
National Research University Higher School of Economics
Laboratory of Algorithms and Technologies for Network Analysis

# Decision-Making in Visual Product Recommendation using Neural Aggregation Network and Context Gating

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# Motivation

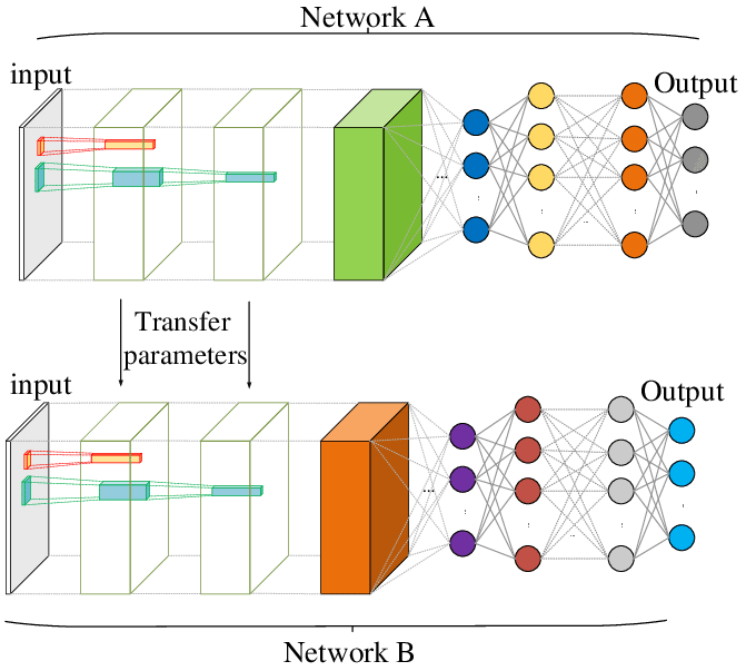
# Outline

1. Proposed approach
2. Experimental results
3. Conclusion and future work

# Task Formulation

Let there be given N users: n-th user is associated with $M_n$ images $\{X_n(m)\}$, $m = 1, 2, \ldots, M_n$ of products (single product on each image) that this user has purchased or interacted with. Each product belongs to one or more of D categories. The task is to predict the relevant classes of products to a user based on a collection of images of products that user has interacted with, i.e. generated a D-dimensional vector of scores (estimates of posterior probabilities) that the corresponding category is relevant to the user.

