西安财经学院 信息学院
第三届学科建设与科研工作会议
——Cooperative Fuzzy Game and Application

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2009-05-16

Outline

- past work
- present work
- future work

past work——paper 1(独立)

Web Community Discovery Research for Cluster Ranking of Integrated Cohesion （computer engineering and applications,2009.7）

- Aim: settle the problems of community optimal partitioning and subject optimization based on the deficiency of traditional web community discovery algorithm and cluster strength measure
- Methods: object of web community nodes and edges and structure were given, a new cluster strength measure method was researched, object function of maximal community was presented
- Results: community discovery algorithm based on cluster ranking of integrated cohesion was described, it was experimented based on existing information searching kit, The result of experiment show that the algorithm is highly effective and valuable in academic study

研究出发点：

随着Web信息资源的急剧膨胀，如何从中抽取潜在的、有价值的信息，进而充分有效地利用Web信息资源，是当今信息领域及知识工程领域最具挑战性的研究内容之一。

Web 社区发现技术是提高网络搜索引擎检索质量的重要途径之一，发现Web社区对信息检索有很多好处，不同的Web社区展示不同的内容，将搜索结果以社区的方式呈现并自动进行聚合，有助于用户迅速定位到感兴趣的内容，还可辅助制作网页目录等

总结现有研究方法

- 目前对社区进行研究分析的方法大致分为两种：(1)网络结构化分析；(2)基于个体属性的代数分析。纵观社区分析算法，可分为四个方向：(1)迭代二分法；(2)层次聚类法；(3)G-N(Girvan-Newman)方法；(4)图结构分析法。 仍存在很大的发展空间。
- 本文主要利用集成聚类等级算法进行Web社区划分 。

Web社区聚合强度的度量

节点聚合度

- 选择合适的聚合强度测量方法至关重要，传统节点聚合程度只取决于社区内节点连接度，基于流量的基础上定义的节点聚合度取决于通过节点及以其为终点的流量的总和，即 $\vartheta c_f(v) = \sum_{p \text{ pass through } v} f(p) + \sum_{p \text{ start or ends at } v} f(p)/2$
- 与社区之间的连接方式无关，可见节点聚合程度本身不足以描述该社区即为所需，进一步考虑边的聚合度、信息传递聚合度及集成聚合度等十分必要。

- **边的聚合度**

  可通过边的稀疏度进行描述

$$\rho(U,U^c)=\varpi(U,U^c)/(|U||U^c|)$$

- **信息传递的聚合度**

  可用节点之间的传递概率进行度量，$TC_i=\frac{\sum_{j=1}^{n}\sum_{k=1}^{n_k}p_{jk}}{n_i(n_i-1)},(j\neq k)$

  即信息经过随机传递后，社区内节点发出的信息传播留在社区内的概率，即反映了社区内信息传递的聚合程度 。

- **结构聚合度**

可通过结构划分的稀疏度进行描述

$$cohesion(c)=\min_{(S,A,B)}\frac{|S|}{\min\{|A|,|B|\}+|S|}$$

即当且仅当社区不能通过消除部分节点而被进一步划分时它是聚合的 。

- **集成聚合度**

$$\operatorname{int} cohesion(c)=\int_0^{\infty} cohesion(c^{\tau})\,d\tau$$

- 通过以上度量，考虑了传统web社区分析中忽略的其他特征，以期提高社区发现的有效性，来更好地反映web社区聚团程度即web社区的概念及社区之间的复杂关系。

Web社区的最优划分

- **最大化目标函数**

通过社区内及总的链接数及度之间的关联进行定义 $Q=\sum_{c}[\frac{L_c}{L}-(\frac{D_c}{2L})^2]$
再将划分的社区映射到{0,1}，标准为布尔函数 。
若所得Web社区不被其它社区包含，则为最大化。

- **主题优化**

主题优化，转化为社区同解问题 ，所有节点将基于连通性进行排序，将每个节点允许分配到其中一个社区中

$$\begin{cases}\sum_{l} X_{lc} \geq \alpha E_c, \forall_c \\ \sum_{l} X_{lc} \geq \beta E_c, \forall_c\end{cases}$$

