4QE@$K4p$E$/J8>OMWLs$N$?$a$N=EMWJ8Cj=PK!
—E8K>Bf%7%9%F%`—

A System for Making Summary by Extracting Key Sentences Using Viewpoints -A Panoramic View System-

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Keywords: Summary, Viewpoints, Keywords Extraction, Extraction of Key Sentences, Co-occurence of Keywords

Summary

There are so many resources of electronical documents. However, we cannot access the all documents and we cannot examine each document precisely. Therefore, summaries are available for the selections of the documents. A system for making summary is Panoramic View System(PVS) which extracts key sentences from a document by the original method. PVS extracts keywords from the top or the other viewpoint of a term-frequency mountain. Many ordinary systems extract keywords by high frequency. However, PVS also extracts low frequency keywords based on the co-occurence of the keywords in sentences. Such keywords feature each sentence and are useful for extractions of key sentences.

1. $O $8 $a $K

6aG/K*1k>pJs2=;:6H$NH/E8$K$OL\$r8+D%kbN,$"$j!$%$%s%?!<%M%C%H$dEE;R%a!<%k$JIKhk>pJs$NEAC#$,@9sK9TJolF$$$k!%$"$kOCBj$K4X$9$k>pJs$rF@$?$$$H;W$($P!$$=lrF~<j9k$?$a$N<jCJ$H7F%$%s%?!<%M%C%H$rMQ$$$k3H$,!$$4$/$"$?$j$^$($N;~Be$HJCF-$?!%$7$+$7$=$N>pJsNLO"$^$j$KKDBg$G$"$j!$;~4V$d?4?H$N@)Ls$KhC$F!$A4FN>pJs$KL\$rDL$9$3HOHs>o$K:$FqG"$k!%

:G6a!$$=Nh$&$JB?$/$N>pJsNCf+iI,MWJ>pJs$rAGAa$/3MF@9k$?$a$N8&5f$,!$>pJs8!:w$JINJ,Ln$G@9$s$K9T$Jol$F$$$k!%:G$bBeI=E*$J>pJs8!:w$N<jCJ$H7F$O%5!<%A%(%s%8%s$,5s2i$l!$%f!<%6$,F~NO$7$?8!:w8l$r4^$`%Z!<%8$r=PNO9k:]$K!$3F8!:w8l$N3FWeb%Z!<%8Cf$G$N=EMWEY$rFH<+$K7h$a$F=g0LIU$1$N8e$K=PNO5l$k[*1]!%$9Jo$A!$3FWeb%Z!<%8$N%-!<%o!<%I$H%f!<%6$,F~NO$7$?8!:w8l$H$,?tB?$/0lCW7F$$$l$P>e0L$K=PNO5l$kI>2A4X?t$HJk!%$=$lf(J8>ONCfG=EMW$JItJ,!$%-!<%o!<%I$d=EMWJ8!K$OI3$+$r8+$D$1=P$9$3HK$O!$8!:w$N%i%s%-%s%0$r2~A1$9$k>e$G0UL#$,$"$k!%

$^$?!$8=:_%5!<%A%(%s%8%s$N=PNOKh$/8+$+1kC;$$35MW$OA4$F!$8!:w$5l?3FWeb%Z!<%8$NKAF,$+$i<h$j=P5l$F$$$k!%%K%e!<%95-;vNh$&$KKAF,J8$K0UL#$N$"$kFbMF$,4^$^lF$$$k$H$$$&@)Ls$O0lHL$K$OK~$?5l$J$$$?$a!$7k6IO=$N%Z!<%8$^$G%O%$%Q!<%j%s%/$rC)$C$?>e$G!$F~NO$7$?8!:w8l$,INh&$K;H$olF$$$k$+$r<B:]$K3NG'$9k3Hb7P7PG"$k!%$3$N860x$O!$J8>OCf$G=EMW$JItJ,$rFCDjG-$J$$$3HKhC$F$$$k!%$"$i$+$8$a=EMWJ8$rCj=P7F$*$/3H$G!$8!:w8l$r4^$`=EMWJ8$rM%@h$7$F35MW$KMQ$$$k3HKhCF$b!$8!:w$NG=N($,>e$,$k$H9M$(il$k!%

8!:w$NG=N($r>e2k=>Mh8&5fH7$F!$Web%Z!<%8$K4^$^lk%-!<%o!<%I$r%f!<%6$KDs6!7F8!:w$r;Y1g$9$k%7%9%F%`[:=;3 99]$,$"$k!%3l$O3FWeb%Z!<%8$+$iIQEY$KhC$F=g0LIU$1$5$l$?%-!<%o!<%I$rMQ$$$F!$8!:w8l$K%^%C%A7?B?$/$NWeb%Z!<%8$K6&DL$K8=lk%-!<%o!<%I$r%f!<%6$KDs6!7F$$$k!%3N$"$i$+$8$a3F%Z!<%8$KM?$($F$*$/%-!<%o!<%I$O!$3FWeb%Z!<%8Cf$G=EMW$H5l$kJ8$K4^$^$l$F$$$J1l$P!$8!:w;Y1gH7FN8z2L$O==J,$GOJ$$$@m&!%

=>Mh$N=EMWJ8Cj=P$KhkMWLs@8@.K*$$$F$O!$%7%9%F%`FH<+$NI>2A4p=`KhCF!$I>2ACM$N9b$$J8$rCj=P$9kH$$$&J}K!$,:N$ilF$$$k!%$=$7$F3FJ8$OC18lKhCF9=@.5l$F$$$k$?$a!$J8$NI>2AHO3FC18l$NI>2A$KB>Ji$J$$!%J8Cf$N3FC18l$O!$<g$K<!$N#2E@$KhC$FI>2A$5lk!%

[*1] $?$H$($P!$%V?%$%H%k$K4^$^lk!W$d!V%U%)%s%H$,Bg$-$$!WJIG"$k!%

1.J8>OCf$GIQEY$N9b$$C181

2.B>$NJ8$K$O8=$1$J$$!$$"$kJ8FH<+$NC181

$^$:!$1 $NJ}K!$O:G$bC1=c$G$"$k$,M-8z$JC181$NI>2AJ}K!$G$"$k!%J8>OCf$G7+$jJV$7MQ$$$i1kC181$OJ8>O$N<gD%$H6/$/4Xoj$,$"kH9M$($i1k$?$a!$%-!<%o!<%ICj=PK!$H7F9-$/MQ$$$i1F$$$k!%D>@\C181$NIQEY$rMQ$$$F$O$$$J$$$,!$81WCE*O":?[Morris 91] $KBeI=$5$1$kh&$J!$B>$NJ8$HB?$/$N7kSIU-rb$DJ8$r=EMWH_$J$9=EMWJ8Cj=PK![55ED 97] $,$"$k!%J8$HJ8$O!$N<T$K=P8=$9$kF1$8C181b7$/$OF10135G0$rI=$9C181$N=P8=$KhC$F7k$SD1i1!$$3$NJ84V$N4XO"EY$K4p$E$$$FB?$/$NJ8$H4X$oj,$"$kJ8$r=EMWJ8$H7FA*sG$$$k!%7+$7!$0lDNJ8$,B?$/$NJ8$H6/$$4XO"EYrbD?aK$O!$I,A3E*$KB?$/$NJ8$K=P8=9kC181$r4^$^MPJi$:!$$dOjIQEY$N9b$$81$,=EMWJ8$K4^$^$1$k7k2L$HJjd9$$!%

