

A large teal-colored shape with a wavy, irregular bottom edge, resembling a stylized wave or a decorative header element, positioned at the top of the slide.

# Deep Neural Networks for YouTube Recommendations

YouTube深度学习推荐系统

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# 大纲 / Outline

- Challenge
- Method
- Experiment
- Conclusion

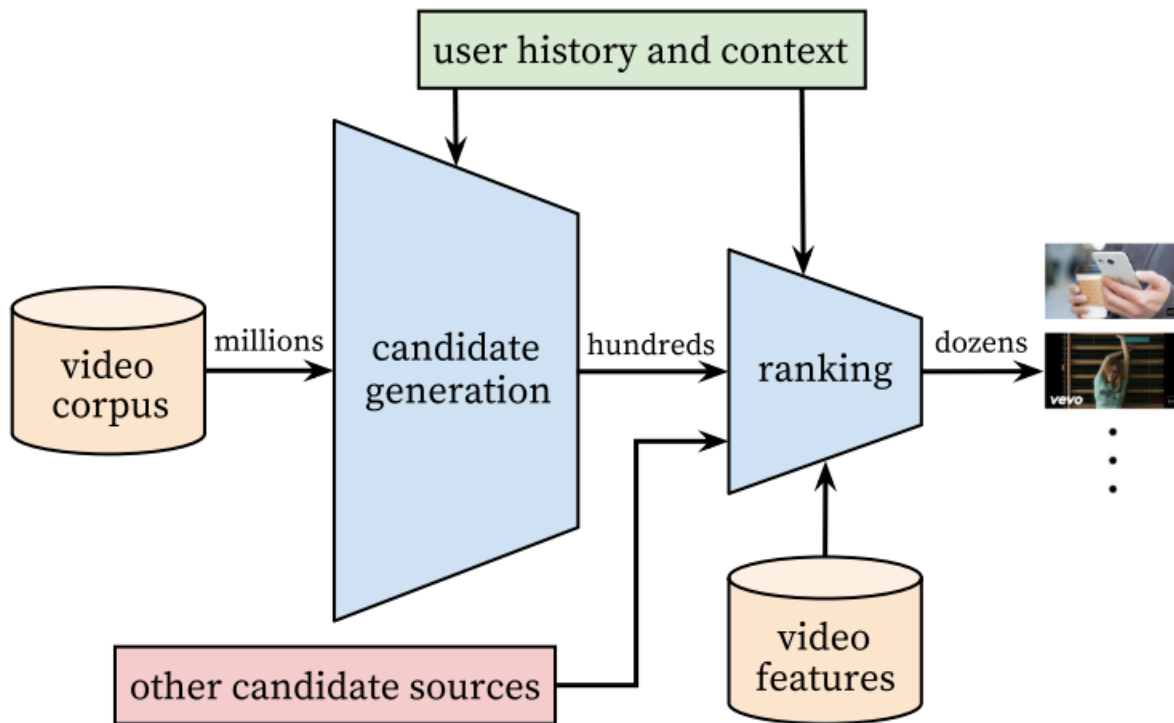


## Challenge

- Scale: massive user base and corpus
- Freshness: YouTube has a very dynamic corpus with many hours of video are uploaded per second.
- Noise:
  - Historical user behavior on YouTube is inherently difficult to predict
  - Metadata associated with content is poorly structured



