Bh 4 2s>pJs9)3XNX9V (A04|) ;qNA

2hA|=hM}$H<+A38@81=hM}$NM;9g

— *"An Integration of Natural Language and Vision Processing towards an Agent-based Future TV system"* [3] hj —

=$;N2]Dx 2 G/ 0f<j 01*O:

J?@.7 G/ 6 7n 12 F| H/I=

1 O8aK

%"%a%j%+K*1k>pJs%9!<%Q!<%O%$%&%'%$7W2h$r;O$aH9$kDL?.%$%s%U%i%9%H%i%/%
$N@0Hw$d!"%G%#%9%W%l%$I=<(G=NO!&5-21G^BN$NMFNLJI$NHtLvE*$J8~>eKhCF<B8=$
$k%^%k%A%a%G%#%";~Be$NE~Mh$r95$(!"2hA|!&1GA|!&2;@<!&J8;zNsJI$N>pJs$rE}9g7
%k%A%a%G%#%"!&%G!<%?%Y!<%9KBP9$k4X?4$,9b$^$jDD$"$k!#

7+$7!"4{B8$N2hA|!&1GA|%G!<%?%Y!<%9K*$$$F$O!"%G!<%?$N8!:w$O%?%$%H%k!&%8%
%k!&EP>l?MJ*$H$$$C$?$+JjBg;(GD$J%-!<$,?6il$F$$$kN_G"$k!#6a$$>-Mh!"J|A
B?%A%c%s%M%k2=$d!"G|Bg$JNL$N1GA|%G!<%?$N%G!<%?%Y!<%9G"$k VOD %7%9%F%`$JIN
>l$,M=A[$5lk$,!"$3$NDxEY$N%-!<Kh$k8!:w$G$OMxMQ<T$,MW5a9k%G!<%?$r8!:w$9$
HO:FqG$"$k!#$=$3$G!"$h$jCNE*$J8!:w$,MW5a$5lk3HKJ$k!#$=N?aK$O!"$
:Y$+$$%-!<$NIUM?!&HVAHFbMF$N9=B$>pJs$NCj=P!&MxMQ<THN<+A3$J%$%s%?%U%'!<%9J
I,MWKJ$k!#

K\NX9VGO!"$=$Nh&$JH/A[$N2<$K NHK J|Aw5;=Q8&5f=j$G9TJolF$$$k!Vagent $
hkL$Mh7? TV %7%9%F%`!W$N8&5f$r>R2p$9$k!#

2 **agent** KhkLMh7? **TV** %7%9%F%`

35MW

K\O@J8GO agent KhkLMh7? TV %7%9%F%` (Agent-based Future TV system = **AFTV**)
KD$$$F>R2p9k!#AFTV GO<+A38@81=hM} (Natural Language Processing = **NLP**) $H
2hA|=hM} (Visual Processing = **VP**) HrAH$_9g$o$;$F!";kD0<T$NMW5a$KEz$($k3H$,$G
$-$k!#3Nh&$J%7%9%F%`$r<B8=9k$?$aKO!"HVAHFbMF$NIA<L$r6u4V$H;~4V$NFs<!8
>pJsH7$F5-=R$7!"HVAHK\BN$H$HbKJ|Aw9k!#

01J}!"AFTV %b%G%kHHbK!"HVAHFbMF$NIA<L$N$?$a$N5;=Q$b>R2p9k!#3N5;=Q$
bdOj NLP $H VP $NM;9g$,I,MWHJ$k!#AFTV %7%9%F%`$K$*$1$k VP $H NLP HNM;
9gKh$k8z2L$K4X7F$O!"agent $H;kD0<T$NdjHj$NF0:nNc$rDL7F<($9!#$=7F!"
8e$K4JC1$K8=:_$N5;=Q?e=`$*hS9M$($ilk<BAuJ}K!$r5DO@$9$k!#

*EE5$9)3X@196 EDCf (1Q) 8&5f<<; ide@mtl.t.u-tokyo.ac.jp

2.1 =x

6aG/$N1GA|@8@.5;=Q$NHtLvE*?JJbKh$j!"**HDTV** (High-Definition TV system), B?%A%c %s%M%kJ|Aw$d%3%s%T%e!<%?>e$N%^%k%A%a%G%#%"!&%"%W%j%1!<%7%g%s$,<B8=$5lDD" 3lirGX7J$K!"KDBg$JNL$*$h$S<oN`$NHVAH$rDs6!$9$k%G%#%8%?%kJ|Aw$,6a$$>-Mh<B8 lk$@$m$&!#$3Nh$&$J4D6-2<GO!"HVAHOh$j@lLgE*$K:YJ,2=5l!"HVAHEv$?$j$N; <T?t$b<+$:$H>/J/Jj!"$R$$$F$OHVAH?t$H>pJsNL$NA}2C$KDJ$,$k3H$,M=A[$5$l 8=:_$N TV J|Aw$N%A%c%s%M%k?t$O5[$IB?$/OJ$$$N$G!"?7J9$N TV Ms$dHVAH>pJs;o$+ ;kD0$7$?$$HVAH$rC5$9$3$H$,$G$-$k$[1]MhB?%A%c%s%M%k2=$,?J$`$H9l$P!"HVAHFbMF $N8!:w$OFq7/Jk$@$m$&!#$^$?!"8=:_$OHVAH$N%?%$%H%k$d4JC1$J2r@b$+$i$*$*h=$ MF$rGD0.$G$-$k$,!"$h$j@lLg2=$7$?HVAH$KJk$[$I!"$=$Nh&$J4JC1$J>pJs$+$i$OHVA MF$N?dB,$,:$FqKJkK0c$$$J$/!"HVAHFb$NFCDj$N>lLL$K4X9k>pJsJIbI,MWKJ m&!#

$=$3$G!"J|Aw$5lF$$$k?tB?$NHVAH$NCf$+$i;kD0<T$,<+M3$K;kD0$7$?$$HVAH$rC5$9$ $,$G$-$kh&$J%7%9%F%`$N3+H/$,K>$^$l!"$3$3$K agent $K$h$kL$Mh7? TV %7%9%F%` (AFTV $rDs0F$9$k!#K\%7%9%F%`$NFCD'$r0J2<$K<($9!#

1. >lLL2r@O!&8!:w$rMF0W$K9TJ&$?$a$K!"J|Aw6IB&$G>lLL$NIA<L$K4X9k>pJs$rAw 9k!#3N>pJs$OFs<!85$N5-=R (Program Description Script = **PDS**) $+$iJC$F $$$k:
   - 2#<4 !D ;~4V<4 (%U%l!<%`C10L)
   - =D<4 !D >lLLCf$N2D;kE*$JItIJ (J*BNJI)!&Hs2D;k$JItIJ (F0:n$J$I)
2. ;kD0<TKh$k<+A38@8lE*$JMW5a$r!"NLP %f%K%C%H$rMQ$$$F PDS $N5-=R$KJQ49$9$k 3HKh$j!"C5:w$rMF0W$K9T$&3H$,2DG=$G$"$k!#
3. A09`$N PDS Kh$k5-9fE*$J8!:w$K<:GT7?H-$O!"VP $rMQ$$$?8!:w$b2DG=$G$" $k!#$=N?aK!"CN<1%Y!<%9$O VP $r9T$J$($kh&$JCN<1$rHw$($F$$$k!#

AFTV HHbK!"NLP $H VP $rMQ$$$FJ|Aw<T$N;kE@$+$i PDS $r8zN(E*$K@8@.9k<j K!$bDs0F$9$k!#

