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ภาคผนวก

ภาคผนวก ก

โปรแกรมเปลือกระบบผู้เชี่ยวชาญที่ทำการวิจัย

```
/** Expert system with multiple solutions and multi-databases **/
DOMAINS
  DATA_FILELIST = data_file*
  CONDITIONS = BNO*
  HISTORY = RNO*
  RECOMENDS = RENO*
  RNO, BNO, FNO, RENO = INTEGER
  CATEGORY = STRING
  data_file = string
  file = save_file
DATABASE -rulebase
  rule(RNO,CATEGORY,CATEGORY,RECOMENDS,CONDITIONS,data_file)
  cond(BNO,STRING)
  rec(RENO,STRING)
  data_file(data_file)
  fact(FNO,CATEGORY,CATEGORY)
DATABASE -managebase
  yes(data_file,BNO)
  no(data_file,BNO)
  mygo(data_file,CATEGORY)
  rememhow(data_file,string)
  rememwhy(data_file,string)
  rememfile(data_file,data_file)
  rememrule(data_file,RNO)
```

```
  rememdisk(STRING)
include "tdoms.pro"
include "tpreds.pro"
include "menu2.pro"
include "linemenu.pro"
PREDICATES
/************************Commands*****************************/
  title_go
  update
  edit_kb
  list
  llist(HISTORY,string)
  load_know
  save_know
  pick_dba(data_file)
  erase
  tell
  clear
  changedir
  doscom
  proces(integer)
  endd(integer)
  info(STRINGLIST,CATEGORY)
  unique(STRINGLIST,STRINGLIST)
  un(STRINGLIST,STRINGLIST,STRINGLIST)
  dele(string,STRINGLIST,STRINGLIST)
  match(integer,STRINGLIST,string)
  goes(CATEGORY)
  run
```

```
  start
  reverse(CONDITIONS,CONDITIONS)
  reverse1(CONDITIONS,CONDITIONS,CONDITIONS)
  re(RECOMENDS,RECOMENDS)
  re1(RECOMENDS,RECOMENDS,RECOMENDS)
  rever(HISTORY,HISTORY)
  rever1(HISTORY,HISTORY,HISTORY)
  rev(STRINGLIST,STRINGLIST)
  rev1(STRINGLIST,STRINGLIST,STRINGLIST)
  show_con(CONDITIONS)
  show_rec(RECOMENDS)
/*******************Inferences mechanisms*******************/
  dogo(HISTORY,CATEGORY)
  go(HISTORY,CATEGORY)
  check(RNO,HISTORY,CONDITIONS)
  notest(BNO)
  inpq(HISTORY,RNO,BNO,STRING)
  do_answer(HISTORY,RNO,STRING,BNO,INTEGER,INTEGER)
  usefile(STRING)
/************************Explanations************************/
  sub_cat(CATEGORY,CATEGORY,CATEGORY)
  show_conditions(CONDITIONS,string)
  show_recomends(RECOMENDS,string)
  show_rule(RNO,string)
  show_cond(BNO,string)
  show_reco(RENO,string)
  report(HISTORY,string)
  quest(CATEGORY,integer,integer,CATEGORY)
```

```
/*********************Update the knowledge*********************/
  getrnr(RNO,RNO)
  getbnr(BNO,BNO)
  getcnr(RENO,RENO)
  readcond1( CONDITIONS )
  readrec1(RECOMENDS)
  help
  getcond(BNO,STRING)
  getrec(RENO,STRING)
  save_y(char,string,data_file)
  how(HISTORY)
  rectest(string,string,string)
  testfile(string,string,string)
  append(STRINGLIST,STRINGLIST,STRINGLIST)
  findno
  change(STRING,STRING)
  countstrs(STRING,STRING,STRING,STRING)
  limitlen(STRING,STRING)
GOAL
  makewindow(1,23,22,"",0,0,23,80),makewindow(2,22,23,"",0,0,23,80),
  makewindow(5,23,22,"",0,0,23,80),makewindow(8,71,0,"",23,0,2,80),
  start.
clauses
  start:- makewindow(13,20,112,"EXPERT SYSTEM TOOL",0,0,25,80),
  write("\n\n\t\t MULTI-KNOWLEDGE BASES EXPERT SYSTEM SHELL"),
  nl,nl,nl, write("\t\t\t        VERSION  1.5"),nl,nl,nl,
  write("\t\t\t                BY"),nl,nl,nl,
  write("\t\tDR. VARIDDHI UNGBHAKORN  &  MR. THAWATCHAI CHANKONG"),
  nl,nl,nl, write("\t\t\t       FEBRUARY  1991"),nl,nl,nl,
```

```
 write("\t\t\t  CHULALONGKORN UNIVERSITY"),nl,nl,nl,
 write("\t\t\t     Please Press ENTER"),nl,
 field_attr(20,42,5,206),readln(_),clearwindow,removewindow, run.
run :- disk(DISK1), assert(rememdisk(DISK1)),/*disk("B:\\"),*/
 repeat, shiftwindow(8), clearwindow,
 write("\tSelect option with Arrow Key or press letter 'a' to 'k'
 for that Menu"), shiftwindow(1),clearwindow,
 menu(6,30,7,7,["A. Select Knowledge Base","B. Start Consultation",
   "C. Save Knowledge Base","D. Inspect Knowledge Base",
   "E. Create Or Update Knowledge Base ","F. Erase Knowledge In
   Memory","G. Edit Knowledge Base","H. Help Information","I. Exit
   To DOS Shell","J. Exit Expert System","K. Change Knowledge
   Base Directory"],"Select A Main Menu Item",1,CHOICE),
   proces(CHOICE), endd(CHOICE),!.
/**********************Process Choice**************************/
 proces(0):-exit.
 proces(1):-trace(off),load_know.
 proces(2):-title_go.
 proces(3):-save_know.
 proces(4):-list.
 proces(5):-update.
 proces(6):-erase,tell.
 proces(7):-edit_kb.
 proces(8):-help.
 proces(9):-doscom.
 proces(10).
 proces(11):-changedir.
 endd(0).
 endd(10):- clearwindow,shiftwindow(8), clearwindow,
```

```
    write("\t\t\t Please press 'y' or 'n'."), shiftwindow(1),
    write("\n\n\n\n\t\tAre you sure (y/n)? "), erase,clear,
    readchar(C),write(C), upper_lower(C,C1), C1='y',!,
    removewindow(8,1),removewindow(5,1),removewindow(2,1),
    removewindow,rememdisk(DDD),retractall(_,managebase),
    disk(DDD),unreadchar('\13'),unreadchar('S'),
    unreadchar('L'), unreadchar('C'),exit.
/*********************Inference mechanism**********************/
  title_go:- goes(Mygoal), nl,nl,dogo([],Mygoal), !.
  title_go:- nl, shiftwindow(8),clearwindow,
    write("\t\t\t Please press 'y' or 'n'. "),shiftwindow(1),
    write("\n\n   Sorry, there is no recommendation/no more
    database for consultation."), data_file(X),clear,
    write("\n\n\t   Do you want to update my knowledge base (y/n)? "),
    readchar(C),upper_lower(C,C1),C1 <> 'n',shiftwindow(8),clearwindow,
    shiftwindow(1), write("\n\n\n\t\t Your file name is  ",X,"."),
    shiftwindow(8),write("\n\n\t\t Please press any key to start
    updating."),readchar(_),clearwindow,shiftwindow(1),findno.
  title_go :- erase,clear,fail.
  goes(Mygoal):-shiftwindow(2),clearwindow,shiftwindow(8),clearwindow,
    write("\t\t   Select domain with arrow key and press enter."),
    shiftwindow(1),findall(DOM,rule(_,DOM,_,_,_,_),DOMLIST),
    unique(DOMLIST,UDOMLIST),rev(UDOMLIST,UDOMLST),
    info(UDOMLST,Mygoal).
  info([],_):-!,shiftwindow(8),clearwindow,shiftwindow(1),fail.
  info([Mygoal|[]],Mygoal):-!,shiftwindow(8),clearwindow,
    shiftwindow(1),data_file(Y),assert(mygo(Y,Mygoal)),
    assert(rememhow(Y," ")),!,assert(rememfile(Y," ")),
    assert(rememwhy(Y," ")).
```

```
info(UDOMLST,Mygoal):-
  menu(2,20,7,7,UDOMLST,"Choose Domain (use arrow key)",1,CH),
  match(CH,UDOMLST,Mygoal),shiftwindow(8),clearwindow,
  shiftwindow(1), data_file(Y), assert(mygo(Y,Mygoal)),
  assert(rememhow(Y," ")),!,assert(rememfile(Y," ")),
  assert(rememwhy(Y," ")).
unique([],[]).
unique(X,Y):-un(X,Y,[]).
un([],Z,Z).
un([A|B],Y,Z):- dele(A,B,C), un(C,Y,[A|Z]),!.
dele(_,[],[]).
dele(X,[X|L],M):- dele(X,L,M).
dele(X,[Y|L],[Y|M]):- dele(X,L,M).
match(1,[X|_],X).
match(N,[_|L],X):- NN = N-1, match(NN,L,X),!.
go([RNO|HISTORY], Mygoal ):-   /******* My best guess *******/
  data_file(X), not(rule(_,Mygoal,_,_,_,_)),nl,
  not(rememrule(X,RNO)),rule(RNO,MM,Mygoal,REC,COND,DATAFILE),
  DATAFILE = "",!,write("I guess it is a ","\n '",Mygoal,"'."),
  nl,nl,    write("Because it is the ","\n '",MM,"'\n"," and"),
  show_con(COND),shiftwindow(8),clearwindow,
  write("\t\t\tPlease press any key to continue."),nl,
  shiftwindow(1), readchar(_),write("Recomendation(s) :"),
  show_rec(REC),nl,how([RNO|HISTORY]),clearwindow,
  assert(rememrule(X,RNO)), write("\n\t   Do you want to search
  for more answer (y/n)? "),!, shiftwindow(8),clearwindow,
  write("\t\t\tPlease press 'y' or 'n'. "),shiftwindow(1),
  readchar(Ans),clearwindow,shiftwindow(8),clearwindow,
  shiftwindow(1),upper_lower(Ans,Ans1),Ans1 = 'n',erase, clear.
```

```
go([RNO|HISTORY],Mygoal):-data_file(X),not(rule(_,Mygoal,_,_,_,_)),
