Where is Your App Frustrating Users?
用户在抱怨App的哪些问题？

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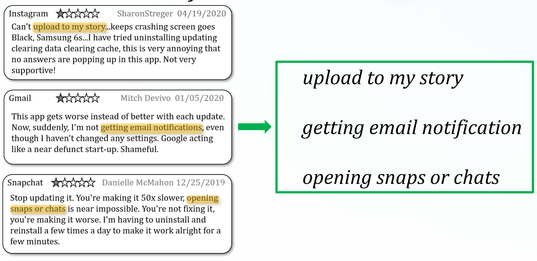
Motivation

- **User Review**
  - *WHAT aspects: The high-level topics/aspects of the reviews, e.g., GUI, compatibility, etc.*
  - *WHERE aspects: The specific App features the users complain about.*
  - *Other aspects: Simple praises, complaints and trivial information.*

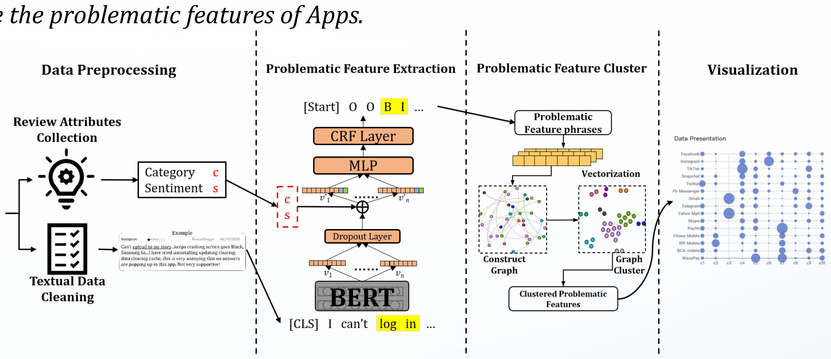
Problematic Feature

Phrases buried in App reviews, which reflect users' complaints about certain App features.



Approach

***SIRA**: A **S**emantic-aware, f**I**ne-grained App **R**eview **A**nalysis approach to extract, cluster, and visualize the problematic features of Apps.*



- **Data Preprocessing**
  - *Textual Data Cleaning*
    - *Sentence Splitting & Non-English Filtering*
    - *Lowercase & Lemmatization & Formatting*
  - *Review Attributes Collection*
    - *App Category*
    - *Review Sentiment*
- **Problematic Feature Extraction**
  - *Named Entity Recognition (NER) task*
  - *BERT encoding review descriptions*
  - *Incorporating review attributes*
- **Problematic Feature Cluster**
  - *Problematic feature vectorization*
  - *Graph constructing*
  - *Graph clustering*
- **Visualization**
  - *y-axis: App name*
  - *x-axis: cluster id*
  - *The size of the bubble*

Evaluation

- **RQ1: Performance on problematic feature extraction**
- **RQ2: Ablation experiment on review attributes**
- **RQ3: Performance on problematic feature cluster**

RQ1

App	Metric	KEFE	Caspar	SAFE	BiLSTM-CRF	SIRA
Instagram	P	40.32%	16.26%	14.17%	80.24%	**83.59%**
	R	60.76%	10.49%	70.61%	71.79%	**85.70%**
	F1	48.29%	12.46%	23.55%	75.58%	**84.53%**
Snapchat	P	42.08%	18.87%	12.95%	78.49%	**82.63%**
	R	58.71%	13.81%	65.60%	74.71%	**84.15%**
	F1	48.70%	15.74%	21.59%	76.47%	**83.30%**
Gmail	P	53.79%	25.60%	22.25%	87.58%	**90.27%**
	R	78.54%	9.88%	**88.21%**	71.74%	84.16%
	F1	63.46%	14.12%	35.49%	78.81%	**87.09%**
Yahoo Mail	P	12.57%	18.26%	12.57%	74.45%	**79.18%**
	R	70.10%	11.85%	70.10%	74.69%	**87.37%**
	F1	21.25%	14.19%	21.25%	74.26%	**83.00%**
BPI Mobile	P	41.92%	20.98%	18.22%	82.58%	**87.37%**
	R	62.75%	9.24%	77.05%	73.53%	**85.07%**
	F1	50.13%	12.51%	29.44%	77.63%	**86.13%**
Chase Mobile	P	36.98%	17.53%	12.17%	77.23%	**80.32%**
	R	52.85%	13.38%	64.85%	68.43%	**84.59%**
	F1	43.16%	15.03%	20.44%	72.31%	**82.26%**
Overall	P	42.79%*	19.14%*	15.51%*	80.40%	**84.27%**
	R	63.50%*	11.27%*	73.94%**	72.48%*	**85.06%**
	F1	51.05%*	14.13%*	25.62%*	76.15%*	**84.64%**

