# Multiple Transfer Learning and Multi-label Balanced Training Strategies for Facial AU Detection In the Wild

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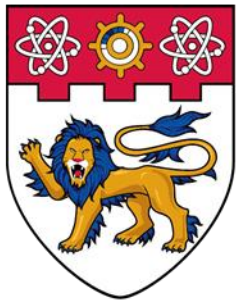

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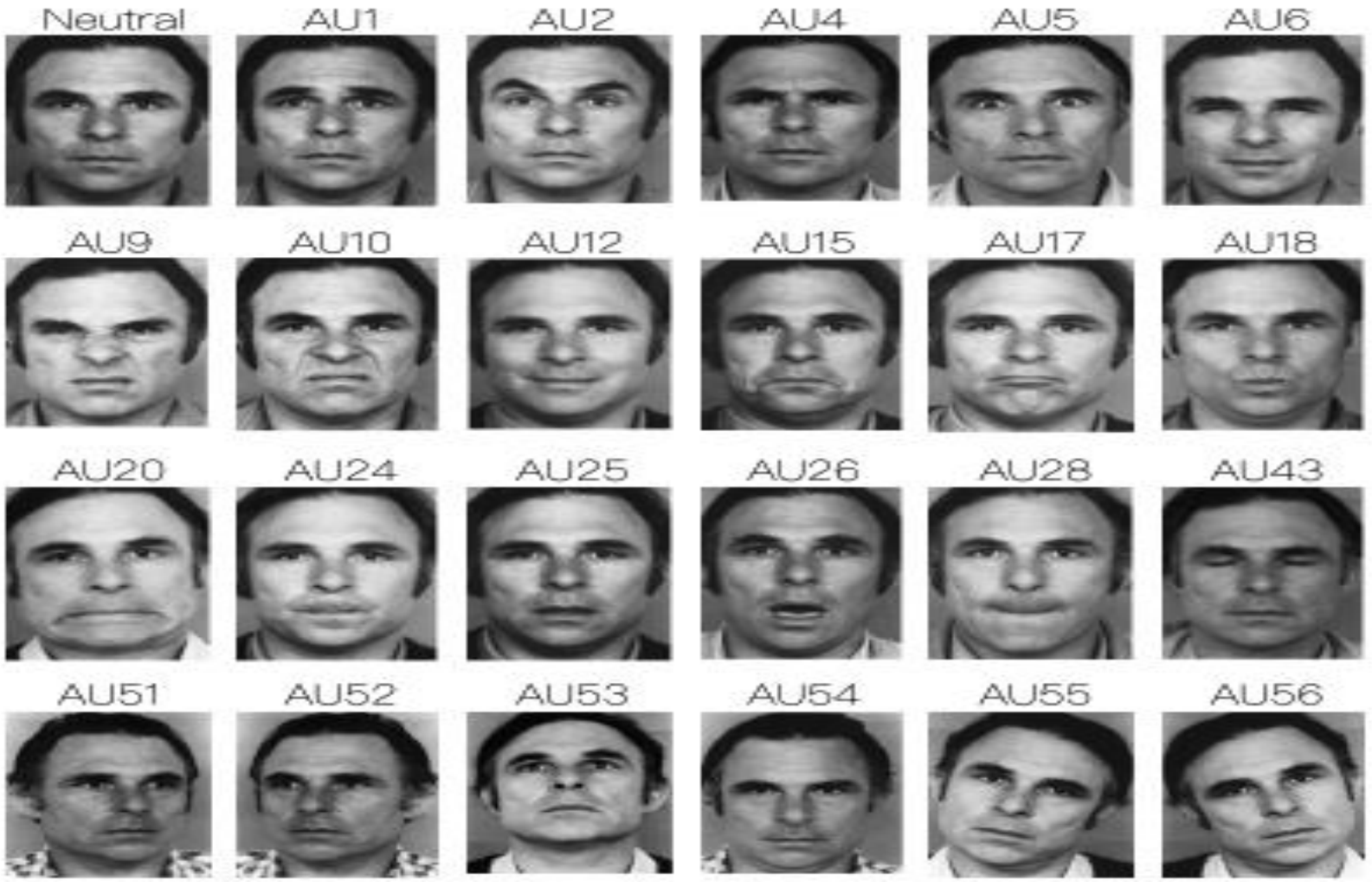
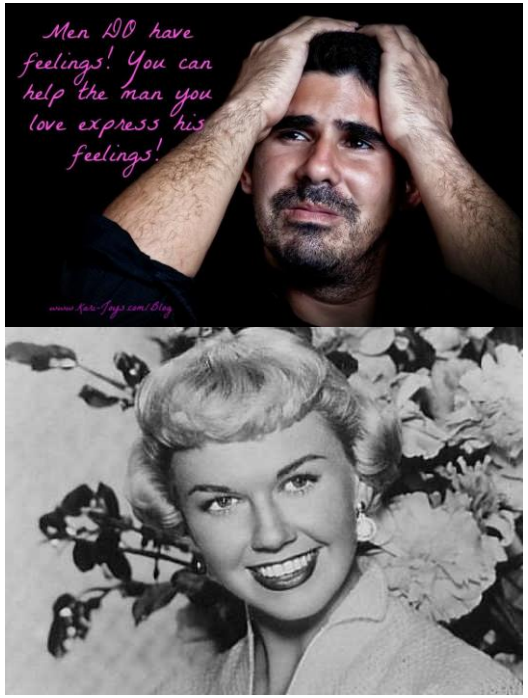
# Facial Action Units(AU)