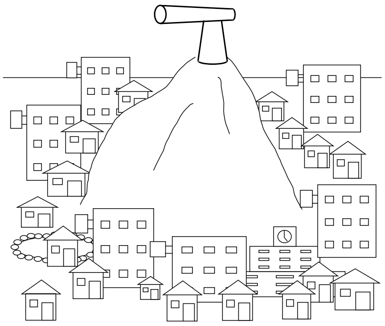
9bIQEY8l0J30$N=EMW8l$rHk$?$a$N<jK!$H7F!$TFIDF K![Salton 97] $,$"$k!%$3$1$O!$>pJs8!:w$K$*$$$F3FJ8=q$rFCD'IU$1$k%-!<%o!<%ICj=PK!$G$"$j!$B>$NJ8=q$K8=$1$J$$J8=q8GM-$NC181$r9b$/I>2A$9$k<jK!$G$"$k!%3NTFIDF K!$r=EMWJ8Cj=P$K1~MQ7?>l9g!$B>$NJ8KO8=1J$$C181$,9b$/I>2A$5$1!$MWLs$K$*$1$k>pJsNL$rA}d9HHbK!$<h$jB;MF$$$k=EMW81$NH/8+$KLrN)Fk3H$,$G$-$k!%7+$7!$>pJs8!:wK*1kJ8>O$HJ8=q=89g$N4X78$H=EMWJ8Cj=P$K$*$1$kJ8>O$HJ8HN4X78GO%P%i%s%9$,0[$J$j!$J8>OO=1[$ID9$/$J$$J8$,?tB?$/=8$^$C$F9=@.$5$1$F$$$k!%$=$N$?$a!$?tB?$/$NIQEY$NDc%-!<%o!<%I$,Cj=P$5$1$k7k2LHJ$j!$$3$N<jK!$@1r=EMWJ8Cj=PN?aNC181$NI>2ACM$H7FMQ$$$k3HOG$-$J$$!%

$=$3G3$N1 $H2 rAH_9go;$?C181$NI>2A$,K>$^1k!%K\9FK*$$$F$O!$3FC181$NIQEY$H3FJ8FbK$*$1$kC181$N6&5/IQEY$K4p$E$/>r7oIU3NN($H$rMQ$$$F!$9bIQEY81$HDcIQEY81rAH_9go;$?=EMWJ8Cj=P$rDs0F9k!%FC$K!$DcIQEY$N%-!<%o!<%I$H7F$O!$B>$NJ8$K8=1J$$$3HK2C$($F!$J8>O$N<gBjb7$/$OM?$($i1?4QE@Kb9gCW7FJ8>O$rFCD'IU$1$F$$$k%-!<%o!<%I$r<h$j=P$9!%

$=$N$[$+!$J8>OCf$K$*$1$kJ8$N0LCV>pJs[Brandow 95] $d@\B3;l$J$IFCD$j$NC181$r<j$,$+jH9k}K![G$98] JI$NJ8>O$NI=AXE*<j$,$+jr85K7$F=EMWJ8$rCj=P9k<jK!b"$k!%$3Nh$&$J<j$,$+jOBP>]H9$kJ8=q=89g$b7/$OI.<T$K0MB8$7$?FCDjNCN<1HJk?$a!$B>8@81XN1~MQ$d;~7ONs%G!<%?$+iN=EMW7ONs$NH/8+JIXN1~MQ$r;kLn$KF~$1!$8=CJ3,GOMQ$$$J$$!%7+$7!$>-MhE*K"kJ,Lnd%f!<%6$KFC2=$7$?%7%9%F%`$r:n@.$9$k>e$G!$$3$1$i$N<jK!$rM;9g$7$?%7%9%F%`9=C[$O$"$jF@kH9M$($F$$$k!%

0J2<$N**2.**$GDs0F9k%7%9%F%`$N35MW$H%"%k%4%j%:%`$N>\:Y$K$D$$$F=R$Y!$**3.**$GJ8>O$+$i=EMWJ8$rCj=P9k<B83$r9T$J$&!%**4.**$G<B837k2LKBP9$kI>2A$*hS9M;!$r9T$J$$!$**5.**$G7kO@$H:#8e$NE8K>KD$$$F=RYk!%

2. E8K>Bf%7%9%F%`



?^**1** E8K>Bf!J%7%9%F%`!K354Q

2!1 E8K>Bf%7%9%F%`$N35O@

??sCfKBg$-$J;3$,$"$kD.$rA[A|7FM_$7$$!%D.$NFCD'$rHi$($F@kEA9k$?$aKOG!2?JkJ}K!$,I,MW$@m&$+!%;30J30$ND.Cf$N01E@$+$iD.A4BN$rD/ah$&$H7F$b!$;k3&KO;3P+j,6/D4$5$1!$$=$10J30$K<~JU$N7zJ*$,$$$/D+8+$($k$@$1G"m&!%FC$K;3$N8~3&B&Js$F2?$,$"$k$+8!F$$bD+$J$$!%$=$3$G!$2f!9$N%7%9%F%`$O;3$KEP$k!%;3D:$K$"$kE8K>Bf$J$i$PD.A4BN$r8+EO$9$3$H$,2DG=$G$"$k!%D.A4BN$r8+EO$9Cf$G!$$3$ND.$rFCD'IU$1$k7`>1$dGnJ*4[!$8xl`$J$I!$;3$ND<$+iG$O5$$E$-$K$/$$>1=j$^$G$b!$$7C+jHB*$($k3H$,$G$-$kG"m&!%$^$?!$>o$KD.A4BN$NFCD'$,I,MWHO8BiJ$$!%;3$+$i8+$FFnE1$NJ}3Q$K8+$($kD.$NFCD'$,M_$7$$>l9gb"$k!%$3$1$O!$D.$rD/ak:]$N01$D$N4QE@$G$"$j!$$3$N>l9g$KE8K>Bf$OI,$:7b;3D:K"kI,MWO$J$$!%

K\%7%9%F%`$G$O01$D$NJ8>O$r!$C181$N=P8=IQEY$K$h$C$FI=$5$1$k;3$r4^$`D.$H8+$J$9!%IQEY$N9b$$C181Kh$k;3$,$"$j!$IQEY$NDc$$C181$OL12H$d3X9;!$IE1!$HJk!%J8>OrFI`:]KO!$7+$jJV$78=$1$kC181$OFI<T$N0u>]$K;D$jJ8>O$NCfNBg-$JFCD'$H7FB*$($i1k!%7+$7!$<B:]KO8+MnH5$1$d$9$$$1$1$I$bJ8>O$NFCD'IU1r7F$$$kIQEY$,Dc$$$1$1$I$b=EMW$JC181$,B8:_$9kNG"$k!%K\9F$G$O!$$=Nh$&$JJ8>O$NFCD'IU$1$r9T$JCF$$$kC181$rC5$7$FI>2A$9k3HKhC$F!$J8>O$+$i=EMWJ8$rCj=P$9$k!%

2!2 K\%7%9%F%`$N07$&J8>O

K\@aGO!$K\%7%9%F%`$,07$&J8>O$N@-<AKD$$$F@bL@9k!%F~NOHJ$kJ8>O$N@-<AKO!$%F%-%9%H$ND9$5!$%8%c%s%k!$J,Ln!$C101!?J#?t%F%-%9%HNJLJI,$"$k[1|B<99]!%%F%-%9%H$ND9$5KD$$$F$O!$#1J8$d#2J8$JIN6KC<$KC;$$>l9g$r=|$$$FFCKLdo$J$$!%IQEYJI$NE}7W>pJs$rMQ$$$k>l9g!$Cj=P$9$k%-!<%o!<%I$dJ8$N@:EY$rF@k?aK!$$"$kDxEY$ND9$5$rJ8>O$K5a$akN$,DL>o$G$"$k$,!$K\%7%9%F%`$NA@$$$H7F!$C1814V$N4XO"$K4p$E$$$FC;$$

