

Group Evolution Patterns in World of Warcraft®

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Abstract: We study the temporal evolution of different types of guilds in the massively multiplayer online role playing game WORLD OF WARCRAFT®. Given a large corpus of observations of online activities of players, we apply convex-hull non-negative matrix factorization to cluster our data of about 1,400,000 guilds into well interpretable prototypes. Given these prototypes, we analyze guild formation patterns on American and European servers. We find growth patterns according to power laws that result in similar structures in both cases.

1 Introduction and Related Work

In this paper, we present first results of a comprehensive study of patterns of group formation processes in WORLD OF WARCRAFT®. As of this writing, this game has attracted more than 12,000,000 active players. Because of its immense fan-base, it offers unique possibilities for the study of human interaction on a very large scale. In our work, we evaluate 192,000,000 observations of in-game player activity. Based on this data, we provide an interpretable categorization of different types of guilds, visualize general guild evolution patterns, and compare the development of US and EU based guilds.

Web-scale game data mining is of growing interest to academia and industry alike. In earlier work, we analyzed in-game recordings of QUAKE II® to reproduce individual human behavior. Using machine learning techniques, we were able to create reactive, tactical, or strategic behaviors [BTS03, TBS04]. In later work, Weber et al. [WM09] learned predictive opponent models by analyzing expert gameplay from game logs. Drachen et al. [DCY09] recorded player behavior in TOMB RAIDER:UNDERWORLD® and determined four general types of players. More recently, data mining has been applied to analyze processes within *Massively Multiplayer Online Role Playing Game* (MMORPGs). Ducheneaut et al. [DY08] investigated the structure of social networks in WORLD OF WARCRAFT® based on data collected from more than 300,000 characters. They conclude that social networks in MMORPGs are typically sparse and that players experience a form of “collective solitude”. While these contributions are closely related to our research, we are not aware of any previous work that studied formation patterns of social groups in web-based games multiplayer games.

Next, we briefly summarize the in-game mechanics of WORLD OF WARCRAFT®. Then, we introduce and explain the data and experimental setting of our study. A discussion of our findings and a conclusion will end this contribution.

2 WORLD OF WARCRAFT®

WORLD OF WARCRAFT® is an MMORPG that takes place in a medieval fantasy world. It is being played by millions of people worldwide and is arguably the most successful and most popular multiplayer game in video game history¹. The technical architecture of the game consists of hundreds of separate servers each hosting virtual worlds, the so called *realms*, that are populated by several thousand players. Every player controls a single virtual character whose *strength* increases with successful completion of in-game tasks or *quests*. Strength or experience is measured in levels reaching from 1 (a newly created character) to 80 (currently the highest possible level which grants most powerful abilities such as special moves or mighty spells). Note that the initial release of WORLD OF WARCRAFT® capped the maximal experience level at 60. The first expansion package “Burning Crusade” (Jan 2007) extended it to level 70 and the second expansion “Wrath of the Lich King” (Dec 2008) further extended it to level 80.

Due to its open and flexible nature, the game lacks an explicit goal. However, most players strive to advance their character’s experience towards level 80. Other examples of commonly pursued goals are the acquisition of virtual treasures or better equipment.

Social interactions are an important characteristic of the game. While players could play on their own, certain quests are designed such that they can only be accomplished by a group of players. In fact, the most valuable in-game items can only be obtained by groups comprised of several level 80 characters. Therefore, joining a team, also called a *guild*, is vital to successful play. Each character can only join a single guild. Players may leave or join guilds at their liking, however, for a joyful game experience, they typically try to find and stick with a guild that matches their own playing style.

3 Data and Features

For our investigation of group formation patterns in WORLD OF WARCRAFT®, we collected a large corpus of player logs from <http://www.warcraftrealms.com>. Our corpus covers the period from 2005 (when WORLD OF WARCRAFT® was released) to early 2009. It contains records of online appearances of players from European and United States WORLD OF WARCRAFT® realms. Each record contains the player’s name, level, class, as well as information on guild membership. In total, we gathered 192,000,000 recordings of 18,000,000 characters belonging to 1,400,000 guilds. Since we can infer from this data when characters joined or left a guild, how many characters were with a guild at what time, and how experience was distributed among the members of a guild, the data roughly summarizes social in-game activities.

