CUIS at the NTCIR-12 MobileClick2 Task

Kwun Ping LAI[#], Wai LAM[#], Lidong BING[^]

[#]Department of Systems Engineering and Engineering Management, The Chinese University of Hong Kong

[^]Machine Learning Department, Carnegie Mellon University

Presenter: Kwun Ping LAI

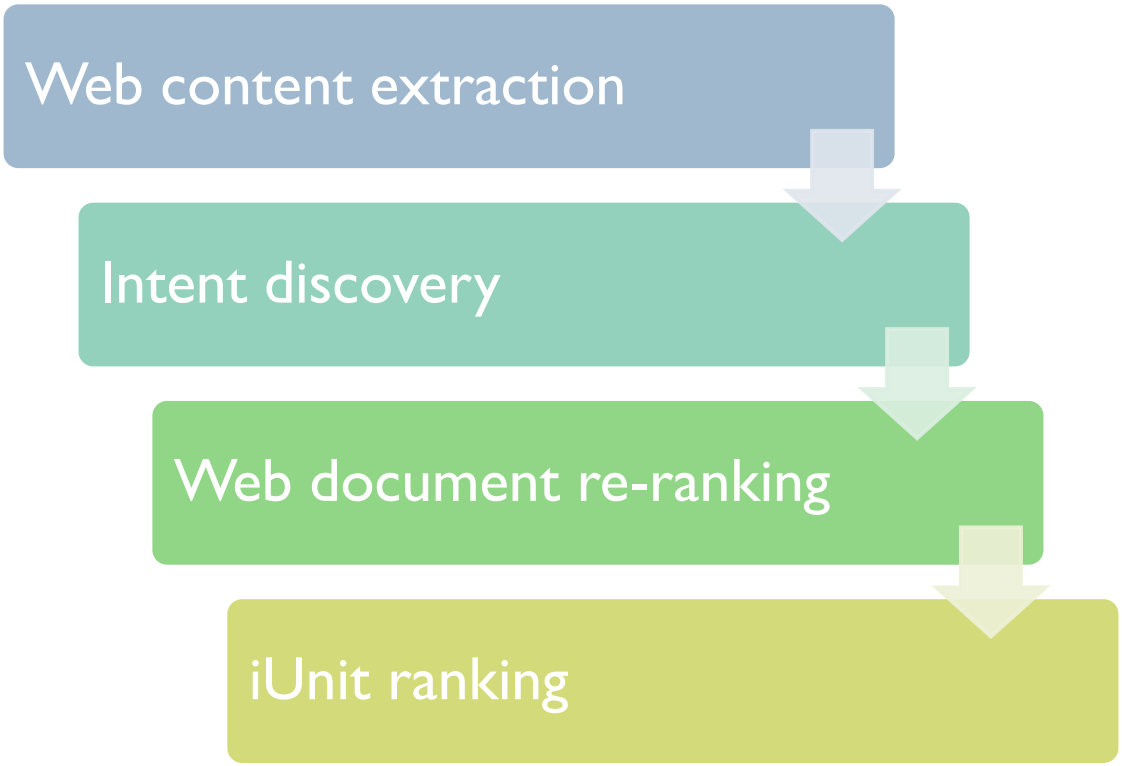
Introduction

- Problems of IR in mobile platform
  - small screen size
  - slow network speed and computing power
- MobileClick Solution
  - iUnit ranking
  - iUnit summarization

iUnit Ranking

- Input
  - a query
  - a list of iUnits
  - a collection of retrieved HTML documents
- Output
  - a list of iUnits with ranking

iUnit Ranking Model



Web content extraction

- Aims at removing unimportant parts such as menu, navigation bar, scripts, etc.

- Tag-based
  - paragraph (p tag)
  - title (h tag)
  - cell in table (td tag)
  - list (li tag)

- Text feature-based
  - Boilerpipe

Christian Kohlschütter, Peter Fankhauser, and Wolfgang Nejdl. "Boilerplate detection using shallow text features." Proceedings of the third ACM international conference on Web search and data mining. ACM, 2010.

Intent discovery

- Use Latent Dirichlet Allocation(LDA) to discover hidden intent
  - Train a LDA model using the Web content documents
  - Rank the intents based on P(i|q)
    - q: query
    - i: intent
  - Query folding-in
    - $q = \{q_1, q_2, \ldots, q_k\}$, where $k = |q|$

$$P(i|q_j) = \frac{P(q_j|i)P(i)}{P(q_j)}$$

    - $P(q_j|i)$ is inferred by the LDA model
    - Set a uniform prior

Intent discovery

- Random sampling of the latent topic n times for each q_i

$$P(i|q) = \frac{c_i}{nr}$$

  - c_i: total number of latent topics of the intent i being sampled
  - n: number of sampling of the query
  - r: total number of terms of the query

- Inspired by the work of He et al. (2011)

Jiyin He, Edgar Meij, and Maarten de Rijke. "Result diversification based on query-specific cluster ranking." Journal of the American Society for Information Science and Technology 62.3 (2011): 550-571.

