當學術研究者遇見線上遊戲

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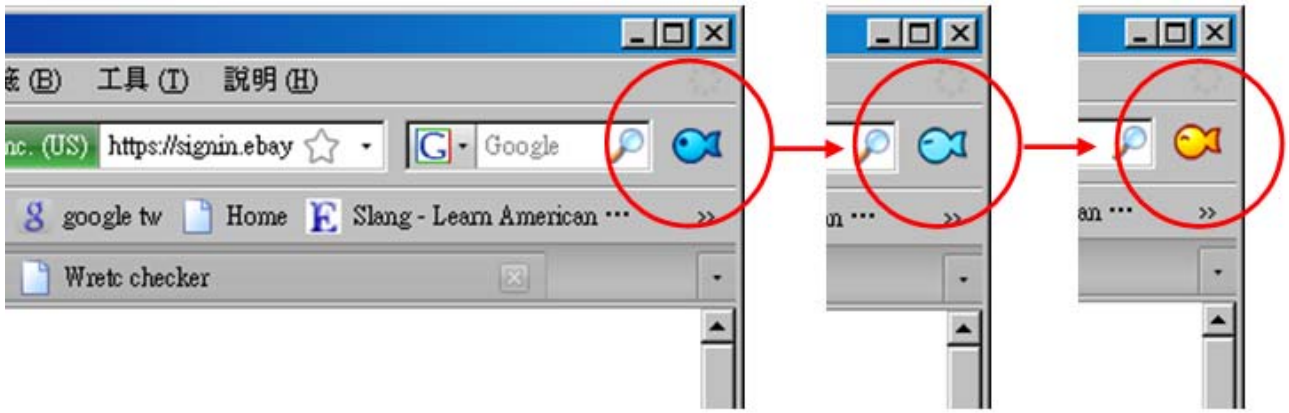
網路及多媒體系統
使用者滿意度

網路安全及使用者隱私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https://signin.ebay
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Slang - Learn American
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分析報告(可用滑鼠選擇名字或標籤)
真實姓名
李宛慈
可能姓名
李婉慈
可能名字
宛慈
無雙
國北
梯笛
國樂
暱稱
宛慈姐
酷弊
天阿
愛死
大美人
小丸子
小丸丸
南京大
宛慈姊
婉慈姐
大丸子
甜姐兒
特有標籤
丸子
無雙
笛子
國樂
蘋果
直笛
直屬
國北師
長笛
教育
目標
想走
姑姑
宇宙
底層
無双
旅行
知心啊
好典範
霹靂漂
竹笛家
丸
李婉慈
通用標籤
氣質
美女
古典
正妹
超級
姐姐
美眉
漂亮
妹妹
女孩
無敵
同學
國小
大學
甜美
學姊
漂漂
女人
老婆
正咩
偶像
好友
性感
姊妹
超正
永遠
好姐妹
女生
我們
老伴
國中


就對
兄弟
林小猴魔羯座
縣立鹿港
再用力
大林
左撇子
學妹
後悔
安達充
彰化縣
棒球
棒球問
小猴
浦澤直樹
浪費電影
漫畫
象迷
猴珮均
Hokiokla
無名小站情報分析事務所

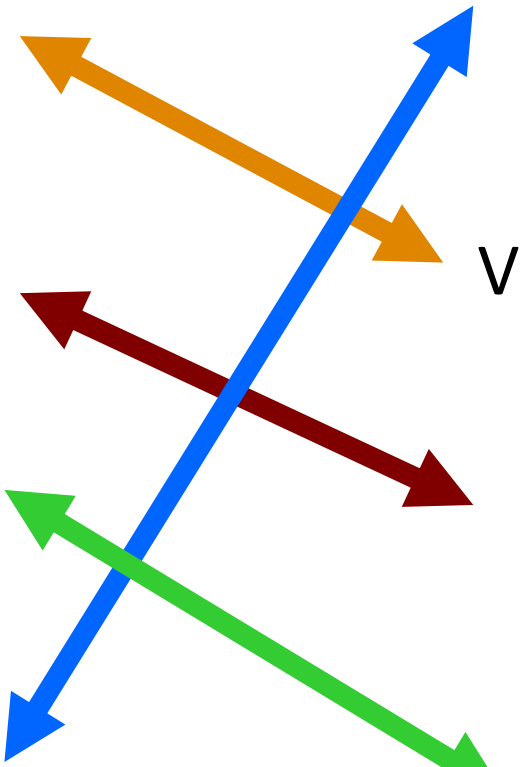
Entertainment Market Size (worldwide)

No. 2 US$ 42 billion

No. 3 US$ 35 billion

No. 1 US$ 63 billion

No. 4 US$ 27 billion



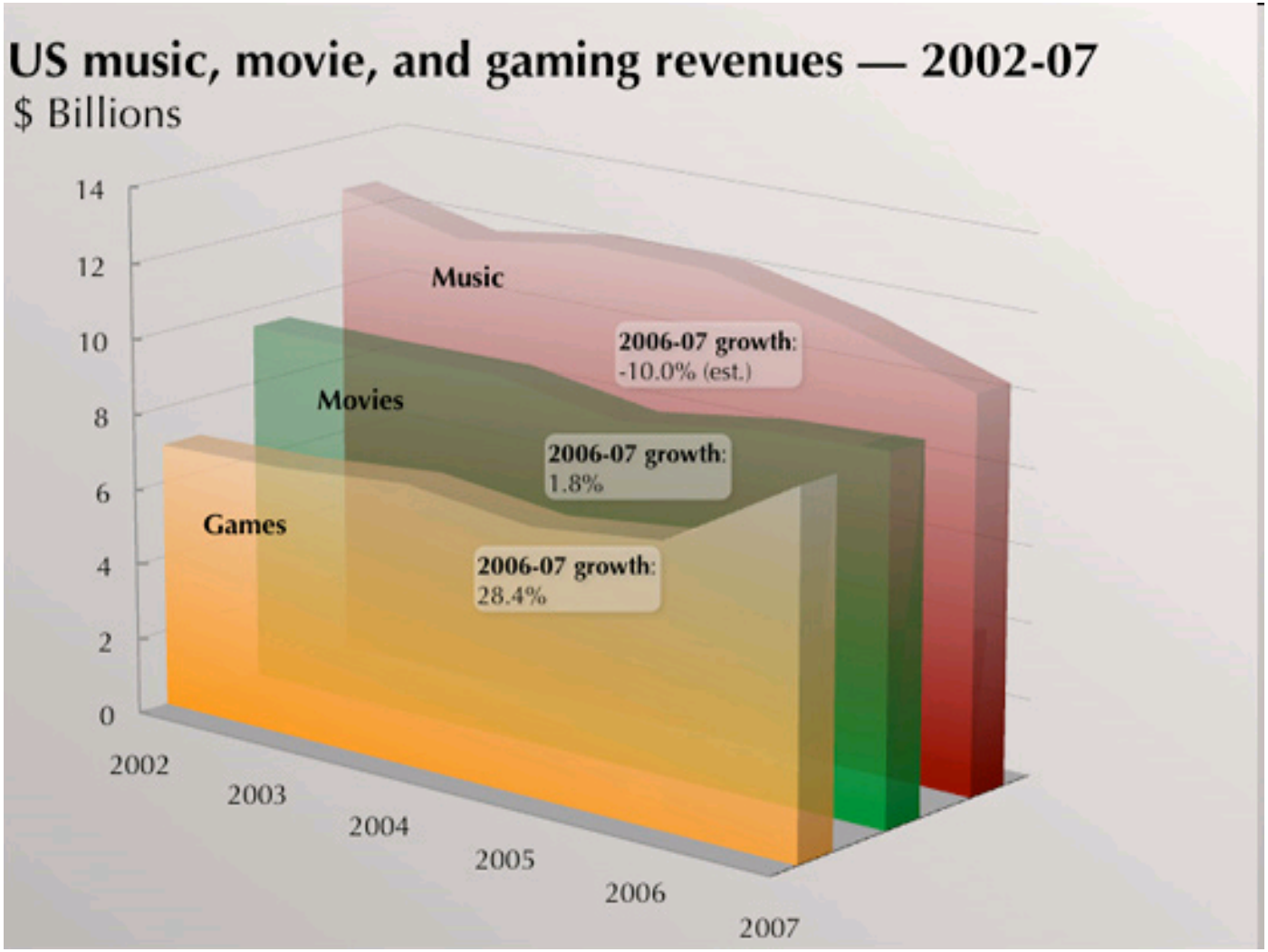
Movie

Video games

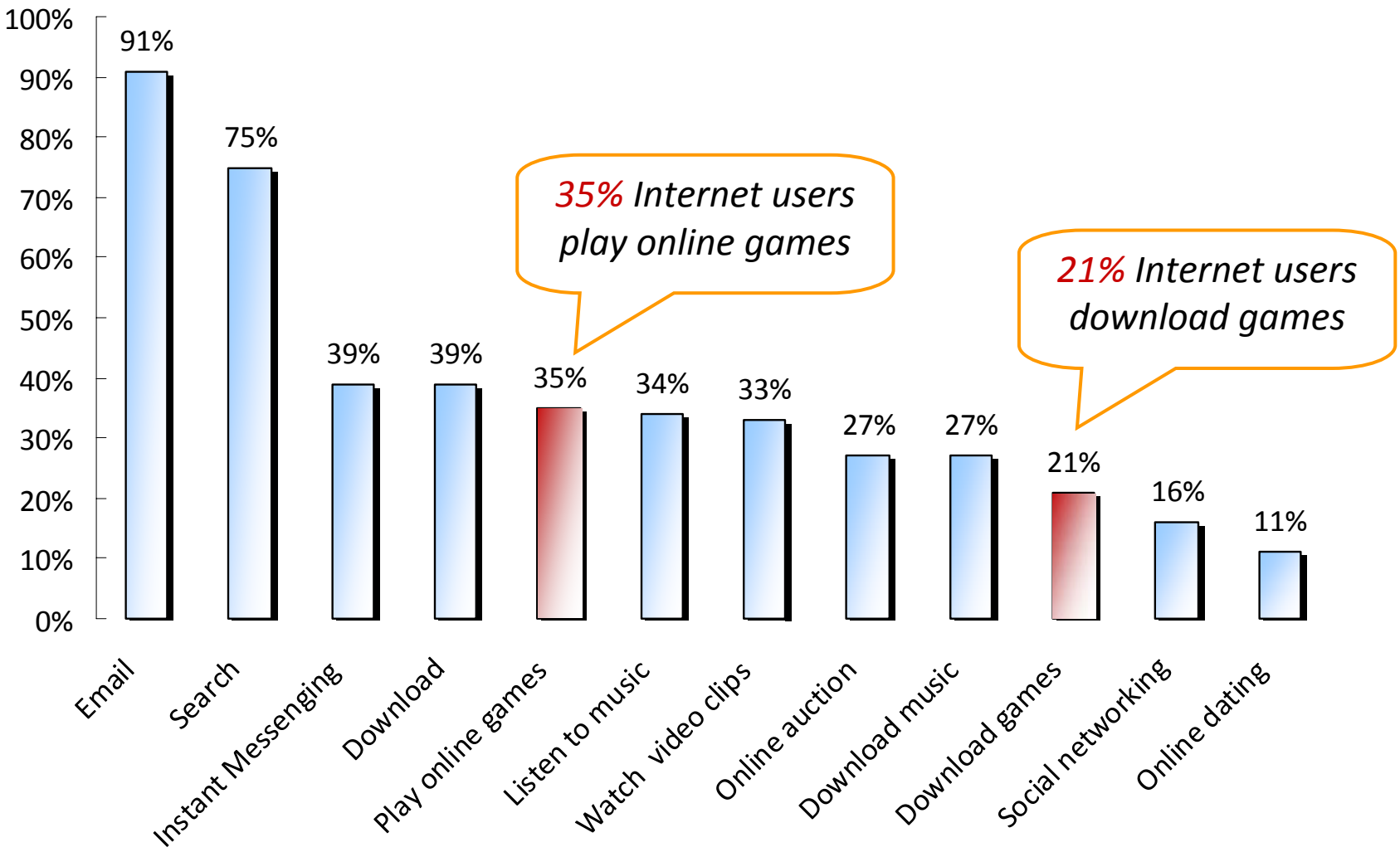
Music

Book

http://vgsales.wikia.com/wiki/Video_game_industry


US music, movie, and gaming revenues — 2002-07
$ Billions
14
12
10
8
6
4
2
0
Music
2006-07 growth:
-10.0% (est.)
Movies
2006-07 growth:
1.8%
Games
2006-07 growth:
28.4%
2002
2003
2004
2005
2006
2007

Online Gaming: A Major Internet Activity



Game Research: My Own Reasons

As A PC Gamer …

As A Programmer …

As A Researcher …

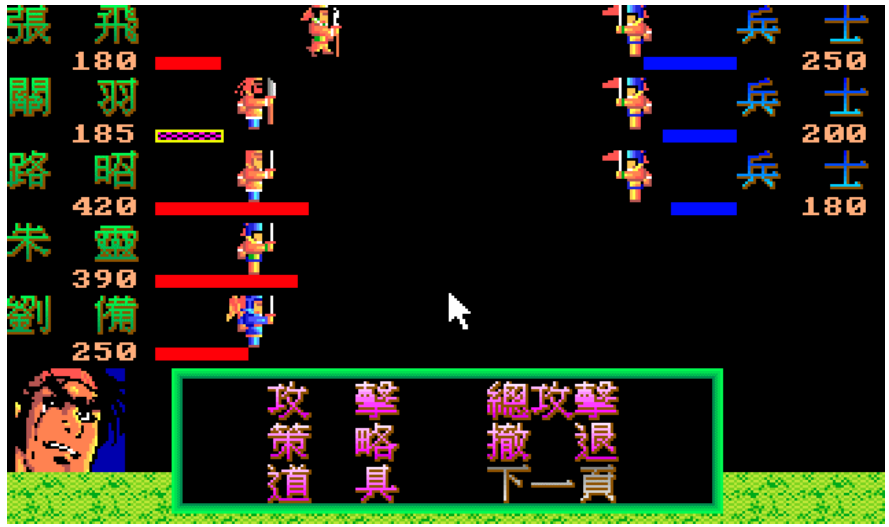
As A PC Gamer (1)

1988

1989

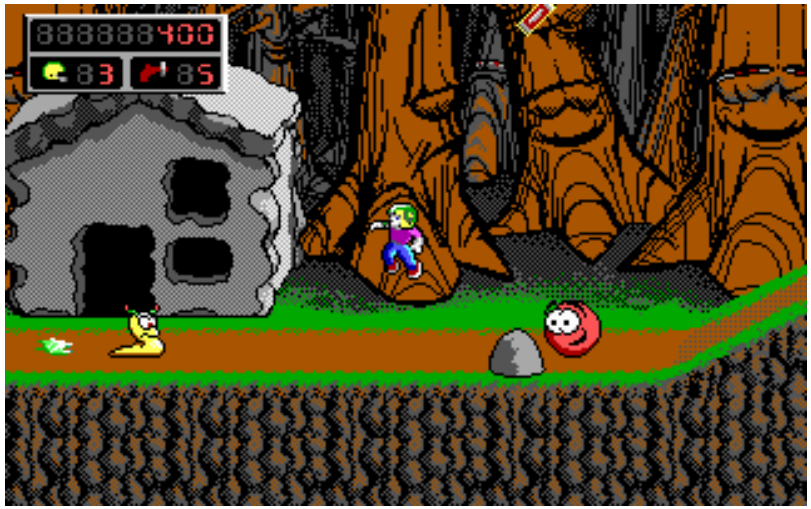
1990

1991



As A PC Gamer (2)

1990



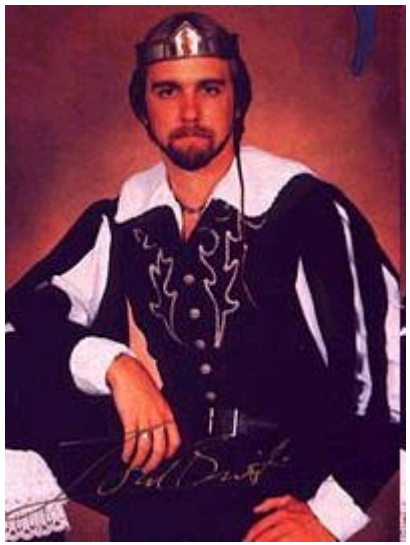
1992

1993

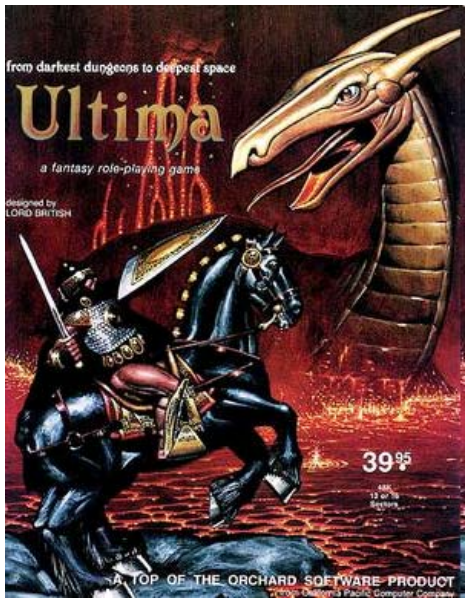
1998

As A Programmer (1)

- 10 歲寫 football game with ROM BASIC
- 國中寫對打遊戲 with dBASE & Pascal
- 高中寫 RPG with C & Assembly



Richard Garriott

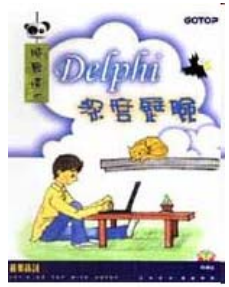


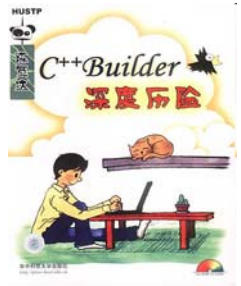
1980

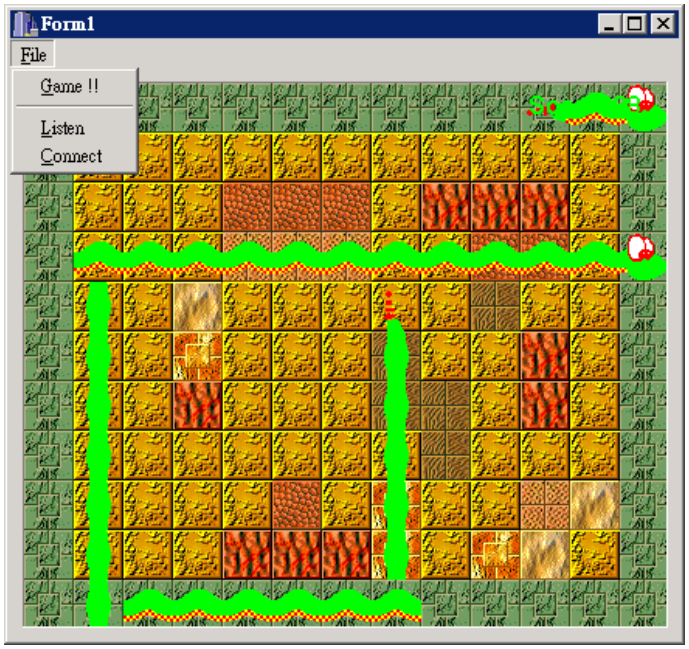
My Role Model in 1990

As A Programmer (2)

- 1999 – 2002 資策會教育訓練課程 (C/C++, Winsock Programming, Delphi, C++Builder) 夾帶遊戲設計課程
- 1999 – 2001《遊戲設計大師》專欄作家
- 2000 出版《Delphi 深度歷險》
- 2002 出版《C++Builder 深度歷險》





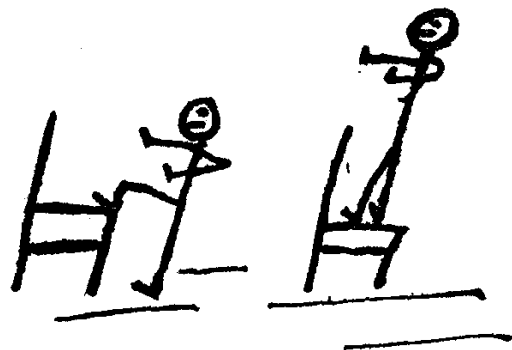


As A Researcher

- **A killer application**
  - 35% Internet users & larger business than movie & music
- **An emerging field**
  - E.g., IEEE Transactions on AI and CI in Games since Sep 2008
- **Asia-based researchers have some niches**
  - Large user base (50%)
  - Lots of local game companies
- **It's fun!**

Topics

1. 遊戲外掛偵測技術
2. 遊戲玩家的忠誠度分析
3. 網路品質對於遊戲玩家的行爲影響
4. 網路流量分析及通訊協定
5. 遊戲玩家社群分析
6. 自動漫畫製作技術



Security Topics

Game Bot Detection

Game Bots

- Game bots: automated AI programs that can perform certain tasks in place of gamers
- Popular in MMORPG and FPS games
  - MMORPGs (Role Playing Games)
    accumulate rewards in 24 hours a day
    ➔ break the balance of power and economies in game
  - FPS games (First-Person Shooting Games)
    a) improve aiming accuracy only
    b) fully automated
    ➔ achieve high ranking without proficient skills and efforts

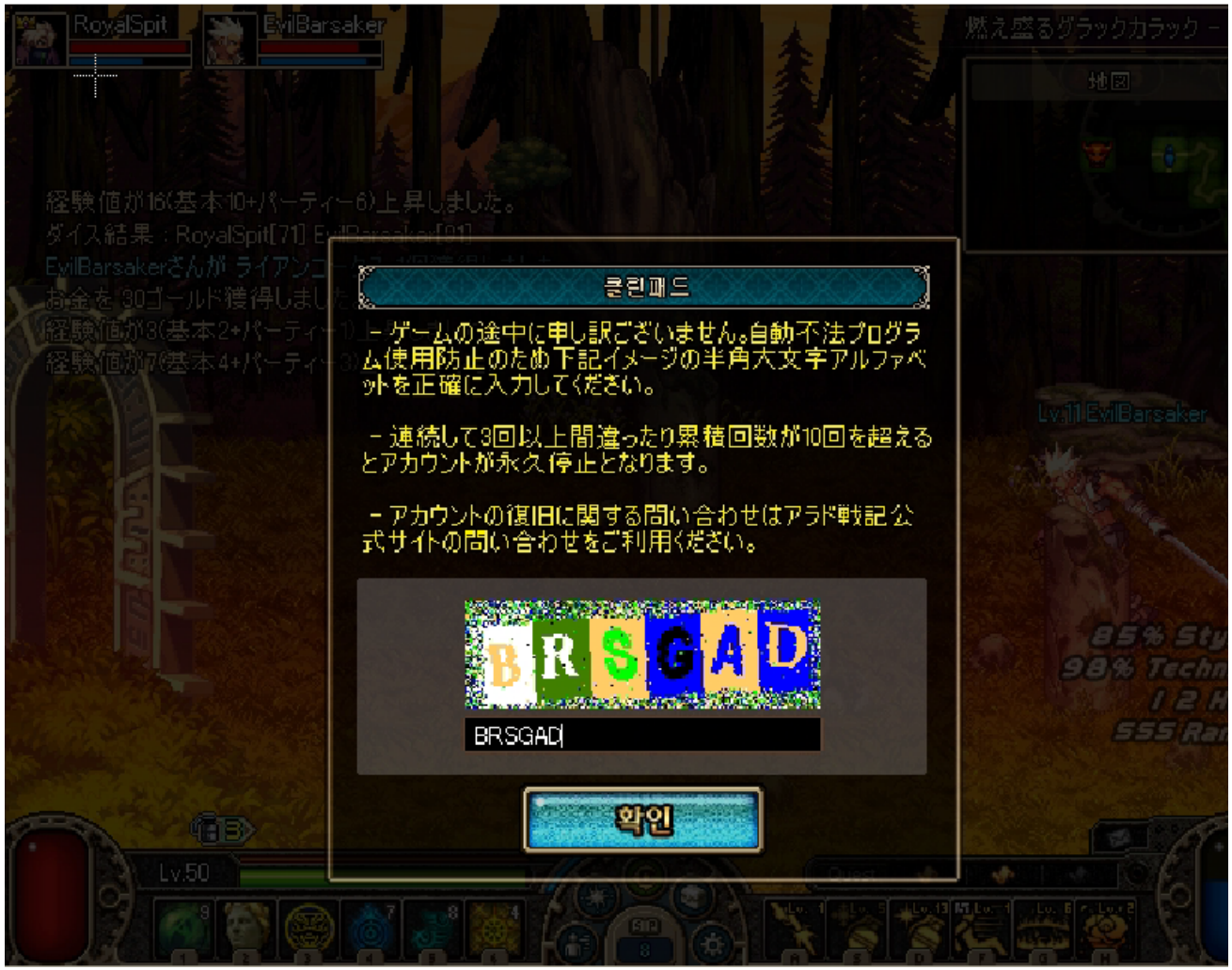
Bot Detection

- Detecting whether a character is controlled by a bot is difficult since a bot obeys the game rules perfectly
- No general detection methods are available today

- State of practice is identifying via human intelligence
  - Detect by "bots may show regular patterns or peculiar behavior"
  - Confirm by "bots cannot talk like humans"
  - Labor-intensive and may annoy innocent players

CAPTCHA in a Japanese Online Game

(Completely Automated Public Turing test to tell Computers and Humans Apart)



Our Goal of Bot Detection Solutions

- Passive detection

  ➔ No intrusion in players' gaming experience

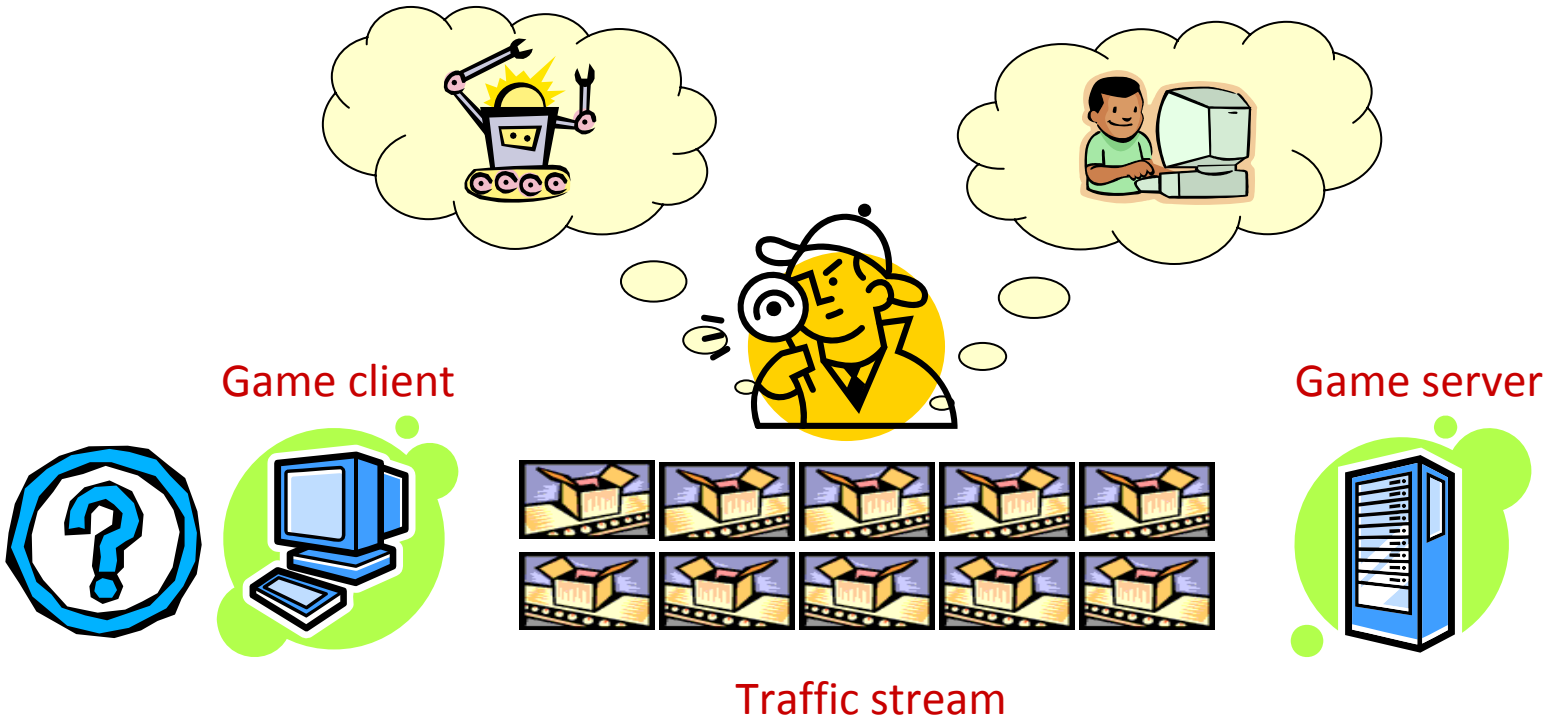
- No client software support is required

- Generalizable schemes (for other games and other game genres)

Our Solution I: Traffic Analysis

Q: Whether a bot is controlling a game client given the traffic stream it generates?

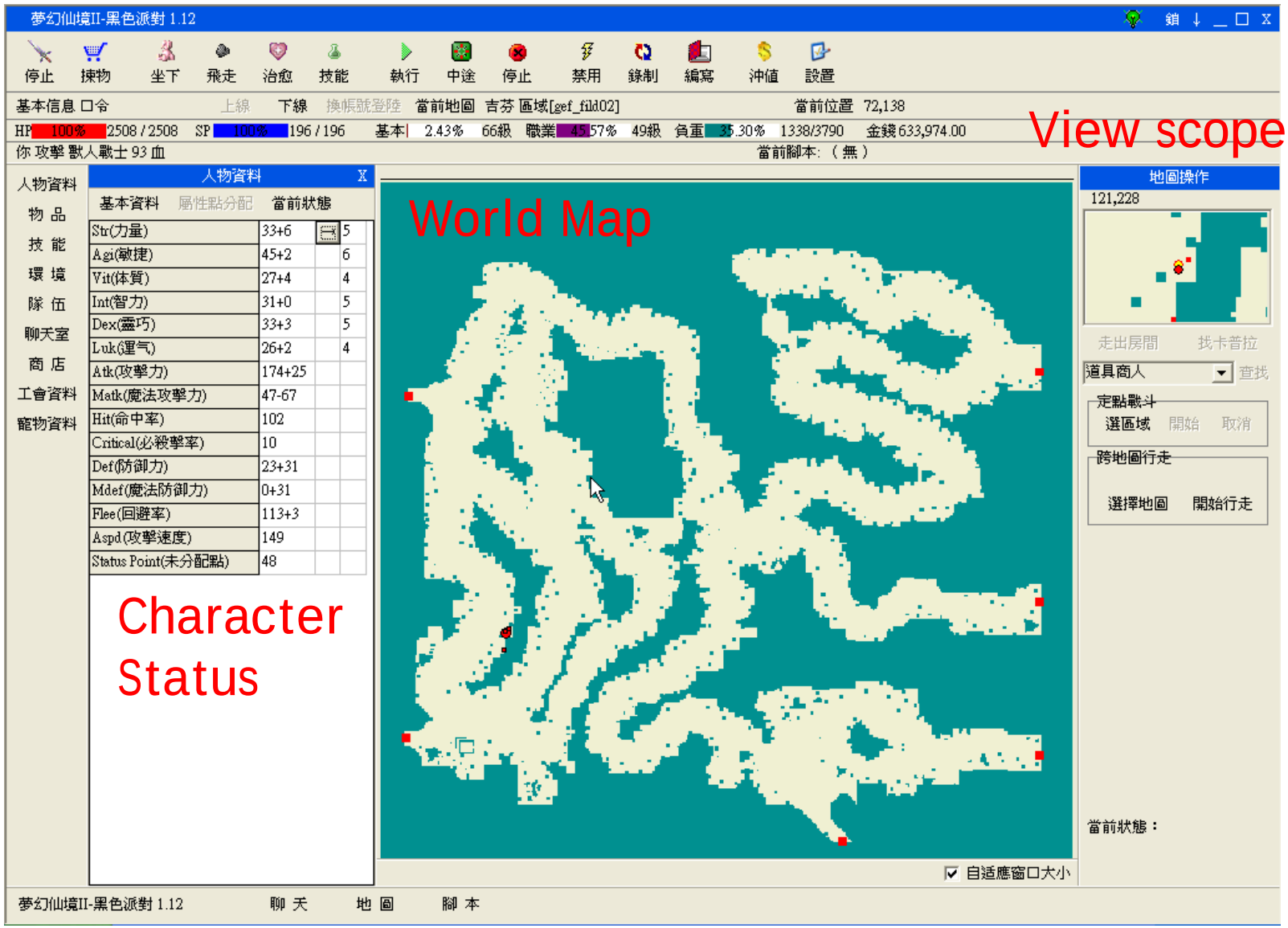
A: Yes or No



Case Study: Ragnarok Online

(Figure courtesy of www.Ragnarok.co.kr)

DreamRO -- A screen shot



Trace Collection

Category	Tr#	ID	Avg. Period	Avg. Pkt rate	Network
Human players	8	A, B, C, D	2.6 hr	1.0 / 3.2 pkt/s	ADSL, Cable Modem, Campus Network
Bots	11	K (Kore) R (DreamRO)	17 hr	1.0 / 2.2 pkt/s	

Heterogeneity in player skills and network conditions

Category	participants	Client pkt rate	Avg. RTT	Avg. Loss rate
Human players	2 rookies 2 experts	0.8 ~ 1.2 pkt/s	45 ~ 192 ms	0.01% ~ 1.73%
Bots	2 bots	0.5 ~ 1.7 pkt/s	33 ~ 97 ms	0.004% ~ 0.2%

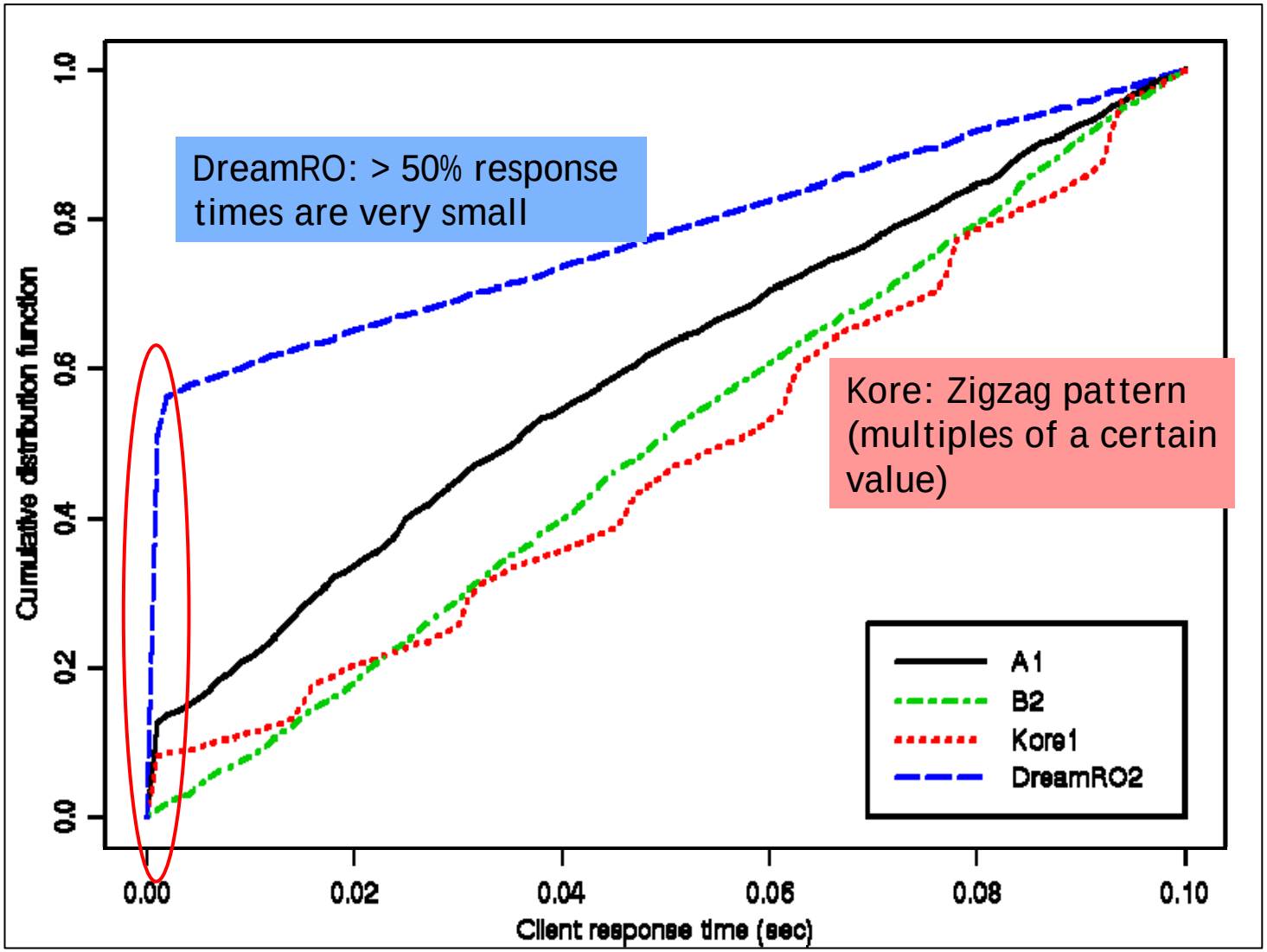
207 hours, 3.8 million packets were traced in total

Command Timing

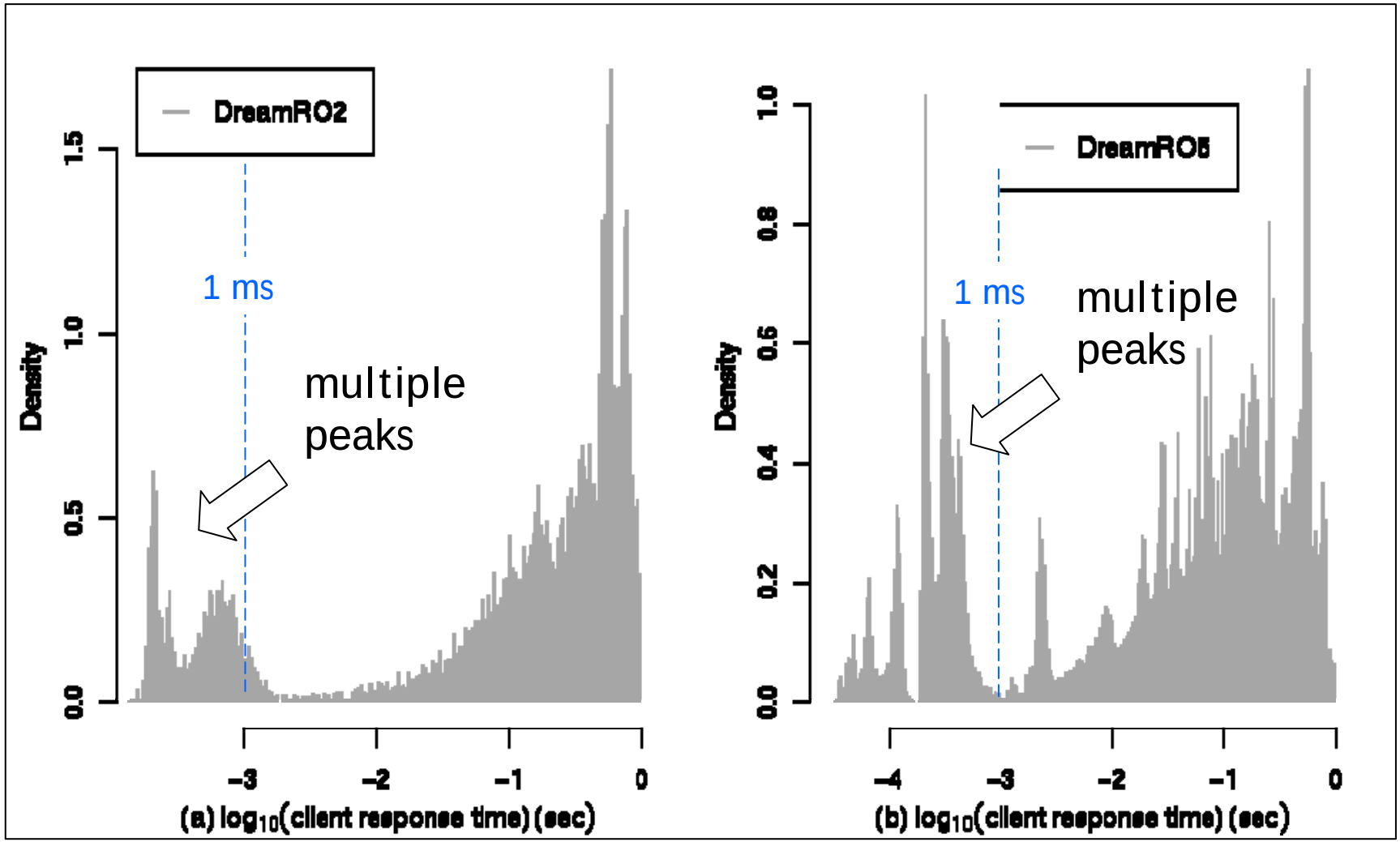
Observation
bots often issue their commands based on arrivals of server packets, which carry the latest status of the character and environment

- Client response time (response time):
  time difference between the client packet departure time and the most recent server packet arrival time
- We expect the following patterns:
  - A large number of small response times (bots respond server packets immediately)
  - Regularity in response times

