

Relationships among Features in Top Ranked Apps

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Motivation. In the paper, SAFER considers two relationships among features from descriptions. Two features are treated either the same (in the same cluster) or different (in two different clusters) in this study. we do not consider other complex relationships among features. To explore the relationships among features in reality, we try to explore the percentages of independent features and inter-dependent features in some typical apps in this technical report, i.e., top ranked apps.

Approach. We download the descriptions of top 10 ranked free and paid apps from Google Play. These 20 apps are considered as the typical apps, since they attract millions of users and have higher user ratings and download times. The descriptions are partitioned into sentences, and two authors manually pick out the feature-describing sentences by an open discussion. For the selected feature-describing sentences, they further classify them into independent features and inter-dependent features. By counting their numbers and percentages, we can know the relationships among features in practice.

Result. Table I and Table II show the details of the top 10 free apps and paid apps respectively. For each app, we show the identified feature-describing sentences with some keywords in red font, and the ids of independent features and inter-dependent features.

For the top 10 free apps, we find that there are 4 apps containing inter-dependent features. In the 4 apps, the percentages of inter-dependent features are 50%, 60%, 100% and 50%. On the whole, the percentage of inter-dependent features is 26%. Meanwhile, the percentage of independent features is 74%.

For the top 10 paid apps, there is one app whose description do not contain feature-describing sentences. In the rest 9 apps, there are only 2 apps containing inter-dependent features, whose percentages are 67% and 57% respectively. For the paid apps, we find that the percentage of inter-dependent features is 14% and the percentage of dependent features is 86%.

Considering both top 10 ranked free apps and paid apps, we can see that dependent features take the most percentage (74% in free apps and 86% in paid apps). Our assumption is based on the independent features. As a result, our assumption is reasonable and could reflect the reality to a great extent.

In addition, we find that there is a big difference between free app descriptions and paid app descriptions. The descriptions of paid apps are usually long with a good structure. Some common items are often contained in the paid app descriptions, i.e., some important things should be read before purchase, frequently asked questions, notes, and contact

information. In contrast, free apps usually do not contain such information.

Conclusion. Most features are dependent features in the top ranked apps. Assumption based on dependent features is reasonable and credible.

Table I. Details of top 10 free apps

Id	App name	feature	Independent features id	Inter-dependent features id
1	B612 - Selfiegenic Camera	1. Over 300 million users worldwide use B612 to achieve incredible selfies using live beautification adjustments . 2. Express yourself daily through fun stickers and amazing AR filters that make glamour shots effortless and add life to boring backgrounds. 3. Chat like you're in a cartoon with Play!	1 2 3	--
2	SmartNews	1. Smart Mode -- Streamlined, clutter-free, and optimized for mobile readability . 2. Offline Reading -- Lightning fast load times fetch the news so you can read without an Internet connection. 3. Easy to Use -- Flip through categories and scroll articles with one finger . Our clean UI gets out of the way of your reading. 4. Customizable -- Set the categories you want , in the order you want. Add additional news channels for specific blogs, newspapers and magazines that matter to you.	1 2	3 depends on 4
3	LINE : ディズニー ツムツム	1. Appeared simple puzzle game that will be joined together to collect the popular stuffed TSUM TSUM (Tsumutsumu) at Disney store in LINE! 2. Mickey Mouse and Donald Duck, everybody loves Disney characters such as Winnie the Pooh is studded! 3. How to play the lead very easy .	1 2 3	--
4	ドッキリ神回避-脱出ゲーム	1. Stage looks fun , such as a cartoon! 2. Free of simple , escape (escape), guessing game.	1 2	--
5	星のドラゴンクエスト	1. infinite character Mei King! 2. vast star-shaped map which can also be scaling and rotation! 3. simple and profound skill gauge Battle! 4. Up to four multiplayer! 5. successive series events held!	1 2 3 4 5	--
6	Yahoo!知恵袋 無料 Q&A アプリ	1 Now the topic of the Q & A is seen soon! C7 ranking" 2 Sweet and sour love of trouble is a lot of beleaguered lamb " Glitter Answers " 3 The popular Q & A is delivered in PUSH notification! 4 Doubts and worries are easily Contributions! Immediately confirm the answer-reply with PUSH. 5 Secret question you do not want known to man is secretly questions anonymously. 6 Customize the home screen to suit your interests	1 2 3 4 5 6	--
7	LINE ぶるぼん	1. rules are simple! 2. Customized wallpaper and carpets. 3. Nice gifts get be!	1 2 3	--
8	LINE Free	1. Make Group Calls with 200 People	2	1 depends on 3