# Method Overview





# Method

## Candidate Generation

### Recommendation as Classification

$$P(\omega_t = i | U, C) = \frac{e^{v_i u}}{\sum_{j \in V} e^{v_j u}}$$

$u$ : high-dimensional “embedding” of the user, context pair

$v_j$ : embeddings of each candidate video

$U$ : user

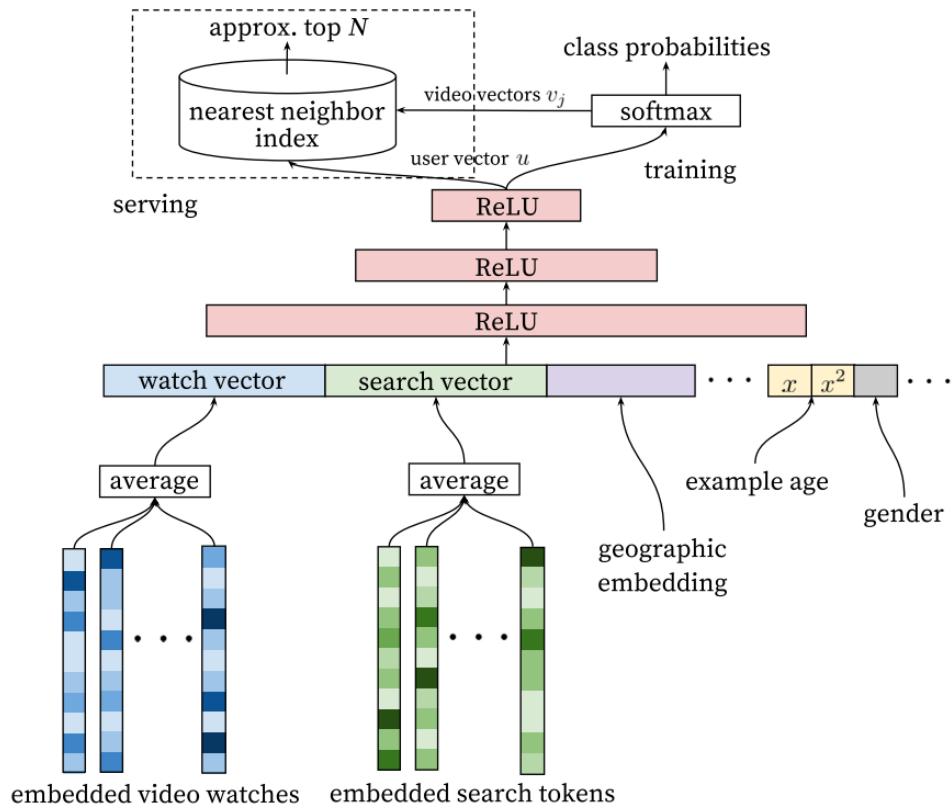
$C$ : content

$V$ : video corpus



# Method

## Candidate Generation





# Method

## Candidate Generation Heterogeneous Signals

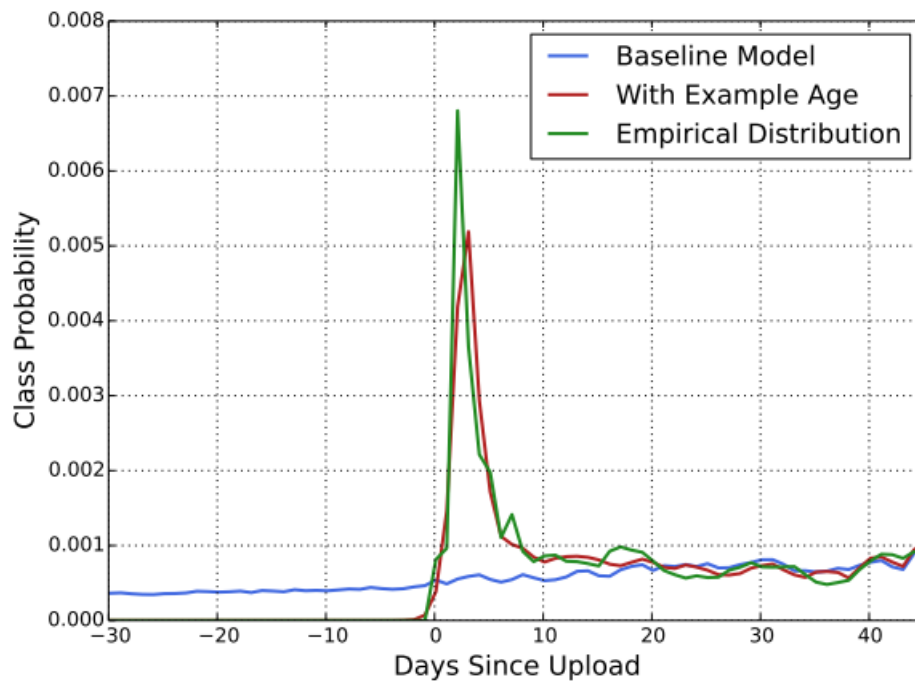
- Watch history
- Search history
- Demographic features
- Other features: logged-in state



# Experiment

## Candidate Generation

"Example age"