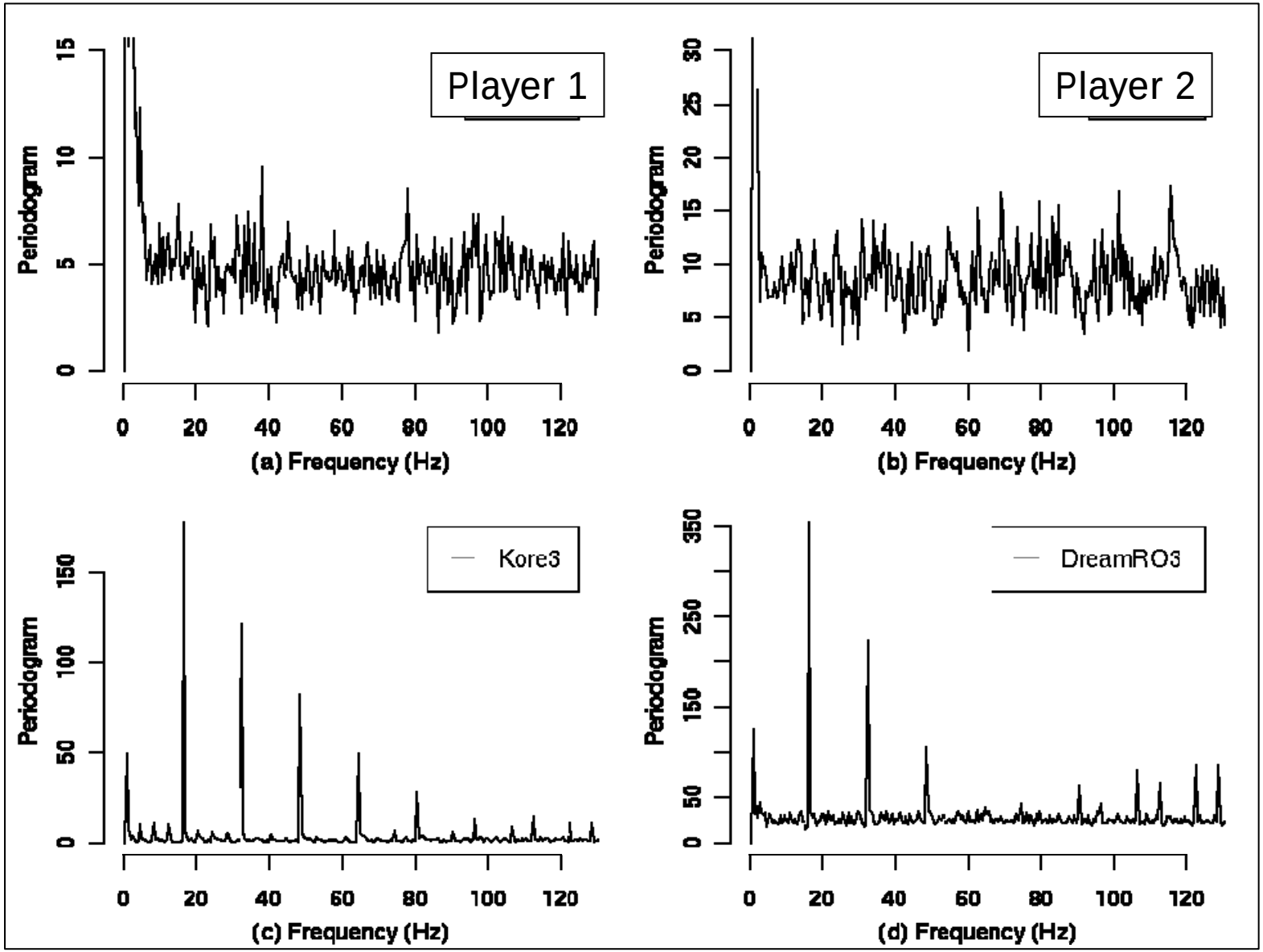
CDF of Client Response Times



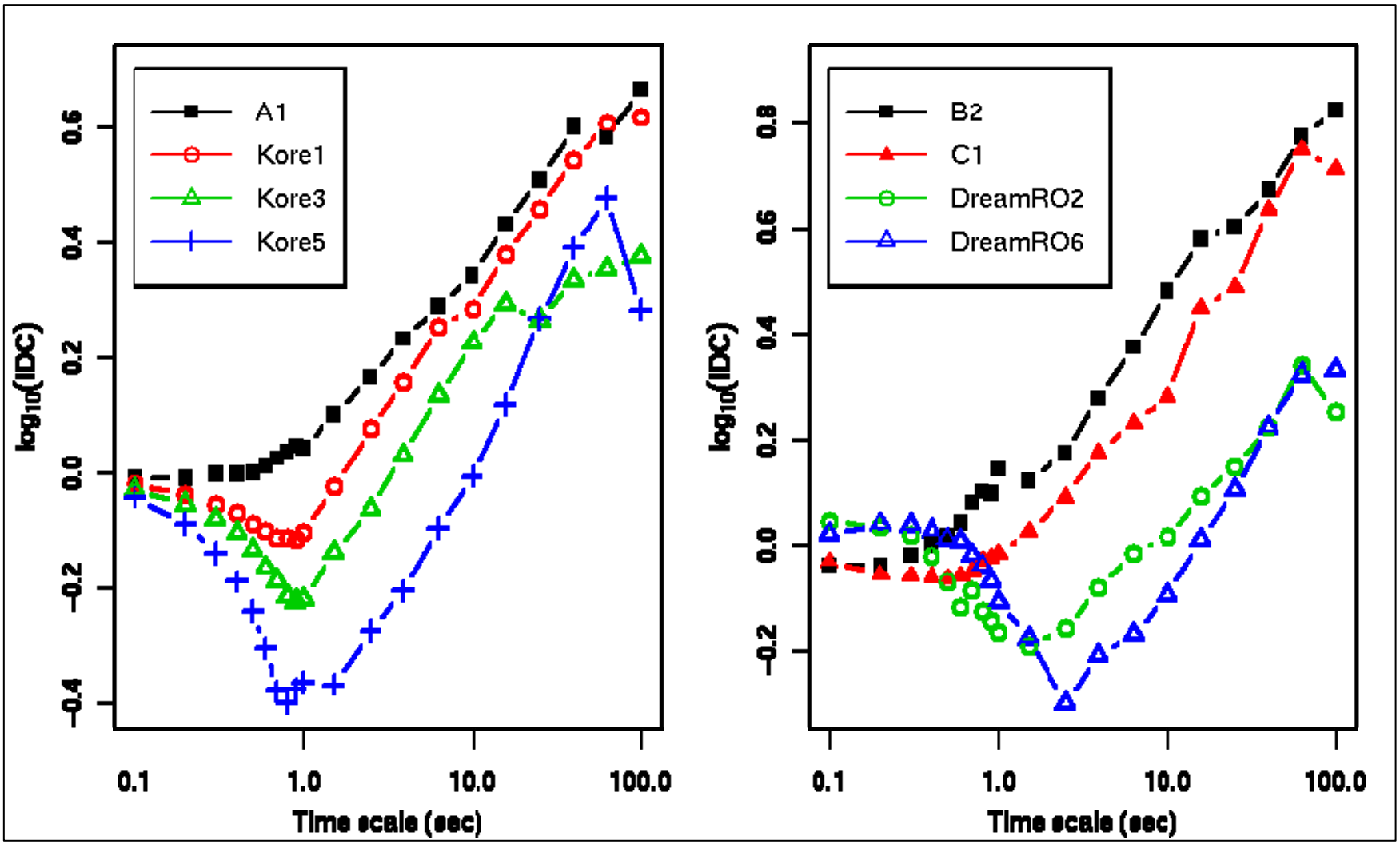
Histograms of Response Times



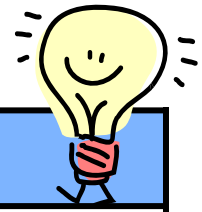
Periodograms of Histograms of Response times



Examining the Trend of Traffic Burstiness

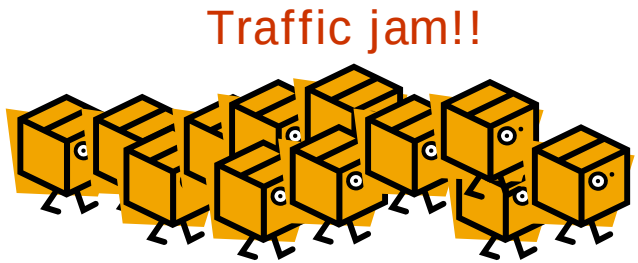


Reaction to Network Conditions



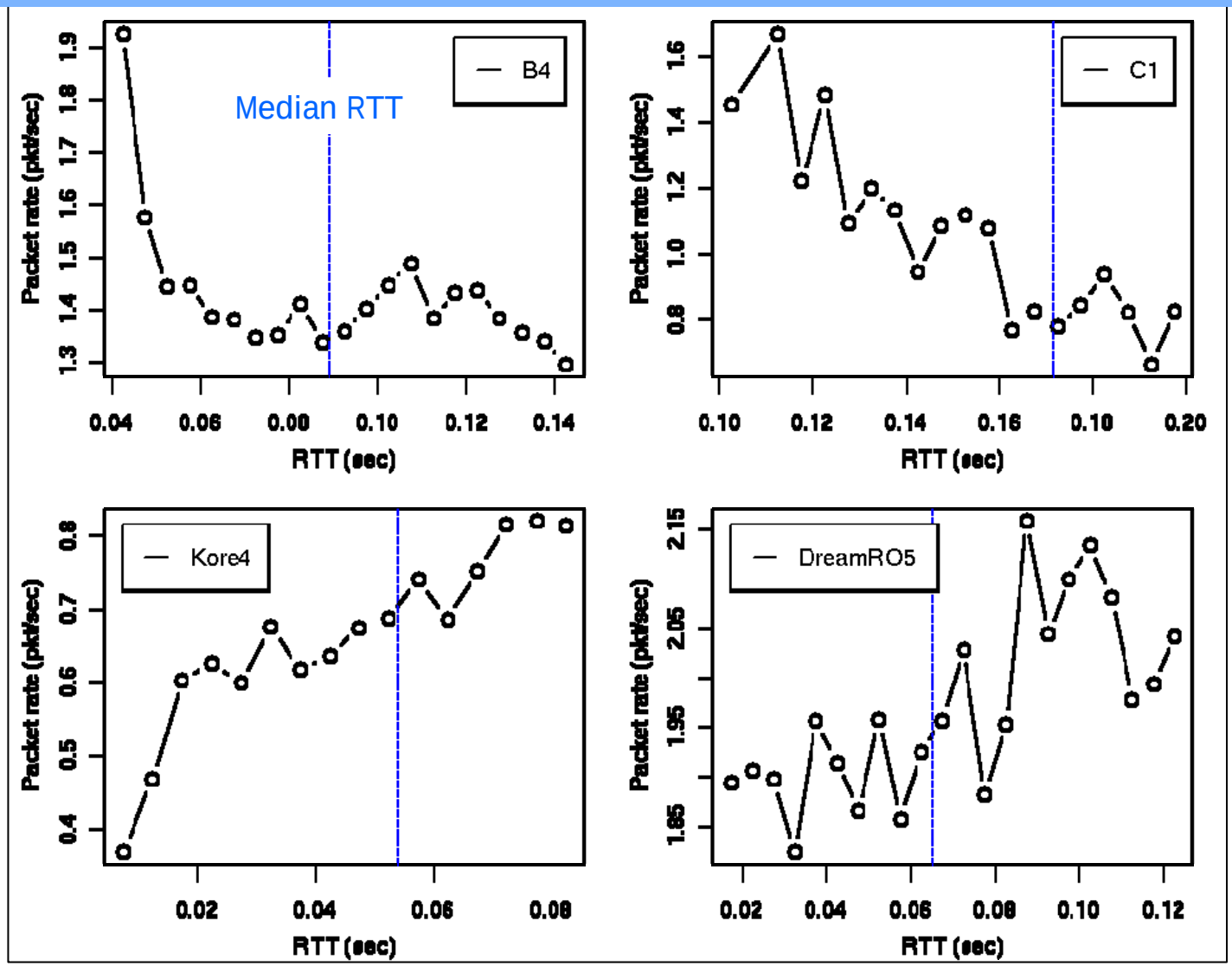
Hypothesis
1. Transit delay of packets will influence the pace of game playing (the rate of screen updates, character movements) 2. Human players will involuntarily adapt to the game pace

- Observe the relationship between round trip time samples and packet rate sent within the following 1 second

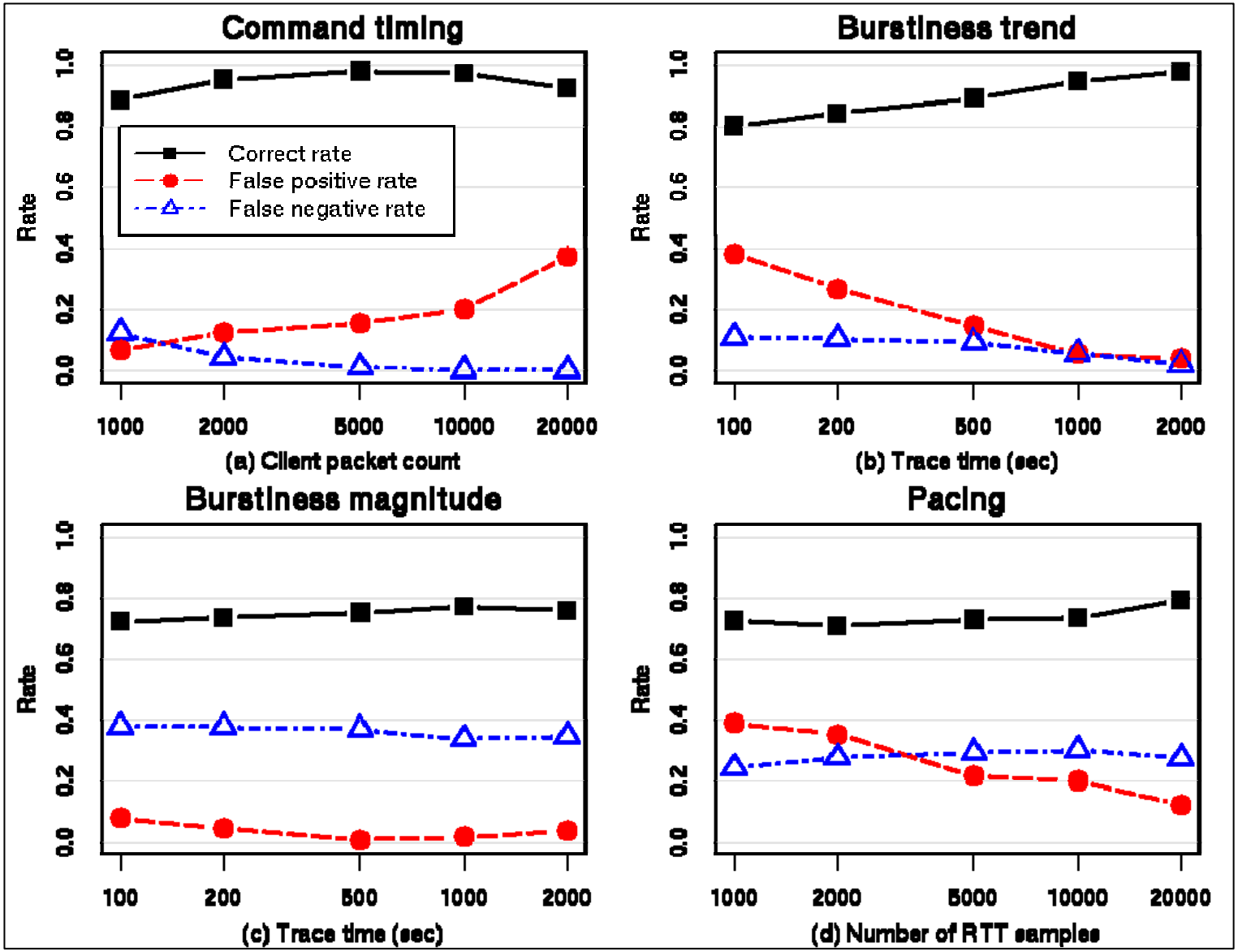


Avg. packet rate vs. round trip times

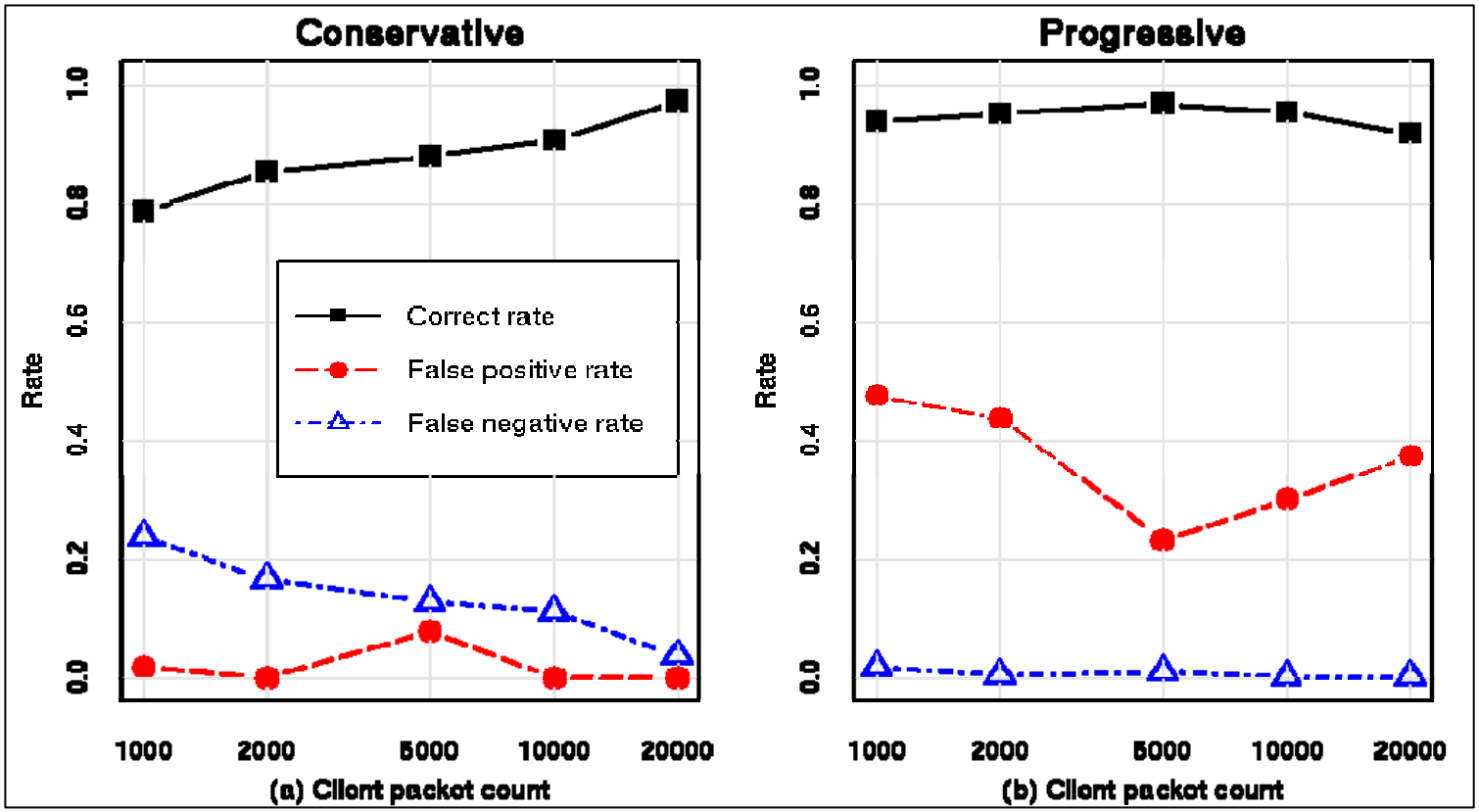
Downward trend for human players; upward trend for bots



Performance Evaluation



An Integrated Classifier

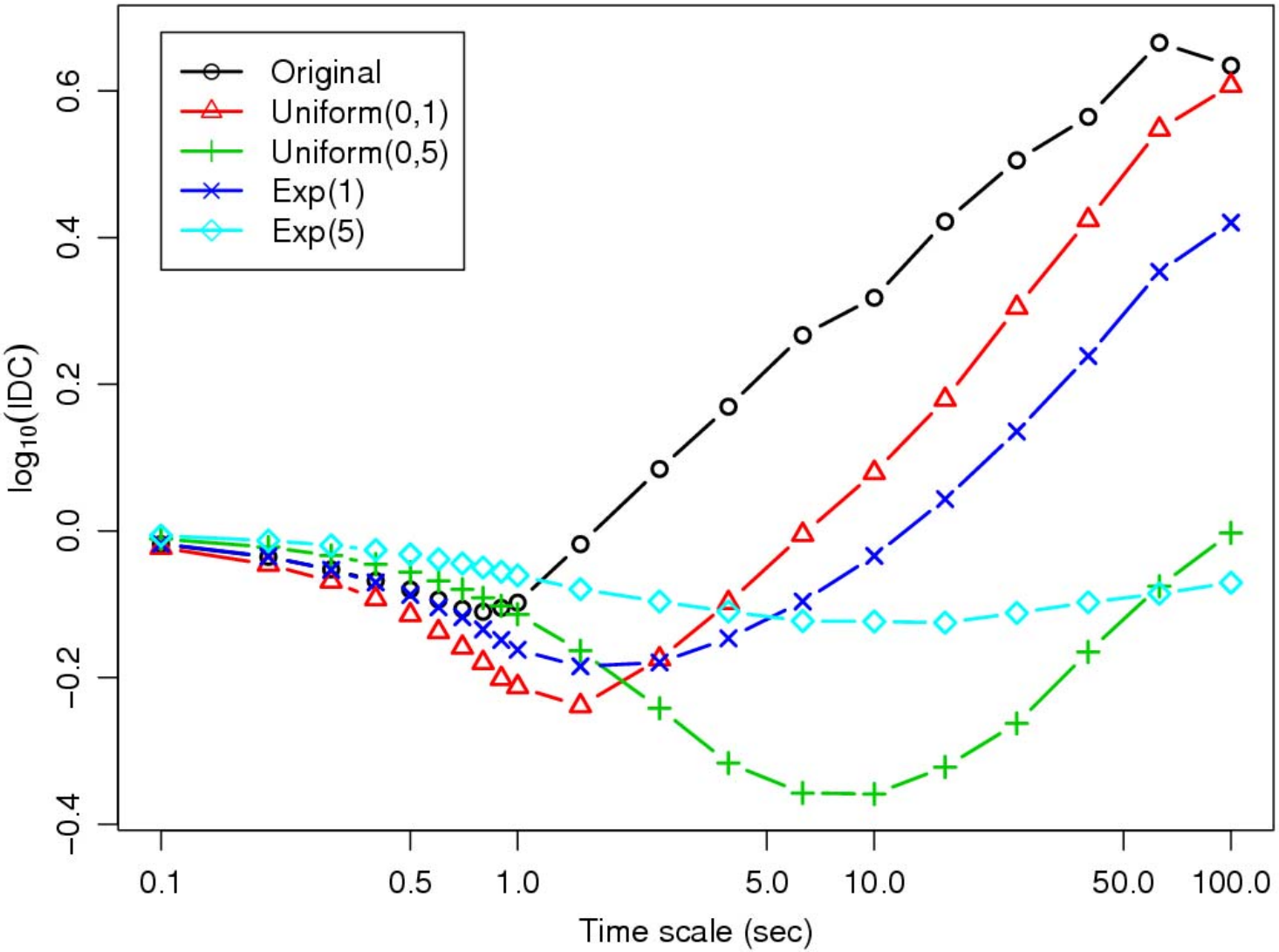


Progressive approach (2000 packets):
false negative rate < 1% and 95% correct rate

Robustness against Counter Attacks

- Adding random delays to the release time of client commands
  - Command timing scheme will be ineffective
  - Schemes based on traffic burstiness and human reaction to network conditions are robust
    - Adding random delay to command timing will not eliminate the regularity unless the added delay is longer than the updating interval by orders of magnitude or heavy-tailed
    - However, adding such long delays will make the bots incompetent as this will slowdown the character's speed by orders of magnitude

The IDC of the original packet arrival process and that of intentionally-delayed versions



Our Solution II: Movement Trajectory

- Based on the avatar's movement trajectory in game
- Applicable for all genres of games where players control the avatar's movement directly
- Avatar's trajectory is high-dimensional (both in time and spatial domain)

The Rationale behind Our Scheme

- The trajectory of the avatar controlled by a human player is hard to simulate for two reasons:
  - Complex context information:
    Players control the movement of avatars based on their knowledge, experience, intuition, and a great deal of environmental information in game.
  - Human behavior is not always logical and optimal
- How to model and simulate realistic movements (for game agents) is still an open question in the AI field.

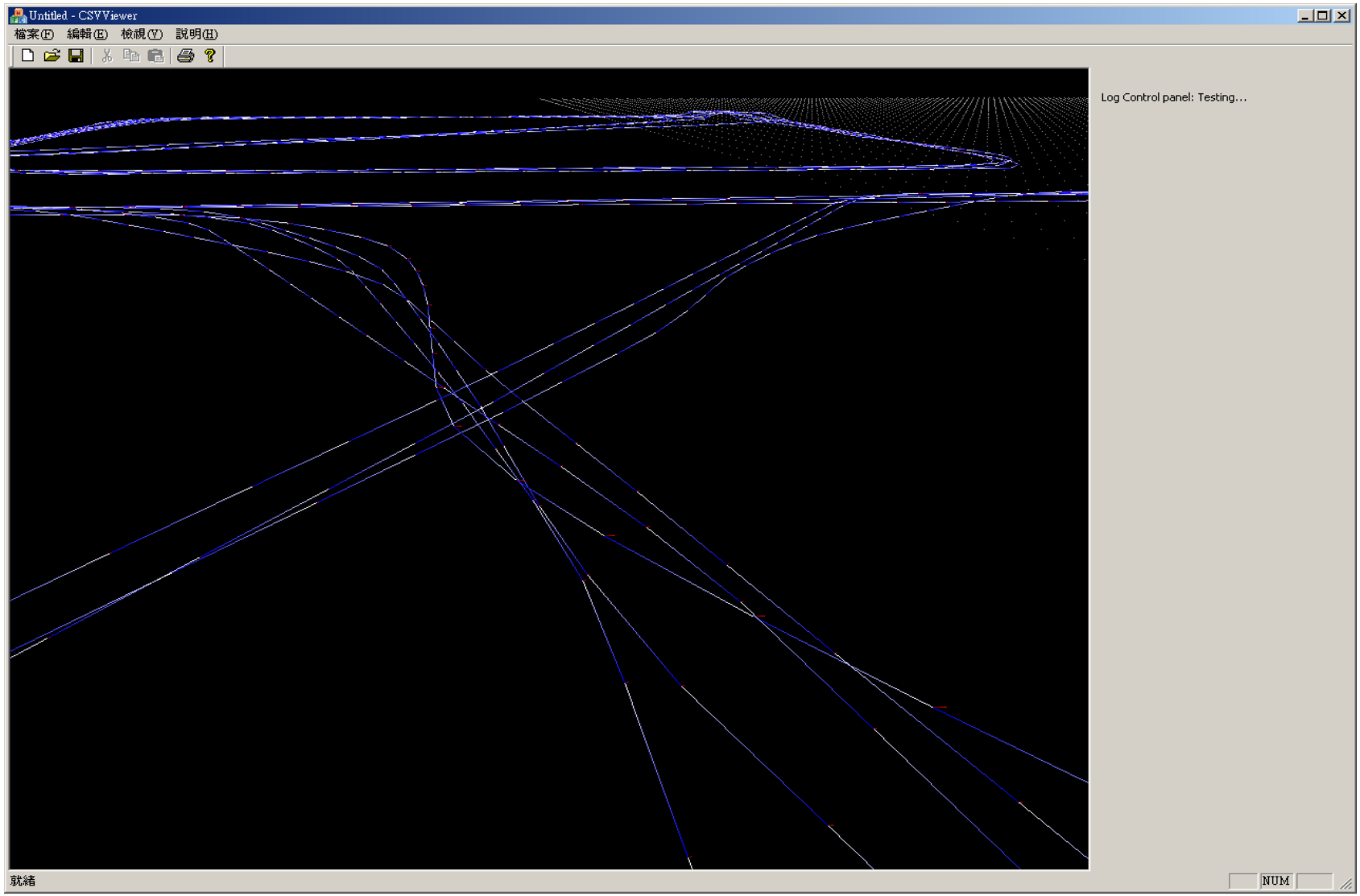
Bot Detection: A Decision Problem

Q: Whether a bot is controlling a game client given the movement trajectory of the avatar?

A: Yes / No?

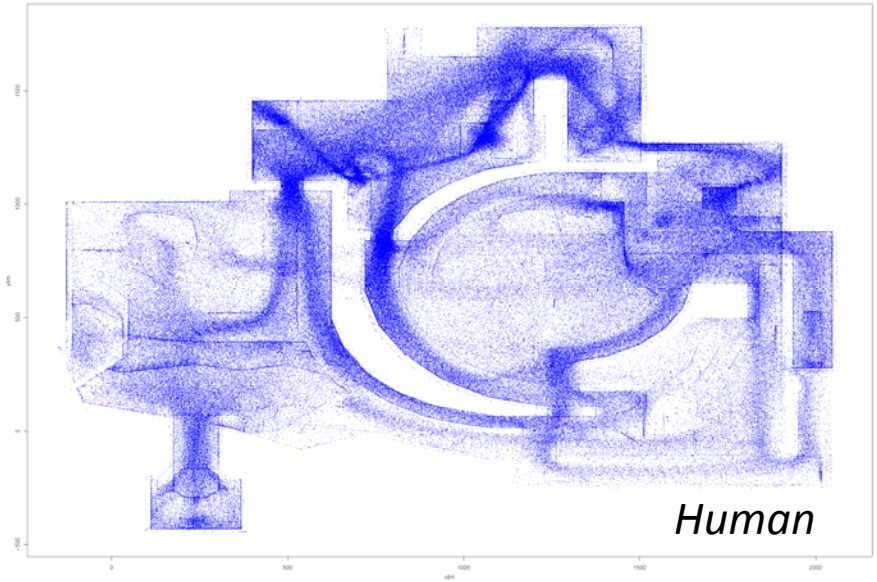
User Movement Trails

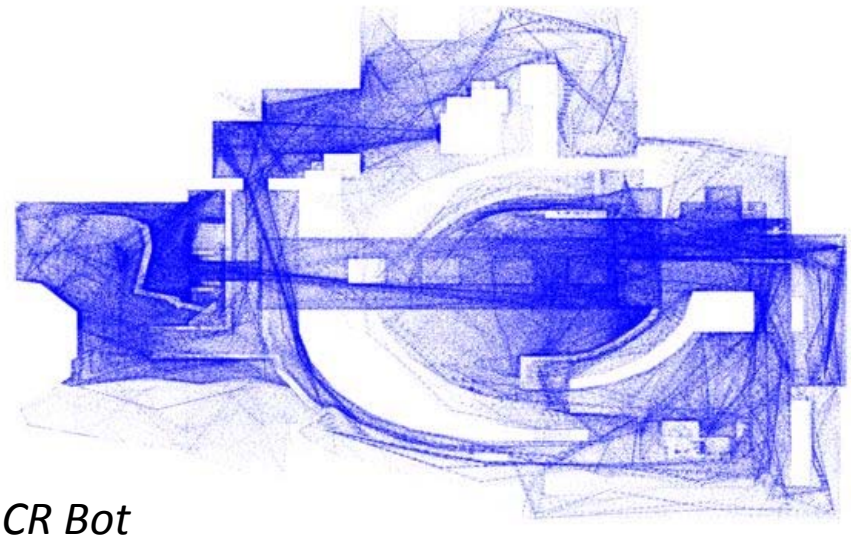
3D Path Visualization Tool

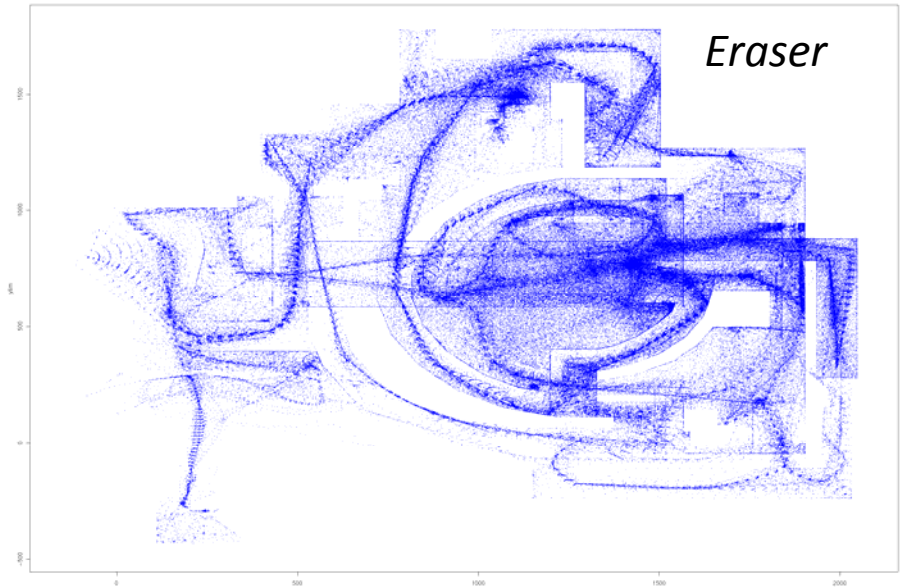


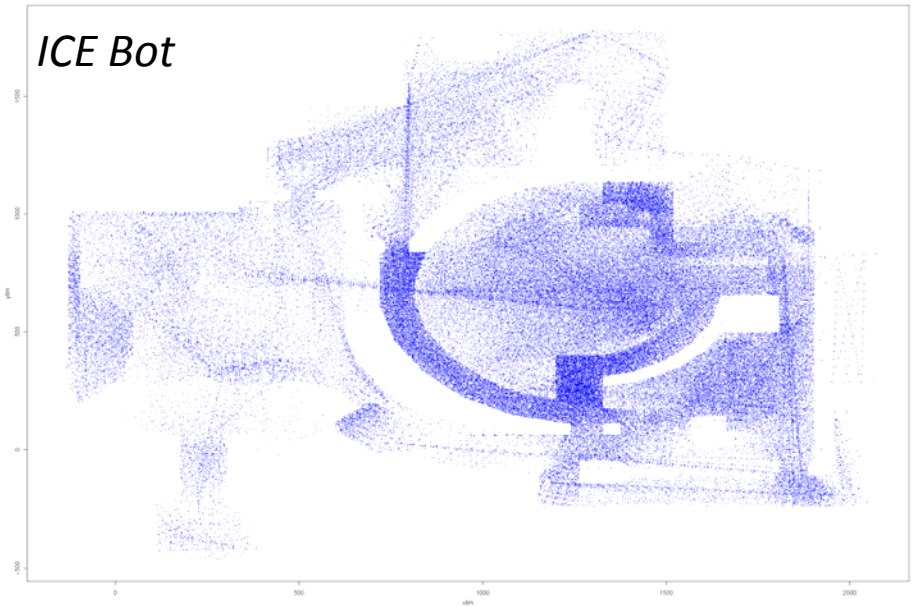
Case Study: Quake 2

Aggregate View of Trails (Human & 3 Bots)

