Deep Convolutional Neural Network with Independent Softmax for Large Scale Face Recognition

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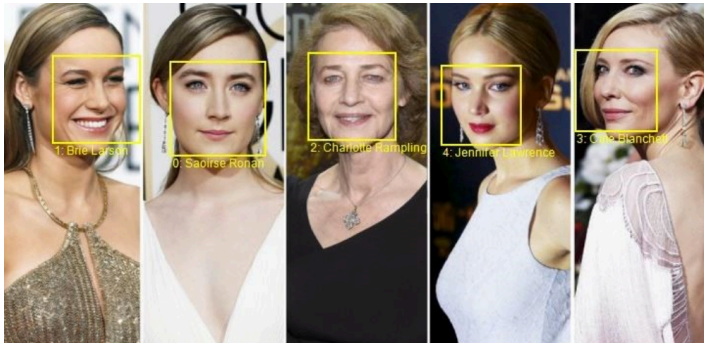
Outline

- Task and Challenges
- Our solution
- Final Evaluation
- Conclusion

Task and Challenges

- Recognize 1M celebrities
- A classification problem
  - Large number of classes
    - 100K celebrities
  - Large number of images
    - 10M images



Full images

Cropped face images

Aligned face images

https://www.microsoft.com/en-us/research/project/ms-celeb-1m-challenge-recognizing-one-million-celebrities-real-world/

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First Try

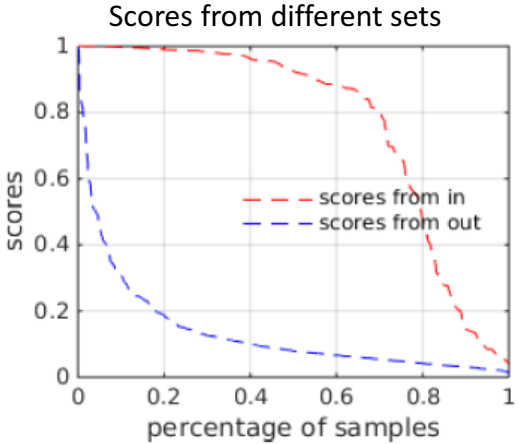
- ResNet 18-layer* model on full dataset
  - Convergence?
  - Training very slow: 4 months (estimated)

- ResNet-18 on 10K classes out of 100K classes
  - Training fast: 5 days
  - Top-5 error: 32%

*Deep Residual Learning for Image Recognition, CVPR 2016

What if we test faces not in 10K?

- 1000 images are tested
  - ‘scores’ is top-1 scores
  - ’in’ means faces in 10K
  - ’out’ means faces not in 10K
    - Almost a uniform output



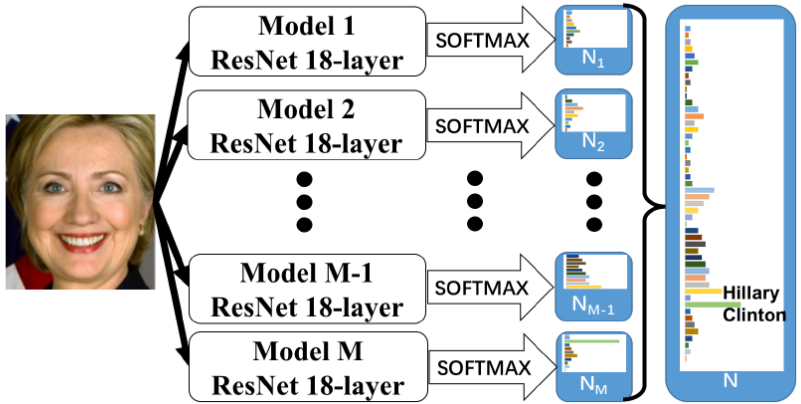
- We can train several non-overlapped, independent models distributed in different machines.

Independent Softmax Models(ISM)

- 5 ResNet-18 models
  - Training separately
  - One week to finished
  - Distributed
    - A single Geforce Titan X
    - Two Geforce 970
- Classify a face
  - Get scores for each class from 5 models
  - Concentrate all scores
  - Get the top-1 result for 100K classes

100K Partition Information

Fold	Classes	Train Images	Val Images
1	10,001	760,656	89,461
2	23,000	1,743,649	205,377
3	23,000	1,740,138	204,921
4	23,000	1,742,208	205,092
5	20,890	1,578,945	185,807