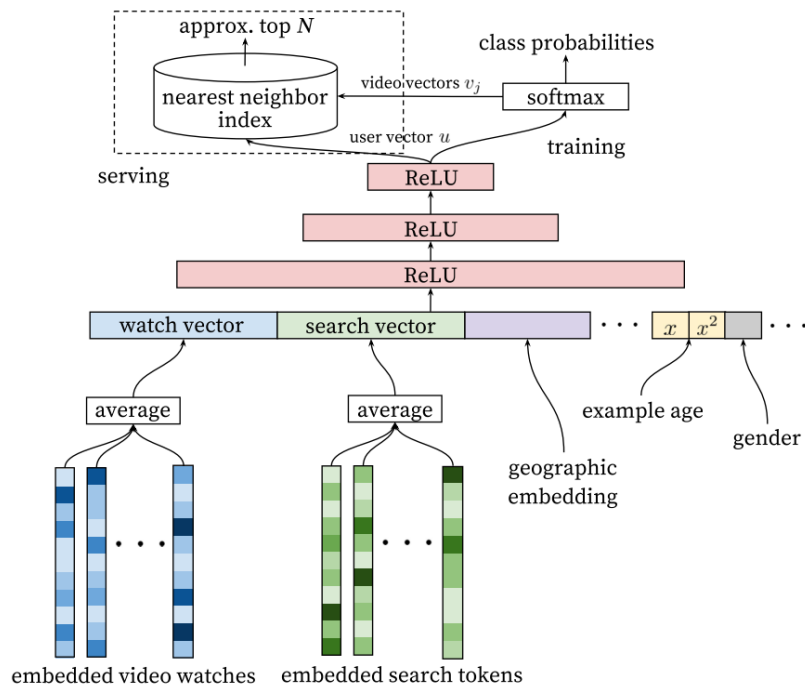




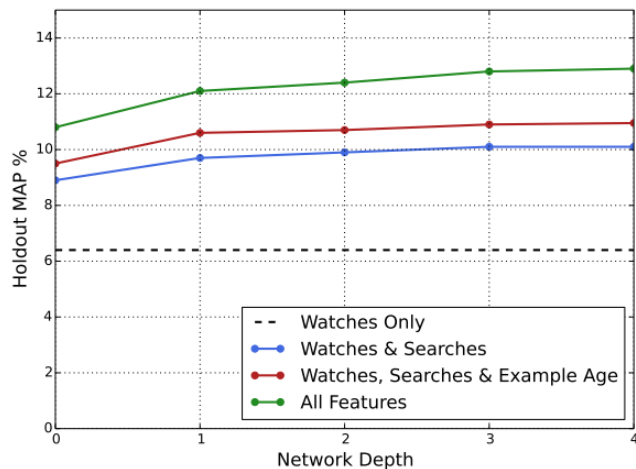
# Experiment

## Candidate Generation

### Experiments with Features and Depth

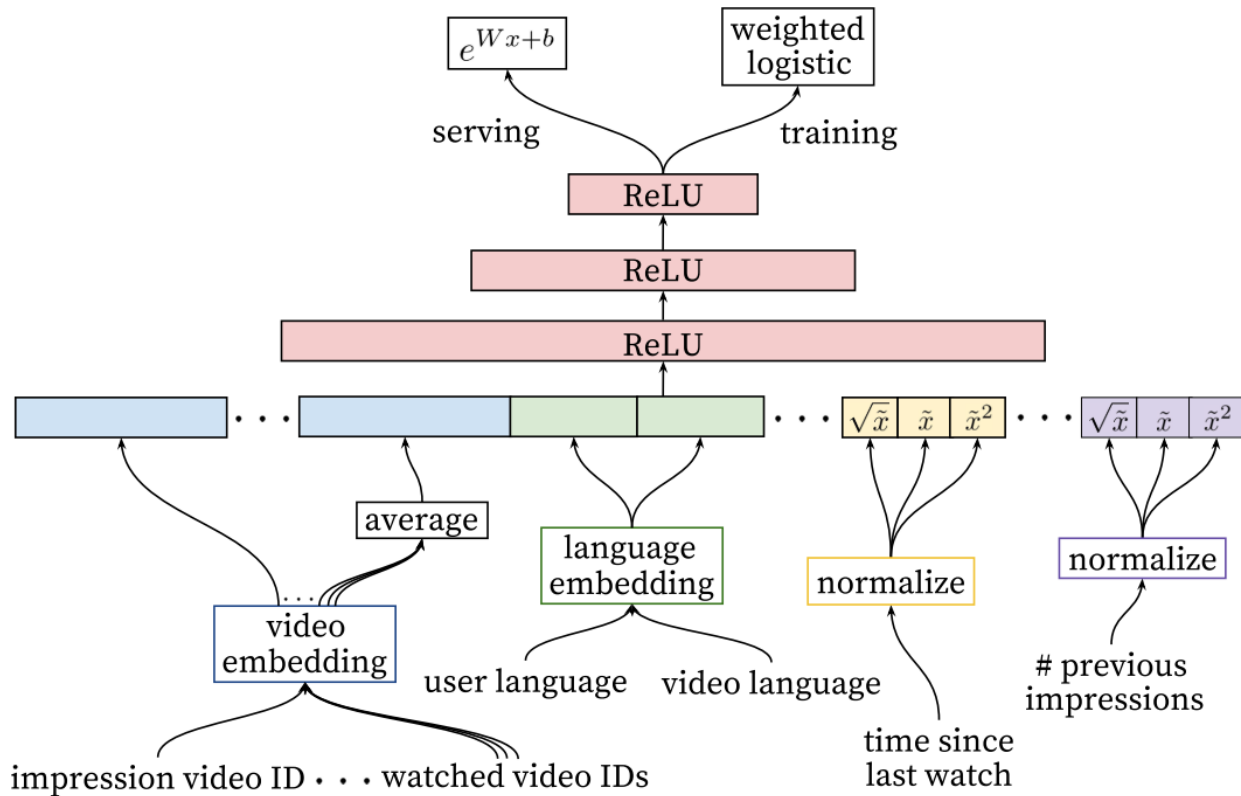


- Depth 0: A linear layer simply transforms the concatenation layer to match the softmax dimension of 256
- Depth 1: 256 ReLU
- Depth 2: 512 ReLU  $\rightarrow$  256 ReLU
- Depth 3: 1024 ReLU  $\rightarrow$  512 ReLU  $\rightarrow$  256 ReLU