# Transfer learning



# Algorithms

1. Average pooling
2. Neural Aggregation
3. Neural Aggregation + Context Gating

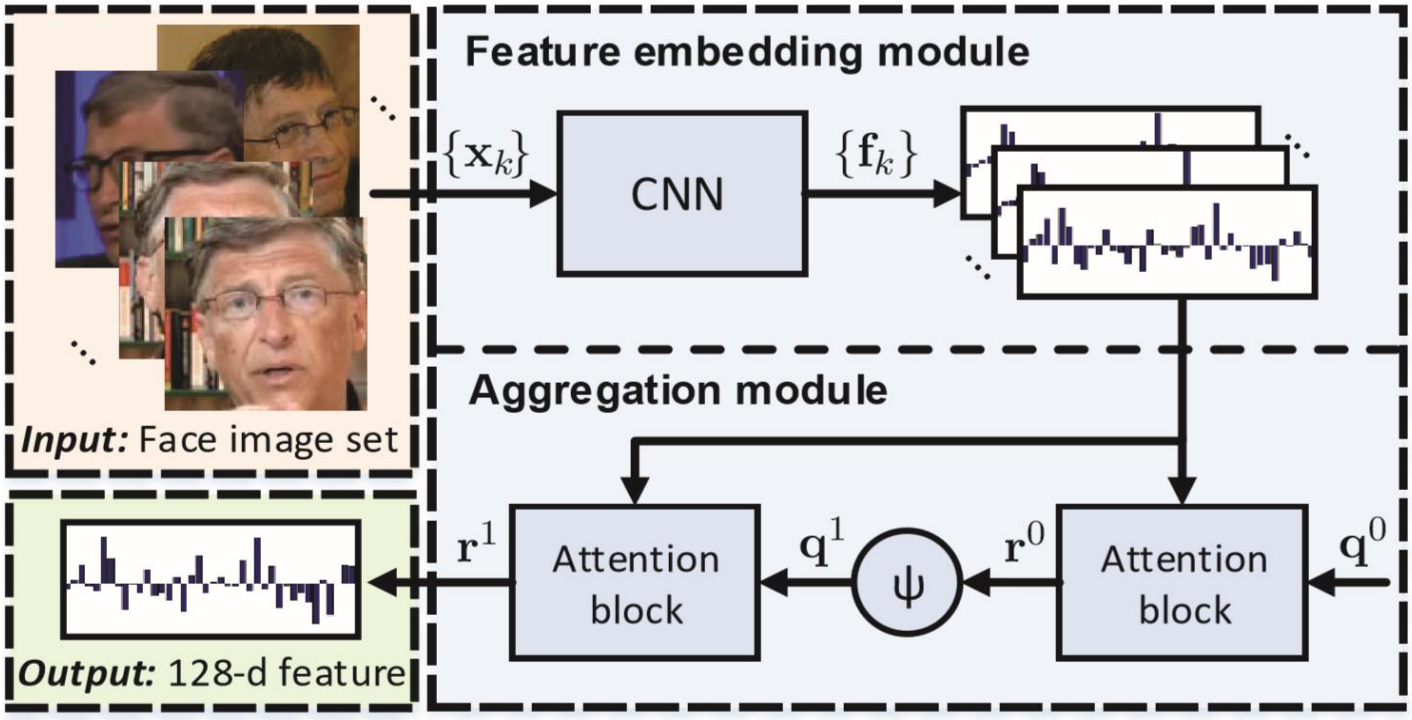
# Average Pooling

$$x_n = 1/M_n \sum_{m=1}^{M_n} (x_n(m))x_n(m)$$

# Learnable Pooling

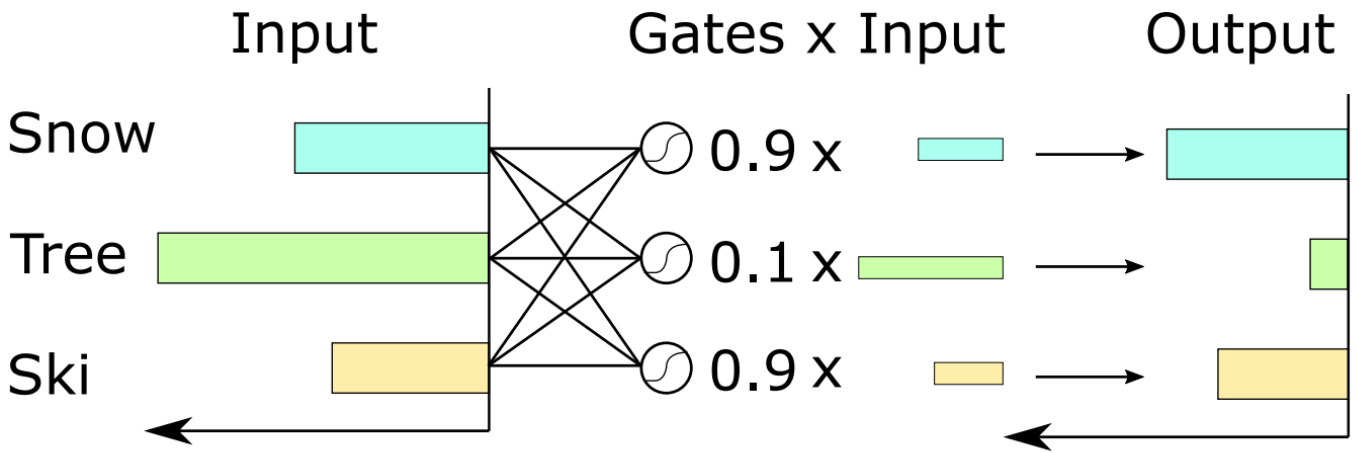
$$x_n = \sum_{m=1}^{M_n} w(x_n(m))x_n(m)$$