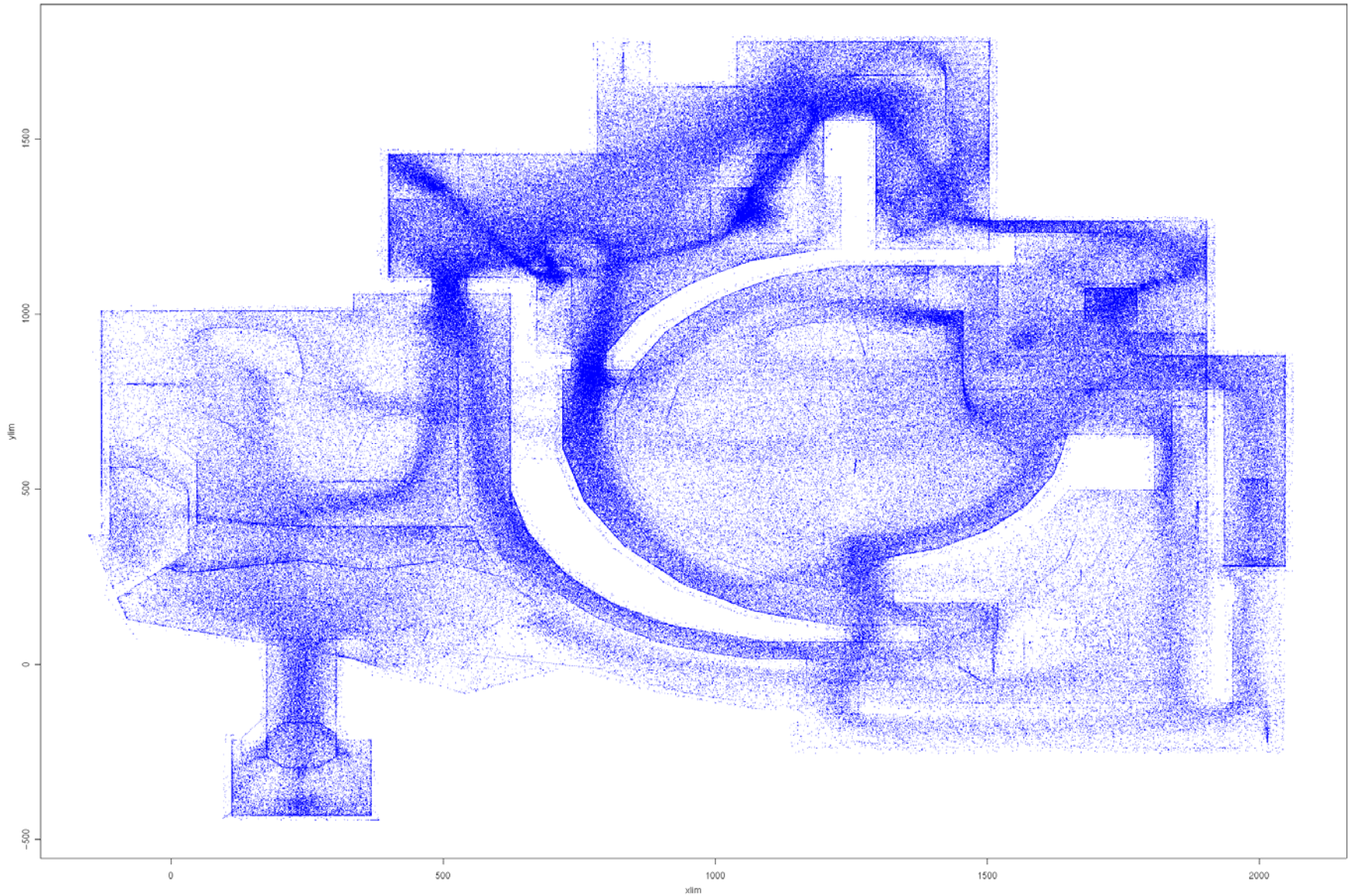




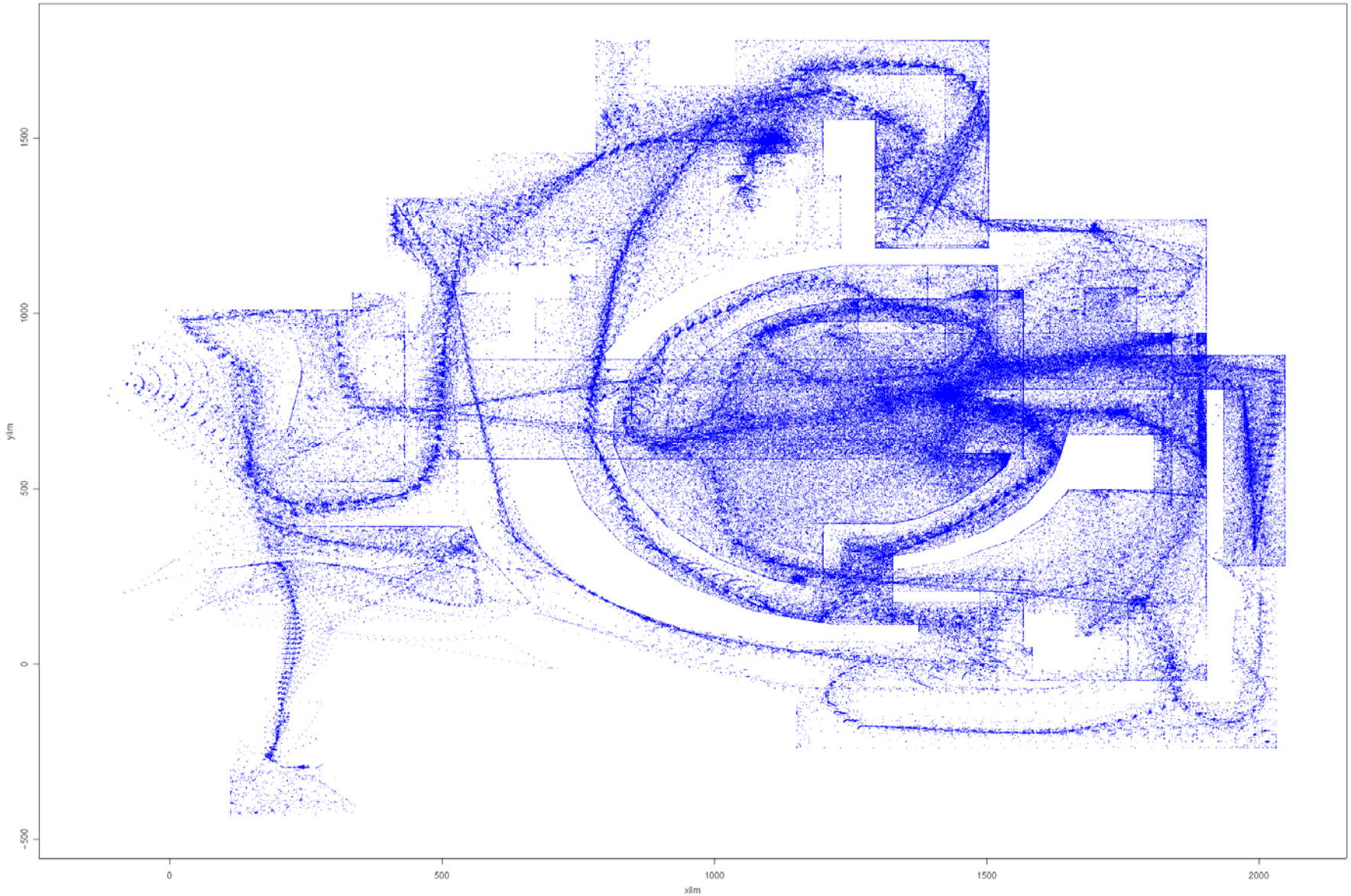




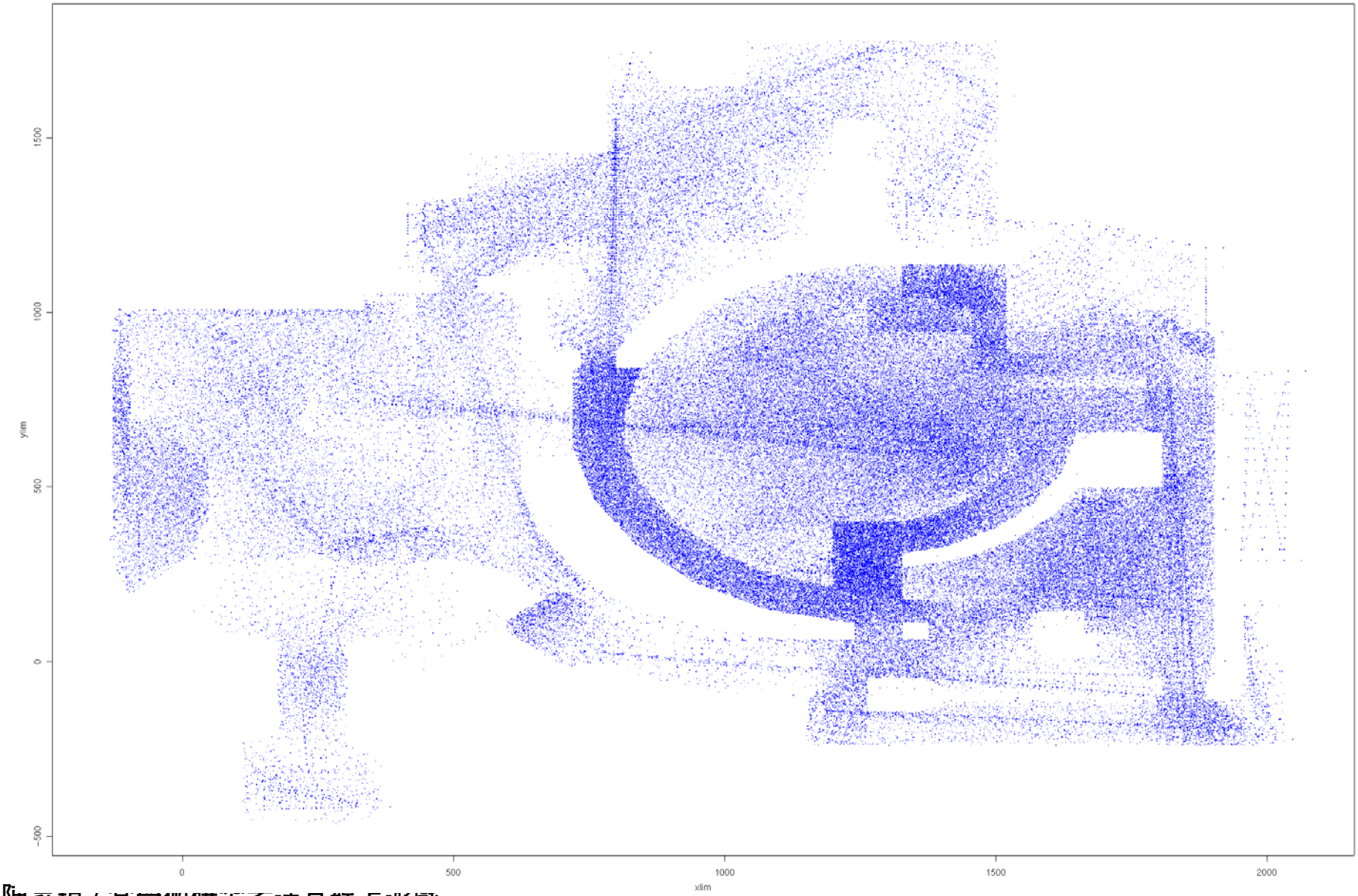
Trails of Human Players



Trails of Eraser Bot



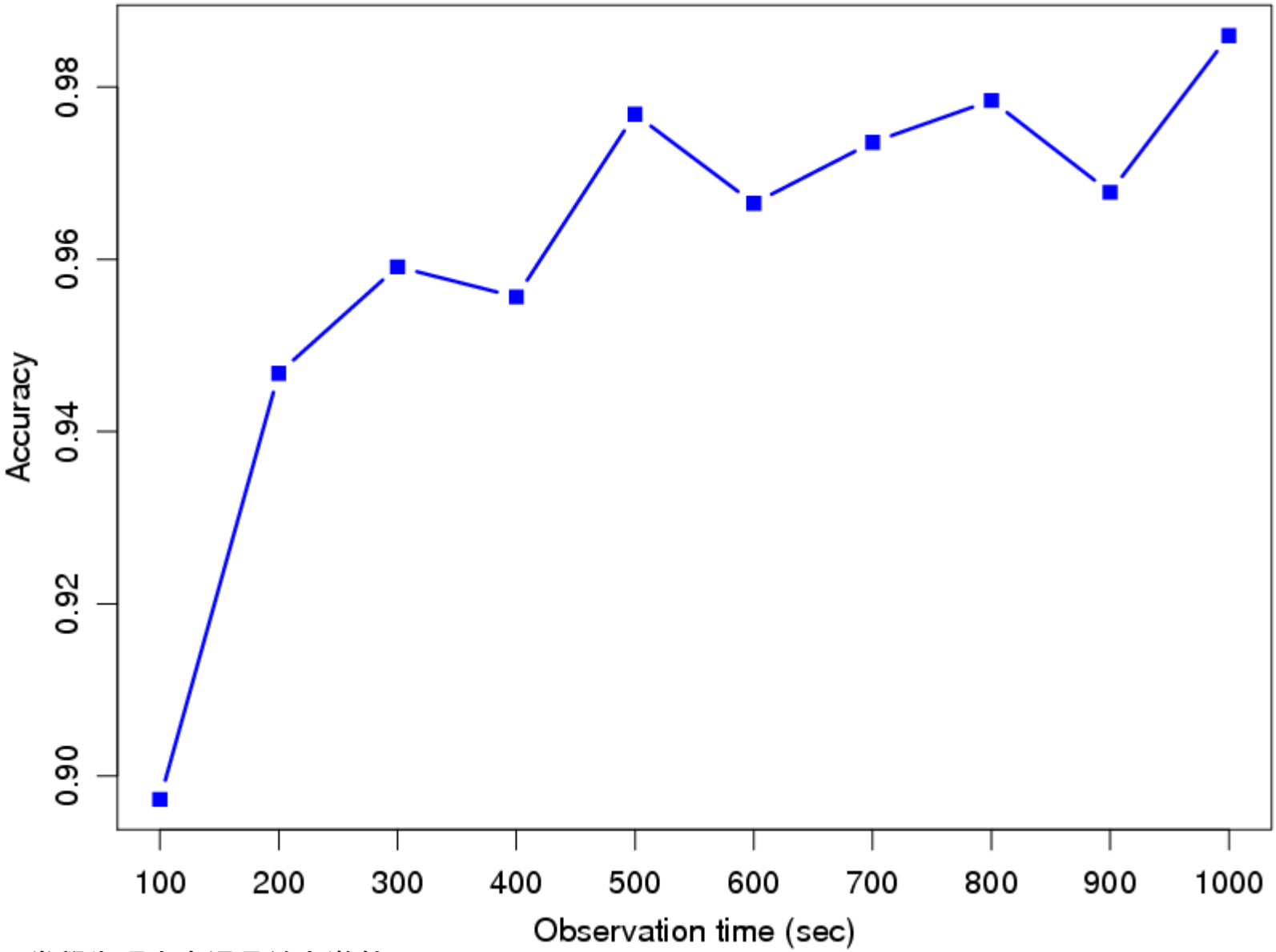
Trails of ICE Bot



Movement Trail Analysis

- Activity
  - mean/sd of ON/OFF periods
- Pace
  - speed/offset in each time period
  - teleportation frequency
- Path
  - linger frequency/length
  - smoothness
  - detourness
- Turn
  - frequency of mild turn, U-turn, …

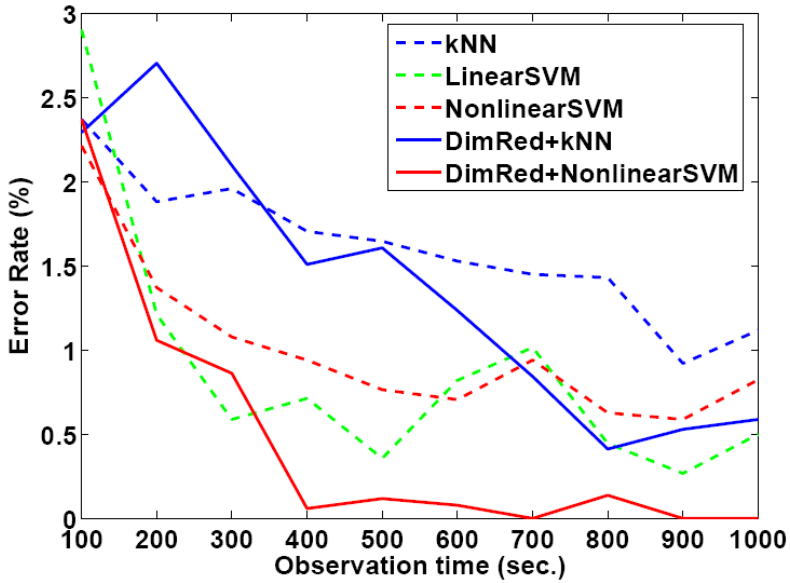
Bot Detection Performance



Five Methods for Comparison

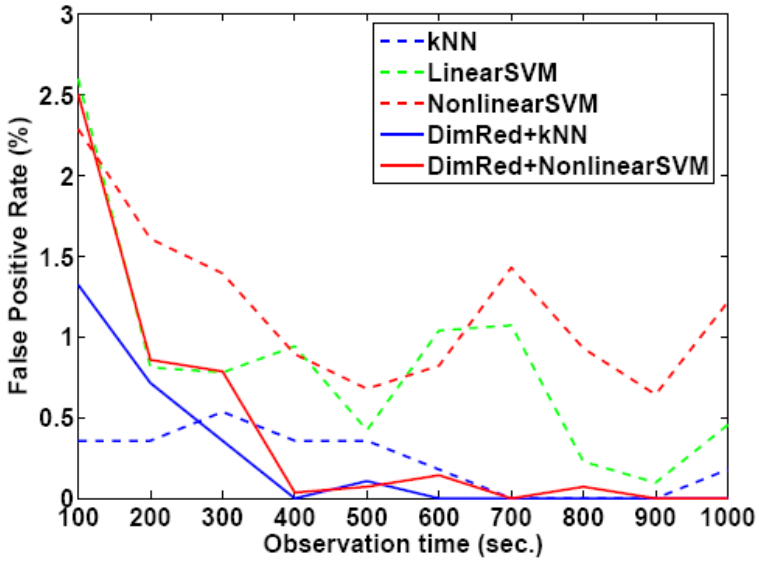
Method	Data Input
kNN	Original 200-dimension Pace Vectors
Linear SVM	
Nonlinear SVM	
Isomap + kNN	Isomap-reduced Pace Vectors
Isomap + Nonlinear SVM	

Evaluation Results

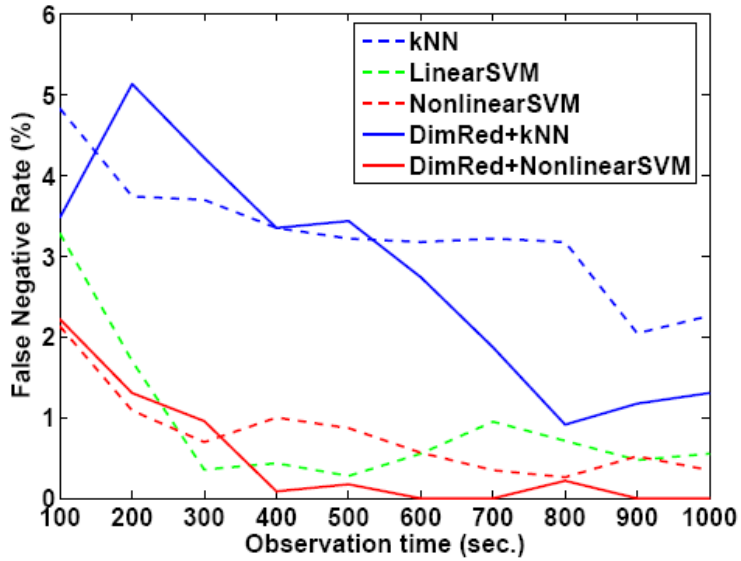


Error Rate

False Positive Rate



False Negative Rate



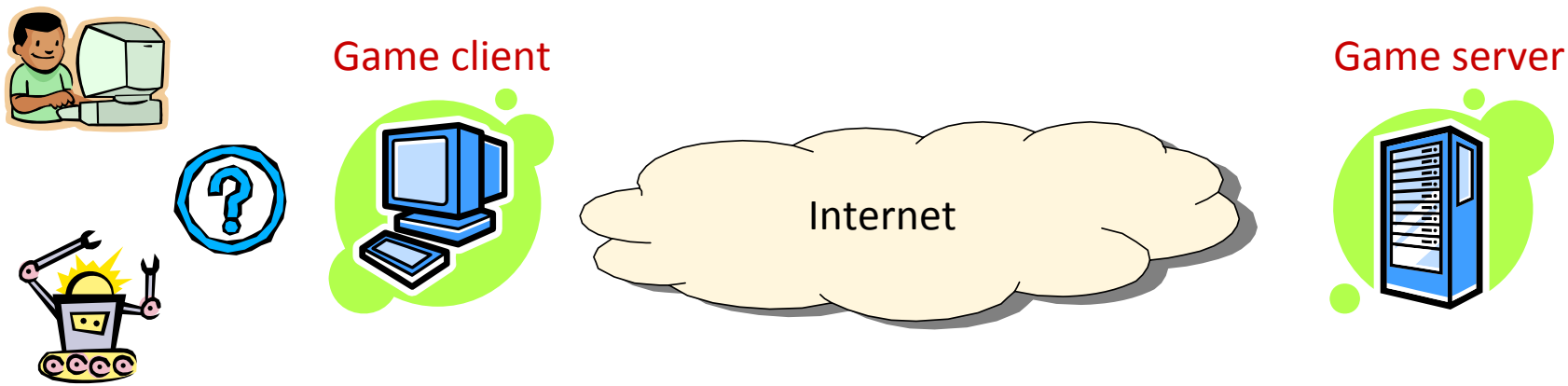
Online Rhythm Games

- One of the popular casual games is the dancing game

Let’s Watch Some Dances

Dancing Game Bots

- Game bots: automated AI programs that can perform certain tasks in place of gamers
- Player performance based on timing information, which is provided by the client ➔ easy to cheat



The Challenges

- It's easy to construct a classifier to detect game bots as
  - 1) human behavior contains more variance,
  - 2) each player has her own tendency to make errors / skill levels
- BUT, it's easy for bots to fight back by learning human behavior

偵測方法一：按鍵延遲時間模型

- 玩家在輸入方向鍵（↑、↓、←、→）時，會受到前幾次輸入的影響，而有些許的延遲，本研究即利用這些延遲所造成的差異建構檢測的方法。
- 本研究目前檢測前一次輸入的影響，所以共有 4x4 = 16 種組合。

- 上圖中所顯示的 $t_1, t_2, t_3, t_4, t_5, t_6, t_7, t_8$ 是個別方向鍵間隔的時間，可以視為個別所花費的時間（除了第一個按鍵），而這就是本研究中所擷取的資料。

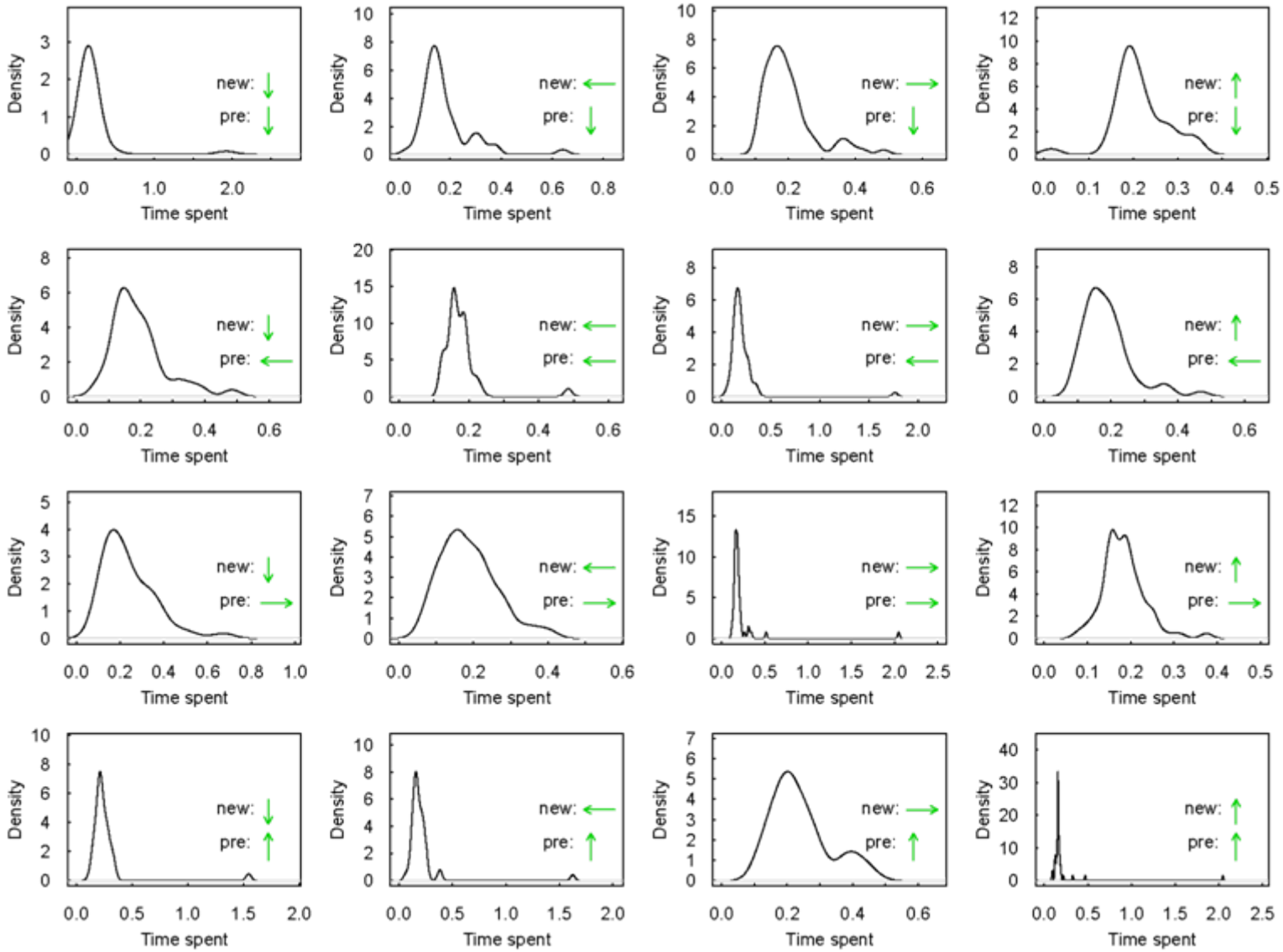
Conditional Probability Distribution

- 我們著眼於各種組合的機率分佈。例如：前一次輸入↑，新的一次輸入←，記為（new: ←，pre: ↑）；其機率分佈函數可寫為

$$f(t \mid \text{current input} = \leftarrow, \text{previous input} = \uparrow)$$

- 從一個玩家的遊戲記錄，我們可得到 16 個機率分佈函數

16 個機率分佈


Density
Time spent
new: ↓
pre: ↓
new: ←
pre: ↓
new: →
pre: ↓
new: ↑
pre: ↓
new: ↓
pre: ←
new: ←
pre: ←
new: →
pre: ←
new: ↑
pre: ←
new: ↓
pre: →
new: ←
pre: →
new: →
pre: →
new: ↑
pre: →
new: ↓
pre: ↑
new: ←
pre: ↑
new: →
pre: ↑
new: ↑
pre: ↑

判別方法 (1)

- 對玩家而言，16 種分佈通常各有不同，有的分散、有的集中；而非如同外掛都呈現集中的狀態。
- 利用無母數檢定 Kolmogorov-Smirnov test (KS test) 檢測出玩家與外掛表現的差異。
- KS test 為利用兩組資料的累積機率函數 (CDF) 之間最大差異的假設檢定。用於做為適合度檢定的無母數檢定。檢定統計量為 $$D_{1,2} = \sup_x \left| F_1(x) - F_2(x) \right|$$

  其中 1, 2 表示兩筆的資料，F 為經驗累積機率函數

判別方法 (2)

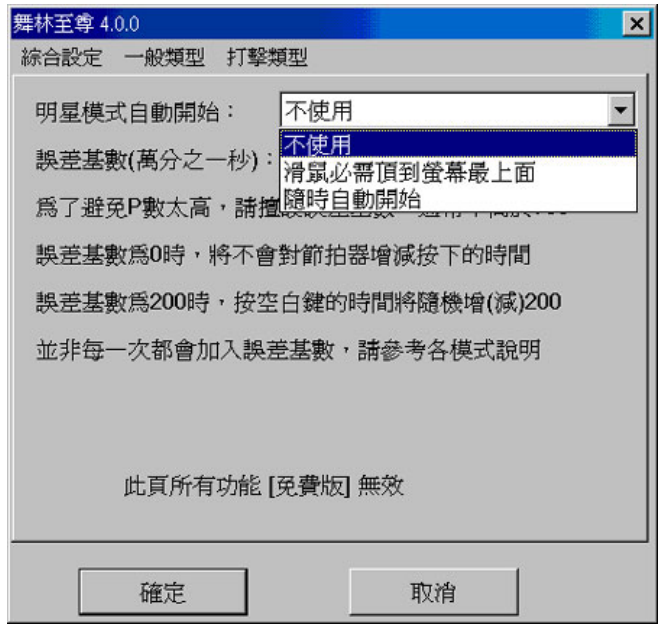
- 由於本方法進行多重比較 (16 種組合)，我們使用 Bonferroni method 進行顯著水準 (significance level) 的調整，使得 $\alpha = 0.05/16 \approx 0.003$

- 若單體的犯錯率仍然維持 5%，則整體的犯錯率將會爬升至

$$1-(1-0.05)^{16} = 0.5599$$

效能評估

- 真實外掛：舞林至尊

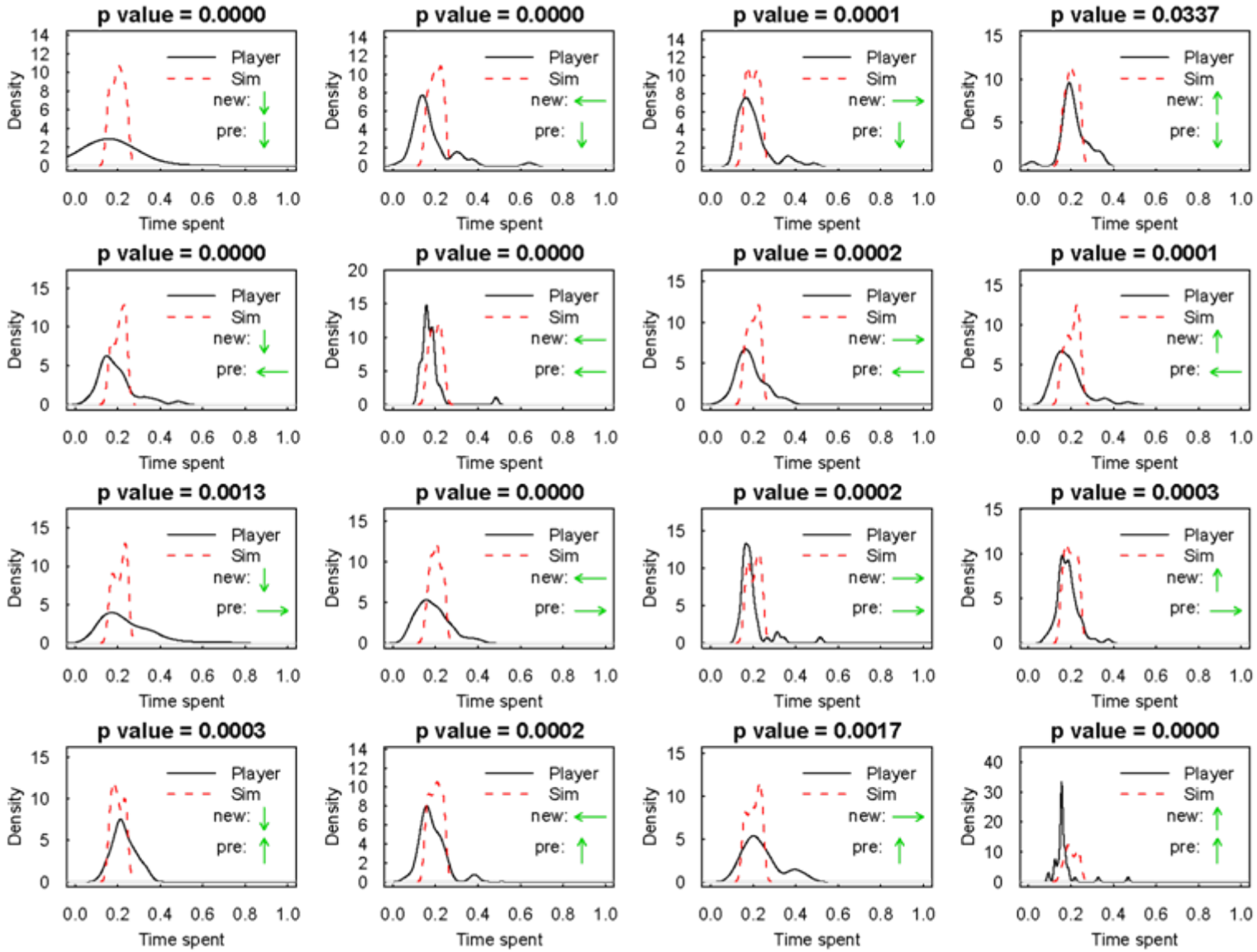


- 模擬外掛 1：延遲固定時間 + Uniform Distribution (例如 0.2 ± 0.05 秒)

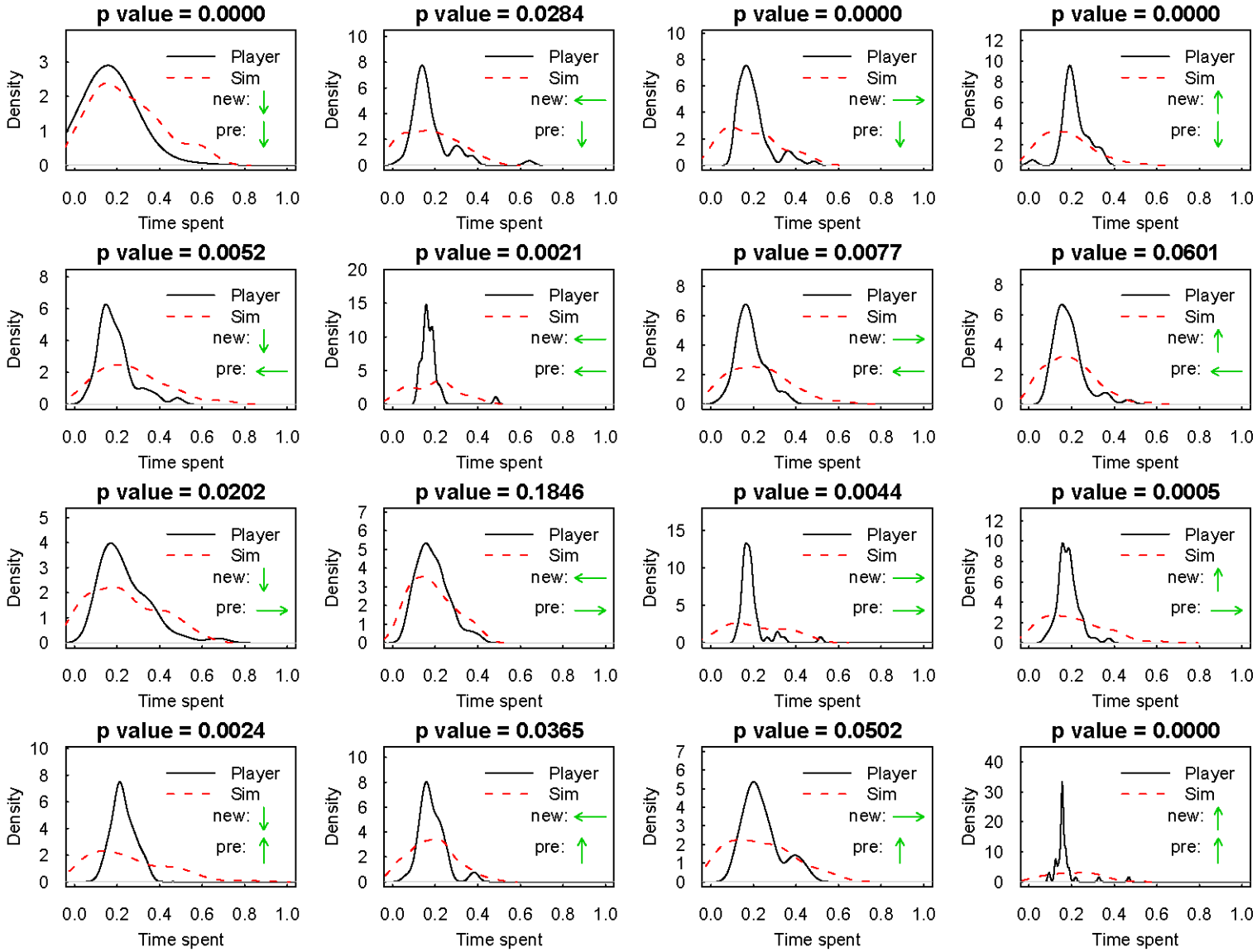
- 模擬外掛 2：延遲固定時間 + Normal Distribution (mean and standard deviation extracted from empirical data)

- 模擬外掛 3：模擬使用者延遲時間 (normal distribution, condition on current input)

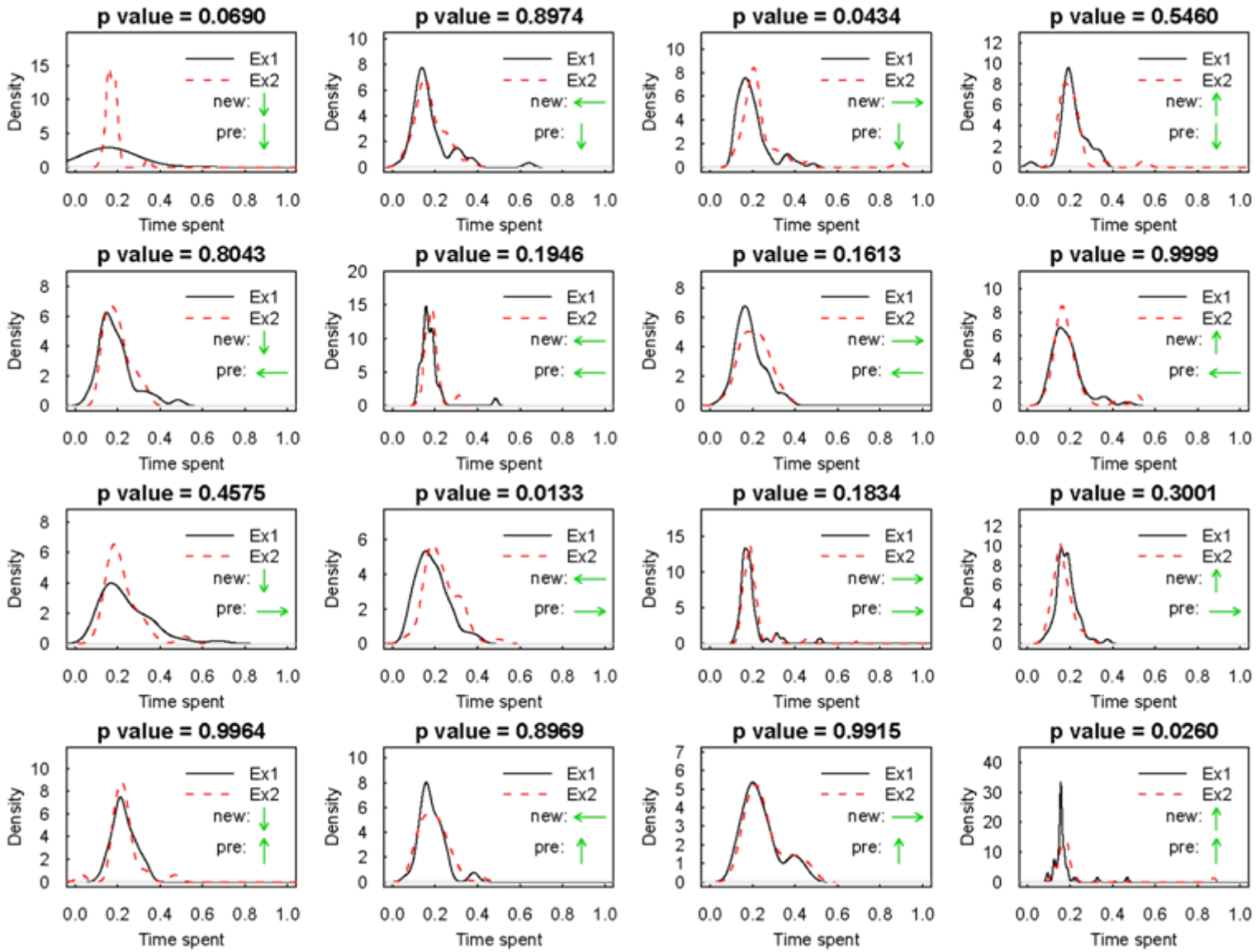
模擬外掛 1


p value = 0.0000
p value = 0.0000
p value = 0.0001
p value = 0.0337
p value = 0.0000
p value = 0.0000
p value = 0.0002
p value = 0.0001
p value = 0.0013
p value = 0.0000
p value = 0.0002
p value = 0.0003
p value = 0.0003
p value = 0.0002
p value = 0.0017
p value = 0.0000
Player
Sim
new:
pre:
Density
Time spent

模擬外掛 3


p value = 0.0000
p value = 0.0284
p value = 0.0000
p value = 0.0000
p value = 0.0052
p value = 0.0021
p value = 0.0077
p value = 0.0601
p value = 0.0202
p value = 0.1846
p value = 0.0044
p value = 0.0005
p value = 0.0024
p value = 0.0365
p value = 0.0502
p value = 0.0000
Player
Sim
new:
pre:
Density
Time spent

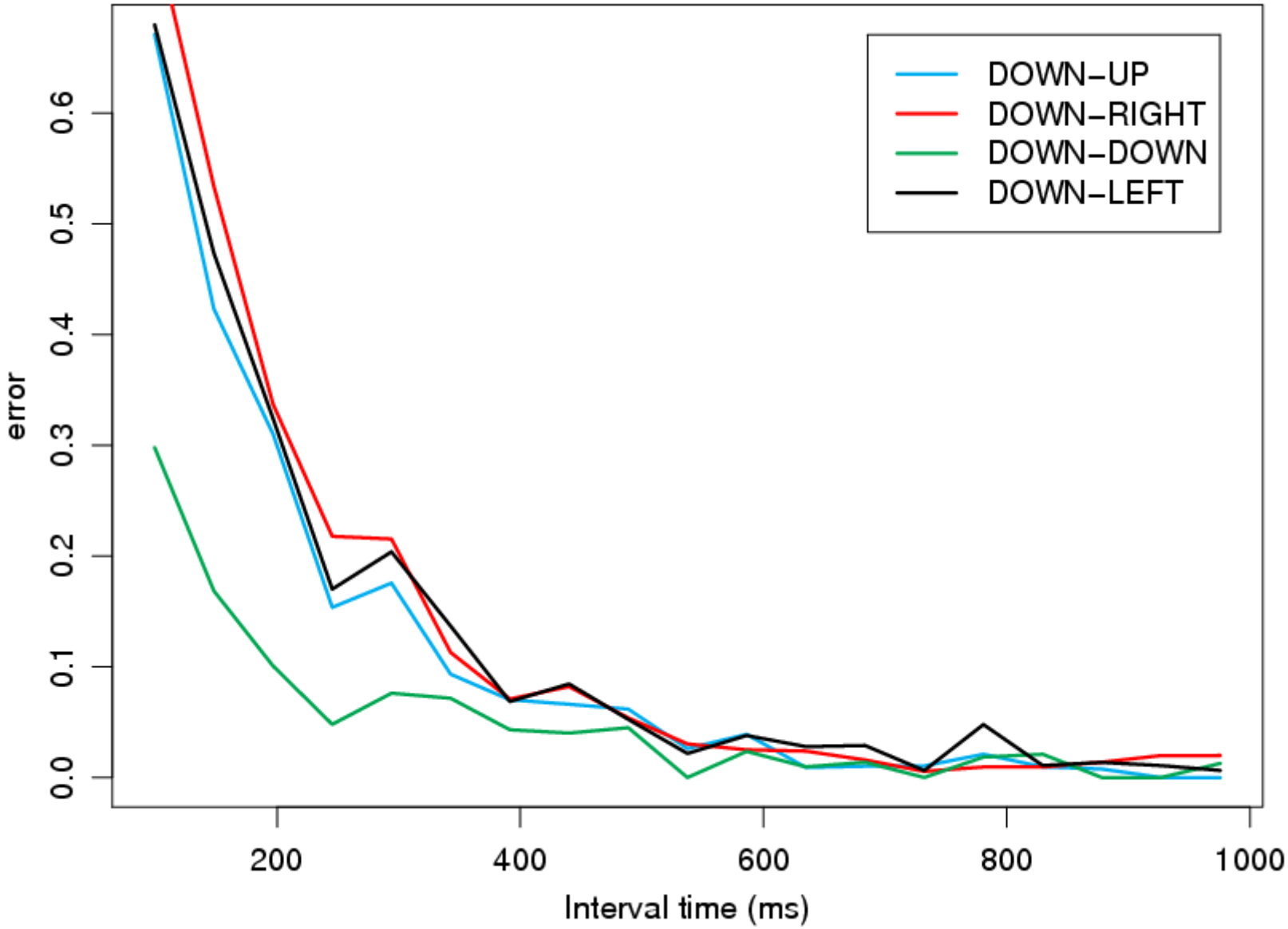
行為一致性檢測


p value = 0.0690
p value = 0.8974
p value = 0.0434
p value = 0.5460
p value = 0.8043
p value = 0.1946
p value = 0.1613
p value = 0.9999
p value = 0.4575
p value = 0.0133
p value = 0.1834
p value = 0.3001
p value = 0.9964
p value = 0.8969
p value = 0.9915
p value = 0.0260
Density
Time spent
Ex1
Ex2
new:
pre:

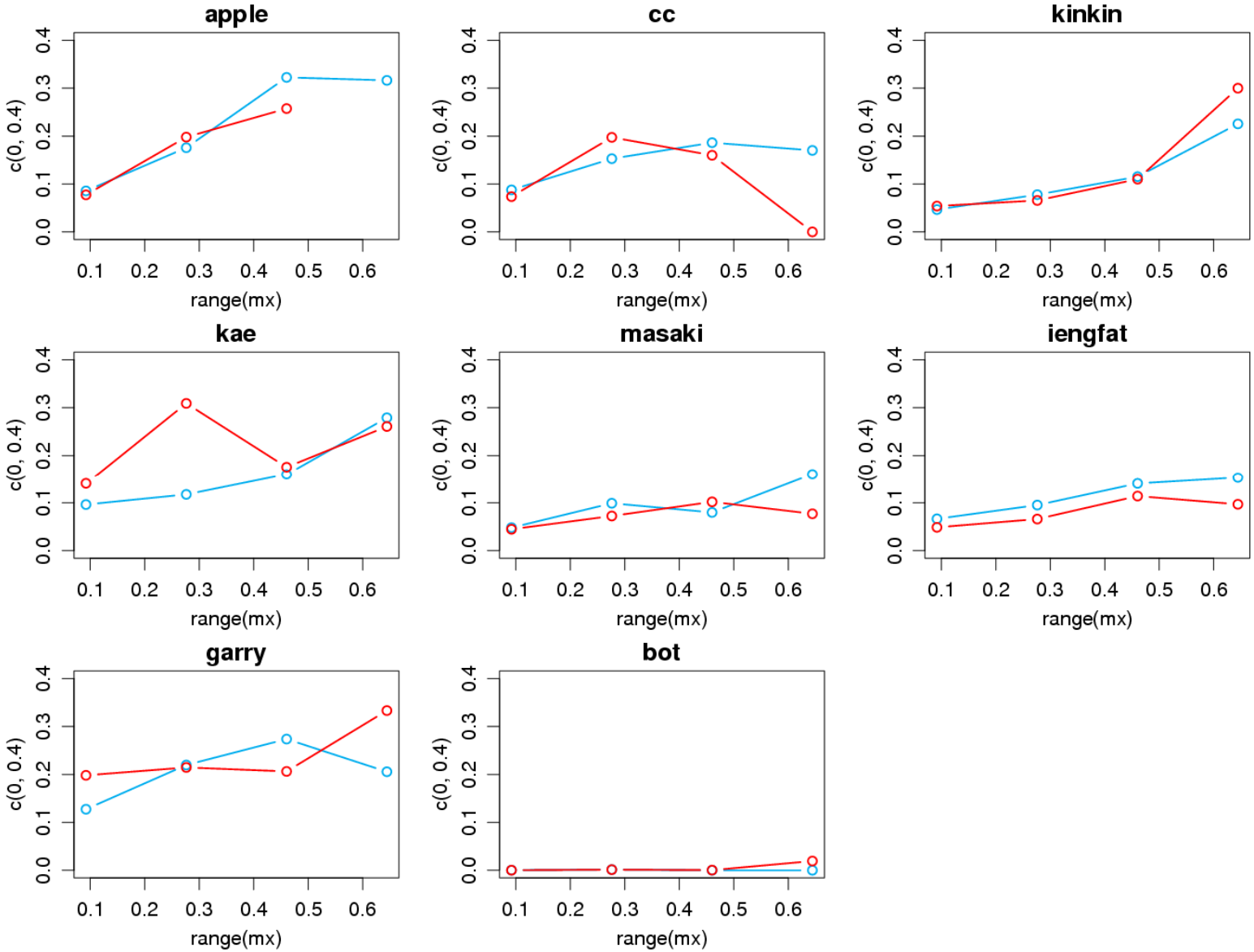
偵測方法二：失誤模型

- 玩家的錯誤可分為兩類
  - 隨機出現：好量測，好模擬
  - 壓力下的失誤：無現成模型
- 建立壓力下失誤模型
  - 量化 “壓力”
    - 連續及快速按鍵需求 (多連續? 多快速?)
    - 按鍵間隔時間有變動性
    - 需求按鍵有變動性
  - 描述壓力與失誤機率的關係
- 若使用者的失誤模型有明顯變動，可能是使用外掛

量化壓力


DOWN–UP
DOWN–RIGHT
DOWN–DOWN
DOWN–LEFT
error
0.0
0.1
0.2
0.3
0.4
0.5
0.6
200
400
600
800
1000
Interval time (ms)