Picture from: http://cbcsl.ece.ohio-state.edu/enc-2020/index.html

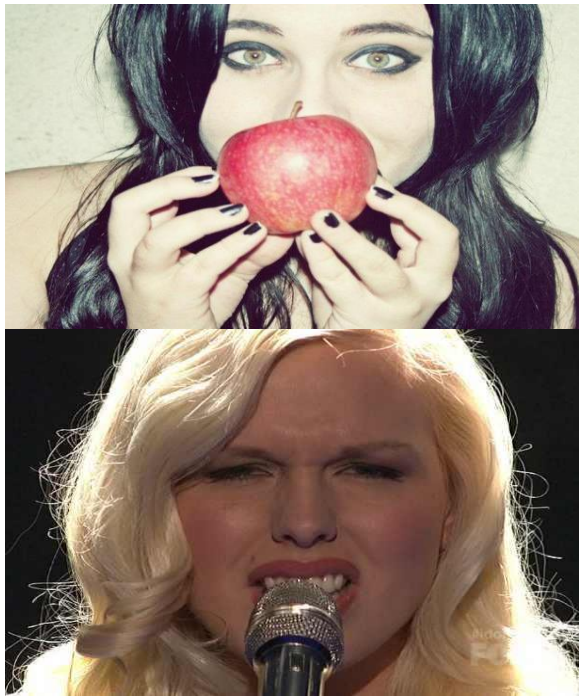
# Challenge: unconstrained heterogeneity of in the wild facial images


