CS4344
Networked and Mobile Games
About CS4344
• To learn about technical issues and solutions in networked/mobile game development

• Complements CS4213 “Game Development”
We are at the frontier of the topic
No perfect textbook for this class.
Networking and Online Games: Understanding and Engineering Multiplayer Internet Games

Author: Armitage, Grenville.
Title: Networking and online games: understanding and engineering multiplayer Internet games / Grenville Armitage, Mark Claypool, Philip Branch.

Click on the following to:
View the electronic version (full-text) via Wiley-Interscience

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Descrip.: ix, 218 p. : ill. ; 25 cm.
Bibliog.: Includes bibliographical references and index.
Note: Online version restricted to NUS staff and students only through NUSNET.
Also available in online version.

Subject: Computer games -- Programming.
Show similar items
TCP/IP (Computer network protocol)
Internet games.

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Branch, Philip.

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Networking and online games [electronic resource]
Additional materials comes from online resources and research papers.
“We don’t know what we are doing. That’s why it’s research”
So, don’t believe everything you read in a paper without thinking.
I am learning about the area myself.
CS4344 Assessment

- Final Exam: 25%
- Assignments: 40%
- Quizzes/Midterm: 35%
About CS4344

- Who: Ooi Wei Tsang (ooiwt)
- Where: SR2 (COM1 #02–04)
- When: Mon 1000–1200
- Workload: Lecture (2hr) Preparation (6hr) Homework (2hr) per week
- CA: Open Book Exam (35%) Assignments (40%) Quizzes/Midterm (25%)
- Objective: This module aims at providing students a deep understanding of various technical issues pertaining to the development of networked games and mobile games. Students will be exposed to concepts from distributed systems, operating systems, security and cryptography, networking and embedded systems. In particular, issues such as game server architectures (mirrored, centralised, peer-to-peer etc.), consistency management (bucket synchronisation, dead reckoning etc.), interest management, scalability to large number of clients (C10K problem), cheat prevention and detection, power management, will be discussed.

Topics

- Communication architecture of networked games
- Synchronization protocols/consistency maintenance
- Interest management
- Scalability issues
- Cheat prevention and detection.
- Case studies

Related Courses (Elsewhere)

- COMP 521 Modern Computer Games at McGill University
- CSC337 Computer Games Development at Newcastle University
- CS5961 Networked Game Design at University of Utah
- CS679 Computer Game Technology at University of Wisconsin

http://www.comp.nus.edu.sg/~cs4344
Learning Pyramid
(percentage of retention)

- Lecture: 5%
- Reading: 10%
- Audiovisual: 20%
- Demo: 30%
- Discussion: 50%
- Practice Doing: 75%
- Teach Others: 80%
Questions?
“Networked Games” ?
Games that involved more than one hosts communicating over the network
INTERACTIVE SUDOKU

sudoku

No 27 Tuesday, August 7th 2007

Submit  Print  Reset  Help
Games that involved more than one player communicating over the Internet/LAN
Turn-based Multi-player Games
Real-time Multi-player Games

We focus on real-time multi-player games in CS4344
MMORPG

First Person Shooter

Real-time Strategy Game

We focus on real-time multi-player games in CS4344
and other similar applications
Military Training Simulator

Networked Virtual Environment

http://www.archiveshub.ac.uk/blog/2007_04_01_archiveshubblog_archive.html
interactive,
distributed simulations
An Abstract Model for Networked Games
A distributed simulation on a host can be viewed as a sequence of states the changes over time, in reaction to events.
State can be discrete or continuous.
Example events: user input, timer, messages from other hosts.
A host may send messages to other hosts.
Example: Two-player Pong

**States**: position of paddles and ball (derived from their velocities)

**Events**: movement
A moves peddle  Ball hits peddle

Player A

Player B

B moves peddle
Design Requirements
Responsive

(reacts to player’s action)
Consistent

(players have the same view of the game state)
Cheat Proof

(player cannot cheat)
Fair

(should be fair to all players)
Resource Efficient

(minimal amount of network traffic, CPU cycles, memory)
Scalable

(able to handle large number of players)
Robust

(able to handle failure gracefully)
Simple

(easy to implement/maintain)
Why Difficult?
Internet is a best-effort network
Packets take time to travel.
Packets can be dropped or corrupted
Ideally, updates should reach other players immediately, so that states are the consistent at all time.
Delay and loss leads to inconsistent states.
Number of players can be huge
WORLD OF WARCRAFT® SURPASSES 9 MILLION SUBSCRIBERS WORLDWIDE

IRVINE, Calif. – July 24, 2007 – Blizzard Entertainment, Inc. announced today that World of Warcraft®, its award-winning massively multiplayer online role-playing game (MMORPG), has reached a new milestone, with a player base now totaling more than 9 million subscribers worldwide. The company is currently working with its partner for World of Warcraft in China, The9, to prepare the game's first expansion, World of Warcraft: The Burning Crusade™, for launch in mainland China and anticipates an influx of new and returning subscribers in conjunction with that event.

