Characterising User Interactivity for Sports Video-on-Demand

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Introduction   Motivation
Analysis   Related Work
Outlook   Experiment Setup

Outline

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Introduction

Characterising User Interactivity for Sports Video-on-Demand

- Created a simple Video-on-Demand service offered to university staff and students
- Served interactive sport videos (specifically 2006 FIFA World Cup)
- Obtained traces and characterised the interactive user behaviour
- Interactivity has an dramatic impact
- Discuss how Content Distribution Networks (CDNs) can exploit this behaviour

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Motivation 1

- Increase in the use of **bandwidth intense streaming** videos

- Users expect **more interactivity** (VCR, Bookmarks, Time-shifting)

- Content Distribution Networks are used to alleviate these problems
  - **Need to know workloads** to exploit behaviour (caching, replication, streaming protocols)

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Motivation 2

- Traditional workloads are **not very interactive**
    - Simple start-to-finish models
    - Only minimal VCR interactivity
    - **Never considered bookmarks**

- Large traces are private

- Publicly available traces are **non-interactive and/or outdated**.

- Previous work **hasn't looked at sports** in particular

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Related Work

An analysis of live streaming workloads on the Internet. Sripanidkulchai *et al*
Understanding user behavior in large scale video-on-demand systems. Yu *et al*

- Looks at what kind of streaming is happening today (2004)
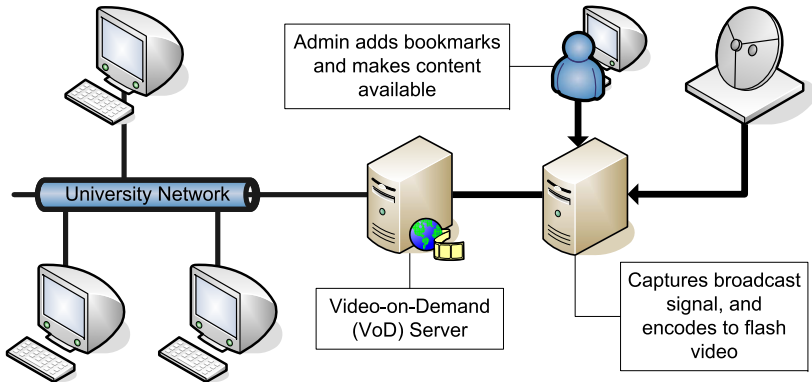- Looks at metrics such as arrival rates and session times

Analyzing client interactivity in streaming media. Costa *et al*

- Looks at **simple VCR** (fast forward/rewind/pause)
- **Only education** and some entertainment

User Behaviour Analysis of a Video-On-Demand Service with a Wide Variety
of Subjects and Lengths. Vilas *et al*

- Again only has simple VCR
- Mostly short news videos on a wide range of subjects

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Video-on-Demand System Setup

Admin adds bookmarks
and makes content
available

University Network

Video-on-Demand
(VoD) Server

Captures broadcast
signal, and
encodes to flash
video

Source code available at: www.rcdn.org

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Player Interface

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Player Interface

Bookmarks

Kick Off
Goal 1-0
Goal 2-0
Goal 3-0
Half-time
2nd Half
Goal 4-0
Goal 5-0
Goal 6-0
Full-time

User
Bookmarks

Riquelme-flick
messi-foul
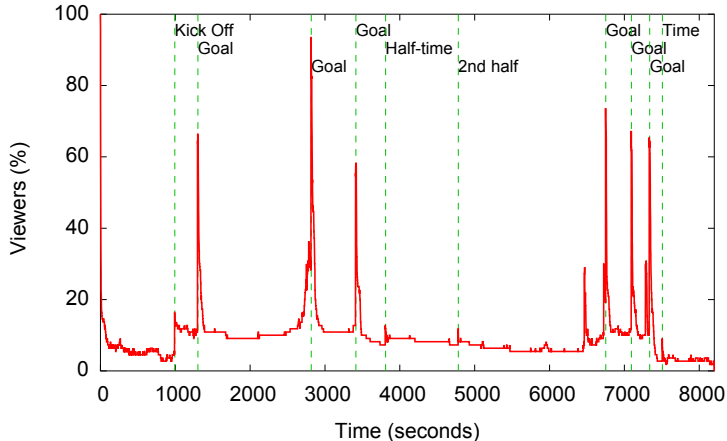messi-pass

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Methodology

Results

- 66 matches (64 Worldcup matches, and 2 pre-competition friendlies)
- 13th June until 16th July 2006
- 405 unique users, average 30.7 users per game