  !,not(rememrule(X,RNO)),!,nl,rule(RNO,_,Mygoal,_,_,DATAFILE),
  rememhow(X,Str),rememwhy(X,St),rever([RNO|HISTORY],HIST),
  report([RNO|HISTORY],St1),concat(St1,St,St2),llist(HIST,Str1),
  concat(Str,Str1,Str2),assert(rememrule(X,RNO)),
  erase,!,usefile(DATAFILE),consult(DATAFILE,rulebase),
  retractall(rememhow(DATAFILE,_)),retractall(rememwhy(DATAFILE,_)),
  retractall(mygo(DATAFILE,_)),retractall(rememfile(DATAFILE,_)),
  assert(rememhow(DATAFILE,Str2)),assert(rememwhy(DATAFILE,St2)),
  assert(mygo(DATAFILE,Mygoal)),assert(rememfile(DATAFILE,X)),!,
  go([],Mygoal).
go( HISTORY, Mygoal ):-rule(RNO,Mygoal,NY,_,COND,_),shiftwindow(8),
  clearwindow,write("\n\t\t   Use arrow key to select option."),
  shiftwindow(1),check(RNO,HISTORY, COND),go([RNO|HISTORY],NY).
dogo([],Y):-go([],Y).
dogo(_,_):-data_file(Z),rememfile(Z,X), X><" ",usefile(X),
  erase,consult(X,rulebase),mygo(X,Mygoal),go([],Mygoal).
dogo(X,Y):-data_file(M),rememfile(M,N),N><" ",dogo(X,Y).
how(_):- shiftwindow(8),clearwindow,
  write("\t\tPlease press only 'y' or 'n'."),shiftwindow(1),
  write("\n\t  Do you want to know how the answer is obtained
  (y/n)?"),readchar(F),write(F),upper_lower(F,F1),F1='n'.
how(HISTORY):-shiftwindow(8),clearwindow,
  write("\t\t\t Press Esc to continue."),shiftwindow(1),
  rever(HISTORY,HIST),llist(HIST,Str),!,data_file(X),
  rememhow(X,Str2),concat(Str2,Str,Str3),
  concat("\n The answer is obtained by using the following
  rule(s) :\n",Str3,Str1), display(Str1),!.
usefile(X):-existfile(X),!,nl,
```

```
    write("Database file ",X," is used"),nl,nl.
  usefile(X):- disk(Y),write("\n\t Please insert diskett with
    file ",X," in drive ",Y),write("\n\t\t and press enter."),nl,!,
    shiftwindow(8),clearwindow,shiftwindow(1),readln(_),
    shiftwindow(8),write("\n\t\t   Use arrow key to select option."),
    shiftwindow(1).
  check( RNO, HISTORY, [BNO|REST] ):- data_file(X),yes(X,BNO), !,
    check(RNO, HISTORY, REST).
  check( _, _, [BNO|_] ):- data_file(X),no(X,BNO), !,fail.
  check( RNO, HISTORY, [BNO|REST] ):- cond(BNO,NCOND),
    fronttoken(NCOND,"not",_COND),frontchar(_COND,_,COND),
    cond(BNO1,COND),notest(BNO1), !,check(RNO, HISTORY, REST).
 check(RNO,HISTORY,[BNO|REST]):- cond(BNO,COND),
    fronttoken(NCOND,"not ",COND),cond(BNO1,NCOND),
    notest(BNO1),!,check(RNO,HISTORY,REST).
 check(_,_, [BNO|_] ):- cond(BNO,NCOND),fronttoken(NCOND,"not",
    _COND),frontchar(_COND,_,COND),cond(BNO1,COND),
    data_file(X),yes(X,BNO1), !,fail.
 check(_,_,[BNO|_]):-cond(BNO,COND),fronttoken(NCOND,"not ",COND),
    cond(BNO1,NCOND),data_file(X),yes(X,BNO1),!,fail.
 check( RNO, HISTORY, [BNO|REST] ):-cond(BNO,TEXT),
    inpq(HISTORY,RNO,BNO,TEXT),check(RNO, HISTORY, REST).
 check( _, _, [] ).
 notest(BNO):-data_file(X),no(X,BNO),!.
 inpq(HISTORY,RNO,BNO,TEXT):-fronttoken(TEXT,"not",_LTEXT),
    frontchar(_LTEXT,_,LTEXT),write("Is it true that \n",LTEXT,
    " ? : "),linemenu(23,7,0,[" A. Yes "," B. No  "," C. Why"],
    CHOICE),do_answer(HISTORY,RNO,TEXT,BNO,CHOICE,1).
 inpq(HISTORY,RNO,BNO,TEXT):- fronttoken(TEXT,FTEXT,_),
```

```
    FTEXT><"not", write("Is it true that \n",TEXT," ? : "),
    linemenu(23,7,0,[" A. Yes "," B. No  "," C. Why"],CHOICE),
    do_answer(HISTORY,RNO,TEXT,BNO,CHOICE,2).
do_answer(_,_,_,_,0,_):-exit.
do_answer(_,_,_,BNO,1,2):-data_file(X),assert(yes(X,BNO)),
  shiftwindow(1),write("Yes"),nl.
do_answer(_,_,_,BNO,2,2):- data_file(X),assert(no(X,BNO)),
  shiftwindow(1),write("No"),nl,fail.
do_answer(_,_,_,BNO,1,1):-data_file(X),assert(no(X,BNO)),
  shiftwindow(1),write("yes"),nl,fail.
do_answer(_,_,_,BNO,2,1):-data_file(X), assert(yes(X,BNO)),
  shiftwindow(1),write("no"),nl.
do_answer(HISTORY,RNO,TEXT,BNO,3,AA):- !,shiftwindow(8),
  clearwindow,write("\t\t   Please press Esc to continue "),
  shiftwindow(2),rule( RNO, Mygoal1, Mygoal2,_,_,_),
  sub_cat(Mygoal1,Mygoal2,Lstr),concat("Because I try to show
  that \n ",Lstr,Lstr1),concat(Lstr1,"'\n by using rule number ",
  Ls1),str_int(Str_num,RNO),concat(Ls1,Str_num,An),data_file(X),
  concat(An," in File ",An1),concat(An1,X,Ans),concat(Ans,".",Ass),
  show_rule(RNO,Lls1),concat(Ass,Lls1,Ans1),report(HISTORY,Sng),
  concat(Ans1,Sng,Answ),rememwhy(X,St2),concat(Answ,St2,Answer),
  display(Answer),shiftwindow(8),clearwindow,
  write("\n\t\t   Use Arrow Keys to select option."),
  shiftwindow(1),linemenu(23,7,0,[" A. Yes "," B. No "," C. Why"],
  CHOICE),!,do_answer(HISTORY,RNO,TEXT,BNO,CHOICE,AA).
/************** List Rules / Explanation Mechanism ***************/
list :-shiftwindow(8),clearwindow,write("\t\t   Press Esc to
  return to Main Menu. "),shiftwindow(1), findall(RNO,rule(RNO,_,
  _,_,_,_),LIST),llist(List,Str),!,display(Str),!.
```

```
llist([],"") :-!.
llist([RNO|List],Str):-llist(List,Oldstr),show_rule(RNO,RNO_Str),
 concat(RNO_Str,Oldstr,Str).
show_rule(RNO,Strg):-
 rule( RNO, Mygoal1, Mygoal2,RECINGELSER,CONDINGELSER,DATAFILE),
 str_int(RNO_str,RNO),concat("\n\n\nRule ",RNO_str,An),
 data_file(X),!,concat(An," File ",An1),concat(An1,X,Ans),
 concat(Ans,"\n ",Ans1),sub_cat(Mygoal1,Mygoal2,Lstr),
 concat(Ans1,Lstr,Ans2),concat(Ans2,"'\n if ",Ans3),
 reverse(CONDINGELSER,CONILS),show_conditions(CONILS,Con),
 re(RECINGELSER,RECILS),concat(Ans3,Con,Ans41),
 concat(Ans41,".",Ans4),show_recomends(RECILS,REC),
 rectest(Ans4,REC,Ans5),testfile(Ans5,DATAFILE,Strg).
show_rule(RNO,Strg):- makewindow(9,23,22,"Give A File Name",8,10,
 11,60),write("\n\n\tPlease enter this knowledge base file name :
 \n\n\n\t\t"),readln(X),!,upper_lower(X1,X),assert(data_file(X1)),
 clearwindow,removewindow,show_rule(RNO,Strg).
rectest(Ans4,"",Strg):- Ans4 = Strg.
rectest(Ans4,REC,Strg):-concat(Ans4,"\n\n Recomendation(s) :\n ",
 Ans5), concat(Ans5,REC,Strg).
testfile(Ans5,"",Strg):- Ans5 = Strg.
testfile(Ans5,DATAFILE,Strg):-concat(Ans5,"\n\n File connection
:  ",Ans6),concat(Ans6,DATAFILE,Strg).
show_conditions([],"").
show_conditions([COND],Ans):- show_cond(COND,Ans),!.
show_conditions([COND|REST],Ans):-show_cond(COND,Text),
 concat("\n and ",Text,Nstr),show_conditions(REST,Next_ans),
 concat(Next_ans,Nstr,Ans).
show_recomends([],"").
```

```
show_recomends([REC],Ans):-show_reco(REC,Ans),!.
show_recomends([REC|REST],Ans):-show_reco(REC,Text),
  concat("\n ",Text,Nstr),show_recomends(REST,Next_ans),
  concat(Next_ans,Nstr,Ans).
show_cond(COND,TEXT):-cond(COND,TEXT).
show_reco(REC,TEXT):-rec(REC,TEXT).
sub_cat(Mygoal1,Mygoal2,Lstr):-concat(Mygoal1,"\n is a '",Str),
  concat(Str,Mygoal2,Lstr).
report([],"").
report([RNO|REST],Strg) :-rule( RNO, Mygoal1, Mygoal2, _,_,_),
  sub_cat(Mygoal1,Mygoal2,Lstr),concat("\n\nSince I have shown
  that \n ",Lstr,L1),concat(L1,"'\n by using rule number ",L2),
  str_int(Str_RNO,RNO),concat(L2,Str_RNO,L3),concat(L3," in File ",
  L41),data_file(X),concat(L41,X,L4),concat(L4,".",L44),
  show_rule(RNO,Str),concat(L44,Str,L5),report(REST,Next_strg),
  concat(L5,Next_strg,Strg).
/*****************Update the knowledge base*******************/
getrnr(N,N):-not(rule(N,_,_,_,_,_)),!.
getrnr(N,N1):-H=N+1,getrnr(H,N1).
getbnr(N,N):-not(cond(N,_)),!.
getbnr(N,N1):-H=N+1,getbnr(H,N1).
getcnr(N,N):-not(rec(N,_)),!.
getcnr(N,N1):-H=N+1,getcnr(H,N1).
readcond1( [BNO|R] ):-shiftwindow(8),clearwindow,
  write("\tPlease input condition and press Enter or"),nl,
  write("\tkeep pressing Enter to continue, if it has no more
  condition."),shiftwindow(5),
  write("\nCondition (NOT OVER 128 CHAR): "),readln(COND),
  COND><"",!,change(COND,COND1),getcond(BNO,COND1),readcond1( R ).
