

Mining Millions of Reviews: A Technique to Rank Products Based on Importance of Reviews

Kunpeng Zhang, Yu Cheng, Wei-keng Liao, Alok Choudhary
Dept. of Electrical Engineering and Computer Science
Center for Ultra-Scale Computing and Security
Northwestern University

kzh980@eecs.northwestern.edu
yucheng2015@u.northwestern.edu
wkliao@eecs.northwestern.edu
choudhar@eecs.northwestern.edu

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Customer Reviews

- More consumers are shopping online than ever before
- Online retailers allow consumers to add reviews of products purchased
- Customer reviews are more unbiased, honest than product descriptions provided by sellers



Star Rating
31 of 38 people found the following review helpful: ← Helpful votes/Total votes

★☆☆☆☆ **Worst Customer Support Experience Ever -- Do Not Buy!**, August 26, 2010

By [\[Redacted\]](#) 

Amazon Verified Purchase [\(What's this?\)](#)

This review is from: **Panasonic Lumix DMC-FH20 14.1 MP Digital Camera with 8x Optical Image Stabilized Zoom and 2.7-Inch LCD (Red) (Electronics)**

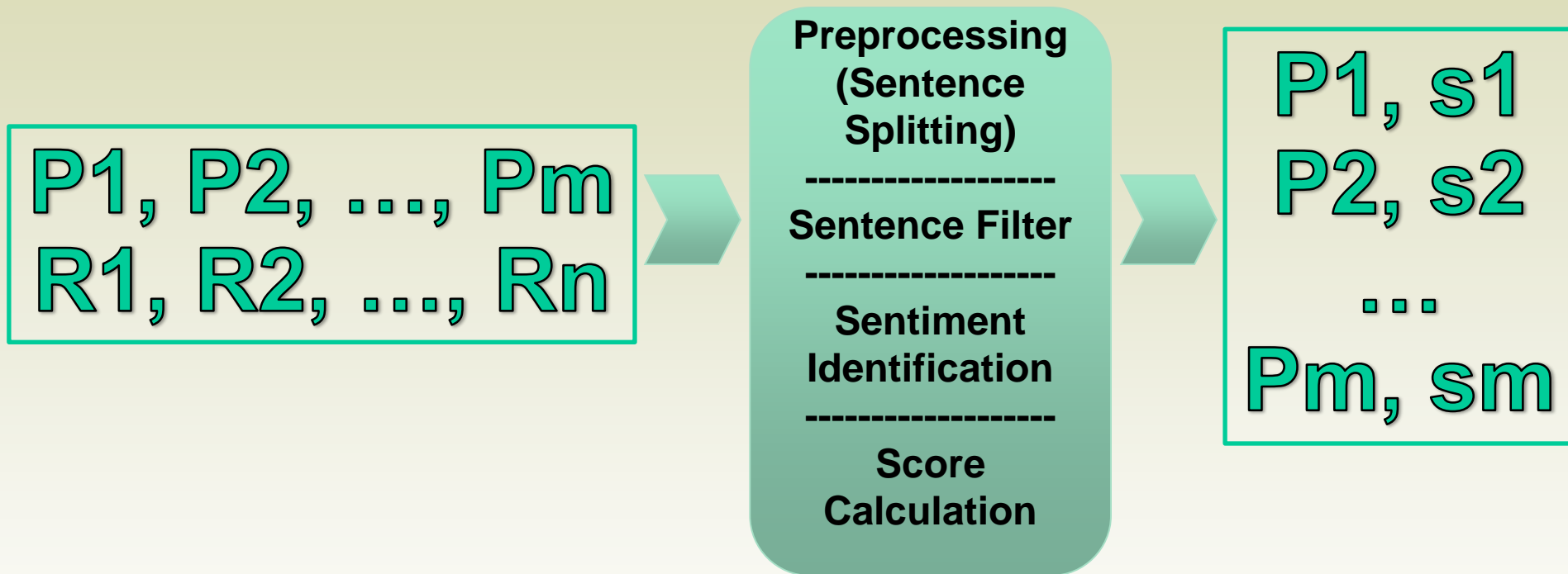
I suggested this camera to my daughter based upon online reviews. She was extremely excited about the camera and the pictures looked really good. She used it twice within the first 6 weeks she had it. The second time using it, a piece of flimsy plastic that sits in front of the lens fell off. Panasonic / Lumix had me send it it (on my dime) and I clearly specified that it was not dropped. I sent it in and received no acknowledgement that they'd received it and / or where it may now be in their process. After waiting 2 weeks and calling them, they informed me that it was the user's fault and I could receive a broken camera back (I assume they'd return the broken camera on their nickel) or pay \$128 to fix a 6 week old, never dropped \$160 camera. I informed them that this is the single worst customer support experience I have ever encountered. Panasonic / Lumix, as promised...here is your review. I will never buy another product from you and hopefully I may influence a few others out there. You had a chance...

