



Google ML Winter Camp
谷歌机器学习应用冬令营

Comment Grading for Recommendation

A Solution to Cold Start Issue

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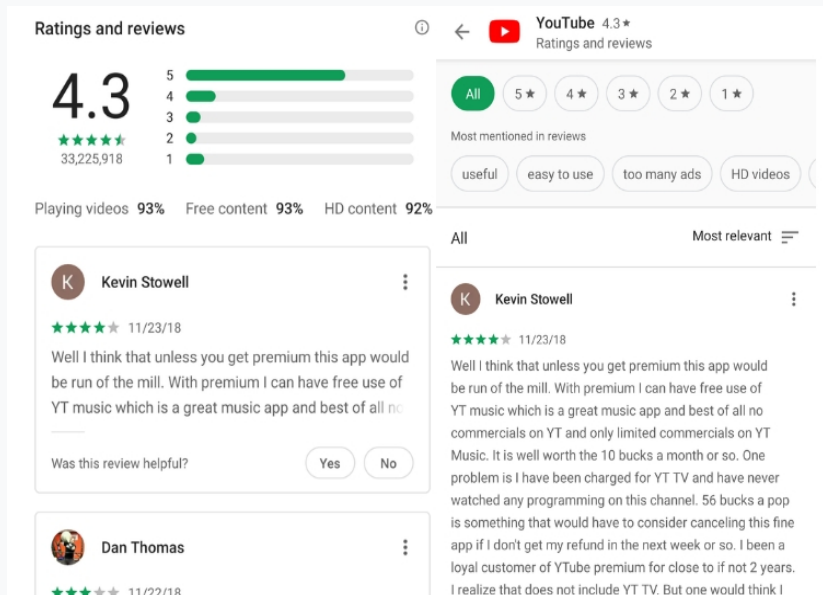
- Group Name: Turiss
- Group Members:
 - Hengyi Wang
 - Yaofeng Sun
 - Jiaqi Xi
- We are undergraduates from EECS, PKU



Hengyi Wang

Introduction

- Real world setting
- Deficiency of users' grading
- Cold Start Issue



Problems

- Score prediction
- Helpfulness prediction
- Ranking algorithm for recommendation

Preliminaries

- Dataset: **Amazon Fine Food Reviews**
- Helpfulness measurement

$$h = \text{sigmoid}(\text{Helpfulness_Denominator}) \cdot \frac{\text{Helpfulness_Numerator}}{\text{Helpfulness_Denominator}}$$