Web document re-ranking

- Associate one intent to each Web document

$$i^* = \arg\max_{i \in I} P(i|d)$$

  - d: document
  - i: intent
  - the Web document with same intent form an intent document group G_i

- Web document re-ranking using Round-Robin
  - document weighting

$$w_d = |D| + 1 - ranking(d)$$

    - |*D*|: the total number of documents
    - *ranking(.)*: the new ranking score of the document

Web document re-ranking

Algorithm 1 Web document re-ranking

```
1: function RR-RANK(|D|, G, R_I)
2: input: The total number of Web document |D|; intent
   document group G; intent ranking R_I
3: output: New intent-based ranking of all Web docu-
   ment
4:     ranking = ∅
5:     while |ranking| ≠ |D| do
6:         for each i ∈ R_I do
7:             if G_i ≠ ∅ then
8:                 ranking.add(G_i.poll())
9:             end if
10:        end for
11:    end while
12:    return ranking
13: end function
```

iUnit Ranking

- Importance measure *I(u,d)*
  - The importance of iUnit u in each document d

$$I(u,d) = \frac{\sum_{w \in \mathbf{u}} exist(w,d)}{|\mathbf{u}|}$$

    - *exist(w,d)*: indicator function denoting the existence of the word w in the doucment d

$$exist(w,d) = \begin{cases} 1 & w \in d \\ 0 & w \notin d \end{cases}$$

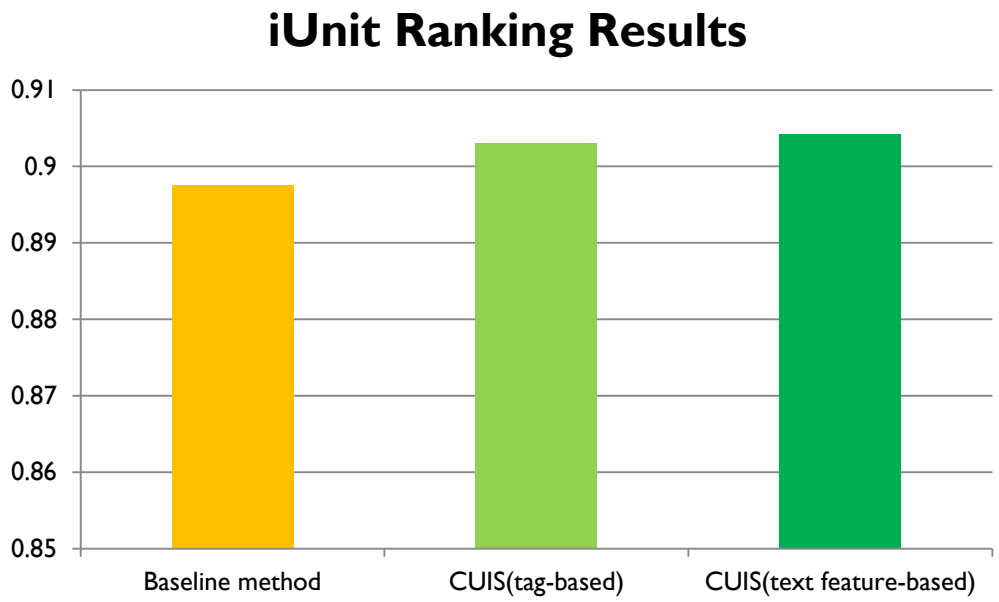
- Overall score

$$score(u) = \sum_{d \in D_q} w_d I(u,d)$$

    - u: iUnit, w_d: document weighting of the document d