- **孤立点修复**

在Web社区划分及优化过程中，存在孤立点的现象，传统方法采用绝对修复策略， 本文采用柔性策略 ，$\eta=\beta/\alpha$

CRIC算法

- 通过3步完成：①鉴别侯选社区；②对侯选社区进行等级评价；③消除非最大化社区。

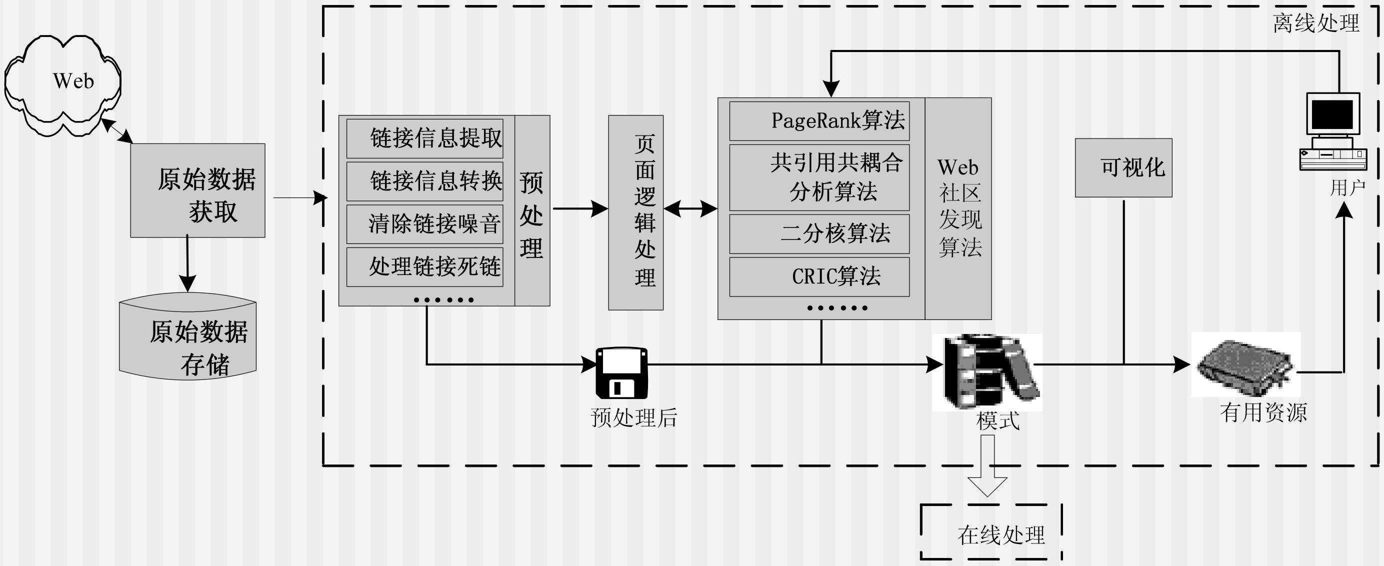
算法评价

$$recall(A,G)=\frac{|A(G)\cap I(G)|}{|I(G)|}$$

$$precision(A,G)=\frac{|A(G)\cap I(G)|}{|A(G)|}$$

实验

- 基于原始数据获取工具及现有信息搜索软件工具包的基础上，设计了Web社区发现应用系统WCDAS。



- 原始数据获取，是算法分析的基础，即利用计算机生成已知社区结构的网络 。
- 离线处理，进行预处理，作为算法的输入 。
- 在线处理 ，对算法进一步应用与扩展，以更好地与Web信息搜索技术相结合，以提高信息搜索精度 。

通过测试结果的分析，有提高之处但有待于进一步改善。

后续工作：

- 还有很多问题需进一步研究与探讨：
  ①综合考虑个体按不同关系结成的网络来发现社区；②对发现社区的真实性和可靠性的评价手段；③在结构变化频繁的网络中进行增量式计算并保证社区发现的实时性；④web社区发现与语义分析相结合等研究问题。

past work——paper 2(合作)

Algorithm of bug classification valuation for software quality (Computer Engineering and Design 2008.12)

- Aim: guide the software developing and assure software quality by existent bug information in order to reduce the software hidden danger caused by bugs to the maximum extent.
- Methods: Bug classifications on function requirement and developing cycle are studied, bug access control and bug life cycle indepth are analyzed.
- Results: An algorithm of bug classification valuation for software quality is proposed via combining the existent bug database and introducing the least square fitting method for discrete data.

