**Problem**

- **What is facial action unit?**

  - Facial action units refer to a set of facial muscle movements coded by their appearance on the face, which can be used for coding nearly any anatomically possible facial expression.

- **Since** AUs are subtle, local and have significant subject-dependent variations, qualified FACS experts are required to annotate facial AUs. In addition, labeling AUs is labor-intensive and expensive, making it impractical to manually annotate a large set of face images.

**Overview**

- **Semi-supervised AU recognition** using multi-view co-training and AU relationship modeling to leverage massive labeled face images and a small set of labeled face images.

**Method Details**

- **Multi-view Loss**

  - A multi-view loss by orthogonalizing the weights of the AU classifiers of different views to encourage the two feature generators to get conditional independent features.

- **Co-regularization Loss**

  - A co-regularization loss to encourage the classifiers from different views to generate similar predictions in order to make the two views to learn from each other.

- **AU Relationship Learning**

  - Two layer graph convolution layer to model the relationship between different AUs.

  - Adjacency matrix defined by the dependency matrix.

- **Overall Loss Functions**

  - Binary cross-entropy loss for AU recognition

  - Overall loss function

**Experimental Results**

- **Datasets**

  - EmotioNet: In-the-wild
  - BP4D: Spontaneous

- **Performance on EmotioNet database**

- **Performance on BP4D database**

- **Ablation Study on EmotioNet**

- **Extension to Facial Attributes Analysis**

- **Overall F1 Score (%)**

**Results**

- **Baseline**

  - 68.1

- **Baseline + Lcr + Lmv + GCN**

  - 67.5

- **Baseline + Lcr + Lmv**

  - 67.1

- **Baseline + Lcr**

  - 62.3

- **Baseline**

  - 61.7

- **Baseline + Lcr + Lmv + GCN**

  - 68.1

**Attributes**

- **AU**

  - 1

  - 2

  - 3

  - 4

  - 5

  - 6

  - 7

  - 8

  - 9

  - 10

  - 11

  - 12

  - 13

  - 14

  - 15

  - 16

  - 17

  - 18

  - 19

  - 20

  - 21

  - 22

  - 23

  - 24

  - 25

  - 26

  - 27

  - 28

  - 29

  - 30

  - 31

  - 32

  - 33

  - 34

  - 35

  - 36

  - 37

  - 38

  - 39

  - 40

  - Avg.