2.2 GO AFTV %7%9%F%`$N4pK\E*$J35G0$H5!G=$K$D$$$F!"**2.3** $G$O>lLL$NIA<L$rCf?4$ $7$? PDS $NItIJ$K$D$$$F!"**2.4** $G$O agent $N$*$*$^$+$J9=B$$H!"F0:nNc$rDL$7$F NLP $H VP $r$I$N$h$&$KAH$_9g$o$;$F$$$k$+$K$D$$$F!"**2.5** $G$O PDS $r@8@.$9$k<jK!$K$D$$$F :G8e$K **2.6** $G$O%7%9%F%`$r<BAu$9$k>e$GI,MW$J5;=Q$K$D$$$F!"3F!95-$9!#

2.2 AFTV %7%9%F%`$N4pK\E*$J35G0

AFTV %7%9%F%`GOC1$K1GA|$rI=<(7?$j2;@<$r=P7?j9k@1GOJ$$$N$G!" NO$J7W;;5!4D6-$,MW5a$5lk!#

%7%9%F%`$NCf3K$O;kD0<TB&$N%7%9%F%`$KFbB"$5lF$$$k "agent" G"$k!#agent $O<+A 8@8l$r2r<a$7!"2hA|$NG'<1$r9T$J$&$3HKhC$F!"9b$$8!:wG=NO$rM-$7!";kD0<T$H%7 %`$H$N4V$K$h$$%$%s%?%U%'!<%9$rDs6!9k!#

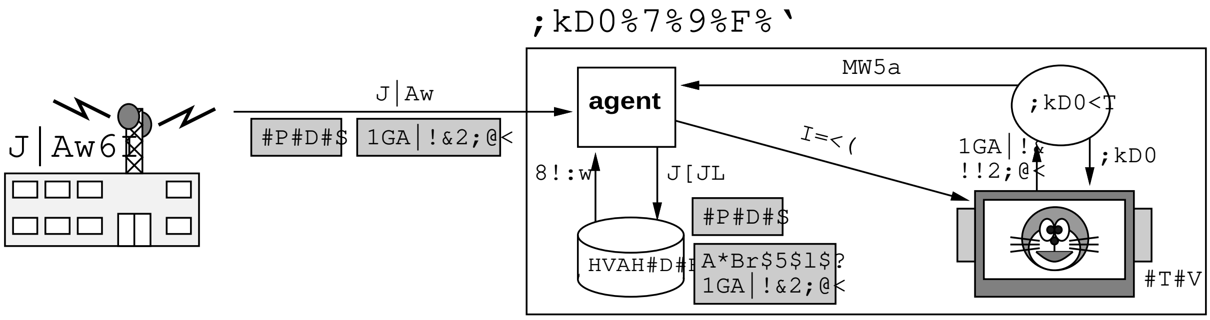
[1] $=$lGb!"%"%a%j%+JI$GIa5Z$7$F$$$k%1!<%V%k TV (**CATV**) $NDs6!$7$F$$$k%A%c%s%M%k?t$O3F6I$ 100!A200 6a$/$"$j!"HVAH>pJs;o$+$iL\E*$NHVAH$rC5$9Nb7k9=BgJQG"$k!#

$3$3$G!"“agent” HO!"=c?h$K;kD0<T$NMW5a$K1~8F!"CNE*$J%^%s!&%^%7%s%$%s%?%U%'
%9rDL8$F!"HVAH$rFCDj$7A`:n$r;\$9bN$HDj5A$9$k!#

2.2.1 AFTV %7%9%F%`$N35G09=@.

?^ ??$KK\%7%9%F%`$N35G09=@.$r<($9!#agent $O!"J|Aw$5lF$/$kHVAH$N PDS $rD4$Y!
;kD0<T$N;XDj$K1hC?FbMF$NHVAH$rJ[JL$7!"PDS HHbKHVAH DB $KJ]4I$9$k!#

;kD0<T$O<+A38@8l$rMQ$$$F agent $KMW5a$r=P$7!"agent $O1GA|!&2;@<$N=PNO$H$$$&7A$
$=$l$K1~$($k!#



?^ 1: AFTV %7%9%F%`$N35G09=@.

2.2.2 AFTV %7%9%F%`$N5!G=

agent $O<!$N5!G=rHw($F$$$kI,MW$,$"$k!#

- J[JL/J]4I !D J|Aw5lk9YF$NHVAH$NCf$+$i!";kD0<T$NMW5a$K1~8?>lLL$dHV
  $rJ[JL$7!"HVAH DB $KJ]4I$9$k!#
- :F@8 !D HVAH DB $+$i;kD0<T$NMW5a$K1~8?>lLL$dHVAH$r<h$j=P$7$F:F@8$9$k!#
- %3%_%e%K%1!<%7%g%s !D <+A38@8l$rMQ$$$F;kD0<T$HBPOC$9$k!#

3liN5!G=$r<B8=$9k?aK$O!"0J2<$N;v9`$,<B8=$5lF$$$J1lPJiJ$$!#

1. HVAH$NFbMF$rGD0.7F$$$k3H
   >lLLIA<L!&J,Ln!&F|;~!&%?%$%H%k$JINHVAHFbMF$O!"PDS $H$$$&7A$GHVAH$HHb$
   J|Aw5lF/kN$G!"MF0W$KHVAHFbMF$rGD0.$G$-$k!#<u?.B&$GFbMF$r2r@O9kN
   7W;;NL$NLdBj$JI+iFq7$$$H;Wol$k!#
2. ;kD0<T$NMW5a$r2r@O$7!"2r<a$9k3$H
   agent $O;kD0<T$,HVAH DB NCf+$iK>$_$N>pJs$r8!:w9kNr!"JkY/<+A3$J7A
   $G<jEA$oJ1lPJi$J$$!#f($K!"<+A38@8l=hM}$H2hA|=hM}$NG=NO$,MW5a5l$

2.3 PDS $NItIJ

K\%7%9%F%`GO!"HVAH$OO"B3E*$J>lLL$NN.$l$H!"$=lKKd$a9~$^l?MM!9$JIA<L$+$
$k!#$=NCfG$b!">lLL$NIA<L$r9T$J$&ItIJ$O!";kD0<T$+$i$NMW5a$,JQ49$5$l$F!"agent
:G=i$K8!:w$KMQ$$$k7A<0Gb$"$kNG!":G$b4pK\E*$JbNG"$k!#

>lLLIA<L$O<!$NFsDLjKJ,$+$l$k!#

- 1GA|ItIJ !D L\$K8+$($kMWAG$K4X$9$kIA<L
- 5-=R;R !D L\$K8+$($J$$MWAG$K4X$9$kIA<L

3liNItIJ$OFs<!85$N6u4V-;~4V5-=R9=B$$N=D<4KHil$k!#$J$*!"2#<4$O;~4V(
%l!<%`) G"$k!#>lLL$K4X7F!"3Nh&$JI=8=$r9TJ&3HKh$j0J2<$NMxE@$,$"$

- F02hA|$r07$&:]$K!"MF0W$K>lLLIA<L$r;~4V<4$KBP1~IU1ilk!#
- >lLLIA<L$K3HD%@-$,$"$kNG!"MF0W$KItIJ$r9b5i2=G-$k!#
- 5-9fE*8!:w$,2DG=$G$"$k!#

