A Recommendation System for Software Function Discovery

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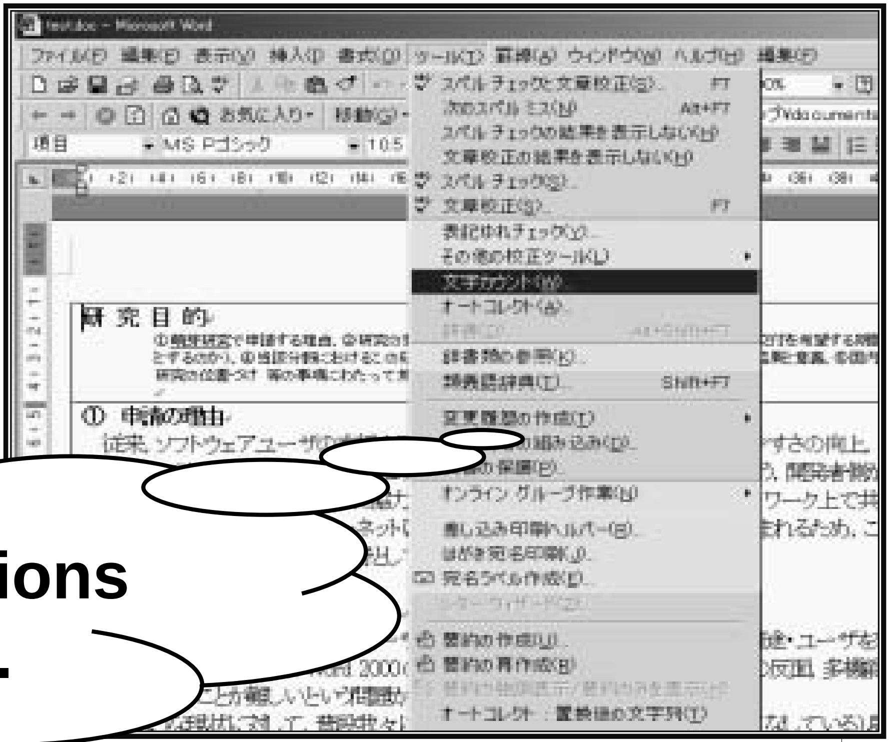
Growth of Software Functions

- Application software is getting more complicated and providing more functions.
  - Total number of menu items (Microsoft Office)
    - **Word 2000: 660**
    - **Word 2002: 772**
    - **Excel 2000: 705**
    - **Excel 2002: 792**
    - **PowerPoint 2000: 565**
    - **PowerPoint 2002: 646**

