

Session Viewer:

Visual Exploratory Analysis of Web Session Logs

Heidi Lam, Daniel M. Russell, Diane Tang and Tamara Munzner

University of British Columbia, Canada Google Inc., USA





Web Session Log Data

- Basic unit of web session log analysis is a session
- Session is a time-stamped sequence of events performed by a user
- Each event represents a user action, e.g., submitting a query, clicking on a result link
- A session population is a group of sessions with shared characteristics, e.g., task type or usage patterns

Web Session Log Data

- Both sessions and events have attributes
 - Session attributes include total duration, total number of events
 - Event attributes include time stamp, page title, page URL
- Example user study log
 - collected with browser plug-in from a study with volunteer users

Pane▶	Paneli	Que Navigation_Event	Event_	URL	Title
1	15238	44 Begin_Section	1		
2	15238	45 Begin_Objective	1		
3	15238	45 Go to Start URL of Objecti▶	31	http://www.msn.com	
4	15238	45 Browser Navigate	59	http://search.msn.com/results.asp▶	MSN Search: london and tours
5	15238	45 Browser Navigate	118	http://www.london-tours.info/	London Tours Info - over 70 London, UK & Pari
6	15238	45 Browser Add Favorite	175	http://www.london-tours.info/	London Tours Info - over 70 London, UK & Pari
7	15238	45 Browser Navigate	204	http://www.london-tours.info/londo	Discovering London (Full Day Tour No 4) Ticke
8	15238	45 Browser Back	244	http://www.london-tours.info/	London Tours Info - over 70 London, UK & Pari
9	15238	45 Browser Navigate	265	http://www.london-tours.info/londo	Oxford, Stratford & Warwick Castle (Tour 23) Ti
10	15238	45 Browser Back	316	http://www.london-tours.info/	London Tours Info - over 70 London, UK & Pari
11	15238	45 Browser Back	320	http://search.msn.com/results.asp▶	MSN Search: london and tours
12	15238	45 End Objective	360		

Web Session Log Analysis

- Analysis provides better understanding of web usage behaviours to improve support
- Two main approach in analysis:
 - **Detailed-session:** look at sessions one by one, event by event
 - Aggregate-statistical: look at session/event attributes using statistics (e.g., total task time)
- Both methods have merits and problems:
 - **Detailed-session:** can understand usage, but only analyze a very small portion of data and may have selection bias
 - Aggregate-statistical: highly scalable, but understand sessions by attributes and may be too hypothesis-driven

Visualization and Exploratory Analysis

- Visualization can support data exploration and bridge between the detailed and statistical analysis approaches
 - **Detailed**: guides session selection with session-attribute distribution
 - Aggregate: provides context and content to statistical results

Session Viewer

- Displays multiple data levels to facilitate cross-level analysis
- Displays multiple session populations for side-by-side population comparisons