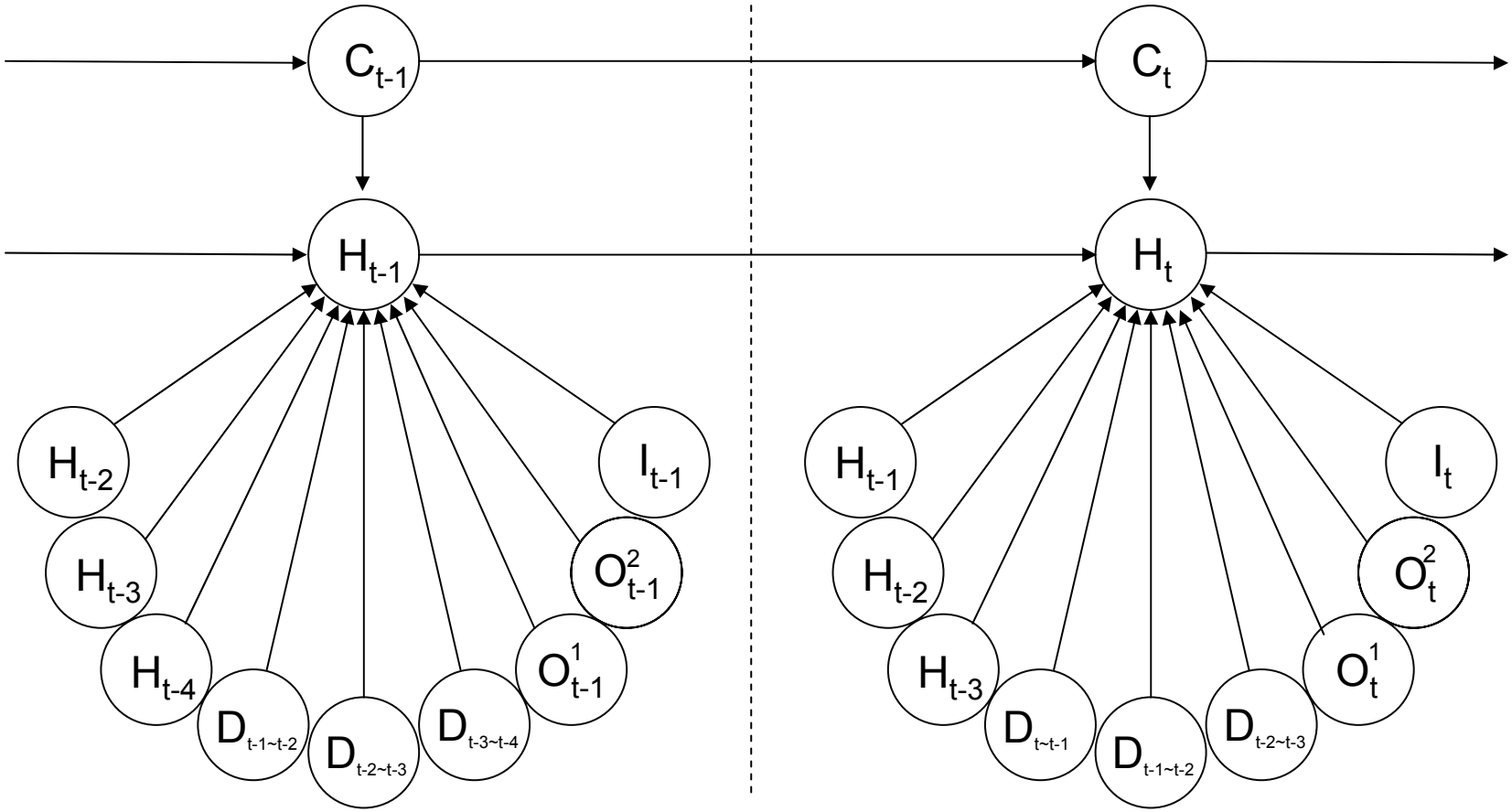
Users' Error Rate under Different Pressures



防禦力分析

- 方法一：按鍵延遲時間模型
  - 基於多層條件下的條件分布
  - 若外掛開發者知道我們使用幾層條件來做，且熟悉機率 / 統計，可能破解
- 方法二：建立玩家的失誤模型
  - 沒有固定的壓力下失誤模型
  - 外掛無法使用“重撥失誤攻擊”
  - 除非外掛開發者知道我們的失誤模型的 “精確定義” (數學式)，否則無法破解

Dynamic Bayesian Networks



Dynamic Bayesian Networks

- C：cheat (true, false)
- H： perfect, great, cool, bad, miss (true, false) (連段成功為cool以上為1，其它0)(Ht-1為上一次) (Ht-2為上上一次) (Ht-3為上上上一次) (Ht-4為上上上上一次)
- D：direction (true, false) (t~t-1這次與上次的方向是否相同)(t-1~t-2上次與上上次的方向是否相同) (t-2~t-3上上次與上上上次的方向是否相同)
- O：output (true, false)(在此次事件中前一秒鐘和兩秒鐘之內是否有新事件)(密集度)
- I：input (true, false)(玩家在此次事件中是否真的有輸入)(是按錯及delay過大的miss還是根本沒有按的miss)

User Behavior Topics

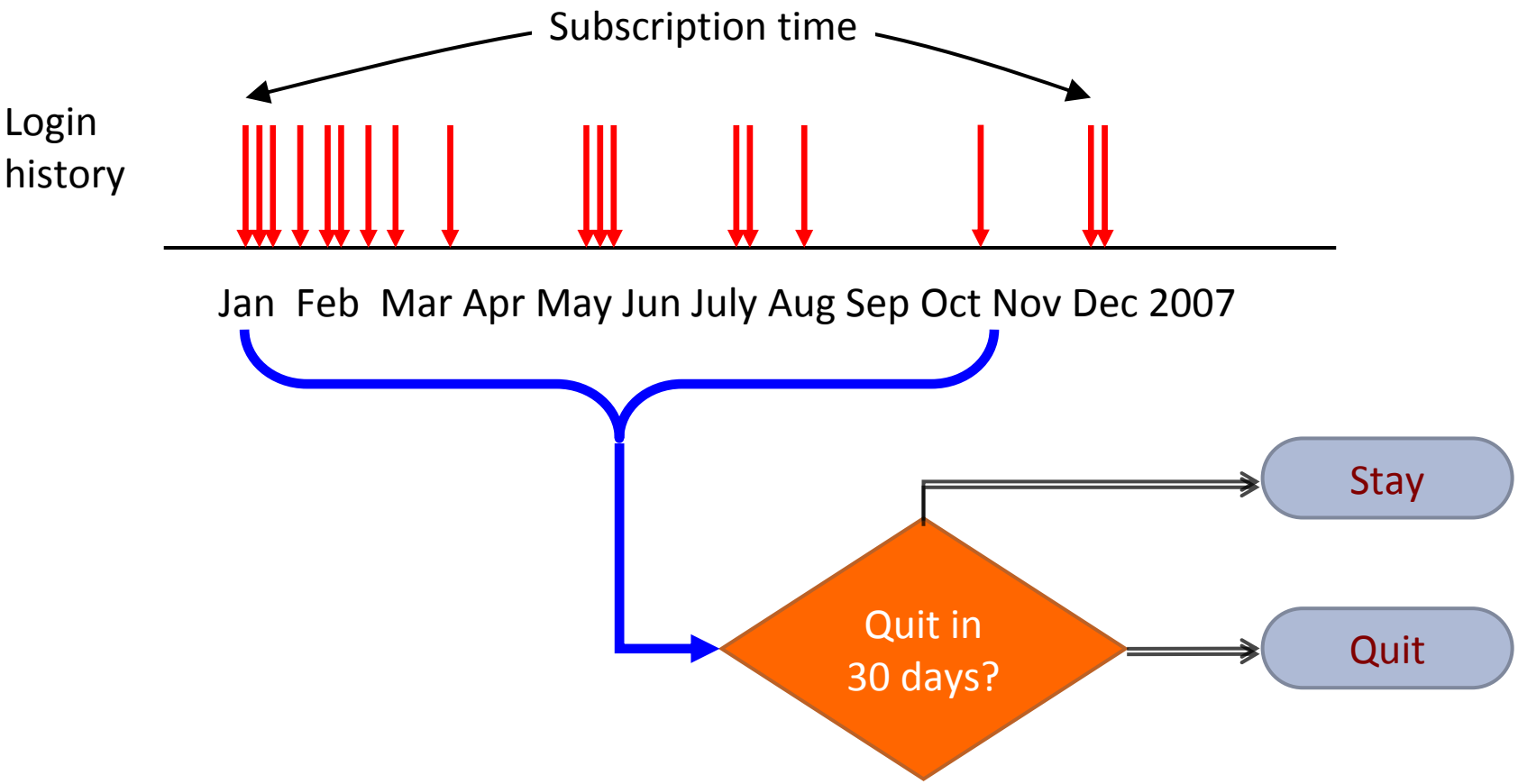
Game-Play Time Prediction

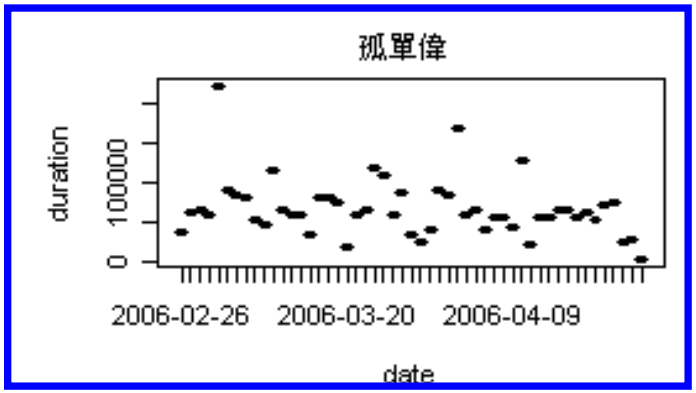
Unsubscription Prediction

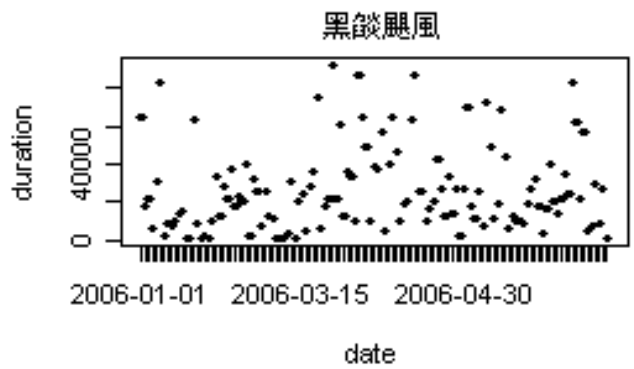
- Game improvement
  - Players' unsubscription ➔ low satisfaction
  - Surveys can be conducted to determine the causes of player dissatisfaction and improve the game accordingly
  - More likely to receive useful comments before players quit
- Prevent VIP players' quitting (maintain revenue)
  - For "item mall" model, users' contribution (of revenue) is heavy-tailed
  - Losing VIP players may significantly harm the revenue
- Network/system planning and diagnosis
  - By predicting "which" players tend to leave the game ➔ investigating is there any problem regarding network resource planning, network congestion, or server arrangement

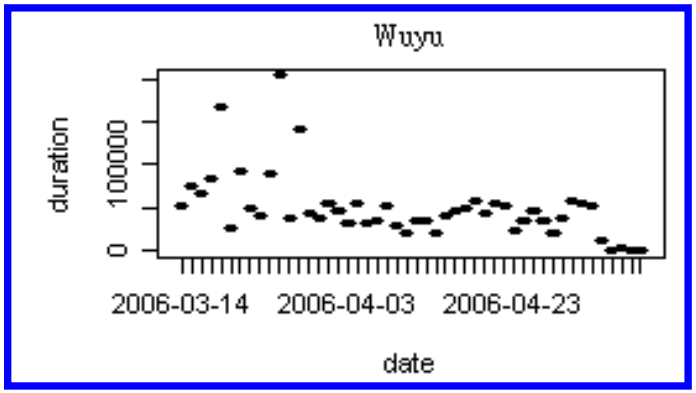
Unsubscription Prediction: Our Proposal

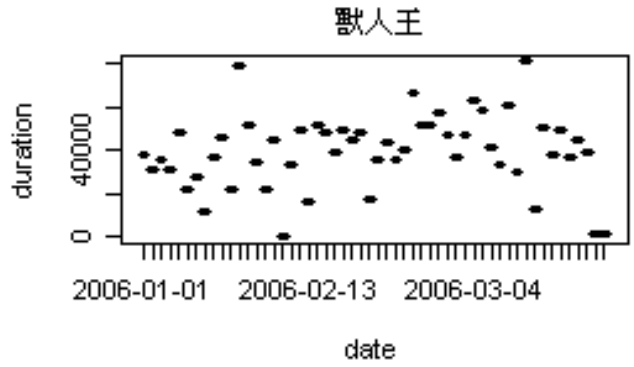
- Rationale: players' satisfaction / enthusiasm / addiction to a game is embedded in her game play history

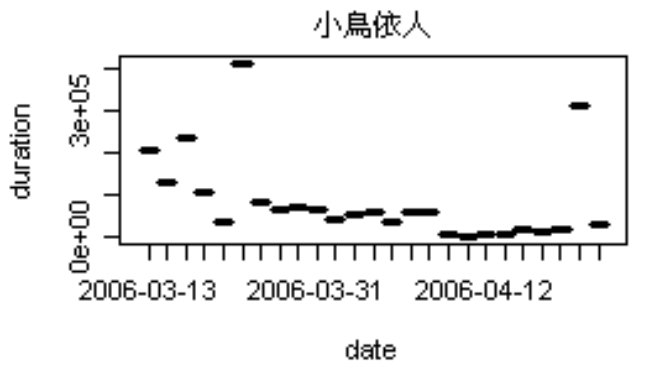


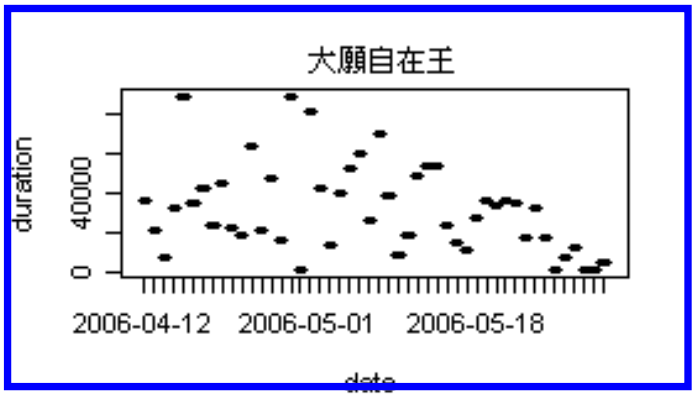

孤單偉
duration
0
100000
2006-02-26
2006-03-20
2006-04-09
date


黑鈸颶風
duration
0
40000
2006-01-01
2006-03-15
2006-04-30
date


Wuyu
duration
0
100000
2006-03-14
2006-04-03
2006-04-23
date

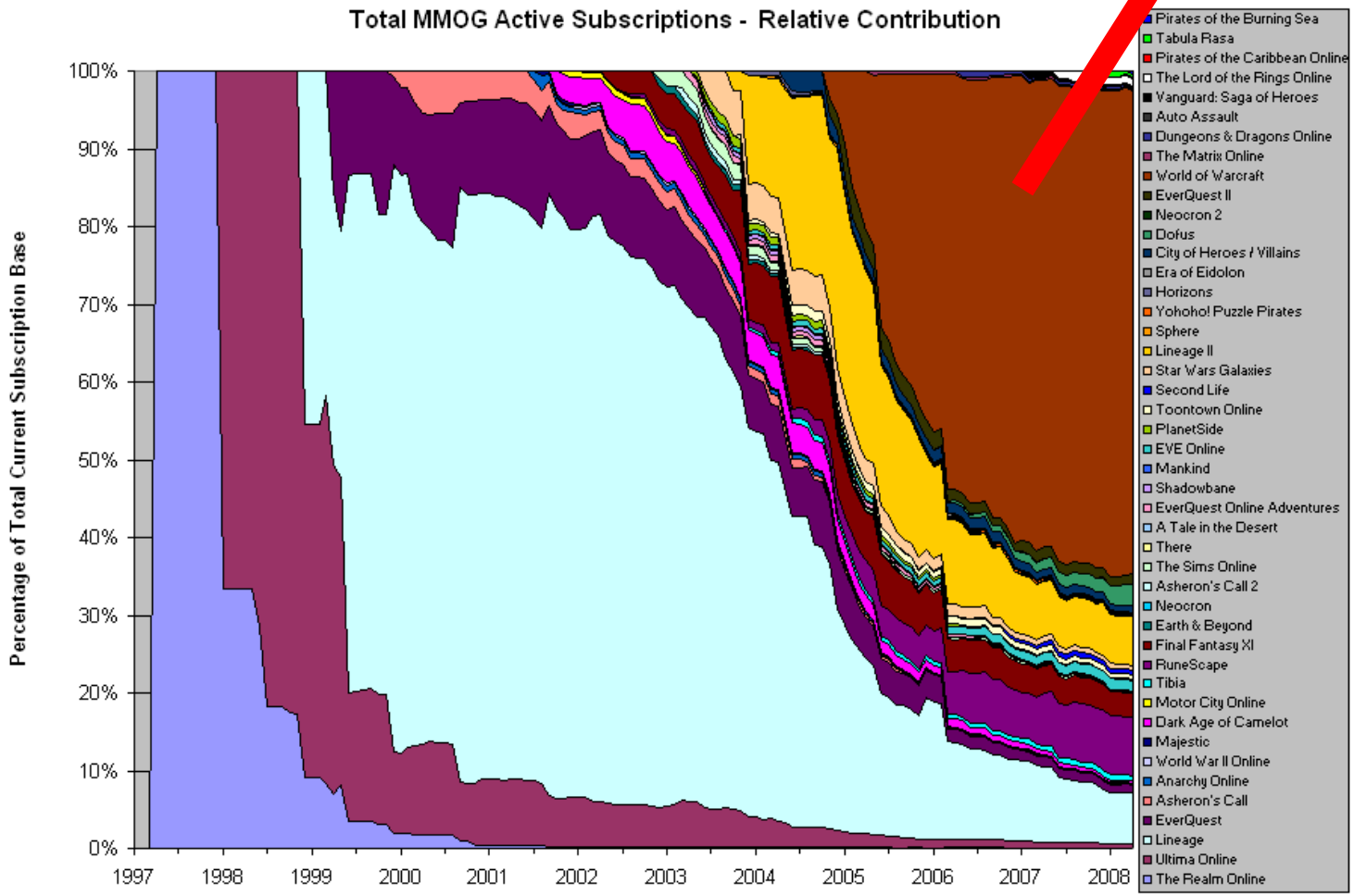

獸人王
duration
0
40000
2006-01-01
2006-02-13
2006-03-04
date


小鳥依人
duration
0e+00
3e+05
2006-03-13
2006-03-31
2006-04-12
date


大願自在王
duration
0
40000
2006-04-12
2006-05-01
2006-05-18
date

World of Warcraft

- The most popular MMOG for now



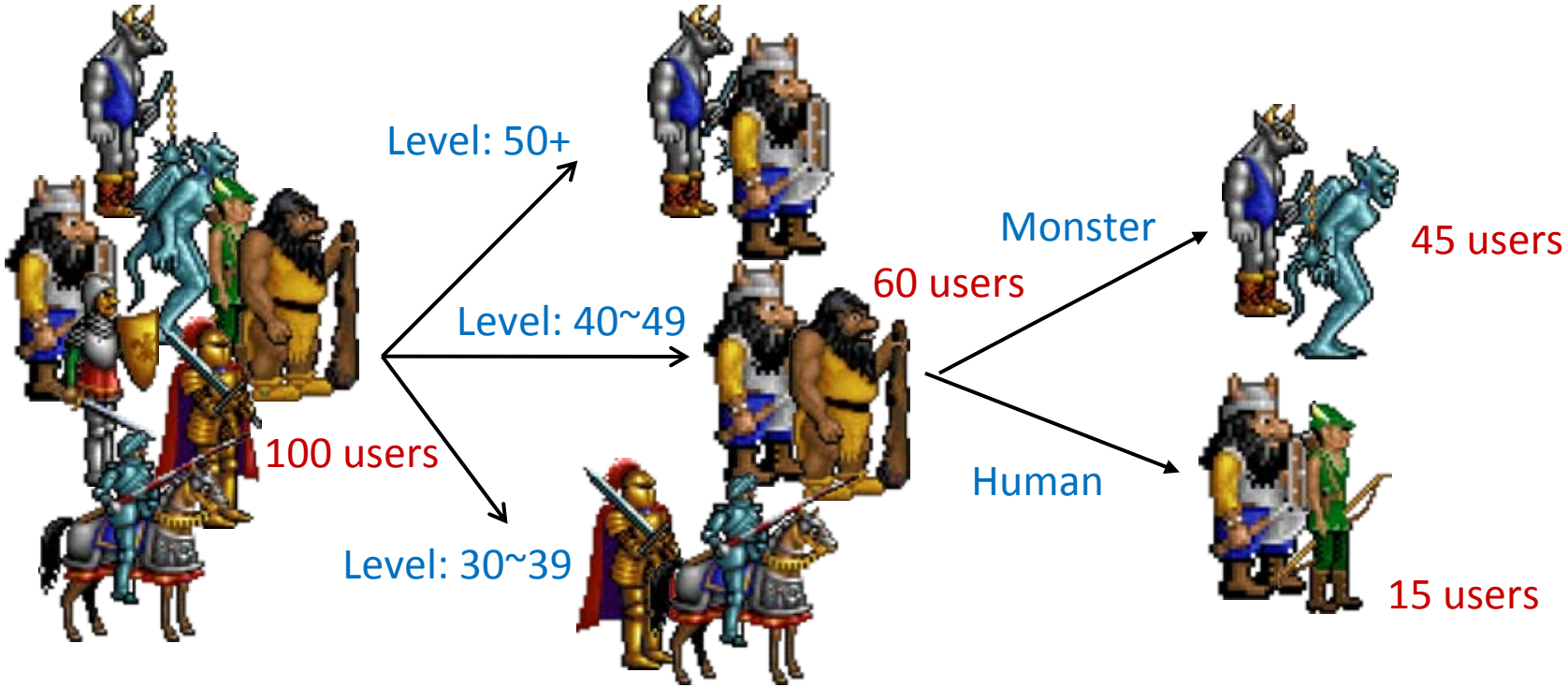
Data Collection Methodology

- Create a game character
- Use the command '*\who*'
- The command asks the game server to reply with a list of players who are currently online

- Write a specialized data-collection program (using C#, VBScript, and Lua)

The Limitation of WoW API

- WoW returns at most 50 users in one query
- We narrow down our query ranges by dividing all the users into different races, professions, and levels



Trace Summary

WoW trace	
Start date	2005-12-22
End date	2007-10-17
Length	664 days
Total sessions	1,672,820
Accounts observed	34,521

福克斯大神之謎？？ (1)

網友A：不知道在聖光之願部落的玩家有沒有發現到，在新手村薩滿訓練師的後面，永遠都會站著一個叫「福克斯大神」的獵人玩家！在半年前我到聖光定居時我在新手村見到他，到現在他仍然還是留守在那個地方……不會暫離、而且可以觀察他= ="
這種事該回報給GM嗎？創新手看到他的時候都覺得好恐佈啊囧

網友B：me too
看到的一瞬間 突然起雞皮疙瘩.....

網友C："已離去"玩家的怨念(怨魂@@)嗎?
還是在悲傷愛情故事裡,癡等所愛的另一人?
^^^^^^^^QQ

網友D：哈 線在好多人在看噢
旁邊爲了一大群人@@
觀光景點呀XD

ref. http://forum.gamebase.com.tw/content.jsp?no=4715&cno=47150002&sno=75201947
ref. http://www.wings-of-narnia.com/viewtopic.php?t=3012

福克斯大神之謎？？ (2)

網友E：我剛剛也有去看了一下 開了一個ID叫做“聽說有鬼”的獸人戰士 坐在他面前的桶子一直望著他~ 忽然!

<暫離>福克斯大神
他蹲下了...隔一分鐘..消失=ˇ="
..
..
現在我心裡也是毛毛的..

網友F：好猛鬼啊!!!!!!大神的力量好可怕啊,一堆信眾死在他之前！！！！！！

網友G：我上次有開過去看，還遇到了兩位同好，看的時候眞的蠻不可思議的...

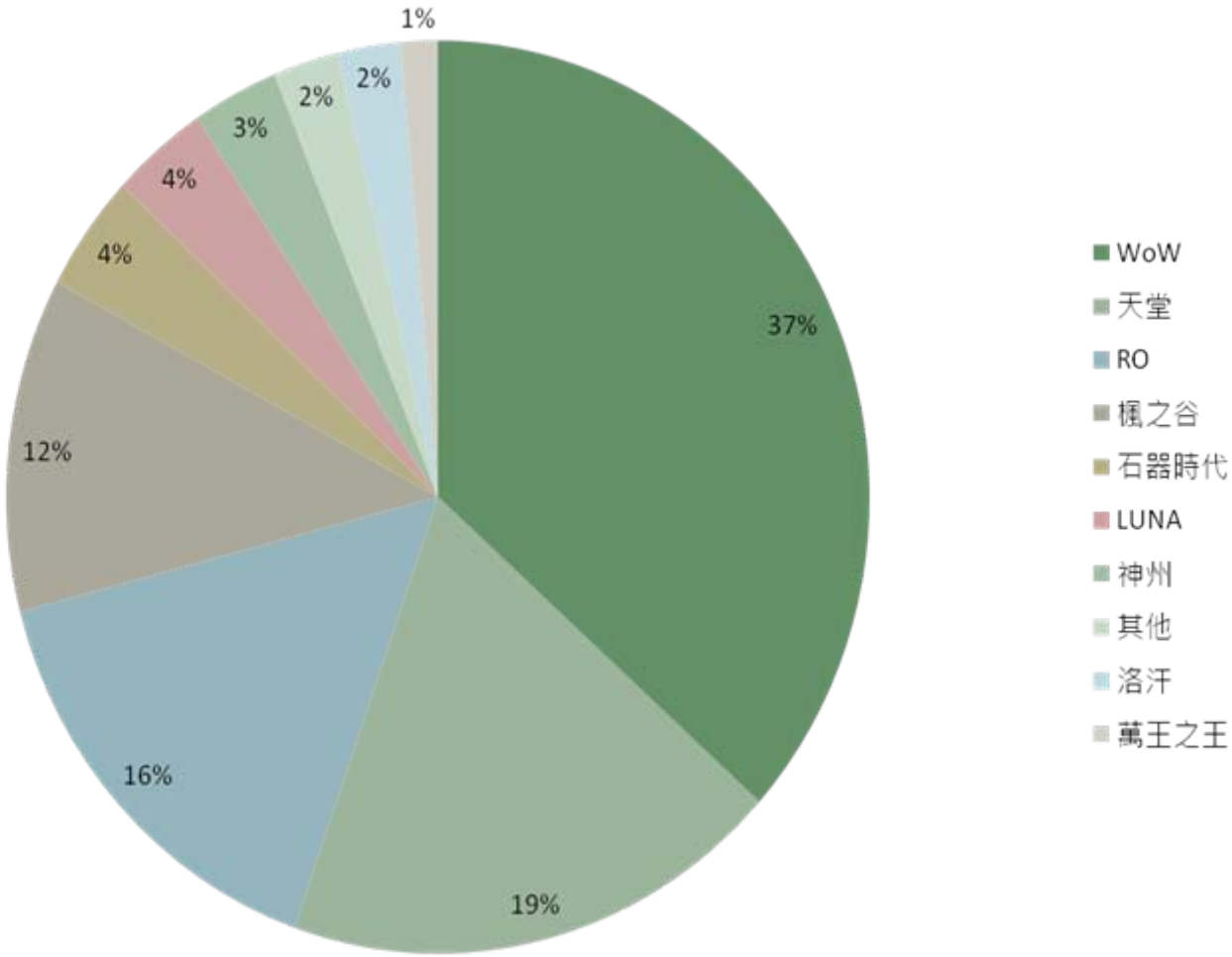
可以列入魔獸10大世界奇觀吧!

福克斯大神與祂的信眾們 -_-


記者
福克斯大神
試煉谷
3:27
媽啊 這就是傳說中的大神 所有事情的起源 福克斯大神了
3:22 AM
[03:22] [記者]說: 我們一起去看看發生了什麼事!
[03:22] [記者]說: 注意到什麼了嗎?
[03:23] [記者]說: 這裡的屍首名字大多都和大神有關
[03:23] [記者]說: 到底發生了什麼事呢?
[03:27] [暗影殺神]悄悄地說: ?
[03:27] [記者]說: 媽啊 這就是傳說中的大神 所有事情的起源 福克斯大神了
芙柯蘇的屍體

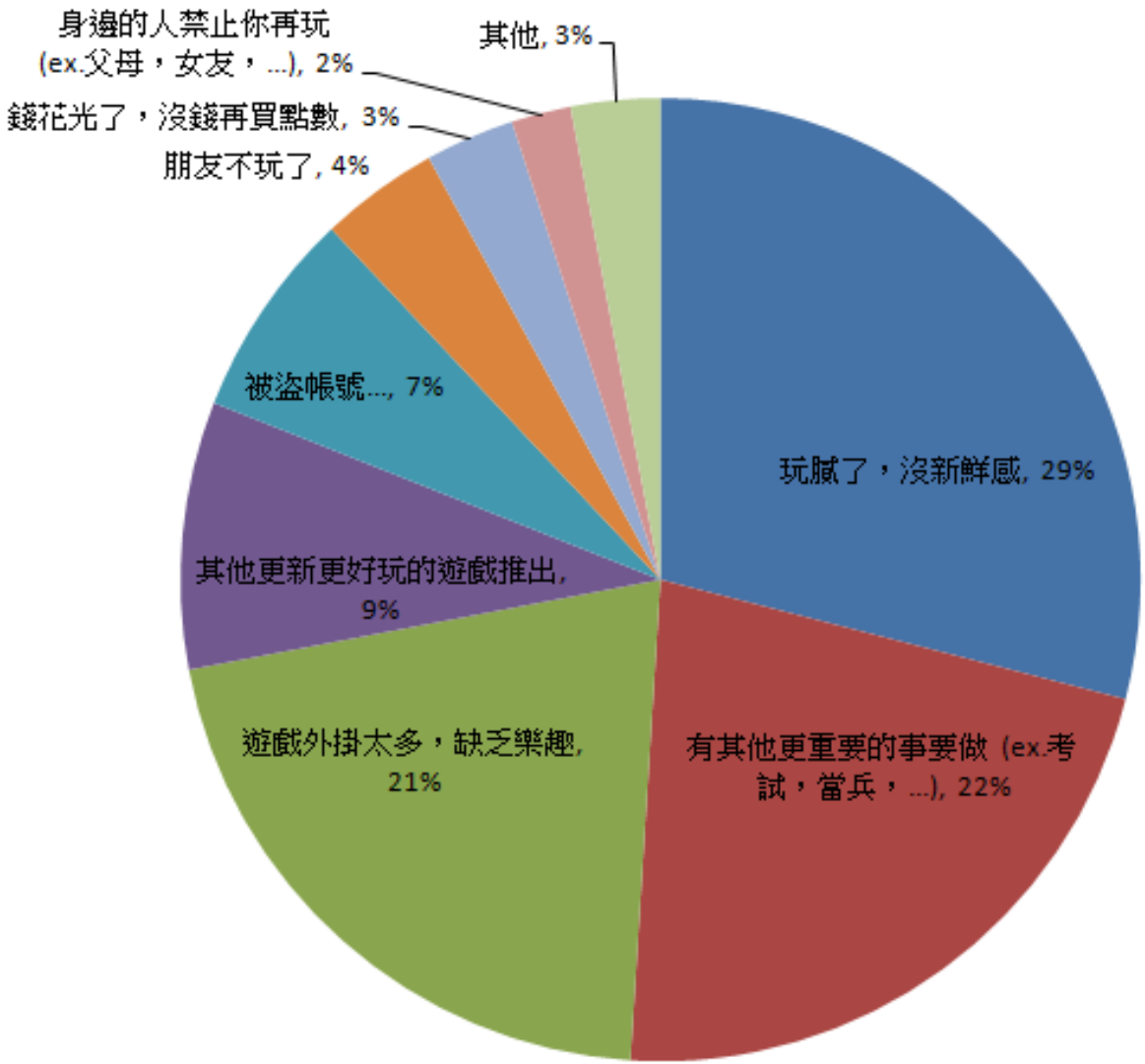

Centos
80 / 80
0 / 100
福克斯大神
100%
81 / 81
試煉谷
大神好噎
暗矛
福克斯大神
Xmanxa
<福克斯大神教>
福克斯小王
<福克斯大神教>
肚肚看大神
<福克斯大神教>
神牙救救我
Decursive
囧囧馬在決鬥中戰勝了Ytryty
[福克斯不知神]大義：大神面前不得泡妞
[神之盜賊手]說：專殺鄉民
囧囧馬在嘲笑Ytryty
囧囧馬在嘲笑Ytryty
Ytryty在嘲笑囧囧馬
囧囧馬在嘲笑Ytryty
[鄉民一個]說：大神阿 求你給我一個女朋友八!!
幻滅級星

Questionnaire

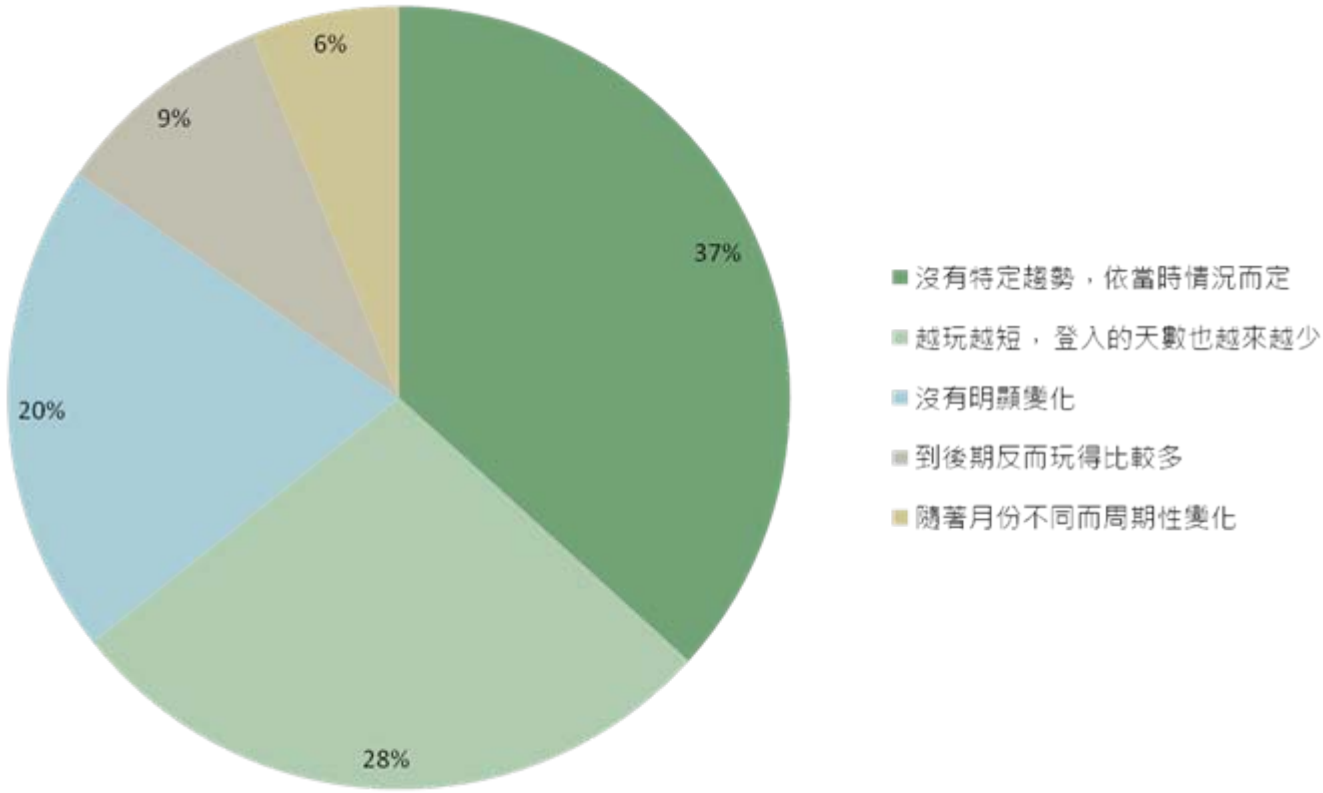


Sample number: 1747

Reasons for User Unsubscription



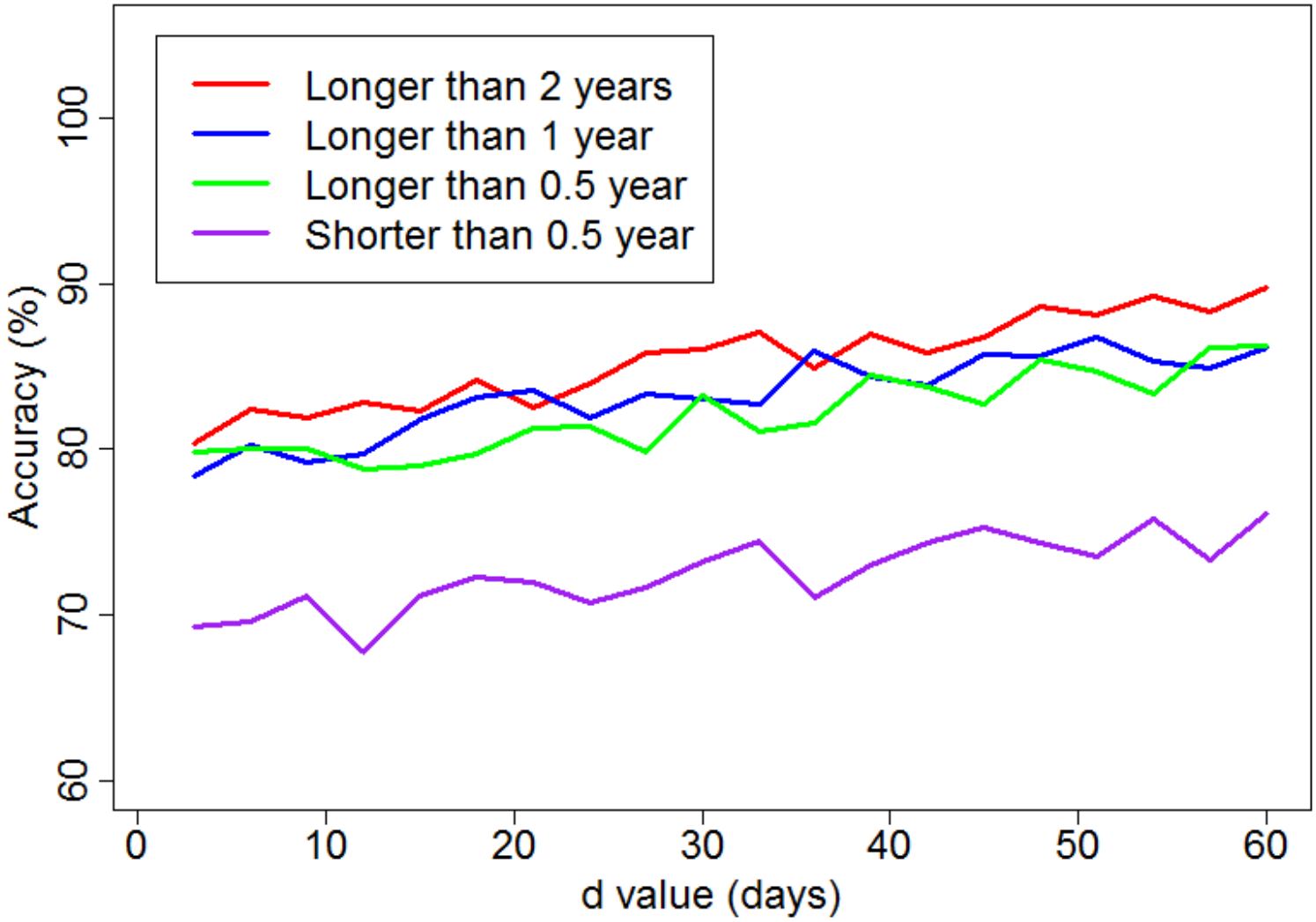
Trend of Game Playing Time



Logisitic Regression Model for Unsubscription Prediction

- Significant features (out of > 20 features)
  - Avg. session time
  - Daily session count
  - Variation of the login hour (when the player starts playing a game each day)
  - Variation of daily play time (number of hours)
- A naive logistic regression model achieves approximately 75% prediction accuracy

Unsubscription Prediction Result



Networking Topics

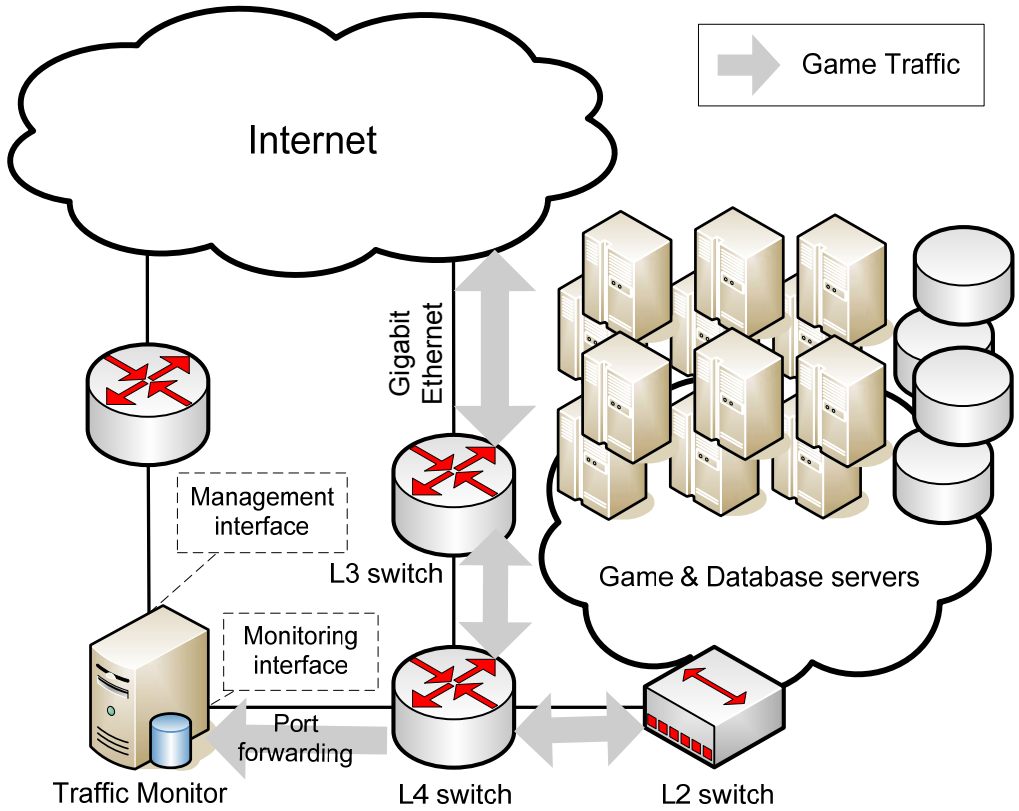
Game Traffic Analysis

- Understand game traffic characteristics (and effect on current Internet)
- Predict bandwidth demand
- Identify potential performance problems

(Ref: Kuan-Ta Chen and Polly Huang and Chin-Laung Lei, "Game Traffic Analysis: An MMORPG Perspective," Computer Networks, volume 50, number 16, November 2006.)