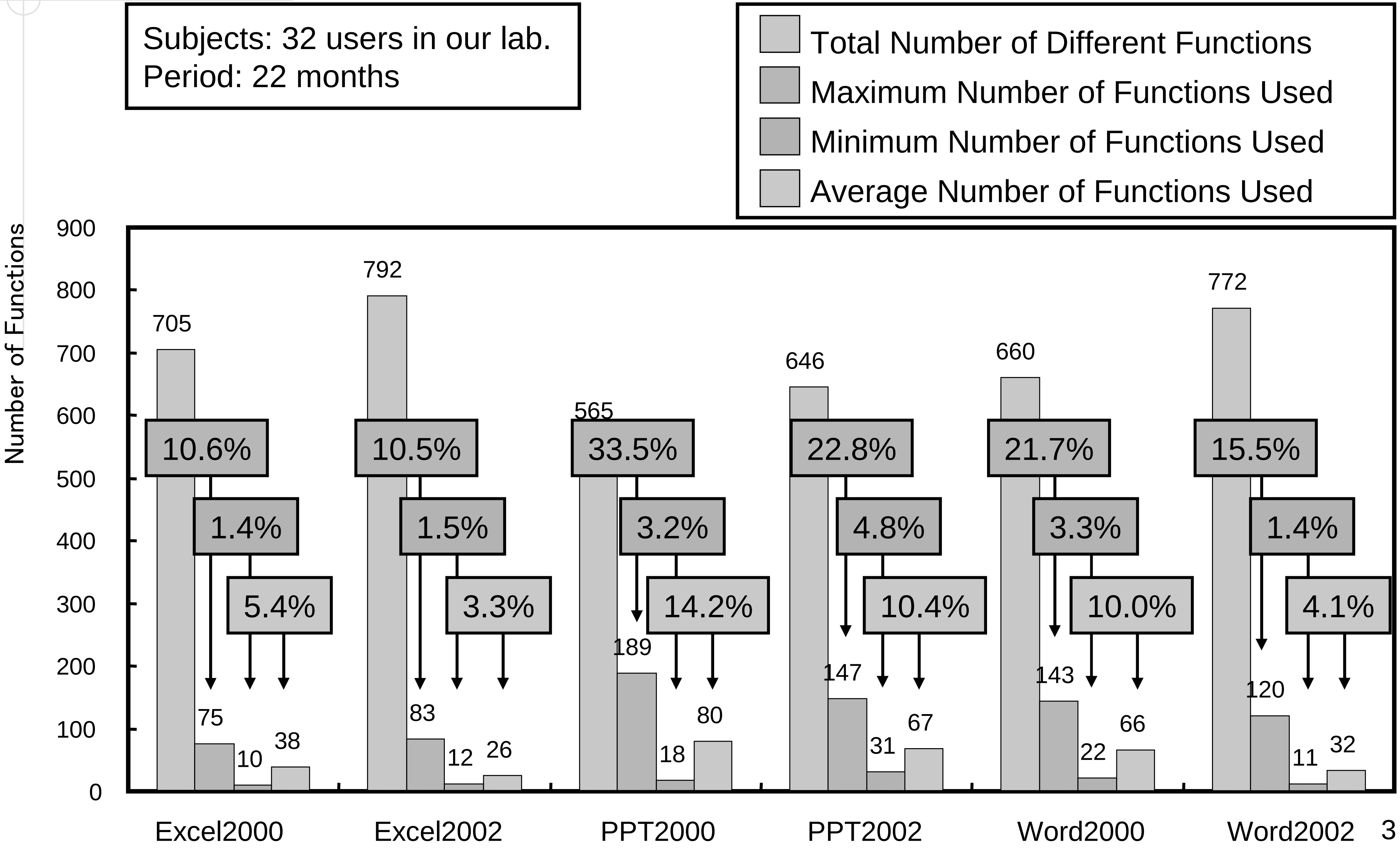

test.doc - Microsoft Word
ファイル(F) 編集(E) 表示(V) 挿入(I) 書式(O) ツール(T) 罫線(A) ウィンドウ(W) ヘルプ(H)
スペル チェックと文章校正(S)... F7
次のスペル ミス(N) Alt+F7
スペル チェックの結果を表示しない(K)
文章校正の結果を表示しない(H)
スペル チェック(S)...
文章校正(G)... F7
表記ゆれチェック(Y)...
その他の校正ツール(L)
文字カウント(W)...
オートコレクト(A)...
辞書類の参照(K)...
類義語辞典(T)... Shift+F7
変更履歴の作成(T)
オンライン グループ作業(N)
差し込み印刷ヘルパー(R)...
はがき宛名印刷(J)...
宛名ラベル作成(L)...
要約の作成(U)...
要約の再作成(B)
オートコレクト：置換後の文字列(T)
研 究 目 的
① 申請の理由

Users can’t find useful functions from too many functions.

Screenshot of MS-Word 2002

Users Could Not Find Some Useful Functions!

Subjects: 32 users in our lab.
Period: 22 months

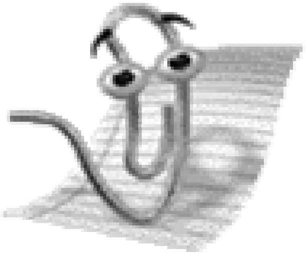


A Recommendation System for Software Function Discovery

- The system recommends individual users a set of candidate functions, which may be useful.
- Our solution is a Collaborative Filtering approach.

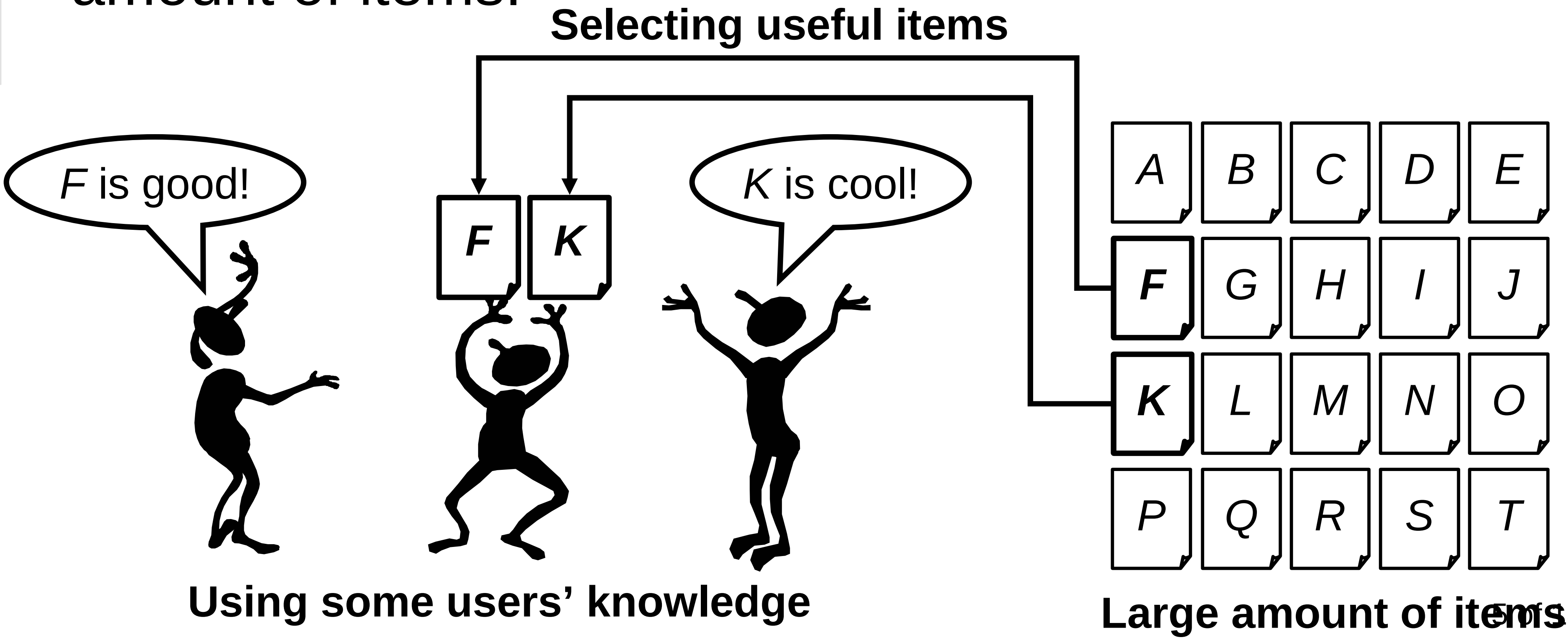
Here’s my recommendation:

Tools → Word Count…	21 pts
Insert → Date Time…	20 pts
Tools → Thesaurus…	18 pts
Insert → Footnote…	18 pts
Tools → Spelling…	17 pts



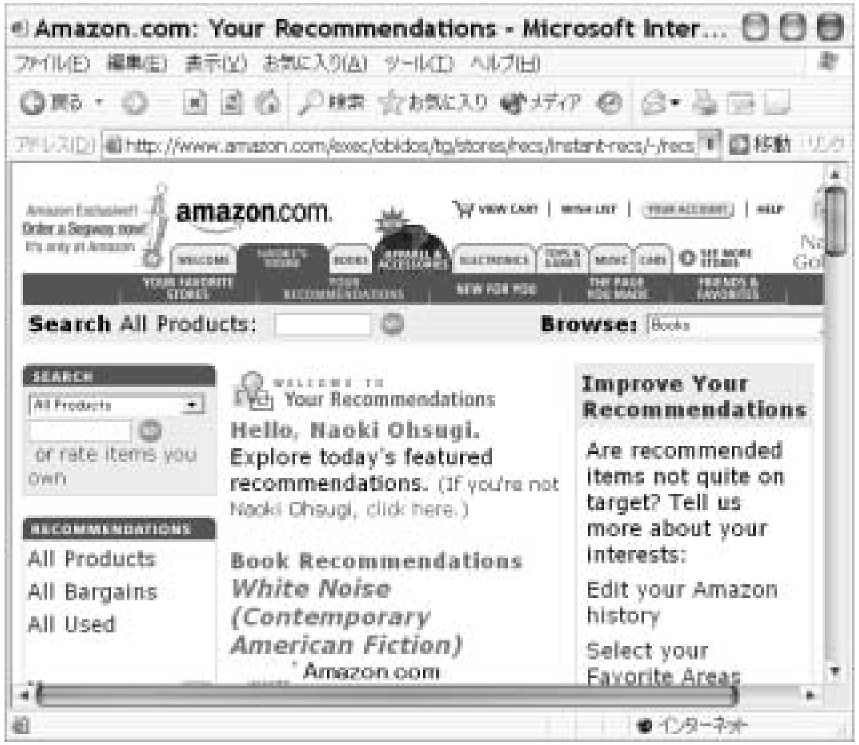
What is Collaborative Filtering (CF)?

- **“Collaborative**” means using some users’ knowledge for filtering.
- **“Filtering”** means selecting useful items from large amount of items.



Voting-based Recommendation Systems with CF

- The systems collect *explicit* votes as users' knowledge.



Amazon.com: Your Recommendations - Microsoft Inter...

http://www.amazon.com/exec/obidos/tg/stores/recs/instant-recs/-/recs

Search All Products:

Browse: Books

WELCOME TO Your Recommendations

Hello, Naoki Ohsugi. Explore today's featured recommendations. (If you're not Naoki Ohsugi, click here.)