Session Viewer: Main Screen



Session Viewer: Multiple Data Levels



Session Viewer: Aggregate Level

ļ	All_7366 File Edit	i6_Search_Task_A_Google_CS5.csv-Session Viewer										ď Cr
	Tind:											
		To Archive All_7366_Search_Task_A_Google_CS5.csv	ſ	Save		Camera.		Sav	1		Watch	
		State Transitions		Stage Transition	15			Stage T	ans itions			
EA D												
300		Search		@Qearch	- Presult Citcle	Neott Piage			search (Search	nan Chic iji Mere Sener	Page	
	¢ .	State Counts	•	State Counts				State C	u.mits			
		50			Distribution / filter							
		0 Event	#Ev	ents								
	#Events	Distribution / filter		ento	(7.5)	< 0			_			77>
	#Search	(7.5) < 0 // > (2.0) < 0 // >	#Se	arch	(2.0)	< 0					13>	
Contraction of the local distribution of the	Task Time	(138.0) <0 1086>	Tas	k Time	(138.0)	20						1086
	Satisfaction	1(2) 2(2) 3(5) 4(3) 5(5) 5(28) 7(45)	0		(1.30.0)		1.57					103012
		Annotations Own task	Out	come		Patieres	<u>8)</u>	Give	up(1)		Success(80)	
			Sati	isfaction		1(2)	2(2)	3(5)	4(3)	5(5)	5(28)	7(45)
	#Events	Session Attributes50	1#Events					<u>.</u>				
í	#Search		Ricarch					elt			وبروا والمستوين	197.41
	Outcome	Failure	Outcome					C. Deces		· · · · ·		- Saccess
S	atisfaction	Sessions	Satisfaction	in no in it t	и Манананији – и и и и и и и Манананији – и и и и и и и и и	"norme"onenone"s"	in mana in the state of the	fa - n mollo ^{ll} h Kare bar	hatari batan ata A	Contraction (************************************		******
	Search Result Click		Search									
	NextPage		NextPage									
		1 1 .2										
	NAL											
	RDI	2										
	0											
	Σ.							4				
		Events:1658635						h noz ID 7				
		27 812 61 http://promo.e eBay. Vintage Han.		4 238 7	http://www.go	Google Search	Mo More, mo	ne, e. 12 17 re, e. 142 17	78 6 http:/	/shopping.msn.	. Watches for Men pro)
		31 882 3 http://www.ma Custom,Handmad		5 245 8 6 253 6	http://www.go.	Froogle Froogle Search	: nik nikon coo	pi 44 17	on (3 (http:/ 187 (3 (http:/	/shopping.msh. /shopping.msh.	. Watches for Meh pro	J
		32 885 6 http://www.go braided rug hand braided r		7 259 0 9 550 99	http://incogie.				SCOLE MEDI GR 15 http:/	/www.cisopile.cl. /frongle.go.ogl	Invater resistant 200 Proodle Search: wat	water resistant
			Control		CONTRACT CONTRACTOR AND A DATA SAME					a second distribution of the first state of the second state of th		

Session Viewer: Multiple Level



Session Viewer: Multiple & Detail Levels



Session Viewer: Multiple Population Views

"Own" Task Population

"Camera" Task Population

"Watch" Task Population



Use-case Scenario: Analyzing Study Logs

- Illustrate the use of Session Viewer with existing study log data
 - Large-scale user study conducted by Keynote
 - Study log data collected with browser plug-in with user consent
- Study gathered >6,000 sessions, grouped by
 - Search engine type
 - Search domain (Image, Shopping, News, Local/Maps)
 - Question variant (3 pre-defined, one participant's own)
 - E.g., "Camera" task to look for image resolution of a camera, and the "Watch" task to look for a water-resistant watch under \$100
- Study Logs analyzed previously: participants' own tasks are longer and more involved than pre-defined tasks (Russell & Grimes, 2007)

Use-case Scenario: Analyzing Study Logs

- Previous analysis identified two population groups: "Own" task, and "Pre-defined" task populations
- We revisited the same study logs with Session Viewer, and found two **new findings:**
 - 1. Pre-defined tasks are not isomorphic, and can be classified further by task type
 - 2. Task type classification, based on task instructions, is reflected as usage patterns in session logs
- We also verified correlation between two participant feedback: task outcome and satisfaction scores

Use-case Scenario: Analyzing Study Logs

- To analyze the study logs, we customized Session Viewer by defining...
 - Event types: Search, ResultClick, NextPage, and non-search engine events
 - Session attributes
 - Calculated based on event attributes: #Events, Task Time
 - Read from log: Task Outcome, Satisfaction scores

Use-case Scenario: Three Shopping Populations



Use-case Scenario: Compare between aggregates

- Expected the populations to look similar, as the question variants were assumed to be isomorphic
- But the "Camera" task population has shorter sessions with fewer events



Use-case Scenario: Compare between aggregates

- Expected the populations to look similar, as the question variant were assumed to be isomorphic
- But the "Camera" task population has shorter sessions with fewer events



Use-case Scenario: Compare between aggregates

- Expected the populations to look similar, as the question variant were assumed to be isomorphic
- But the "Camera" task population has shorter sessions with fewer events



