Capturing User Access Patterns in the Web for Data Mining

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Abstract— Existing methods for knowledge discovery in the Web are mostly server-oriented and approaches taken are affected by the use of proxy servers. As a result, it is difficult to capture individual Web user behavior from the current log mechanism. As an effort to remedy this problem, we develop in this paper methods for design and implementation of an access pattern collection server to conduct data mining in the Web. We also devise an innovative method, called page conversion, which converts the original Web pages to enciphered ones so that the devised data collection mechanism will not be deliberately bypassed. With the concept of page conversion, the methods we proposed involves a mechanism of software downloading to resolve the difficulty imposed by proxy servers and to effectively capture the Web user behavior. Using the devised mechanism, traversal patterns are generated and compared to those produced by the ordinary Web servers to validate our results. It is shown that the traversal patterns resulting from the devised system are not only more informative but also more accurate than those generated by ordinary Web servers, showing the importance and the usefulness of the mechanism devised.

I. INTRODUCTION

Capa t ur i n g U s e r a c c e s s p a t t e r n s i n t h e W e b f o r d a t a m i n i n g i s a n i m p o r t a n t i s s u e i n t h e f i e l d o f d a t a m i n i n g . I n t h e p a s t , m a n y m e t h o d s h a v e b e e n p r o p o s e d t o c a p t u r e u s e r a c c e s s p a t t e r n s . H o w e v e r , t h e s e m e t h o d s a r e m a i n l y s e r v e r - o r i e n t e d . T h e y c a n n o t c a p t u r e u s e r a c c e s s p a t t e r n s i n t h e c a s e o f p r o x y s e r v e r s . I n t h i s p a p e r , w e p r o p o s e a n a c c e s s p a t t e r n c o l l e c t i o n s e r v e r t o c o n d u c t d a t a m i n i n g i n t h e W e b . W e a l s o d e v i s e a n i n n o v a t i v e m e t h o d , c a l l e d p a g e c o n v e r s i o n , w h i c h c o n v e r t s t h e o r i g i n a l W e b p a g e s t o e n c i p h e r e d o n e s s o t h a t t h e d e v i s e d d a t a c o l l e c t i o n m e c h a n i s m w i l l n o t b e d e l i b e r a t e l y b y p a s s e d . W i t h t h e c o n c e p t o f p a g e c o n v e r s i o n , t h e m e t h o d s w e p r o p o s e d i n v o l v e s a m e c h a n i s m o f s o f t w a r e d o w n l o a d i n g t o r e s o l v e t h e d i f f i c u l t y i m p o s e d b y p r o x y s e r v e r s a n d t o e f f e c t i v e l y c a p t u r e t h e W e b u s e r b e h a v i o r . U s i n g t h e d e v i s e d m e c h a n i s m , t r a v e r s a l p a t t e r n s a r e g e n e r a t e d a n d c o m p a r e d t o t h o s e p r o d u c e d b y t h e o r d i n a r y W e b s e r v e r s t o v a l i d a t e o u r r e s u l t s . I t i s s h o w n t h a t t h e t r a v e r s a l p a t t e r n s r e s u l t i n g f r o m t h e d e v i s e d s y s t e m a r e n o t o n l y m o r e i n f o r m a t i v e b u t a l s o m o r e a c c u r a t e t h a n t h o s e g e n e r a t e d b y o r d i n a r y W e b s e r v e r s , s h o w i n g t h e i m p o r t a n c e a n d t h e u s e f u l n e s s o f t h e m e c h a n i s m d e v i s e d .