J8>O$+$i$b@53N$K=EMW$JC18l$dJ8$rCj=P$9k3HrL\;X7F$$$k!%

$^$?J8>O$N%8%c%s%k$dJ,Ln$K4X$7Fb!$%8%c%s%k$dJ,Ln$Kl~$8$?CN<1$d!$0UL#=hM}$r9TJo$J$$?aKFC$K;XDj$O$J$$[*2]!%3l$O!$@hKb=RY?B>8@8l$d;~7ONs%G!<%?$X$N1~MQ$r2DG=H9$kE@$G!$=EMW$+DI,MWJA0Ds>r7oG"$k!%

:G8e$K!$07$&%F%-%9%H$OC10l$N%F%-%9%H$H9k!%7+$7J8>OA4BN$+iN=EMWJ8$NCj=P$r9M$($k:]KO!$K\%7%9%F%`$O8=:_!$J8$N=P8==g=x$K4X$9$k>pJs$rMQ$$$J$$?$a$K!$M?$($i$l$?A4$F$N%F%-%9%H$rJB$Y$F$G$-$k#1$D$N%F%-%9%H$KBP$7$F!$K\%7%9%F%`$,MQ$$$ilk2DG=@-O"$k!%

2!3 %-!<%o!<%I$H=EMWJ8$NDj5A

J8>O$N%-!<%o!<%I$H0l8}$K$$$CFb!$$=$N2L$?9Y$-Lr3d$Kl~8F%-!<%o!<%I$b6hJL$5lkY-G"$k!%K\8&5f$K$*$1$k%-!<%o!<%I$O!$<~JU!$Cf?4!FCD'N;0<oN`G"$j!$$=l>lNLr3d$r0J2<$Nh&KDja$k!%

1. <~JU%-!<%o!<%I
   J8>ONCfG4pACE*$J35G0$rI=$9C18l
2. Cf?4%-!<%o!<%I
   J8>O$NCf?4E*<gBj$rI=$9C18l
3. FCD'%-!<%o!<%I
   J8>O$N<gBj$HN_L)@\$K4XokC18l

$^$?!$K\8&5f$K$*$$$FO3li$N%-!<%o!<%I$rF1;~$K4^$`J8$r=EMWJ8$H7FCj=P9k!%J8>O$N=EMWJ8$H7F9M$($ilkNO!$

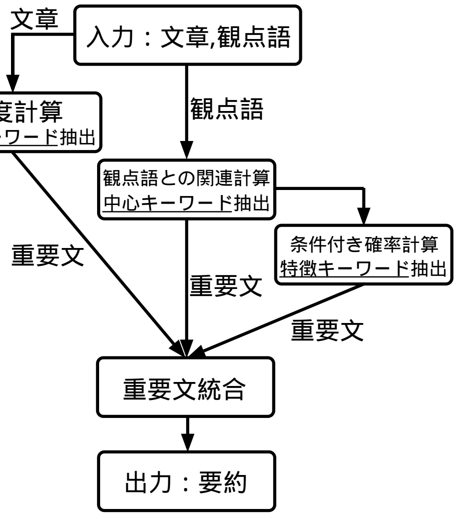
1. J8>O$N<gBj$rM}2r9k>e$G=EMW$JJ8
2. J8>O$N9=@.!J*8l!K$rM}2r9k>e$G=EMW$JJ8

$N#2$DG"k,!$K\8&5f$GO3$NA0<T$rA@C?%7%9%F%`HJCF$$$k!%=>Mh$N=EMWJ8Cj=P$K$*$$$FO3$N#2$D$,6hJL$5lF$$$J$$?aK!$J8>O$NCf$GI.<T$,=RY?$$=EMW$JItJ,$K2C$($F!OCNE83+rCNk$?$a$N=EMW$JItJ,Hr$^$HaF=PNO$7!$$=$N7k2L$H7F1$H2$NICAD$+$:$NMWLs$,@8@.5l$F$$$k!%6qBNNc$r>e$2kH!$J8>O$NKAF,J8OOCN>l$d>r7o$N@_Dj$r9T$J$&$?aK=EMW$JJ8$HJk$,!$OC$NCf?4$HJk<gD%E@O^$@@h$NJ8>OK"k?aK!$J8>O$N<gBj$+$i8+$?=EMWJ8$HOJjK$/$$!%

$^$?!$=EMWJ8Cj=P%7%9%F%`$rI>2A$9$k$?$a$K!$?M4V$K=EMWJ8$rA*$s$G$b$i$&>l9g$K$*$$$F$b!$Ho83<T$,>e5-1$H2$N$I$A$i$K=E$-$r$*$/$+$OITL@$G$"$k$?$a!$1B&$N=EMWJ8$r<h$j=P$9?M4V$H!$24s$j$N=EMWJ8$r<h$j=P$9%7%9%F%`$H$N4V$G%.%c%C%W$,@8$8!$@5$7$$I>2A$r9T$J$&$3Hb3poJ$/$J$k!%$=N?$a!$=EMWJ8b=$N0UL#$Kl~8F6hJL7F07olk3H,4NMWHJ$k!%

2!4 4QE@$K4p$E$/MWLs@8@.%"%k%4%j%:%`

K\@aGO!$F~NO$HJkJ8>O$*$h$S%f!<%6FH<+$N4QE@$rI=$94QE@8l$+$i=EMWJ8$rCj=P$7$FMWLs$r@8@.9k%"%k%4%j%:%`KD$$$F@bL@9k!%3F%9%F%C%W$N3g8LFb$K2!1k$K4p$E$/J*M}E*0UL#$r<($9!%



?^2 MWLs@8@.%"%k%4%j%:%`

%9%F%C%W#0!'%-!<%o!<%I8uJd$N=`Hw
!J.:njN$?$a$N@0CO!K

J8>O$N%-!<%o!<%I$N8uJdH7$F!$M=$a7ABVAG2r@O [Chasen] KhCF!$L>;l!$F0;l!$7AMF;l[*3]$r<h$j=P$7F*$/!%

%9%F%C%W#1!'<~JU%-!<%o!<%I$NCj=P
!JIQEYKh$kC18l$N;3$HD.$r@8@.!K

$^$:!$C1=c$KC18l w $N=P8=IQEY $frequency(w)$ KhCF!$%-!<%o!<%I$rCj=P9k!%3N%-!<%o!<%I$r<~JU%-!<%o!<%I$H8F$V!%$3$NIQEY$KhkC18l$NI>2ACM$r<!<0$N $key1$ H9$k!%

$$key1(w) = frequency(w) \tag{1}$$

<~JU%-!<%o!<%I$N?t$O!$J8>O$K4^$^$l$kL>;l$N<oN`?t$N20!s$rL\0BH7$F!$:GBg$G20 8D$r<h$k[*4]!%9bIQEY$KhC$FC18l$K9bI>2A$rM?$($kB?$/$N<jK!$,$"$kh&$K!$J#?t2sMQ$$$ilkC18l$N=EMW@-$O:F$S8@$&$^$GbJ$$ [Luhn 58]!%7+$7!$IQEYN_GO3FC18l$,J8>O$NCfGINh$&$K8=$l!$$INh$&$JLr3d$r2L$?7F$$$k$+$rCNk3H,G-$J$$$N$G!$C18l4V$N4XO"$rbH$K=EMW$J%-!<%o!<%I$rC5$9A`:n$,I,MW$HJk!%