Various pose




Various illumination

Various resolution



Different kind of occlusion

Picture from Emotinet Dataset

# Solution: jointly face detection and alignment

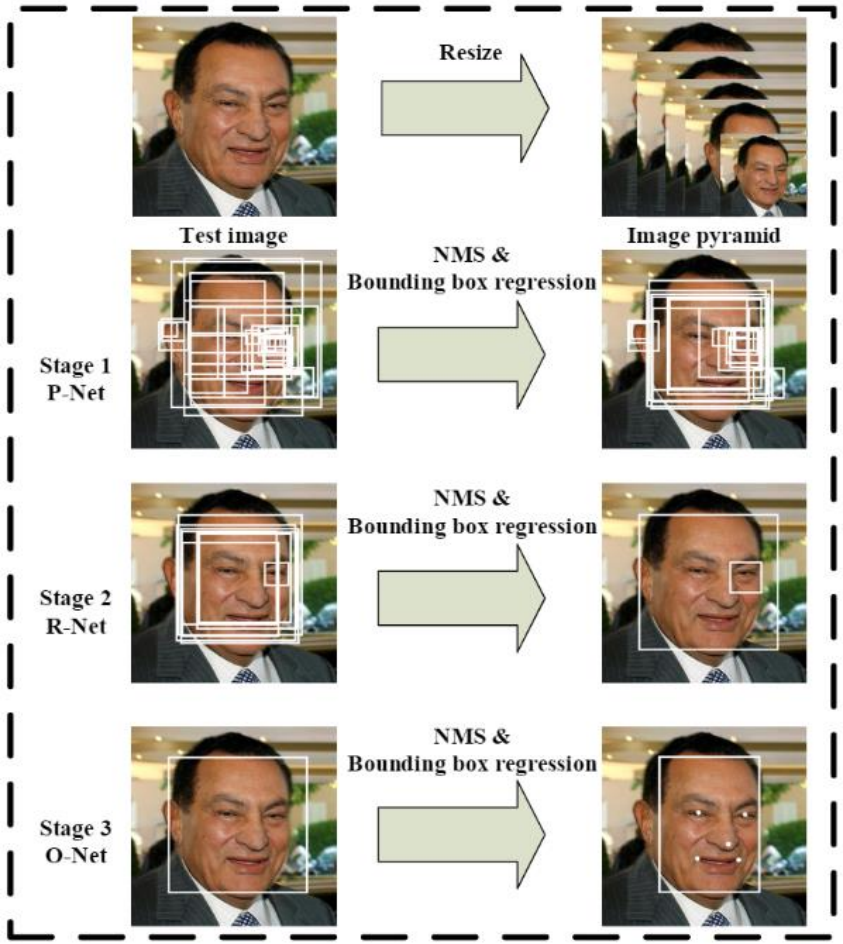
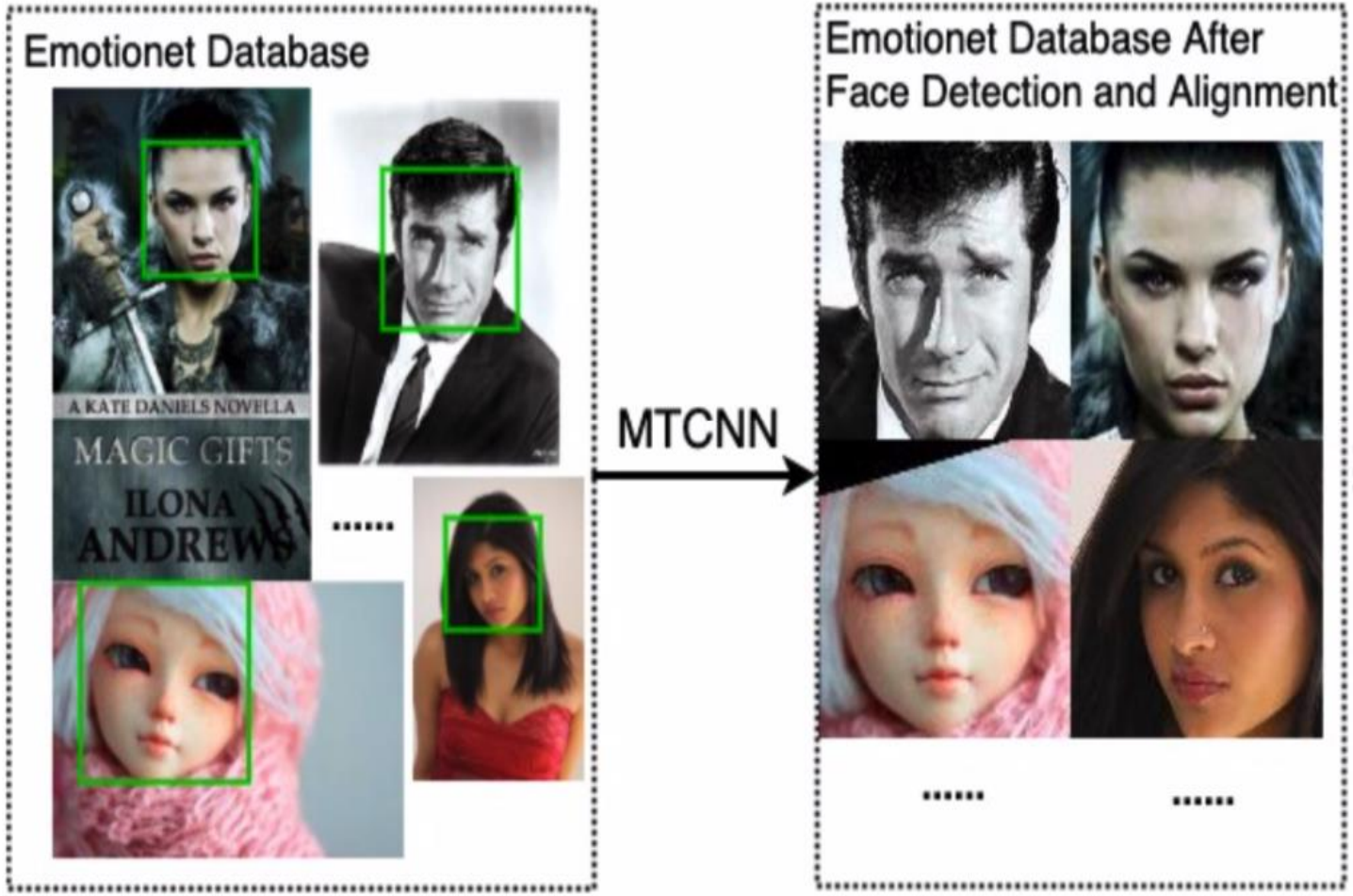