Models

- Fitted models (where appropriate)
- Helps to understand the nature of the result
- Allows future simulations to use models

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Argentina vs. Serbia and Montenegro viewers

- Most of the video was equally popular, with peaks of high interest around bookmarks

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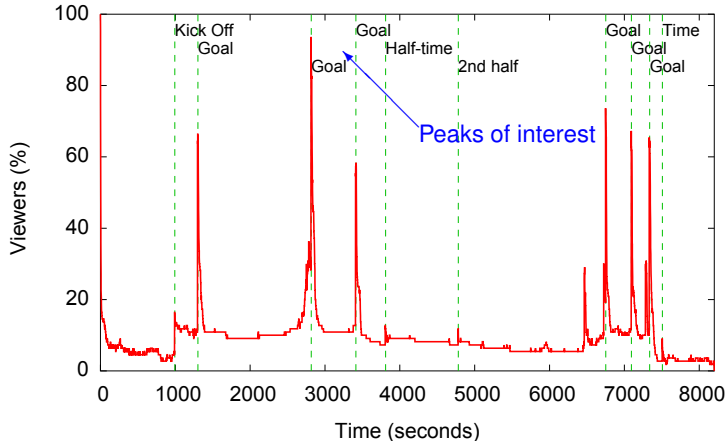
Object and Segment Popularity
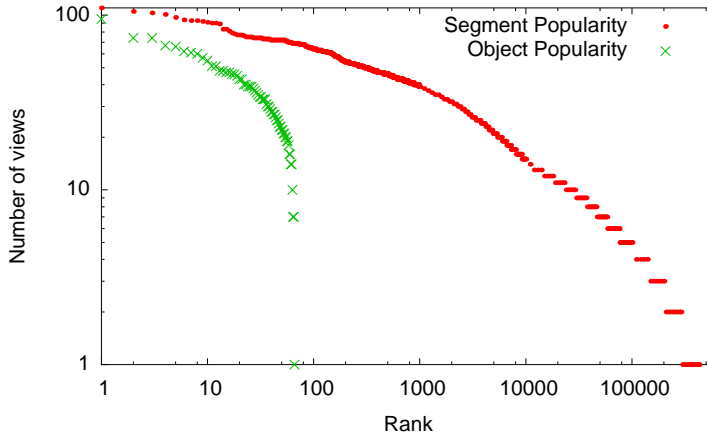
- Segment popularity exhibits Power-law distribution

Occurrences of interactive actions

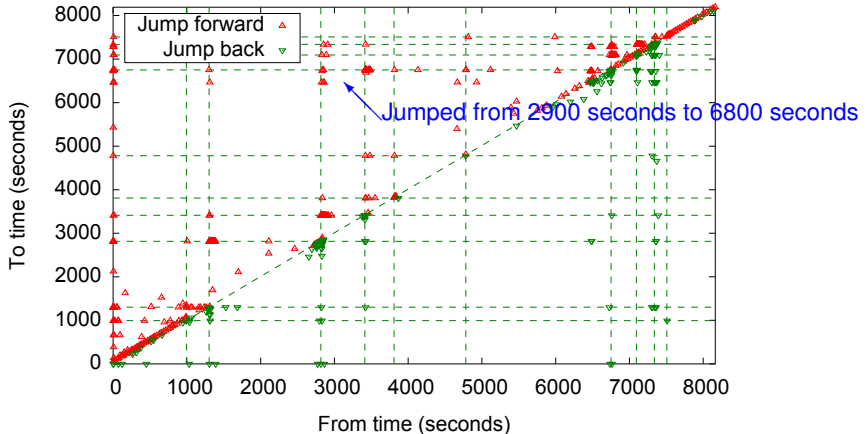| Action	Occurrences	Percentage(%)	per Session
Back 10s	1353	5.98	0.58
Back 30s	556	2.46	0.24
Back 60s	775	3.43	0.33
Forward 10s	3319	14.67	1.42
Forward 30s	1664	7.36	0.71
Forward 60s	3488	15.42	1.49
Seek-bar	2101	9.29	0.90
Bookmarks	5203	23.00	2.22
User bookmarks	585	2.59	0.25
Add bookmark	43	0.19	0.02
Pause	1847	8.16	0.79
Resume	1690	7.47	0.72
Total Back	2684	11.87	1.15
Total Forward	8471	37.45	3.62
Total Seeks	19044	84.2	8.14
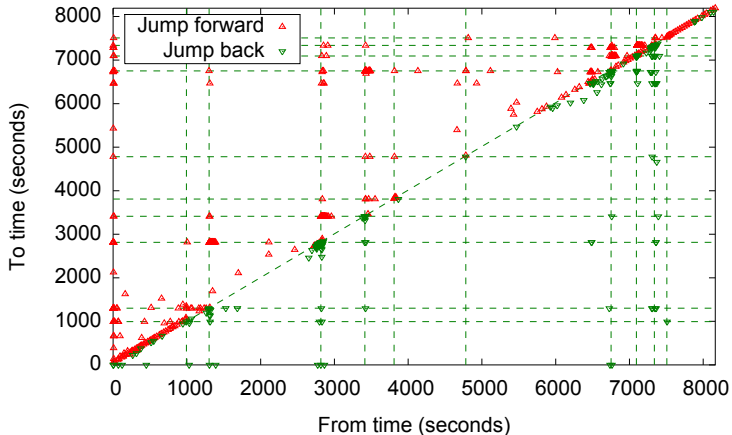
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Argentina vs. Serbia and Montenegro jumps