```

```
    readcond1( [] ).
    readrec1([RENO|R]):-shiftwindow(8),clearwindow,
      write("\tPlease input recomendation and press Enter or"),nl,
      write("\tkeep pressing Enter to continue, if it has no more
      recomendation."),shiftwindow(5),write("\nRecomendation (NOT
      OVER 128 CHAR):"),readln(REC),REC><"",!,change(REC,REC1),
      getrec(RENO,REC1),readrec1( R ).
    readrec1( [] ).
    getcond(BNO,COND):-cond(BNO,COND),!.
    getcond(BNO,COND):-getbnr(1,BNO), assert( cond(BNO,COND) ).
    getrec(RENO,REC):-rec(RENO,REC),!.
    getrec(RENO,REC):-getcnr(1,RENO),assert( rec(RENO,REC)).
    change(X,X1):-fronttoken(X,"not",_),str_len(X,L),L<74,!,X1=X.
    change(X,X1):-fronttoken(X,"not",_),!,frontstr(62,X,X2,X3),
      countstrs(X,X2,X3,X1).
    change(X,X1):- str_len(X,L), L<70,!,X1=X.
    change(X,X1):-!, frontstr(58,X,X2,X3), countstrs(X,X2,X3,X1).
    countstrs(X1,X2,X3,X4):- fronttoken(X3,X10,X11),
      concat(X2,X10,X12),concat(X12,X11,X13),str_len(X1,L1),
      str_len(X13,L13), L1>L13,!,concat(X2," - \n ",X5),
      concat(X5,X3,X4).
    countstrs(_,X2,X3,X4):-!,fronttoken(X3,X5,X6),concat(X2,X5,X7),
      concat(X7," - \n ",X8),concat(X8,X6,X4).
/************************EDIT KNOWLEDGE*****************************/
    edit_kb :-erase,clear,pick_dba(Filename),file_str(Filename,Data),
      shiftwindow(8),clearwindow,
      write("\t   Press F10 to end editing or Esc to abort editing. "),
      shiftwindow(1),edit(Data,NewData),clearwindow,shiftwindow(8),
```

```
    clearwindow,write("\t\t\t Please press 'y' or 'n'."),
    shiftwindow(1),
    write("\n\t\tDo you want to save the Knowledge Base (y/n)? "),
    readchar(Ans),upper_lower(Ans,Ans1),save_y(Ans1,NewData,Filename).
  save_y('y',D,Filename):- openwrite(save_file,Filename),
    writedevice(save_file), write(D),closefile(save_file).
  save_y('n',_,_).
/************************HELP !!!*****************************/
  help :- disk(D1),rememdisk(D),disk(D),file_str("expert.hlp",Help),
    shiftwindow(8),clearwindow,write("\t\t   Please press Esc to
    continue "),shiftwindow(1), display(Help), disk(D1).
/*********************User  commands************************/
  load_know:- retractall(_,rulebase), pick_dba(Data),
    consult(Data,rulebase).
  save_know :- shiftwindow(8),clearwindow,write("\t\t  Press Esc
    to return to main menue."),shiftwindow(1),data_file(Data),
    bound(Data),!,save(Data,rulebase), clearwindow,writef("\n\n\t
    Your % Knowledge Base has been saved.",Data),readchar(_).
  save_know :- shiftwindow(8),clearwindow,write("\t\t   Press Esc
    to return to Main Menu. "),shiftwindow(1),makewindow(11,23,22,
    "Give A File Name",8,20,9,40),write("\n   Enter Knowledge Base
    File Name: \n\n\n\t"),readln(Data),upper_lower(Data1,Data),
    assert(data_file(Data1)),removewindow,save(Data,rulebase),
    clearwindow,writef("\n\n\tYour % Knowledge Base has been saved.",
    Data), readchar(_).
  pick_dba(Data) :- shiftwindow(8),clearwindow,
    write("\t Select knowledge base file name with arrow key and
    press enter."),makewindow(10,7,7,"PICK A KNOWLEDGE BASE",5,10,
    12,60),disk(D1),dir(D1,"*",Data),removewindow,clearwindow.
```

```
doscom :-disk(DISK2),rememdisk(DISK1),disk(DISK1),
  system(""),disk(DISK2).
changedir :-disk(DISK1),shiftwindow(8),clearwindow,
  write("\t\t Use Format : ",DISK1," or press Esc to return to
  main menu."),shiftwindow(1),makewindow(6,23,22,"Change
  Knowledge Bases Directory",8,10,7,60),write("\n\t\t Current
  Directory : ",DISK1),write("\n\t\t Change to New Dir : "),
  readln(DISK),upper_lower(DISK2,DISK),disk(DISK2),
  removewindow,shiftwindow(8),clearwindow,shiftwindow(1).
erase:-retractall(_,rulebase).
tell:-shiftwindow(8),clearwindow,write("\t\t Press any key to
  return to main menu."),shiftwindow(1),clearwindow,
  write("\n\n\tKnowledge In Memory has been erased."),readchar(_).
clear:-ememdisk(DISK),retractall(_,managebase),
  assert(rememdisk(DISK)),!.
update:- shiftwindow(8),clearwindow,
  write("\t  Keep pressing Enter to return to Main Menu or '?'
  for help."),shiftwindow(1),shiftwindow(5),clearwindow,
  write("\nCreate or Update Knowledge\n-------------------------"),
  nl, write("Name of Domain (NOT OVER 70 CHAR): "),nl,nl,
  write("Name of Subdomain (NOT OVER 70 CHAR): "),nl,nl,
  cursor(3,40),readln(KAT1),KAT1><"",limitlen(KAT1,KAT2),
  quest(KAT2,3,40,KAT),cursor(5,40),readln(SUB1),SUB1><"",
  limitlen(SUB1,SUB2),quest(SUB2,5,40,SUB),readcond1(CONDL),
  readrec1(RECL),shiftwindow(8),clearwindow,
  write("\t If it has no file connection, please press enter
  to continue."),shiftwindow(5),write("\nName of file connection
  (USE UPPERCASE) : "),readln(Fileconnect),upper_lower(File,
  Fileconnect),getrnr(1,RNO),clearwindow,
```

```
    assert( rule(RNO,KAT,SUB,RECL,CONDL,File) ),update.
  quest(Q,X,Y,Q2):- Q = "?",!,shiftwindow(8),clearwindow,
    write("\t\t  Please press any key to continue."),
    shiftwindow(2),clearwindow,write("\tThis is an example of how
    to create knowledge base with the domains"),
    write("\n       'Engine Problem' and 'Cooling System Problem'."),
    nl,nl,nl, write("                                          File ENGINE
    File COOLING          "),nl,nl,write("+------+----------------+
    ----------------------+-------------------------+"),nl,
    write("|      | Domain           | Engine Problem          |
    Cooling System Problem   |"),nl,write("| is a |'Subdomain'
    | Cooling System Problem| fan belt loose or missing|"),nl,
    write("| if   | Condition 1      | engine overheats        |
    fan turns improperly     |"),nl,write("| and  | Condition 2
    |          -             | fan belt is noisy        |"),nl,
    write("| and  | Condition 3      |          -              |
    -                |"),nl,write("|      | Recomendation 1 |
    -              |  Adjust or replace belt.  |"),nl,
    write("|      | Recomendation 2 |          -              |
    -                |"),nl,write("|      | File Connection |
    COOLING          |          -                |"),nl,
    write("+------+----------------+-------------------------+-
    ------------------------+"),nl, readchar(_), clearwindow,
    shiftwindow(8),clearwindow,write("\t\t Keep pressing Enter to
    return to main menue."),shiftwindow(5), cursor(X,Y),readln(Q2).
quest(Q,_,_,Q).
limitlen(X,X1):-str_len(X,L),L<71,!,X1=X.
limitlen(X,X1):-frontstr(70,X,X1,_),!.
```

```
/*********************system  commands*****************************/
 re(X,Y):- re1([],X,Y).
 re1(Y,[],Y),
 re1(X1,[U|X2],Y):-re1([U|X1],X2,Y).
 rever(X,Y):- rever1([],X,Y).
 rever1(Y,[],Y).
 rever1(X1,[U|X2],Y):-rever1([U|X1],X2,Y).
 reverse(X,Y):- reverse1([],X,Y).
 reverse1(Y,[],Y).
 reverse1(X1,[U|X2],Y):-reverse1([U|X1],X2,Y).
 rev(X,Y):- rev1([],X,Y).
 rev1(Y,[],Y).
 rev1(X1,[U|X2],Y):-rev1([U|X1],X2,Y).
 show_con([FCOND|[]]):- cond(FCOND,CON),write(" ",CON,".\n"),nl.
 show_con([FCOND|LCOND]):-cond(FCOND,CON),write(" ",CON,"\n and"),
    show_con(LCOND).
 show_rec([]):-nl,nl.
 show_rec([FREC|LREC]):-rec(FREC,REC),write("\n ",REC),
    show_rec(LREC).
 findno:-getrnr(1,RNO), RNO > 30,!,
    write("\n\n\t This file is very big."),
    write("\n\n\t Please create new file which relation to this
    file, if it is posible."),
    write ("\n\n\t Press any key to continue."),
    readchar(_),  update.
 findno:-!,update.
 append([],L,L).
 append([I|L1],L2,[I|L3]):- append(L1,L2,L3).
```