Consider study field of software engineering in financial college

- 软件工程专业在财经院校未来将如何发展？
- 怎样体现财经类院校的特色？
- 阐述了我们的观点。

My ideas:

- Combine web community discovery (information transmitting) and fuzzy game & Routing game

cooperative game and solutions

- **Proof: (密)**
  - Conclusion1: The monotonic cover of a convex game is convex.
  - Conclusion2: convex game (N,v), $M(v)=C(v)$,
    $$M(v,r,c)=C(v,r,c)$$
  - Conclusion3: AMG, $M(v)=C(v)$,
    $$M(v,r,c)\approx C(v,r,c)$$

Fuzzy game and solutions

- Coalition（for an n-person game）:

  Let $N=\{1,2,\ldots\ldots,n\}$ **be the set of all players.**

  Any nonempty subset of N is called coalition.

- Fuzzy coalition **（for a cooperative fuzzy game）:**

  $N=\{1,2,\ldots\ldots,n\}$ **be a nonempty set of players considering possibilities of fuzzy cooperation.**

  Every player can choose his level of participation in a coalition, not only whether to participate or not.

- Participation level: **between 0（non-cooperation）**

  And 1（full cooperation）

A fuzzy coalition of players in N is: a vector $s\in[0,1]^N$ **, write** F^N

The i-th coordinate s_i **is called the participation level of player i.**

Special cases:

- fuzzy coalitions → crisp coalitions $S \in 2^N$

  Denotes e^S , where $\begin{cases} e^S = 1 & if \quad i \in S \\ e^S = 0 & if \quad i \in N \setminus S \end{cases}$
- then:

  $e^{\phi} = (0, \cdots, 0)$ stands for the empty coalition

  $e^N = (1, \cdots, 1)$ denotes the grand coalition

  e^i is the fuzzy coalition corresponding to the crisp coalition $S = \{i\}$
- a fuzzy coalition: → a point in the hypercube $[0,1]^N$
- the fuzzy coalitions:

  e^S , $S \in 2^N$, are the $2^{|N|}$ extreme points(vertices) of this hypercube.

- An n-person game:

is a real valued function v defined on the subsets of N satisfying

$$\begin{cases} v(\phi)=0 \\ v(S\bigcup T)\geq v(S)+v(T) \quad for \quad S,T\subseteq N \quad with \quad S\bigcap T=\phi \end{cases}$$

- A cooperative fuzzy game(FG^N) with players set N is a function: $v:[0,1]^N\to R$

$$\begin{cases} v(e^{\phi})=0 \\ v(s\vee t)\geq v(s)+v(t) \quad for \quad s,t\in[0,1]^N \quad with \quad s\wedge t=0 \end{cases}$$

$s\vee t$ are those elements of $[0,1]^N$, with i-th coordinate equal to $\max\{s_i,t_i\}$

assigning to each coalition s the value v(s) achieved as the result of cooperation with participation level $s_i, i\in N$

Let $([0,1]^N,v)$ be a fuzzy game and $s\in[0,1]^N$,the sub-game of $([0,1]^N,v)$ with respect to s is the fuzzy game (s,v_s) ,where $d\in e^S$, $v_s(d)=v(d)$.