Help other customers find the most helpful reviews

Was this review helpful to you?

[Report abuse](#) | [Permalink](#)

System Architecture



Our ranking system assumes that the ranking score is determined by the *review contents, relevance of a review to the product quality, helpful votes and total votes from posterior customers, and posting date and durability of reviews*

Filtering Mechanism

- A relevant sentence is either a overall or feature-based comment on a product.
- Support Vector Machine[Vapnik,1995]
 - Brand-level: Nikon, Canon,...
 - Product-level: product features, product names, keywords(shipping, customer service)
 - Source-level: Amazon.com, retailer, seller...

Product Categories	Recall Rate	Precision rate
SLR Camera	89.53	78.46
TV	91.22	82.86

Feature Keywords

Table 1: Keywords Representing 10 Most Important Product Features for *Digital Camera* and *Television* Domains

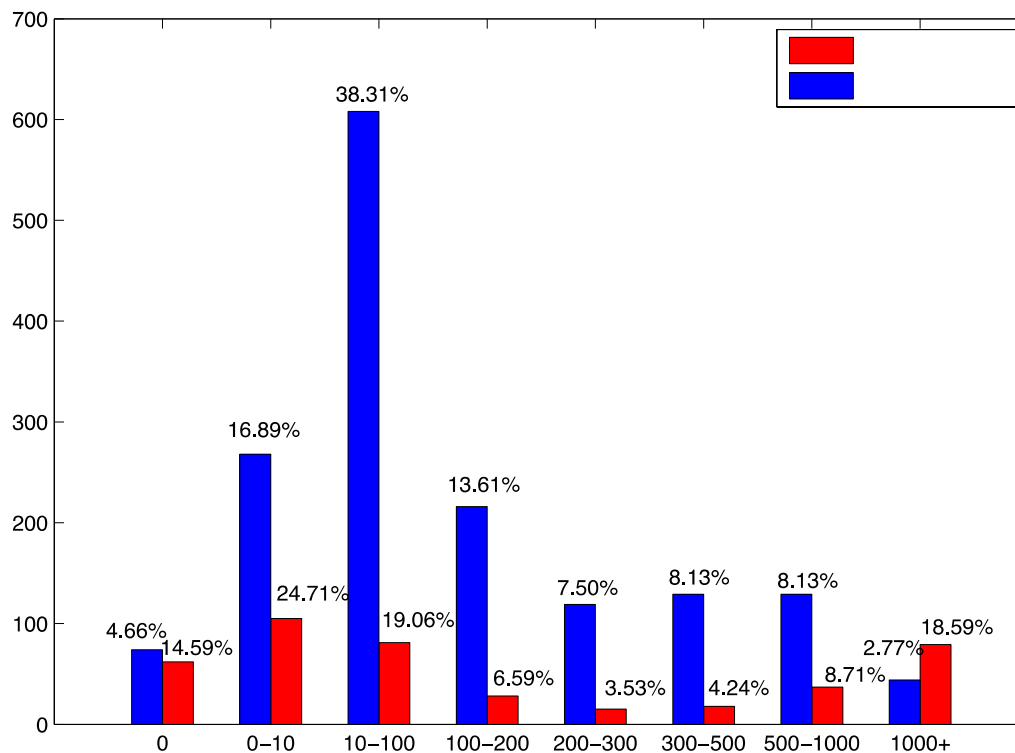
Digital Camera	TV
resolution pixel megapixel	connection input output component video composite video HDMI
lens wide angle normal range	adjustment stretch zoom expand compress
optical zoom optical zoom digital zoom	film-mode frame theatrical 3:2 pull-down motion compensation CineMotion
memory megabytes MB	pip picture-in-picture dual-tuner pop picture-outside-picture two-tuner
burst continuous shutter recovery motion sport	resolution 1080p 1080i 720p
battery batteries power	screen anti-glare reflectivity burn-in shiny screensaver pixel-shift
focus exposure manual iso	picture image picture quality image quality
LCD screen	sound sound quality speaker stereo audio
compression compress jpeg	size height width depth weight inch
flash light	remoter remote gear universal

- Example: features from consumer reports

Review Weight Factors

1. Helpful/Total Votes

Assign higher weights to the reviews with more votes.



$$H(r, p) = \begin{cases} 0 & \text{if } Y(r, p) < 10 \\ \frac{H_v(r, p)}{T_v(r, p)} & \text{if } 10 \leq Y(r, p) \leq 200 \\ \frac{H_v(r, p)}{T_v(r, p)} \cdot \delta & \text{if } Y(r, p) > 200 \end{cases} \quad 7$$