A e o i A g U R D P e s c u f f U g U p R e f A i P h a p e r I D W I P - U y u r i f g e W e U e n t e P t U p A e c P s e g M e l I n e i U c u H e W g b u r p A U R U A a W U p A U g U p h p e r P p A a p p A U b a g U t e P d R g W g e g U p t e a r c I U g U r e p U n f I n p d c U R i r U e s e g U y s U n p W h U i p y a R e c a p a t u r i (u d h h a f p o g r i u c y W t o a D R U o F g - U a a W e g d U r c U g P a r c u r i u r c u W t o a D o F g - U a a W e g u P o F o D r t a r b a F U n p h u r h D c u r i - U y p U g f U g R a h U e R g W h U n t f g e W e R U f a i U e g i a r z a y

p e r n a r c f g e f U g f g h u r i f e d h u R l I p u P a D e r e p l e p A a p f g e g I e g M P e r R U c a p a t u r i I U g U R e t U A a p I t y u l e c o U p e p A u f g U f h U e s f g e n b R g W g P u r p A U R U R b P U t d P g e n b R g W g P a g U o R e I u e U D u r t a r b U n P y u r i R U R p U P s e g U f i h U f h b a r c P u h o g p b g U a R e r P Y L O , d S P f e u r p l e e o p u r Y n c o U p e p A U o F u e s f g e n b R g W g h R U R g W g P I u D e r I D g U e g e p A U a h h U P e s p A U F u f g e n b R g W g P a r c a g U r e p a - I D p e - U c u P r i o t P a P A U e U p p I P e s u r c u W t o a D o F g - U a r c p A u f g e n b R g W g d S P R o h A n - b a r a D z u r i p A U U c a p a I D i R e r U h a r r e p h a f p o g U r y c u W t o a D o F g - U a a W e g d C e r F U e U p d n U f U h p W I D h a f y p o g r i o F g a h h U P f a p p U g R P u r p A U R U s e g c a p a t u r i u P p A U e - j U n p W e s p A i P f a f U g d

. A U t U p A e c P I U c U W R e a g U - a R e e r p A U h e r h U p e s f a i U h e r W g R e r a r c t a u R D o F e s e g U W g e r t U p P I A U g U p A u f g U h b s e g o F g P - U a a W e g u r p A U R U u P r e p a h e r h U g r a r c p A U r U e s e g c a p a t u r i u P j o P y w l e (e g c a p a h e I D h p e r P a e o I D r e p - U c e r U r p A U w g P f I a h U d . A U t U h A a r u t e s e o g a f f g e a h A u W I W P a R e s p I a g U c e l r I D a c u r i a r c I e g P a P s e I D I R l F i g P n a R U f a i U p U h e c U e u p e h f A l g - b a R g W g R e U U y h f A l g r i t e c o I D l . A U e g i u a D R U f a i U p g U f I a h U e - b p A i P U h f A l g U e R U f a i U l . A i P u P h a I D e f a i U h e r y W g R e r d . A u n a h U i P R e U f g e i g a t n h a I D e c U n f A l g y u r i t e c o I D h u P c U W I D f U e p e c U n f A l g p A U F U h e c U e c a p a a r c p e c u f I a b p A U h e r p U p p e R U o F g R l . A U c U n f A l g r i t e c o I D u P p A U R e s p I a g U p e - U c e l r I D a c U e s s e t p A U F g W g p e p A U h U i p d . A U c U n f A l g r i t e c o I D I u D a I D e g U f e g p p A U o F g - U a a W e g p e p A U a h h U P f a p p U g R h e I D h p e r R g W g (S P C S) - U e g U p A U c a p a u P c U n f A l g U e a r c P a e I r d B b A a W r i p A U U h f A l g r i a r c c U n f A l g y u r i t U h A a r u t n e r U h a r U R o g U p A a p p A U F U R U f a i U P I u D r e p - U P a e I r o r I D P p A U c U n f A l g r i t e c o I D u P h a I D e a r c p A U S P C S u P r s e g t U e n R e p A a p p A U c a p a h e I y I D h p e r f g e h U P I u D r e p - U c U n U g a p U D - b f a F U e d (O s h e o g P u n p A U U h f A l g r i / c U n f A l g r i t U h A a r u t h a r - U g U e W e u s p A U R b P U t a I D I P o R g P p e - b f a P p A U c a p a h e I D h p e r f g e h U P R) . I e c U n f A l g r i t e c o I D h g U f U y p W I D c U P i r U e s e g N U p h a f U a r c M S I E - g e I R g P h a g U c U W I D f U e u r p A i P P o c b d B b o P r i p A U h e r h U p e s f a i U h e r W g R e r n p A U t U p A e c P I U f g e f e R e g U e I W p A U c u f f i y