"We're thrilled that gamers around the world have continued to embrace World of Warcraft so enthusiastically," said Mike Morhaime, president and cofounder of Blizzard Entertainment®. "We've worked hard to provide a compelling experience for our players, and we plan to continue updating the game with exciting new content for them to enjoy for many years to come."

Since debuting in North America on November 23, 2004, World of Warcraft has become the most popular MMORPG around the world. It was the bestselling PC game of 2005 and 2006* and has remained at or near the top of the weekly PC-game sales charts for much of 2007 as well. Blizzard's Burning Crusade expansion released to critical acclaim in several regions earlier this year and shattered PC-game sales records in North America and Europe, with nearly 2.4 million copies sold in its first 24 hours of release and approximately 3.5 million in its first month. World of Warcraft is available in seven different languages and, in addition to North America and Europe, is played in mainland China, Korea, Australia, New Zealand, Singapore, Thailand, Malaysia, and the regions of Taiwan, Hong Kong, and Macau.

For further information on World of Warcraft and The Burning Crusade, please visit the official website at www.worldofwarcraft.com. To keep pace with the continued growth of World of Warcraft as well as development on other Blizzard games, the company is currently hiring for numerous open positions -- more information on available career opportunities at Blizzard can be found at http://jobs.blizzard.com.
North America and Europe become latest territories to hit major milestone

AUSTIN, Texas, November 15, 2006 — NCsoft® today announced Lineage® II, with more than 14 million customers worldwide, has reached 100,000 active players in North America and Europe. The title started as a cult favorite of many massively multiplayer online (MMO) gamers in North America and Europe and continues its success as the premiere player-versus-player (PvP) online role playing game for the elite PvP player.

Lineage II was launched in North America in 2004 as a modest success. The game has since built itself into one of the top MMOs in the western markets, with a 25 percent growth rate in 2006. NCsoft credits the growth of the game to regular updates and free expansions to the product, and delivering features requested by players. Additionally, NCsoft has implemented aggressive policies to eliminate activities like “botting” and “farming” which give some players unfair advantages over legitimate players.

“This is a great franchise that has dominated Asia and now we are seeing very positive growth in North America and Europe,” said Robert Garriott, CEO for NCsoft North America. “This game took a little time to find its audience because it is such a rich, tough and complex world. It is not a game for the feint of heart, but we worked to adjust the game to fit our customers and we’re seeing more players view it as the pinnacle of MMO gaming. More and more players are
EVE Online Tops 10,000 Simultaneous Players In The Same World

REYKJAVIK, Iceland, April 26
CCP announced today that EVE Online has broken through the 10,000 simultaneous users threshold, when 10,396 users played EVE Online at the same time in the same world. This confirms that a "one world" game design is not just a vision but a reality and breaks the boundaries a multi-world (shards) game design places on players.

"The EVE 'one world' design has enabled CCP to create the single largest MMORPG world to date according to our information," said Hilmar Veigar Pétursson, CTO at CCP. "There have often been times when we thought this would not be possible, but by working closely with our community we have been able to create a game platform that players seem to enjoy, and is capable to handle the current and future influx of new users."

In conjunction with the recently announced availability of online distribution and the availability of the Tech Level 2 Expansion Pack, EVE Online has emerged as on the fastest growing MMORPG with a prolific and multi-faceted player base from across the globe all connected to a single game world, something that is rarity in the MMORPG genre.

"Although having more than 10,000 players in the same world is a technical and architectural feat," said PhD Kjartan Pierre Emilsson, CCP’s Lead Game Designer. "The most important thing is what this means to the players. It is well known that the richness and variety of interaction available between people rises dramatically with the number of people that can actually interact. With ten thousand people you have over hundred million possible link options. If you are notorious in EVE you are so to the whole population of EVE, not just in your little 'shard' of the game."

About EVE Online

EVE Online is the next generation in massive multiplayer online games. Set in a world of galactic magnitude, governed by a hyper capitalistic economy. Your aim is to establish yourself as a major mover and shaker, trusted by your friends and respected by your enemies. Your main tools to accomplish this, apart from the whole panoply of sophisticated equipment, space ships and corporations will be your business acumen and social skills, Machiavellian thinking and cunning combat strategies.
Huge cost in network/CPU resources
Users are competitive
Players cheat to gain advantage

http://www.msxsecurity.com/bbf21421.jpg
Games should be fair to all players
network delay and losses
large number of users
cheating
Communication Architectures
Centralized Architecture
Client sends command to the server. Server computes new states and updates clients with new states.
Client sends command to the server. Server computes new states and updates clients with new states.
“Smart” server, dumb clients

Role of server
Maintain states
Simulate games
Notify clients
Resolve conflicts
Dumb server, smart clients

**Role of server**
- Notify clients
- Resolve conflicts

**Role of clients**
- Maintain states
- Simulate games
Clients simulate and maintain states. Server resolves conflicts and forwards updates to clients.
Peer-to-Peer Architecture
Peer-to-Peer Architecture

Role of clients
- Notify clients
- Resolve conflicts
- Maintain states
- Simulate games
Clients simulate the game, maintain states, and forward message to each other.
Maintaining consistency is not trivial.
Centralized vs. Distributed
Latency
Robustness
Conflict/Cheating
Consistency
Accounting
Scalability
Complexity