- An imputation for an n-person game (N, v) is a vector x satisfying $\begin{cases} \sum_{i \in N} x_i = v(N) \\ x_i \geq v(\{i\}) \quad for \quad all \quad i \in N \end{cases}$

- An imputation for a fuzzy game $([0,1]^N, v)$ is a vector $x = (x_1, x_2, \cdots, x_n)$ satisfying $\begin{cases} \sum_{i \in N} x_i = v(e^N) \\ x_i e_i \geq v(e_i^i) \quad for \quad every \quad i \in N \end{cases}$

  all imputations of $([0,1]^N, v)$ denoted $I([0,1]^N, v)$

- the core of a game (N, v) : $\begin{cases} \sum_{i \in N} x_i = v(N) \\ \sum_{i \in S} x_i \geq v(S) \; for \quad all \quad S \subseteq N \end{cases}$

- the core of a fuzzy game $([0,1]^N, v)$: $\begin{cases} \sum_{i \in N} x_i = v(e^N) \\ \sum_{i \in N} s_i x_i \geq v(s) \; for \quad each \quad s \in [0,1]^N \end{cases}$

  purpose: achieve a refinement of the core by enlarging the set of constrains that a potential core allocation.

- x dominates y (denoted by $x \succ_S y$)

$$\begin{cases} x_i > y_i \quad for \quad all \quad i \in S \\ \sum_{i \in S} x_i \le v(S) \end{cases}$$

- for $x, y \in I([0,1]^N, v)$, and a fuzzy coalition $c \in [0,1]^N$, we say that x dominates y via c(denoted by $x \ge_c y$)

$$\begin{cases} x_i > y_i \quad for \quad every \quad i \in \{i \in; c_i > 0\} \\ xc \le v(c) \end{cases}$$

- we say that x dominates y(denoted by $x \succeq y$)
- if there exist $c \in [0,1]^N$, such that $x \succeq_c y$

- The game (N, v) has a large core if,

  for every vector $y \in R^n$ with $y(S) \geq v(S)$ *for every* $S \subseteq N$,there is a core member x such that $x \leq y$

- The fuzzy game $([0,1]^N, v)$ has a large core if,

  for every $y \in R^n$ that satisfies $yc \geq v(c)$ *for every* $c \in [0,1]^N$,there is $x \in core([0,1]^N, v)$ such that $x \leq y$

- The set of imputations $D \subseteq I([0,1]^N, v)$ is stable if

  (1)If $x, y \in D$,then it is not true that $x \succeq y$

  (2)For every imputation $y \notin D$,there is $x \in D$ such that $x \succeq y$

Convex game and convex fuzzy game

- convex game: $\begin{cases} v(\phi)=0 \\ v(S)+v(T)\le v(S\bigcup T)+v(S\bigcap T) \qquad S,T\subseteq N \end{cases}$
- a fuzzy game is said to be convex (CFG^N)if it satisfies the following two properties:

$$\begin{cases} v(s)+v(t)\le v(s\vee t)+v(s\wedge t) \quad for \quad all \quad s,t\in[0,1]^N \\ v_{s^{-i}}(t)=v(s^{-i}\parallel t) \end{cases}$$

(1) $v:[0,1]^N\to R$ be a real-valued function on $[0,1]^N$,called coordinate-wise convex function (supermodular function).

where $s\vee t\Leftrightarrow \max\{s_i,t_i\}$ $\quad s\wedge t\Leftrightarrow \min\{s_i,t_i\}$

(2) $v_{s^{-i}}:[0,1]\to R$ with $v_{s^{-i}}(t)=v(s^{-i}\parallel t)$ for each $i\in N, S^{-i}\in[0,1]^{N\setminus\{i\}}, t\in[0,1]$ is convex function.

where $(s^{-i}\parallel t)$ is the element in $[0,1]^N$, with $(s^{-i}\parallel t)_j=s_j$ for each $j\in N\setminus\{i\}$ and $(s^{-i}\parallel t)_i=t$

- important results:

  convex fuzzy game form a convex cone:

  for all $v, w \in CFG^N$, and all $a, b \ge 0$, $av + bw \in CFG^N$

  the core of a convex fuzzy game is stable;

- Let $v \in CFG^N$,then the following properties hold:

  (1)Increasing marginal contribution for players.

  (2)Increasing marginal contribution for coalitions.

  (3)stable marginal contribution property.

  (4)Increasing average marginal return property.

- and

  exact

  extendable

  balanced & totally balanced

  derivative

  …………..

Present work

- English papers
- Basal knowledge
- summarization

future work

- To My Best !

Thanks !