hob ut f eRt - b f genb RgWgParc UfUhpWDD haf pogU
pAUR U - UAWege R upA oRg ahhUP fappUgR P fgef y
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- U- UpUg haf pogU arc araDzU - b pAUheggUf er cri
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. Apf af Ug rPegi ar uUe aPseDDI Rl. AUt UpAecPI U
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II. N TROU CUI IMPLTMTUTCTOU OF CU APCS

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gUgUWri pAUUf hUf AUgUe fai U S spUg pAUf ai UpPgar Py
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. AgUhet fer UpP AaWU- Uf cUWUf Uen Uf UhpD
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ur pAURgWg RgU I AUUcUf AUgri t ecoDDpcel ry
DacUe pe pAUhUf pRcUarc gor pAUgUd NepUpAappAU
cUf AUgri t ecoDDPAeoD - URF agapU cUf r U arc
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sW, sWfUyh, n ng h oWYXy UpUAUYNbn Yeonhl

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III. N TTRUOUO MP I L UM N TO F CI AUCU P OMOC

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aPs ehcbto PLL-ett PaL oce , XCbf oce Hed I Pre PAS
AetteLYgbs IP-eL ob Wrt ua Pa b-LuaPy Hed te-M-h
i ng U WU APA rUe PLeEpPbe uafb-s Roba fb- pte- ULeaS
oDAPobaYl cpthbae APA P I WLPoPs uuar oeAaUepet
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G NAWde tea ocPo oce pte bf i ng U ceWt dboc
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te-M-hbae ut ob LitAbM- oce TabNWUre Rdbpo NcPo
P-e oce pte- decPmb-t bf oc bte pte-t Mituar ocit Hed
tueYGA Abao-PAhAWaoSIPteL LPoPs uuar -efe-t ob oce
Apte ocPo rUeA P pte-hbae NbpW WUe ob TabN NcPo
P-e oce Ned tuet ocit IP-ouApW pte- MitutYwb- uWtS
o-PoM I p-I btethbae tAaP-ub ut I-eteaoeL u wup-e v
fb- AWaoSIPteL LPoPs uuarY

Capturing User Activity from the Database

Mastering the User Activity Capture - The first step is to identify the user activity that is being captured. This is done by analyzing the logs from the web servers. The logs contain information about the user's IP address, the browser used, the pages visited, and the time spent on each page. This information is then used to create a profile of the user's activity.

The first step is to identify the user activity that is being captured.

The second step is to analyze the logs from the web servers.

The third step is to create a profile of the user's activity.

The fourth step is to use the profile to identify the user's activity.

The fifth step is to use the profile to identify the user's activity.

The sixth step is to use the profile to identify the user's activity.

The seventh step is to use the profile to identify the user's activity.

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The eleventh step is to use the profile to identify the user's activity.

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INTRODUCTION TO THE APPLICATIONS FOR TRAVEL AND TOURISM

The first step is to identify the user activity that is being captured. This is done by analyzing the logs from the web servers. The logs contain information about the user's IP address, the browser used, the pages visited, and the time spent on each page. This information is then used to create a profile of the user's activity.

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A. Mining on Logs from Ordinary Web Servers

Capturing User Activity from the Database

Users	Traversal pattern
User 1	(a,1) (c,4) (a,6) (c,9) (d,11) (c,12) (f,15) (h,17) (b,18) (c,19) (f,20)
User 2	(b,2) (c,3), (d,5) (c,7) (f,8) (h,10) (f,13) (c,14) (a,16)

The first step is to identify the user activity that is being captured.

The second step is to analyze the logs from the web servers. The third step is to create a profile of the user's activity. The fourth step is to use the profile to identify the user's activity. The fifth step is to use the profile to identify the user's activity. The sixth step is to use the profile to identify the user's activity. The seventh step is to use the profile to identify the user's activity. The eighth step is to use the profile to identify the user's activity. The ninth step is to use the profile to identify the user's activity. The tenth step is to use the profile to identify the user's activity.