Since a character’s experience level provides a measure of skill, a guild formed by more higher level characters is more likely to succeed whereas a guild of only low level characters is literally excluded from certain parts of the game. The distribution of experience

¹Note that the famous facebook application *FarmVille* is not a multiplayer game.

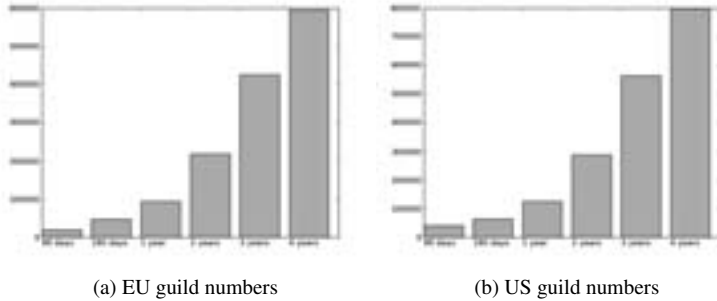


Figure 1: Growth of the total number of guilds in WORLD OF WARCRAFT® . For the US and the EU realms, the increase is surprisingly similar and exponential in nature.

levels within a guild therefore provides a feature to assess the guild in terms of in-game success (see Fig. 2). If we compute an experience histogram for a guild, it will also characterize the evolutionary state of the guild. This is regardless of whether we compute separate histograms for consecutive observations from distinct time slices, or if we compute a single histogram for the overall monitoring period: consider the example of a guild newly formed by several level 80 characters. There will be no activity of level 10 players in this guild and the corresponding histogram bin will be empty. A guild originally formed by level 10 players, on the other hand, is likely to evolve over time so that in the end, its histogram may also contain observations of players of level 20 to 80.

4 Results

The results we present in the following were obtained using convex-hull non-negative matrix factorization (CH-NMF). This technique has recently been introduced as an efficient approach towards finding meaningful lower dimensional representation of massive amounts of data. In contrast to most known clustering techniques, it looks for the most extreme data points rather than for local means. Using CH-NMF, we can express every data point as a convex combination of the resulting extreme prototypes. This, in turn, allows for intuitive interpretation of the data because human cognition and language, too, often relies on extremes (consider the example of an almost empty glass, or a bottle that is half full). Due to lack of space we refer the reader to [TKB09] for the intricate mathematical details of the method.

We applied CH-NMF to 1,400,000 guild histograms that summarize data covering a period of 4 years. All results reported here were obtained by parameterizing CH-NMF to produce 8 basis vectors. Note that we experimented with different numbers of basis vectors and found that larger numbers hamper visualization whereas smaller numbers fail to capture the data variability. The 8 basis vectors used in this study are shown in Fig. 2. Using

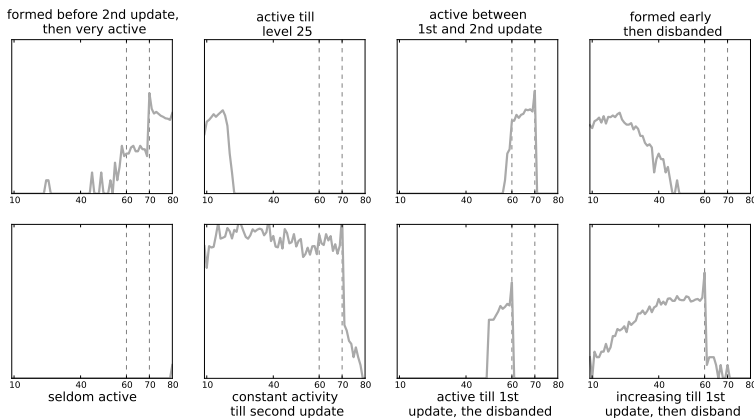


Figure 2: Basis vectors resulting from the application of CH-NMF to the WORLD OF WARCRAFT® guild database. The x-axis denotes experience levels, the y-axis denotes the number of observations per level. These histograms represent *archetypal* guilds and were automatically extracted from 1,400,000 data points.