- Clusters of jumps (indicates users followed similar patterns)
- Small Forward and Back jumps occur in certain areas

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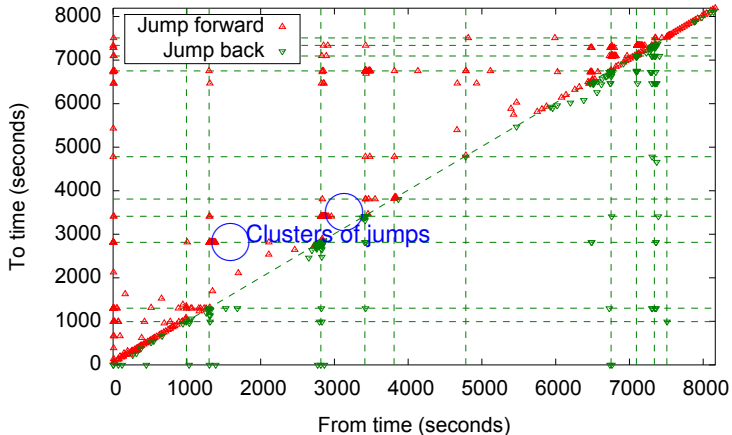# Argentina vs. Serbia and Montenegro jumps

Jumped from 2900 seconds to 6800 seconds

- Clusters of jumps (indicates users followed similar patterns)
- Small Forward and Back jumps occur in certain areas
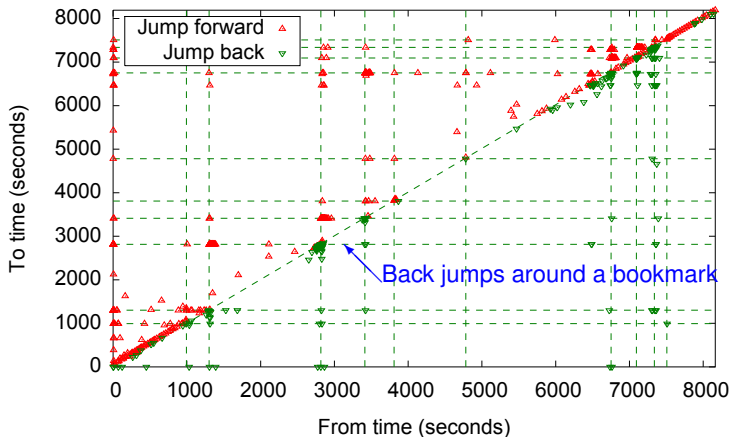
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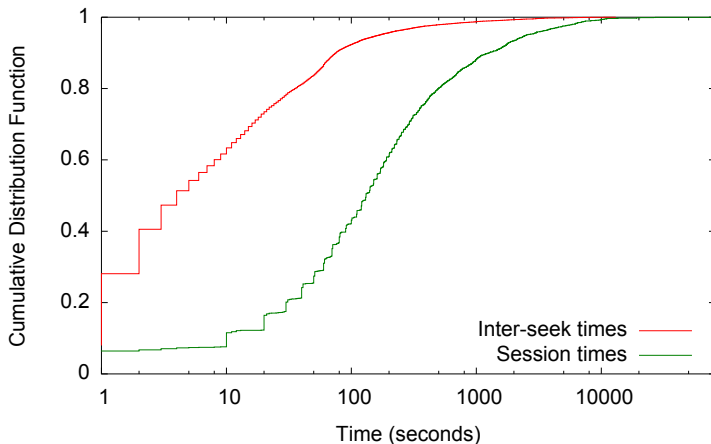