2.3.1 1GA|ItIJ

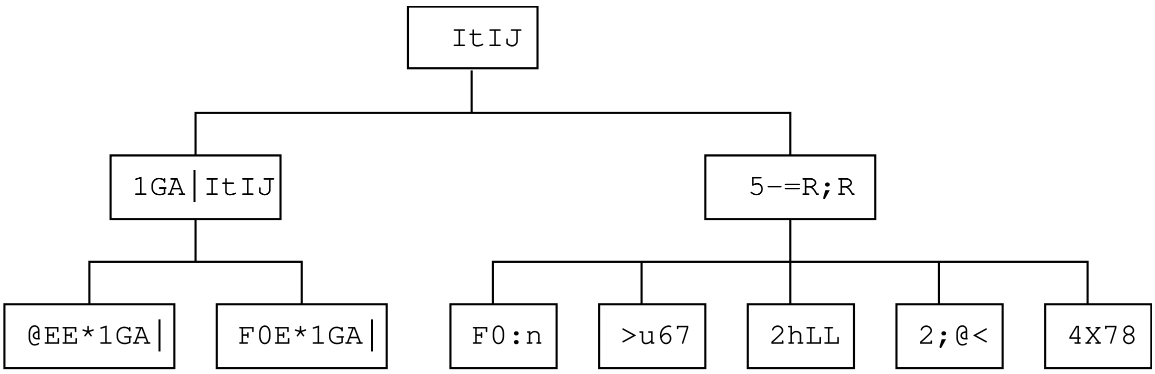
>lLLCf$N2D;kE*$JItIJ$r1GA|ItIJ$H8F$V!#$3li$O!"?^ ??$N%D%j!<$N:8B&$N;^$K<(
h&$K!"0J2<$NFs%/%i%9$KJ,N`$5lk!#

- F0E*1GA| !D (Nc) ?M4V, F0J*
- @EE*1GA| !D (Nc) ;3, 2H

2.3.2 5-=R;R

>lLLCf$NHs2D;kE*$JItIJ$r5-=R;R$H8F$V!#$3li$O!"?^ ??$N%D%j!<$N1&B&$N;^$K<(
h&$K!"0J2<$Nh&$J$$$/D+$N%/%i%9$KJ,N`5l$k!#

- F0:n !D Ho<LBN$NF0$- (Nc) ?)Yk, 1?V, Avk
- >u67 !D 8D!9$NHo<LBN!&>lLLA4BN$N>uBV (Nc) 8e8~$-, Lk
- 2hLL !D %+%a%i%o!<%/!&1GA|8z2L$K4X$9$kA`:n
- 2;@< !D 2;@<!&2;6A8z2L
- 4X78 !D 5-=RItIJ4V$N4X78



?^ 2: 5-=RItIJ$N%/%i%93,AX

2.3.3 **PDS** K*1k>p7JIA<L

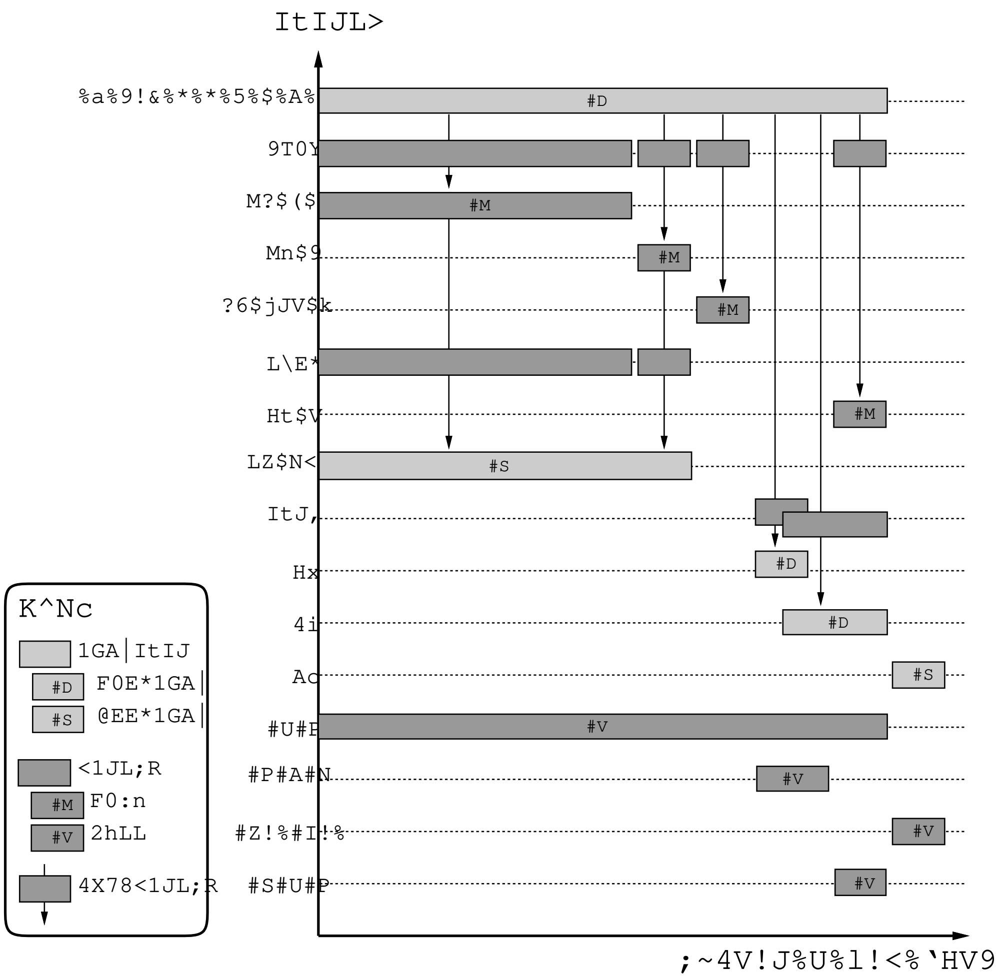
<!JG$K PDS $N5-=R[2]N$r<($9!#

[2] J88% [1] hj0zMQ7?!#=P=j$O!"NHK $N<+A3%I%-%e%a%s%?%j!<HVAH!VCO5e%U%!%_%j!<!W#

!Z%7%J%j%*![

;~4V	2hLL$NMM;R	%J%l!<%7%g%s
!c%+%C%H!d 0'22"	%a%9!!#U#P	
		D9$$!"2+?'$N%/%A%P%7$O#3#0%;%s%A!# Mc$r9-$2kHA4D9$,#2#m0J>e$KbJ$k5pBg$JD;G9
	LZ$N<B$rM?$($k	
		LZN[$i7j$N1|$K$$$k%R%JKLZN<B$rM?$($F$$$k$s
	Mn$9	!V%*%C!W$H!%!%!%$"$^$j4oMQGO$J$$$h$&$G9M!#
	"-	
	$&$7mr?6$j8~$/	
	Hx$+$i4i$X	GI<j$J?'!"D9$9$.$k%/%A%P%7$=$7$F>x5$5!4X<VNh A{!9$7$$1)2;!#
		3N4qL/$J;Q$r8+$F!"$"$k?M$,!V3ND;Ob7+$9 ?@MM$N<:GT:n$+$b$7$1$J$$!W$H8@$C$?$=$&$G9,!] 5F!"3'5sOI$&;W$$$^9+!#
	!c%9!<%Q!<%$%s%]!<%:!d ?@MM$N<:GT:n!) 5pD;!V%5%$%A%g%&!W !AAcN)$A$^$G!& !!<yF6$N#1#2#0F|!A	
	Ht$V	
	"-	
	Ac$X#Z!%#I!%	
!c%+%C%H!d 1'25"		

