Unintrusive Customization Techniques for Web Advertising

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Overview

- Introduction
  - Ad targeting and current methods
  - Targeting with ADWIZ
- The ADWIZ System
  - Architecture and basic interaction
  - The learning process
  - Experimental results
- Conclusions
Ad Targeting

- **Goal**
  - Show advertisement only to desired target audience

- **Means**
  - Dynamically select different ad for each Web site visitor

- **Targeting Parameters (Examples)**
  - Browser, OS, time of day, country
Manual Ad Targeting

- Method
  - Manually define targeting parameters for each ad

- Advantages
  - Reaches only desired target audience
  - Predictable (How many ads will be shown?)

- Disadvantages
  - Laborious to setup and maintain
Automated Ad Targeting

- **Method**
  - Neural network learns user interests

- **Advantages**
  - Fully automated

- **Disadvantages**
  - User tracking violates privacy
  - Unable to predict number of times an ad is shown (contract constraints)
Targeting with ADWIZ

- Automated Targeting
  - based on search keywords or page URI
- Respects User Privacy
  - No user tracking necessary
- Handles Contract Constraints
  - Supports minimum number of displays and other constraints
Control & Data Flow

2.1 Control & Data Flow

- Content Site
- User
- Ad Server

Request page ➔ Parse ➔ Request ad image ➔ Extract parameters ➔ Select ad ➔ Return GIF/JPG ➔ Display page ➔ Return HTML ➔ Display page
2.2 Basic Interaction

User searches for "car"

Keyword-Based Ad Customization
Basic Interaction

2.2 Basic Interaction

System selects a car related advertisement

Keyword-Based Ad Customization
Basic Interaction

2.2 Basic Interaction

User browses sports section in directory

System selects a sports related advertisement

Page-Based Ad Customization
System Components

2.3 ADWIZ Architecture
Scheduling Ad Displays

1. Select advertisement graphic to display
2. Set minimum number of necessary displays
3. What is the timeframe for showing the ad?
4. Any special keyword you want to reserve?
Updating Display Weights

Automatically updates every 3, 10 or 30 Minutes
Inspecting the Weights

List of ads and their probabilities of being displayed for a certain keyword

<table>
<thead>
<tr>
<th>Advertisement</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota Camry</td>
<td>41.1802</td>
</tr>
<tr>
<td>Toyota Corolla</td>
<td>32.5702</td>
</tr>
<tr>
<td>Skinet</td>
<td>8.4863</td>
</tr>
<tr>
<td>Subaru Japan</td>
<td>2.4656</td>
</tr>
<tr>
<td>Biglobe InforNext Service</td>
<td>2.4473</td>
</tr>
<tr>
<td>ASCII News 1</td>
<td>1.4310</td>
</tr>
<tr>
<td>Other</td>
<td>1.0136</td>
</tr>
</tbody>
</table>
Inspecting the Weights

List of keyword weights per advertisement

- **Keyword**: Word
- **Weight**: Value

- car: 46,140,3994
- map: 45,587,9974
- toyota: 35,113,8992
- golf: 29,793,0984
- sports: 26,408,5993
- movie: 7,197,0470
- dunlop: 2,187,4960
- discount: 0,139,8560

Back to the Main Menu

Show weights for Advertisement Toyota Camry
(this advertisement has no section constraints)

- Campaign Title: Toyota Camry
- Ad(s): *Toyota Camry
- Begins: 1999-03-01
- End: 1999-11-01
- Imp.: 110,000
- Keywords: --
- Sections: --
- Actions: Edit, Insert, Delete

Rentals:

Group by:

- Keywords
- Sections
- Set of Directories
- Web Pages

Internet
Inspecting the Weights

List of page weights per advertisement

List of page weights per advertisement
Inspecting the Weights

List of advertisement weights per page

<table>
<thead>
<tr>
<th>Advertisement</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Toyota Camry</td>
<td>71.1802</td>
</tr>
<tr>
<td>Cyberwing Golf Club</td>
<td>11.5702</td>
</tr>
<tr>
<td>Maption</td>
<td>8.5702</td>
</tr>
<tr>
<td>GoNet Weather</td>
<td>2.4863</td>
</tr>
<tr>
<td>IBM Sports</td>
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<td>1.4310</td>
</tr>
<tr>
<td>Toyota Corolla</td>
<td>1.4310</td>
</tr>
<tr>
<td>CNN</td>
<td>0.4032</td>
</tr>
<tr>
<td>Digital Spotlight</td>
<td>0.3911</td>
</tr>
</tbody>
</table>
## 2.5 The Learning Process

