining + deep learning*



* Schema of CNN architecture employed in the 3rd experiment.

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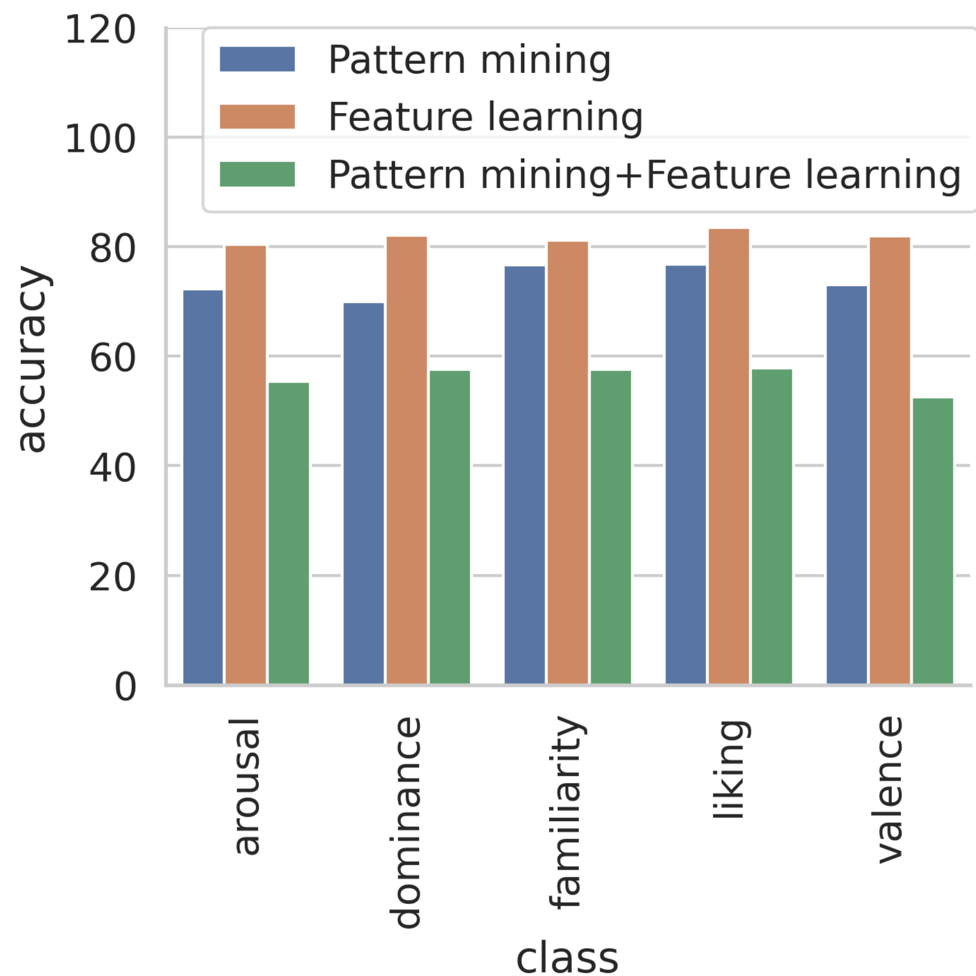
Results



Mean accuracy of the different experimental scenarios.

Conclusions

- ☺ This paper presents a comparative analysis of the use of pattern mining against deep learning approaches for feature learning.
- ☺ Results on feature learning are slightly better.
- ☺ Patterns has more potential for explainability (i.e. a TIRP <skin_conductance_b,temperature_b>, b informs us that low skin conductance is followed by low body temperature).
- ☺ Pattern mining has good explainability properties, although its performance is slightly lower than feature learning.

Future work

- ☺ Extending the analysis from the well known DEAP dataset to other datasets (DREAMER)
- ☺ Research of pattern mining and feature learning interactions.