

Gaming Research

http://www.pds.ewi.tudelft.nl/~iosup/research_gaming.html

Rationale

why and how is this work relevant?

Massively Multiplayer Online Games (MMOGs) have recently emerged as a novel Internet-based entertainment application. Hundreds of MMOGs already serve tens of millions of paying customers world-wide, with virtual worlds such as World of Warcraft and Runescape hosting daily several millions of players. These players want fast-paced entertainment delivered through the Internet, which raises important content and resource requirements; when these are not met in full and on time, players will quit. However, the current industry approach in addressing these requirements has high cost and limited scalability. The high cost makes the market inaccessible for amateur and small game developers. The limited scalability means that even the largest game developers cannot support this rapidly growing community. We aim to investigate scalable, dependable, yet low-cost computational technologies for MMOGs.

Recently, a social component was added to MMOGs---Massively Social Gaming defines MMOGs in which the social interaction between players enhances and extends the gameplay experience, not the least through emergent behavior. We aim to investigate the social component of MMOGs, and to understand how to leverage it to make the lives of MMOG players better.

As a third main goal, we would like to better integrate gaming into education (for a complex set of reasons that include but go beyond this rationale).

People

who is part of the group?

- **Undergraduate Students:** Adrian Lascateu, Alexandru Dimitriu (Politehnica University of Bucharest, Romania).
- **Graduate Students:** Vlad Nae (U. Innsbruck, Austria).
- **Collaborators:** [Dick Epema](#), [Henk Sips](#) (both TU Delft), Thomas Fahringer, Radu Prodan (both U. Innsbruck, Austria), Nicolae Tapus, Vlad Posea, Mihaela Balint (Politehnica University of Bucharest, Romania).
- **Yours truly:** [Alexandru Iosup](#).

Main Research Questions

what do we try to achieve?

1. **What are the characteristics of real MMOG workloads?** Much effort has been put into characterizing the workloads of MMO Role Playing Games, a popular branch of MMOGs. However, many questions remain unanswered before the characterization is complete. What are the differences between MMOGs and other Internet-based applications? What are the characteristics of different types of MMOGs?
2. **How to evaluate the performance of a system, algorithm, or mechanism designed for MMOGs?** A major impediment to developing the area of MMOGs is the lack of an accepted method to evaluate the impact of new findings in system, algorithm, and mechanism design. How to evaluate the performance of MMOGs using simulations? Or real system experiments? Or analytical models?
3. **What are the characteristics of the social networks present in MMOGs?** While researchers have investigated the structure of (social) networks for decades, the activity characteristics and the community structure of online social gaming remain relatively unknown. What are the

unique characteristics of the MMOG community? What characteristics do MMOG communities share with traditional (online) communities such as FaceBook, Youtube, Microsoft Messenger, and Flickr?

4. **Can MMOGs make use of clouds?** As a consequence of their internal organization or of the policies of existing data centers towards hosting MMOGs, many MMOG operators have to maintain large computing infrastructures, either self-owned or leased over long periods of time. A possible alternative is to use resources and services provisioned from commercial clouds, perhaps as a complement to existing infrastructure and services. But which MMOGs can now leverage cloud infrastructure and platform services? Can MMOGs function well under the availability and performance profiles of the current production cloud services? Can we improve the MMOG analytics to MMOG social analysis?

Main Achievements

what did we do?

1. **Collected input to characterize the workloads of several real MMOGs.** We have collected long-term traces that can be used to characterize the workloads of several real MMOGs. We have already used [1,7] one such trace to uncover the interaction between players as a major strain to the system; this was ignored in previous work on MMOG workloads, and also helps distinguishing MMOGs from well-studied Internet-based applications such as Web servers.
2. **Designed CAMEO, a framework for continuous analytics for massively multiplayer online games (MMOGs) using cloud resources.** We have provided [4] a first estimate of the feasibility and costs of performing continuous analytics for MMOGs on cloud resources.
3. **Within edutain@grid, analyzed the feasibility of running massively multiplayer online games (MMOGs) on cloud resources.** We have analyzed [1,7] the potential gains of running MMOGs on cloud resources, based on an ideal cloud/data center model. We have started to investigate [5] the impact of virtualization on running MMOGs on cloud resources.
4. **Analyzed several aspects of the social component for the BBO / BBO Fans online bridge communities.** We have analyzed [11] the community structure and the ability of the community to coordinate its activity (self-organization, synchronization) among tens of thousands of players.

Main Findings

what did we find?

1. "It is possible to automatically generate at massive scale puzzle instances of commercial quality on grid infrastructure." [6,7]
2. "Otherwise unused (spare) resources may be used to solve complex puzzle instances at almost zero cost and with reduced overhead, if appropriate resource allocation policies are used." [3]
3. "The performance of the production cloud services offered by Amazon Web Services and Google App Engine varies over time, and can alter significantly




the performance and cost profiles of large-scale applications such as social gaming (state management, trading virtual goods, etc.)." [9]

4. "Continuous analytics for MMOGs on cloud resources is feasible and shows good promise of being cost-effective." [4]
5. "Dynamic resource allocation from clouds can lead to a tenfold reduction of the platform operation costs for massively multiplayer online games (MMOGs). However, virtualization overheads due to large-scale system size and to coverage of a wide group of user requirements through the same set of virtual resources may cancel out some of the benefits of using cloud infrastructure and platform services." [2,5,8]
6. "Games can be used as and are a good vehicle for teaching the principles of Software Engineering, provided the curriculum uses the appropriate games for teaching the right topics." [1]
7. "Without adequate resource virtualization policies, the performance limitations threaten to cancel out the benefits of resource virtualization." [5,10]
8. "For online bridge, the following player behavior type are common: community builder, community member, random player, faithful player. Moreover, online bridge communities are coordinated (self-organized, synchronized) even for large numbers of players (tens of thousands). " [11]