%9%F%C%W#2!'4QE@8l$NF~NO(E8K>Bf$N7zC[)

%f!<%6$+$iM?$($ilkF~NOH7$F!$J8>OrINh$&$J4QE@$+$iMWLs7?$$$+$rI=$7$?4QE@8l$r<u1H$k!%$3$N

[*2] 7ABVAG2r@O$rMQ$$$F$$$k$?$a!$F|K\8l$G<-=q$K4^$^lF$$$kC18l$,;H$olF$"$k3H$H!$J8$N@Z$lL\$G$"$kFIE@$,J8>O$K4^$^$l$F$$$k3H$,K>$^$7$$!%

[*3] 7A<0;lG"$k!V9$k!$$J$k!$$"$k!$$h$k!$$$$&!$$J$$!W$r=|$/!%

[*4] 20!s$H$$$&CM$O!$M=Hw<B83$+$iF@il$?J8>OCf$GJ#?t2s=P8=9kC18l$N3d9g$NJ?6QCMG"$k!%F1IQEY$NC18lO9YFA*Br9k$H$$$&>r7o$N2<$G20!s$K:G$b6a$/$Jk7$-$$CM$r@_Dj$7$?>l9g!$A4FN<~JU%-!<%o!<%I$,J#?t2s=P8=$9$kC18l$HJC$?!%

4QE@8l$rJ8>O$NCf?4$rI=$94QE@8l$N=i4 |=89g$H9k!%f!< %6FH<+$N4QE@$rI=$94QE@8l$N?t$OC18l<dN'?t$N4 !s$G:G Bg5 8D$H9k!%

%9%F%C%W#3 !'4QE@8l$NJd40(E8K>Bf$NJd6/)

A0%9%F%C%W$GM?$(il$?4QE@8l$N=89grbHK!$J8>O Cf$G4QE@8l$H6/$/4XO"9kC18l$r!$4QE@8l$K2C$(!$<h$j B;MF$$$kJ8>O$N3K$HJkC18lrJd&!%$=$3$G!$4QE@8l =89g$S$$,8=l?H-$K!$F1;~$K8=$ld9$$C18l$r5a$a$k!% 9JoA!$A4FNC18l$K<!$N<0$KhkI>2ACM$key2$ $rM? $(!$$=$NI>2ACM$Khk>e0L !JC18l<dN'?t$N4 !s$G:GBg5 $D!K$K4^$^$l$+$D!$$^$@$S$$KB0$5$J$$C18l$r?7$?$J4QE@ 8l$H7F$S$$K2C$($k!%3NI>2ACM>e0L$N4QE@8l$rU/$' %-!<%o!<%I$rCf?4%-!<%o!<%I$H8F$V!%

$$key2(w) = \prod_{s \subset S} \frac{n(w \cap s)^2}{n(w)n(s)} \tag{2}$$

3N<0$OC18l$s$ $,8=$l$?;~$KC18l$w$$,8=lk>r7oIU3N N($H!$C18l$w$$,8=l?;~$KC18l$s$ $,8=$l$k3NN($H$N@Q$r I=7F$*$j!FsD$NC18l$N6&5/IQEYr=$N=P8=2s?t$G@5 5,2=7?CM$KAjEv$7$F$$$k!%3N%9%F%C%W#3$r?7$?$J4Q E@8l$,DI2C5lJ/Jk$^$G7+jJV9!%

%9%F%C%W#4 !'FCD'%-!<%o!<%I$NH/8+ !JE8K>Bf$+iND/aKhkH/8+!K

:G8e$KJ8>O$N4QE@HJCF$$$kCf?4%-!<%o!<%I$NN.$l $K1h$$!$$+$DJ8>O$rFCD'IU1F$$$k%-!<%o!<%I$rCj=P$9 $k!%$=N?aNC18l$NI>2ACM$key3$ $r<!<0$GM?$($k!%

$$key3(w) = \prod_{s \subset S} \frac{n(w \cap s)}{n(w)} \tag{3}$$

9JoA!$4QE@8l$,=P8=9k;~KN$_=P8=$9$kC18l$r C5$9L\E*$G!$$$Il@$1B?$/$N4QE@8l$HL)@\$K4X78$7$F$$ k+$rI=$9I>2ACM$r3FC18l$w$$KM?$($k!%J8>ONCfG=EMW $JLr3d$r2L$?$9%-!<%o!<%I$O!$9bIQEY$N%-!<%o!<%I$@$1 GO$J$$!%J8Cf$K?t>/$J$/8=$l$k%-!<%o!<%I$NFbKb!$ J80U$rI=$9>e$G=EMW$J%-!<%o!<%I$,B8:_$7$F$$$k!%3N h&$JFCD'%-!<%o!<%I$OFC$KIQEY$,Dc$/$J$k798~$K$"$j!$ Cf?4%-!<%o!<%I$,B?$/8=lkJ8G7$+;H$olF$$$J$$C1 8l$,FCD'%-!<%o!<%I$HJk!%9JoA!$J8>O$N4QE@HJ $kCf?4%-!<%o!<%I$+$i0o$l$J$$$HO0O$G!$B>$NJ8$K$O8=$l $F$$$J$$C18l$r9b$/I>2A9k3H$KAjEv$7!$C1=c$KJ8C1 0L$GTFIDF $r9T$JC?;~KHfY$F!$J8>O$N<gBj$K4X$7 $F0l4S@-$N$"$kJ8$+$i$N%-!<%o!<%I$,F@il$k!%

%9%F%C%W#5 !'J8>OCf$N3FJ8$rI>2A !JO0h$NI>2A!K

J8>OCf$N3FJ8$KJ8Cf$K4^$^lkC18l$NI>2ACM$NAmOB$r 3FJ8$N=EMWEYH7$FM?$($k[Zechner 96]!%3FJ8$T$$K$O<0 (4)$+$i<0 (6)$N#3DNI>2ACM$rM?$($k!%$?$@$7C18l w $NI>2ACM$key1(w)$ $,!$A4C18l$N<0 (1)$KhkI>2ACMJ?6Q $N1.5 G\$r2<2s$k>l9g$K$O!$$key1(w) = 0$ H9$k!%$^$?!$ $key2(w), key3(w)$ KD$$$F$bF1MM$NA`:n$r9T$J$&[*5]!%

