Personalizing Software and Web Services by Leveraging

Unstructured Application Usage Traces

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Day to day work activities are increasingly dependent on digital applications and services

```c
/*
 * You may think you know what the following code does.
 * But you dont. Trust me.
 */

unsigned int reverse(register unsigned int x)
{
    x = (((x & 0xaaaaaaaa) >> 1) | ((x & 0x55555555) << 1));
    x = (((x & 0xcccccccc) >> 2) | ((x & 0x33333333) << 2));
    x = (((x & 0xf0f0f0f0) >> 4) | ((x & 0x0f0f0f0f) << 4));
    x = (((x & 0xff00ff00) >> 8) | ((x & 0x00ff00ff) << 8));
    return((x >> 16) | (x << 16));
}
```
Potentials of application usage traces

Personalizing software and web: recommendation, personal assistants …
Use cases studied in this work

Personalizing Software

Adobe Photoshop

Application Usage Traces

Behance

Personalizing Web
Outline

Part I  
utilization-to-vector (util2vec)

Part II  
Personalizing software

Part III  
Personalizing web
**Part I.** utilization-to-vector (util2vec)

**Part II**
- Personalizing software

**Part III**
- Personalizing web
- inspiration engine

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**Part I**

utilization-to-vector (**util2vec**)
Software user representation learning

An intuitive approach: **Bag-of-Actions**
utilization-to-vector (util2vec)

sliding window
utilization-to-vector (**util2vec**)

*sliding window*
utilization-to-vector (util2vec) inside each window

2n+1 actions (n=4)

inputs

prediction target
utilization-to-vector (\texttt{util2vec})
inside each window

2n+1 actions (n=4)

predictor

inputs

prediction target
utilization-to-vector (util2vec) predictor
Evaluation of **util2vec**

Build user fingerprints with the most recent 50 sessions

Index representation
Evaluation of **util2vec**

Reciprocal Rank (RR) = 1

Reciprocal Rank (RR) = 1/N

Part I  11/21
Evaluation of **util2vec**

Model Training: **22 billion** actions from **3 million** users

Model Testing: randomly selected **15K** users
each had more than 100 sessions

<table>
<thead>
<tr>
<th>Model</th>
<th>Mean Reciprocal Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>util2vec</strong></td>
<td>0.824</td>
</tr>
<tr>
<td><strong>bag-of-actions+tf-idf</strong></td>
<td>0.604</td>
</tr>
<tr>
<td><strong>bag-of-actions</strong></td>
<td>0.594</td>
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</tbody>
</table>

% of improvement **31.72%**
Part II. Personalizing Software

Part I
utilization-to-vector (util2vec)

Part II
Personalizing software

Part III
Personalizing web

Inspiration engine
Personalizing software: software user tagging

Web design, Photography, Graphic Design…

Fully Connected Layer (FC)

Sigmoid Cross-entropy Loss
Quantitative evaluation

67 tags self-disclosed by 65,331 users (on Behance).
45,331 users for training, 20,000 users for testing

<table>
<thead>
<tr>
<th>Recall@K</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>util2vec</td>
<td>0.232</td>
<td>0.357</td>
</tr>
<tr>
<td>popular tags</td>
<td>0.177</td>
<td>0.264</td>
</tr>
<tr>
<td>% improvement</td>
<td>31%</td>
<td>35%</td>
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</table>
Qualitative evaluation

Our predictions: Illustration, Digital Art, Character Design, Cartooning, Graphic Design

Our predictions: Web Design, Web Development, UI/UX, Graphic Design, Branching
Part III. Personalizing web

Part II
Personalizing software

Part III
Personalizing web

Part I
utilization-to-vector ($\text{util2vec}$)

action → action → action → action → action
Personalizing web: cold-start creative content recommendation
Two-step recommendation algorithm
Evaluation

Recall@K

<table>
<thead>
<tr>
<th></th>
<th>100</th>
<th>200</th>
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</thead>
<tbody>
<tr>
<td>util2vec</td>
<td>0.0143</td>
<td>0.0213</td>
</tr>
<tr>
<td>popularity</td>
<td>0.0118</td>
<td>0.0188</td>
</tr>
<tr>
<td>% improvement</td>
<td>21.2%</td>
<td>13.3%</td>
</tr>
</tbody>
</table>
Conclusion: User-centric Personalization
Thank you!

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