!Z#P#D#S![



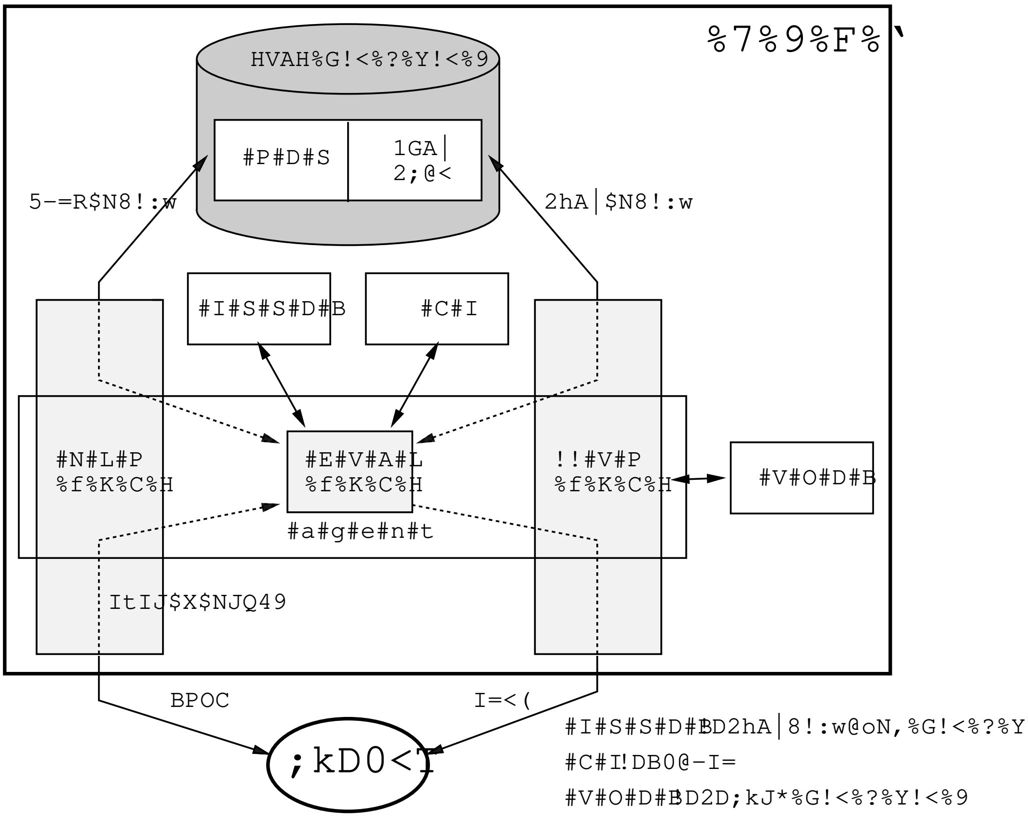
2.4 agent K*1k NLP $H VP $NM;9g

2.4.1 Agent $N5!G=$N35MW

$3$3GO!"agent $NCf?H$K$D$$$F@bL@9k!#?^ ??$K<($9h&$K!"agent $O NLP %f%K%C %H$H VP %f%K%C%H$H!"$=li$r@)8f$9$k EVAL %f%K%C%H$+iJ$j!"3FIt$O6(D4$7$F=hM $r9T$J$&!#EVAL %f%K%C%H$O NLP %f%K%C%H$H VP %f%K%C%H$r@)8f7F!"<+A38@8l$d2hA $N8!:w$r9TJ&!#

NLP %f%K%C%H$O!";kD0<T$N<+A38@8lKh$kMW5a$r PDS $HF1$8h&$J5-=R$KJQ49$7!"V %f%K%C%H$O2hA|$N8!:w$,I,MWJH$-$KMQ$$$ilk!#

K\@aGO3FIt%f%K%C%H$N5!G=$r>R2p$7!"3F!9$,INh&$K6(D4$7$F8!:w$r9TJ&$+ <($9!#



?^ 3: agent $N5!G=

2.4.2 ItIJXNJQ49

NLP %f%K%C%H$O!"<+F02qOCG'<1%b%8%e!<%kKhCFG'<1$5$l$?;kD0<T$NMW5a$r2r@O$ 2r<a9k!#3N%f%K%C%H$N<g$J5!G=$O!"<+A38@8lJ8$r PDS $KJQ49$9k3HG$"$j!"<! J87?$NJ8>O$r07$&$3H,G-$k!#

- L?Na@a + L\E*@a
- J?=x@a + L\E*@a
- 5?Ld@a + L\E*@a

01HL$KMW5a$O *show*, *get*, *put*, *let me see*, *save* Nh$&$JL?Na@a$d *I want to see*, *it's* *enough* Nh$&$JJ?=x@a$G;O$^$j!"$=$N8e$KL\E*@a$,Mh$k!#3liO!"search-and-display, search-and-save, end-search $H$$$C$?L?Na$KJQ49G-$k!#*who is*, *what is* Nh$&$J5?Ld@a$G;O$^$kMW5a$O!"search-and-answer L?Na$KJQ49$5lk!#

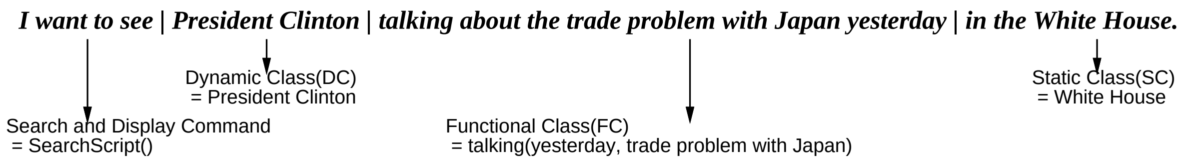
L\E*@a$rJQ49$9kKO5iK?<$/2r@O$7J1lPJi$J$$!#01HL$K!"<g81$O1GA|ItI BP1~IU1ilk!#$=$NItIJ$,F0E*$G$"$k$+@EE*$G$"$k$+$O!"3FJ*BN$NJ*M}E*@-<A$Kh H=CG5lk3H,B?$$!#

L\E*@a$N<gF0;l$O!"3JMWAG$r0z?t$H9k4X?t$GI=8=$5$l!"B>F0;l$+<+F0;lKhCF! ?t$r;}$D$+;}$?$J$$$+$,7h$^$k!#*fly* $d *run* Nh$&$J<+F0;l$OI{;l6g$,IUB0$7$J$$8Bj 0z?t$r;}$?$:!"*fly* $O fly() $K!"*fly high* $O fly(adverb=high) HJ$k!#01J}!"*eat* $d *give* Nh$&$JB>F0;l$O!"$?H($P eat(DO=Apple), give(DO=apple,IO=somebody) Nh$&$K I=8=5l$k[3]!#

7AMF;l$b4X?t$H7FI=8=G-k,!"agent $O7AMF;l$NDjNLE*$J2r<a$,G-$J$$$N$G!" =RCf$KM[$K5-=R$5lF$$$k>l9g$r=|$$$F!"8!:wCf$OL5;k$5lk!#D^$j!"*a pretty girl* $ *a girl* $HEy2A$K07ol$k!#

A0CV;l6g$O!"6g$N<gMWIt$N<oN`$K1~8F0[JkItIJ$KJQ49$5lk!#$?$H$($P!"<gMWI *dungeon* Nh$&$K!V>l=j!W$KB0$9kbNG$"$l$P!"A0CV;l *in* $O@EE*1GA|ItIJ$KJQ49$5$ $k!#01J}!"<gMWIt$, *dark* Nh$&$K!V>u67!W$KB0$9kbNG$"$l$P!">u675-=R;R$KJQ49 lk!#