I=**1** <~JU%-!<%o!<%I !J>e0L!K

Word	Frequency
J8	94
J8>O	64
=EMW	60
%-!<%o!<%I	57
C18l	55
%7%9%F%`	25
Cj=P	24
4QE@	22
I>2A	21
M?$($k	20
8l	20

$$sentence1(T) = \sum_{w \subset T} key1(w) \tag{4}$$

$$sentence2(T) = \sum_{w \subset T} key2(w) \tag{5}$$

$$sentence3(T) = \sum_{w \subset T} key3(w) \tag{6}$$

%9%F%C%W#6 !'=EMWJ8$N7hDj !J@kEACO0h$NFCDj!K

<0 (1)$+$i<0 (3)Kh$k3FJ8$NI>2ACM$r85$K!$=EMWJ8$r Am9gE*$K7hDj$9$k!%$=lK$O!$$^$:3FJ8$K<0 (4)$+$i<0 (6) N=l>lNCM$K4p$E$$$F!$I>2ACM$N9b$$$=g$K=g0L$r$D$1 $k!%$9Jo$A!$3FJ8$T$$O<0 (4)Kh$k=g0L$rank1(T)$!$<0 (5)Kh$k=g0L$rank2(T)$ $H<0 (6)$Khk=g0L$\mathrm{rank}3(\mathrm{T})$ $N#3<oN`$N=g0Lrb$D[*6]!%$=$N=g0LIU$1$N8e$K!$<0 (7)$N 3FJ8$N=g0L$N9g7Wr=$NJ8$NI>2ACMH7$FM?$($k!%

$$value(T) = rank1(T) + rank2(T) + rank3(T) \tag{7}$$

3N<0 (7)NCMK4p$E$$$F!$MQES$K1~8FI,MW$J?t[*7]$N=EMWJ8$r=PNO$H9k!%

3. =EMWJ8Cj=P<B83!'7k2L$H2r<a

3!%1 =EMWJ8Cj=P<B83

K\<jK!$K4p$E$$$F!$J8>O$K4^$^$l$k3FC18l !JL>;l!K$K I>2ACM$rM?$($F!$=EMWJ8$rCj=P$9$k<B83$r9TJC$?!%<B 834D6-$O!$Pentium II 350MHz (256MB) OS-Linux $G $"$j!$%W%m%0%i%`$OC 8@8l$G=q$+lF$$$k!%<B83$KMQ$$ $?%F%-%9%H$O!$K\9F !JK\>O$r=|$/132 J8452 <o1786 8D $NC18l!K$G$"$k[*8]!%

$^$:!$%7%9%F%`$OI=1$NIQEY$K4p$E$$$F>e0L20 8D$NC1 8l$r<~JU%-!<%o!<%IH7$F<h$j=P$9 !2J!4&$N%9%F%C%W#1!K!%

<!$K!$%f!<%6$,4QE@8l$rF~NO9k !J%9%F%C%W#2!K!%K\

[*5] 3NA`:n$O!$D9$$J8$[$I<+A3$KI>2ACM$,9b$/$Jk3HrM^$(kH6&$K!$M-8z$JC18lH=$&GJ$$C18lHrL@3N$K6hJL$9k? aK9TJC$F$$$k!%$^$?!$M-8z$JC18l$rF($5$J$$$G=J,$K4^$' h&$K!$3FI>2A4X?tKh$kI>2ACMJ?6Q$N1.5 G\$r7-$$CM$H$7 $F@_Dj$7$?!%

[*6] F1$8I>2ACM$rbD>l9g$OF1=g0L$HJk!%

[*7] :G=EMWJ8$,I,MW$J>l9g$O#1$D!$10 !s$NMWLs$KMQ$$$k>l9g$K $OA4J8?t$N10 !sKEv?$k?t$NJ8$r<h$j=P$9!%

[*8] $?$@$7!$2<=q$-$NAp9F$rMQ$$$?$?$a8 7L)KOK\J8$H0lCW$7$J $$

I=**2** Cf?4%-!<%o!<%I !:Je0L!KV1

Word	Value	Freq.
!vJ8	5.94	94
!vJ8>O	4.42	64
!v=EMW	4.41	60
!vC18l	2.90	55
!v%-!<%o!<%I	2.32	57
Cj=P	1.44	24
IQEY	0.94	19
MQ$$$k	0.83	17
4QE@	0.83	22
%7%9%F%`	0.80	25

I=**3** Cf?4%-!<%o!<%I !:Je0L!KV2

Word	Value	Freq.
!vJ8	5.87	94
!v=EMW	4.82	60
!vJ8>O	4.59	64
!vMWLs	1.66	15
Cj=P	1.58	24
C18l	1.20	55
%-!<%o!<%I	1.11	57
4QE@	1.06	22
4pE/	1.02	14
@8@.	1.01	12

I=**4** Cf?4%-!<%o!<%I !:Je0L!KV3

Word	Value	Freq.
!v;3	2.73	10
!vD.	2.44	7
IQEY	1.23	19
C18l	1.23	55
%7%9%F%`	1.23	25
M_$7$$	1.11	2
=P8=	1.11	11
FCD'	0.99	10
E8K>Bf	0.99	10
0l$D	0.99	8

I=**5** FCD'%-!<%o!<%I !:Je0L!KV1

Word	Value	Freq.
L\;X$9	18.90	1
E}7W	18.90	1
DxEY	18.90	1
@:EY	18.90	1
4pAC	18.90	1
C18l4V	9.86	2
A@$&	9.86	2
35G0	9.86	2
0olk	8.40	1
0l4S@-	8.40	1

I=**6** FCD'%-!<%o!<%I !:Je0L!KV2

Word	Value	Freq.
J,1k	10.50	1
E,@Z	10.50	1
Ds<(	10.50	1
;vB-jk	10.50	1
7A	10.50	1
0lJ8	10.50	1
%"%k%4%j%:%`	5.68	4
CN$k	5.48	2
MWLs	5.09	15
M}2r	4.67	1

I=**7** FCD'%-!<%o!<%I !:Je0L!KV3

Word	Value	Freq.
O<	3.24	1
M_$7$$	3.24	2
J}3Q	3.24	1
GnJ*4[	3.24	1
FnEl	3.24	1
A[A|	3.24	1
??$sCf	3.24	1
>l=j	3.24	1
8xl`	3.24	1
8+$J$9	3.24	1

<B83GO<!$N#3<dN`$rMQ0U7?!3Jg8lFb$OC18l$NIQEY!K%

- <B83V1 !!JV8(94)!W!JV8>O(64)!W!V=EMW(60)!W!V%-!<%o!<%I(57)!W!VC18l(55)!W
- <B83V2 !!JV8>O(64)!W!MWLs(15)!W
- <B83V3 !!D.(7)!W!;V3(10)!W

$^$?!$M?$(il$?Cf?4%-!<%o!<%I$r85$K!$:F5"E*$KCf?4%-!<%o!<%I$r=8akA`:n$r9T$J$$!%J9%F%C%W#3!KCf?4%-!<%o!<%I=89g!J=2$+$iI=4$N!v0u$NC18l!K$,@8@.$5l?!%

F@il$?Cf?4%-!<%o!<%I=89g$r85$K!$Cf?4%-!<%o!<%I$,=P8=$9$k;~$KN_MQ$$$ild$9$$%-!<%o!<%I$rFCD'%-!<%o!<%I!J=5$+$iI=7!K$H7F$=$NI>2ACM$rF@$k!%J9%F%C%W#4!K!%

<!$K!$3FC18l$NI>2ACM$K4p$E$$$F3FJ8$KI>2ACM$rM?$($k!%J9%F%C%W#5!K*9!%:G8e$K!$3F%-!<%o!<%IC$j=PK!$KhkJ8$NI>2ACM$Khk=g0L$r85$K=EMWJ8$r=PNO$9$k!%J9%F%C%W#6!K!%K\9F$N>e0L#5J8Kh$kMWLs$O0J2<Nh$&$KJC$?!J8>OFb$G$N=P8==g$KI=<(!K!%3g8lFb$K<0(7)$NCM(9g7W!a<~JU!\Cf?4!\FCD')$,$"$k!%

[<B83 **V1** MWLs]