### Keyword based Learning

#### Inputs

<table>
<thead>
<tr>
<th>Advertisements $A_j$</th>
<th>Required displays $h_j$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota Camry</td>
<td>110 000</td>
</tr>
<tr>
<td>Cyberwing Golf</td>
<td>50 000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Keywords $W_i$</th>
<th>Usage rate $k_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>car</td>
<td>17 462</td>
</tr>
<tr>
<td>golf</td>
<td>34 921</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Click-through rate $c_{ij}$</th>
<th>car</th>
<th>golf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota Camry</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>Cyberwing Golf</td>
<td>1%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Maximize expected total click-through rate

$$\sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} k_i d_{ij}$$

1. Show all required displays

$$\sum_{i=1}^{n} k_i d_{ij} = h_j$$

2. Weights sum up to 100%

$$\sum_{j=1}^{m} d_{ij} = 1$$

3. No negative weights allowed

$$d_{ij} \geq 0$$
Keyword based Learning

2.5 The Learning Process

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Keywords $W_i$

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<tbody>
<tr>
<td>car</td>
</tr>
<tr>
<td>golf</td>
</tr>
</tbody>
</table>

Click-through rate $c_{ij}$

| Toyota Camry | 7% 8% |
| Cyberwing Golf | 1% 11% |

Maximize expected total click-through rate

$$\sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} k_i d_{ij}$$

Output

<table>
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<th>Display rate $d_{ij}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota Camry</td>
</tr>
<tr>
<td>Cyberwing Golf</td>
</tr>
</tbody>
</table>

Total: 100% 100%
Ad Selection Process

2.5 The Learning Process

Ad Server

HTTP

Extract Keyword

"car"

Lookup Weights

P(A_1 | "car")

Weights

Select Ad

Return GIF/JPG

A_1

Database Server

Click-Through & Usage rate

Learning System

Administration Server

Required Displays

NEC Corporation
Experimental Setup

- Keyword based
  - 32 Ads
  - 128 Keywords

- Setup
  - Simulated keyword search
  - Artificial User Interest Models
  - Repeated 1 million times
  - Averaged over 5 runs

- Methods compared
  - Random Selection
  - Constraint-based Learning
  - Max-Click Method

Always select the advertisement which had the highest click-through rate for given keyword in the past.
Experimental Results

- Random Selection

![Graph showing number of clicks and number of displays for advertisement ID]
Experimental Results

2.6 Experiments

Max-Click Method

- More total clicks
- Fails to show more than half of the ads
Experimental Results

2.6 Experiments

- **Max-Click Method**
  - More total clicks
  - Fails to show more than half of the ads

- **Constraint-based Learning**
  - Increases click-through for all ads
  - Shows minimum number of required displays

![Bar charts comparing Max-Click Method and Constraint-based Learning](chart.png)
Experimental Results

2.6 Experiments

- Max-Click Method
  - More total clicks
  - Fails to show more than half of the ads

- Constraint-based Learning
  - Increases click-through for all ads
  - Shows minimum number of required displays
Experimental Results II

Random Method

![Bar chart showing the number of times and number of clicks for different advertisement IDs. The chart represents the Random Method.]
Experimental Results II

2.6 Experiments

Number of times

Advertisement ID

Number of clicks
Number of displays (x 1/100)

Random Method
Max-Click Method
2.6 Experiments

Experimental Results II

- Random Method
- Max-Click Method
- Constraint-Based Learning

![Chart showing experimental results for different methods in terms of advertisement clicks and displays over advertisement IDs.]

Number of clicks and Number of displays (x 1/101)

Advertisement ID

Number of times

0 5 10 15 20 25 30 35
Experimental Results II

- More than 15% improvement over Max-Click Method
Conclusions

3.1 Conclusions

- Current Ad Targeting Solutions
  - Manual:
    - Laborious
  - Automated:
    - Threatens privacy
    - Difficult to incorporate contract constraints

- ADWIZ
  - Offers Automated Targeting
  - Respects User Privacy
  - Handles Contract Constraints
Future Work

- Scaling Up
  - Thousands of keywords, pages, ads
  - Clustering techniques

- Faster Learning for New Ads
  - How to reuse previously learned parameters for new advertisements

- Real-World Deployment
  - "Real" experiments
Related Work

- Web Advertisement
  - effectiveness [Risden98]
  - alternative forms [Kohda96, Briggs97]
  - customization [Baudisch97]

- Privacy
  - user surveys [Rogers98, Cranor99]
  - cookies & profiling
  - FTC reports, EU Directive
ADWIZ Homepage

http://www.ccrl.com/adwiz/