0J2<$KJQ49$NNc$r<($9!#



?^ 4: ItIJXNJQ49$NNc

2.4.3 8!:w@oN,$HCN<1%Y!<%9

EVAL %f%K%C%HGO!"NLP %f%K%C%H$GF@$il?ItIJ$H01CW$9$kItIJ$r PDS $NItIJ<4$N Cf$+$iC5$9!#$3$N8!:w$OItIJ$r0z?t$KbD4X?tKh$j9T$Jol$k!#$?H($P!"?^ '??$N $GEP>l$7$? SearchScript(DC,SC,FC,VC)[4] Nh$&$JbN$,$"$k!#$9YF$N0z?t$,ItIJ<4 $NItIJ$H01CW9kH3m,8+D+lP!"EVAL %f%K%C%H$O;~4V<4$N$=$NItJ,$KBP1~$9$k A|$r<h$j=P$9!#$^$?!"01It7+01CW7J$$>l9gKO!";kD0<TKBP7F=$N;]Js9p$7!"$ Jk;X<($r6D$0!#

>lLLCfN"if$k;vJ*$rIA<L9kNOL@i+$KHs8=<BE*$G$"$j!"f($K EVAL %f%K %H$Khk8!:w$,<:GT$9k3Hb$"$k!#3NLdBj$r9nI~$9k?aK!"EVAL %f%K%C%HKO $N;0$D$NCN<1%Y!<%9$rbC$F$$$k!#

- 2hA|8!:w@oN,%G!<%?%Y!<%9 (Image Search Strategy DataBase = **ISSDB**)
- B0@-I= (Category Index = **CI**)

[3] $3$3$G!"DO $OBP3J$r!"IO $OM?3J$rI=$9!#

[4] $3$3$G!"DC $OF0E*1GA|ItIJ, SC $O@EE*1GA|ItIJ, FC $O01HL$N<1JL;R, VC $O2hLL<1JL;R$rI=$9!#

• 2D;kJ*%G!<%?%Y!<%9 (Visual Object DataBase = **VODB**)

3N$&$A!"ISSDB $O *eagle*, *man* $H$$$C$?ItIJL>$d BIRD, HUMAN $H$$$C$?B0@-L>$rMQ$$ $F1GA|ItIJ$r8!:w9k$?$a$N%N%&%O%&$r<}aF$$$k!#4pK\E*KO!"0J2<$K<($9h&$J7 $N if-else $N5,B'$G5-=R5l$F$$$k!#

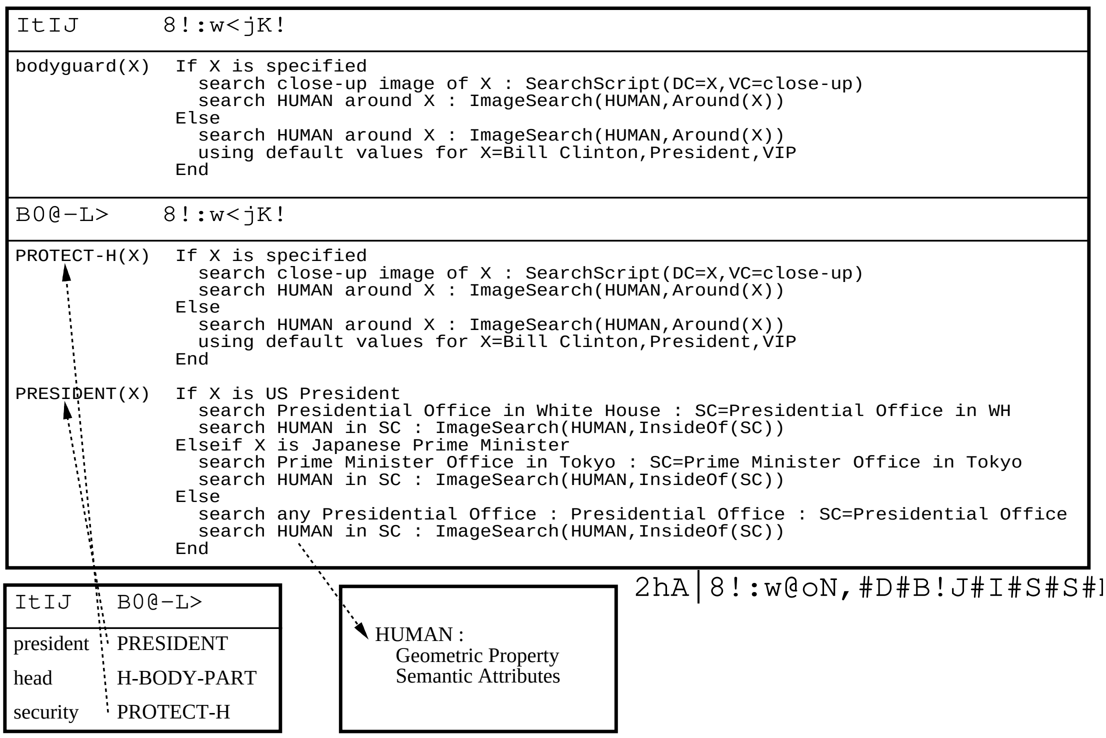
```
component value([list of argument])
if [condition]
  list of commands
else
  list of commands
end
```

$3$3$G!"component value $O!"ISSDB Cf$N5,B'$N8+=P$7KJ$j!"if J8$N condition $O!" 0z?t$G5-=R5l$k!#$^$?!"list of commands $O4pK\E*$K$O5-=R8!:wL?Na$*hS2hA|8!:w L?Na$+$iJk!#

5-=R8!:wL?Na$O SearchScript([list of components]) Nh$&$J7ABVG"$k!#list of components KO8!:w7?$$1GA|ItIJ$,F~$k!#3NL?Na$O9b2rA|EY$N2hA|%G!<%?$N8 :w$KMQ$$$i$l!"VP %f%K%C%H$rJd=u9k!#

01J}!"2hA|8!:wL?Na$O ImageSearch([object-in-search,search-directions]) Nh $&$J7ABVG"$k!#object-in-search $O VODB $K<}$ail$F$$$k2D;kJ*$N4v2?3XE*$JFC D'$d0UL#B0@-$r8!:w9k:]$N8+=P$7KJ$k!#$^$?!"search-directions $O!">lLLCf$+$i J*BN$rC5$9<jK!$r;XDj9k!#<jK!$O Around(), CenterOf(), InsideOf() Nh$&$J4X?tE* $JI=8=$GI=5l$k!#