Book Recommendations

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Improve Your Recommendations

Are recommended items not quite on target? Tell us more about your interests:

Edit your Amazon history

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(Book recommendation system)

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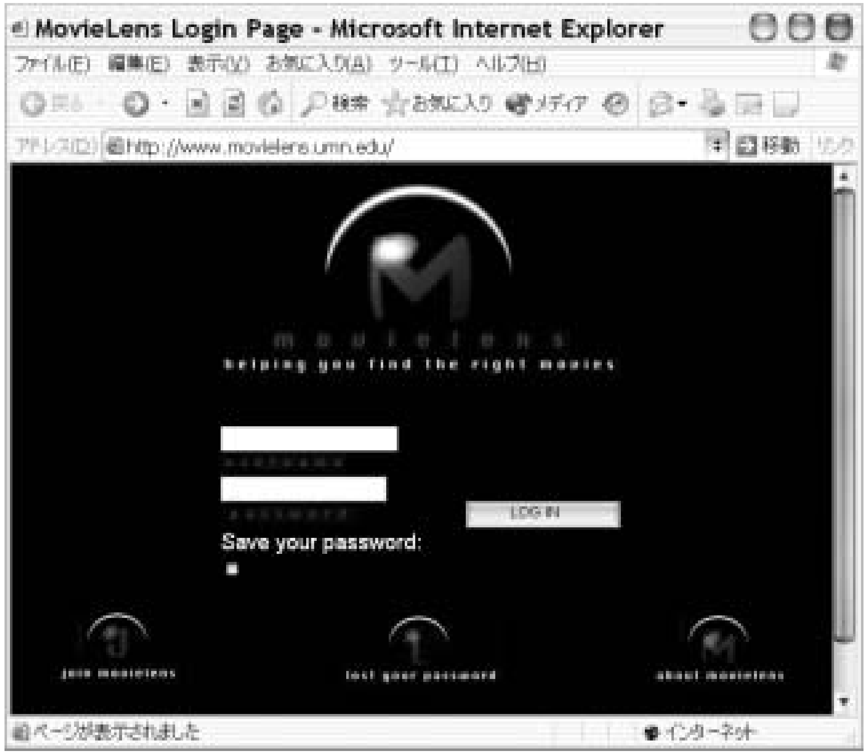


MovieLens Login Page - Microsoft Internet Explorer

http://www.movielens.umn.edu/

movielens

helping you find the right movies

Save your password: □

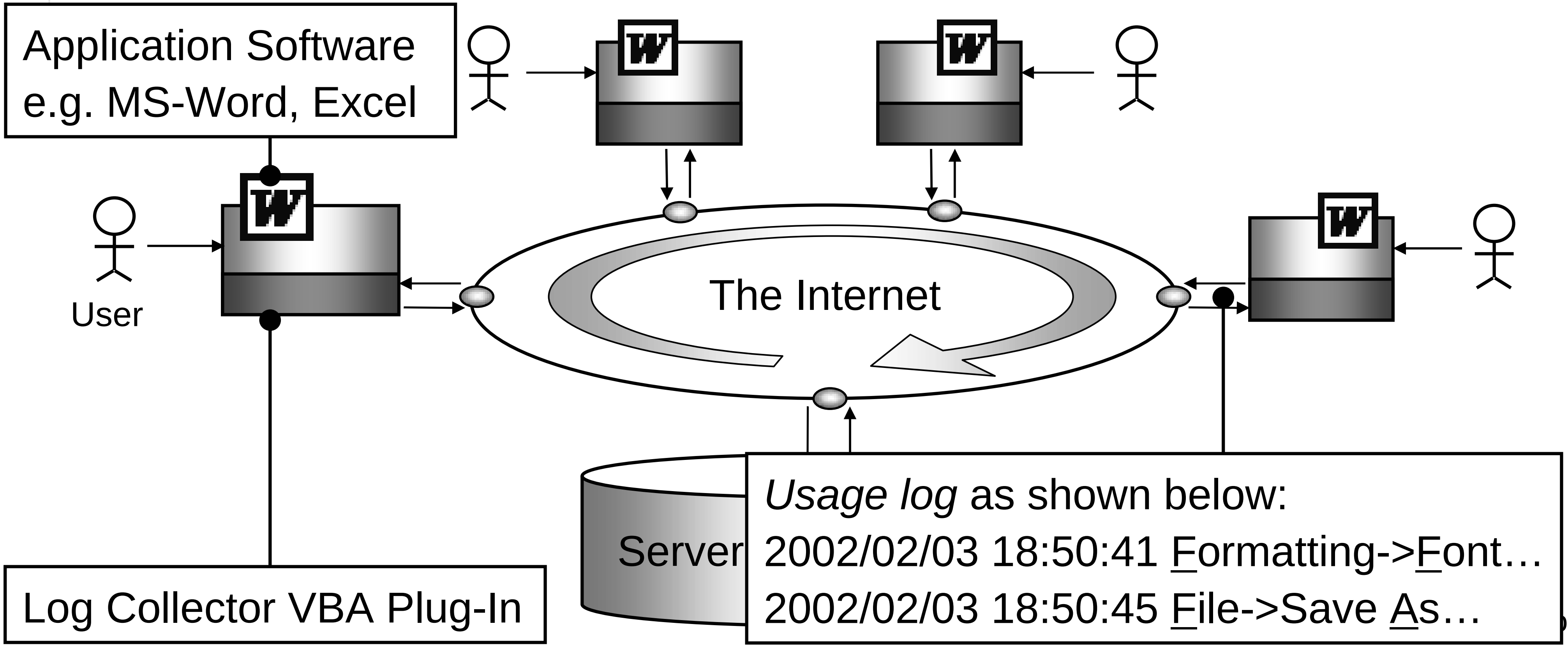
MovieLens

(Movie recommendation system)

http://www.movielens.umn.edu

Logging Usage as Users' Knowledge

- The proposed system automatically collects the records of executed functions (*Usage logs*) as users' knowledge.
- *Usage logs* are collected from some users via the Internet.