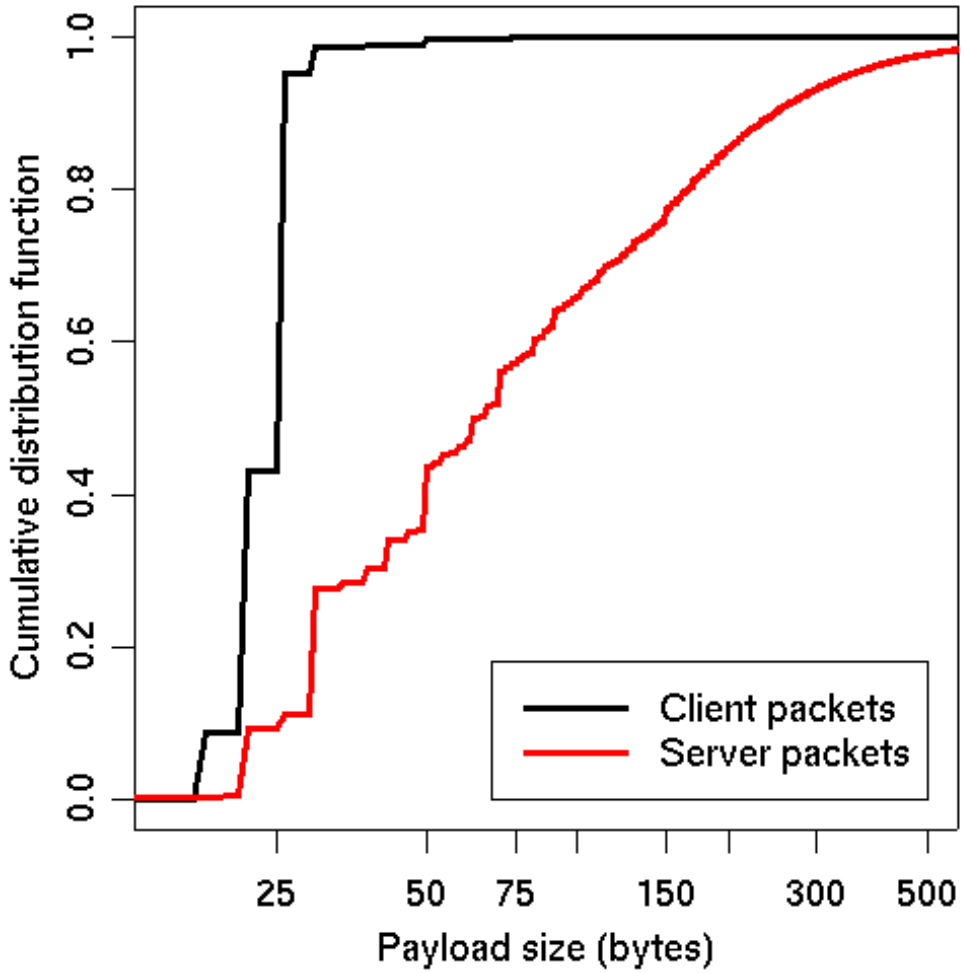
Case Study: ShenZhou Online

Traffic Trace Collection



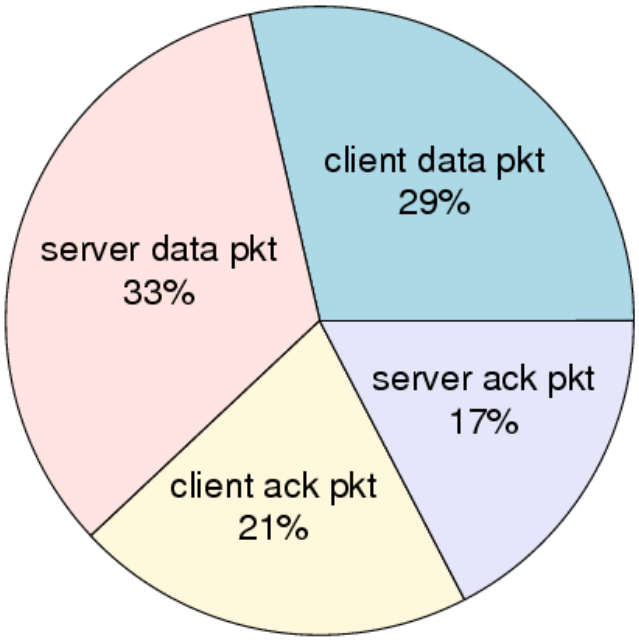
trace	conn. #	packets (in/out/both)	bytes (in/out/both)
N1	57,945	342M / 353M / 695M	4.7TB / 27.3TB / 32.0TB
N2	54,424	325M / 336M / 661M	4.7TB / 21.7TB / 26.5TB

Payload size distribution - CDF

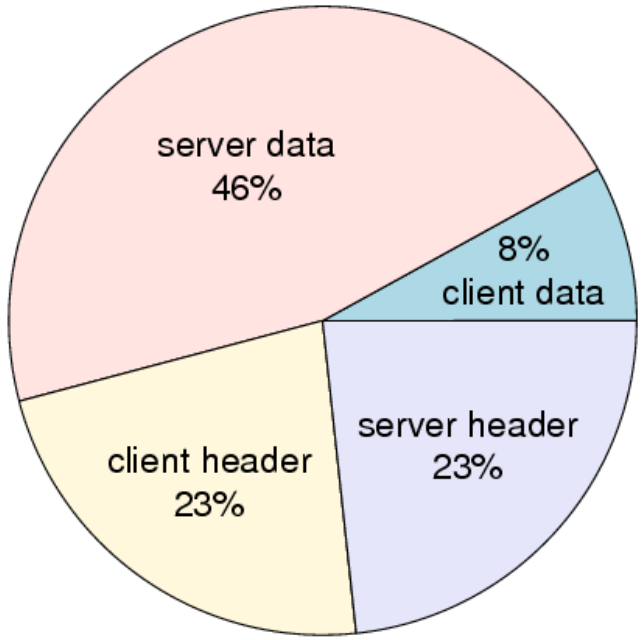


- client packets
  - 98% pkts' payload ≤ 31 bytes
  - the most two modes occupy 90% ⇒ certain commands are popular
- server packets
  - avg. payload size 114 bytes
- contrast to the mean packet size 400 bytes observed in backbones

Protocol Overhead



(a) Packet count



(b) Byte count

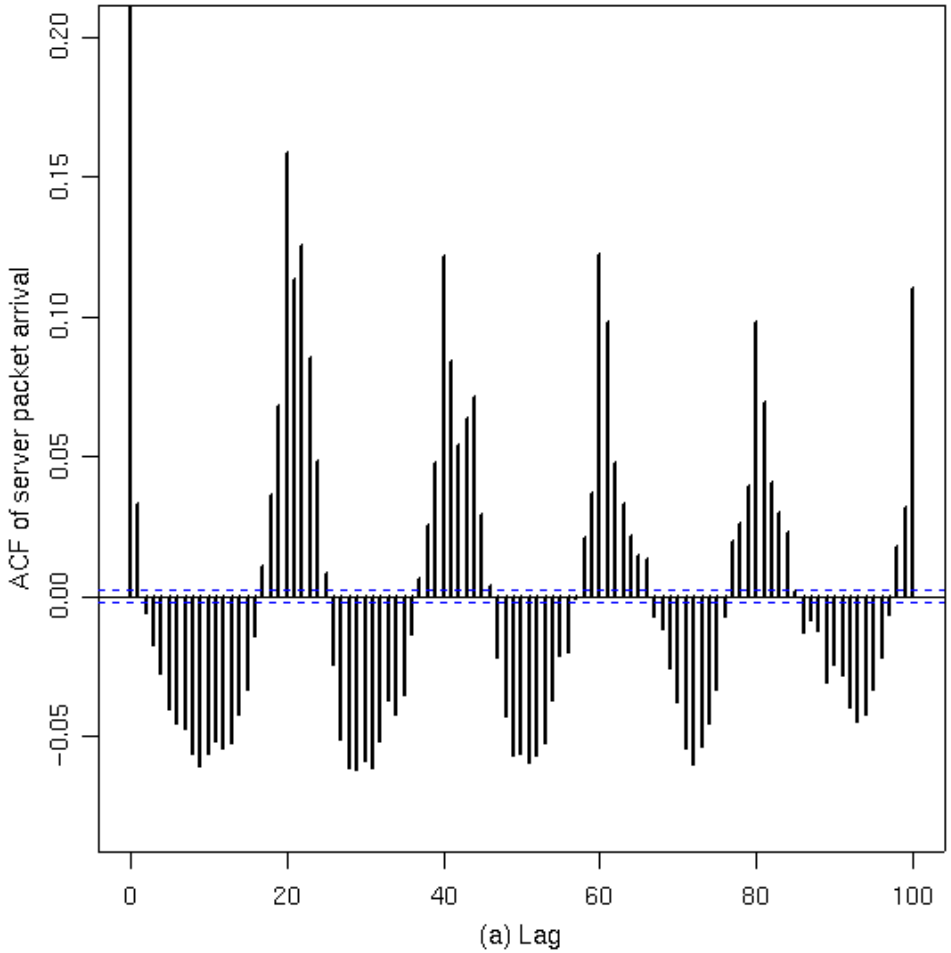
38% packets are TCP ACK packets

46% bandwidth are used by TCP/IP headers

ACF of Aggregate Server Packet Arrivals

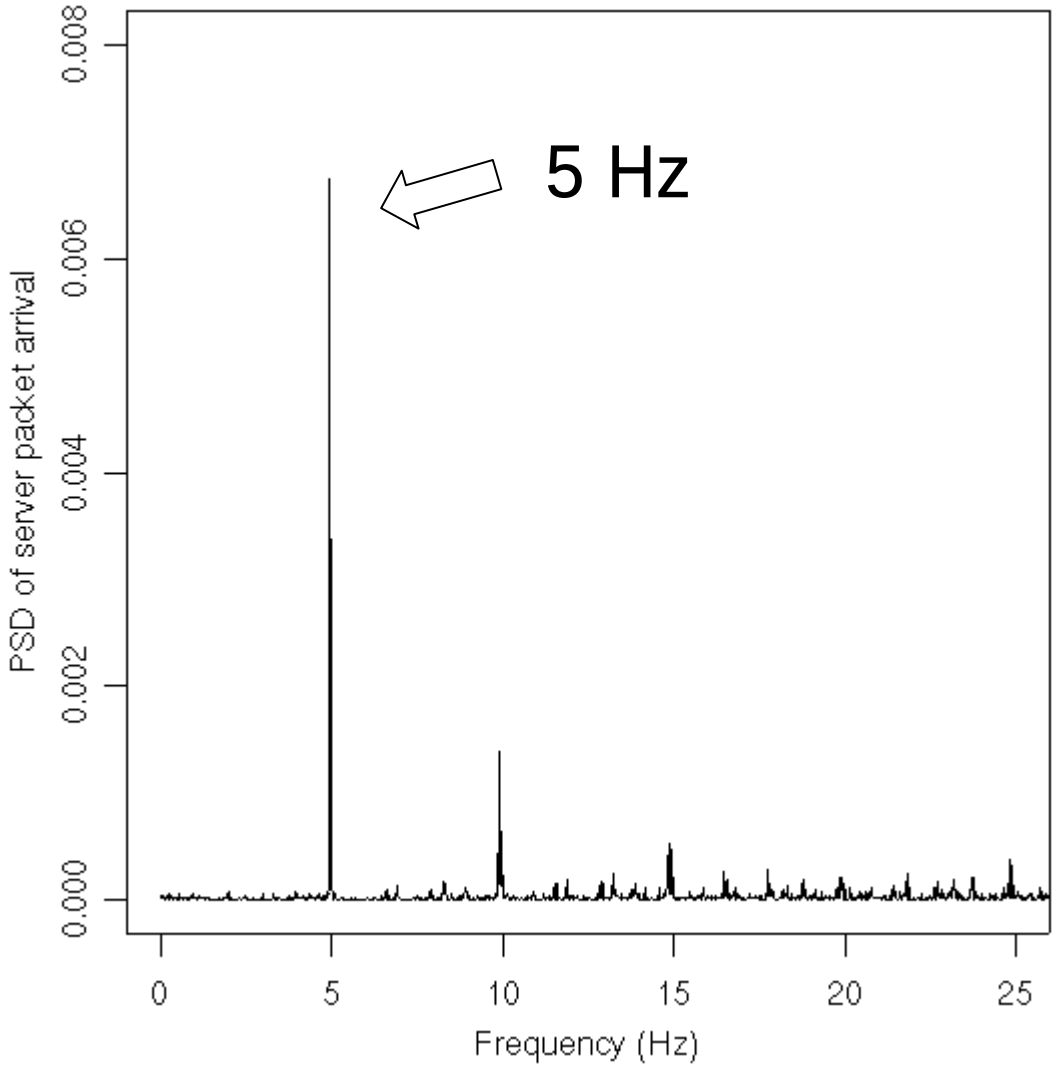
(taken in every 10 ms)

Auto-correlation function



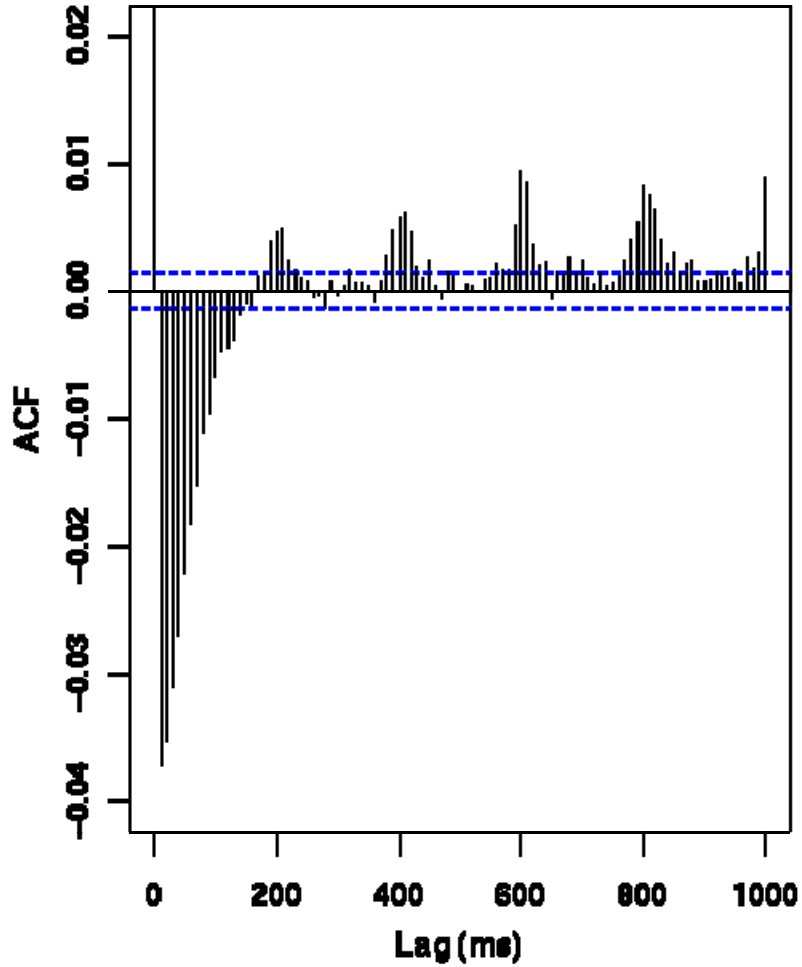
- periodicity: 200 ms
- position updates are synchronous for all clients
- incurring periodic packet bursts

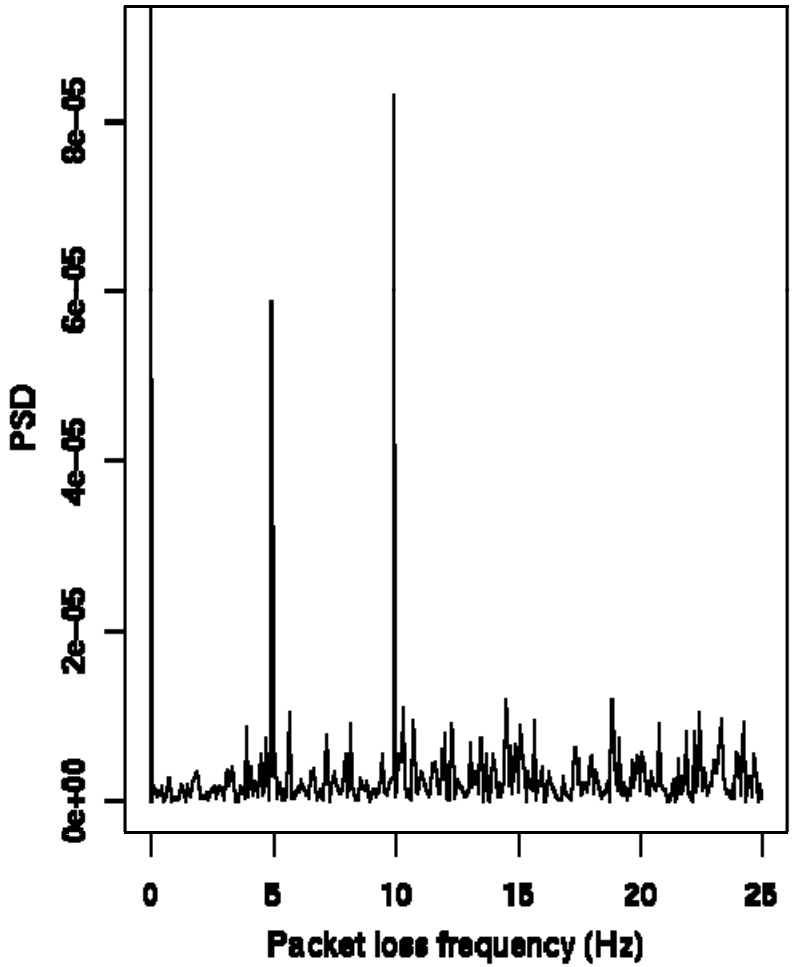
Frequency Components in Server Traffic



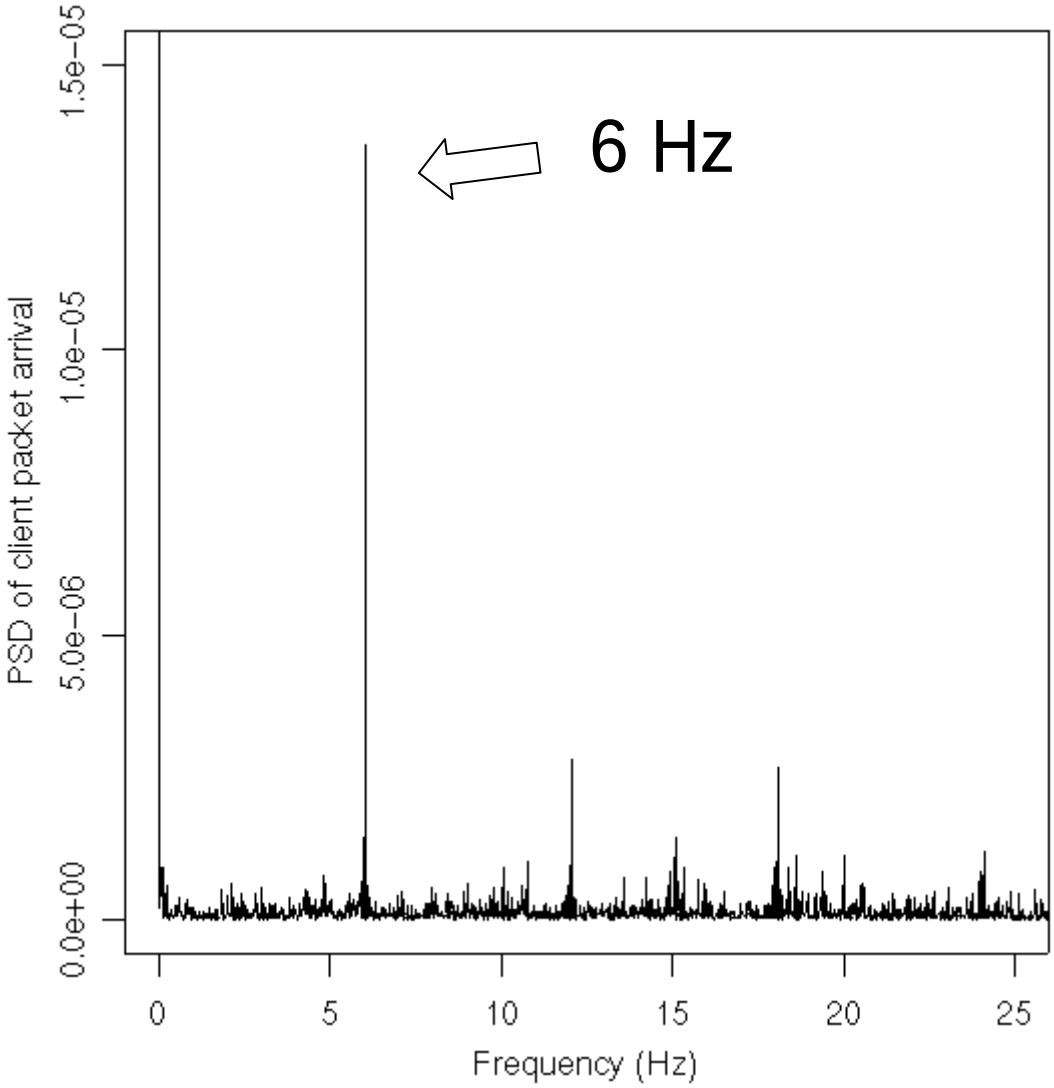
- 5 updates per second
- Nagle's algorithm / delayed ack options
- server timer synchronized?

Packet Loss Pattern





Frequency Components in Client Traffic



- by auto-walk and auto-attack timers
- Adjust frequency by level/skill and weapons held
- client timers are synchronized?

Lessons Learned

- High protocol overhead
  - Aggregate messages if possible
- TCP Options
  - Turn off “delayed ack” and “Nagle’s algorithm” options
- High synchronicity between flows
  - A common design pattern (dispatch packets in a loop)
- High synchronicity between servers
  - NTP clock synchronization

Networking Topics

User Perception Measurement

- How gamers are aware of service quality?
- How to improve users' gaming experience?

(Ref: Kuan-Ta Chen, Polly Huang, and Chin-Laung Lei, "Effect of Network Quality on Player Departure Behavior in Online Games," To Appear in IEEE Transactions on Parallel and Distributed Systems.)

How Gamers are Aware of Service Quality?

- Real-time interactive online games are generally considered QoS-sensitive
- Gamers are always complaining about high "ping-times" or network lags

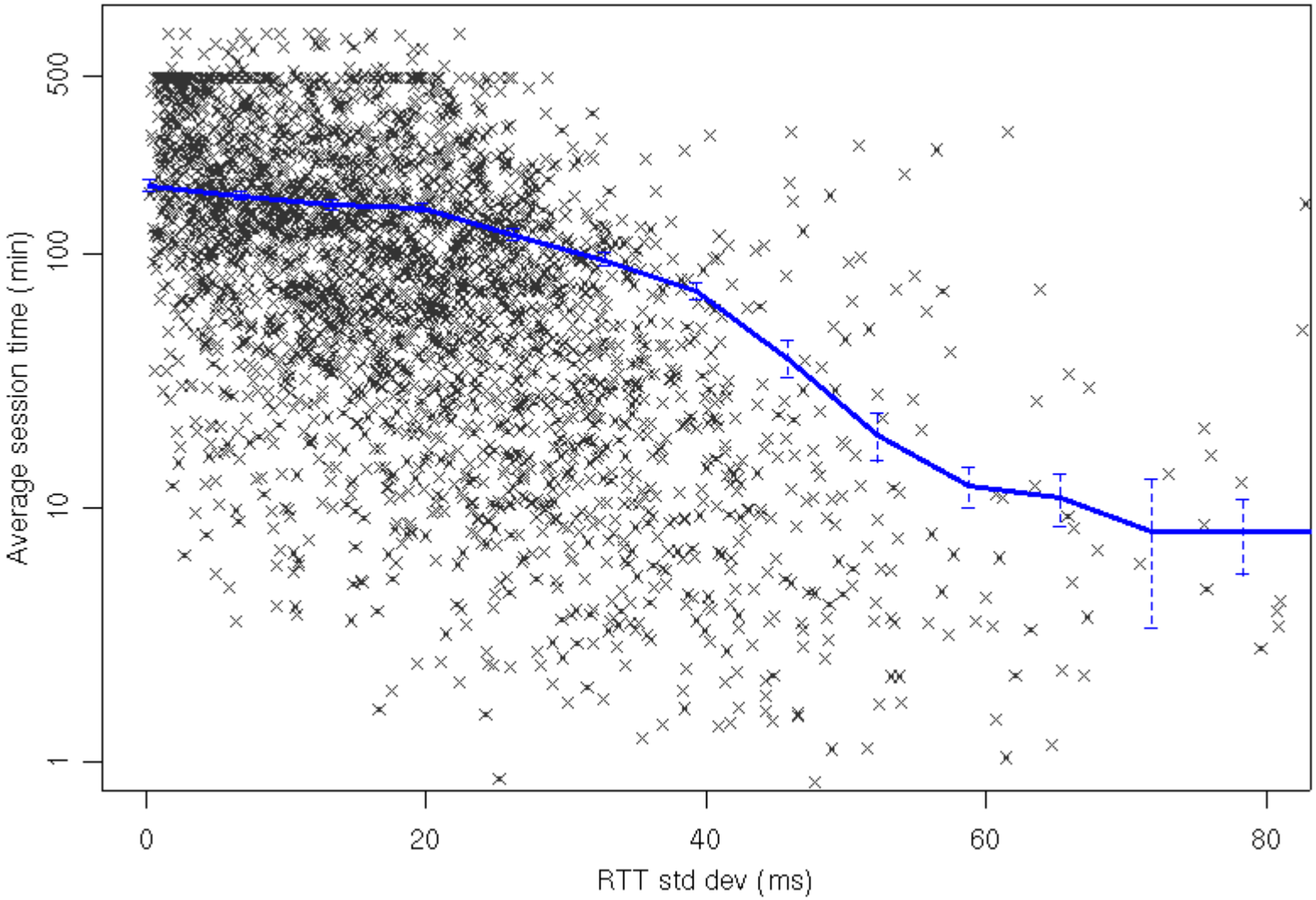
- Online gaming is increasingly popular despite the best-effort Internet

Q1: Are game players really sensitive to network quality as they claim?

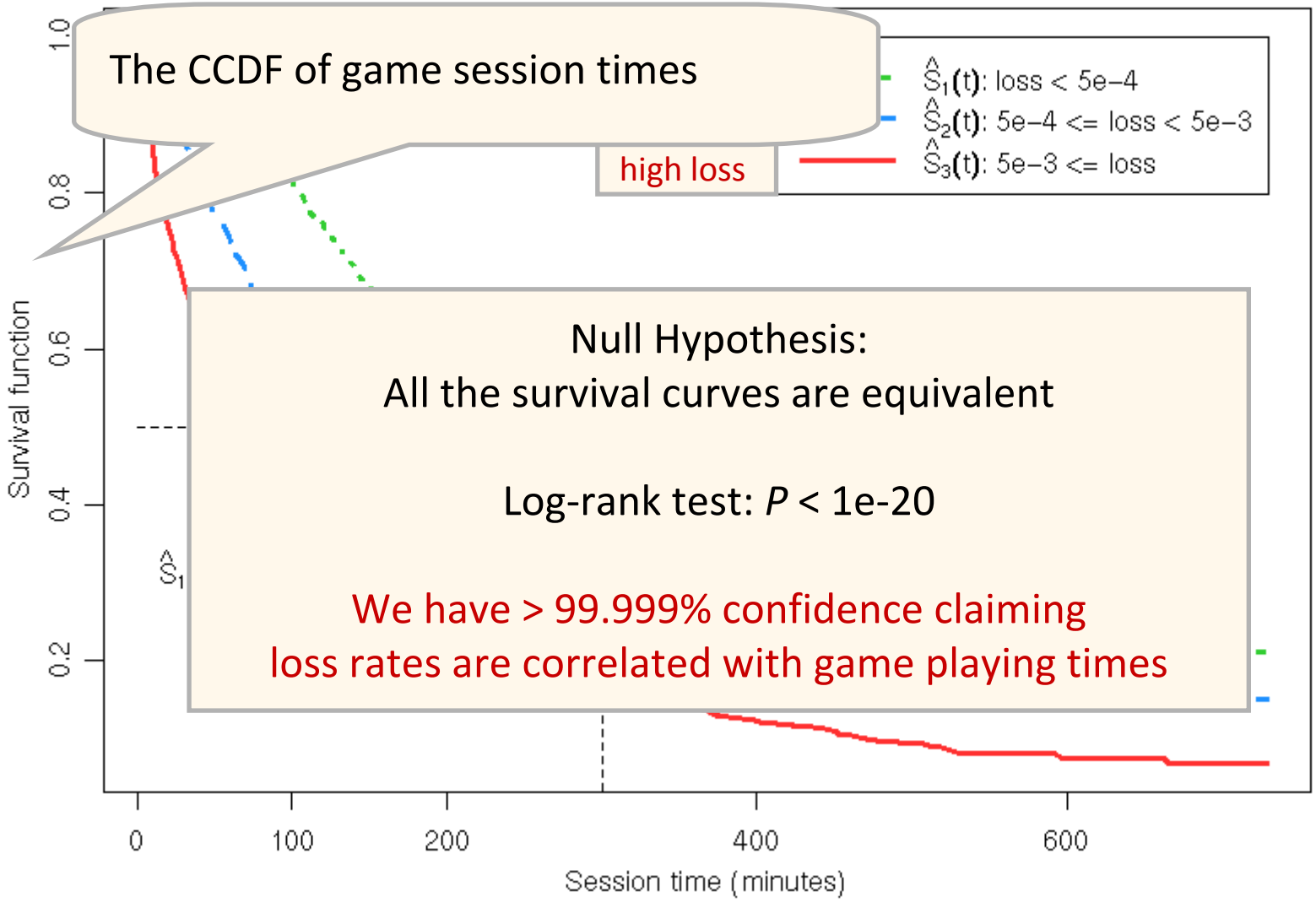
Q2: If so, how do they react to poor network quality?

Delay Jitter vs. Session Time

(std. dev. of the round-trip times)



Hypothesis Testing -- Effect of Loss Rate



Regression Modeling

- Linear regression is not adequate
  - Violating the assumptions (normal errors, equal variance, …)
- The Cox regression model provides a good fit
  - Log-hazard function is proportional to the weighted sum of factors

$$\log h(t|\mathbf{Z}) \propto \boldsymbol{\beta}^t \mathbf{Z}$$ (our aim is to compute $\boldsymbol{\beta}$)

where each session has factors Z (RTT=x, jitter=y, …)

Hazard function (conditional failure rate)
The instantaneous rate of quitting a game for a player (session)

$$h(t) = \lim_{\Delta t \to 0} \frac{\Pr[t \leq T < t + \Delta t | T \geq t]}{\Delta t}$$

Final Model & Interpretation

Variable	Coef	Std. Err.	Signif.
log(RTT)	1.27	0.04	< 1e-20
log(jitter)	0.68	0.03	< 1e-20
log(closs)	0.12	0.01	< 1e-20
log(sloss)	0.09	0.01	7e-13

Interpretation

A: RTT = 200 ms

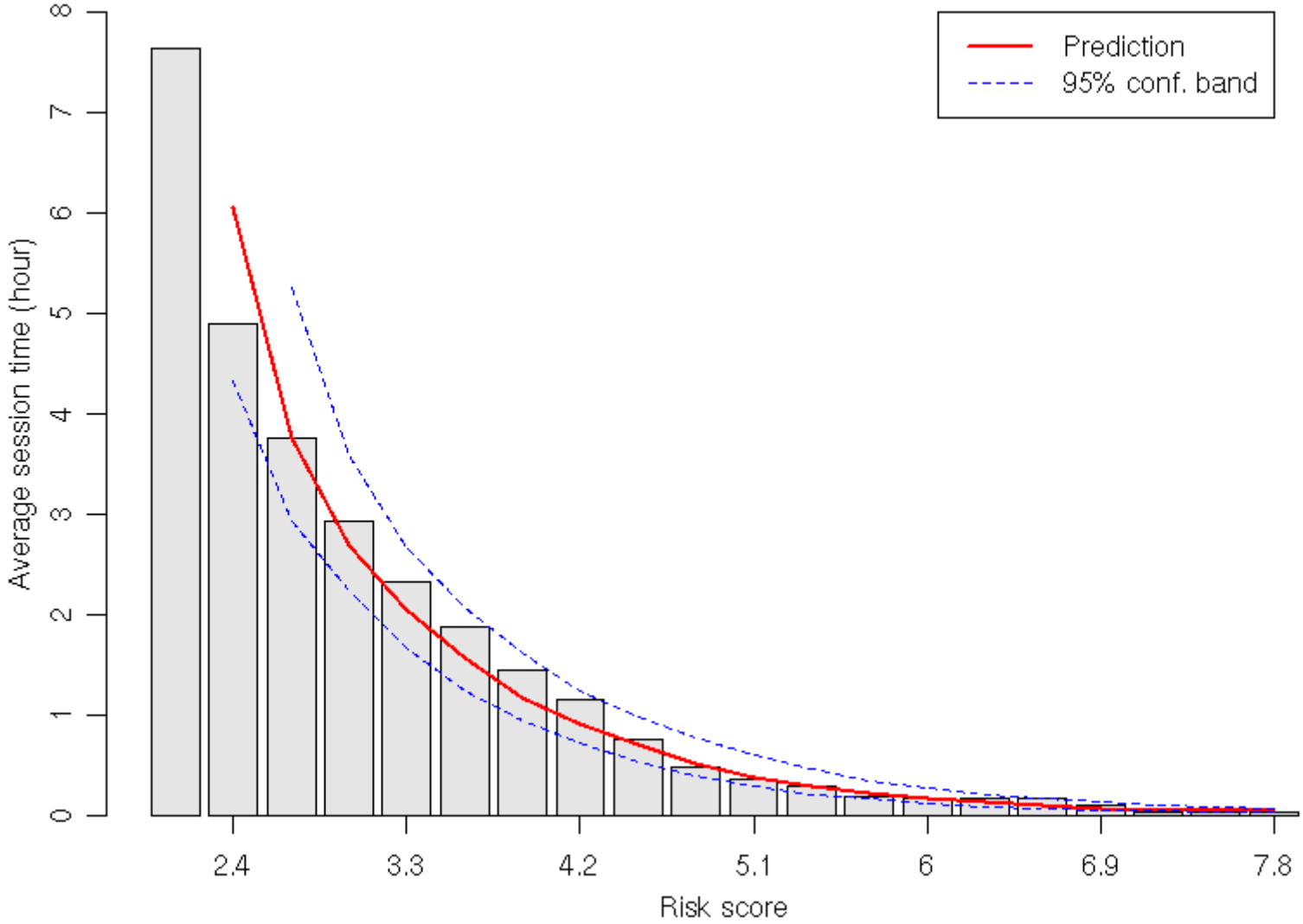
B: RTT = 100 ms, other factors same as A

Hazard ratio between A and B:

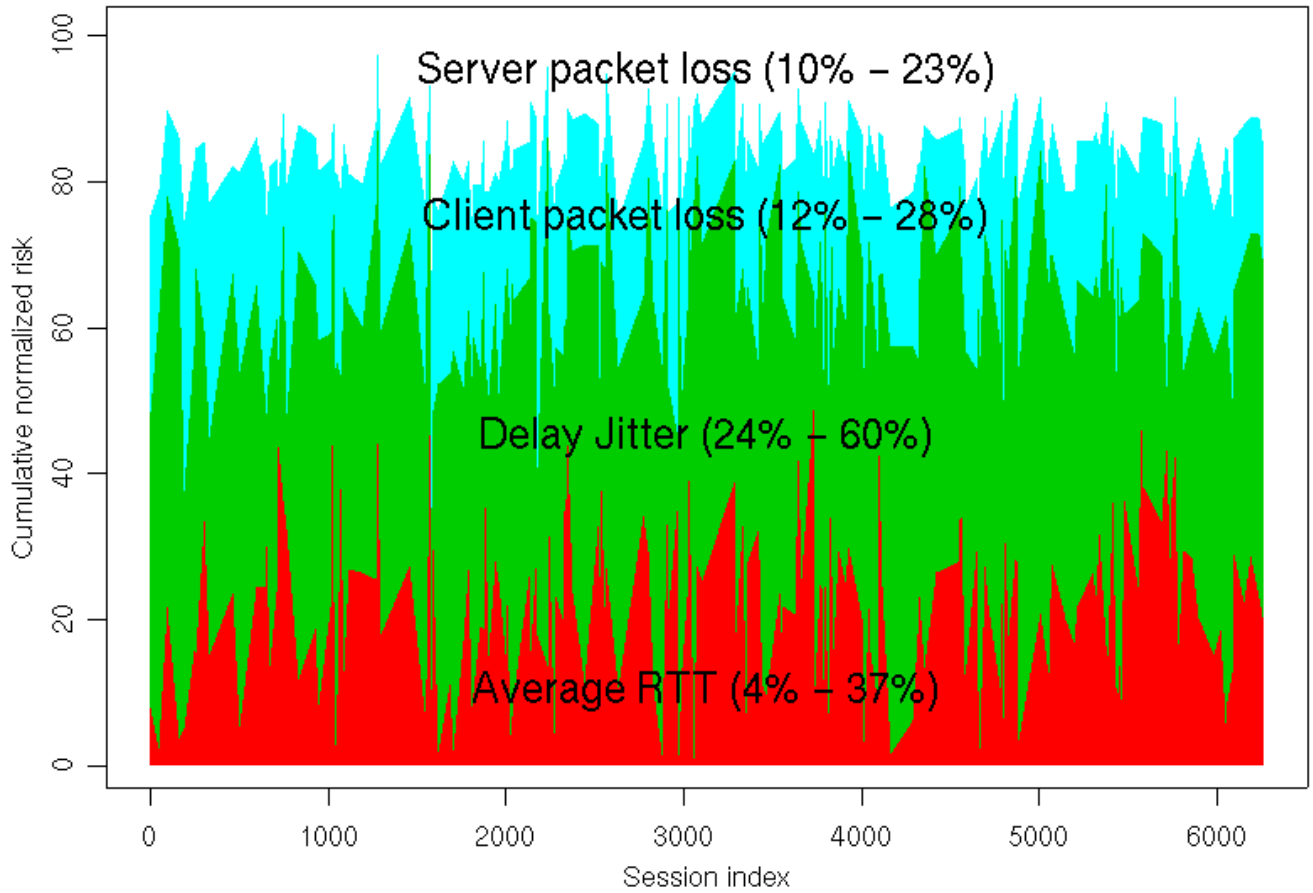
$\exp((\log(0.2) - \log(0.1)) \times 1.27) \approx 2.4$

A will more likely leave a game (2.4 times probability) than B at any moment

How good does the model fit?



Relative Influence of QoS Factors



Latency = 20%	Client packet loss = 20%
Delay jitter = 45%	Server packet loss = 15%

An Index for ShenZhou Online

$$\log(\text{departure rate}) \propto 1.27 \times \log(\text{RTT}) + 0.68 \times \log(\text{jitter}) + 0.12 \times \log(\text{closs}) + 0.09 \times \log(\text{sloss})$$

RTT:	round-trip times
jitter:	level of network congestion
closs:	loss rate of client packets
sloss:	loss rate of server packets

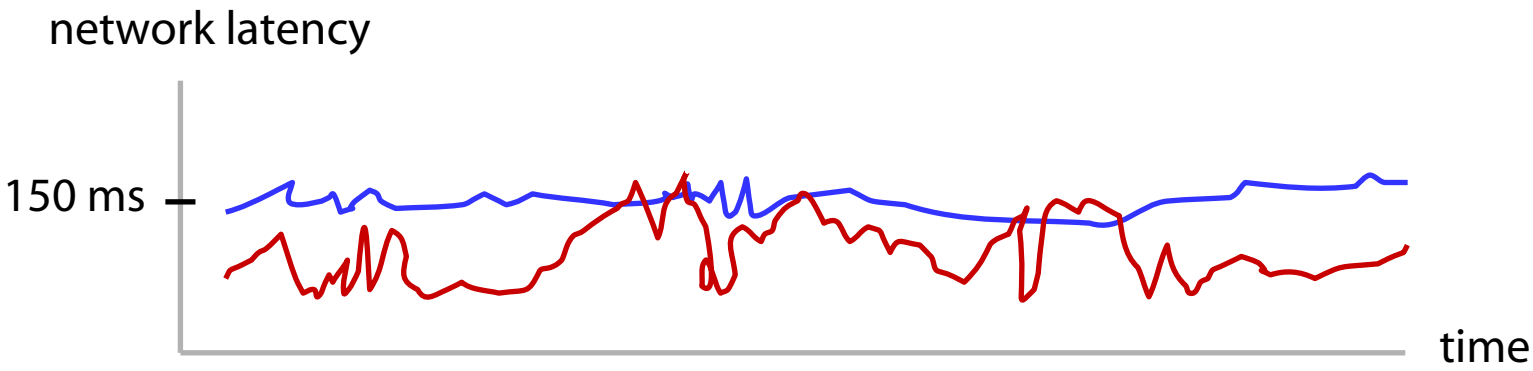
Features

- derived from real-life game sessions
- accessible and computable in real time
- implications: delay jitter is more intolerable than delay

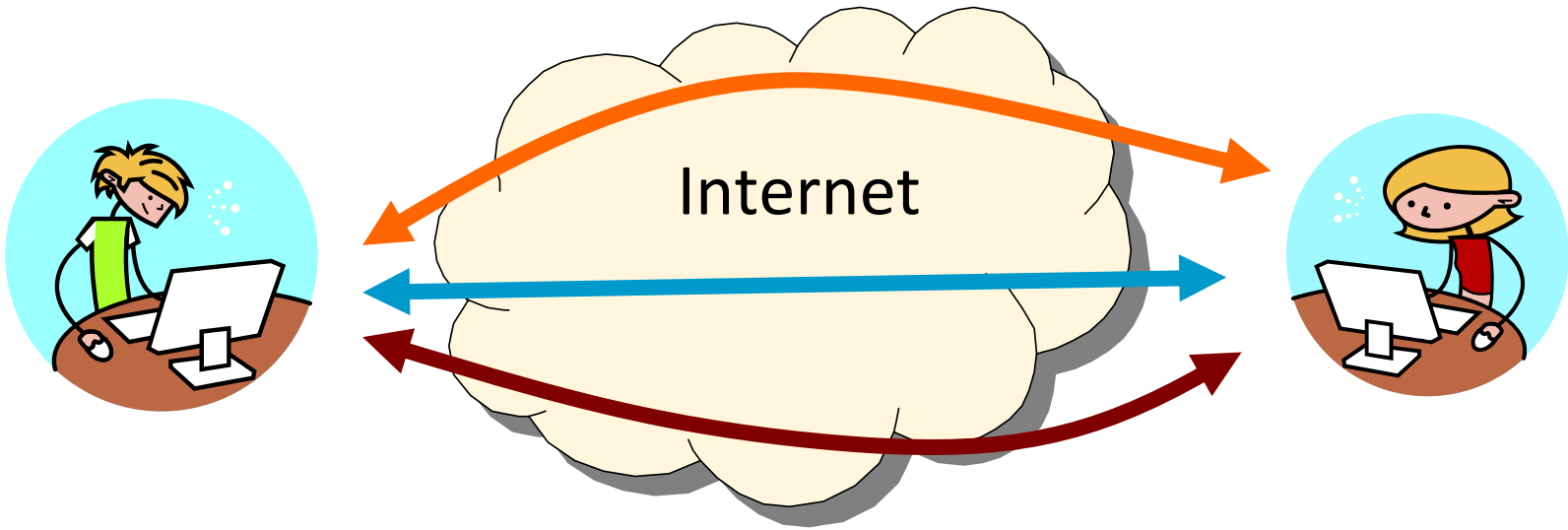
App #1: Evaluation of Alternative Designs

Suppose now we have two designs (e.g., protocols)

- One leads to lower delay but high jitter:
  - 100 ms, 120 ms, 100 ms, 120 ms, 100 ms, 120 ms, 100 ms, 120 ms, …
- One leads to higher delay but lower jitter:
  - 150 ms, 150 ms, 150 ms, 150 ms, 150 ms, 150 ms, 150 ms, 150 ms, …
- Which one design shall we choose?