Publications

journals/conferences/workshops | [all PDS group publications](#) | [my publications \(with BibTeX\)](#) | [my DBLP entry](#) | [my ACM DL entry](#)




2010 [details](#) <-- click to see more details

- [11] V. Posea, M. Balint, A. Dimitriu, **A. Iosup**, [An analysis of the BBO fans online social gaming community](#), In Roedunet International Conference (RoEduNet), 2010 9th, Jun 24-26, 2010 (accepted). 
keywords massively social gaming, social network analysis, BBO Fans, social networks, massively multiplayer online games, game analytics, MMOG analytics, MSG analytics..
- [10] **A. Iosup**, Vlad Nae, and Radu Prodan, [The Impact of Virtualization on the Performance and Operational Costs of Massively Multiplayer Online Games](#), In Int. J. Adv. Media and Comput. (IJAMC), 2010 (accepted, in print). 
keywords massively multiplayer online games, platform, virtualization, cloud computing. **journal**
- [9] **A. Iosup**, N. Yigitbasi, and D. Epema, [On the Performance Variability of Production Cloud Services](#), (under submission). **keywords** social gaming, cloud computing, performance variability, social applications, Amazon Web Services, Google App Engine.
- [8] R. Prodan, V. Nae, and **A. Iosup**, [Dynamic Resource Provisioning in Massively Multiplayer Online Games](#), In IEEE Transactions on Parallel and Distributed Systems (TPDS), 2010 (accepted). 
keywords massively multiplayer online games, platform, virtualization, cloud computing. **journal**
- [7] **A. Iosup**, [POGGI: Generating Puzzle Instances for Online Games on Grid Infrastructures](#), In Concurrency and Computation: Practice and Experience (CPE), 2010 (accepted, in print). 
keywords puzzle instance generation, massively multiplayer online games, content generation, platform, grid computing, cloud computing. **journal**

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- [9] **A. Iosup**, N. Yigitbasi, and D. Epema, [On the Performance Variability of Production Cloud Services](#), (under submission). **keywords** social gaming, cloud computing, performance variability, social applications, Amazon Web Services, Google App Engine.
- [8] R. Prodan, V. Nae, and **A. Iosup**, [Dynamic Resource Provisioning in Massively Multiplayer Online Games](#), In IEEE Transactions on Parallel and Distributed Systems (TPDS), 2010 (accepted, in print). 
keywords massively multiplayer online games, platform, virtualization, cloud computing. **journal**
- [7] **A. Iosup**, [POGGI: Generating Puzzle Instances for Online Games on Grid Infrastructures](#), (under submission). 
keywords massively multiplayer online games, game content generation, grid computing, resource management, workflows. **journal**

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- [6] **A. Iosup**, [POGGI: Puzzle-Based Online Games on Grid Infrastructures](#), In Euro-Par Conference 2009, Aug 25-29, 2009 (accepted). **Distinguished Paper Award!** 
keywords massively multiplayer online games, game content generation, grid computing, resource management, workflows. **Award**
- [5] V. Nae, **A. Iosup**, R. Prodan, and T. Fahringer, [The Impact of Virtualization on the Performance of Massively Multiplayer Online Games](#), In ACM/IEEE Symposium on Network and Systems Support for Games (NetGames 2009), Paris, France, November 23-24, 2009 (accepted, acceptance ratio **27%**=10/37). 
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- [4] **A. Iosup**, [CAMEO: Continuous Analytics for Massively Multiplayer Online Games on](#) 

[Cloud Resources](#), In 2nd International Workshop on Real Time Online Interactive Applications on the Grid (ROIA 2009), Delft, the Netherlands, August 24, 2009, Springer, LNCS vol.?, p.1--10 (accepted, in print).

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- [3] O. Sonmez, B. Grundeken, H. Mohamed, **A. Iosup**, and D.H.J. Epema, [Scheduling Strategies for Cycle Scavenging in Multicenter Grid Systems](#), In the IEEE International Symposium on Cluster Computing and the Grid (CCGrid'09), May 18-21, 2009 (accepted; acceptance ratio **21%**=57/271).

keywords cycle scavenging, grid computing, scheduling, game solving, [eternity ii](#).



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- [2] V. Nae, **A. Iosup**, S. Podlipnig, R. Prodan, D.H.J. Epema, T. Fahringer, [Efficient Management of Data Center Resources for Massively Multiplayer Online Games](#), In the ACM/IEEE SuperComputing Conference on High Performance Networking and Computing (SC'08), Nov 10-16, 2008 (accepted; acceptance ratio **20%**).

keywords massively multiplyer online games (MMOG), cloud computing, data centers, virtual environments, resource provisioning, games.



2004 [details](#) <-- click to see more details

- [1] **A. Iosup**, A.L. Varbanescu, T. Ionescu, N. Tapus, [Gaming for Knowledge --- Curriculum on Programming Fundamentals and Technologies](#), In Proceedings of the The Fourth International Conference, Internet---Education---Science IES'04, 5-9 October 2004, Vinnytsia, Ukraine.

keywords gaming, teaching, software engineering.

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