- Model error

$$\epsilon = E_{x \sim D}(y_{\text{pred}} - y_{\text{true}})$$

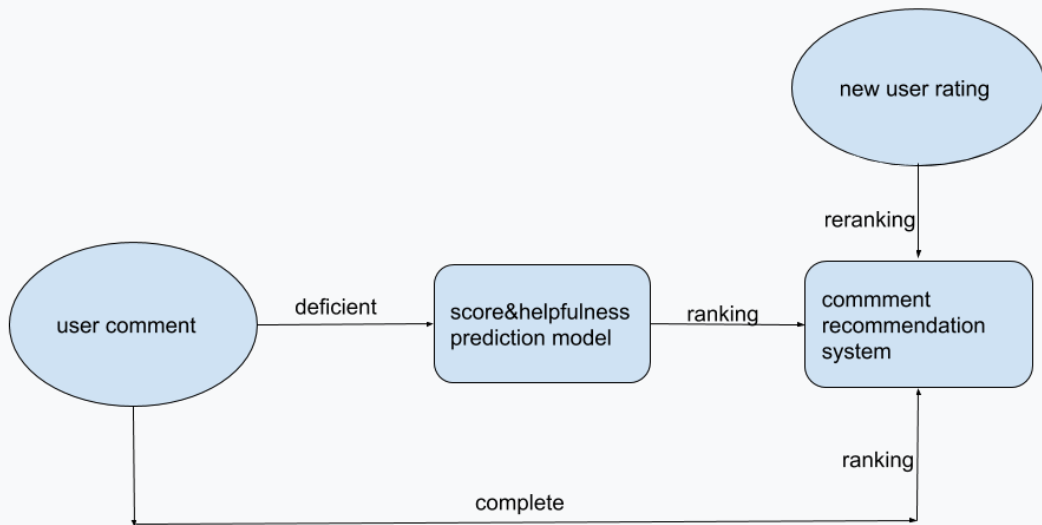
- System error

$$\Delta = \text{rank}_{\text{pred}} - \text{rank}_{\text{true}}$$

HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text
1	1	5	1303862400	Good Quality Dog Food	I have bought several of the Vitality canned dog food produc
0	0	1	1346976000	Not as Advertised	Product arrived labeled as Jumbo Salted Peanuts...the peanut
1	1	4	1219017600	"Delight" says it all	This is a confection that has been around a few centuries. It
3	3	2	1307923200	Cough Medicine	If you are looking for the secret ingredient in Robitussin I bel
0	0	5	1350777600	Great taffy	Great taffy at a great price. There was a wide assortment of
0	0	4	1342051200	Nice Taffy	I got a wild hair for taffy and ordered this five pound bag. Th
0	0	5	1340150400	Great! Just as good as the expensive brands!	This saltwater taffy had great flavors and was very soft and c
0	0	5	1336003200	Wonderful, tasty taffy	This taffy is so good. It is very soft and chewy. The flavors a
1	1	5	1322006400	Yay Barley	Right now I'm mostly just sprouting this so my cats can eat th
0	0	5	1351209600	Healthy Dog Food	This is a very healthy dog food. Good for their digestion. Als
1	1	5	1107820800	The Best Hot Sauce in the World	I don't know if it's the cactus or the tequila or just the unique

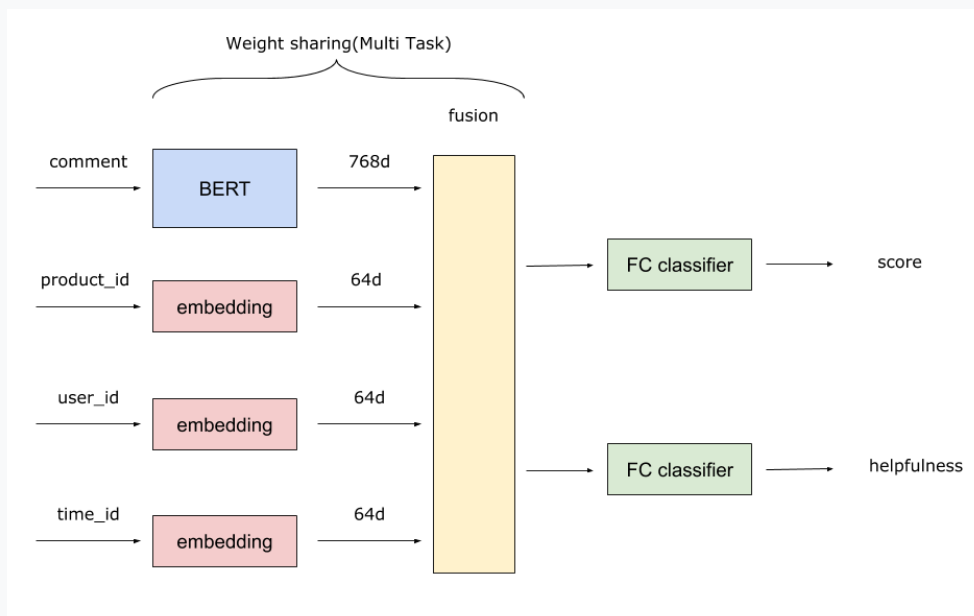
Project Overview

We established an interactive system for joint grading and recommendation of user comments



Grading Prediction

- Input: ProductID, UserID, ProfileName, Text
- Output: Score, Helpfulness
- Baseline: Neural Classifier based on LSTM
- Our Method: Multimodal Multitask Classification via Fine Tuning on BERT