ภาคผนวก ข

ตัวอย่างการใช้งานเปลือกระบบผู้เชี่ยวชาญ

เงื่อนไขการใช้งาน

ในการนำเปลือกระบบผู้เชี่ยวชาญที่พัฒนาขึ้นมาใช้ให้ได้ผลและให้มีประสิทธิภาพมากที่สุดนั้น ผู้ใช้จะต้องมีความรู้พื้นฐานทางด้านระบบผู้เชี่ยวชาญบ้างพอสมควร เข้าใจถึงองค์ประกอบพื้นฐานของระบบผู้เชี่ยวชาญ การแทนความรู้ และกลยุทธ์การแก้ปัญหาของระบบผู้เชี่ยวชาญ และผู้ที่จะนำเปลือกระบบผู้เชี่ยวชาญนี้ไปสร้างระบบผู้เชี่ยวชาญทางด้านต่าง ๆ นั้น จะต้องมีความรู้ในด้านที่จะนำไปใช้นั้น ๆ เป็นอย่างดี จึงจะสามารถสร้างระบบผู้เชี่ยวชาญใหม่ขึ้นมาได้ หรือไม่เช่นนั้น ก็ต้องใช้วิธีการถ่ายทอดความรู้มาจากผู้เชี่ยวชาญอีกทีหนึ่ง