1. (14=12+1+1) !VQEYJI$NE}7W>pJs$rMQ$$$k>l9g!$Cj=P$9$k%-!<%o!<%I$dJ8$N@:EY$rF@k?aK!$$"$kDxEY$ND9$5$rJ8>O$K5a$akN$,DL>o$G$"$k$,!$K\%7%9%F%`$NA@$$$H7F!$C18l4V$N4XO"$K4p$E$$$FC;$$J8>O$+$i$b@53N$K=EMW$JC18l$dJ8$rCj=P$9k3HrL\;X7F$$$k!%W
2. (15=10+2+3) !V.<~JU%-!<%o!<%IJ8>ONCfG4pAC E*$J35G0$rI=$9C18l!$2.Cf?4%-!<%o!<%IJ8>O$NCf?4E*<gBj$rI=$9C18l!$3.FCD'%-!<%o!<%IJ8>O$N<gBj$HN_L)@\$K4XokC18l!$$^$?!$K\8&5fK*$$$FO3li$N%-!<%o!<%I$rF1;~$K4^$`J8$r=EMWJ8$H7FCj=P9k!%W
3. (16=6+8+2) !V9Jo$A!$J8>O$N4QE@$HJkCf?4%-!<%o!<%I$+$i0olJ$$HO0O$G!$B>$NJ8$K$O8=$l$F$$$J$$C18l$r9b$/I>2A9k3H$KAjEv$7!$C1=c$KJ8C10L$GTFIDF$r9TJC$?;~$KHfYF!$J8>O$N<gBj$K4X$7$F0l4S@-$N$"$kJ8$+$i$N%-!<%o!<%I$,F@il$k!%W

[*9] I>2ACMN7$-$$CM$O<~JU!$Cf?4!$FCD'%-!<%o!<%I$N=g$K!$<B83 V1 $G (2.7,0.64,2.25)!$V2 $G (2.7,0.75,1.75)!$V3 $G (2.7,1.01,0.77) HJC?!%3N7-$$CMKhCFI>2ACM$,M?$(il$kC18l?t$O!$A4452<dN`$KBP7F<~JU!$Cf?4!$FCD'%-!<%o!<%I$N=g$K!$<B83V1 $G(124,18,156)!$V2 $G(126,12,192)!$V3 $G(127,7,52) C18l$G$"$k!%

4.(24=1+6+17) !V7%9%F%`I>2A!$>pJs8!:w$H$N%"%J%m%8!<!$K\%7%9%F%`Nh$&$K?M4V$,C181$r4QE@H7$FM?$(!$$=$N4QE@$K4p$E$$$?=EMWJ8Cj=P$r9T$J$&$3HO!$J8>OCf$N3FJ8$r01$D$NJ8=q!$?M$,M?$($kC181$r8!:w81H7$?>pJs8!:w$HN`;w9k!%W

5.(30=7+3+20) !VkO@!$K\9F$G$O!$%f!<%6$,M?$($k4QE@$rI=$9C181$K4p$E$$$F!$J8>O$+$i=EMWJ8$rCj=P9kE8K>Bf%7%9%F%`KD$$$F=RY?!%W

[<B83**V2** MWLs]

1.(17=1+5+11) !VG$bBeI=E*$J>pJs8!:w$N<jCJ$H7F$O%5!<%A%(%s%8%s$,5s2i$1!$%f!<%6$,F~NO$7$?8!:w81$r4^$`%Z!<%8$r=PNO9k:]$K!$3F8!:w81$N3FWeb%Z!<%8Cf$G$N=EMWEY$rFH<+$K7h$a$F=g0LIU$1$N8e$K=PNO$5$1$k!$J?H($P!$V?%$%H%k$K4^$^$1$k!W$d!VU%)%s%H$,Bg$-$$!WJIG"$k!K!%W

2.(20=8+5+7) !V3Nh$&$J<j$,$+jOBP>]H9$kJ8=q=89g$b7/$OI.<T$K0MB8$7$?FCD'j$NCN<1$HJk$?$a!$B>8@81$X$N1~MQ$d;~7ON%s$G!<%?$+iN=EMW7ON%s$NH/8+$JIX$N1~MQ$r;kLn$KF~$1!$8=CJ3,$G$OMQ$$$J$$!%W

3.(5=2+1+2) !VQEYJI$NE}7W>pJs$rMQ$$$k>19g!$Cj=P$9$k%-!<%o!<%I$dJ8$N@:EY$rF@k?aK!$$"$kDxEY$ND9$5$rJ8>O$K5a$akN$,DL>o$G$"$k$,!$K\%7%9%F%`$NA@$$$H7F!$C181$4V$N4XO"$K4p$E$$$FC;$$J8>O$+$i$b@53N$K=EMW$JC181$dJ8$rCj=P$9k3HrL\;X7F$$$k!%W

4.(10=3+2+5) !V^$?J8>O$N%8%c%s%kdJ,LnK4X7F$b!$%8%c%s%kdJ,LnK1~8?CN<1$d!$0UL#=hM}$r9T$JoJ$$$?aKFC$K;XDj$O$J$$!J7ABVAG2r@O$rMQ$$$F$$$k$?$a!$F|K\81$G<-=q$K4^$^1F$$$kC181$,;H$o1F$"$k3H$H!$J8$N@Z$1L\$G$"$kF IE@$,J8>O$K4^$^$1$F$$$k3H$,K>$^$7$$!K!%W

5.(15=9+3+3) !V^$?!$=EMWJ8Cj=P%7%9%F%`$rI>2A$9$k$?$a$K!$?M4V$K=EMWJ8$rA*$s$G$b$i$&>19g$K$*$$$F$b!$Ho83<T$,>e5-1$H2$N$I$A$i$K=E$-$r$*$/$+$OI1L@$G$"$k$?$a!$1B&$N=EMWJ8$r<h$j=P$9?M4V$H!$2 4s$j$N=EMWJ8$r<h$j=P$9%7%9%F%`HN4V$G%.%c%C%W$,@8$8!$@5$7$$I>2A$r9T$J$&$3Hb3poJ$/$J$k!%W

[<B83**V3** MWLs-**1**]

1.(52=20+14+18) !V. J8>OCf$GIQEY$N9b$$C181!$2. B>$NJ8KO8=1J$$!$$"$kJ8FH<+$NC181!$$^$:!$1$NJ}K!$O:G$bC1=c$G$"$k$,M-8z$JC181$NI>2AJ}K!$G$"$k!%W

2.(39=10+9+20) !V7$+$7!01D$NJ8$,B?$/$NJ8$H6/$$4XO"EYrbD?aK$O!$I,A3E*$KB?$/$NJ8$K=P8=9kC181$r4^$^MPJi$:!$$dOjIQEY$N9b$$81$,=EMWJ8$K4^$^$1$k7k2L$HJjd9$$!%W

3.(47=3+8+36) !VQEYJI$NE}7W>pJs$rMQ$$$k>19g!$Cj=P$9$k%-!<%o!<%I$dJ8$N@:EY$rF@k?aK!$$"$kDxEY$ND9$5$rJ8>O$K5a$akN$,DL>o$G$"$k$,!$K\%7%9%F%`$NA@$$$H7F!$C181$4V$N4XO"$K4p$E$$$FC;$$J8>O$+$i$b@53N$K=EMW$JC181$dJ8$rCj=P$9k3HrL\;X7F$$$k!%W

4.(45=1+14+30) !V7%9%F%`I>2A!$>pJs8!:w$H$N%"%J%m%8!<!$K\%7%9%F%`Nh$&$K?M4V$,C181$r4QE@H7$FM?$(!$$=$N4QE@$K4p$E$$$?=EMWJ8Cj=P$r9T$J$&$3HO!$J8>OCf$N3FJ8$r01$D$NJ8=q!$?M$,M?$($kC181$r8!:w81H7$?>pJs8!:w$HN`;w9k!%W