Review Weight Factors (Cont'd)

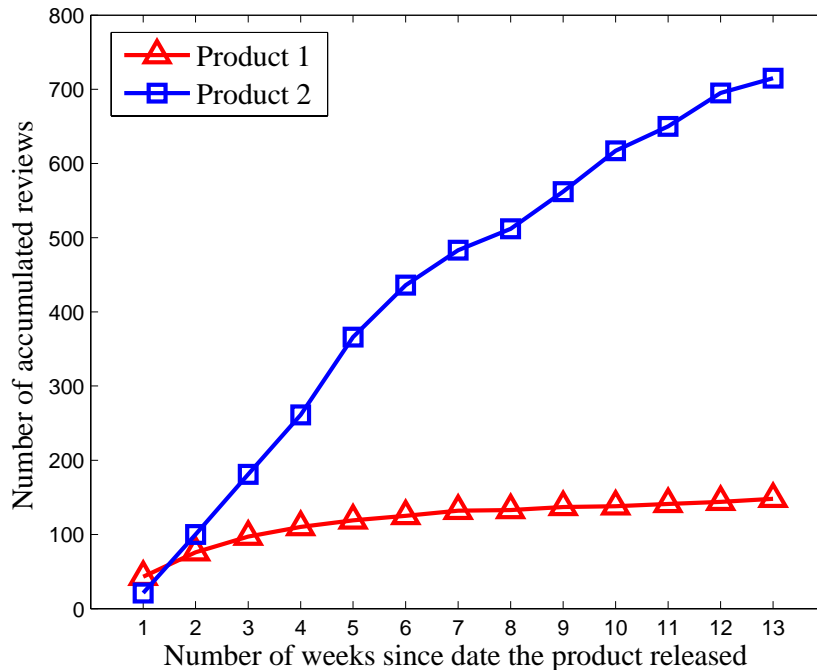
2. Age of Review and Durability

Reviews posted more recently receive higher weights in assessing their importance.

a. Without adding weights to the newer reviews, they would contribute less to the ranking score, as they are “young” and likely receive less votes.

b. The number of reviews for a product released earlier is likely higher than the product released recently. In order to balance the contributions to the ranking scores among the similar products and minimize the effects from large volumes gaps, we reduce the importance of older reviews and increase the weight for newer reviews.

Review Weight Factors (Cont'd)



$$T(r, p) = e^{\beta(t_r - t_0) + d} \quad (3)$$

where $T(r, p)$ is the estimated weight, t_0 is the product p release date, t_r is the published date of review r , β controls the decay rate of $T(r, p)$, and d is an initializing factor. Note

Sentiment Identification

- Use the keyword strategy

{MPQA[1] + our own words → 1974 positive words + 4605 negative words + 42 negation words}

Accuracy: ~80%

- Positive Sentence(PS)
 - *This camera has **great** picture quality and **conveniently** priced.*
- Negative Sentence(NS)
 - *The picture quality of this camera is really **bad**.*
 - *I **don't** like it.*

Scoring Strategy

- Overall Score Function:

$$S(p) = \frac{\sum_{\text{all } r} \text{Polarity}(r, p) \cdot T(r, p) \cdot H(r, p)}{\sum_{\text{all } r} H(r, p) \cdot \sum_{\text{all } r} T(r, p)} \quad (4)$$

where $\text{Polarity}(r, p) = \text{Pos}(r, p) - \text{Neg}(r, p)$. $\text{Pos}(r, p)$ and $\text{Neg}(r, p)$ are the numbers of positive and negative sentences in review r of product p , respectively.

Experiments

- Data
 - Digital camera and TV (\$500-\$700)

Table 2: Statistics of review data and their corresponding sentences for SLR camera and TV within the price range from \$500 to \$700. Symbol '#' represents the number. Symbol '%' represents the percentage.

Category	SLR camera	TV
# of products	252	245
# of reviews	9932	3256
# of sentences	96006	28748
# of irrelevant sentences(filtered out)	3080	1656
# of total votes	108995	21447
# of helpful votes	83829	16983
% of positive sentences	41.39%	39.46%
% of negative sentences	20.37%	21.24%

Experiments (Cont'd)

- Star Rating is not reliable
 - Each reviewer has a different grading standard.
 - The average star rating score for a product with very few reviews is not statistically significant. *For example, 94 out of 191 TVs in the price range of \$800 to \$1000 contain only 1 review.*
 - As observed on Amazon.com, a large number of products share the same star rating scores, rendering such a rating system meaningless.

Experiment Results

- Evaluation (Salesrank)
 - The Spearman correlation function

$$\rho(\vec{s}_a, \vec{s}_b) = 1 - \frac{6 \cdot \sum_{all\ i} (s_{ai} - s_{bi})^2}{n(n^2 - 1)}$$

- MAP(Mean Average Precision)

Table 3: Correlations with the Sales Rank generated by different ranking methods under SLR camera category.