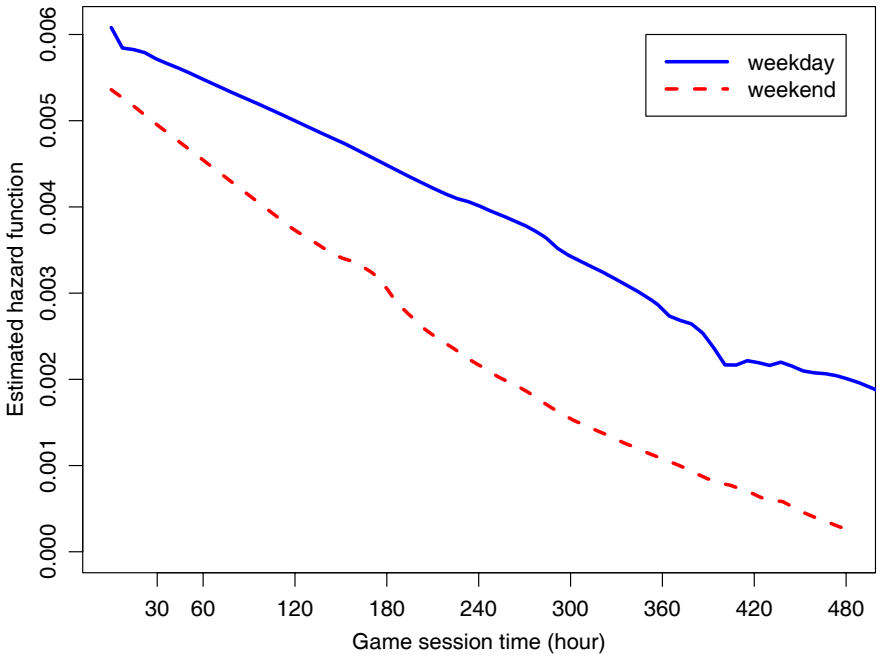
App #2: Overlay Path Selection

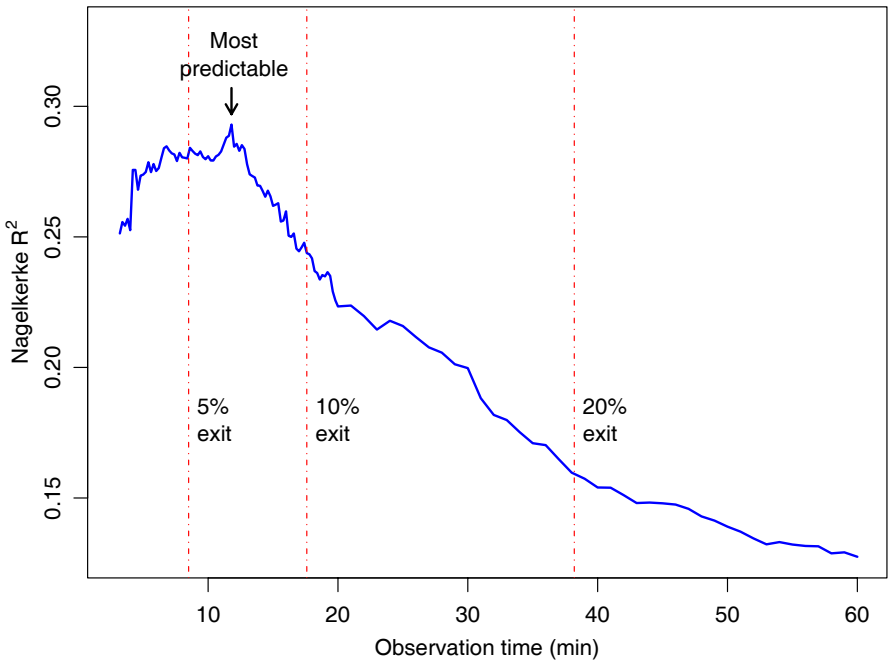


path	delay	jitter	loss rate	score
	100 ms (G)	50 ms (P)	5% (P)	3.84
	150 ms (A)	20 ms (G)	1% (A)	6.33
	200 ms (P)	30 ms (A)	1% (A)	5.43

Player Departure Behavior Analysis

- Player departure rate is decreasing by time
- Golden time is the first 10 minutes: the longer gamers play, the more external factors would affect their decisions to stay or leave
  - allocating more resources to players just entered





Networking Topics

Transport Protocol Design

- Is TCP good enough for MMOG?
- How to design a suitable protocol for (fast-paced) MMOG?

(Ref: Chen-Chi Wu, Kuan-Ta Chen, Chih-Ming Chen, Polly Huang, and Chin-Laung Lei, "On the Challenge and Design of Transport Protocols for MMORPGs," Springer Multimedia Tools and Applications, 2009.)

Choice of Transport Protocol

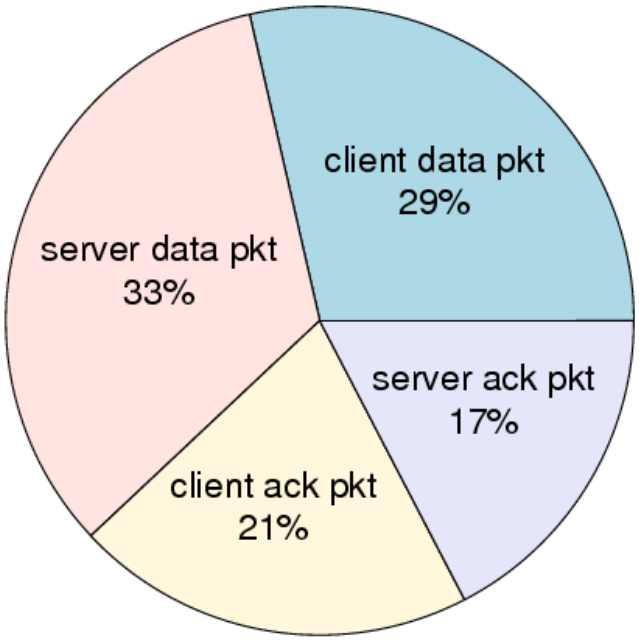
- TCP is considered not suitable for real-time communication
- All first-person shooting games use UDP
- No consensus has been reached for MMORPGs
  - Heated debate occurs at game developers' forums
  - Each protocol has quite a few proponents

Protocol	MMORPGs
TCP	World of Warcraft, Lineage I/II, Guild Wars, Ragnarok Online, Anarchy Online, Mabinogi
UDP	EverQuest, Star Wars Galaxies, City of Heroes, Ultima Online, Asherons Call, Final Fantasy XI
TCP+UDP	Dark Age of Camelot

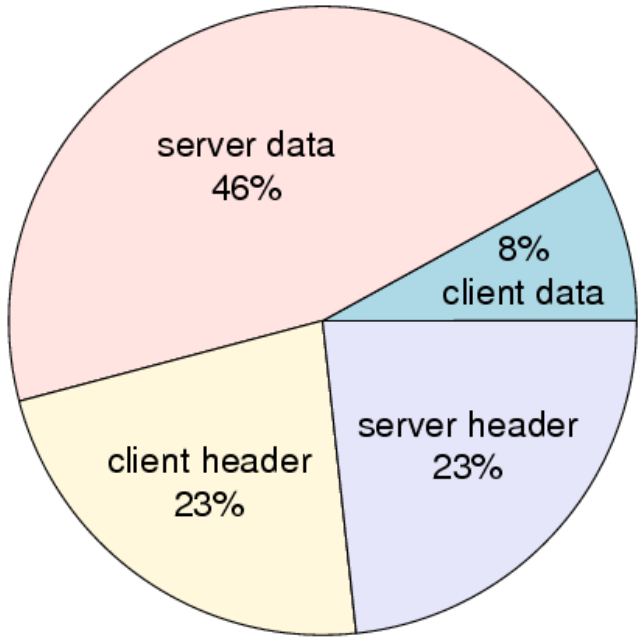
TCP Performance Analysis

- Protocol overhead
- In-order delivery
- Congestion control
- Loss recovery

Protocol Overhead



(a) Packet count



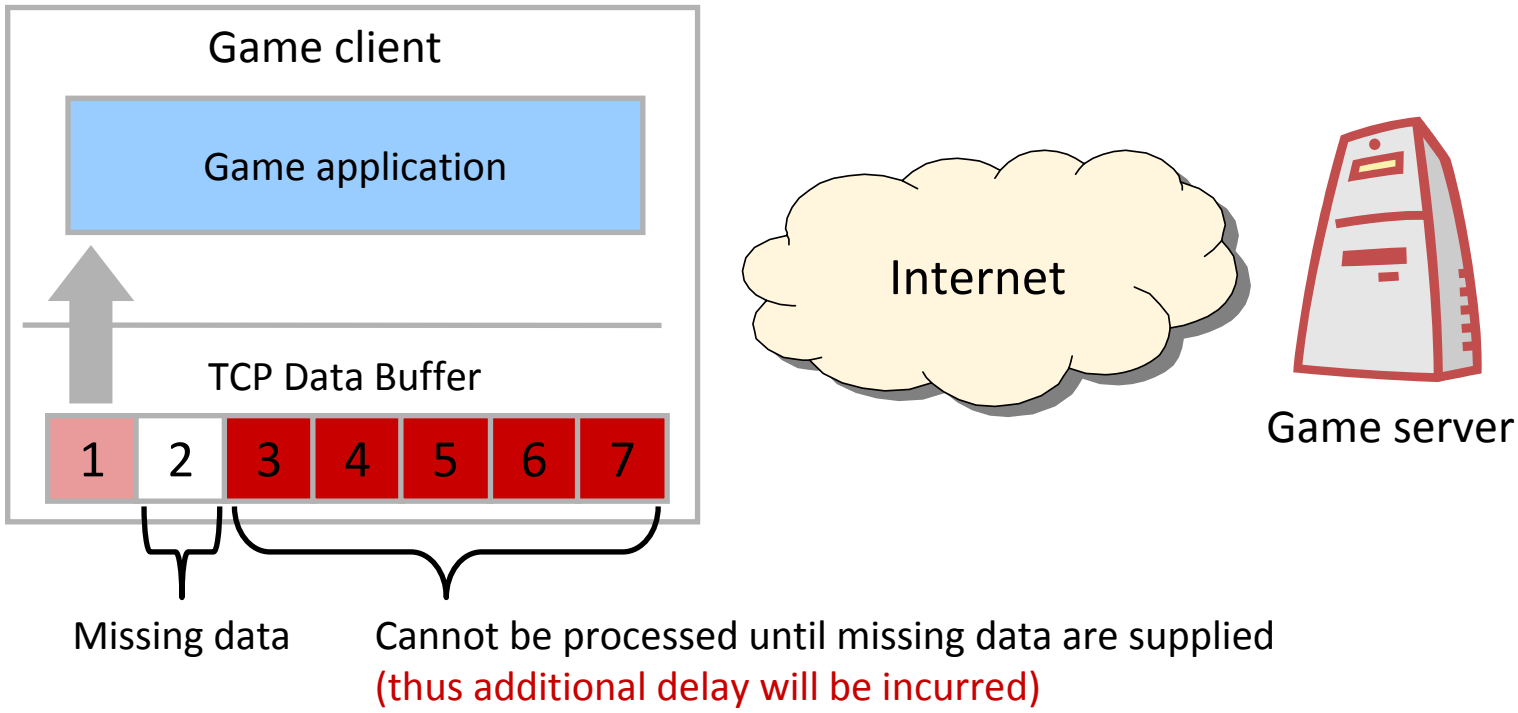
(b) Byte count

38% packets are TCP ACK packets

46% bandwidth are used by TCP/IP headers

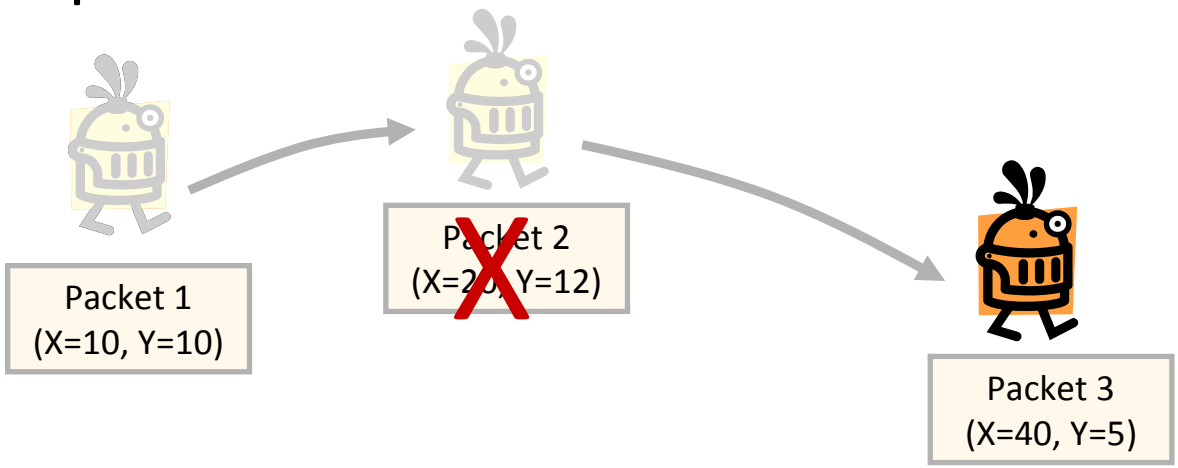
In-Order Delivery

- TCP enforces byte-level in-order delivery
- Cons: a dropped packet causes a stall in subsequent network data until that packet is delivered



In-Order Delivery is Not Always Required

- Server to client: state updates, dialogue messages, responses to users' queries
- Client to server: many commands are accumulative, e.g., position updates

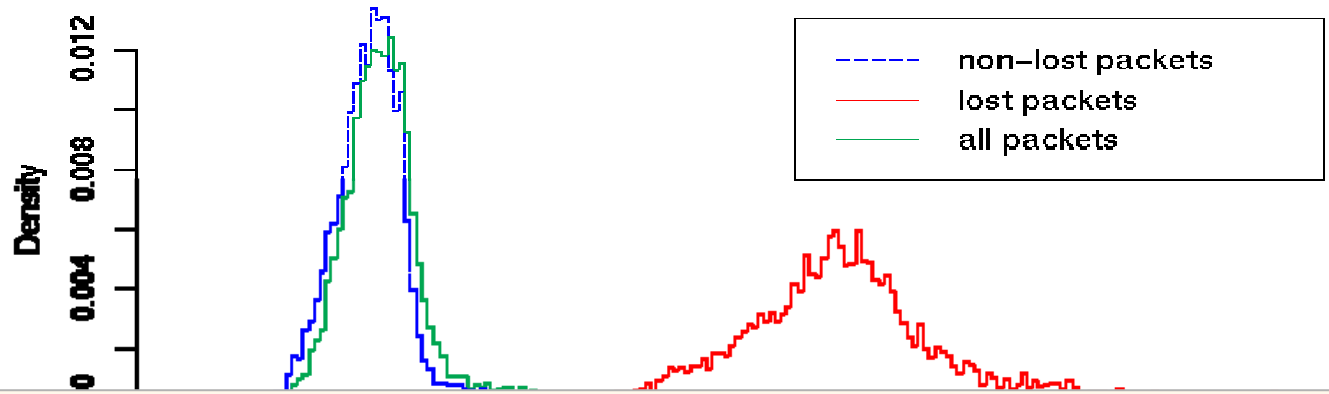


Processing packet 3 without waiting for packet 2 is OK and leads to more smooth game play

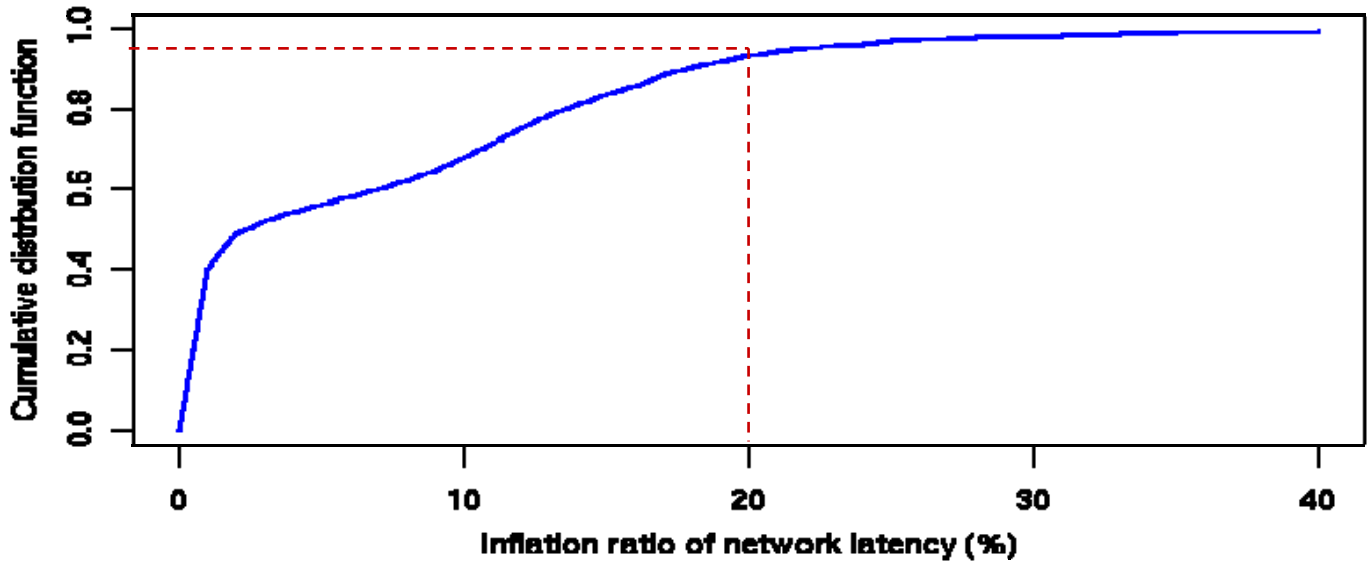
Overhead of In-Order Delivery

- Assuming an ideal case that all packets can be processed in any order
- The overhead of in-order delivery is measured by
  - The increase of round-trip times (RTT)
  - The increase of RTT jitters (std. dev.)

The Effect of In-Order Delivery on RTT

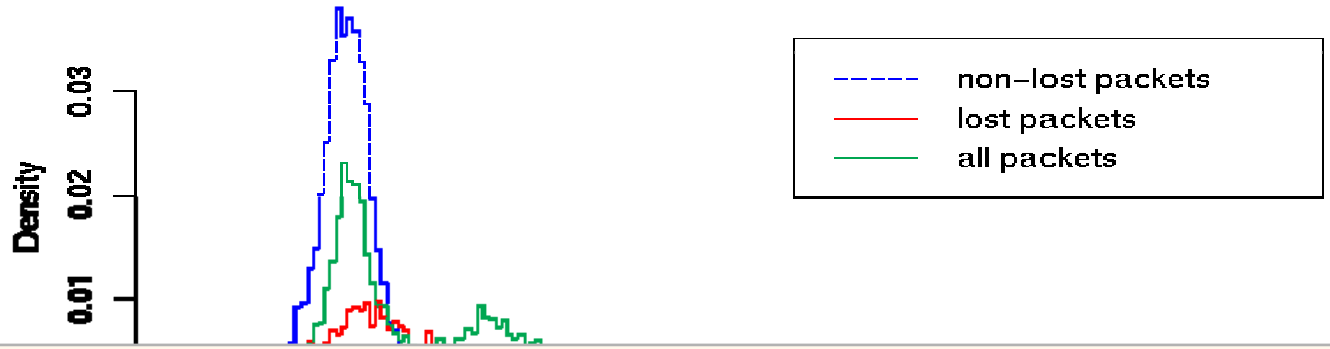


7% connections incurred more than 20% additional average RTTs



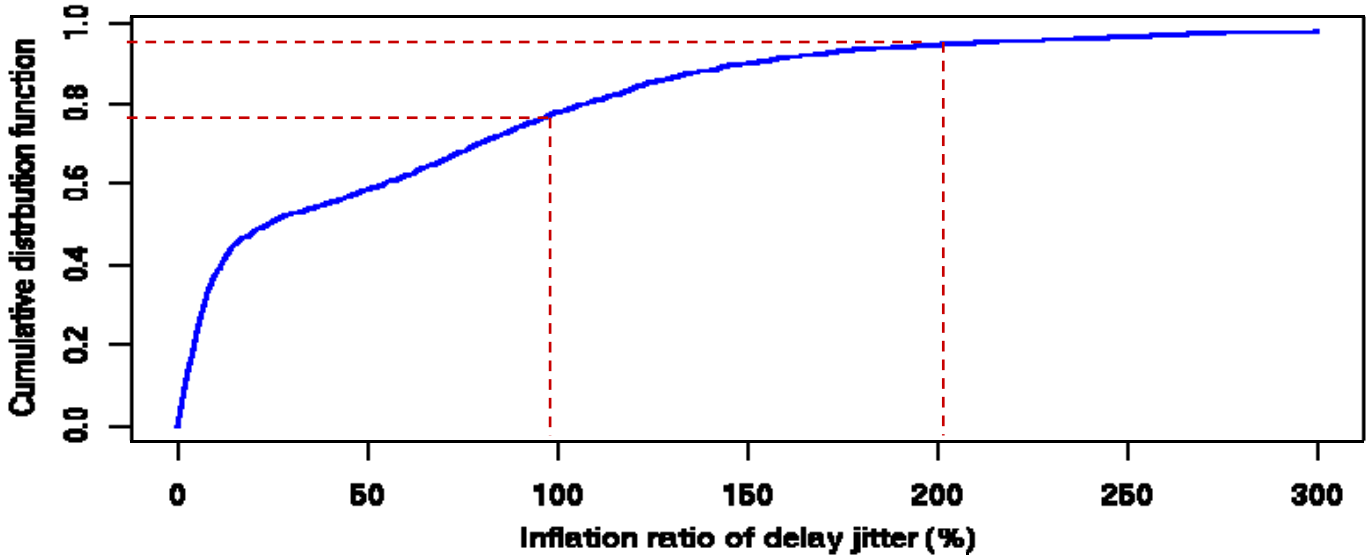
The Effect of In-Order Delivery on RTT Jitter

(std. dev. of RTTs)



22% connections incurred more than 100% additional RTT jitters.

6% connections incurred more than 200% additional RTT jitters.



Unnecessary Congestion Window Reset

- The "restart after idle periods" policy:
  TCP resets its window to 2 if a connection stops sending data for a short interval (usually < 1 second)

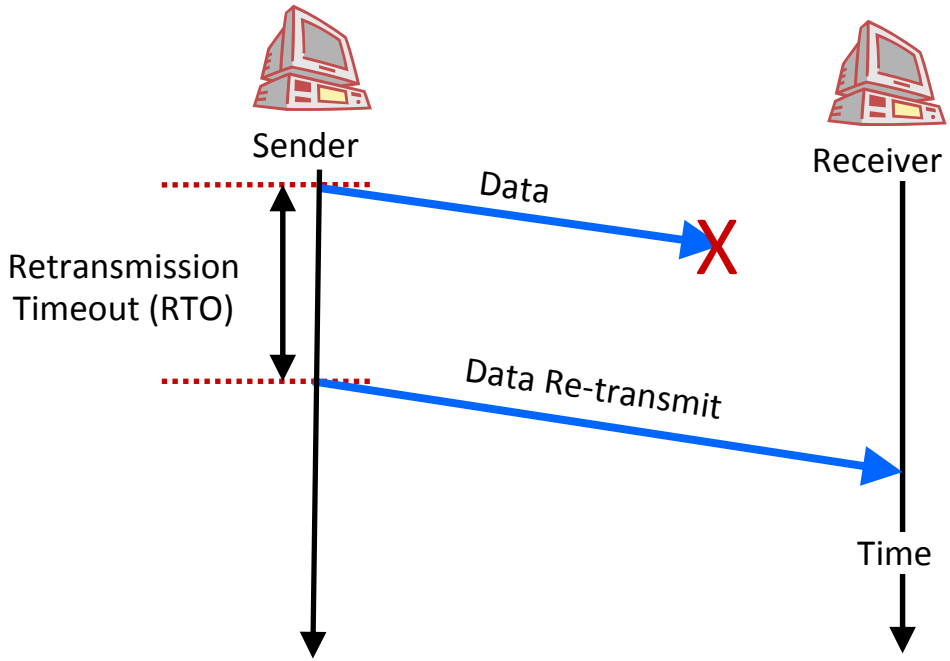
- The policy prevents inappropriate bursts of packets being sent due to an out-of-date window

- But, game packet rate is so low ➔ window is occasionally reset (18% of packets faced a window reset)

- In this case, a series of three commands following a thinking time will be penalized (the 3rd packet will be delayed until the first two have been delivered)

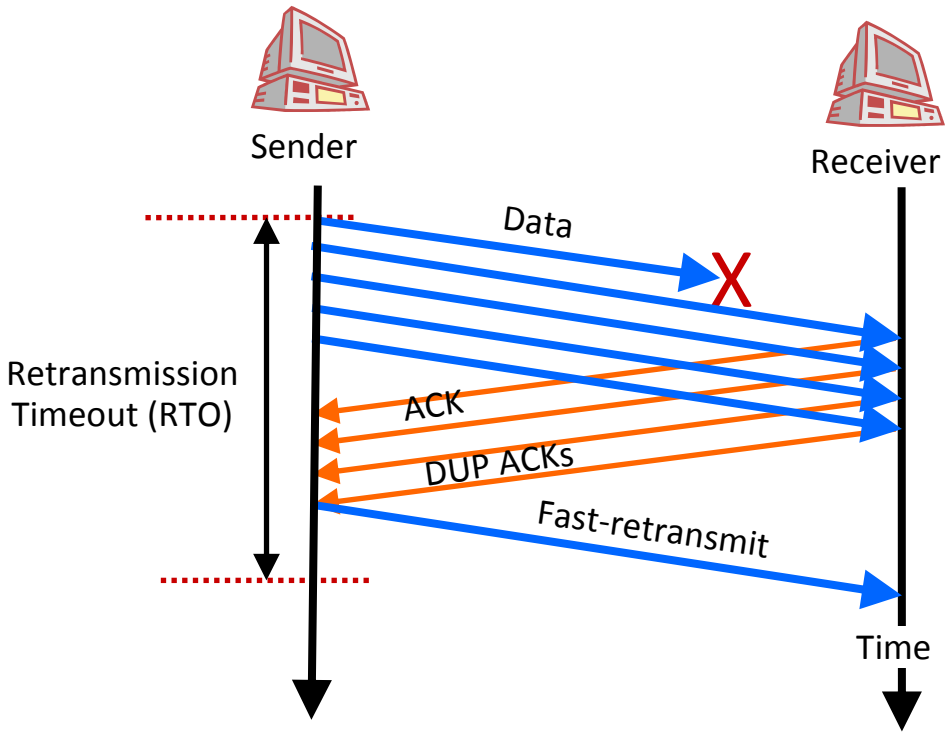
Loss Recovery -- Retransmission TimeOut

- Originally, TCP only relies on a timer to detect packet loss and resend packets



Loss Recovery -- Fast Retransmit

- TCP Tahoe/Reno improves loss detection with duplicate acknowledgement packets



The Failure of Fast Retransmit

- Insufficient duplicate acks
  - The game packet rate is too low
  - Required: more than 4 packets in (RTO – RTT) (mostly less than
  - More than 99% dropped packets were not detected by fast retransmit
  - Average latency for non-dropped packets was 180 ms; Average latency for dropped packets was 700 ms
  - This is why in-order delivery incurred so much overhead in transmission latency and delay jitters
- Ga
  - packet not contain data
  - The fast retransmit may not be triggered even sufficient dup acks are generated

TCP Performance: Summary

TCP is unwieldy and inappropriate for MMORPGs

- due to the unique features of game traffic:
  tiny packets, low packet rate, bi-directional traffic, application-limited traffic generation

Benefit from replacing TCP with an ideal protocol

- player departure rate is expected to decrease by 20%
- an increase of average playing time from 100 min to 135 min

Transport Protocol Design

- Research issues
  - congestion control, flow control
  - dissemination scheme (data aggregation)
  - ordering and reliability support (how to do ack?)
  - packet loss handling (loss detection, local recovery)
  - synchronicity between flows (reducing traffic burstiness)
  - and many more …

Protocol Design Guidelines (1)

- Supporting both reliable and unreliable delivery
  - Some packets can be safely discarded without affecting gaming experience
  - E.g., A gesture of a character faraway from the notified character may need not to be reliably transmitted

- Supporting both in-order and out-of-order delivery
  - Only ordering packets whenever absolutely necessary
  - E.g., Ordering is irrelevant for repeated attack actions (fight the same enemy with the same weapon)

Protocol Design Guidelines (2)

- Accumulative delivery
  - A new messages can override all the previous ones
  - Missing some packets in a series of accumulative commands does not matter (unless the last one in series is also dropped)
  - E.g., position updates

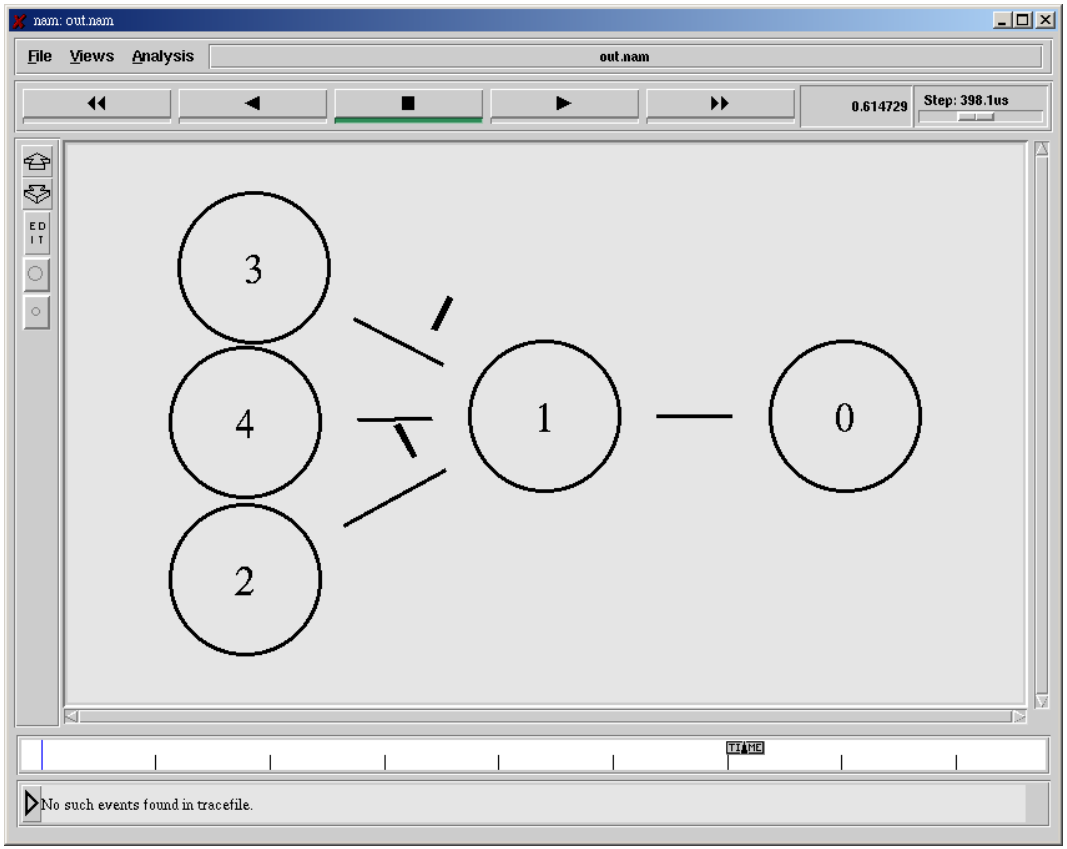
- Multiple streams
  - Make messages as independent as possible
  - Messages need to be ordered only when they are in the same stream
  - E.g., chat messages are independent of game play commands

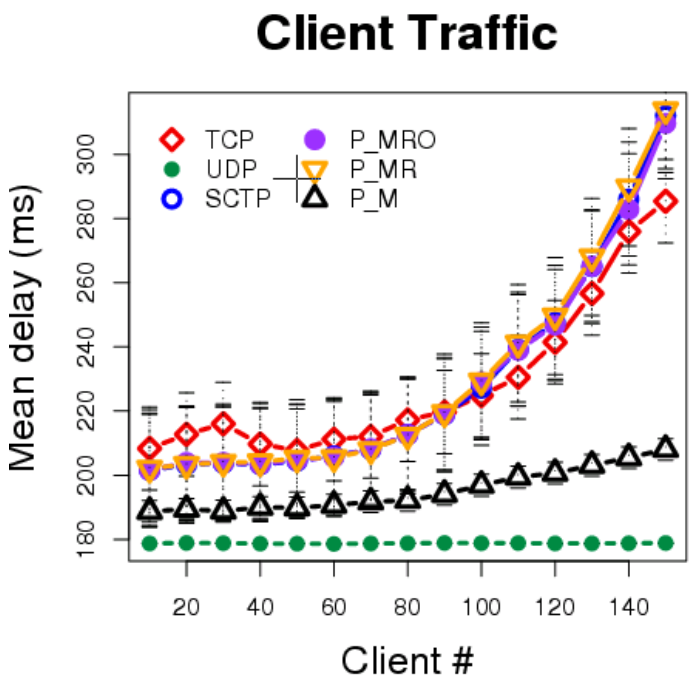
Protocol Design Guidelines (3)

- Coordinated congestion control
  - Tens of thousands of flows are not unusual
  - Difficult for all the flows to achieve an efficient bandwidth sharing by competition
  - Make congestion control in a coordinated, rather than competitive, manner
  - E.g., avoid dispatching game message synchronously for all game clients ➔ alleviate traffic burstiness ➔ reduce overall packet loss rate

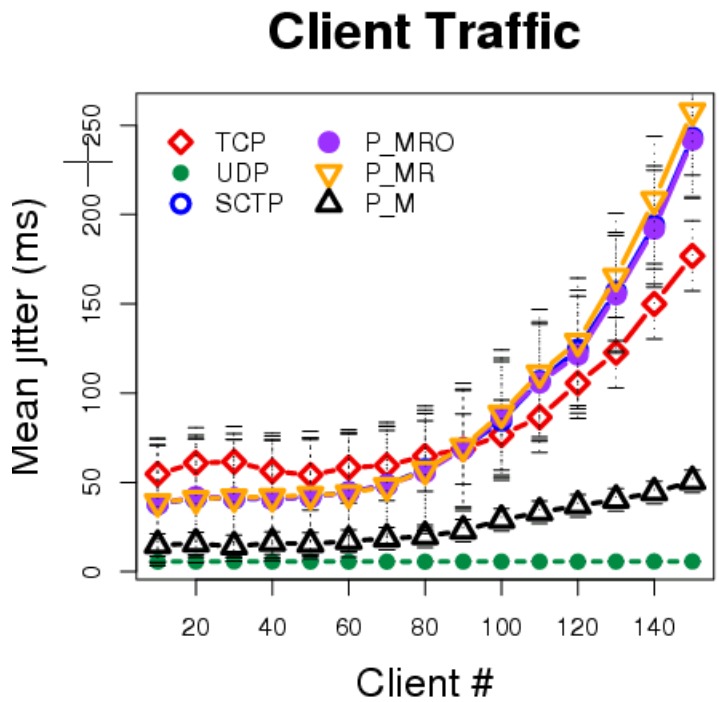
Evaluation Methodology

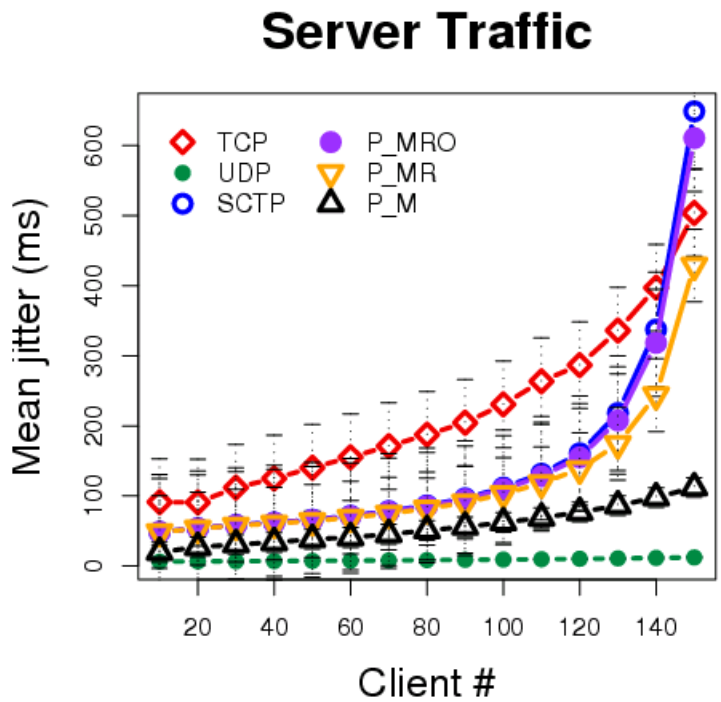
- A ns2-based testbed which simulates MMORPG client/server
- supports TCP, UDP, SCTP, DCCP




Client Traffic
TCP
UDP
SCTP
P_MRO
P_MR
P_M
Mean delay (ms)
180
200
220
240
260
280
300
20
40
60
80
100
120
140
Client #


Server Traffic
TCP
UDP
SCTP
P_MRO
P_MR
P_M
Mean delay (ms)
200
300
400
500
600
20
40
60
80
100
120
140
Client #


Client Traffic
TCP
UDP
SCTP
P_MRO
P_MR
P_M
Mean jitter (ms)
0
50
100
150
200
250
20
40
60
80
100
120
140
Client #


Server Traffic
TCP
UDP
SCTP
P_MRO
P_MR
P_M
Mean jitter (ms)
0
100
200
300
400
500
600
20
40
60
80
100
120
140
Client #

User Behavior Topics

Game Social Network Analysis

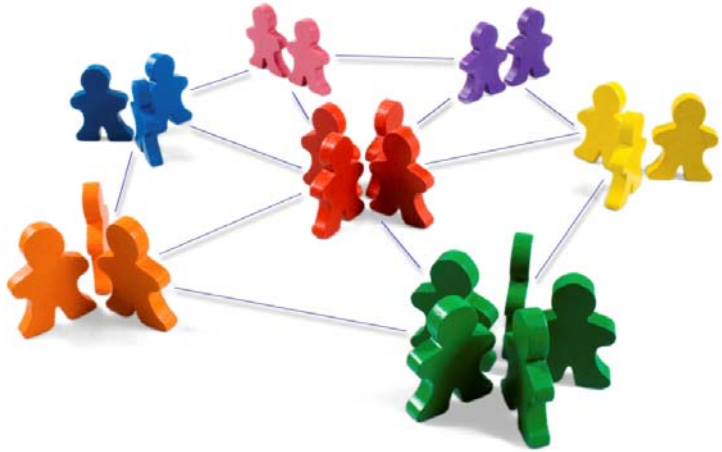
Motivation

- Q: What encourages the social interaction between online gamers?

