EE 382V: Social Computing **Fall 2018**

Lecture 1: August 24

Lecturer: Vijay Garg *Scribe: Patrick Sigourney*

1.1 Introduction

Scribe: Students are required to act as scribe and take notes during one class section. Link to Google Docs sheet for scribe duty signups was emailed on Aug 24. The notes need to be formatted using LaTeX (overleaf.com is an online tool for this). The generated PDF will be sent to the class TA for review and revisions, after the student has made all necessary corrections and submitted the final .TEX and .PDF files to the TA, the notes will be posted for student use:

https://github.com/Sunny666/EE382V_Social_Computing

TA: The class TA is Sunny Bhagia (sunnysb@utexas.edu). Office hours are TBA and available either in-person or via Skype.

Assignment Teams: All assignments will be done in self-selected teams of 2, with the exception of the textbook chapter presentation, which will be done in assigned teams of 2. Links to Google Docs sheets for both assignment and presentation teams was emailed on Aug 24.

Exams: There will be 2 midterm exams and a final exam. For each exam you are allowed one 8.5"x11" page of notes, handwritten, both sides.

Textbook Assignments: Each month, 5-6 sections of the textbook will be covered by assigned student presentations. In addition to these presentations, all students will need to select 2 of these sections each month, read them, and write a half-page summary for each section. This will be handed in at the start of the first class session each month.

1.1.1 Topics for the Class

1. Matching: Buyers and sellers, pairing, stable matches.
2. Auctions: Buyer's valuation of item
3. Games: Two-player games, payoff matrix with row player & column player; prisoner's dilemma.
4. Voting: One-to-one and priority list; Arrow's Theorem.
5. Experts Algorithm: Accuracy of past predictions impacts weight applied to future predictions
6. Security: RSA public key algorithm

1.2 Matching

Bipartite graph: A graph $G = (V, E)$ is bipartite if V can be partitioned into A and B such that there are no edges between vertices in the same partition. ie: Elements in A can only be connected to elements of B and elements in B can only be connected to elements of A.

Matching: A matching M is a subset of edges E ($M \subseteq E$) such that no two edges in M share any vertex. ie: one-to-one relationship; a pairing.

Perfect Matching: Perfect matching occurs when the vertex partitions A and B are of the same cardinality (number of elements) ($|A| == |B|$), each element of A is connected to exactly one element of B, and each element of B is connected to exactly one element of A.

Let $G = (A, B, E)$ be a bipartite graph such that $|A| == |B|$.
$M \subseteq E$ is a perfect matching if $|M| == |A|$

Maximal Matching: A matching M is maximal if it cannot be extended to include more matches.

Maximum Matching: A matching M is maximum in a graph if it has the largest cardinality possible. A maximum matching is always a maximal matching, whereas maximal matching is not always maximum matching and may have scope for improvement.

1.2.1 Hall's Marriage Theorem - Conditions for Perfect Matching (PM)

For a vertex a in set A, we define the neighboring set of a as:
$N(a) = \{b \in B | (a, b) \in E\}$
(B is a neighboring set of a which contains all b where there is an edge between a and b)

Let s be a subset of vertex set A; Then the neighboring set of subset s is defined as:
$N(s) = \bigcup\limits_{a \in s} N(a)$
(Neighbor of subset s is the union of all neighboring sets $N(a)$ of each element a in s)

Constricted Set: A constricted set is one where there are more elements in the set s than there are elements in the associated neighbor set $N(s)$.
$\exists s : |s| > |N(s)|$
(There exists a subset s where the number of elements in s is greater than the number of elements in the neighbor set $N(s)$)

Perfect Matching is not possible with a constricted set.

Perfect Matching is possible if: $\forall s \subseteq A : |s| <= |N(s)|$
(For all subsets s in A, the cardinality of s is less than or equal to the cardinality of the neighbor set)