# Neural Aggregation Module



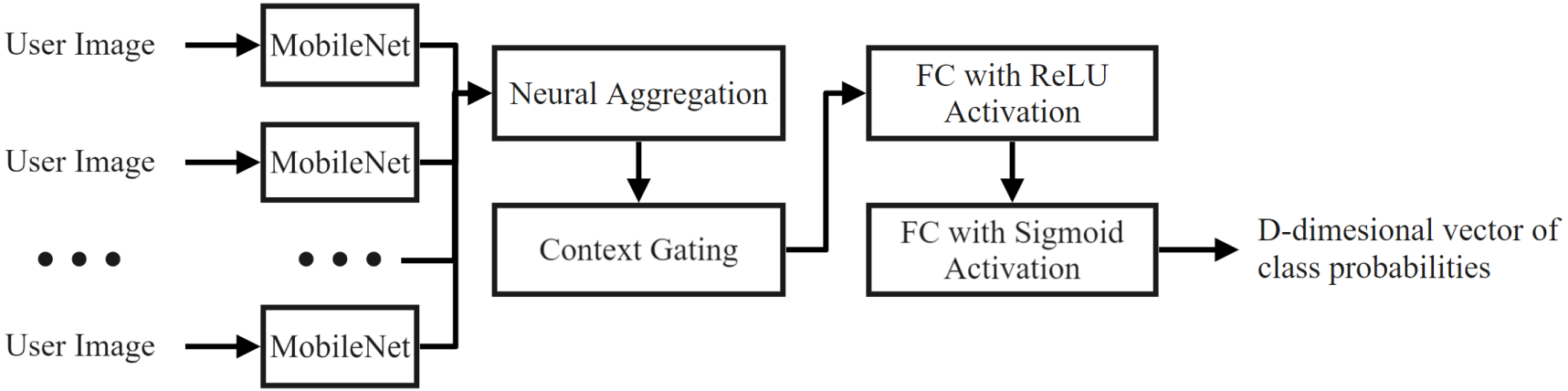

Source: https://arxiv.org/abs/1603.05474

# Context Gating Module




Source: https://arxiv.org/abs/1706.06905

# Proposed Approach



# Training Pipeline

Pretrained MobileNet v1

Transfer learning

Neural aggregation training

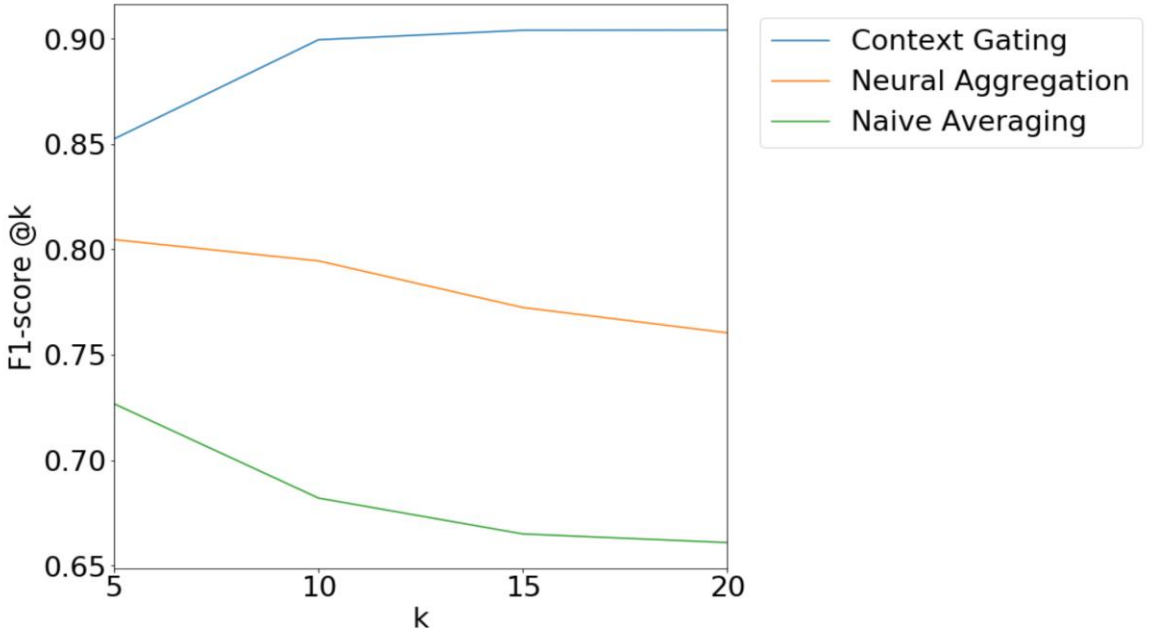
+


# Dataset

547700 entries
66519 unique users
28237 unique items
1000 categories


"Amazon Products"

# Dependence of F1-measure on the number of recommendations k



# Recall@k and Precision@k for different aggregation strategies

| k | Aggregation | Recall @k | Precision @k |
|---|---|---|---|
| 5 | Average | 0.704867 | 0.749925 |
| | Neural Aggregation | 0.772574 | 0.839458 |
| | Neural Aggregation + Context Gating | **0.792203** | **0.922438** |
| 10 | Average | 0.797340 | 0.595867 |
| | Neural Aggregation | 0.901716 | 0.710123 |
| | Neural Aggregation + Context Gating | **0.91846** | **0.881151** |
| 15 | Average | 0.815469 | 0.561431 |
| | Neural Aggregation | 0.932418 | 0.710123 |
| | Neural Aggregation + Context Gating | **0.942565** | **0.868210** |
| 20 | Average | 0.820141 | 0.553453 |
| | Neural Aggregation | 0.943513 | 0.636783 |
| | Neural Aggregation + Context Gating | **0.947498** | **0.864384** |

# Conclusions:

1. The neural aggregation with context gating outperforms the naive averaging method by up to 34%

# Future work:

1. Mobile recommender system
2. Comparing the performance of the proposed approach with traditional recommender system


# Thank you!