- Goals
  - Understand the causes of the vigorousness of a game social network
  - Find a way to maintain and even promote the social interaction between online gamers

Static Analysis

- Graph structure (of each network)
  - Degree
  - Clustering
  - Degree Correlation Distribution
  - K-Core
  - Community Structure

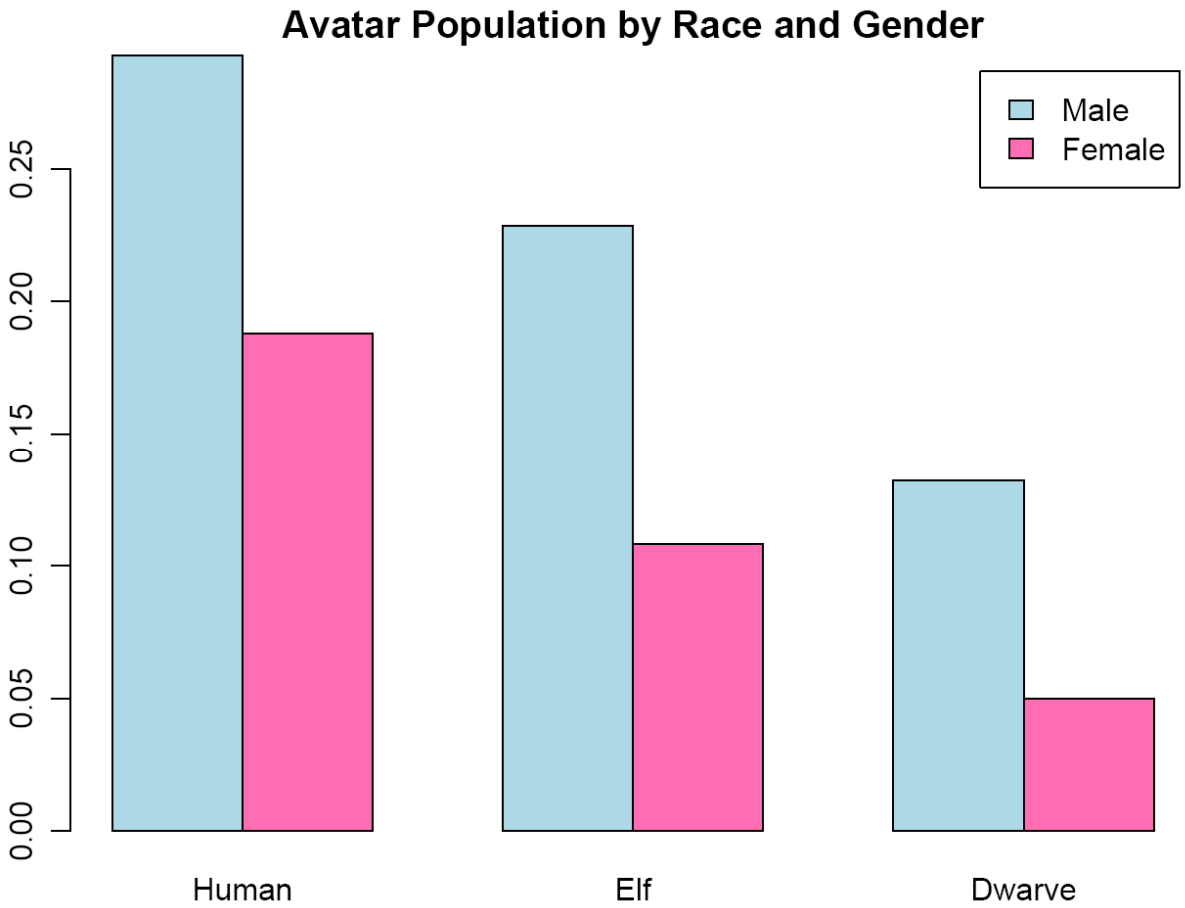


- Correlations between different networks (layers)

Dynamic / Temporal Analysis

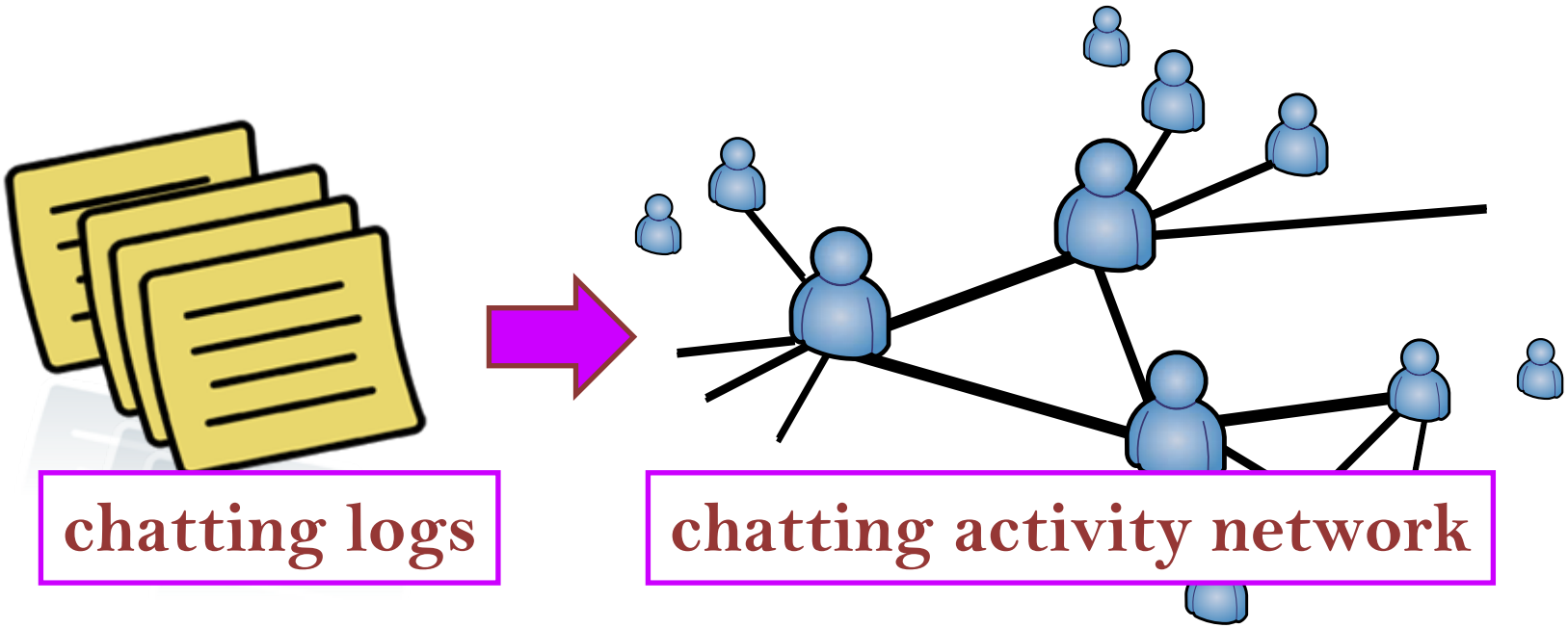
- Which social relationship is more robust / fragile?
- Causal effects between social relationship
  - E.g., trade ➔ same guild OR join the same guild ➔ trade
- How to define an "aggregate" index that can quantify the strength of the relationship between gamers?

In-Game Demographics



Chatting Activity Network

- We build the **chatting activity network** to describe the chatting behavior between gamers



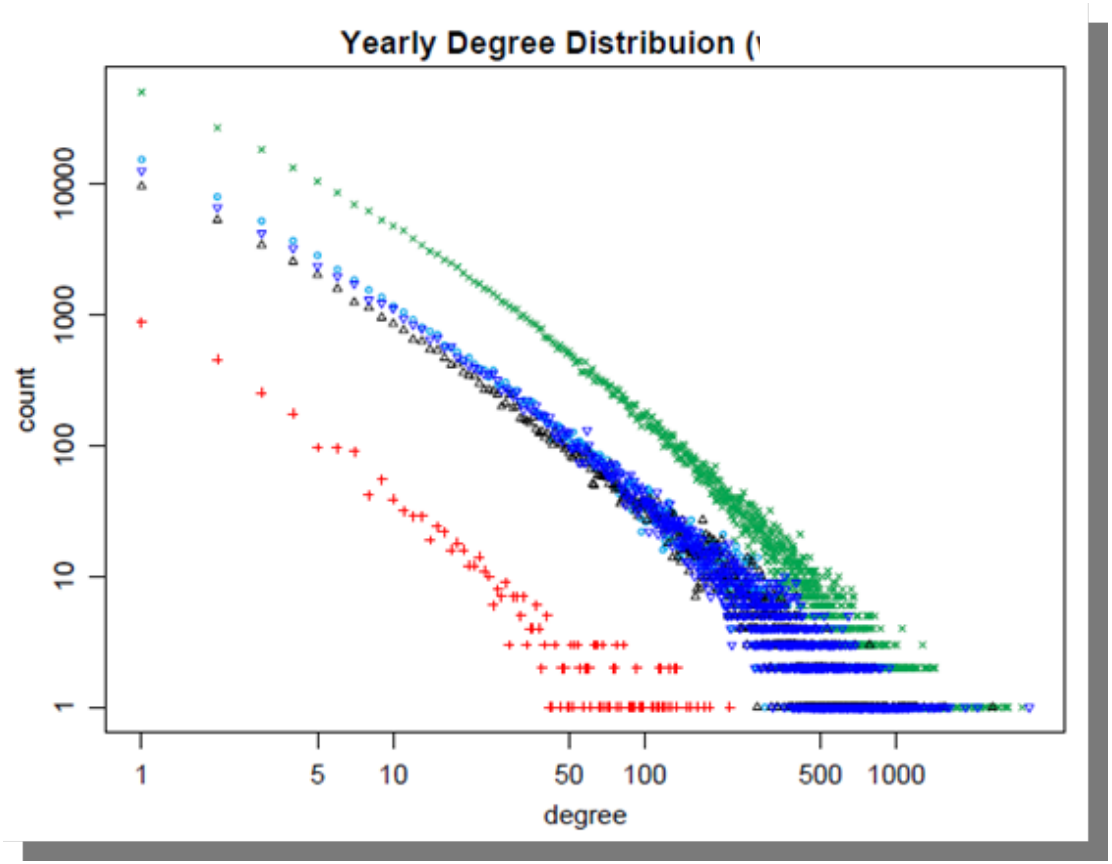
Degree Distribution

- A **scale-free** network is a network whose degree distribution follows a **power law**, at least asymptotically.
- The **power law distribution** highly influences the **network topology**. It turns out that the major hubs are closely followed by smaller ones.

(a) Random network

(b) Scale-free network

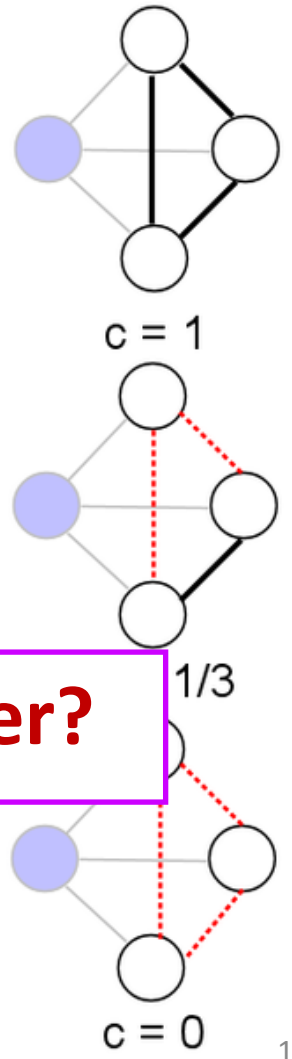
Degree Distribution (log-log plot)



Game social network follows a power-law distribution

Clustering Coefficient

- Example clustering coefficient on an undirected graph for the shaded node *i*.
- Black line segments are actual edges connecting neighbors of *i*, and dotted red segments are missing edges.



$$N_i = \{v_j : e_{ij} \in E \wedge e_{ji} \in E\}.$$

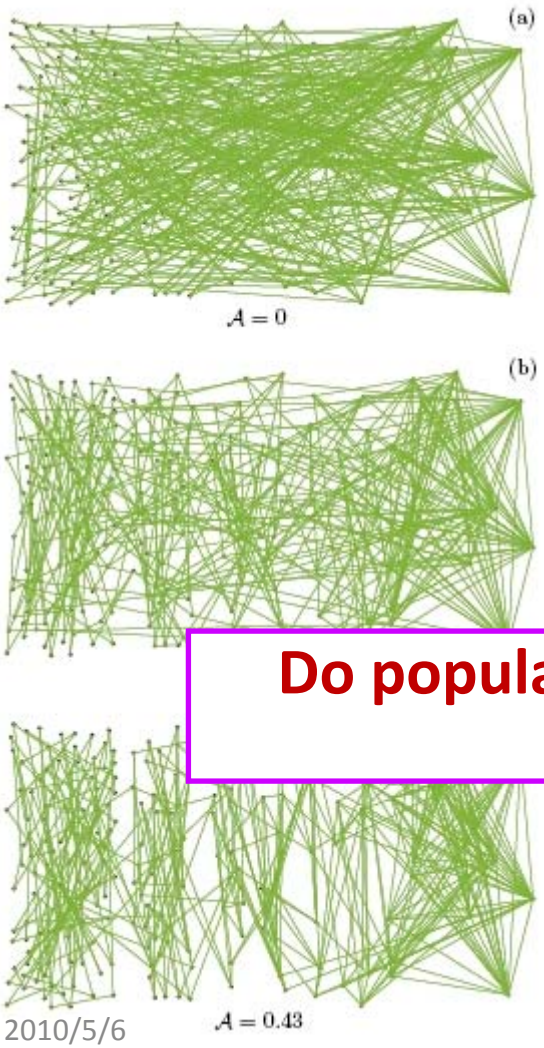
The degree k_i of a vertex is defined as $| N_i |$

Do your friends know each other?

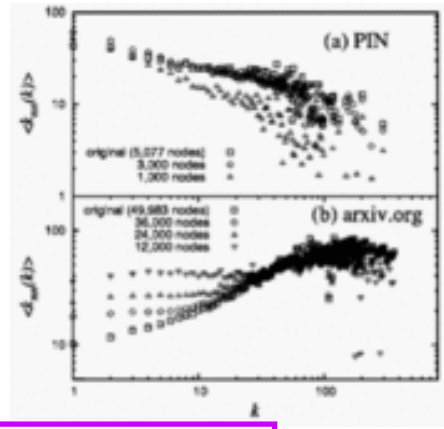
Assortativity

$$r = \frac{\sum_{jk} jk(e_{jk} - q_j q_k)}{\sigma_q^2}$$

- Scale-free networks for different degrees of assortativity: (a) A = 0 (uncorrelated network), (b) A = 0.26, (c) A = 0.43



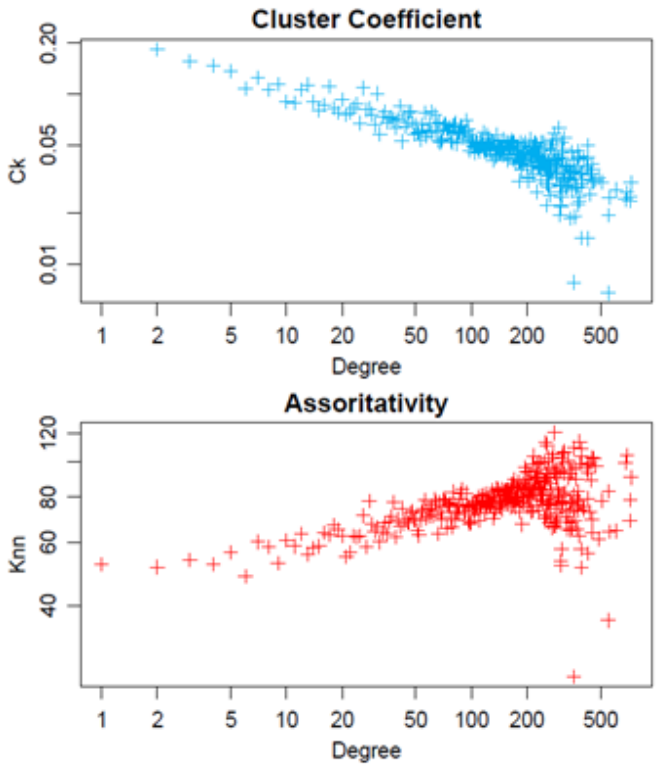
Network	n	r
Physics coauthorship (a)	52 909	0.363
Biology coauthorship (a)	1 520 251	0.127
Mathematics coauthorship (b)	253 339	0.120
Film actor collaborations (c)	449 913	0.208
Company directors (d)	7 673	0.276
Internet (e)	10 697	−0.189
World-Wide Web (f)	269 504	−0.065
Protein interactions (g)	2 115	−0.156
Neural network (h)	307	−0.163
Marine food web (i)	134	−0.247
Freshwater food web (j)	92	−0.276
Random graph (u)		0



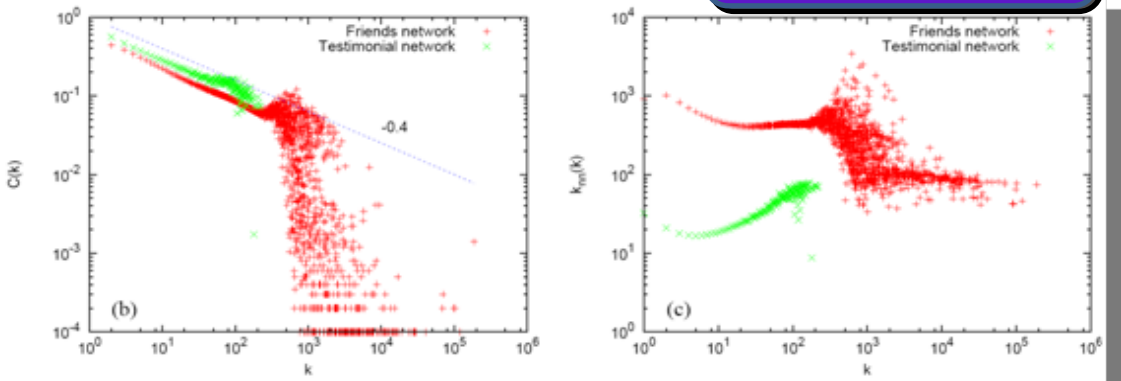
Do popular players tend to talk to popular players?

- knn distribution for two real-world networks. The top network (a) is dissortative, since the slope is negative. On the other hand, (b) is assortative, since the slope is positiv

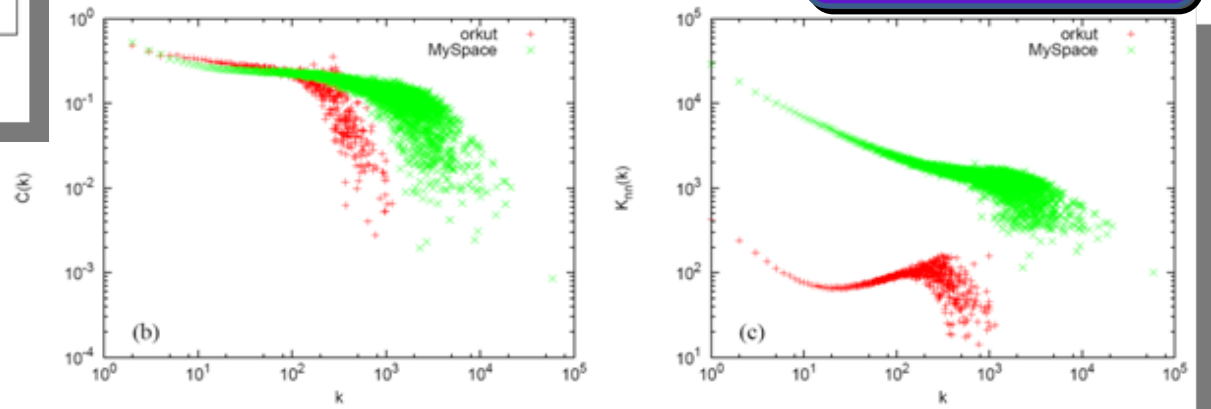
Game



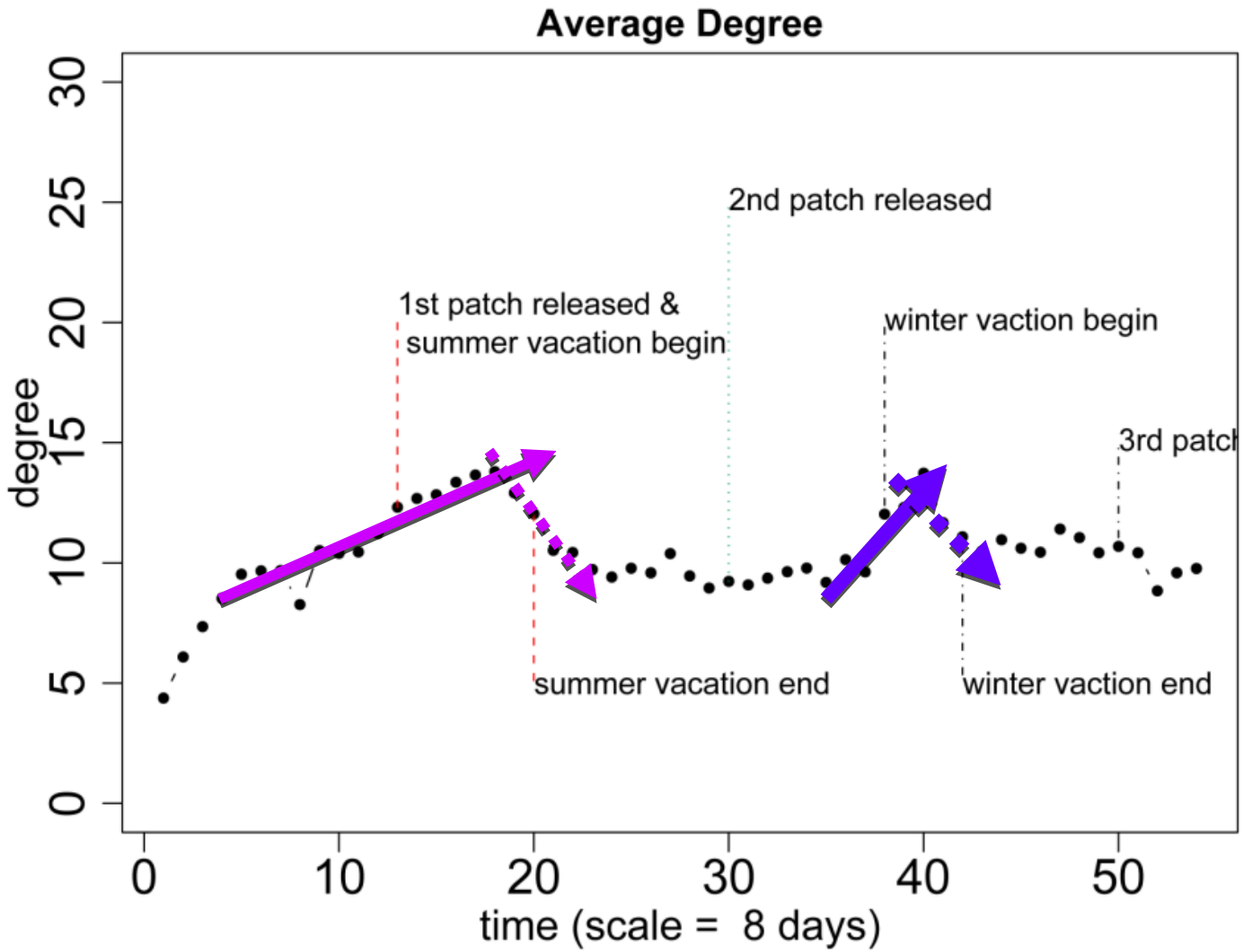
Cyworld



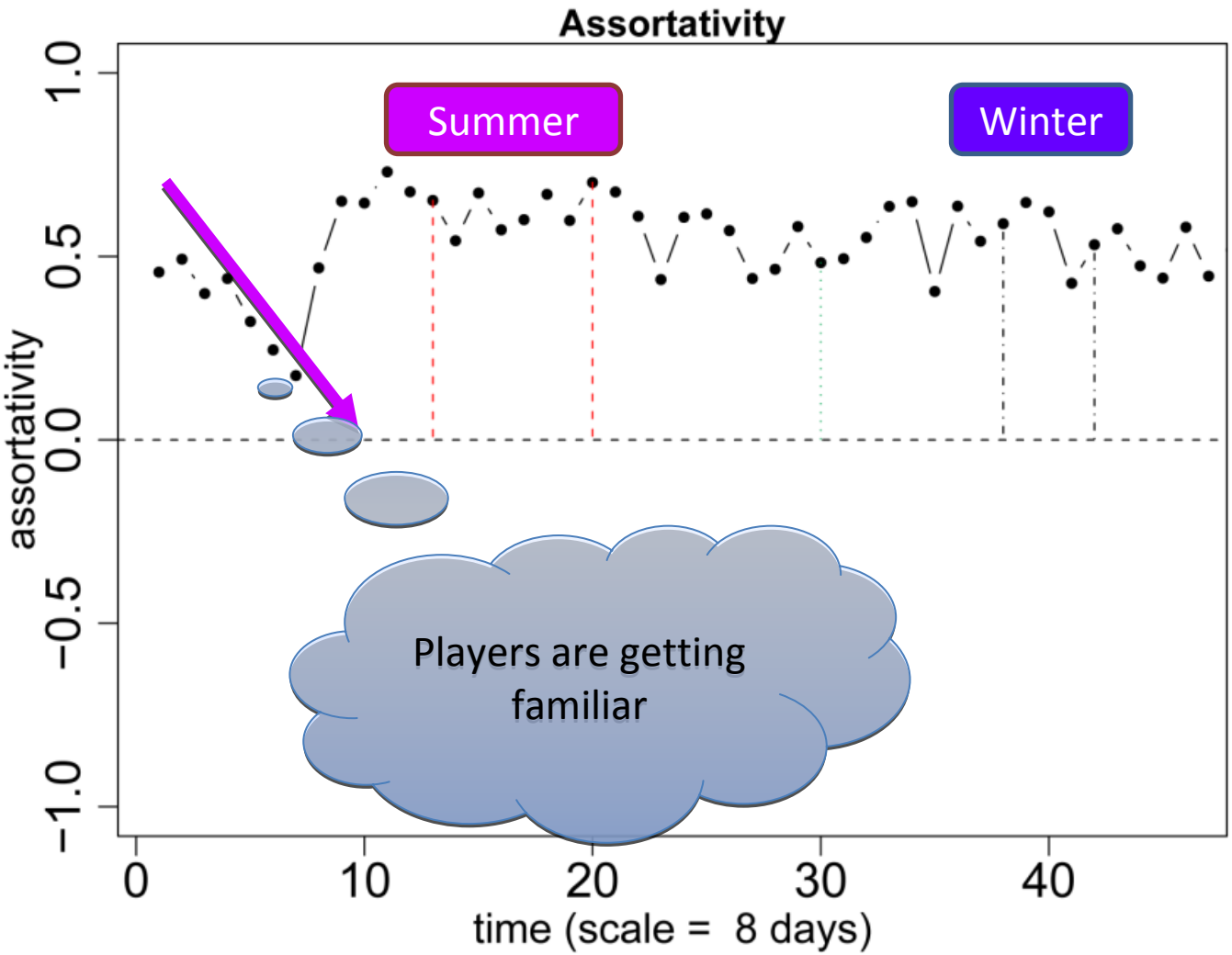
MySpace / orkut



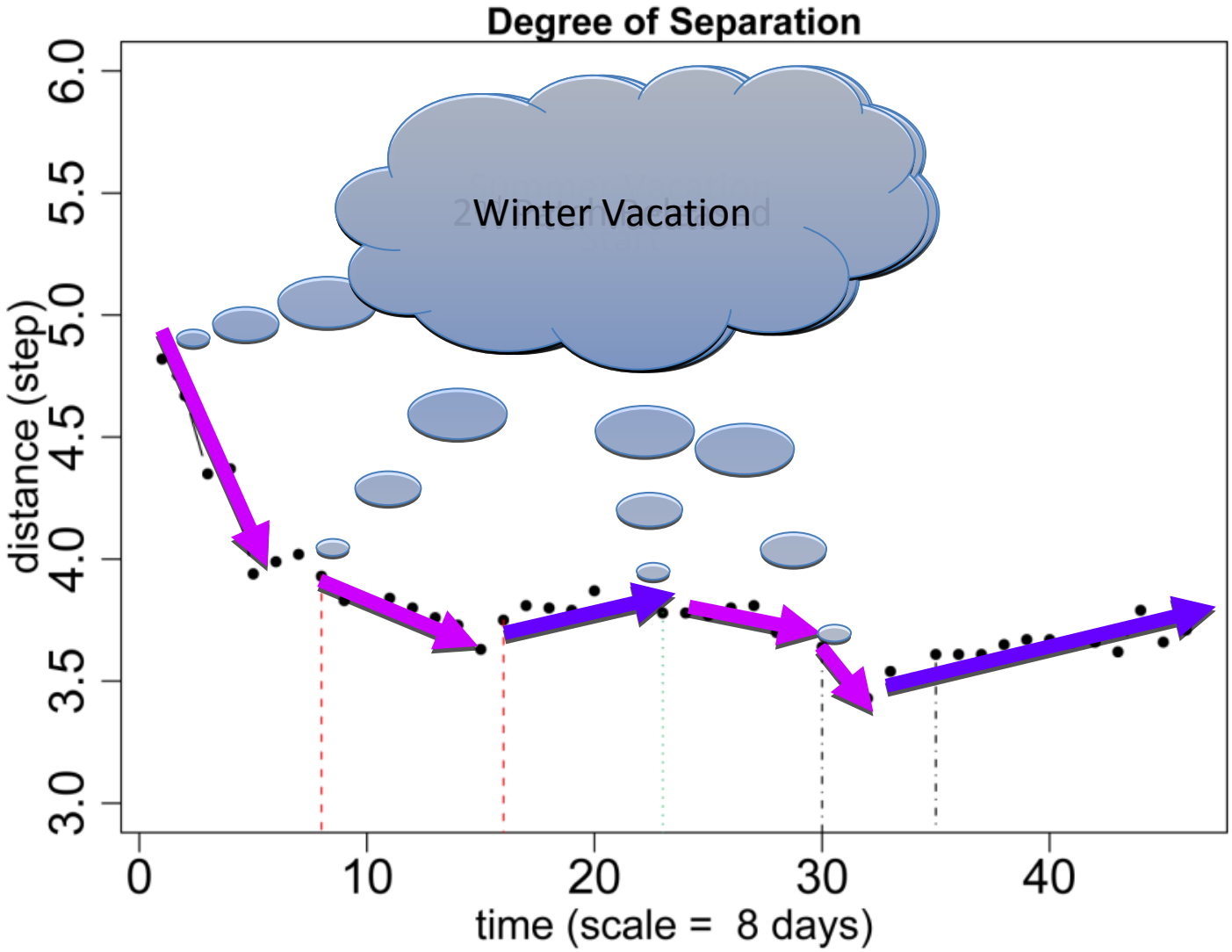
Degree Evolution



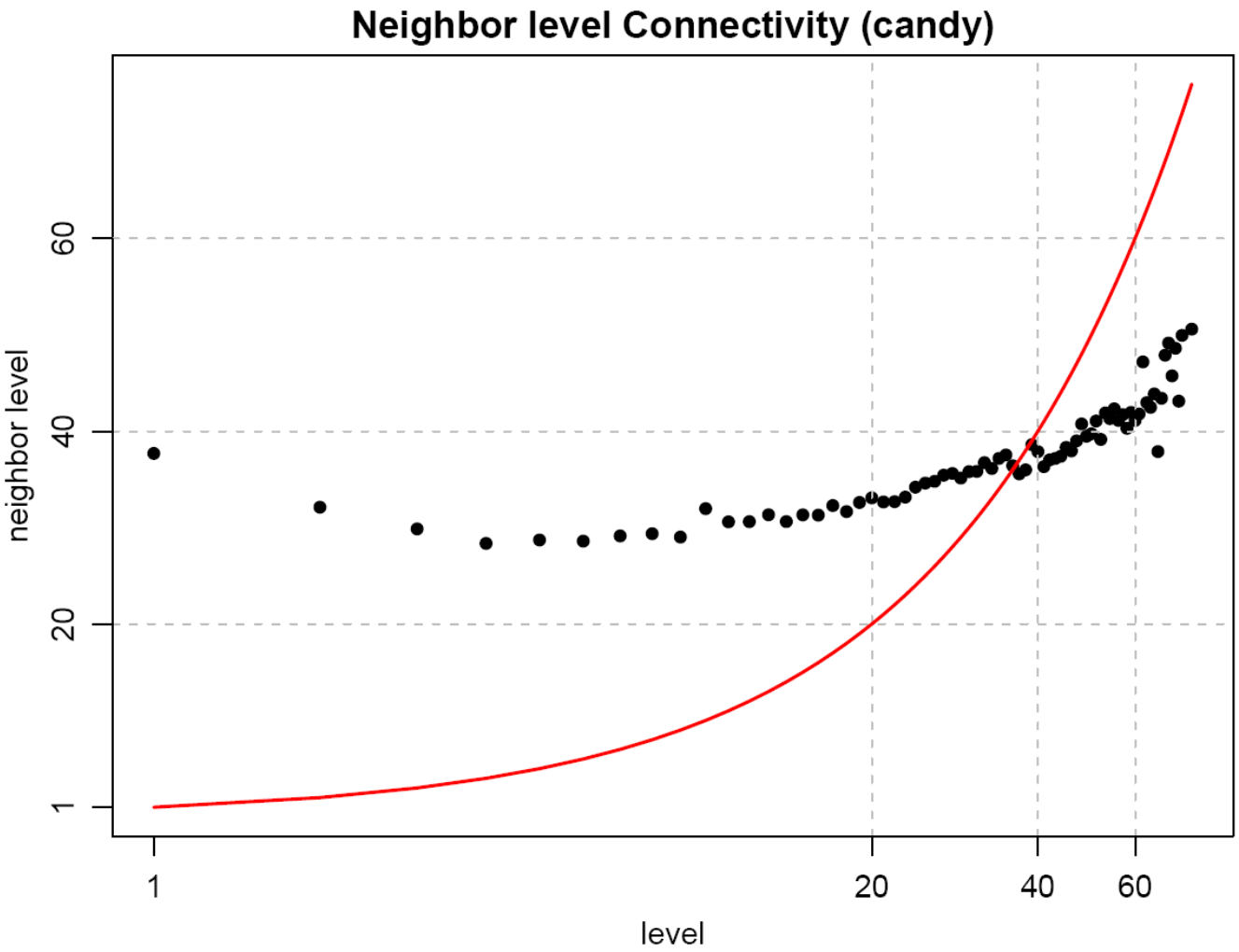
Assortativity Evolution



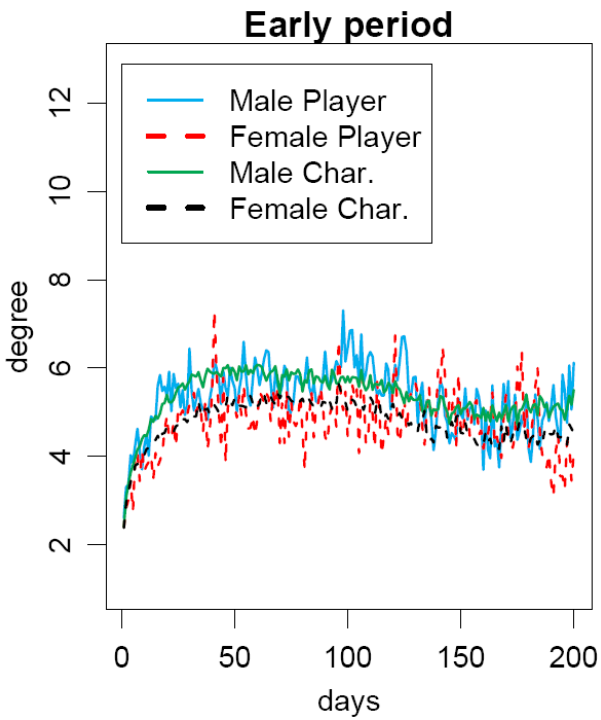
Degree of Separation Evolution

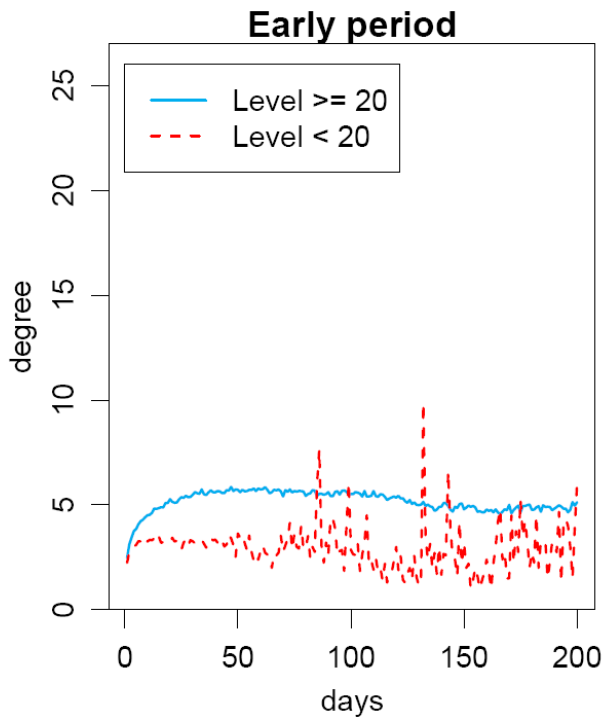


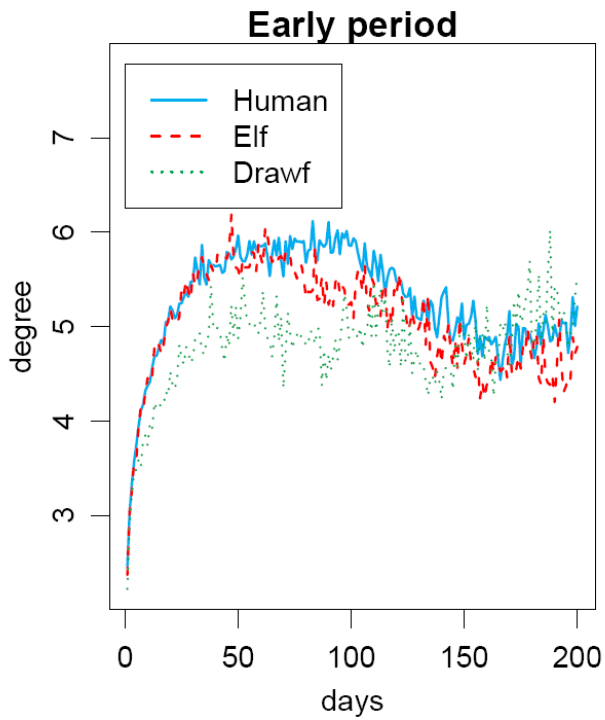
Level Assortativity (log-log plot)



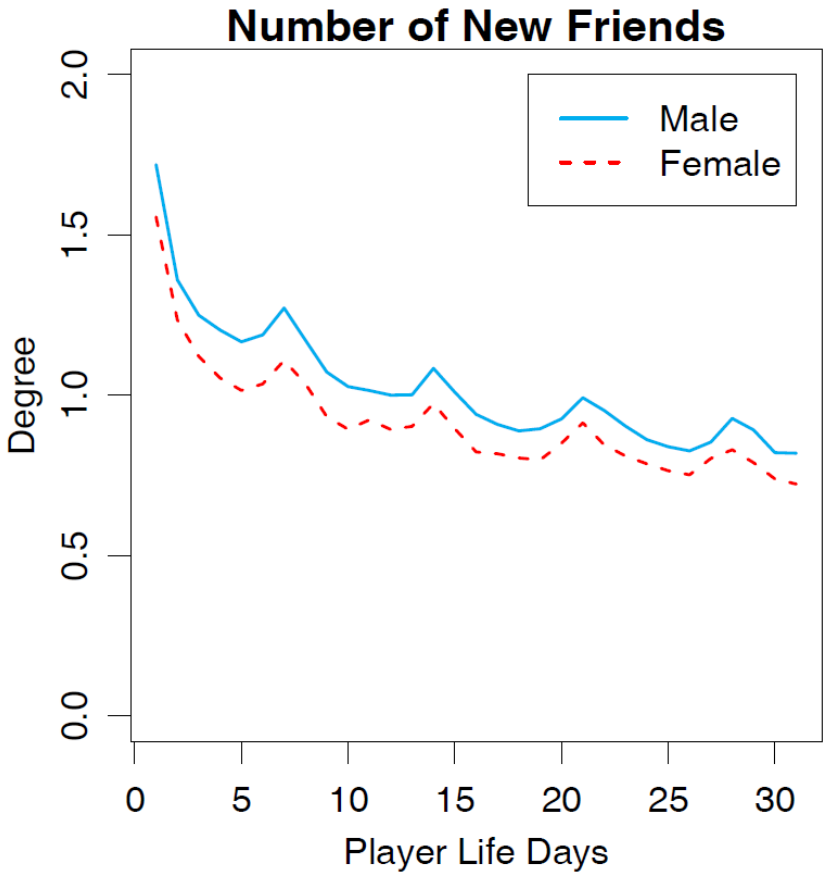
Number of Chatting Targets

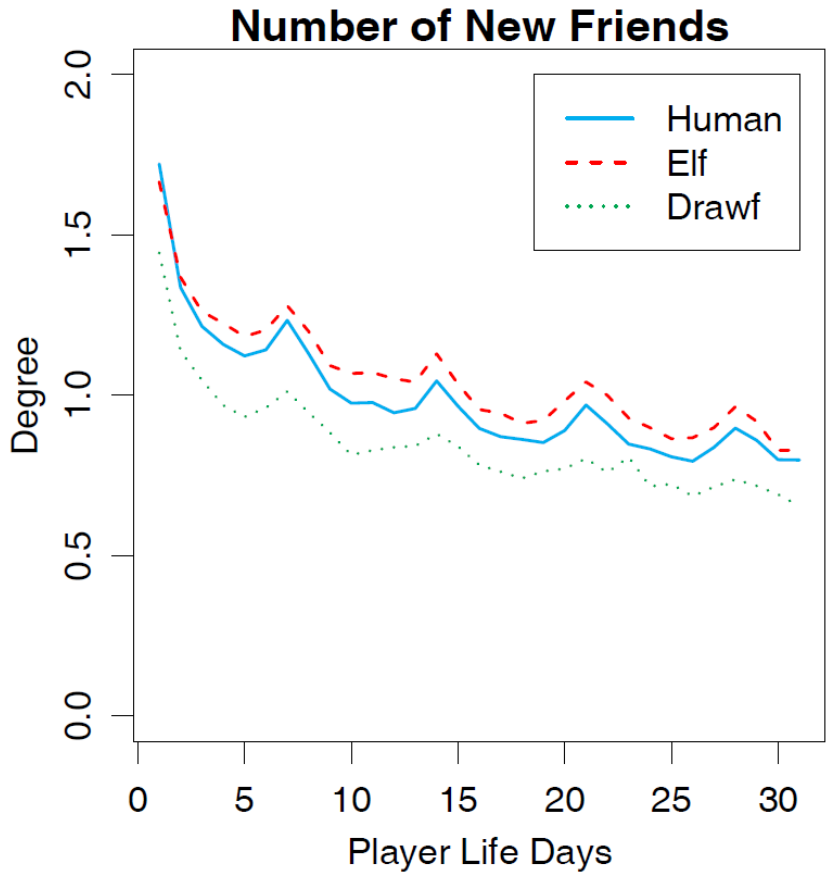




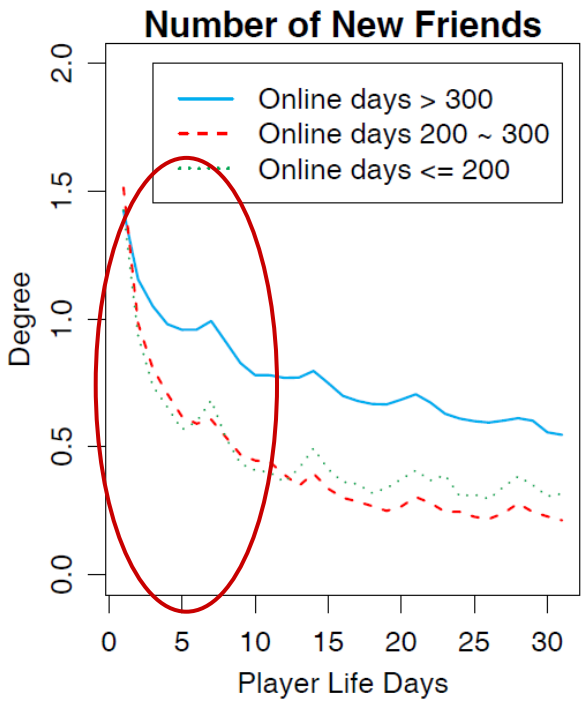


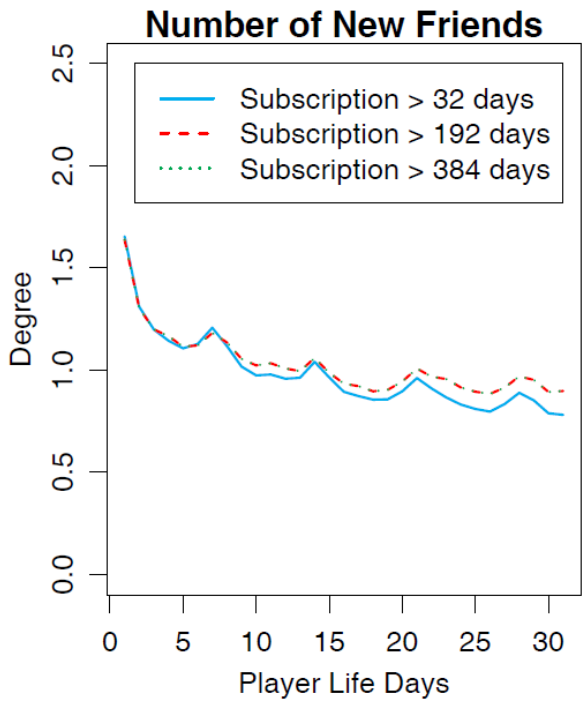
Number of New Friends (1)