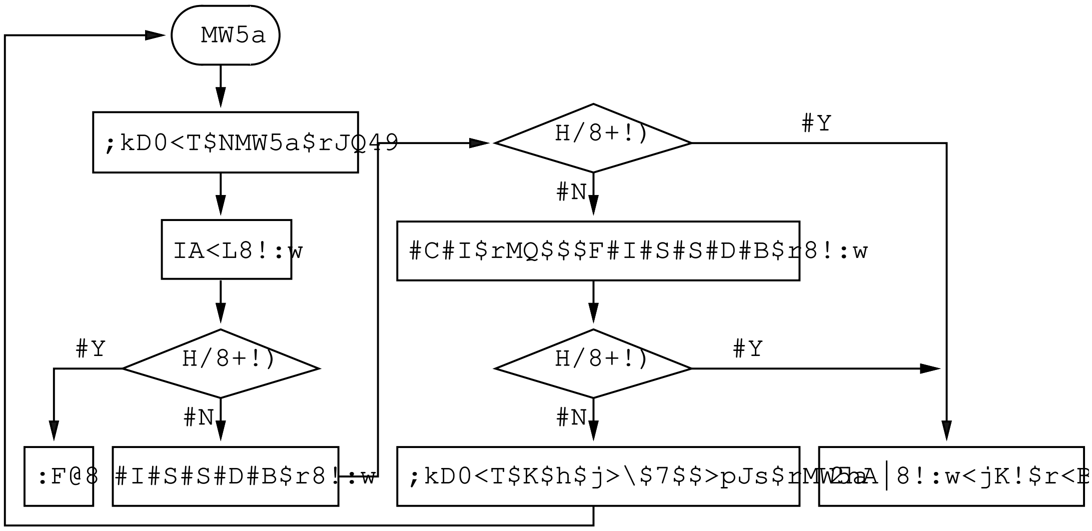
?^ ??$KCN<1%Y!<%94V$NAj8_4X78$r<($9!#



?^ 5: CN<1%Y!<%94V$NAj8_4X78$NNc

2.4.4 EVAL %f%K%C%H$NA4BNE*$J%"%k%4%j%:%`

?^ ??$K EVAL %f%K%C%H$NA4BNE*$J%"%k%4%j%:%`$N%U%m!<%A%c!<%H$r<($9!#



?^ 6: EVAL %f%K%C%H$NA4BNE*$J%"%k%4%j%:%`

2.4.5 F0:nNc

0J2<$K agent $H;kD0<T$N4VNdjHjNF0:nNcrFsD5s2k!#

F0:nNc 1 GO!";kD0<T$O%l!<%,%sBgE}NN$,EP>l9k9YFN>lLL$rMW5a$7$F$$$k!#$3 Nc$G$O!"PDS $N8!:w$r9TJ&$@$1G"$k!#

01J}!"F0:nNc 2 GOIT==J,$J>pJs$+iG$b agent $,$&$^$/MW5a$5$1$?>lLL$r8!:w9kN ;R$r<($9!#3NNcGO!"PDS $N8!:w$H2hA|8!:w$,AH$_9go5lF$$$k!#

!ZF0:nNc **1**![

;kD0<T: *Show me Reagan walking in the White House.*

a) NLP %f%K%C%H$,MW5a$NCf$N<+A38@8lMWAG$rItIJ$KJQ49$9$k!#

Show me "* `SearchScript()`
Reagan "* `DC=Reagan`
walking "* `FC=Walk()`
in the White House "* `SC=White House`
`VC=(null)`

b) NLP %f%K%C%H$, a) $N7k2L$r EVAL %f%K%C%HXAwk!#

c) EVAL %f%K%C%H$O!"$^$: `SearchScript(DC,SC,FC,VC)` $r PDS $NItIJ<4$KBP7F<B 9T9k!#

d) DC $, *President Reagan* $H *Nancy Reagan* $NN>J}$K01CW7F[#Kf$J7k2L$K=*$k!#

e) [#Kf@-$r2r>C$9k?aK EVAL %f%K%C%H$O8!:w$rCfCG9k!#

agent: *Are you looking for President Reagan or Nancy Reagan?*

;kD0<T: *President Reagan*

f) EVAL %f%K%C%H$O@h$[INCfCGE@KLaj!"?7$?$K3NDj7? `DC=President Reagan` $r 85$K8!:w$rB39T$9$k!#

g) 8!:w$N7k2L!"10 >1LLH/8+$5$1$?!#

h) EVAL %f%K%C%H$,;kD0<T$KI=<(J}$rJ9$/!#

agent: *10 different scenes are available. Do you want to see all of them?*

;kD0<T: *No, just the first two.*

i) agent $O:G=i$N 2 >1LL$@$1I=<(9k!#

!ZF0:nNc **2**[5][

;kD0<T: *Show me the security for President Reagan.*

a) NLP %f%K%C%H$,MW5a$NCf$N<+A38@8lMWAG$rItIJ$KJQ49$9$k!#

Show me "* SearchScript()
the security for President Reagan "* DC=security for President Reagan
FC=(null), SC=(null), VC=(null)

b) NLP %f%K%C%H$, a) $N7k2L$r EVAL %f%K%C%HXAwk!#

c) EVAL %f%K%C%H$O!"$^$: SearchScript(DC,SC,FC,VC) $r PDS $NItIJ<4$KBP7F<B9T9k!#

d) DC=security for President Reagan $, PDS Cf$KB8:_7J$$$?aK!"8!:w$K<:GT$9$k!#

e) EVAL %f%K%C%H$O!"*security* $H *President Reagan* $rHf3S$7$F!"$IAi$,=EMW$JMWAGG"k+2r@O9k!#<B:]$O!"*President Reagan* $, *security* $r=$>~9kNG!"*security* $NJ}$,=EMWG"k3H,J,$+$k!#

f) EVAL %f%K%C%H$O!":#EY$O DC=security $N85$G!"*President Reagan* $K4X$9k9YF$N PDS $r8!:w$9$k!#

g) DC=security $, PDS Cf$KB8:_7J$$$N$G!"$^$?$b$d8!:w$O<:GT9k!#

h) EVAL %f%K%C%H$O!"ISSDB Cf$N *security* $N8+=P$7$r8!:w$9$k!#

i) EVAL %f%K%C%H$O!"bodyguard $O8+IU$1k, !"security $O8+IU$1il$J$$$N$G!"$3$N8!:w$K$b<:GT$9$k!#

j) EVAL %f%K%C%H$O!":#EY$O CI Cf$r *security* $NB0@-$r8!:w9k!#9k$H!"PROTECT-H(X) $,8+IU$+C?!#

k) EVAL %f%K%C%H$O!":F$S category=PROTECT-H(X) $N85$K ISSDB Cf$r8!:w$9$k!#

l) EVAL %f%K%C%H$O!":#EY$O8!:w<jK!$r8+IU$1!"$^$: SearchScript(DC=President Reagan, VC=close-up) $r<B9T$7$F!"VP %f%K%C%H$GJd=uE*$J%G!<%?$H7FMQ$$$ilkh&$K!"*President Reagan* $N9b2rA|EY$N2hA|$rF@$k!#

m) EVAL %f%K%C%H$, VP %f%K%C%H$K l) $GF@$i1? *President Reagan* $N6a@\A|$HHb$K!"ImageSearch(HUMAN,Around(X=President Reagan)) rAwk!#

n) VP %f%K%C%H$O!"ImageSearch L?Na$r!"*search object(HUMAN) around President Reagan* $N0UL#$H2r<a9k!#$^$:!"VODB $+$i HUMAN $N (2hA|$H7F$N) FCD' $rF@$F!"*President Reagan* $N<~JU$N9YFN?M4V$rC5$9!#

o) 7k2LH7$F!"20 ?M$N8uJd$r8+IU$1$?!#

p) EVAL %f%K%C%H$,;kD0<T$KI=<(J}$rJ9$/!#

agent: *Twenty possible candidates have been found. Do you want me to show them one by one?*

