Research Statement

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Background

My research interests are social computing, computational social science, and data mining. My doctoral research focuses on individual and group performance, with an emphasis on online games and virtual worlds. My dissertation explores statistical and machine learning techniques for modeling and prediction of game player and group behaviors. Broadly, I am interested in 1) leveraging data mining techniques to analyze behavioral patterns, 2) developing software programs and leveraging hardware resources for processing large datasets in a time-efficient manner, and 3) building end-to-end analytics pipelines that either can be run independently or can be integrated into existing systems.

My research method is to gather empirical data from real world systems (i.e. game companies’ game log databases), analyze the data to look for behavioral patterns of certain entities (i.e. game players, combat groups), predict future behaviors, visualize these findings in a variety of forms (i.e. dashboard, report, graphs, charts), and incorporate these findings into other systems (i.e. recommendation, marketing campaigns, strategy planning, etc.).

I have a particular interest in the usage of virtual worlds (such as online games) in serious domains such as military (weapon training, communication training, performance assessment and prediction, etc.), healthcare (social applications and games for autistic children and those suffering Alzheimer's or Parkinson's), and education (individual/social applications and games customized towards each individual student's needs). Specifically, I am particularly interested in analyzing and designing game mechanics to illicit desirable behaviors in various contexts (i.e. healthy eating behavior, healthy socialization behavior, environment-friendly behavior, stress management, etc.). My overall goal is to identify those areas of our lives (individually and socially) that we wish to change and enhance and to bring and integrate technology into those areas in a beneficial manner.

Current Research

Introduction

The market for video games skyrocketed over the past decade. In the United States alone, the video game industry in 2009 generated almost $20 billion USD in sales [1]. Furthermore, according to [2], estimated 97% of the teenage population and 53% adult population are regular game players.

Massively Multiplayer Online Games (MMOGs) have become increasingly popular and have communities comprising over 47 million subscribers by the year 2008. MMOGs are online spaces providing users with comprehensive virtual universes, each with its own unique context and mechanics. They range from the fantastical world of elves, dwarfs, and humans to spacefaring corporations and mirrors of our
world. Large numbers of users interact and role-play via the in-game mechanics.

Yet another popular video game genre is First-Person-Shooter (FPS). This category of games involves gun and weapon-based combat fighting, and the game play is through the first perspective. While some game titles are restricted to single person modes (in which case, the player would play against bots or computer-controlled characters), others offer multiplayer gaming experience either exclusively or jointly with single person modes. FPS games are available on a variety of platforms: PC, Xbox, PlayStation, and Nintendo. FPS games are highly popular. As of December 2010, Call of Duty: Black Ops sold 13.7 million units since its release in early November 9, 2010, making it the best selling video game ever in the U.S. [7]. And, Halo: Reach since its release in mid September 2010 sold over 7.8 million copies [8].

With their increasing popularity, researchers are realizing that video games can be a means to fully observe an entire isolated universe. Each action is logged, and the level of granularity and completeness with which information is collected is unmatched by any real-life experimental setup. They serve as unprecedented tools to theorize and empirically model the social and behavioral dynamics of individuals, groups, and networks within large communities.

**Game Logs**

Virtual world applications usually have a thin-client architecture, practically all user actions are captured in the click-stream logged at the server. This data contains a comprehensive record of every user's in-network activities, accomplishments, interactions, economic status, etc. A brief record of the user's side information (i.e. profile data) is also stored. It is common for popular social networking and collaborative systems to have hundreds of thousands of users generating copious amounts of data based on the many different activities they are participating in at any given time. One key research challenge is developing analysis methods that can analyze relationships while scaling to terabytes of data. The data also has a temporal component, which is often an integral part of the analysis and introduces further relationships that must be accounted for. Thus, while providing an exciting new tool for the social sciences, the virtual worlds also present a set of difficult and novel computational challenges.

**Opportunities for Social Sciences and Military**

The data collected provides an excellent means of studying human social behavior with respect to the complete context of the environment for a large population. They serve as unprecedented tools to theorize and empirically model the social and behavioral dynamics of individuals, groups, and networks within large communities. For instance, in recent years, educational research has found virtual environments to be a sound venue for studying learning, collaboration, social participation, literacy in online space, and learning trajectory at the individual level as well as at the group level. MMOGs in particular are of great interest to social scientists that study social interactions and social structures because of a variety of social systems present in those games. Interestingly, networks generated by in-game processes are closely analogous to the real world. For example, money transactions are similar in the game world and the real world [3]. In contrast, role-playing networks differ from any real-world networks because this is a unique in-game phenomenon. FPS games are of great interest to social scientists in a similar manner, but in particular, the U.S. military has found a great use of such games for recruiting soldiers and training
soldiers in marksmanship and stealth [10,11,12]. The military also uses MMOGs for team coordination and other types of training [11]. MMOGs provide an immersive environment where any of a variety of training scenarios can be built in. Training sessions can be recorded and replayed/rerun to see how making different choices would lead to different outcomes. Understanding and explaining social behavior as well as individual player/soldier-level behavior can fundamentally alter the functioning of professional organizations, battlefield scenarios, and multi-player professional teams.