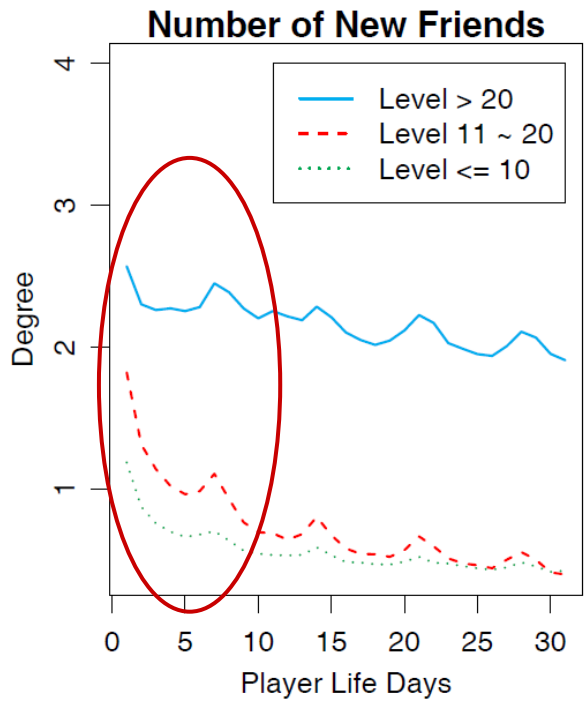




Number of New Friends (2)







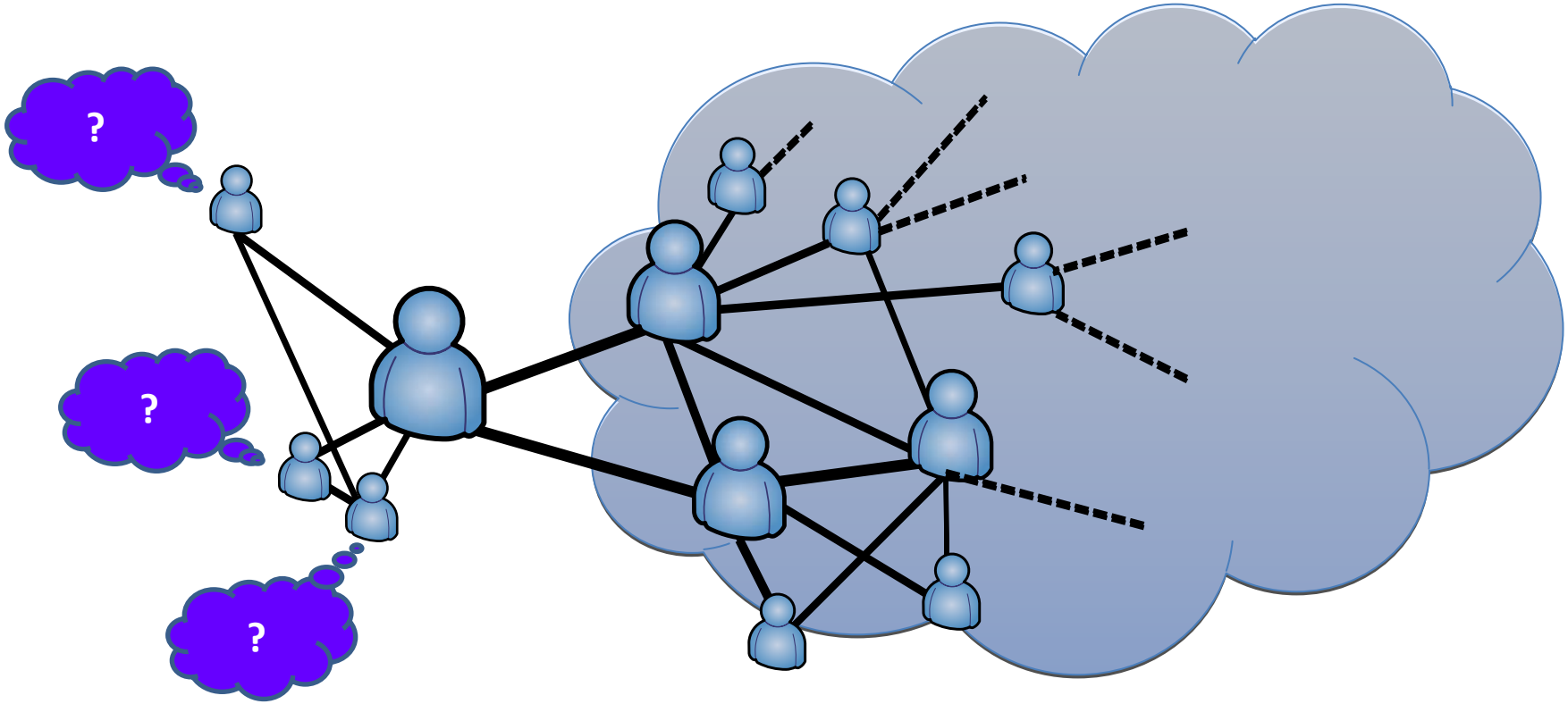
Game-Domain Analysis (1)

- Player Analysis
  - What kind of players tend to build relationship with others?
  - What kind of players tend to connect other two groups?

- Leadership
  - Is there social leader in game?
  - The positive effects of the leaders?
    (how they contribute to the robustness of networks)
  - The negative effects of the leaders?
    (their departure decision may affect other players)
  - The persistence of the leaders?
  - The characteristics of the leaders?
  - How to “foster” new leaders?

Effect of Leave

- The bridge one leaves, then the left ones would leave later as well?



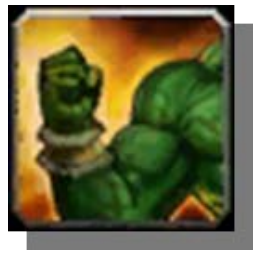
Game-Domain Analysis (2)

- New Player Analysis
  - (background knowledge: the quit rate of new players is normally high)
  - How they join the existing networks?
  - How much time they will continue to player if they cannot join the core networks?

- System Design Analysis
  - What kind of events can encourage a lot of new connections?
  - What kind of interaction design can encourage new connections?
  - What kind of interaction design can encourage robust connections?

Some More Interesting Issues

- How does demographical factors, such gender, age, living area, effect their in-game activities?
- Economic behavior in games



Feedback to Game Management

- Player classification (for rewarding, promotion, and marketing)
  - Who are the “leaders”?
  - Who tend to connect other players?
  - By the trend of their social relationships (upward, stable, or downward)
- Prediction
  - Who may be leaving game soon
    - Cannot make new friends
    - Old friends are already left
- Improvement
  - Foster or maintain social leaders
  - Analyze the reasons why players’ social connection become weaker
  - Targeted surveys based on player classification results (saving survey cost)
  - Determine the best time point to release new data patches (missions)

Computed-Aided Storytelling in Comics

Motivation

- 在網路上常常可以看見玩家們利用部落格或其他平台來分享遊戲經驗或其中的故事
  - 遇到什麼怪物
  - 解決什麼任務
  - 遇見什麼怪人
- 目前用來紀錄遊戲過程的方法通常
  - 製作耗時（文字撰寫、影像剪輯）
  - 消耗資源（影像）

Comics?

- A storytelling medium
- Vocabulary of comics
  - Panel layout
    - Border shape
    - Panel size
    - Bleed, splash page
  - Speech balloon and sound effects
  - Motion lines
- Visual language
  - **Draw attention to important events**

Reference: http://scottmccloud.com/2-print/index.html (McCloud, Scott)

Storytelling in Comics

- **Recall**, **share** and **preserve** (gaming) experience
  - **Virtual community** such as forums, blogs
  - Video, screenshots, **comics** or other art formats
  - **Narrative**, summary, story

Search "*Lineage Story*" or "*Lineage Comics*"…

- Around 26,600 files in YouTube and 724,000 items in Google
- http://www.lineage2.com/community/fanart.html
- http://himewikia.blogspot.com/
- …

- **Example:**


LINEAGE II
by NICOLAS JONES
KLAAAANK!
SWIIIISHH!
END


샤방~
샤방~
음...
짜잔
오다가 이런걸 주웠답니다.
무기 일까요?
음..이것은 고대의 언어로 해석하자면,
어디서 길 헤메고 있냐..?
크로니클2 그것을 알려주마!!
오오..이런 때맞춰 만화적인 상황이..?!
만화니까요~
음.. 가이드도 생겼으니 한번 구경 가보죠.
수상도시 하이네스
물과 건축물이 어우러진 아름다운 곳이네요~

Comic Life (2005)

Application for creating comics:

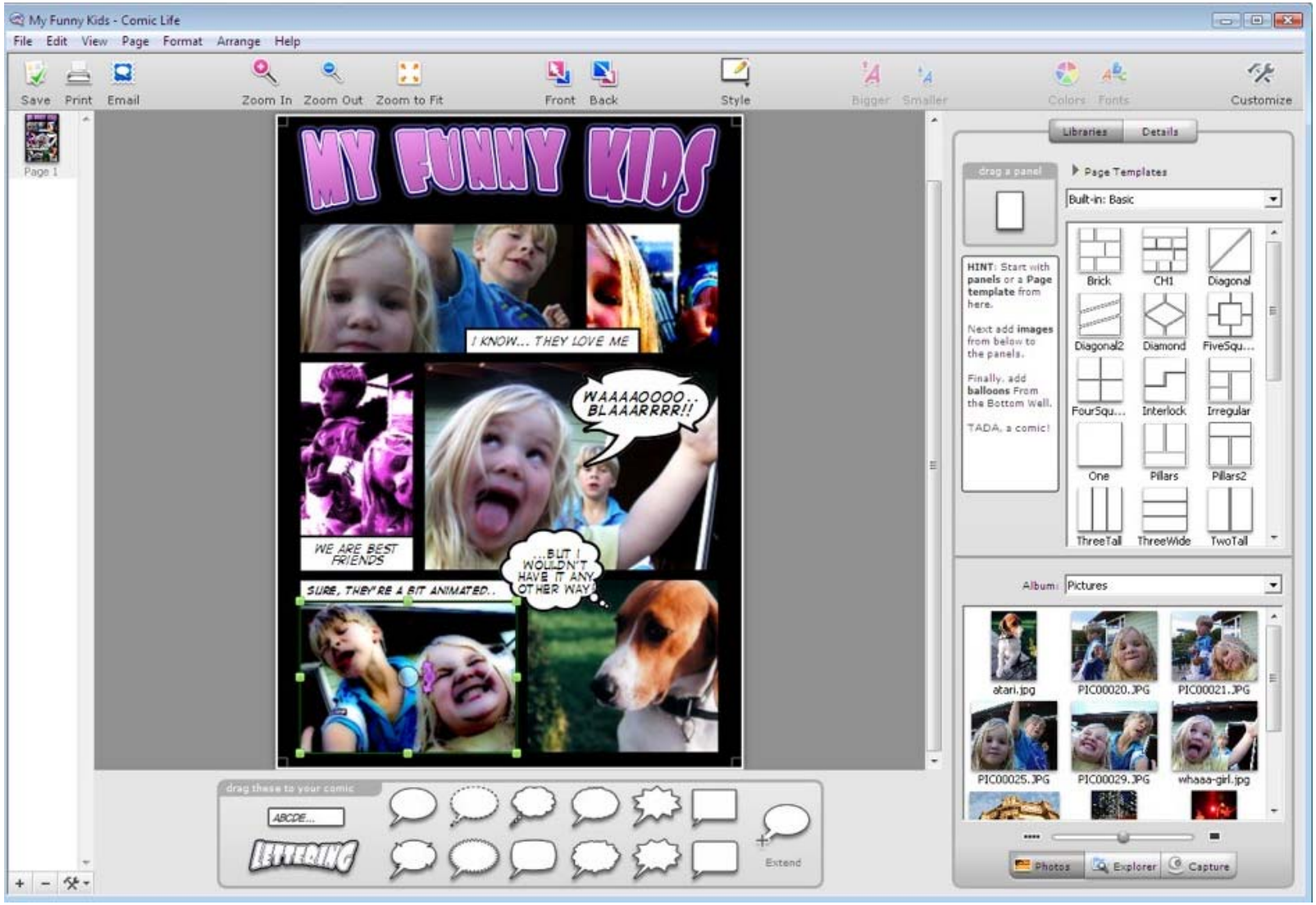
loading images into comic panels

Authoring support:

- **Simple and Easy-to-use** interface
  - Drag in your pictures, captions, sound effects (‘ka-blam!') and speech balloons and it’s done!
  - Layout templates
  - Filters like hand-drawn, painted and night vision
- More freedom to create comic but *still some restrictions*

Reference:
http://plasq.com/comiclife-win

- **Comic Life 1.3**



- Example:


NORTHSHIRE ABBEY...
... BASTION OF THE JUST
... HOME OF THE RIGHTEOUS
YOUNG SQUIRE, OUR FORESTS ARE INFESTED.
CULL THE PLAGUE AND RETURN TO ME WITH PROOF. TWELVE EARS FROM THE CREATURES SHOULD SUFFICE.
AT ONCE MY LORD!
OUTSIDE...
NIBBLE
CHEW
FOR THE LIGHT!
WELL, THAT'S TWO EARS.
AND FOUR...
AND SIX...
I'LL BE DONE IN NO TIME!
HMM.. THIS RABBIT ONLY HAS ONE EAR.
BLINKS AND THIS ONE HAS NO EARS?
NO EARS AGAIN. *SIGH*
MANY, MANY RABBITS LATER...
AAAARGH!!!
SEVEN!!?
MEANWHILE, AT BLIZZARD HQ...
OK. I THINK HE'S ABOUT TO GIVE UP. LET'S TURN THE DROP RATE BACK UP.
http://www.lsmason.com
Copyright © 2007 Llew Mason All Rights Reserved

IDEA

- 漫畫自動產生系統
- 整理與總結玩家在遊戲中的過程
- 講述故事
- 使用者介面
  - 讓使用者或玩家參與漫畫的創作

Challenges

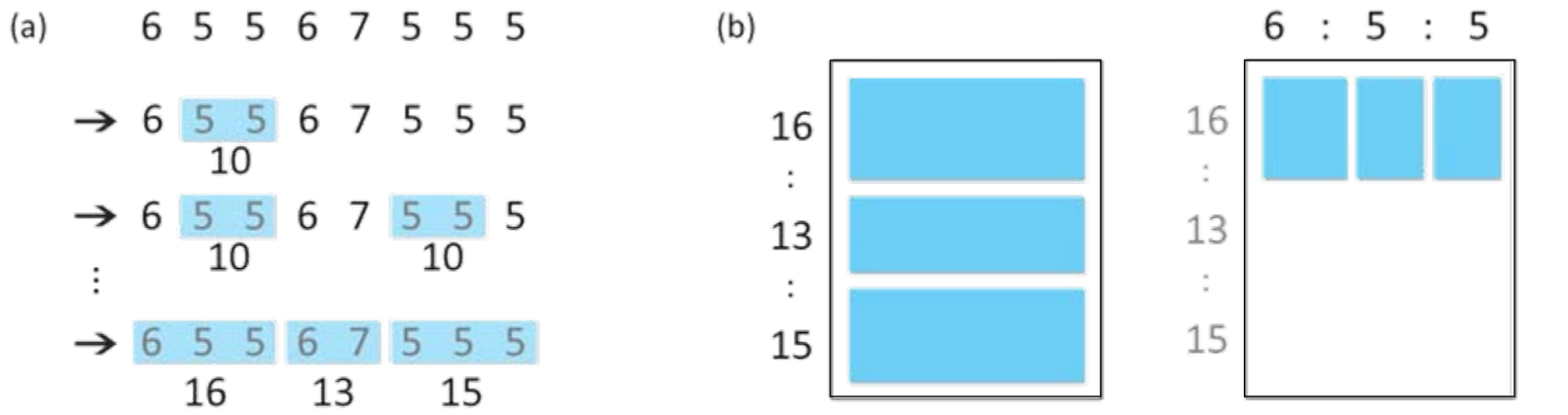
- 技術上
  - 利用 machine learning 選擇重要的畫面
  - 分析圖片影像，根據畫面調整特效排版（字型大小、顏色、位置）
    - 對話框 (word balloons)
    - 聲音效果 (onomatopoeic sounds)
- 設計上
  - 如何畫出漫畫風格的版面
    - 怎麼排版
  - 如何自動設計出使用者覺得好看的漫畫
    - 分鏡、鏡頭遠近
    - 說故事的流程
    - 節奏掌握

Frame Selection

- 依照使用者所設定的頁數 (*p*) 來產生漫畫
- 利用 *p* 來估計產生這組漫畫總共需要多少張圖片 (*n*)
- 對於所有圖片，依照使用者對事件重要性所設的值 (*weight*)來計算的每張圖的總分 (*significance score*)
- 所有圖片依照 *significance score* 排序，再選出產生漫畫所需要的 *n* 張圖片

Layout Computation

- 演算法如下圖所示

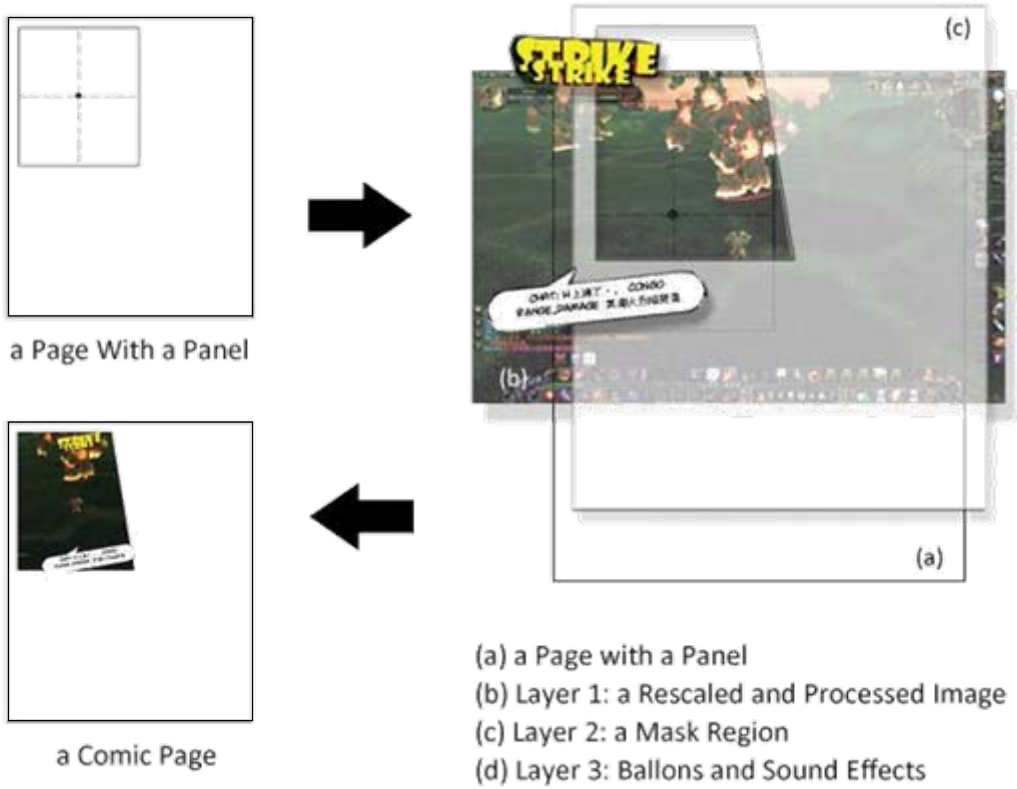


(a) The iteration that groups eight images into 3 rows. The numbers are the significant scores of the images.

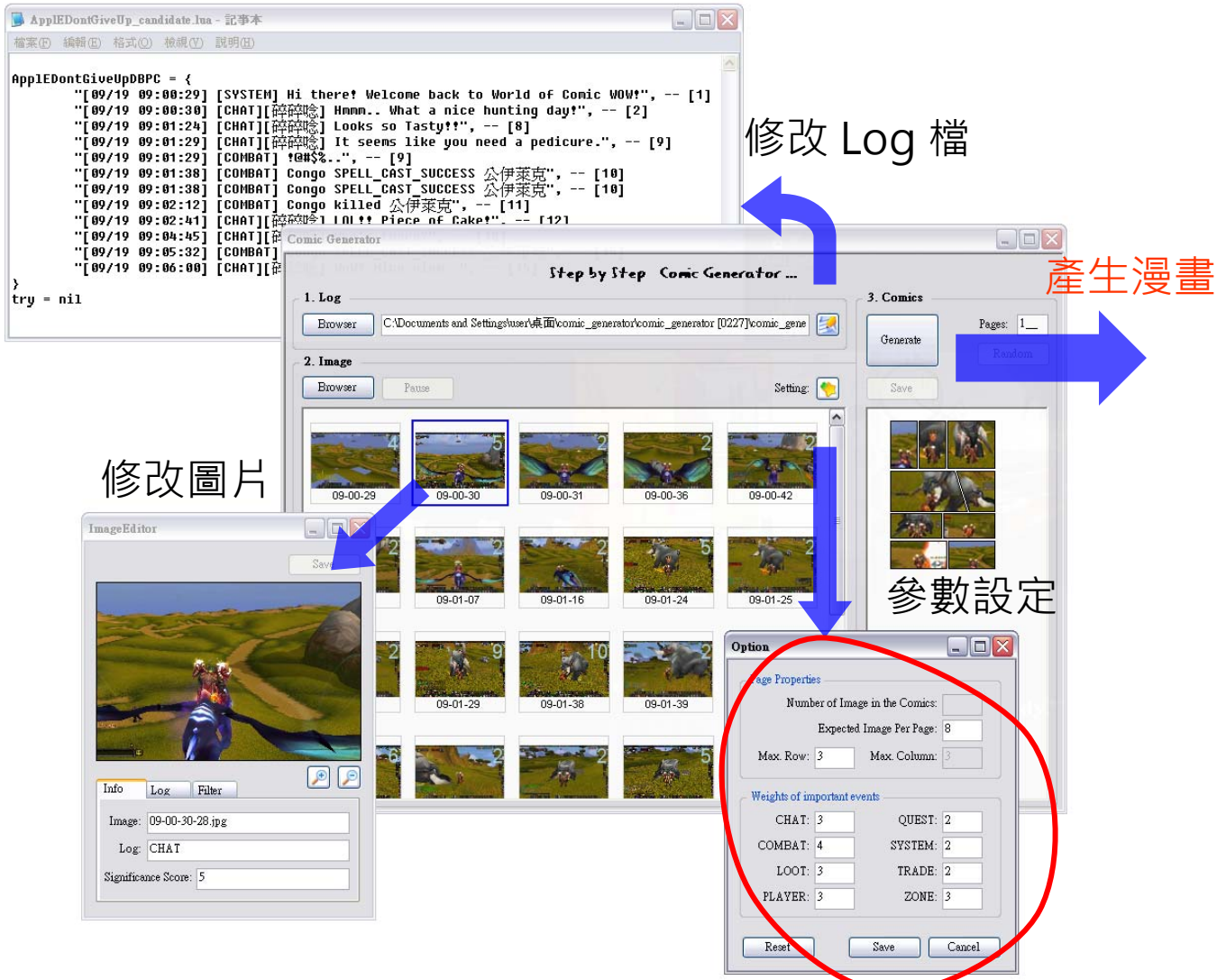
(b) The placement and the sizes of those images on a page.

Rendering

- 每一張圖都是由三個圖層 (Layer) 所畫出



User Interface



以上兩頁漫畫是由同一份 Log 和圖檔但不同的參數設定所產生

More Comics


Comic Layout
CRACK
CRACK
CRACK
Who's there?
CRACK
WoW! Nice view..
Previous
3 / 3
Next
Comic Layout
CRACK
LOL!! Piece of Cake!
Previous
2 / 3
Next
Comic Layout
Hmmm.. What a nice hunting day!
Looks so Tasty!!
CRACK
It seems like you need a pedicure.
Previous
1 / 3
Next

Comic Layout

Previous 1 / 3 Next

Comic Layout

Previous 2 / 3 Next

CRACK CRACK CRACK
CRACK
安心上路....
CRACK CRACK
拉骷髏
CRACK
工程學是你的好
CRACK CRACK CRACK
有點刺激ㄡ
CRACK
換裝有30秒 CD來不及惹
我已經不是聖騎了
正妹來了
CRACK CRACK CRACK
你與血之谷占卜者一起分享勝利的榮耀。
熊出鬼沒下線了
熊出鬼沒離開了隊伍
CRACK
你沉醉在勝利的榮耀之中。
H俄塞.欠補 你沉醉在勝利的榮耀之中。
普:安卡 -1保 1坦 根本就是在拍電影ㄚ

Applications

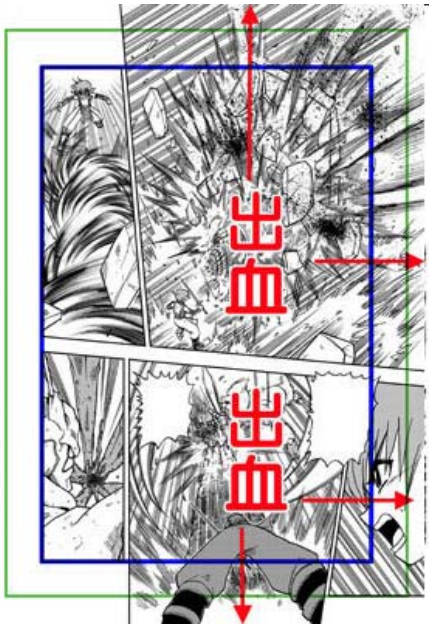
- 玩家在部落格或論壇上分享遊戲心得/經驗
- 以漫畫格式紀錄使用者遊戲的過程
  - 玩家可在遊戲中隨時調出自己加入遊戲後任何一天的遊戲日誌，以漫畫呈現

無框分格

- 強烈視覺感受
- 外框拿掉，開放式構圖
  - 頁底
  - 一般開放式構圖
- 情境式漫畫，圖顯抽象是氣氛或人物內心情境描述

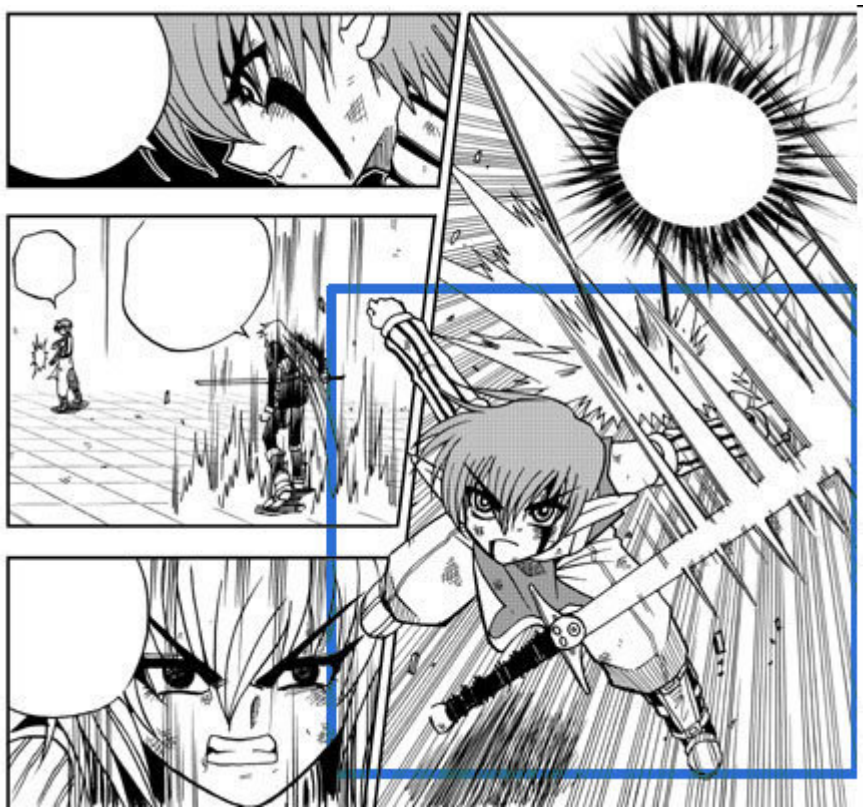
出血畫面

- 因應劇情需求，而有需要表現畫面張力的情況
- 畫面突破內框線，延伸到裁切線外
- 除非跨頁，否則盡量避免構圖朝向裝訂線方向出血



破格

- 加強突顯主體的效果
- 讓格子內的圖像或文字打破格子框線的限制



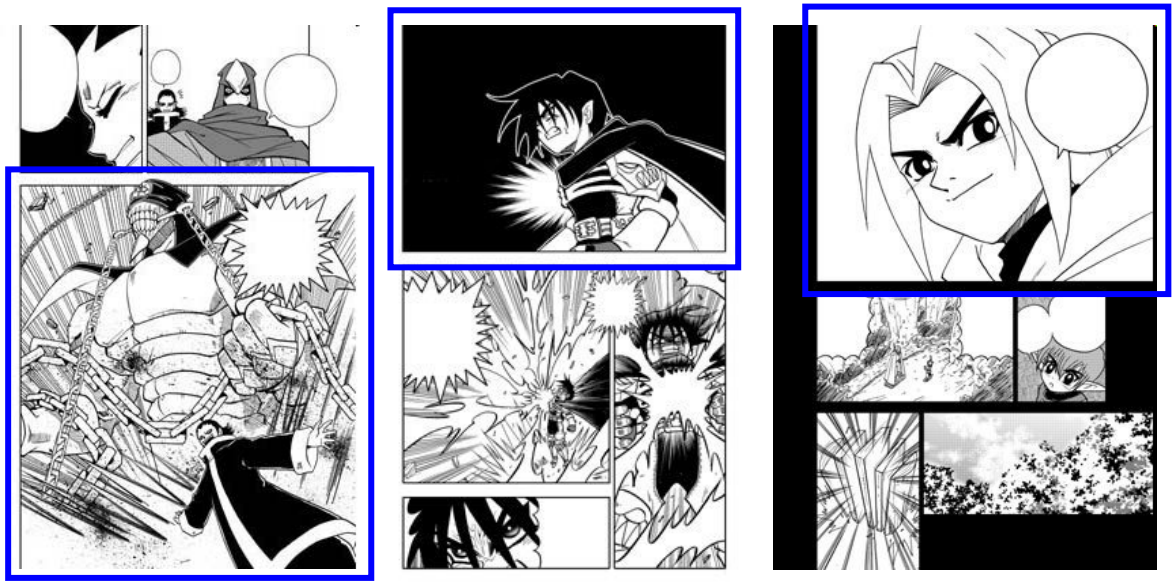
效果背景

- 集中畫面焦點的功用
  - 效果線式背景：依據人物內心的狀態，利用筆觸繪製適用的效果線
  - 黑白對比式背景：利用黑與白的對比，表達人物情緒的方法
  - 網點式背景：可分爲穩重型的平網，以及俏麗型的花網表現

漫畫張力

- 善用格子形狀：
  - 跨頁 破格 出血 無框分格 浮動格

- 方法：
  - 最大分格
  - 光影對比
  - 畫面逼近



漫畫家風格分析/模擬

		頁數		跨頁	無框分格		浮動格	出血畫面	破格	
日本					頁底	非頁底				
手塚治虫	怪醫黑傑克		差異大	0	0	0	0	1	1	
鳥山明	七龍珠			0	1	3	1	5	1 3	對話框和效果字破格較多
普澤直樹	冥王星		差異小	0	0	0	0	5	1	
尾田榮一郎	航海王			3	0	0	0	5	3	
岸本齊史	火影忍者			0	0	0	1	5	1	

		對話框	效果字	速度線	(背景)				
		Type			效果線	網點	黑白對比	其他	
手塚治虫	怪醫黑傑克	3	1	3	3	3	3		背景外加效果線或網點多
鳥山明	七龍珠	4 5	3	3	0	1	1		
普澤直樹	冥王星	5	1	1	1	1	0	3 (grey)	畫面乾淨
尾田榮一郎	航海王								
岸本齊史	火影忍者								

		分格間距	大小		形狀 方	壓	斜		
			大	中 | 小		H|V	H|V	其它	
手塚治虫	怪醫黑傑克					1	3	1	整齊 or 奇怪
鳥山明	七龍珠					3 1	1		格子看起來不協調
普澤直樹	冥王星					3	1		格子整齊
尾田榮一郎	航海王								
岸本齊史	火影忍者								

User Interface Prototype

中研院新技術

線上遊戲變漫畫 過關、打魔王

【記者李承宇／台北報導】每個線上遊戲玩家打怪、拿寶物、破關的歷程都是獨一無二的精彩故事，把這些畫面加上與其他玩家的交談互動，編織成一篇「攻略劇情漫畫」對玩家來說很有成就感。中研院學者研發的線上遊戲歷程自動摘要技術，讓玩家可以輕鬆完成這個夢想。

中研院資訊科技創新中心助研究員陳昇瑋率領研究團隊，透過機器學習、統計、人機介面等理論結合開發實務，研發出一套讓玩家輕鬆記錄並分享遊戲歷程的系統，結合遊戲資料與畫面，形成玩家希望的漫畫風格。

研究團隊成員、中研院資訊所研究助理許景翔表示，線上遊戲玩家的交流，不外乎破解難關的方法，或討論藏得很隱密的寶物究竟在哪裡。玩家如果要分享這些攻略，必須用文字、從遊戲畫面截圖，辛辛苦苦才能把自己的心得分享給其他玩家。

「線上遊戲歷程自動漫畫摘要技術」利用演算法，把玩家可能認爲重要畫面，自動記錄包括過關、打魔王、拿寶物等畫面，玩家只要啓動系統，在玩遊戲的過程中就會自動記錄，等玩家玩完，一篇包含這次遊戲重要歷程畫面的漫畫就會出爐，玩家跟其他人的對話也會以漫畫對話框的形式呈現。

許景翔指出，在實驗室裡很多成員都愛玩線上遊戲「魔獸世界」，「陳昇瑋老師自己也很愛看漫畫」，於是發想出這個系統的點子。這個系統的關鍵技術在演算法找出的關鍵畫面是否與玩家希望得到的畫面相同，而且能自動產出漫畫格式。他指出，如果玩家想特別記錄下什麼過程（像是與其他玩家交換裝備），也可以自行設定。

關鍵紀錄

中研院研發線上遊戲自動摘要技術，可以將玩家的遊戲過程輸出成獨一無二的漫畫劇情。

圖／中研院多媒體網路與系統實驗室

Research Resources

Interest Groups

Books

Journals

Conferences

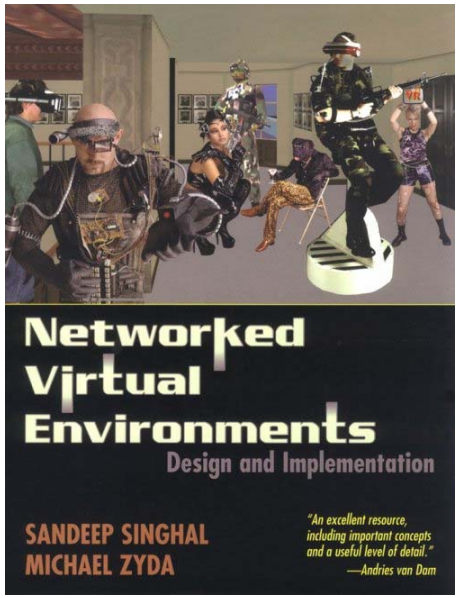
Publications

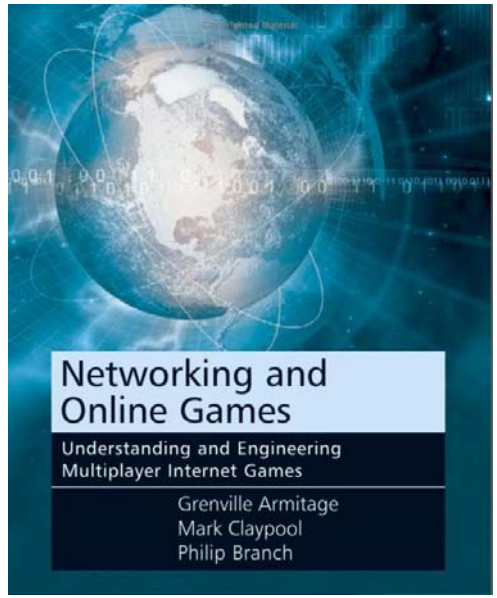
Interest Groups

- IEEE Computer Society Task Force on Game Technologies (TFGT)
- ACM SIGCOMM, SIGMM, SIGCHI
- IGDA (International Game Developers Associations)

Books

Networked Virtual Environments: Design and Implementation by Sandeep Singhal, Michael Zyda





Networking and Online Games: Understanding and Engineering Multiplayer Internet Games

Academic Journals

- ACM Computers in Entertainment
- IEEE Transactions on Computational Intelligence and AI in Games
- IFIP Entertainment Computing
- Game Studies
- Games and Culture
- Journal of Game Development
- Futureplay
- Simulation & Gaming
- International Journal of Intelligent Games & Simulation
- International Journal of Virtual Reality
- PRESENCE: Teleoperators and Virtual Environments

Academic Conferences

NetGames	ACM SIGCOMM Network Support of Network Games
NOSSDAV	ACM SIGMULTIMEDIA International Workshop on Network and Operating Systems Support for Digital Audio and Video
ACE	ACM SIGCHI International Conference on Advances in Computer Entertainment Technology
MM	ACM SIGMULTIMEDIA International Multimedia Conference
CHI	ACM SIGCHI Conference on Human Factors in Computing Systems
CCNC	IEEE Consumer Communications and Networking Conference
MMCN	SPIE/ACM Multimedia Computing and Networking
MMSP	IEEE International Workshop on Multimedia Signal Processing
DS-RT	IEEE/ACM International Symposium on Distributed Simulation and Real Time Application
ADCOG	International Conference on Application and Development of Computer Games
VRST	ACM Symposium on Virtual Reality Software and Technology
CSCW	ACM Conference on Computer Supported Cooperative Work
NIME	IEEE International Workshop on Networking Issues in Multimedia Entertainment
ICEC	International Conference on Entertainment Computing
PerGames	International Workshop on Pervasive Gaming Applications
Edutainment	International Conference on E-learning and Games

Game Research Bibliography

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  http://digiplay.info/bibliography
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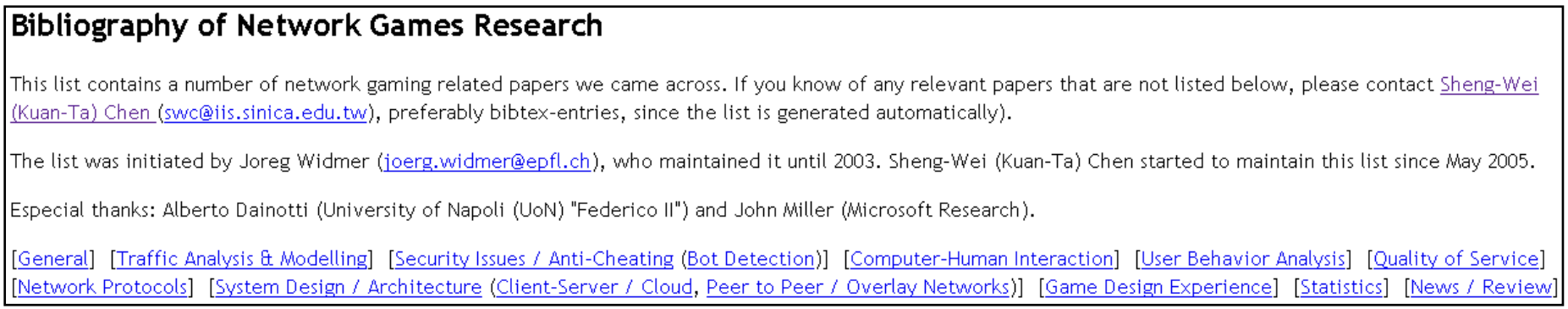
  http://www.iis.sinica.edu.tw/~swc/ngbib.html



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This list contains a number of network gaming related papers we came across. If you know of any relevant papers that are not listed below, please contact Sheng-Wei (Kuan-Ta) Chen (swc@iis.sinica.edu.tw), preferably bibtex-entries, since the list is generated automatically).

The list was initiated by Joreg Widmer (joerg.widmer@epfl.ch), who maintained it until 2003. Sheng-Wei (Kuan-Ta) Chen started to maintain this list since May 2005.

Especial thanks: Alberto Dainotti (University of Napoli (UoN) "Federico II") and John Miller (Microsoft Research).

[General] [Traffic Analysis & Modelling] [Security Issues / Anti-Cheating (Bot Detection)] [Computer-Human Interaction] [User Behavior Analysis] [Quality of Service] [Network Protocols] [System Design / Architecture (Client-Server / Cloud, Peer to Peer / Overlay Networks)] [Game Design Experience] [Statistics] [News / Review]

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謝謝聆聽，請多指教。

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