[5];kD0<T$O8n1R *security* NCfN0l?M$N?MJ*$N4i$@$1OCNC$F$$$k (L>A0OCNi$J$$)!#

;kD0<T: *OK.*

q) agent $OBh 1 8uJd$rI=<(9k!#

agent: *Please confirm. Is this the person?*

;kD0<T: *No, that's Nancy.*

r) agent $OBh 2 8uJd$rI=<(9k!#

agent: *Please confirm. Is this the person?*

;kD0<T: *Yes, that's him. Track all his records and store them under the name "Reagan's security".*

s)EVAL %f%K%C%H$O DB Cf$r8!:w$7!"H`$N4i$,EP>l$9$kA4>lLL$r "Reagan's security" $H $$$&L>$N%U%!%$%k$K3JG<$9$k!#

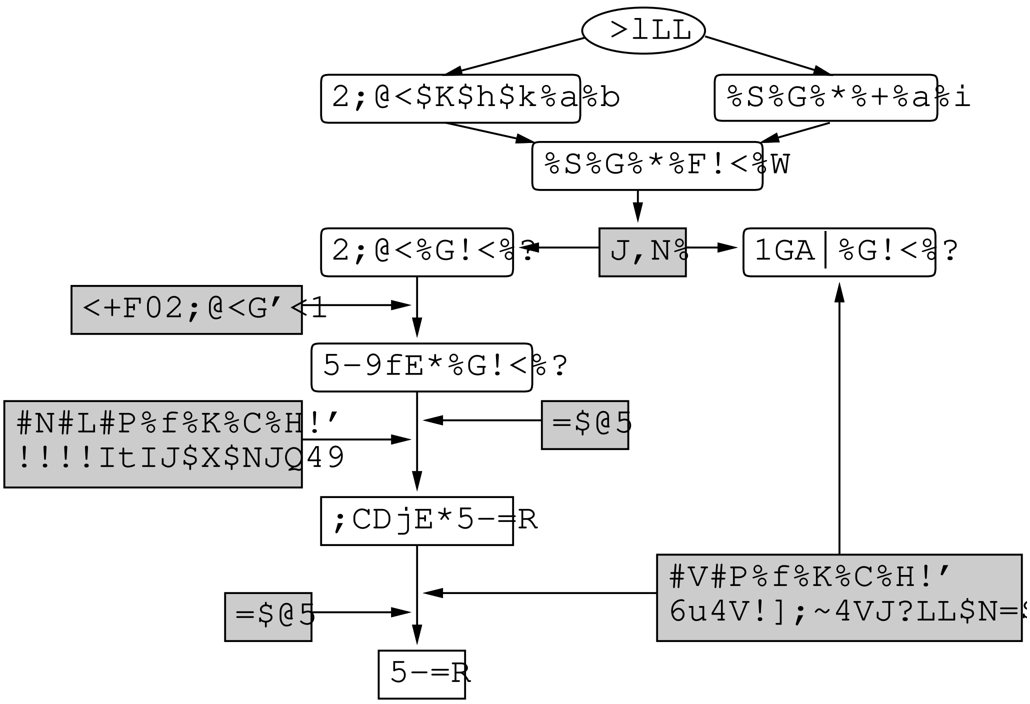
;kD0<T: *When you find his name, let me know.*

agent: *Yes, I will.*

t) EVAL %f%K%C%H$O *security* $NL>A0$,8+IU$+$k$^$G!"H`$N4i2hA|$H0lCW9k$"$ifk %G!<%?$r8!:w$9$k!#<iHw$h$/8+IU$1$1$P!";kD0<T$K65$($k!#

2.5 PDS $N@8@.<jK!

:#$^$G>R2p7F$-$?h&$K!"PDS Kh$k>lLLIA<L$O!"K\%7%9%F%`NMWKJkItJ,$G $k!#8=:_$NH3$m!"PDS $O?M<j$G@8@.5l!"7+b^$@J|Aw$5lF$$$ko1Gb$J$$! $+$7!"<B:]$KJ|Aw$9kh$&$KJk$H!"$3Nh$&$J?M<jKh$k@8@.$GOHFbDI$$IU$+ JkY/B?$/$NItJ,$r<+F02=$9kI,MW,@8$8$k!#?^ ??$K!"@8@.$N;EAH$_$r<($9!#



?^ 7: PDS @8@.%"%k%4%j%:%`

7+$7!"%7%9%F%`$+$i40A4$K?M$N2pF~$9$kItJ,$r=|$/$HB?$/$N5;=QE*$JLdBj$,@8$8 $H$$$&NO!"FCDj$NItJ,$G$O!"?M<j$Khk:n6H$NJ}$,Ok$+$K4JC1G"C?j9k+ $"$k!#

2.5.1 @8@.2aDx

?^ ??$r6qBNE*$K8+F_$k!#

$^$:!";#1F<T$d%G%#%l%/%?!<$Khk4JC1$JIA<L$,2;@<H7$F;#1F;~$K1GA|$KIU2C$5$l

<!$K!"$3$N@8$N%G!<%?$+$i2;@<$H1GA|$rJ,N%9k!#3N:]!"2;@<Kh$kIA<L$H1GA|$
%l!<%`HV9fNBg^$+$KBP1~$,IU$1il$k!#

2;@<%G!<%?$O!"<+F02;@<G'<1%f%K%C%H$KhC$FJ8;zNs$KJQ49$5$l!"$=$N8e?M4V$,8mJ
$r=$@5$9$k!#=$@5$5l?%G!<%?$O!"NLP %f%K%C%H$Khj AFTV %7%9%F%`GNJQ49=hM}$
F1MM$N=hM}$r7P$F!"ItIJ$KJQ49$5$l$k!#JQ49$,=*N;9k$H!"ItIJ$OItIJ<4KJBYil!
$[$IN*$*$^$+$J%U%l!<%`>pJsrbHK7F;CDjE*$J5-=R$,40@.9k!#

7+$7!"$3$NCJ3,$G$OItIJ<4$H;~4V<4$NBP1~$,$"$^$j@53N$GOJ$$$N$G!"VP %f%K%C
$rMQ$$$?=$@5$,9TJolk!#VP %f%K%C%H$O1GA|Cf$N>lLL$N@ZBX$(!"?'$NJQ2=$JIr8
=$@5$r9TJ&!#

=$@5$N@:EY$O2;@<$Khk%a%b$NIJ<A$H1GA|$NJ#;($5Kbhk$,!"J|Aw$KBQ$(F@$k%l%
NbNr@8@.9kKO!"?M<jKh$k=$@5$,IT2D7g$G$"$k!#

2.6 I,MW$J5;=Q

AFTV %7%9%F%`$H PDS $N (H>) <+F0@8@.$r2DG=K9kK$O!"$$$/D+$N4pACE*$J5;=Q
$,I,MW$HJk!#

- <+F02;@<G'<1
  K\%7%9%F%`N"if$k=hM}$O!"<+A38@8l$rJ8;zNs$H7F07$&$N$G!"$3$N5;=Q$N7g
  $O!"Bg$-$J>cJI$KJk!#O"B3<+F02;@<G'<15;=Q$O!"$$$^$@8&5fCJ3,$G!"?tI48lDx
  $N8B$il?C18lKBP7FE,MQG$-$kDxEYG"$k!#K\%7%9%F%`$KI,MW$J?e=`$O$=$l
  jbOk$+$K9b$$$,!"8BDjE*$JG'<1$K?M<jKh$k=$@5$r2C$(lP!"4{B8$N5;=Q?e
  GbHf3SE*$&$^$/$$$/!#

- <+A38@8lM}2r/@8@.
  agent $OD>@\<+A38@8l$G;kD0<THdjHj9kN$G!"<+A38@8l$NeLL)$J2r@OG=NO$
  M-$7!"2qOC$NN.lrDI$($J1lPJiJ$$!#0UL#2r@OK*1k=EMW$JLdBj$H7
  zero-element recovery $dBeL>;l$N2r@OJI$,$"k,!"3liKBP7F$O$$$/D+$N
  2rK!$,DsOF$5lF$$$k!#

  HFMQE*$J<+A38@8lM}2r%7%9%F%`$r9=C[9k3H$O$$$^$@:$Fq$@$,!"$"$kDxEY8BDj
  $J%7%9%F%`$N<BAu$O9T$J$o$l$F$$$k!#K\%7%9%F%`$G8@$($P!"%9%]!<%D$d@/<#$H$
  $?HVAH$NJ,LnKhCF@)8B9lP&$^$/$$$/2DG=@-$,$"$k!#$^$?!";kD0<T$+iN
  5a$OC1=c$GC;$$J8G"k3H,B?$$$N$G!"Hf3SE*=hM}$,3ZG"$k2DG=@-$b$"$k!