ขอบเขตการใช้งาน

เปลือกระบบผู้เชี่ยวชาญที่พัฒนาขึ้นมานี้มีจุดประสงค์เพื่อการวินิจฉัยระบบเครื่องกล เพราะฉะนั้นขอบเขตการใช้งานที่ระบบจะใช้ได้ดีก็คือ ใช้งานวินิจฉัยข้อขัดข้องของระบบเครื่องกลต่าง ๆ เช่น รถยนต์ เครื่องยนต์ เครื่องปรับอากาศ เป็นต้น และในบางครั้งก็สามารถที่จะนำไปประยุกต์ใช้กับงานวินิจฉัยข้อขัดข้องของระบบอื่น ๆ ที่มีลักษณะของการแก้ปัญหาที่เหมือน ๆ กันได้ รวมทั้งสามารถที่จะนำไปประยุกต์ใช้กับงานอื่น ๆ นอกเหนือจากนี้ก็ได้ โดยมีข้อจำกัดคือต้องสามารถแทนความรู้ในฐานความรู้ของงานด้านนั้นให้อยู่ในรูปกฎโปรดักชัน และมีโครงสร้างฐานความรู้เป็นแบบต้นไม้ ดังแสดงในรูปที่ 4.2 ได้

อนึ่งในการนำไปประยุกต์ใช้จะต้องคำนึงถึงความเข้ากันได้ และสื่อความหมายกันได้ดีระหว่างเปลือกระบบผู้เชี่ยวชาญนี้กับฐานความรู้ที่จะนำไปใช้ การปฏิภาคกับผู้ใช้ต้องสื่อความหมายได้ดีเข้ากับเรื่องที่จะนำไปประยุกต์ใช้นั้นด้วย

การใช้งานเปลือกระบบผู้เชี่ยวชาญ

เปลือกระบบผู้เชี่ยวชาญที่ได้พัฒนาขึ้นมานี้มีความสามารถในการทำหน้าที่หลัก 2 ประการ คือ สร้างระบบผู้เชี่ยวชาญใหม่โดยการสร้าง เพิ่มเติม แก้ไขฐานความรู้ และให้คำปรึกษาวินิจฉัยโดยใช้ฐานความรู้ที่ได้สร้างไว้แล้ว ซึ่งจะได้กล่าวถึงรายละเอียดตัวอย่างการใช้งาน ดังต่อไปนี้

1. การสร้างระบบผู้เชี่ยวชาญ

ในส่วนนี้จะรวมถึงทั้งการสร้างฐานความรู้ใหม่ การเพิ่มเติมฐานความรู้เดิมที่มีอยู่แล้วให้มีความรู้กว้างขวางมากยิ่งขึ้น และการแก้ไขฐานความรู้เดิมให้ถูกต้องทันสมัยตามเหตุการณ์ที่เปลี่ยนไป

1.1 การสร้างฐานความรู้ใหม่ จะต้องจัดข้อมูลความรู้นั้น ๆ ให้อยู่ในรูปกฎเกณฑ์ก่อน ดังแสดงตัวอย่างต่อไปนี้

ตัวอย่างความรู้เกี่ยวกับข้อขัดข้องของเครื่องยนต์

กฎที่ 1. Engine Problem is a "Cooling System Problem"
if engine overheats.

กฎที่ 2. Cooling System Problem is a "fan belt loose or missing"
if fan turns improperly and fan belt is noisy.
Recomendation "Adjust or replace belt."

กฎที่ 3. Cooling System Problem is a "air does not cool water"
if there are leaves or insects or dirt on radiator
or condenser.
Recomendation "Clean radiator or condenser."

จากตัวอย่างความรู้นี้ จะต้องมาจัดให้อยู่ในรูป Domain, Subdomain, conditions, recomendations และ file connection ได้ดังนี้

ชื่อไฟล์ ENGINE

rule 1	Domain	:	Engine Problem
	Subdomain	:	Cooling System Problem
	Condition	:	engine overheats
	Recomendation	:	-
	File Connection	:	COOLING

ชื่อไฟล์ COOLING

rule 1	Domain	:	Cooling System Problem
	Subdomain	:	fan belt loose or missing
	Condition 1	:	fan turns improperly
	Condition 2	:	fan belt is noisy
	Recomendation	:	Adjust or replace belt.
	File Connection	:	-
rule 2	Domain	:	Cooling System Problem
	Subdomain	:	air does not cool water
	Condition	:	there are leaves or insects or dirt on radiator
	Recomendation	:	Clean radiator or condenser.
	File Connection	:	-

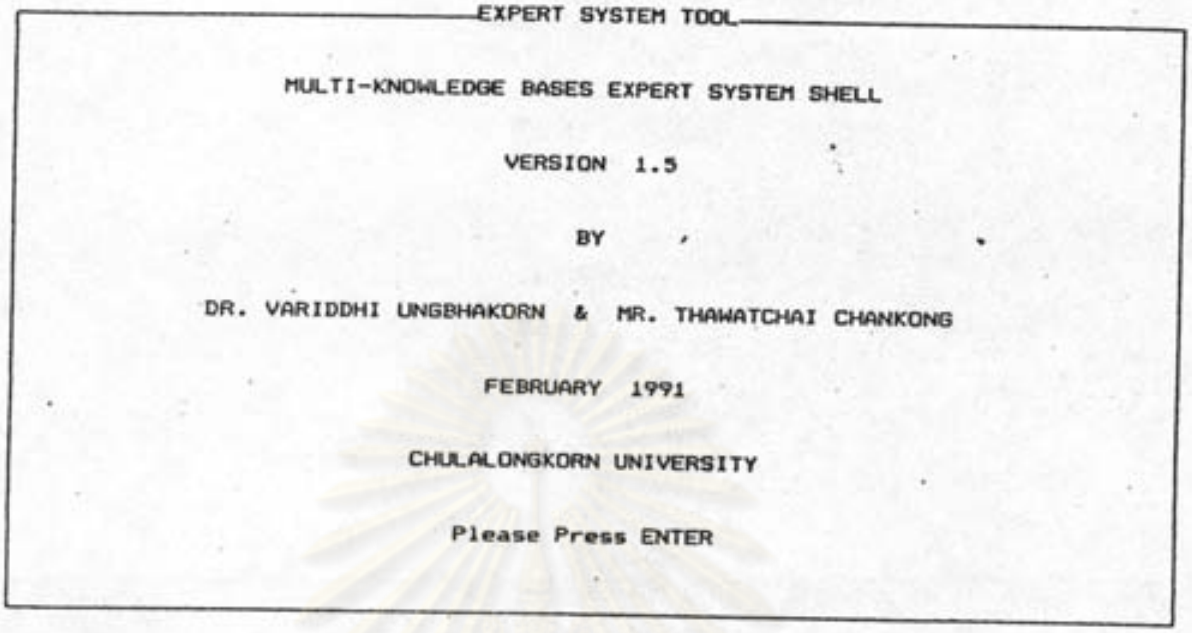
จากการที่ปัญหาของเครื่องยนต์มีมาก มีสาเหตุจากหลาย ๆ ระบบ การสร้างฐานความรู้จึงต้องแยกออกเป็นไฟล์ย่อย ๆ หลาย ๆ ไฟล์ เพื่อตรวจดูและแก้ไขเพิ่มเติมได้ง่ายในโอกาสต่อไป ในที่นี้จึงแยกออกเป็นไฟล์ชื่อ ENGINE ซึ่งบรรจุกฎที่ 1 ไว้ และไฟล์ COOLING บรรจุกฎที่ 2 และ 3 ไว้

ขั้นต่อไปใช้เปลือกระบบผู้เชี่ยวชาญสร้างฐานความรู้ ดังนี้

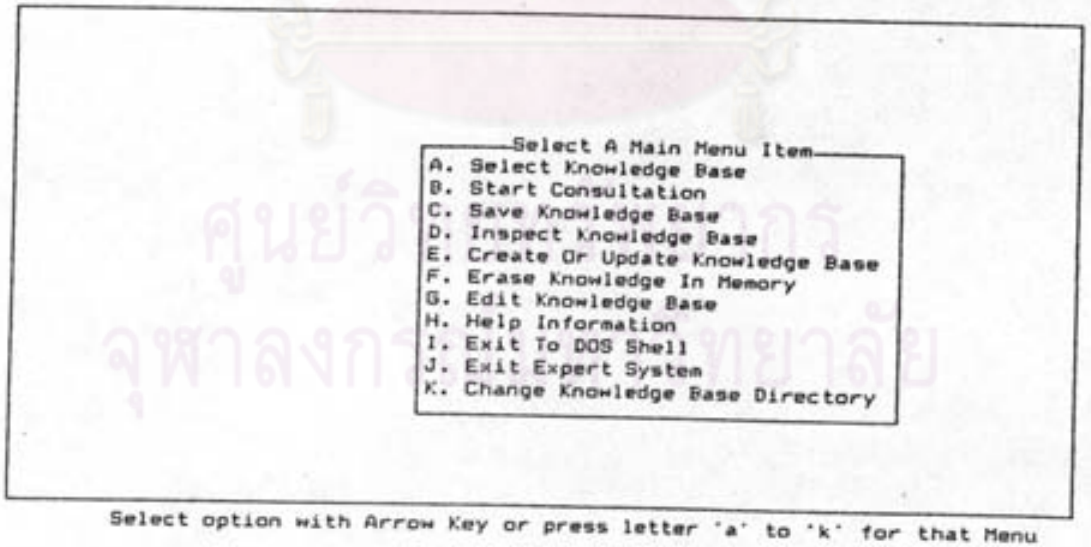
1.1.1 เข้าสู่ระบบผู้เชี่ยวชาญ จะปรากฏจอภาพดังรูปที่ 7.1