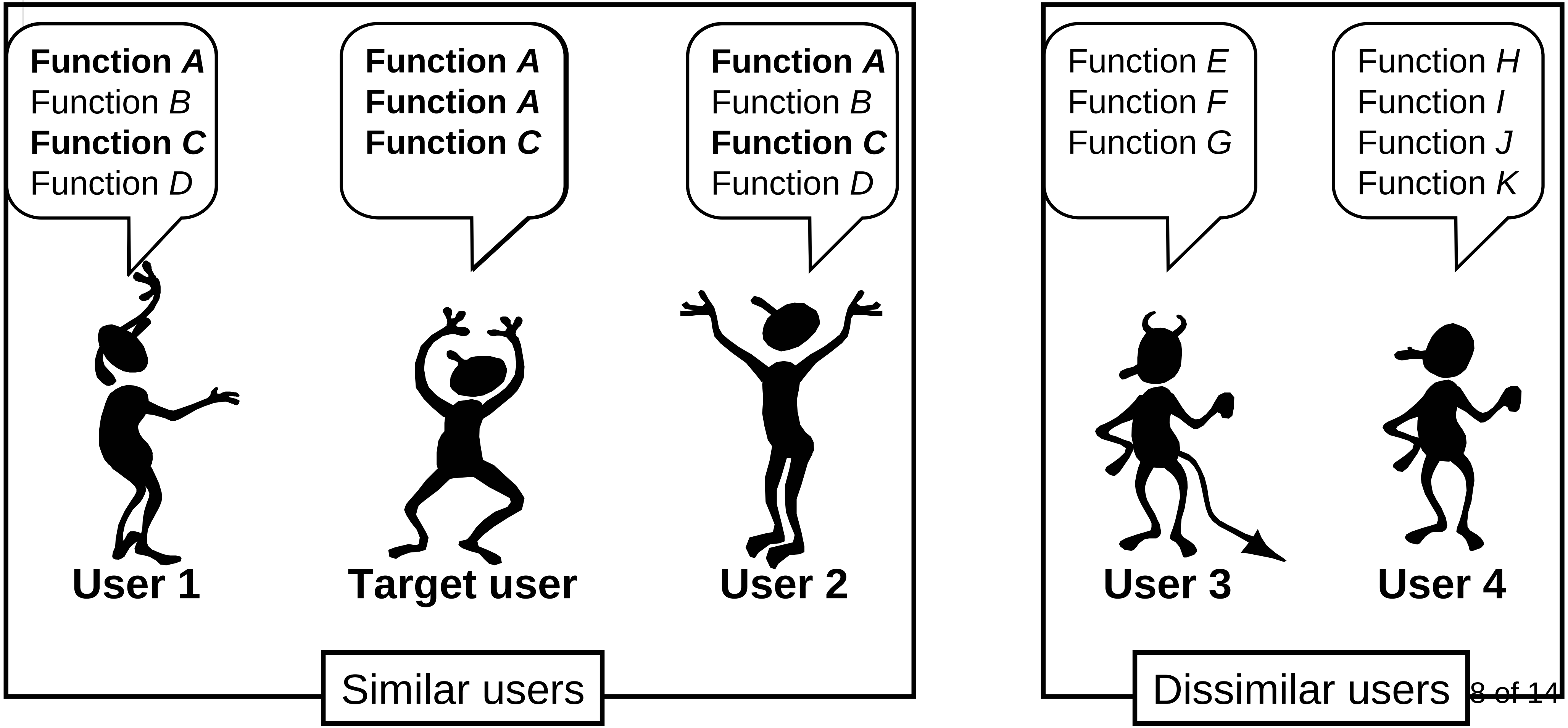


Usage log as shown below:

```
2002/02/03 18:50:41 Formatting->Font…
2002/02/03 18:50:45 File->Save As…
```