Figure of MTCNN[1]

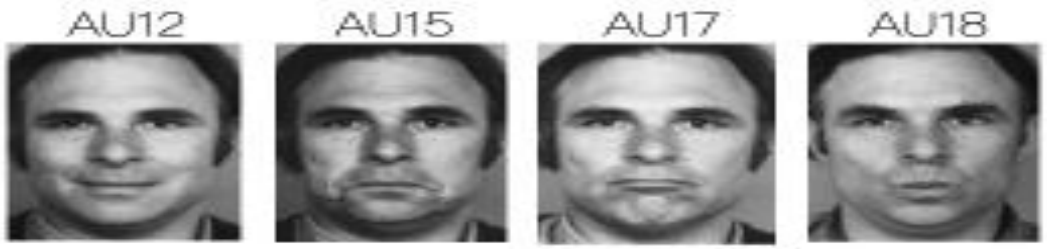



Result demonstrate

Zhang, K., Zhang, Z., Li, Z., and Qiao, Y. (2016). Joint face detection and alignment using multitask cascaded convolutional networks. IEEE Signal Processing Letters, 23(10):1499–1503.

# Challenge: discriminative feature learning

- Tiny face muscle change leads to different AU




- Sub-face level changes requires network to learn deep fine-grained representative features
- Lack of labelled data(25K) have a risk of overfitting