Experiment

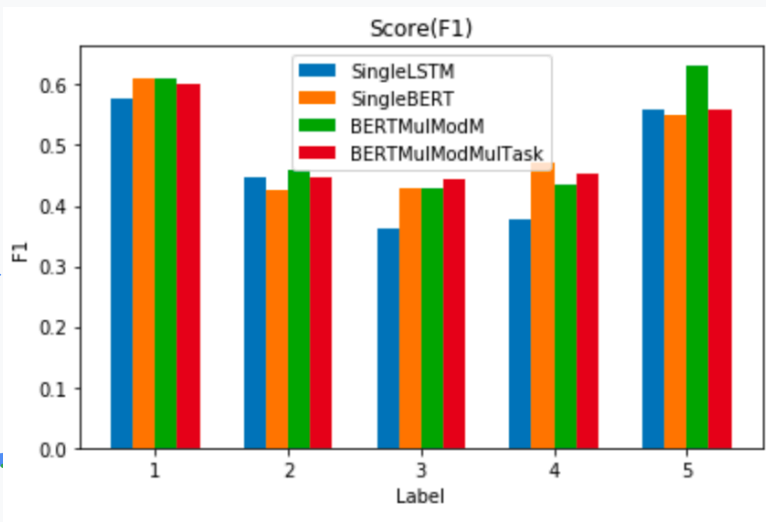


Table 1: Model Comparison

Model	Score (Acc.)	Helpfulness (Acc.)
SingleLSTM	47.4%	33.3%
SingleBERT	51.3 %	35.9 %
BERT MulMod	51.5 %	35.9 %
BERT MulMod MulTask	50.7 %	34.4 %

Experiment

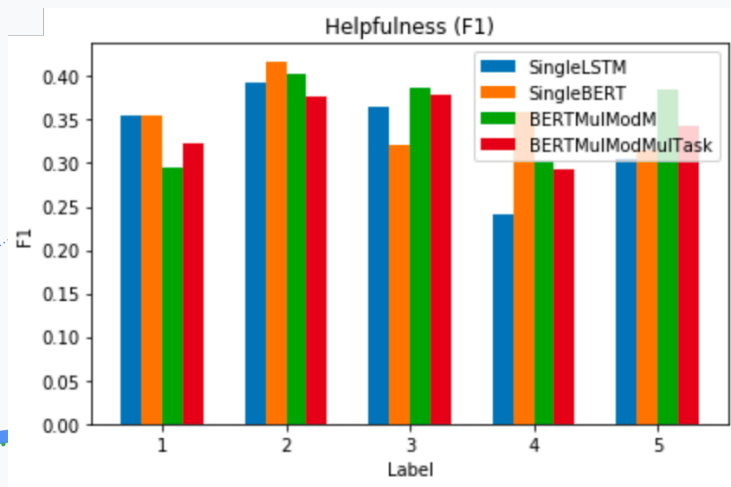
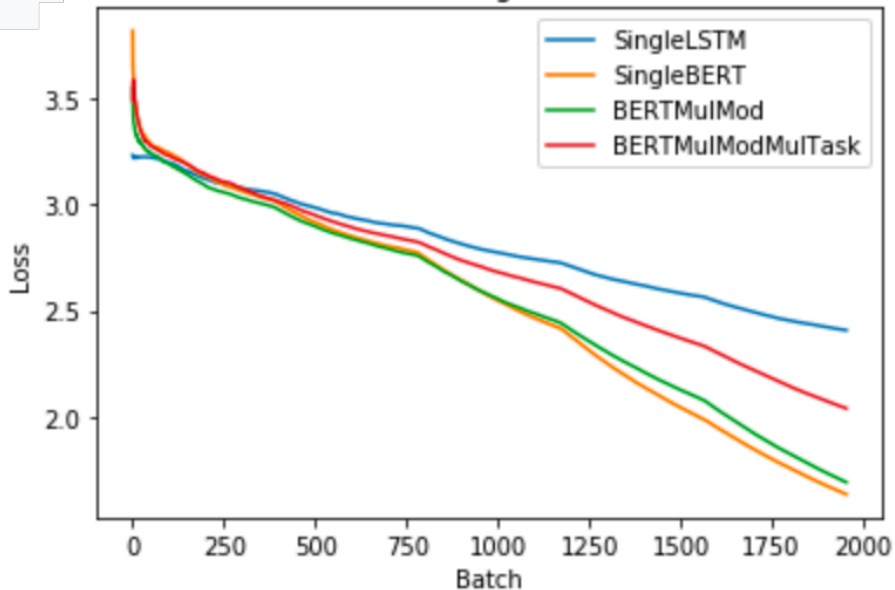