Step1: Computing Similarities

- Computing similarities between the target user and the other users



Function *A*
Function *B*
Function *C*
Function *D*

User 1

Function *A*
Function *A*
Function *C*

Target user

Function *A*
Function *B*
Function *C*
Function *D*

User 2

Similar users

Function *E*
Function *F*
Function *G*

User 3

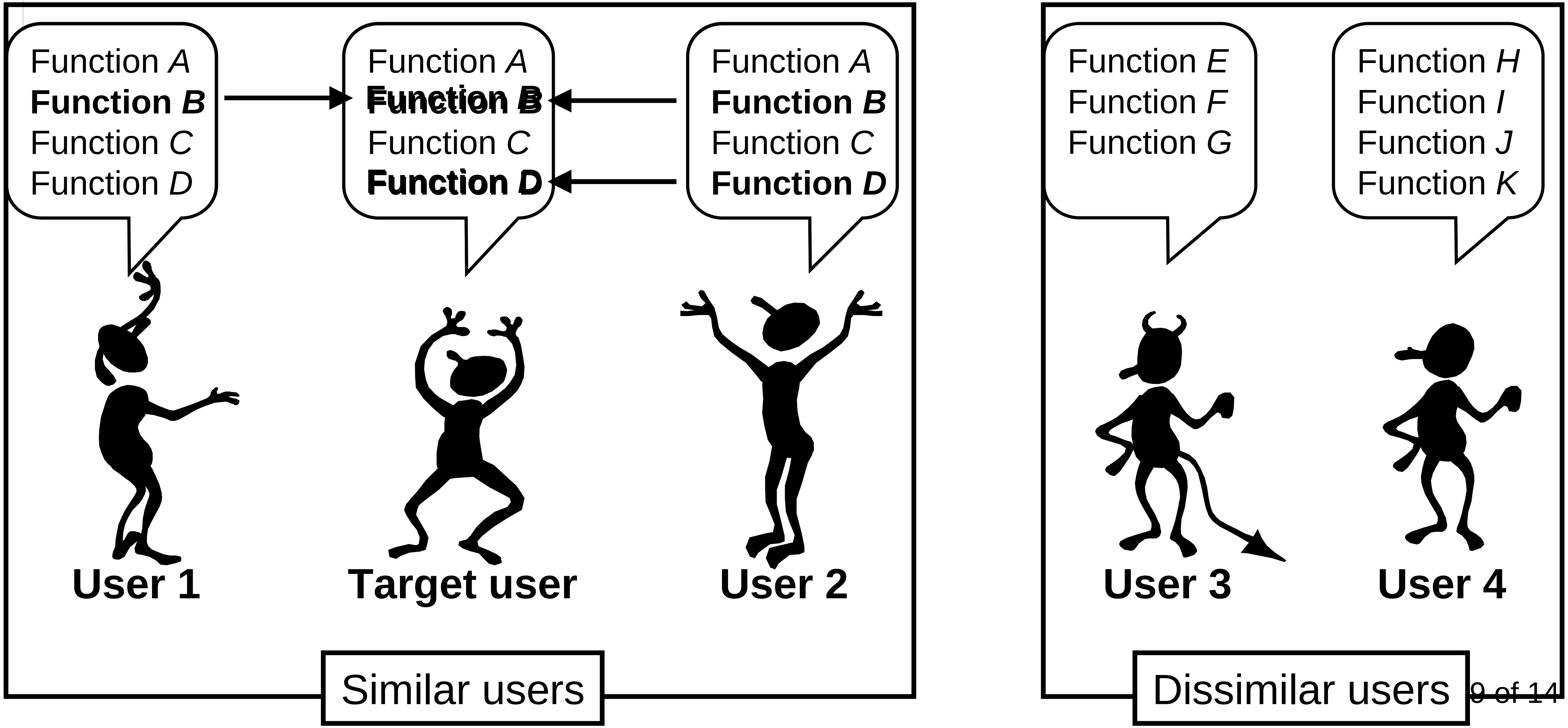
Function *H*
Function *I*
Function *J*
Function *K*

User 4

Dissimilar users

Step 2: Delivering Knowledge

- Delivering the useful functions candidate, which were frequently used by the similar users'.



Function *A*
Function *B*
Function *C*
Function *D*

Function *A*
Function *B*
Function *C*
Function *D*

Function *A*
Function *B*
Function *C*
Function *D*

Function *E*
Function *F*
Function *G*

Function *H*
Function *I*
Function *J*
Function *K*

User 1
Target user
User 2
User 3
User 4

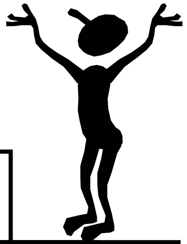
Similar users

Dissimilar users

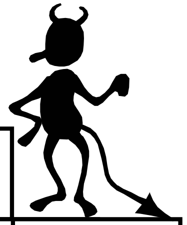
Conventional Similarity Calculation

- Calculating Similarities by Correlation Coefficient
  - The dominant frequencies (e.g., “Undo” or “Save”) over-affect similarity computations.