1.1.2 กด Enter เพื่อเข้าสู่เมนูหลัก ดังรูปที่ 7.2

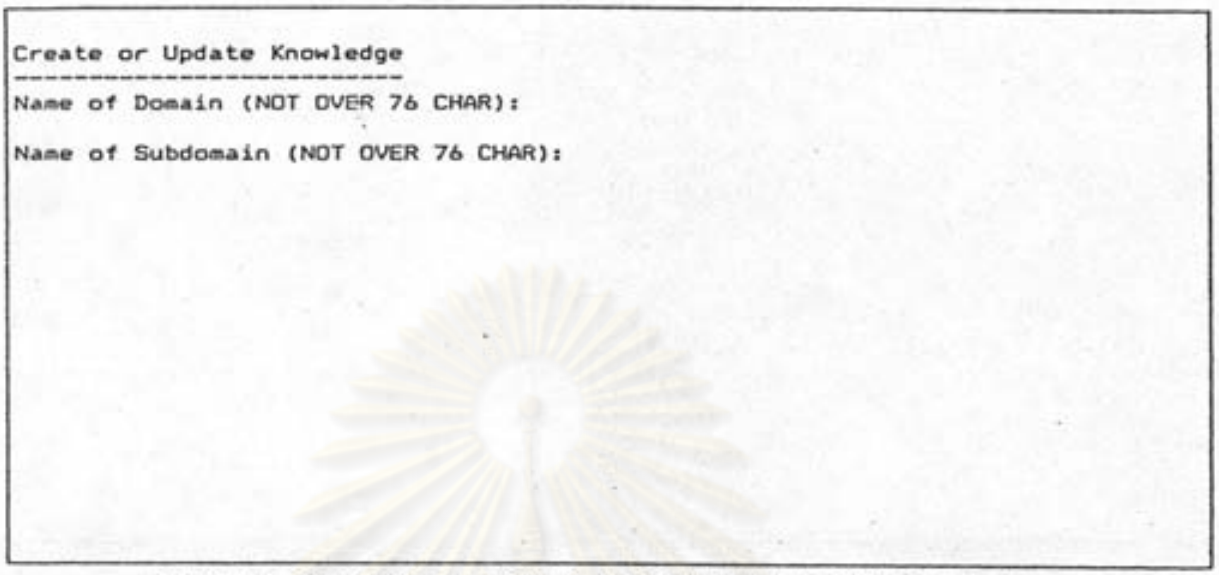
1.1.3 กด E (E. Create Or Update Knowledge Base)



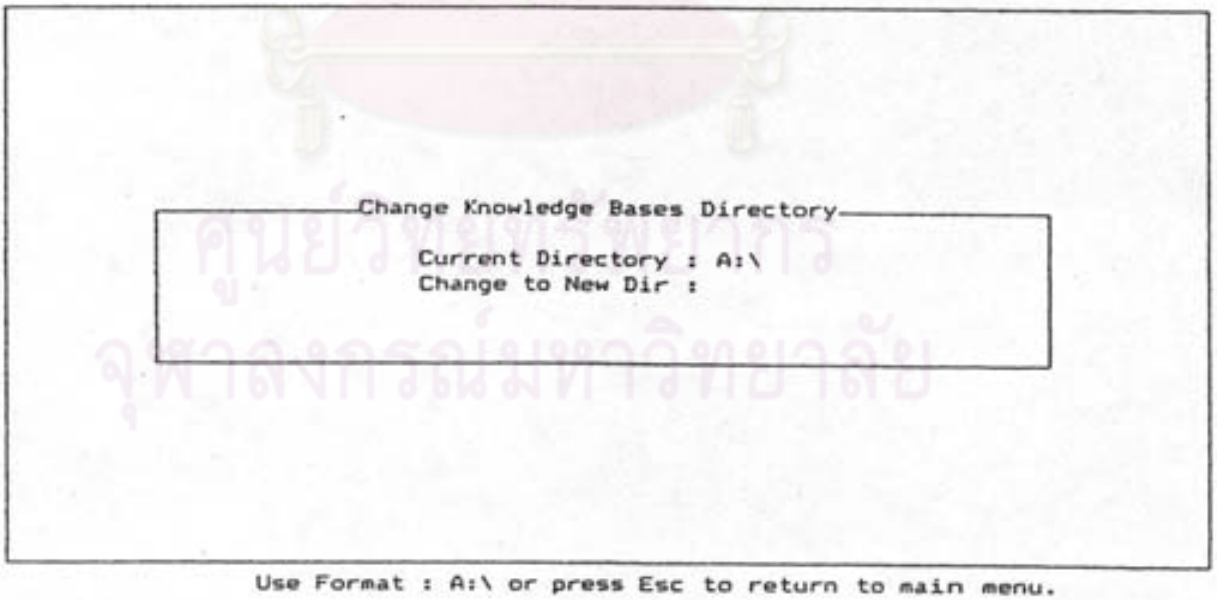
รูปที่ 7.1 จอภาพแสดงการเริ่มต้นเข้าสู่เปลือกระบบผู้เชี่ยวชาญ



รูปที่ 7.2 จอภาพแสดงรายการเมนูหลัก



รูปที่ 7.3 จอภาพแสดงการพร้อมรับข้อมูลการสร้างฐานความรู้



รูปที่ 7.4 จอภาพแสดงการกำหนดช่องเก็บข้อมูลฐานความรู้

หรือใช้ปุ่มดอกศรเลื่อนแถบสว่างไปที่ E แล้วกด Enter สร้างฐานข้อมูลใหม่จะปรากฏจอภาพ ดังรูปที่ 7.3

1.1.4 ทำการพิมพ์ Engine Problem แล้วกด Enter

พิมพ์ Cooling System Problem แล้วกด Enter

พิมพ์ engine overheats แล้วกด Enter

กด Enter อีกครั้งเพื่อผ่านไปยัง Recomendation

กด Enter เนื่องจากไม่มี Recomendation

พิมพ์ cooling ตัวใหญ่หรือตัวเล็กก็ได้ แล้วกด Enter จะปรากฏจอภาพ ดังรูปที่ 7.3 อีกครั้งหนึ่ง

1.1.5 กด Enter เพื่อเลิกการเพิ่มข้อมูล จะปรากฏจอภาพเป็นเมนูหลัก ดังรูปที่ 7.2 อีกครั้ง

1.1.6 กด K (K. Change Knowledge Base Directory) เพื่อเปลี่ยนช่องเก็บข้อมูลไปเป็นช่องที่ต้องการ จอภาพจะปรากฏ ดังรูปที่ 7.4

