Lecture 2

Lag
events

server

Collect Events

Simulate Games

State: Game States

Collect Events

Wait

Update State

Render

Wait

events

states
Demo:
Two-player Pong
Event Messages

{
    type: x,
    key1: value1,
    key2: value2..
}
{
    type: "move",
    x: 30
}

{
    type: "start",
}
{  
    type: "accelerate",
    vx: 30
}

{  
    type: "delay",
    delay: 100
}
{
    type: "update",
    ballX: 10,
    ballY: 10,
    myPaddleX: 10,
    myPaddleY: 400,
    oppPaddleX: 100,
    oppPaddleY: 0
}
Game States

Ball

\((x, y)\)

\((v_x, v_y)\)

moving?

Paddle

\((x, y)\)

\(v_x\)

Paddle

\((x, y)\)

\(v_x\)
Game Simulation:

move the paddles
move the ball
if hit walls or paddles, bounce
if miss, restart game
Received-Order Delivery

Server executes the events as they are received.
A

server

B
Unfair

Different users experience different response time (aka lag)
Idea:
Artificial Server Delay
Equalize response time for all players by delaying the processing of events from players.
Responsiveness

laggy game play annoys player
Idea:
Short Circuiting
Update states locally first, consolidate with server later.
events

Collect Events

Simulate Games

Update State

Render

Wait

server

Simulate Games

states

Collect Events

Simulate Games

Update State

Render

Wait
Demo:
Two-player Pong
What could go wrong?
Consider a FPS..

A

server

B

B shoots C
A shoots B, B killed
A shoots B, B killed

B shoots C

B killed by A
A shoots B, B killed

B shoots C

A

server

B

B shoots C

B killed by A
“A dead man that shoots”
How to mitigate?
Idea:
Local Lag
Update local state after some acceptable lag
Games can use audio/visual tricks to hide the lag.
What is acceptable lag?
User Studies on Acceptable Lag
Goal: How much lag is tolerable?
Method: User studies using Unreal Tournament 2003
Clients

Router

Add delay here

Server
Game Activity:
move and shoot
Movement Test: Construct obstacle course
Spin around and then jump, pick up the chain gun and ammo, and walk out to wards the door. Then translate up to the platform with the double damage, pick up the double damage (Figure 17), walk down the ramp, quad jump up to the steaming structure, jump off toward the alcove, run up and dodge through the alcove.
Over 200 users
Shooting Test:
Two players shooting at each other using precision weapon
These include the Minigun, capable of firing high volumes of bullets in a very short time, the Flak Cannon, used to scatter shards of metal in the general vicinity of your opponents, and the Rocket Launcher, able to load and launch up to three rockets at a time. Along with the Lightning Gun, UT2003's version of a sniper rifle, there are many ways for players to deal with their opponents.

In addition to the numerous maps, weapons and game play modes, UT2003 also comes standard with two more features: bots and mutators.

Bots are used when playing UT2003's single player, and bots are also used for mutators, which are custom modifications to the game environment that allow unique scenarios.
"latency as low as 100 ms were noticeable and latencies around 200 ms were annoying"
Read the paper for complete results.

Other conclusion: loss rate up to 5% has no measurable effects.
Method: User Studies using Warcraft III
Game Activity: build, explore, fight!
Finding: Players with larger delays see exactly the same events as players with smaller delays, only at a later time.
Finding: Latency of up to 800 ms has negligible effect on the outcome of Warcraft III.
Finding: Latency of up to 500 ms can be compensated by the players
Finding: Latencies between 500 and 800 ms degrade game experience.
Strategy is more important in RTS games, not reaction time.
Q: What is the acceptable lag?

A: Depends on the characteristics of game.
Assignment 2
Task 1

Find the acceptable lag for Pong.