Use-case Scenario: Compare between aggregates Directed, closed, information *based on Rose & Levinson 2004 How many megapixels is the search* Information image resolution of the Nikon Find a water-resistant locate* Coolpix 4600? watch for under \$100 "Own" Task Population "Camera" Task Population "Watch" Task Population All_7366_Search_Task_A_Google_CS5.csv-Session View r 2 🛛 Google File Edit View Ontions Window Heli X Find: To Archive All 7366 Search Task A Google CS5.csv Save Camera Save Watch State Transition State Transitio State Transition ResultClick NextPage O Search State Count State Counts State Counts 50 Distribution / filte Distribution / filter Distribution / filte #Events #Events (7.5) < 0 77> 2.0) < 0 20> (7.0) < 0 #Search #Search 7> (2.0) < 0 13> 1.0) < 0 (3.0)< 0 17> Task Time Task Time (138.0) < 01086> 20 (140.5) 5 0) 978> < 0 927 Outcome Outcome uccocc (0.4) Satisfaction Satisfaction Annotation Own task Annotations amera task Watch task Session Attribu ession Attribu Event: Events #Events #Search Task Time #Search Task Tim Outcome Outcome Satisfactio Satisfacti _____ and second Search ResultClick NextPage ResultClick NextPage ID Time D... URL Title 42 1778 6 http://shopping.msn... Watches for Men pro... 43 1784 3 http://shopping.msn Watches for Men pro... ID Time Ur.l. URL Title 27 812 61 http://promo.e... eBay. Vintage Han. 30 873 9 http://www.go... braided rug hand . Searcirc D Time Dura... LIRI Title Search sar 238 http://www.go... Google Search: Mo... More, more, 🔺 19 http://www.go... braided rug hand . http://www.ma... Custom,Handmad.. braided r 245 http://www.go... Froogle 31 882 44 1787 http://shopping.msn... Watches for Men pro. 253 http://froogle.. ... Froogle Search: nik... nikon coolpi 2 885 6 http://www.go... braided rug hand . braided 259 0 http://froogle.... WolfCamera.com 259 18 http://www.w... WolfCamera.com 45 1790 3 http://www.google.c... water resistant 100 ... water resistant 100 http://froogle.... WolfCamera.com 46 1793 15 http://froogle.googl... Froogle Search: wate... water resistant 100 33 891 10 http://www.co... Custom Braided R. 47 1808 10 http://froogle.googl... Froogle Search: wate 48 1818 7 http://froogle.googl... Froogle Product Swis 34 901 2 http://www.do... braided rud hand ... braided 🚎 http://froogle.... Froogle Search: nik... nikon coolpi: Froogle Search: wate... water resistant 100 CDW 201 Instance Class

Use-case scenario: Usage-pattern distributions

- How do these populations differ?
- Iteratively defined usage patterns:
 - Short navigation: S[Start] → X[End]
 - Topic exploration: $S \rightarrow X \rightarrow X \rightarrow X$
- More Short navigations in Camera-Task population More Topic explorations in Watch-Task population

Sessions	Sessions
Camera Task Population	Watch Task Population

Use-case scenario: Usage pattern details

- Short-navigation makes sense for direct, closed information task (look for image resolution in Nikon Coolpix 4600)
- What is Topic Exploration $(S \rightarrow X \rightarrow X \rightarrow X)$? What were the participants doing in those non-search engine events?
- 1. Sorted sessions by event count
- 2. Focused on sessions with larger number of events
- 3. Expand sessions to better view usage patterns





Use-case scenario: 2D expanded sessions



search-result page

Google ⁻ water resistant wate	hos Search
Web Results 1 - 10 of about 280,000 for y	water resistant watches. (0.27 seco
Water Resistant Information There are several features that help make a watch water-resistantR is not recommended to wear your water resistant watch in a hot shower, www bluedial com/BD_wn htm - 32k - Cached - Similar pages	Sponsored Links <u>TX - Technoluxury Watches</u> Striking Italian design. German engineering. Advanced functional www.txwatches.com
Answers to Questions About Watches - Questions in Time - Watch	Water Resistant Watches Bargain Prices. You want it, we got it!