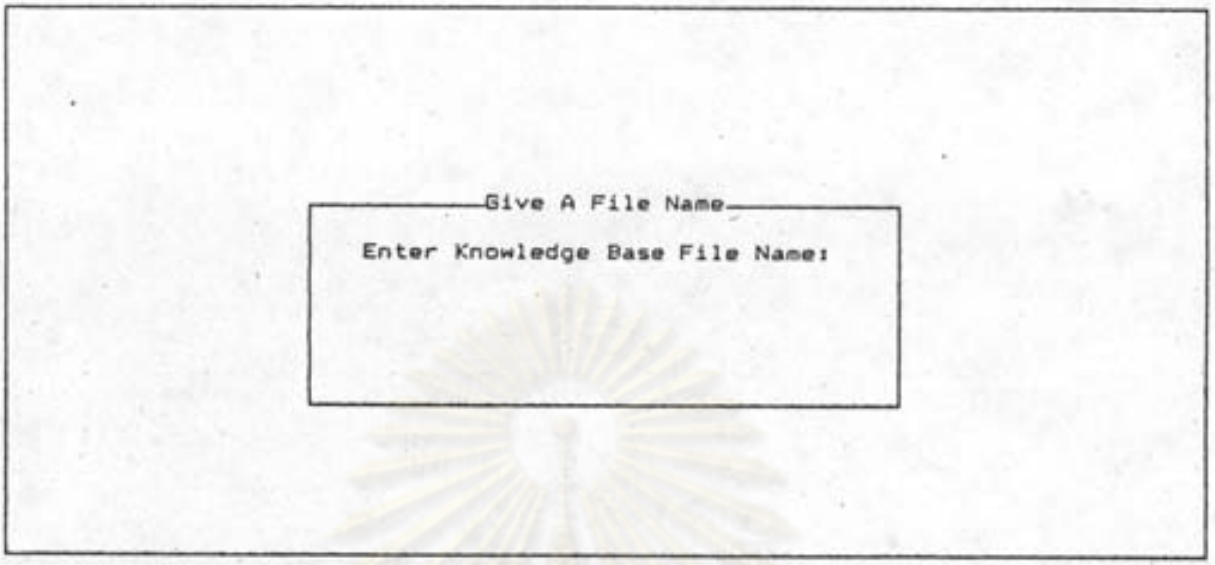
1.1.7 กำหนดช่องเก็บข้อมูลตามแบบฟอร์มที่แสดงเป็นตัวอย่างในรูปที่ 7.4 ในที่นี้เลือกใช้ช่องเก็บข้อมูลที่ B โดยการพิมพ์ B:\ ลงไปแล้วกด Enter

1.1.8 กด C (C. Save Knowledge Base) เพื่อทำการเก็บข้อมูลที่สร้างขึ้นมานี้ลงแผ่นข้อมูล จะปรากฏจอภาพ ดังรูปที่ 7.5

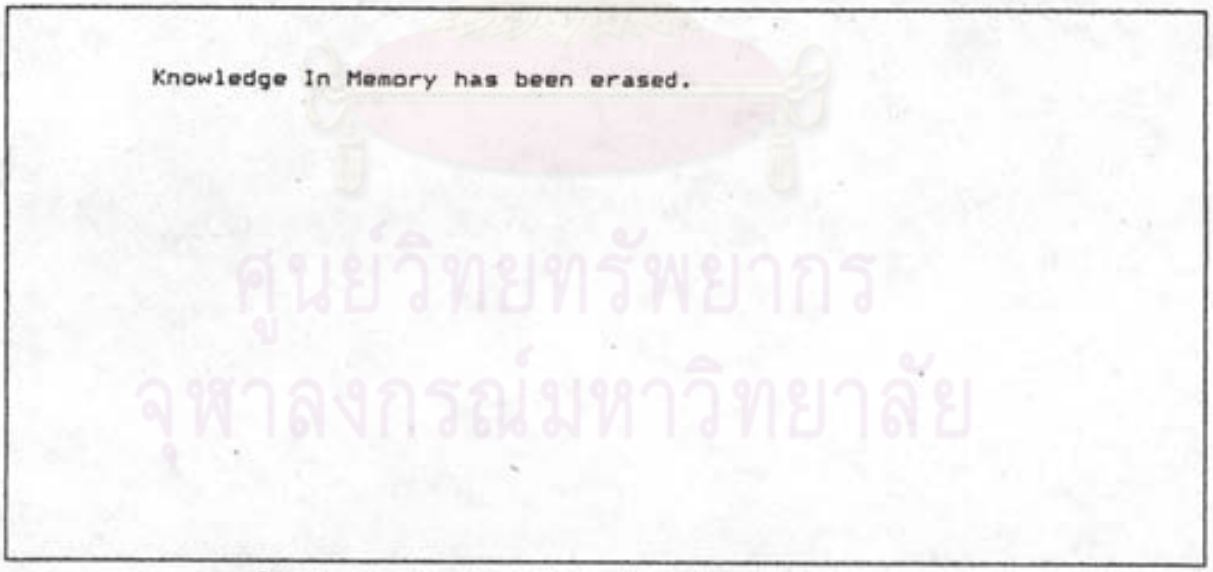
1.1.9 ใส่ชื่อไฟล์ฐานข้อมูลคือ Engine แล้วกด Enter ก็จะได้ไฟล์ฐานข้อมูลชื่อ ENGINE บรรจุด้วยกฎ 1 กฎ ในแผ่นข้อมูล

สำหรับการสร้างไฟล์ฐานความรู้ COOLING ก็ทำในทำนองเดียวกัน แต่ก่อนใส่ข้อมูลต้องลบข้อมูลเก่าที่ผ่านมาจากขั้นตอนต่าง ๆ ที่กล่าวมาออกก่อน โดยเลือกเมนู F. Erase Knowledge In Memory จะปรากฏจอภาพ ดังรูปที่ 7.6 แล้วกดปุ่มใด ๆ เพื่อทำงานต่อ แล้วจึงเลือกเมนู E.เพื่อสร้างไฟล์ฐานข้อมูลตามขั้นตอนที่ได้กล่าวแล้วก็จะได้ไฟล์ฐานข้อมูลไฟล์ที่ 2 ชื่อ COOLING ประกอบด้วยกฎ 2 กฎ

หากต้องการจะตรวจดูฐานความรู้ในไฟล์ฐานความรู้ใดฐานความรู้หนึ่งก็จะสามารถกระทำได้ โดยการเลือกไฟล์ฐานความรู้นั้น ๆ มาแล้วเลือกเมนู D. Inspect Knowledge Base เช่นหากเลือกไฟล์ COOLING ก็จะปรากฏข้อมูลความรู้บนจอภาพ ดังรูปที่ 7.7 แต่ไม่สามารถแก้ไขได้ จะใช้ในการตรวจดูเพียงอย่างเดียวเท่านั้น



รูปที่ 7.5 จอภาพแสดงการพร้อมรับชื่อไฟล์ฐานความรู้



รูปที่ 7.6 แสดงจอภาพหลังการลบข้อมูลในหน่วยความจำ

```
Database file COOLING is used

Is it true that
fan turns improperly ? : Yes
Is it true that
fan belt is noisy ? : Yes

I guess it is a
 'fan belt loose or missing'.

Because it is the
 'Cooling System Problem'
 and fan turns improperly
 and fan belt is noisy.

Recomendation(s) :
 Adjust or replace belt.


          Do you want to know how the answer is obtained (y/n)?
```

Please press only 'y' or 'n'.

รูปที่ 7.7 จอภาพแสดงฐานความรู้สำหรับตรวจดู

```
  Line 1     Col 1       Indent  Insert
rule(1,"Cooling System Problem","fan belt loose or missing",[1],[1,2],"")
rule(2,"Cooling System Problem","air does not cool water",[2],[3],"")
rule(3,"Cooling System Problem","leak in system",[3],[4],"")
cond(1,"fan turns improperly")
cond(2,"fan belt noises")
cond(3,"there are leaves or insects or dirt on radiator")
cond(4,"the coolant level in the reservoir is always found to be lower than -
rec(1,"Adjust or replace belt.")
rec(2,"Clean radiator or condenser.")
rec(3,"Check for leak and repair as necessary.")
data_file("COOLING")
```

Press F10 to end editing or Esc to abort editing.