Web content extraction
Intent discovery
Web document re-ranking
iUnit ranking

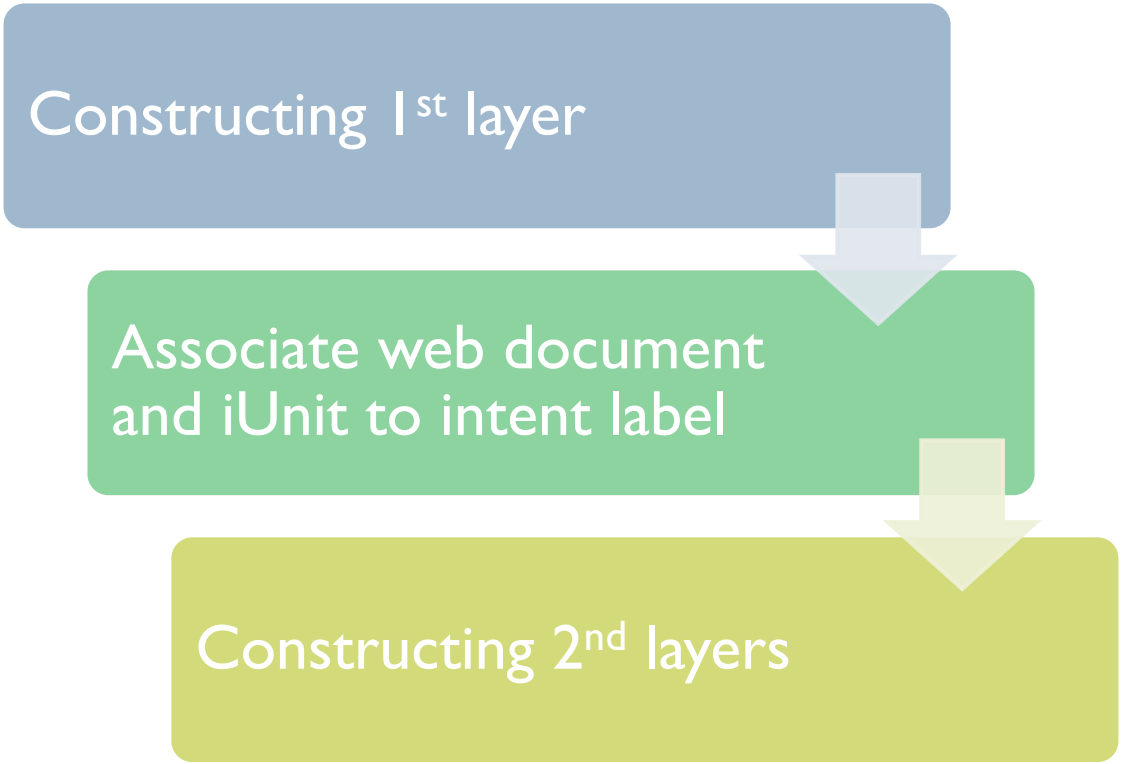
Result of iUnit Ranking Model



iUnit Summarization

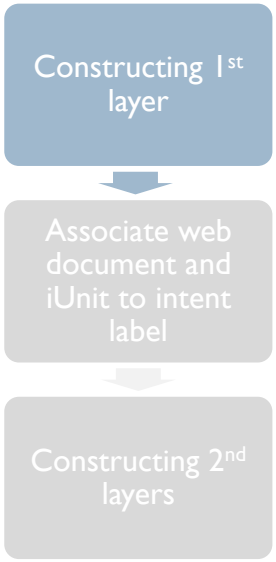
- Input
  - a query
  - a list of iUnits
  - a collection of retrieved HTML documents
  - a list of intent labels
- Output
  - a two-layered structure

iUnit Summarization Model



Constructing 1st layer

- Concatenate the iUnits in the order obtained in iUnit ranking result until reaching character limit(420 characters)
- Append all intent labels at the tail



Associate Web document and iUnit to intent label

Web document containing words of intent label

- Probability of the intent given the Web document

$$P(i|d) = \frac{f(i,d)}{\sum_{i' \in I_q} f(i',d)}$$

- The intent importance in the Web document

$$f(i,d) = \min_{w \in i} tf(w,d)$$

Web document not containing words of intent label

$$P(i|d') = \frac{\sum_{d'' \in D_i} sim(\boldsymbol{v}_{d'}, \boldsymbol{v}_{d''})}{|D_i|}$$

Constructing 1st layer

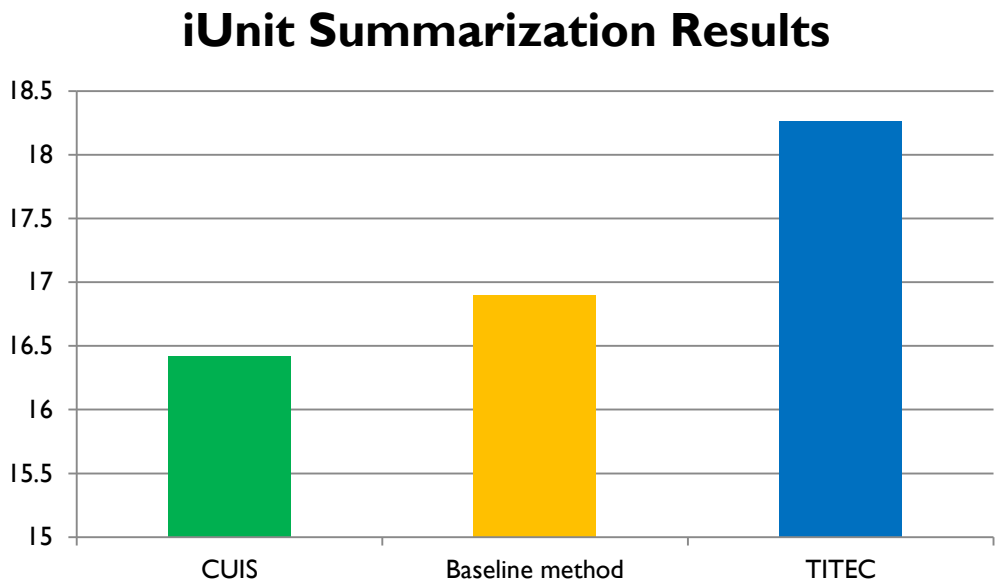
Associate web document and iUnit to intent label

Constructing 2nd layers

Constructing 2nd layers

- Construct a layer for each intent
- Concatenate the iUnits corresponding to the intent in the order obtained in iUnit ranking result

Result of iUnit Summarization Model



- THANK YOU!