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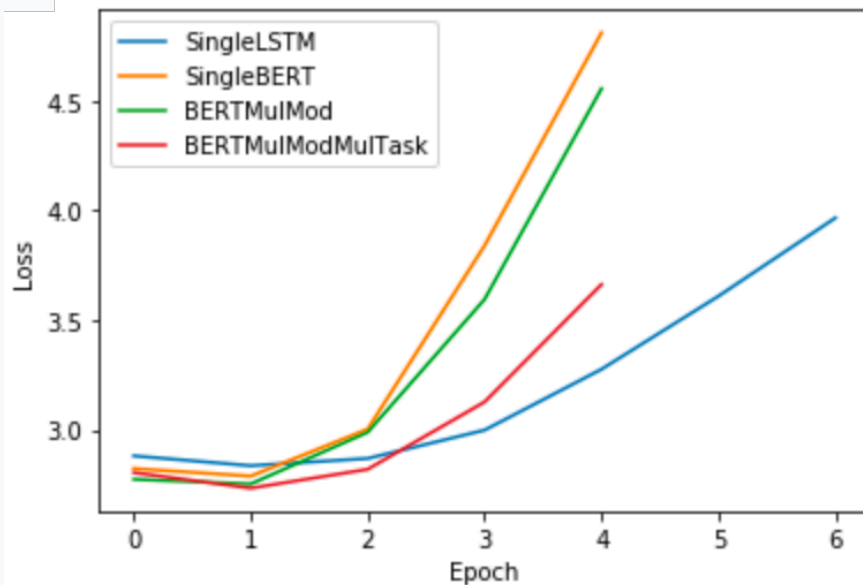
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Experiment

Training Loss



Test Loss

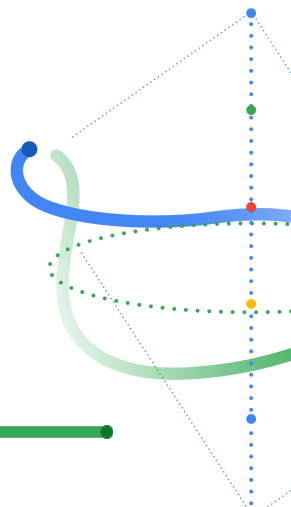


Recommendation System Design

- Principles: sorting according to grading, score as 1st key&usefulness as 2nd key
- Baseline: always append the new comment
- Issue: Cold Start of ranking leads to system error
- Ideal system: always insert the new comment to the right place
- Hybrid system: trade off between model prediction and user rating

19	quaker oatm	1	3
20	a back i orde	1	3
21	i order stuff	1	3
22	i though i w	5	2
23	i pick box ge	4	2
24	of 34 k cup	4	2
25	i deserv get	1	2
26	had crave sc	1	2
27	do purchas	4	1
28	give reason	4	1
29	even sale pr	1	1
30	to make edi	1	1

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Design a Hybrid System

- **Notations:**

- x_t : *HelpfulnessNumerator at timestep t*
- y_t : *HelpfulnessDenominator at timestep t*
- h_t : *Helpfulness predicted by system*

- **Initialization:**

- $h_0 = h_{model}$
- $y_0 = \frac{1}{e^2}$

- **Update Rule:**

- $x_{t+1} = x_t + z_t$, where $z_t \sim B(1, h_{true})$
- $y_{t+1} = y_t + 1$

- $$h_{t+1} = \frac{x_{t+1}}{y_{t+1}}$$

- $$h_{t+1} - h_t = \frac{x_{t+1}y_t - x_t y_{t+1}}{y_t y_{t+1}} = \frac{z_t + h_t}{y_{t+1}}$$