Compared to SIRA, statistical significance $p - value < 0.05$ is denoted by **, and $p - value < 0.01$ is denoted by *.

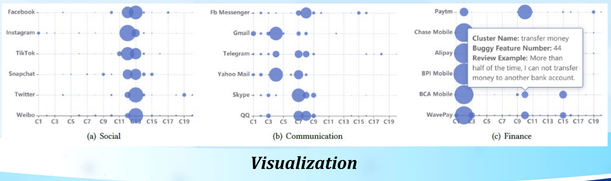
RQ2

App	Metric	BERT -CRF	BERT +CAT -CRF	BERT +SEN -CRF	BERT +Attr -CRF
Instagram	P	82.46%	**84.08%**	83.78%	83.59%
	R	80.39%	85.60%	85.50%	**85.70%**
	F1	81.34%	**84.73%**	84.56%	84.53%
Snapchat	P	**84.58%**	83.82%	83.38%	82.63%
	R	81.49%	83.31%	**85.31%**	84.15%
	F1	82.89%	83.48%	**84.23%**	83.30%
Gmail	P	88.33%	89.30%	**90.59%**	90.27%
	R	78.37%	83.43%	83.50%	**84.16%**
	F1	82.99%	86.16%	86.86%	**87.09%**
Yahoo Mail	P	75.92%	76.67%	78.23%	**79.18%**
	R	83.72%	83.72%	86.09%	**87.37%**
	F1	79.54%	79.94%	81.86%	**83.00%**
BPI Mobile	P	84.87%	85.92%	85.52%	**87.37%**
	R	78.09%	84.94%	82.60%	**85.07%**
	F1	81.25%	85.32%	83.96%	**86.13%**
Chase Mobile	P	78.24%	80.26%	80.05%	**80.32%**
	R	77.59%	82.19%	83.74%	**84.59%**
	F1	77.73%	81.11%	81.76%	**82.26%**
Overall	P	82.59%	83.73%	83.95%	**84.27%**
	R	79.69%	83.88%*	84.31%*	**85.06%***
	F1	81.10%	83.78%**	84.10%**	**84.64%***

Compared to BERT-CRF, statistical significance $p - value < 0.05$ is denoted by **, and $p - value < 0.01$ is denoted by *.

RQ3

App	Metric	LDA	K-Means	SIRA
Instagram	ARI	0.10	**0.30**	0.29
	NMI	0.72	0.78	**0.84**
Snapchat	ARI	0.19	0.13	**0.32**
	NMI	0.80	0.72	**0.85**
Gmail	ARI	0.18	0.07	**0.45**
	NMI	0.73	0.58	**0.82**
Yahoo Mail	ARI	0.42	**0.47**	0.41
	NMI	0.81	**0.83**	0.82
BPI Mobile	ARI	0.44	0.10	**0.59**
	NMI	0.83	0.58	**0.89**
Chase Mobile	ARI	**0.38**	0.21	0.26
	NMI	0.81	0.79	**0.82**
Overall	ARI	0.21	0.14	**0.38**
	NMI	0.57	0.62	**0.77**



Visualization