Target user		
1	Undo	60%
2	Save	20%
3	Redo	10%
4	Copy	4%
5	Paste	3%
6	Cut	2%
7	Clear	1%



User 2		
1	Save	55%
2	Undo	25%
3	Redo	10%
4	Copy	4%
5	Paste	3%
6	Cut	2%
7	Clear	1%



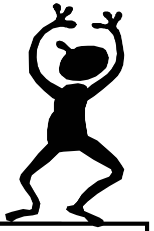
User 3		
1	Undo	60%
2	Save	20%
3	Clear	6%
4	Cut	5%
5	Copy	4%
6	Paste	3%
7	Redo	2%

Correlation based similarity	+0.41	+0.97

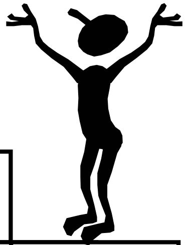
(Range of value [-1.00, +1.00])

Better Similarity Calculation

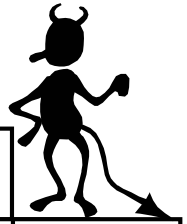
- Calculating Similarities by Rank Correlation
  - The dominant frequencies ("Undo" & "Save") do not affect similarity computations.



Target user		
1	Undo	60%
2	Save	20%
3	Redo	10%
4	Copy	4%
5	Paste	3%
6	Cut	2%
7	Clear	1%



User 2		
1	Save	55%
2	Undo	25%
3	Redo	10%
4	Copy	4%
5	Paste	3%
6	Cut	2%
7	Clear	1%

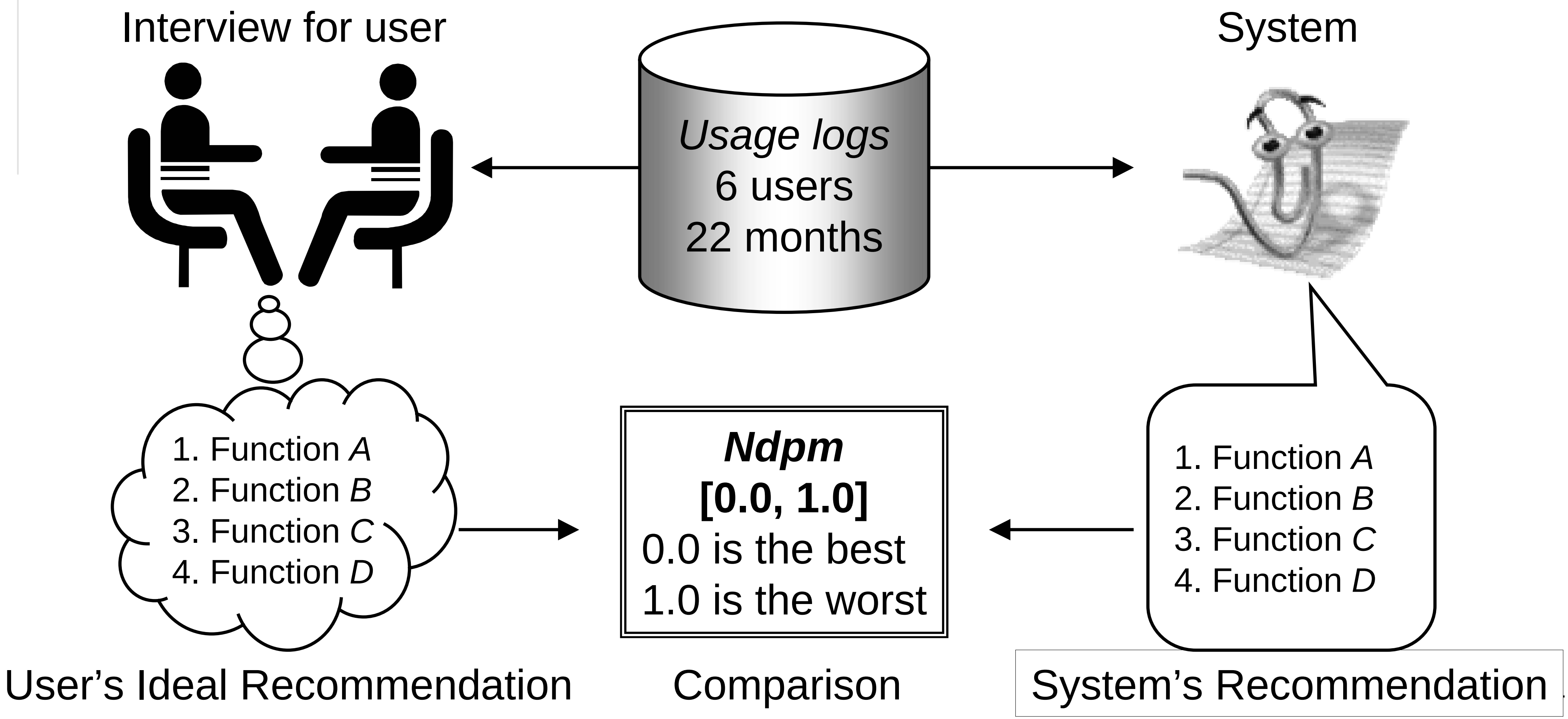


User 3		
1	Undo	60%
2	Save	20%
3	Clear	6%
4	Cut	5%
5	Copy	4%
6	Paste	3%
7	Redo	2%

	User 2	User 3
Correlation based similarity	+0.41	+0.97
Rank correlation based similarity	+0.90	+0.05

Evaluating Accuracy of Recommendation

- Yao's *ndpm* measure
  - * Y.Y. Yao, "Measuring Retrieval Effectiveness Based on User Preference of Documents", *J. of American Society for Information Science*, 46, 2, 1995, pp.133-145.