- Depth 4: 2048 ReLU  $\rightarrow$  1024 ReLU  $\rightarrow$  512 ReLU  $\rightarrow$  256 ReLU





# Method Ranking





# Method

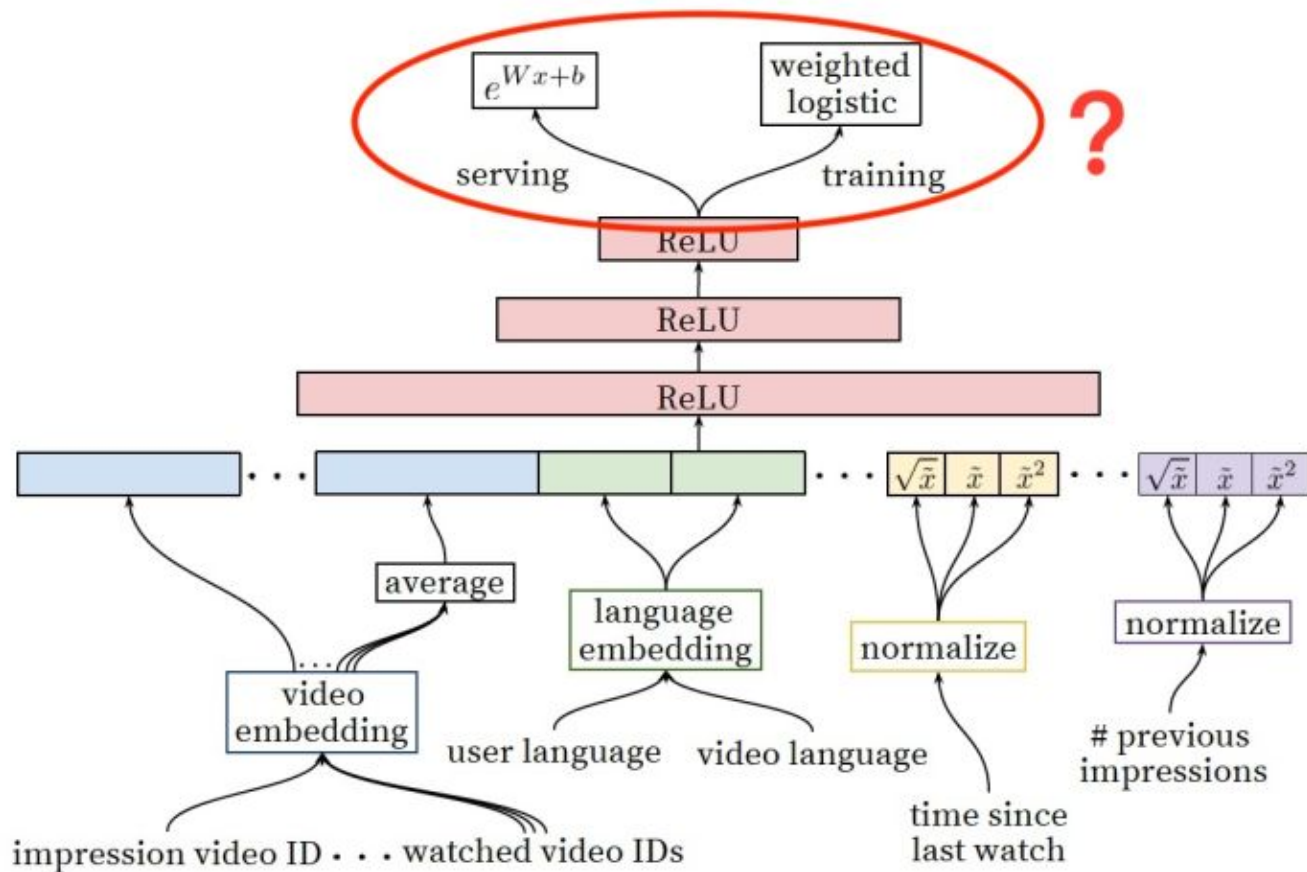
## Ranking

### Feature Engineering

- impression video ID embedding
- watched video IDs average embedding
- language embedding
- time since last watch
- previous impressions



# Method Ranking





## Conclusion

- Two-stage approach
- Final ranking objective
- Negative samples