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CDF of session lengths and inter-seek times

- Short time between seeks
- Majority of sessions are a lot shorter than the media length

Outlook

Characterising

- Confirm these results apply to other types of video content
- Other sports, music, news

Create **protocols**/**algorithms** to exploit these characterisations:

- Segmentation
  - 60% of requests < 10 seconds long
- Bookmarks
  - Caching / replication should exploit them
  - Automatic positioning (or repositioning)

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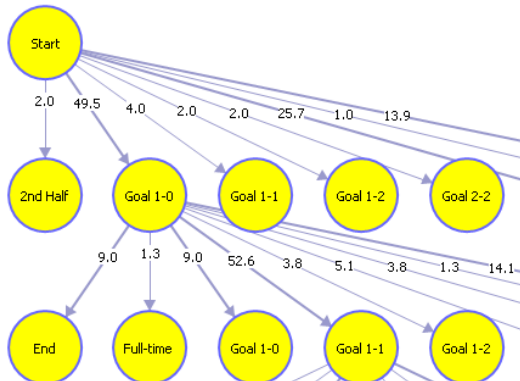UNIVERSITY

Outlook - Bookmarks Misplacement
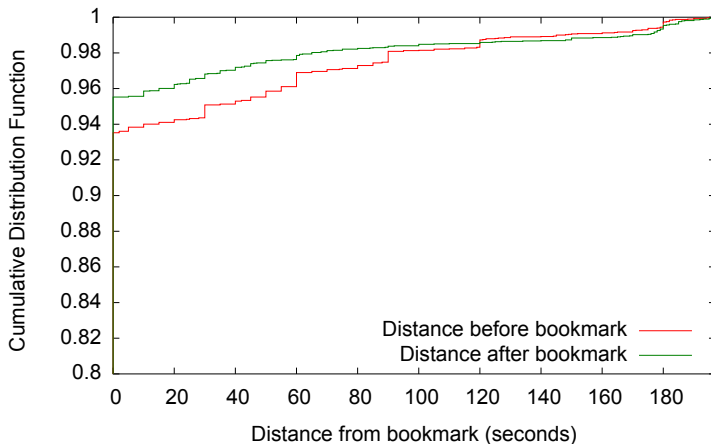
- 93% - 95% of the time users did not seek after visiting a bookmark
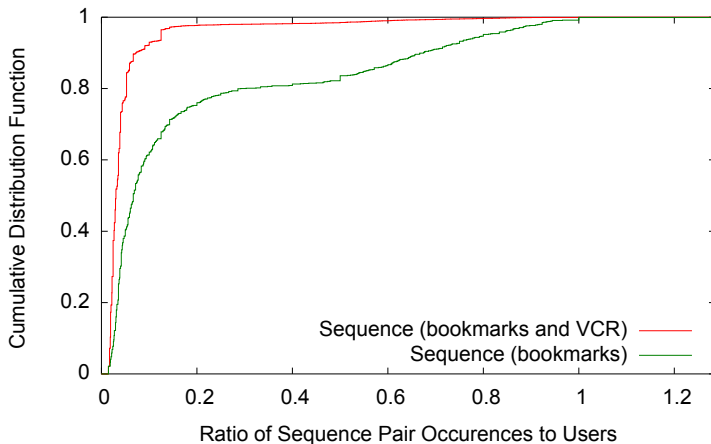- Therefore 5% - 8% of bookmarks were misplaced

Outlook

Prediction

- Users watched bookmarks in a similar order
- Pre-fetch/Pre-push bookmark before it is requested

Sequence of bookmarks:

Outlook - Prediction

- Top 20% bookmark sequence occur 50% of the time
- Sequences with VCR is less predictable

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Conclusion

- Created a interactive VoD service (with the 2006 FIFA Worldcup)

- Characterised interactive user behaviour

- Interactivity highly influences users
  - Bookmarks leads to access patterns not previously seen

- Content Distribution Networks can exploit this behaviour

Thank you for listening
Any questions?

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