Error Analysis

- *Recap ϵ : Error introduced by model prediction*
- *Consider Noise introduced by sampling*

$$\cdot h_{t+1} = \frac{x_{t+1}}{y_{t+1}} = \frac{y_0 h_0 + \sum_{i=0}^t z_t}{y_0 + t}$$

$$\cdot z_t \sim B(1, h_{true})$$

$$\cdot \epsilon_n = \sum_{t=1}^n (z_t - h_{true}) \sim N(0, \frac{1}{n})$$

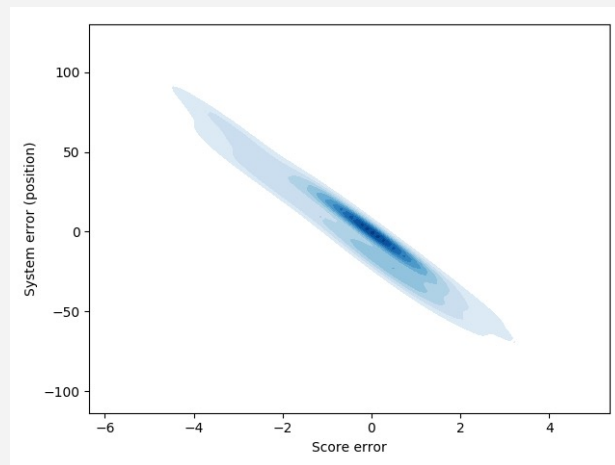
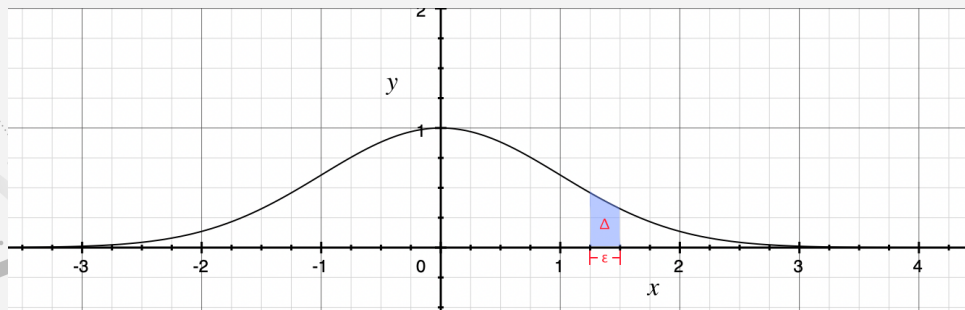
$$\cdot t = y_0 \text{ When } \frac{1}{\sqrt{t}} = \epsilon$$

$$\cdot \text{Let } \epsilon = \frac{1}{\sqrt{y_0}}$$

$$\cdot y_0 = \frac{1}{\epsilon^2}$$

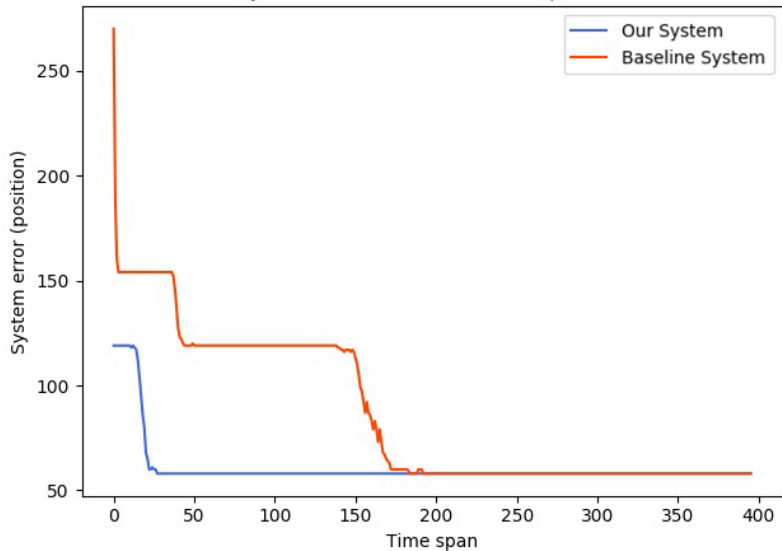
Induced System Error

- Given ϵ , Δ is approximately subjected to a gaussian distribution
- Which variance is proportional to ϵ