Opportunities for Commercial Vendors
The business climate today is very competitive as well as volatile that companies can no longer let their business decisions guided by intuition alone. Companies lacking an intelligent strategy for engaging and retaining their customers will not succeed. Many E-commerce vendors in general are heavily leveraging insights derived from the data collected about how their consumers browse, shop, and interact online. For instance, consumer click stream data can provide information useful for the company to understand how certain ways of arranging items and visualizing product information on their website successfully leads to purchasing behavior. The video games market is no exception when it comes to customer engagement and retention. The term “game analytics” is often heard in many tech forums in recent years.

There is a growing interest in the gaming community in understanding player behaviors both inside and outside the gaming space. Game companies are interested in finding out how their games are played, if they are being played as intended, how the different game mechanics are being played out and how the different game playing patterns lead to a high level of satisfaction and entertainment for customers. Retrospective analyses after the game launch on existing game features can reveal information on which features enhance player’s gaming experience and to which demographic segments they especially appeal to. Features negatively correlated with gaming experience can be considered for removal while those positively correlated with gaming experience can be further enhanced. For new game features, prospective analyses before the game launch can reveal information on which features might appeal to certain player population segments with a certain level of confidence and user-oriented testing can focus on these features for further validation.

Opportunities for Computer Science
As much as game logs bring exciting new opportunities for research and commercial purposes with its detailed and temporal tracking of a variety of activities going on in the game space, it poses new challenges for computer scientists with its massive amount of data containing complex networked relationships spanning multiple entities. Our research uses knowledge discovery as a core mechanism to analyze MMOG logs and build models of social interactions in games and understand how users’ relationships are affected by the variety of environmental factors present in each world. MMOGs provide mechanisms to foster social activities among users, letting them form groups, guilds, corporations, and so on and tackle collaboration-oriented tasks, such as raiding a dungeon for gold. Data collected from these mechanisms provide an excellent means of studying human social behavior with respect to the complete context of the environment. Such research is infeasible for real-life activities because it is impossible to track and record complete information on a large population. Knowledge discovery is a key computational approach to
realizing this promise, and in the process, it creates opportunities to push the frontiers of knowledge discovery itself.

**This Research**

Broadly, this research explores statistical and machine learning techniques for modeling and prediction of game player and group behaviors. How do players learn and advance? How are the different game mechanics played by different players? How do different players make different choices in a particular combat scenario? How do players (each with a different set of abilities and capabilities) collaborate and combat together? What is the effect of team play on individual player performance over time? We explore computational techniques for modeling behaviors of game players. First, we seek to develop individual performance prediction models where player's past behavior is used to predict his future behavior. Behavioral signatures of individual players can reveal the different motivations behind playing the game. Understanding the indicators of these different motivations can lead to in-game task recommendation which can further enhance the player's game experience. Second, we seek to develop group performance prediction models. Observing team characteristics, team composition, and how the game mechanics are played out can reveal what are the recipes for success in high performing and resilient teams. Third, we examine different types of learners by observing their play patterns and performance over time. Insight into different types of learning patterns can reveal information about numerous different ways a game can be played and potentially provide clues as to why certain players stop playing or drop out completely whereas other players continue with the game. This insight is expected to be useful for game companies to have a retrospective look at their games and incorporate the insight into the designing of future releases or new games.

**Conclusion**

The video game market is ever exploding, especially in the past decade. Tens of millions of people play MMOGs and FPS games, generating tons of game logs which serve as unprecedented tools to theorize and empirically model social and behavioral dynamics of individuals, groups, and different social networks within large communities. In the present research work, we explore computational techniques for modeling behaviors of game players. First, we seek to develop individual performance prediction models where player's past behavior is used to predict his future behavior. Behavioral signatures of individual players can reveal the different motivations behind playing the game. Understanding the indicators of these different motivations can lead to in-game task recommendation which can further enhance the player's game experience. Second, we seek to develop group performance prediction models. Observing team characteristics, team composition, and how the game mechanics are played out can reveal what are the recipes for success in high performing and resilient teams. Third, we examine different types of learners by observing their play patterns and performance over time. Insight into different types of learning patterns can reveal information about numerous different ways a game can be played and potentially provide clues as to why certain players stop playing or drop out completely whereas other players continue with the game. This insight is expected to be useful for game companies to have a retrospective look at their games and incorporate the insight into the designing of future releases or new games.

**Future Research**
I have an active interest in other game genres. In particular, I am interested in studying player and group behaviors in mobile games. While the average session time in MMOG’s is about 20-30 minutes, the average session time in mobile games is two to three minutes. Therefore, mobile games must catch the player’s attention almost immediately once the game session starts. Also, many of the mobile games are casual games that are not necessarily immersive story-wise or graphics-wise. How then can these casual games be designed so that non-paying players convert to paying players or subscribers? How can out-of-the-game promotional planning be designed so that game companies can increase customer acquisition and retention rate?

Of all things, I have a particular interest in the usage of virtual worlds (such as online games) in serious domains such as military, healthcare, and education. As part of another project, in the last three years, I have participated in studying a fully interactive, three-dimensional virtual and gaming environment used by the military. Some or parts of the real world combat scenarios and training can be simulated in such an environment, and in much the same way we study MMOG’s or any other games, we can study soldiers’ or combat groups’ behaviors collected in behavioral logs. Virtual worlds have so much potential in other serious domains such as healthcare and education. With over 600 million users, online platforms such as Facebook can be effectively used for health campaigns (i.e. quitting smoking, fight against obesity, promoting environmentally safe diet). In educational psychology, such field as Electronic Tutoring Systems (ETS) has emerged recently, and the built systems are collecting large amount of online behaviors of students.

References