5.(49=5+14+30) !VkO@!$K\9F$G$O!$%f!<%6$,M?$($k4QE@$rI=$9C181$K4p$E$$$F!$J8>O$+$i=EMWJ8$rCj=P9kE8K>Bf%7%9%F%`KD$$$F=RY?!%W

3!2 <B837k2L$N2r<a

$^$:!$<B83V1$NMWLs$OJ8>O$NIQEY$N>e0L#5$D$NC181$r4QE@H7$F%7%9%F%`$KM?$($F$$$k!%7$+$7!$M?$(i1$?#5$D$NC181$OF1Ey$K07$o1k3HOJ$/!$I=2Nh$&$JI>2ACM$,3FC181$KM?$($i1k!%$^$?!$C181$4V$N4XO"$K4p$E$$$F!$Cf?4%-!<%o!<%I$H7F4QE@810J3OKbCM$,M?$(i1$F$$$k!%3$N7k2IF@$i1?MWLs!J<B83V1MWLs!KGO$J8>OA4BN$N<gD%HJ$k=EMWJ8$,Cj=P$5$1$F$$$k!%

<!$K!$<B83V2H7$F!J8>O$NMWLs!W$H$$&4QE@$K4p$E$$$FK\9F$+$i$N=EMWJ8Cj=P$r;n$_$?!%$=$N7k2L!$Cf?4%-!<%o!<%I$N<}B+$N%9%F%C%W$K$*$$$F!$?7$?$J4QE@81$H7F!J8!W$H!VEMW!W$,2C$($i1F$$$k!J=3!K%$=$N7k2IF@i1$?MWLs!J<B83V1MWLs!K$G$O!$<B83V1$N7k2L$H$O[$J$j!$J8>O$NMWLs@8@.$K4XO"9k=EMWJ8$,A*$P1F$$$k!%Cf?4%-!<%o!<%I$N>e0L!J=2$HI=3!K$K6&DL$NC181$,B?$/=P8=7F$$$kKb$+$+oi$:!$=PNO5$1$?MWLsO[Hs$II0[$JCF$$$kNO!$4QE@$K4p$E/FCD'%-!<%o!<%I!J=5$HI=6!K$N0[$JjKhkbNG"$j!$C1=c$JC181$NIQEY$@$1GOJ/C181$4V$N4XO"$r9MN8$7$?7k2L$G$"$k!%

:G8e$K<B83V3$G$"$k$,!$<g$K**2.**>O$NKAF,$G=R$YF"$kFbMF$N81$rMQ$$$F!$D.!W$H!V3!W$r4QE@81$H7FM?$($?!%$=$N7k2L!$Cf?4%-!<%o!<%I$N>e0LKO!V8K>Bf!W$H$$&C181$,4^$^1F$$$k$,!$FCD'%-!<%o!<%INCfK$b**2.**>O$GMQ$$$i1?FCD'E*$JC181$,B?$/=8$1$F$$$k!%7$+$7!$7k2IF@$i1?MWLs!J<B83V3MWLs!KK*$$$F$O!$D.!W$d!V3!W$H$$&M?$($?4QE@81$rA4$/4^sG$*$i$:!$Beoj$KJ8>OA4BN$NMWLs$K6a$$$bN,F@i1$F$$$k!%3$N:GBg$NM}M3$O!$4QE@81$H4X78$J$/%-!<%o!<%I$KhkI>2A$,2C$(i1$F$$$k$+$iG"$j!$%f!<%6$,M?$($?4QE@81$HJ8>O$NFbMF$H$rAm9g$7$F=EMWJ8$rHk>19gKOM-8z$KF/$$/$H9M$(i1!$<B:]I=4$K8=1k!V181!W$d!VQEY!W$H$$&C181$,M%@h$5$1$F=EMWJ8$,=PNO5$1$F$$$k!%

7+$7!$;~KOK\J8$NFbMF$hjb$`$7$m!D.!W$d!V3!W$r=E;k$7$?$>19g$b9M$(i1$k!%$=$N>19g$K$O!$<~JU%-!<%o!<%IKhkCMr3O$9$3HKhC$F!$Cf?4%-!<%o!<%I$HFCD'%-!<%o!<%I$N$_$Khk=EMWJ8Cj=P$r9T$J$($PNI$$!%<B:]$K<~JU%-!<%o!<%I$r3O7?=EMWJ8Cj=P$N7k2L$r0J2<$K<($9!%3g8IFb$K<0(7)$NCM(9g7W!aCf?4!\FCD'!$<~JU)$,

$"$k!%

[<B83**V3**MWLs-**2**]

1. (5=3+2,118) !V8K>Bf%7%9%F%`$N350@!$??sCfKBg$-$J;3$,$"$kD.$rA[A|7FM_$7$$!W
2. (7=6+1,117) !D.A4BN$r8+EO$9Cf$G!$$3$ND.$rFCD'IU1k7`>l$dGnJ*4[!$8x1`JI!$;3$NO<$+$iGO5$$E$-$K$/$$>l=j$^$G$b!$$7C+jHB*$($k3H$,$G$-$kG"m&!W
3. (7=4+3,125) !V3$+$i8+$FFnEl$NJ}3Q$K8+$($kD.$NFCD'$,M_$7$$>l9gb"$k!W
4. (6=1+5,56) !K\%7%9%F%`$G$O0l$D$NJ8>O$r!$C18l$N=P8=IQEY$K$h$C$FI=$5$l$k;3$r4^$`D.$H8+$J$9!W
5. (9=2+7,48) !V9%F%C%W#1!<~JU%-!<%o!<%I$NCj=P!JIQEY$KhkC18l$N;3$HD.$r@8@.!K$^$:!$C1=c$KC18lw$N=P8=IQEYfrequency(w)KhCF!$%-!<%o!<%I$rCj=P9k!W

3Nh&$K!$J8$,C;$/Fb!D.!W$d!V3!W$r4^$_$+$D!$FCD'8l$r4^$`=EMWJ8$rCj=P$9k3Hb2DG=G"$k!%$3li$N=EMWJ8$K$*$$$F$O!$<~JU%-!<%o!<%IKh$k=g0L$,Hs>oKBg-$/$JCF$$$?3H$,$o$+$k!%7?$,$C$F!$=EMWJ8Cj=P$NAH9g$;$b;~$H>l9g$K1~$8$F;H$$$o1k3H$,I,MW$@$H9M$(il$k!%