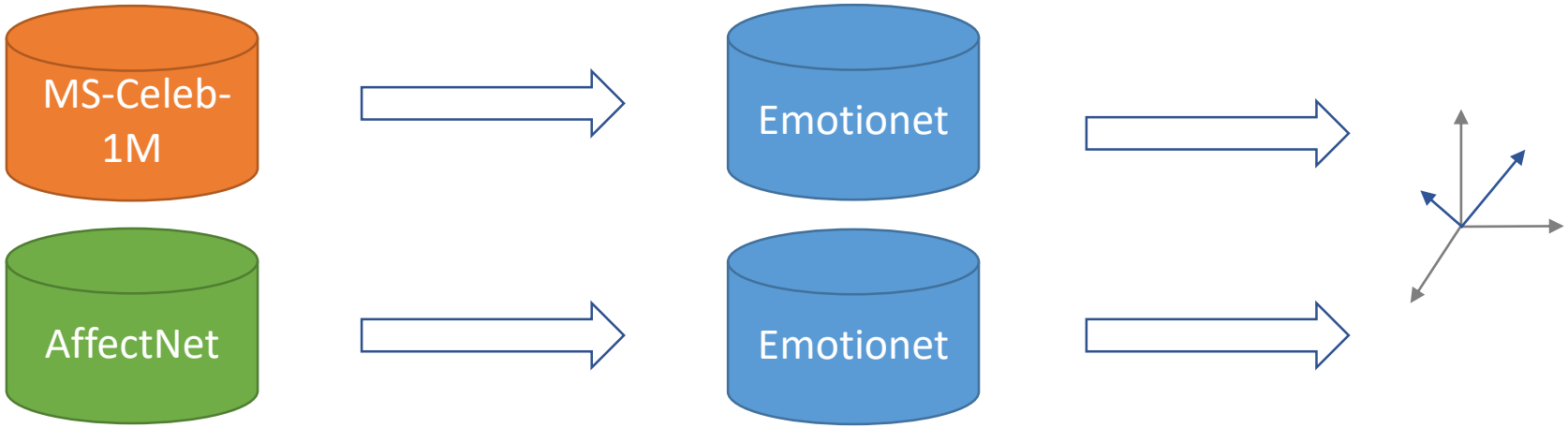
# Solution: transfer knowledge from multi relevant tasks

Opportunity：

- Most location of AU happens on the face landmark position

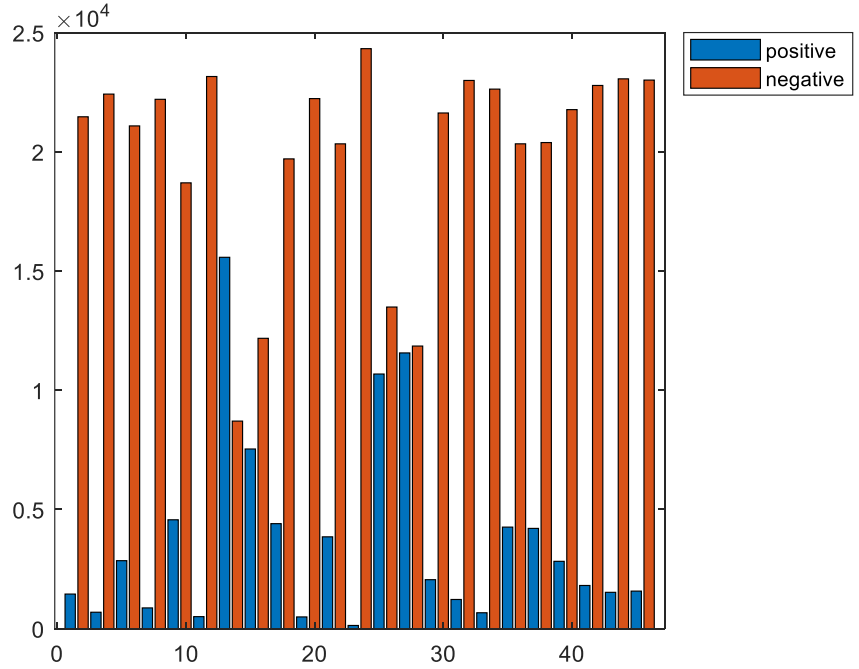
  Transfer knowledge from face recognition task
- Some AU will occur simultaneously to form a specific emotion