  <+A38@8l@8@.O^$?JL$NBg$-$JLdBj$@$,!"HFMQE*$J@8@.5;=Q$,EP>l9k$^$G$O!"
  Dj$N7?$N1~Ezr9$k5;=Q$rMQ$$$lPh$$!#

- 2hA|G'<1
  2hA|=hM}5;=Q$O6C$/$[$I?JJb7?$,!"2hA|G'<1$r4^aF!"@.=O7?HO$$$^$@8@
  $,$?$$!#$3$3Gb!"BP>]$r8BDj$9lP!"4{B8$N5;=Q$G$&$^$/$$$/$H;W$olk!#

- CN<13MF@
  =c?h$K6u4VE*$J4X78$rIA<L$9kh$&$JCN<1$N<+F0E*$J3MF@$O!"L@$i$+$K:FqG$"
  $$$/D+$N8&5f$OJ5lF$$$k$,!"<B@$3&$NCN<1$r<h$jF~$l$?HFMQE*$J<+F03MF
  $$$^$@:$FqG"$j!"8=;~E@$G$O ISSDB $d IC $d VODB $N9=C[$O!"?M<j$G9T$J$&$N
  $,8=<BE*$G$"$k!#

2.7 7kO@

agent KhkLMh7? TV %7%9%F%`$r>R2p$7$?$,!":#8e<+A38@8l$r PDS $KJQ49$7FMQ
k3HNM-8z@-$H8B3&$K$D$$$FD4YJ1lPJiJ$$!#5iKO!"K\%7%9%F%`K*$
NLP $H VP $NM;9g$K4X9kM}O@E*$JN"IU$1$b9T$J$&I,MW$,$"$m$&!#
6a$$>-Mh!"PDS $rMQ$$$? AFTV %7%9%F%`$N%W%m%H%?%$%W$r9=C[$9$kM=Dj$G$"$k!#PDS
$NM-8z@-$=NbNO!"%S%G%*8!:w%7%9%F%`K*$$$F<(5l$F$$$k!#
K\%7%9%F%`Nh$&$KHVAHHHbK$=$NFbMF$rIA<L$9$k>pJs$,J|Aw5lk3HO!"B>$
K!HHfY$FHf3SE*>/$J$$O+NO$G<B8=$G$-$kNG!"<BMQ2=$r9M$($k:]$K$O6=L#?<$$$bN
ol$k!#

3 $*$ojK

K\H/I=GO!"NHK J|Aw5;=Q8&5f=j$G9T$Jol$F$$$k!">-Mh$NJ|AwHVAH8!:w%7%9%F%`
4X9k8&5fKD$$$FH/I=7?!#MM!9$J1GA|8!:wK!$,8&5f5l$F$$$k$,!"$3$N<jK!$NF
$O!"$dOj NHK $H$$$&3H$@$1$"$C$F!"<B:]$NJ|Aw$KFbMFIA<L$rAH$_9~$s$GJ|Aw$9$k
G"$k!#<B:]!"%f!<%6B&$GMM!9$J=hM}$r%j%"%k%?%$%`($b7/O=lK6a$$B.EY$G) $
JC$F!"1GA|$r8!:w9kh&$J%7%9%F%`$O$+$JjN7W;;q8;rI,MWH$7!"EvLL$O8=<BE
OJ$$!#$=$NE@!"J|Aw<TB&G3Nh$&$J%7%9%F%`$r9=C[$9$k5$$,$"$kNJ$i!"MM!9$J5
E*$K:$Fq$JLdBj$O$"$kK;$h!"Hf3SE*8=<BE*$J<jK!$H;W$olk!#
K\%7%9%F%`O^$@<+F02=$O$"$^jJ5l$F$$$J$$$h$&$@$,!"Cx<T$i$N%0%k!<%W$KE
%a!<%k$G6a67$r?RM?$i!"8=:_@.2L$r$^$HaF$$$kCJ3,G"kH$NJV;v$r$$$?$@$$$
$G!"6a$$$&AK5i$K?JJb$7$?7k2L$,8x3+5lk+b7lJ$$!#
$$$:lK$;$h!"3N<o$N5;=Q$O:#8e%^%k%A%a%G%#%"$,H/E8$7$F$$$/>eGOIT2D7gJ
G"k3HO3N$+$G$"$j!"5iJkH/E8$r4|BT$7$?$$!#

;29MJ88% [G/Be=g]

K\NX9V$NH/I=$O<g$KJ88% [1],[3] $K4p$E$$$F$$$k$, !"E,59;2>H$7$?O@J8!&;qNA$bG/Be=g5s2k!#

1. !V1GA|$NFbMF5-=R%b%G%k$H$=$N1GA|9=B$2=$X$N1~MQ!W
   <FED @57<;
   EE;R>pJsDL?.3X2qO@J8;o D-II, Vol. J78-D-II, No. 5, pp.754-764; May 1995.

2. !V1GA|%G!<%?%Y!<%9!W
   ;3K\ 9@;J; EE5$!&EE;R9)3X@l96Bg3X1!O@J8NX9V;qNA; December 1994.

3. **"An Integration of Natural Language and Vision Processing towards an Agent-based Future TV system"**
   Yeun-Bae Kim, Masahiro Shibata, Masaki Hayashi;
   AAAI-94 Workshop – Integratrion of Natural Language and Vision Processing –, pp.99-106; August 1994.

4. !V2hA|!&%^%k%A%a%G%#%"%G!<%?%Y!<%9!W
   :dFb @5IW; %F%l%S%8%g%s3X2q;o, Vol. 46, No. 11, pp.1474-1479; November 1992.

5. !V2hA|%G!<%?%Y!<%9K*1k%G!<%?I=8=!&4IM}!W
   Ln8} 1QCK; >pJs=hM}3X2q;o, Vol. 33, No. 5, pp.457-465; May 1992.

6. !V%+%i!<%S%G%*1GA|K*1k<+F0:w0zIU$1K!$HJ*BNC5:wK!!W
   D9:d 98O/, EDCf >y; >pJs=hM}3X2qO@J8;o, Vol. 33, No. 4, pp.543-550; April 1992.

7. !V2hA|%G!<%?%Y!<%9K*1k%b%G%k7A@.!W
   :dFb @5IW, :4F# ??0l;
   EE;R>pJsDL?.3X2qO@J8;o D-I, Vol. J74-D-I, No. 8, pp.455-466; August 1991.

8. !V2hA|8!:w5;=Q!W
   :dFb @5IW; EE;R>pJsDL?.3X2q;o, Vol. 71, No. 9, pp.911-914; September 1988.