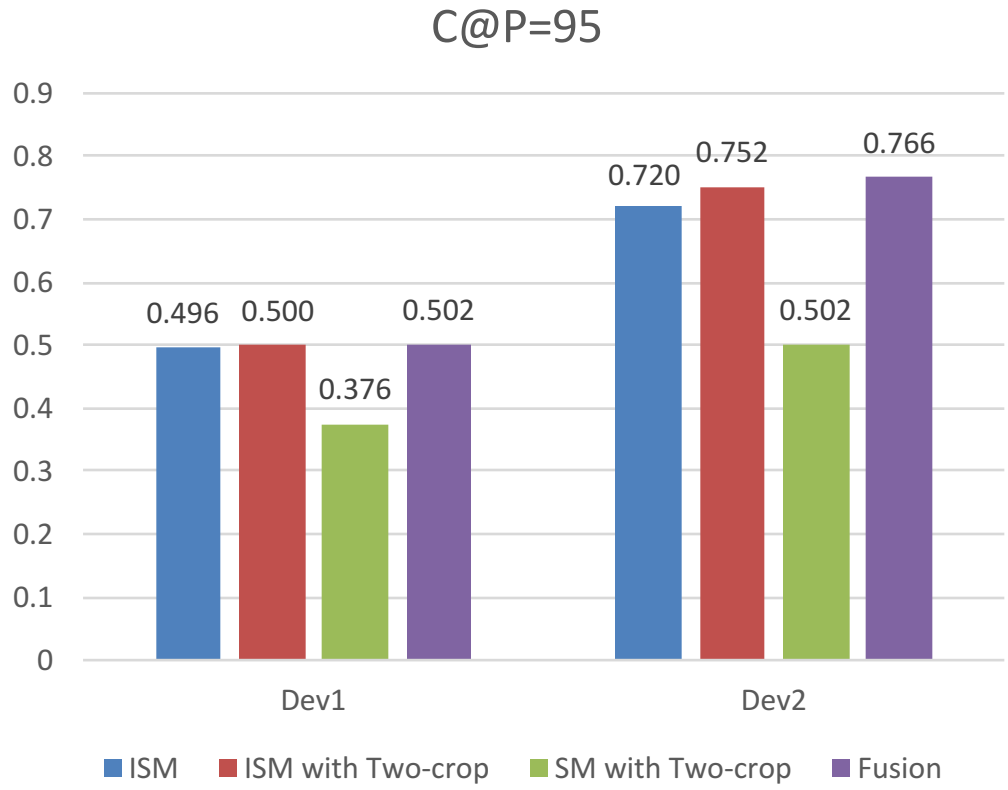


Result

- Development set
  - Dev1: hard set
  - Dev2: random set
- Measurement
  - For N images, M images are recognized, among which C images are correct
    - precision = C/M
    - coverage = M/N
  - Coverage@Precision = 95% (C@P=95)
    - The higher, the better

Result

- Multi-crop testing
  - Multi-crop testing usually give better result but is time-consuming
- Model ensemble
  - Fine-tuned from the 10K model for 3 epochs(SM)
  - Fusion



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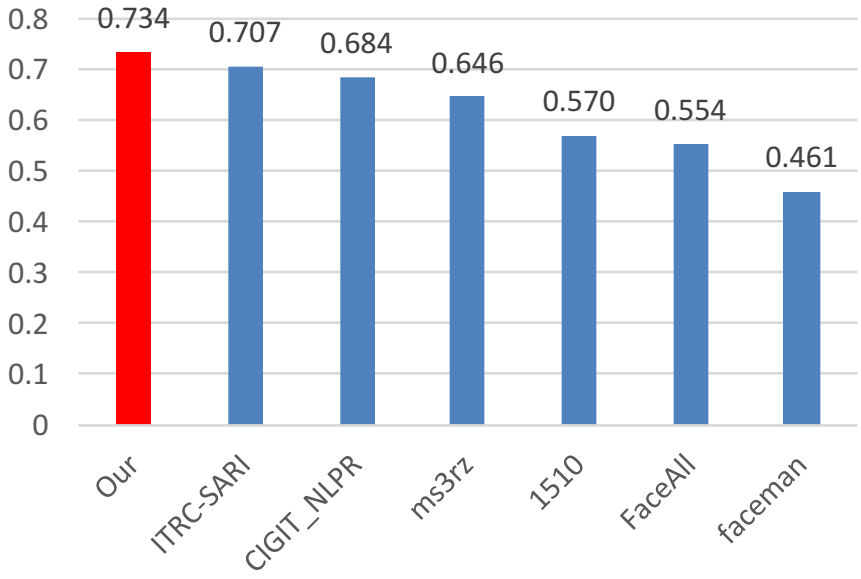
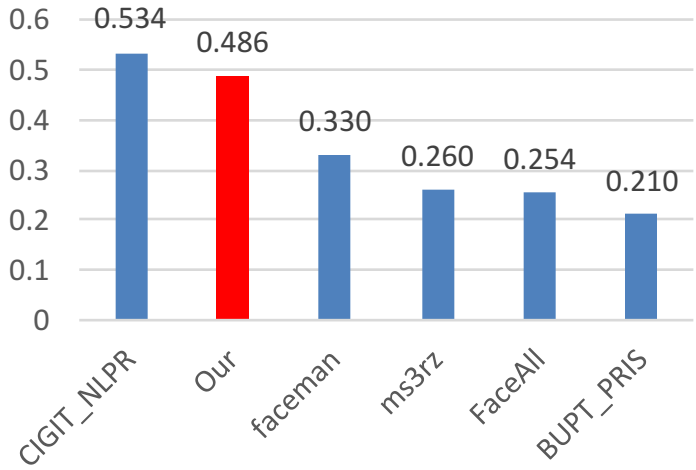
Final Evaluation

Random set C@P=95



Hard set C@P=95



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Conclusion and Thank You!

- Key components:
  - independent Softmax
  - Multi-crop testing
  - Model ensemble

- Public available codes and models
  - https://github.com/wuyuebupt/msceleb2016acmmm