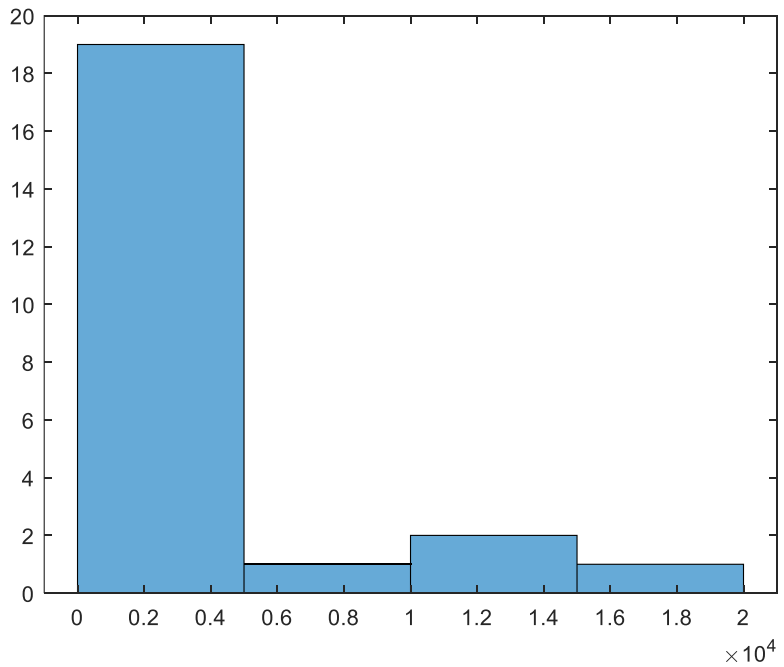
  Transfer knowledge from facial expression recognition task



# Challenge: imbalanced AU distribution

- Most of the Action Unit is labeled negative, negative samples are outnumbered positive samples
- Some AU occurs frequently while some occurs seldomly



# Solution: multi-label balancing strategies

- Balance Sampling

  Data processing phase
- Selective Learning

  Training phase
- Soft Thresholding

  Post optimization phase

# Results

Table 1. Result on Preliminary Backbone Selection

| Backbone | Acc | F1 | Avg |
|---|---|---|---|
| ResNet-18 | 0.901 | 0.364 | 0.633 |
| ResNet-50 | 0.905 | 0.409 | 0.657 |
| ResNet-152 | 0.905 | 0.474 | 0.690 |

Table 2. Ablation Results

| Method | Acc | F1 | Avg |
|---|---|---|---|
| F_face | 0.921 | 0.384 | 0.652 |
| F_emotion | 0.925 | 0.429 | 0.677 |
| F_face + F_emotion | 0.925 | 0.494 | 0.710 |
| Align + F_face + F_emotion | 0.927 | 0.527 | 0.727 |
| Align + F_ face + F_emotion + balancing | 0.915 | 0.552 | 0.734 |

2020 CHALLENGE

| Group | Mean Accuracy | F1 | Final Score |
|---|---|---|---|
| TAL | .9147 | .5465 | .7306 |
| University of Magdeburg | .9124 | .5478 | .7301 |
| SIAT-NTU | .9013 | .4410 | .6711 |
| USTC-alibaba | .8609 | .3497 | .6053 |

2020 VALIDATION TOP-3

| Group | Mean Accuracy | F1 | Final Score |
|---|---|---|---|
| TAL | .9200 | .5720 | .7460 |
| University of Magdeburg | .9198 | .5706 | .7452 |
| SIAT-NTU | .9195 | .3531 | .6363 |

# Conclusion

- Conduct targeted solution to each challenge
  - Jointly face detection and alignment
  - Multiple Transfer Learning
  - Multi-label balancing strategies
- Our solution demonstrates robustness during three phase of Emotionet Challenge 2020 and achieve the 3$^{rd}$ place