Method	Correlation	MAP@10(annotator 1)	MAP@10(annotator 2)
Baseline	0.5140	0.5525	0.5238
S_1	0.5484	0.6214	0.6573
S_2	0.6365	0.8756	0.8926
$S_2(w/Filter)$	0.6380	0.9012	0.9137

Table 4: Correlations with the Sales Rank generated by different ranking methods under TV category.

Method	Correlation	MAP@10(annotator 1)	MAP@10(annotator 2)
Baseline	0.3725	0.4827	0.4659
S_1	0.3752	0.5739	0.5846
S_2	0.5610	0.7525	0.7833
$S_2(w/Filter)$	0.6010	0.8018	0.8406

Experiment Results (Cont'd)

- Effects of Individual Features

Table 5: Individual feature contributions to the overall product ranking.

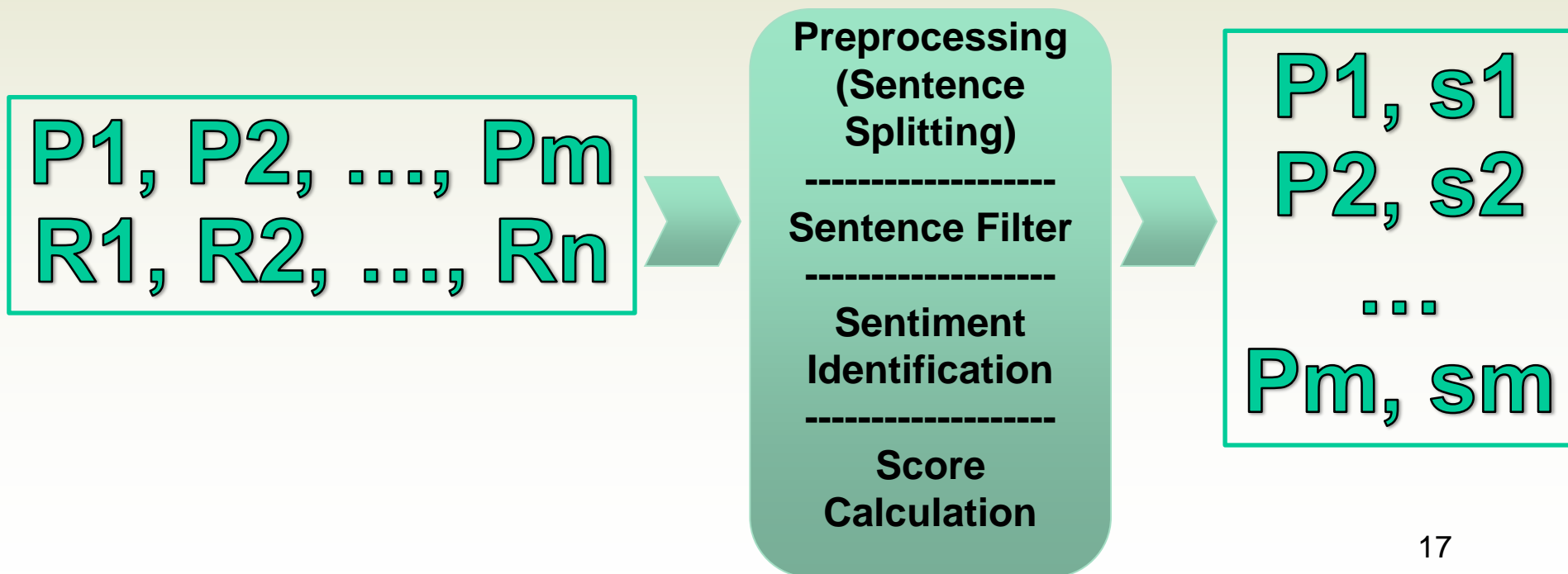
SLR camera	$\rho(\vec{r}_f, \vec{r}_o)$	TV	$\rho(\vec{r}_f, \vec{r}_o)$
Lens	0.8241	Picture Quality	0.7813
Size	0.7411	Size	0.5246
Flash	0.6735	Setup	0.4236
Exposure	0.5919	Input	0.3097
Instruction	0.4309	Control	0.1986
Timer	0.3714	Connect	0.0292
Video	0.3601	Ease of use	0.0021
Battery	0.1696		

Related Work

1. Sentiment analysis [*B. Liu, 2010; B. Pang, 2002*]
2. Extracting product features [*M. Hu, 2004; A. Popescu, 2005*]
3. Review summarization [*M. Hu, 2004, 2006*]

Summary

Scalable technique to mine millions of online customer reviews to rank products



Thank You

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