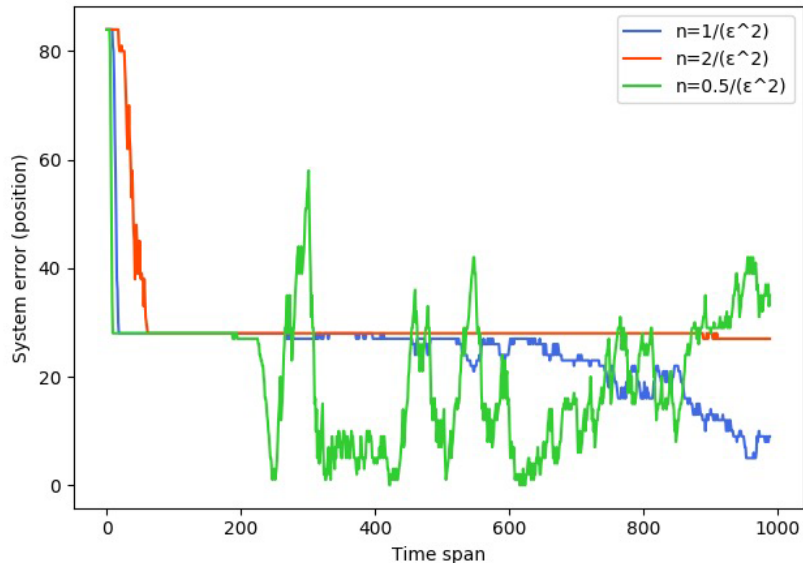
Simulation Results

System rectification rate comparison



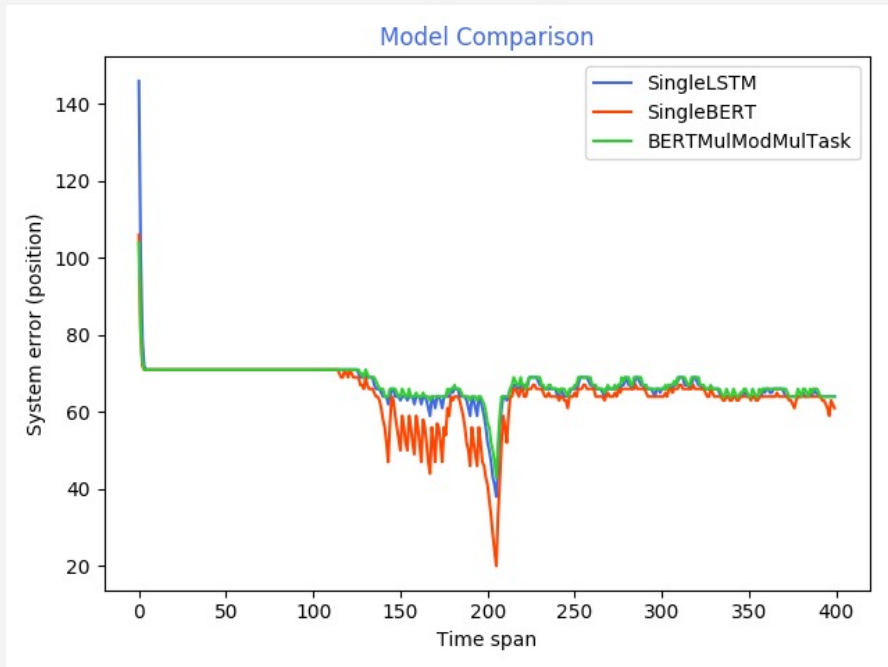
Helpfulness initialization settings

Model Confidence



Denominator initialization settings

Simulation Results



Conclusion and Future Work

- Accuracy of prediction model decides the initial performance of comments ranking
- System dynamics affects the convergence of helpfulness to ground truth
- Fusion module of multimodal classifier can be improved
- Ranking will be more accurate given more fine-grained labels



Reference

<https://github.com/google-research/google-research/tree/master/albert>

provides pretrained ALBERT model

https://tfhub.dev/tensorflow/bert_en_uncased_L-12_H-768_A-12/1

provides pretrained BERT model

<https://www.kaggle.com/rajmehra03/a-complete-text-classfication-guide-word2vec-lstm>

provides baseline models

<https://www.kaggle.com/snap/amazon-fine-food-reviews>

provides raw dataset