natural language, these archetypal guild histograms can be paraphrased as “active from 10 to 80”, “active till 2nd update, then disbanded”, “formed early then disbanded”, “seldom active”, “increasing till 1st update, then disband”, “active between 1st and 2nd update”, “formed before 2nd update, then very active”, and “increasing activity, then disbanded”.

Figure 4 shows projections of guilds in European realms into the space spanned by the CH-NMF basis vectors. The projections show the distribution of guilds w.r.t the archetypal guilds after 60, 120, 240, 480, 720, and 1440 days, respectively. Note that each plot shows an 8 dimensional space visualized in a 2D plane. While this introduces distortions, it still preserves the main characteristics of the guild space.

It is noticeable that the number of guilds increases considerably over time (see also Fig. 1). Moreover, with more and more guilds to observe, the guild space becomes more densely covered. Interestingly, most guilds cluster close to the category “seldom active”. Only a rather small number of guilds (still many thousands) do not at least in part belong to this category. One explanation may be found in the exponential growth of the number of guilds. Since the growth rate of the number of players (not shown due to lack of space) is slower, it appears that formation of new guilds and abandoning of existing guilds are rather common occurrences in the game. Comparing European and American realms (see Fig. 3), we find similar growth patterns and no qualitative differences between the distributions.

5 Conclusion

This paper presented first results of a comprehensive study to understand general group formation processes MMORPGs. To the best of our knowledge, this is the first time that a

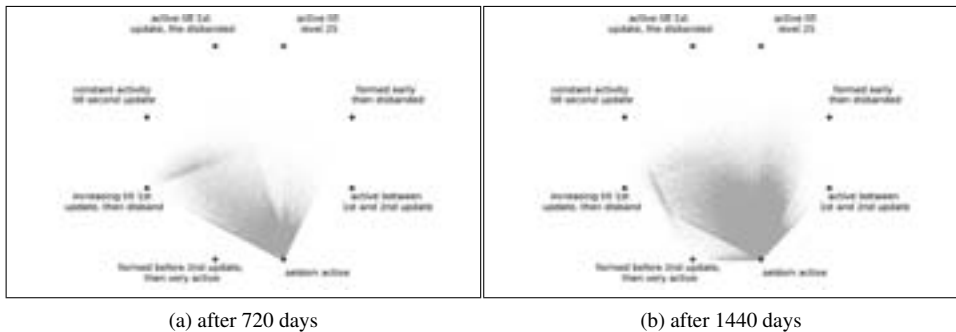


Figure 3: Distribution of American guilds in an 8 dimensional space spanned by archetypal guilds. The two plots show the situation after 720 and 1440 days, respectively. A qualitative difference to the European realms cannot be noticed.

vast amount of data was used for categorizing types of groups and their distribution over time. Applying convex-hull NMF, we determined 8 archetypal guilds and found there is a strong tendency towards more casual guilds. Our study of the temporal evolution of guilds revealed that from the release of the game onwards, most players joined guilds that did never evolve towards serious or even professional competition. Interestingly, this holds for American and European guilds alike, for we were not able to discover cultural differences. For the design of future games, we thus conclude that it is of major importance to cater to the needs of the casual gamer.

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Figure 4: Temporal evolution of the distribution of European guilds in an 8 dimensional space spanned by archetypal guilds. Shortly after the release of the game, most existing guilds were composed of casual players, i.e. they cluster around the *seldom active* archetype. With increasing time, the guild space becomes more densely covered. In particular the release of the first update is noticeable. However, even after four years, the vast majority of guilds consist of players that apparently play for fun rather than professionally and are therefore not very active.