4. :#8e$N2]Bj$HE83+

8=:_NH3m!$K\%7%9%F%`$ND jNIE*$JI>2A$O:#8e$N2]Bj$G$"$k!%$^$?!$MWLs$N<+F0@8@.$K4X$9$k8&5f$,@9$s$K9T$J$o$l$kCf$G!$%f!<%6$K$h$kF~NO$rMW5a$7$F$$$k$?$a$K!$K\%7%9%F%`$NE,MQHO0OKD$$$F$b?<$/8!F$$9$kM>CO$,$"$k!%7+$7!$%f!<%6HN%$%s%?%i%/%7%g%s$,ITMW$+$H$$$&E@$K4X$7$F$$($P!$I.<TiOI,MWG"kH9M$($k!%>pJs8!:wK*$$$F$b!$%f!<%6$,8!:w8l$r=iaKM?$($kI,MW$,$"$j!$$^$?8!:w>r7o$N99?7r9$k:]$K8!:w8l$rDs6!$9$k%7%9%F%`$bA}$($D$D$"$k!%$3$N$h$&$K!$%f!<%6$N>\:Y$J4uK>$d6=L#$O%f!<%6$K$7$+$o$+$i$J$$$H$$$&N)>l$r<h$k$[$&$,!$A4<+F0$N%7%9%F%`$KHfYF%f!<%6$NO+NO$HK~B-$N$$$/7k2L$,F@$ilk$^$G$N;~4V$N%H!<%?%kK*$$$FM-8z$J%7%9%F%`$,=PMh>e$,$k$H9M$($F$$$k!%:#8e$N1~MQ$NO0lDH7F$O!$>pJs8!:wK*1k7k2LI=<($N%"%V%9%H%i%/%H$K$*$$$F!$%f!<%6$,M?$($?8!:w8l$r4QE@8l$H7?MWLs@8@.$r9T$J$&$3HG!$%f!<%6$,8!:w7k2L$rH=CG$9$k;~4V$rC;=L9k3H$,$G$-$k$H9M$($F$$$k!%

4!1 >pJs8!:wHN%"%J%m%8!<

K\%7%9%F%`$N$h$&$K?M4V$,C18l$r4QE@$H$7$FM?$(!$$=$N4QE@$K4p$E$$$?=EMWJ8Cj=P$r9T$J$&$3$H$O!$J8>OCf$N3FJ8$r0l$D$NJ8=q!$?M$,M?$($kC18l$r8!:w8l$H$7$?>pJs8!:w$HN`;w9k!%8!:wK*$$$F$O!$?MKh$CFM?$(il$?8!:w8l$r4^$`3FJ8=q$KBP7F!$8!:w8l$NJ8=qFbGN;HolJ}JI$K1~$8$F3FJ8=q$KI>2ACM$,M?$(il$k!%F1MM$K!$$3$3$GMQ$$$?=EMWJ8Cj=PK*$$$F$b3FJ8$KI>2A$,M?$(il!$$=$NI>2A$N9b$$J8$,=EMWJ8$H7F=PNO5l$k!%>pJs8!:w$H0[JkE@$O!$%G!<%?%Y!<%9KSH(il$kJ8$N=89g$,A4BN$G0lDNJ8>OHJCF$$$k3HG"$k!%$9Jo$A!$8!:wK*$$$F$O3FJ8>O$rJL!9$KI>2A$G$-$kNKBP7F!$J8>O$K$*$$$F!$0l$D$NJ8$@1rD/aF$=$l$r=EMW$+I&$+$rH=CG9k3H$O6K$a$F:$FqG"$k!%$=N?$a!$J8>OK*1kB>$NJ8$H$N4X$ojK$*$$$F3FJ8$rI>2A$;MPJi$J$$!%$=$7$F!$B>$NJ8$H$N4X$ojr9M$($k3HO9Jo$A!$MWLsH7$F=PNO$5lk=EMWJ8$N=89g$rG-$k8B$jDJ$,$jd^H^jN$"$kJ8>O$N7A$GDs<(7?$$$H9M$($ilk!%

$^$?!$8!:w%7%9%F%`$NCf$K$O%f!<%6$N<ALd$KBP$7$F2sEz$rM?$($k0l$D$NJ8=q$,B8:_$7$J$$>l9g!$J#?t$NJ8=q$NAH9g$;$G2sEz$r:n@.$9$k%7%9%F%`[>>B<99]$,$"$k!%J8>OK*1kMWLs:n@.$b!$J8>O$N<gD%$O2?G9$+!)!W$H$$$&%f!<%6$NLd$$$KBP9k2sEz$r:n@.$9k3HKB>Ji$J$$!%3N2sEzH7$FE,@Z$J0lJ8$,J8>OCf$KB8:_9l$P;vB-$jkN$@$,!$J8>O$,J#?t$N<gD%E@$rbC$F$$$?$j!$$$$/D+$NJ8$KJ,1F<gD%$,=R$Yil$F$$$?j9k?aK!$MWLs$rJ9J8$NAH9g$;$r@8@.$9k3H,=EMWHJ$k!%

$3$3$G=EMW$HJCF/kN$O!$:G>/$NJ8$G:GBg$N>pJs$rM?$($kAH9g$;$r@8@.9k3HG"$k!%$=$N0UL#$K$*$$$F$b!$9bIQEY$NC18l$P$+$j$r=8$ak3HG$O!$>iD9$JJ8$NAH9g$;$,@8@.5lF7$^$&!%$=$3$G!$K\8&5fNh$&$JFCD'%-!<%o!<%I$rMQ$$$k3H$G!$J8>OCf$G8B$il?ItJ,G7$+=R$YilFJ$/$F!$$+$DJ8>O$N<gD%$K9g$&J8$r=8$ak3HOM-8zG"kH9M$($ilk!%3NE@K*$$$F!$8!:w$K$*$$$F4XO"%Z!<%8$r=8$a$k4XO"%U%#!<%I%P%C%/5;=Q[Rocchio 71]HHfYk3H,G-!$;wDL$C$?%Z!<%8$r=8ak3H$HMWLs$r:n@.9k3HHNOc$$$,$3$3$K8=$l$F$$$k!%

4!2 4QE@$K4p$E$/J8>O$N%9%H!<%j!<:n@.

K\%7%9%F%`$GF@$ilkNOJ8>O$N<gD%$H7F8=lk=EMWJ8G"$j!$J8>O$N%9%H!<%j!<$rDI$&>e$G$N=EMWJ8$HOJiJ$$!%OC$NE83+$r@8@.9k3H$O8=>u$G$O:$FqG"$k!%J8>OA4BN$H7F$N2DFI@-$r9bak$?$aKOA0@a$G=R$Y$?!$F1$8$3HN7+jJV7KJiJ$$<gD%ItJ,$r@53N$KhjB?$/H4$-=P$9$3H,I,MWG"$k!%K\<B83$N7k2L$+$iF@il$?$N$O!$4QE@8l$r4^$`J8$K$b<!$N#2<oN`9JoA!$

1. 4QE@8l$K4p$E$/<gD%$rI=$9J8
2. 4QE@8l$K4X$9$kGX7J$r=RYkJ8

H,B8:_9k3HG"$k!%$7$?$,CF!$:#8e$O3N#2<oN`$N=EMWJ8$N6hJL$r;n$_k3HKhC$F!$Cj=P5l$?=EMWJ8$NCf$N!GX7J"*<gD%!K$N%Z%"$r:n@.$9kJ$I=EMWJ84V$N4XO"$K4p$E$$$F!$%9%H!<%j!<$r@8@.9k3H$r9M$($F$$$-$?$$!%

5. 7k O@

K\9FGO!$%f!<%6$,M?$($k4QE@$rI=$9C18l$K4p$E$$$F!$J8>O$+$i=EMWJ8$rCj=P9kE8K>Bf%7%9%F%`KD$$$F=RY?!%3l$O!$0lDNJ8>OK*$$$F$b4QE@$,0[Jl$PMWLs$,0[Jk3H$r8 5$K7F!$%f!<%6$N9%$_$d>l9g$Kl~$8$?MWLs$r@8@.9k$?$a$KM-8z$G$"$k!%:#8e$O!$$3$NJ8>O$N4QE@$K4p$E$/=EMWJ8$N=8$^$j$N!$J8>OH7FN2DFI@-$r9b$a$kJ}K!$K$D$$$F8!F$$7$F$$$-$?$$$HI.<TiO9M$($F$$$k!%

◇ ;2 9M J8 8%◇

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