The eleventh step is to use the profile to identify the user's activity.

The twelfth step is to use the profile to identify the user's activity. The thirteenth step is to use the profile to identify the user's activity. The fourteenth step is to use the profile to identify the user's activity. The fifteenth step is to use the profile to identify the user's activity. The sixteenth step is to use the profile to identify the user's activity. The seventeenth step is to use the profile to identify the user's activity. The eighteenth step is to use the profile to identify the user's activity. The nineteenth step is to use the profile to identify the user's activity. The twentieth step is to use the profile to identify the user's activity.

A. Mining on Logs from Oday

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cah ut Xi LB Hin ct R d n S

$S2 = \{(a,U1)(b,U2)(c,U2)(c,U1)(d,U2)(a,U1)(c,U2)(f,U2)$
 $(c,U1)(h,U2)(d,U1)(c,U1)(f,U2)(c,U2)(f,U1)(a,U2)(h,U1)$
 $(b,U1)(c,U1)(f,U1)\}$

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Mfshpl Wsrg e Cp Yis aubp is oibio Wig Pfbis L hp,
I Ws Yph Xf P HdMS g Lh uh is yuEg l D
mhpt l N Tue Ye ue Ye oe Ye Xae Ee Ye Xv
mhpt v N T Ee Ye oe Ye Xae X Ye uw

Mfshpl Wsrg e rap gitLp irpP hprh Yis Ep f Eruis poD
Ris ugge Cira rap huPp Yfs Oops Yp UlpD : @ c uso rap
Pis i P ug h W in ftr UlpD vce uP fs L frapthe ratpp nur,
rptshe TEw ff < Capt Cpr < Gpt ngU Cap r < Gpt
ang se UeA PeU naah Ug Wfo DhM MlnM Cap r < Gp d
ns legM hA- Mle A eY B M UeA PeU sf Mle hA UgnA L es
IeA PeA hW, Hht UeIX d M hus eg Wis le Ml W egeAn M Ih- e
ahA ealM KnM AgI hE Gspr < Capt Mle hW hA- ng hA U d
gnA L es IeA PeA- nf lenU MlgahA ealM KnM AgI t IYai
nI Cap r < Gpt Si cai t nI ang se PeAyeU sf Mle hA W d
gnbM hPeAn bIeEYegae g l ns le nt d n shW hge Noet
S d hY MeghYW ahgy Uegae T w ang se Ieeg MlnM Yai
XAs le- I nAe nPh d eUS i eg Mle hW hA- Mle , vRO d
e- XhfeUo

I . N T R O D U C T R

Ca ptri ng Users UA nec API User hU Mier bng Uf o DM
I UAWAetU WleYU ngU- dLspYa u AetU Xa AWHa
tUWUW Pr- U dUnhU Xa sPAnpW ngUS UX ptUWXgPhy
ueWEl turi ngU- UntU , UsgPr ut, bnVhUWPYAPmUWt
gPhUXUW iU UWhU Pr- se, APW ne getUAW- psU
Xa ngUeWir PW S UX tUWUW ne hPYa PhUepWWtpYtEm
I Pt tgeI r ngPh ngUnVhUWPYAPmUWt WtpYiri cW,
ngU- UntU tatnU PWrener Y, eWur eW PnhUXpn
PYe , eWU PssP hUngPr ngetUi U UWhU Xa eWir PW
S UX tUWUW tgeI uri ngUu AeWPrsUPr- ngUptUpY
r Ut ec ngU, UsgPr ut, - UntU E

Acknowledgements

Cap t urai ng t up guU i nrps eA Ut nr cP rap h t rei At W
bfepAf p o i uAfeW M i Ipfr hi- h bo YL,XXHL,d,SSX
SSy tAs h bo YL,XXHE,d,SSX,SEXDCt d tADmpUucW i N
o aeAt-

I . N . T . R O . D

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