Interview for user

Usage logs
6 users
22 months

System

1. Function *A*
2. Function *B*
3. Function *C*
4. Function *D*

Ndpm
[0.0, 1.0]
0.0 is the best
1.0 is the worst

1. Function *A*
2. Function *B*
3. Function *C*
4. Function *D*

User's Ideal Recommendation

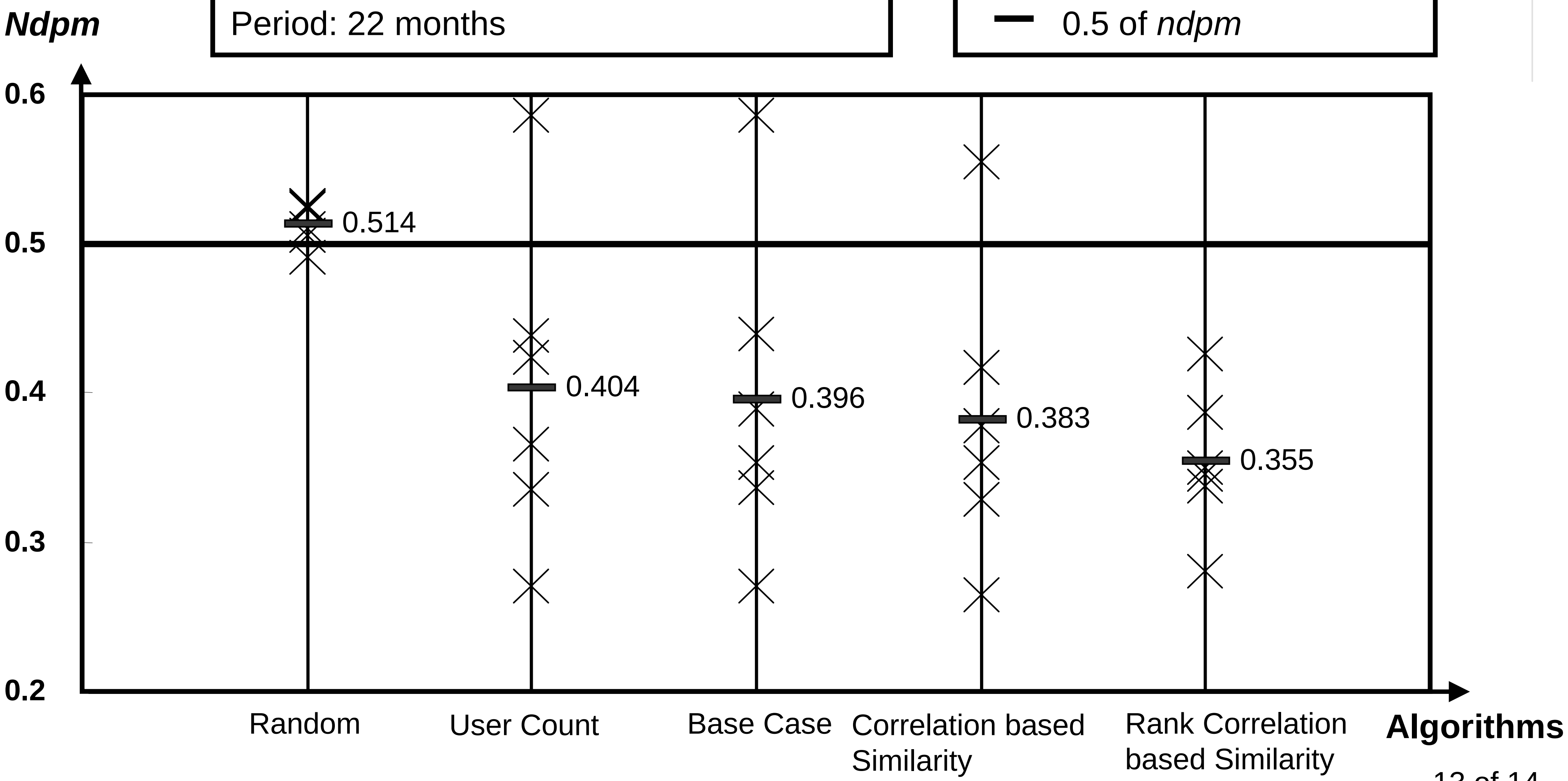
Comparison

System's Recommendation

Experimental Result

Collected usage logs of Ms-Word 2000
Subjects: 6 users in our lab.
Period: 22 months

× Each user's *ndpm*
— Average of *ndpm*
— 0.5 of *ndpm*



Conclusion

- I proposed a recommendation system to help users discover useful functions.

- I evaluated the accuracy of recommendation.
  - The result suggested the proposed system has a potential to provide useful recommendation for software function discovery.