	Calls & Messages	<ol style="list-style-type: none"> 2. Keep Your Things Close with Keep 3. Free voice and video calls: 4. Instant messaging anywhere: 5. A full-featured social networking service: 6. Group chats: 7. Find new expressions in the Sticker Shop: 8. Stay informed with LINE official accounts: 9. Get connected to new apps: 10. Make international calls with LINE Out: 	7 8 9	1 dependents on 5 6 dependents on 1 10 dependents on 3 3 dependents on 5 4 dependents on 5
9	SNOW - Selfie, Motion sticker	<ol style="list-style-type: none"> 1. Take a fun video with live face effects and send it to friends 2. Send a video note instantly while chatting and invite friends to a group chat 3. Add a video to Story to share your moments with friends 4. Friends can view your video only once. No more worries for ridiculous selfies 	--	2 dependents on 1 3 dependents on 1 4 dependents on 1 4 dependents on 2
10	Yahoo! News	<ol style="list-style-type: none"> 1. Our editing team will bring you the latest news 24/7. 2. We provide easy and fun to read articles from the entertainment section. 3. You will also find the latest weather forecast, the stock market, and the operation status of trains. 4. We will alert you real-time so you won't miss out on the latest news. 5. By setting your current location, Yahoo! News will deliver the latest news within the area. 6. We will deliver you news on hot topics in the morning, day, and night. You can customize the time of the delivery. 7. Swipe to change the news category, scroll down to see more news with a different UI. 8. We will alert you real-time on breaking news using the push feature. 9. You can always check out the latest news on your smartphone home screen by setting the widget for Yahoo! News. 10. Share news with friends through mail, social networks, Facebook, Twitter, LINE or any other app you have installed. 	2 3 5 7 10	6 dependents on 1 1 dependents on 9 4 and 8 are the same

Table II. Details of top 10 paid apps

Id	App name	feature	Independent features id	Inter-dependent features id
1	slot バジリス ク～甲賀忍法帖～絆	Do not contain features in app description		
2	Video & TV SideView プレ ーヤープラグイ ン	<ol style="list-style-type: none"> 1. viewing from outside anywhere 2. throughout your entire home anywhere viewing 3. Wireless outing transfer 	3	2 dependents on 1
3	SLOT 魔法少女 まどか☆マギカ	<ol style="list-style-type: none"> 1. Save feature (save the play result / You can resume) 2. Weight cut (you can make a cut of the reel weight) 	1 2	

2	<p>3. Configuration changes (you can make the settings selected in the game at the start of any)</p> <p>4. Auto Play (by setting an arbitrary at the end conditions, enables auto-play.)</p> <p>5. Force flag (can be forced to make a small role / bonus flag.)</p> <p>6. Best Pack (above functions are all available.)</p>	<p>3</p> <p>4</p> <p>5</p> <p>6</p>	
4 囚われのバルマ	<p>1. experience love through the screen of the new sense of</p> <p>2. mysterious story</p> <p>3. "his voice" is, full voice</p> <p>4. delicate and beautiful graphics</p> <p>5. Recommended for people</p>	<p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p>	
5 Minecraft Pocket Edition	<p>1. Explore randomly generated worlds and build amazing things from the simplest of homes to the grandest of castles.</p> <p>2. Play in creative mode with unlimited resources or mine deep into the world in survival mode, crafting weapons and armor to fend off the dangerous mobs.</p>	<p>1</p> <p>2</p>	
6 パチスロ ガー ルズ&バンツァー ー オリンピア	<p>1. that the popular anime is to Pachi app!</p> <p>2. liquid crystal production Voice · BGM fully equipped!</p> <p>3. enhance custom function of!</p> <p>4. equipped with a small role coercion or stage selection!</p>	<p>1</p> <p>2</p> <p>3</p> <p>4</p>	
7 ドラゴンクエ スト V 天空の花嫁	<p>1. Fellow conversation</p> <p>2. 360 degree rotation map</p> <p>3. AI combat</p> <p>4. casino</p> <p>5. Sugoroku field</p> <p>6. Slime touch</p>	<p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p> <p>6</p>	
8 パチスロ ロス ト プラネット 2 オリンピア	<p>1. full battle system installing</p> <p>2. liquid crystal production Voice · BGM fully equipped!</p> <p>3. Let's enjoy more apps!</p>	<p>1</p> <p>2</p> <p>3</p>	
9 【パチスロ】ス ーパーブラック ジャック 2	<p>1. Auto Play function</p> <p>2. various settings</p> <p>3. force flag</p> <p>4. history function</p> <p>5. Auto-save function</p> <p>6. Pachi setting</p> <p>7. LCD screen magnifier</p>	<p>1</p> <p>3</p> <p>7</p>	<p>6 depends on 2</p> <p>4 depends on 5</p>
10 Poweramp Full Version Unlocker	<p>1. gapless play</p> <p>2. an unmatched equalization system</p> <p>3. great crossfade</p> <p>4. support for most popular music file format</p>	<p>1</p> <p>2</p> <p>3</p> <p>4</p>	