University of Konstanz
Department of Computer & Information Science
PD Dr. Sven Kosub / Mehwish Nasim

Network Dynamics
Winter 2013/14

Assignment 4

Ausgabe: 13 Nov 2013 **Abgabe:** 20 Nov 2013

Problem 1: Time-dependent data 10 Points

In a very recent football match, Jordan played Uruguay in a 2014 FIFA World Cup Qualifier at home and lost 0-5. Suppose we were able to record live data from the match in reverse chronological order. The first column denotes the time when a certain event happened and the second column denotes which side was affected by the event.

```
94:12 Finished
92:09 Goal by Uruguay scored by free kick
91:41 5th Goal for Uruguay:  0:5
90:57 2nd Half added time - 4 minutes
90:08 11th Corner to Uruguay
89:39 10th Corner to Uruguay
88:59 9th Corner to Uruguay
88:40 No clear indication of added time
80:06 6th Substitution Uruguay
78:42 8th Corner to Jordan
77:44 Goal by Uruguay scored by shot
77:16 4th Goal for Uruguay:  0:4
75:13 7th Corner to Jordan
73:56 6th Corner to Jordan
72:47 5th Corner to Jordan
69:43 5th Substitution Uruguay
69:32 4th Substitution Uruguay
69:05 Goal by Uruguay scored by shot
68:24 3rd Goal for Uruguay:  0:3
64:20 3rd Substitution Jordan
63:01 4th Corner to Jordan
59:05 3rd Yellow card Jordan
58:16 2nd Substitution Jordan
53:04 1st Substitution Jordan
45:00 2nd Half
46:07 Halftime
45:20 1st Half added time - 1 minute
44:26 2nd Yellow card to Jordan
43:26 No clear indication of added time
41:46 Goal by Uruguay scored by shot
```

```
41:40 Goal for Uruguay:  0:2
31:27 3rd Corner to Jordan
26:53 Goal by Uruguay scored by shot
21:25 Goal for Uruguay:  0:1
17:51 2nd Corner to Jordan
17:42 1st Corner to Jordan
08:42 1st Yellow card for Jordan
00:00 1st Half
```

How would you transform these event data into panel data when we are only interested in goals, corners, and yellow cards? Enumerate the corresponding panel data.

Problem 2: Network representation **10 Points**

Consider the set $A = \{0,1\}^3$ of (atomic) items. That is, items are triples (a_1, a_2, a_3) with $a_i \in \{0,1\}$ such as, e.g., $(0,1,0)$ or $(1,1,1)$. Let $\mathcal{I} = A \times A \setminus \{\ (i,i) \mid i \in A\ \}$ by the interaction domain on A.

Visualize the weighted, undirected graphs of the following networks:

(a) $x \ :\ \mathcal{I} \to \mathbb{N}\ :\ ((a_1,a_2,a_3),(b_1,b_2,b_3)) \ \mapsto\ (a_1-b_1)^2+(a_2-b_2)^2+(a_3-b_3)^2$

(b) $x \ :\ \mathcal{I} \to \mathbb{N}\ :\ ((a_1,a_2,a_3),(b_1,b_2,b_3)) \ \mapsto\ a_1 \cdot b_1 + a_2 \cdot b_2 + a_3 \cdot b_3$

Problem 3: Two-mode networks **10 Punkte**

Suppose we are given the following 6 papers addressing BGP issues:

- Nick Feamster, Jennifer Rexford: Network-wide prediction of BGP routes. IEEE/ACM Trans. Netw. 15(2): 253-266 (2007)
- Nick Feamster, Hari Balakrishnan: Detecting BGP Configuration Faults with Static Analysis (Awarded Best Paper). NSDI 2005
- Nick Feamster, Ramesh Johari, Hari Balakrishnan: Implications of autonomy for the expressiveness of policy routing. SIGCOMM 2005: 25-36
- Nick Feamster, Jared Winick, Jennifer Rexford: A model of BGP routing for network engineering. SIGMETRICS 2004: 331-342
- Lixin Gao, Jennifer Rexford: Stable internet routing without global coordination. IEEE/ACM Trans. Netw. 9(6): 681-692 (2001)
- Lixin Gao, Timothy Griffin, Jennifer Rexford: Inherently Safe Backup Routing with BGP. INFOCOM 2001: 547-556

Visualize the graph of the corresponding two-mode network on A and S where A is the set of authors and S is the set of papers.