Answers to Questions About Watches -Duestions in Time. Watch maddition, water resistant watch cases are india with a sealah....f water posisitant Matches be

URL	Title
http://froogle.google.com/froogle?hl=en&lr&oi	Froogle Search: water resistant watches
http://froogle.google.com/froogle?q=water+re	Froogle Search: water resistant watches
http://www.google.com/search?hl=en&lr=&q=	water resistant watches - Google Search
http://www.google.com/url?sa=I&ai=Bf465ug	Timepieces International Inc - (Klaus Kobec and
http://www.google.com/search?hl=en&lr=&q=	water resistant watches - Google Search
http://www.google.com/search?hl=en&q=wat	watches - Google Search
http://www.google.com/search?hl=en&lr=&q=	water resistant watches - Google Search
http://www.google.com/url?sa=I&ai=B5rwKug	The Sharper Image - Search Results
http://www.google.com/search?hl=en&lr=&q=	water resistant watches - Google Search
http://www.chronocentric.com/watches/wresi	Chronocentric: Water Resistance
http://www.google.com/search?hl=en&lr=&q=	water resistant watches - Google Search
http://www.amazon.com/gp/browse.html?_en	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/gp/browse.html?rh=	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/gp/search.html/sr=3	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/exec/obidos/tg/detail	Amazon.com: Jewelry & Watches: Bulova Carave
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/exec/obidos/tg/detail	Amazon.com: Jewelry & Watches: Bulova Carave
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/exec/obidos/tg/detail	Amazon.com: Jewelry & Watches: Pulsar Men's
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/exec/obidos/tg/detail	Amazon.com: Jewelry & Watches: Bulova Carave
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/exec/obidos/tg/detail	Amazon.com: Jewelry & Watches: Pulsar Analog/
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W
http://www.amazon.com/gp/search.html/103	Amazon.com Jewelry & Watches: By Feature / W

Use-case scenario: Usage pattern details



Patterns found:

- Search-engine searches
- 3rd Party searches
- Result explorations

Use-case scenario: Correlations

- Does participant's outcome correlate with their satisfaction score?
 - Outcome (Success/Failure/Given-up) Score (1 - 7, 7=most satisfied)
 - 1. Remove sessions with scores of 6 and 7
 - 2. Highlight remaining sessions (<= 4)
 - 3. Add the high-score sessions back
 - 4. Reorder by Task Outcome
 - 5. Highlighted low-score sessions clustered at the poor-outcome end suggests high correlation





Session Viewer and Analysis: Multiple Populations

- Provides multiple views for side-by-side comparisons to quickly get a sense of population characteristics based on aggregates
- Camera-Task population looks different



Session Viewer and Analysis: Multiple Levels

 $S \rightarrow X \rightarrow X \rightarrow X$

- Displays multiple data levels to bridge between the high-level statistical and low-level detailed analysis approaches
- Detailed analysis: Reordered session helps select interesting sessions to focus analysis
- Statistical analysis: Linked views provides content and context to interpret results



 http://froogle.google.com/froogle?price1...
 Froogle Search: men's watch water resistant under \$100

 http://froogle.google.com/froogle?price1...
 Froogle Search: men's watch water resistant under \$100

 http://froogle.google.com/froogle?hte=n...
 Froogle Search: men's watch water resistant under \$100

 http://froogle.google.com/froogle?hte=n...
 Froogle Search: men's watch water resistant under \$100

 http://www.google.com/search?hte=n&q...
 men's watch water resistant under \$100

 http://www.google.com/search?hte=n&q...
 men's watch water resistant under \$100

 http://www.google.com/search?hte=n&q...
 Froogle Search: men's watch water resistant under \$100

 http://www.google.com/search?hte=n&q...
 Froogle Search: men's watch water resistant under \$100

Summary

- Web session log analyses tend to take either the high-level statistical or low-level detailed approach
- Session Viewer provides a visual analytic tool that
 - Bridges between the two analysis levels and facilitate cross-level analysis with multiple data levels
 - Provides side-by-side population comparisons with multiple views
- We found that task type is an important factor in session analysis, and task nature is reflected in different event-sequence patterns in sessions
- In a later work, we conducted a field study with 7 analysts where they used their own data and tasks with Session Viewer

Acknowledgements

- The project was funded by Google as internships and a university grant
- I'd like to thank Dan Russell and Diane Tang for hosting me at Google