รูปที่ 7.8 จอภาพแสดงการพร้อมรับการแก้ไขฐานความรู้

จากขั้นตอนที่กล่าวมาทั้งหมดก็จะได้ฐานความรู้ใหม่ทางด้านการวินิจฉัยข้อขัดข้องของเครื่องยนต์ 2 ไฟล์ฐานความรู้ต่อเนื่องกัน ในการสร้างฐานความรู้สำหรับระบบผู้เชี่ยวชาญจริง ๆ แล้วจะมีจำนวนกฎหรือจำนวนไฟล์มากกว่านี้มาก แต่ที่กล่าวมาเป็นเพียงตัวอย่างเพื่อแสดงขั้นตอนการสร้างเท่านั้น

1.2 การเพิ่มเติมฐานความรู้ ในกรณีที่มีไฟล์ฐานความรู้อยู่แล้วต้องการเพิ่มเติมฐานความรู้ให้มีกฎความรู้มากขึ้น ตัวอย่างเช่น ต้องการเพิ่มความรู้นี้ลงในไฟล์ฐานความรู้ COOLING

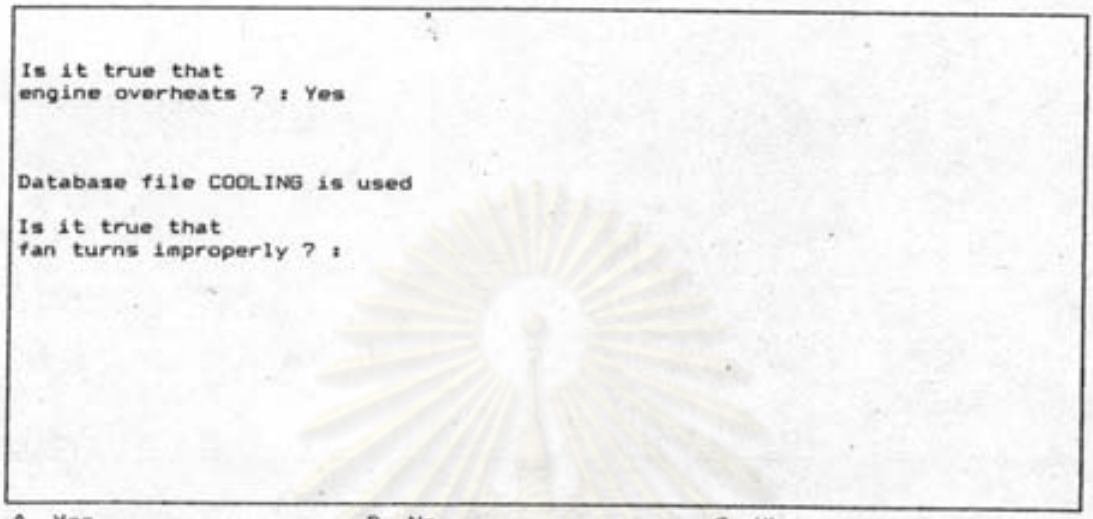
Domain	:	Cooling System Problem
Subdomain	:	leak in system
Condition	:	the coolant level in the reservoir is always found to be lower than the LOW line
Recomendation	:	Check for leak and repair as necessary.
File Connection	:	-

ข้อมูลความรู้เหล่านี้ก็จะมีวิธีการเพิ่มเติมเช่นเดียวกับวิธีการสร้างฐานความรู้ใหม่ แต่การเพิ่มเติมฐานความรู้จะต้องอ่านฐานความรู้เก่าคือไฟล์ COOLING เข้ามาเก็บไว้ในหน่วยความจำก่อน โดยการใช้เมนู A. Select Knowledge Base ความรู้ที่เพิ่มเติมเข้าไปใหม่นี้จะไปต่อกับความรู้เก่าที่มีอยู่แล้วในส่วนท้ายของฐานข้อมูลนั้น ๆ ถึงขณะนี้ไฟล์ COOLING ก็จะประกอบด้วยกฎ 3 กฎ ในการบันทึกข้อมูลลงบนแผ่นข้อมูลระบบจะไม่ถามชื่อไฟล์อีกแล้วเพราะชื่อไฟล์มีอยู่แล้วคือ COOLING

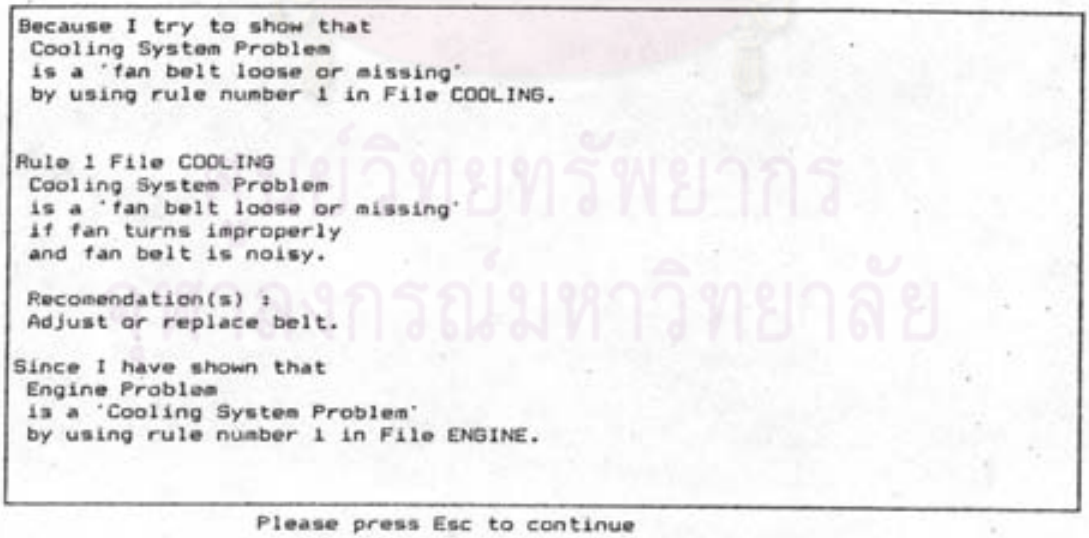
1.3 การแก้ไขฐานความรู้ ใช้ในกรณีที่มีความผิดพลาด เช่น พิมพ์ผิด ตัวอย่างเช่น หากต้องการแก้ไขไฟล์ COOLING ก็จะมีขั้นตอน ดังนี้

1.3.1 เลือกเมนู G. Edit Knowledge Base จากเมนูหลัก ดังรูปที่ 7.2 จะปรากฏจอภาพเป็น Directory ของไฟล์ต่าง ๆ ที่มีอยู่ในขณะนั้นให้เลือก

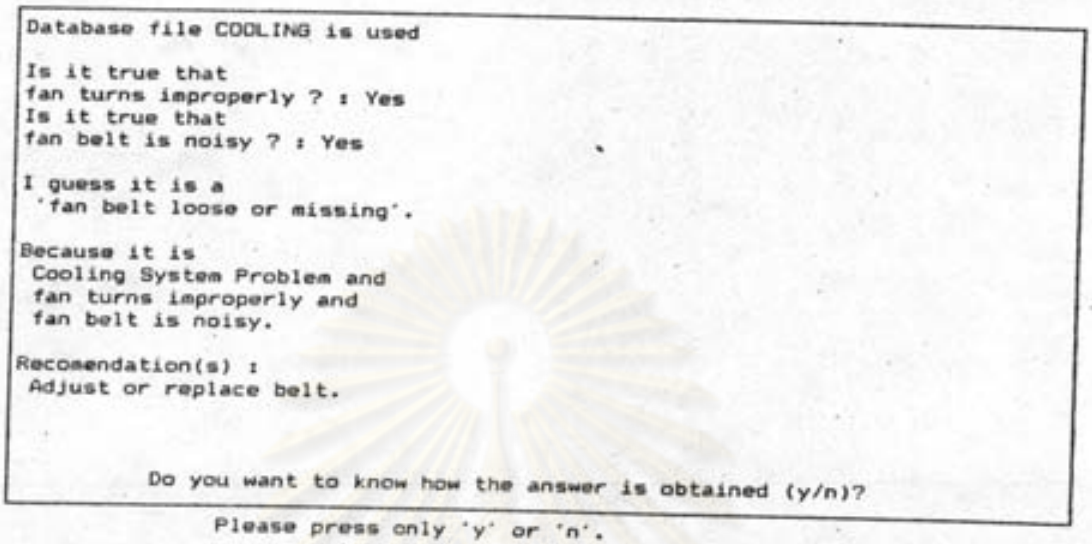
1.3.2 เลือกไฟล์ COOLING โดยใช้คีย์ลูกศรแล้วกด Enter จะปรากฏจอภาพ ดังรูปที่ 7.8



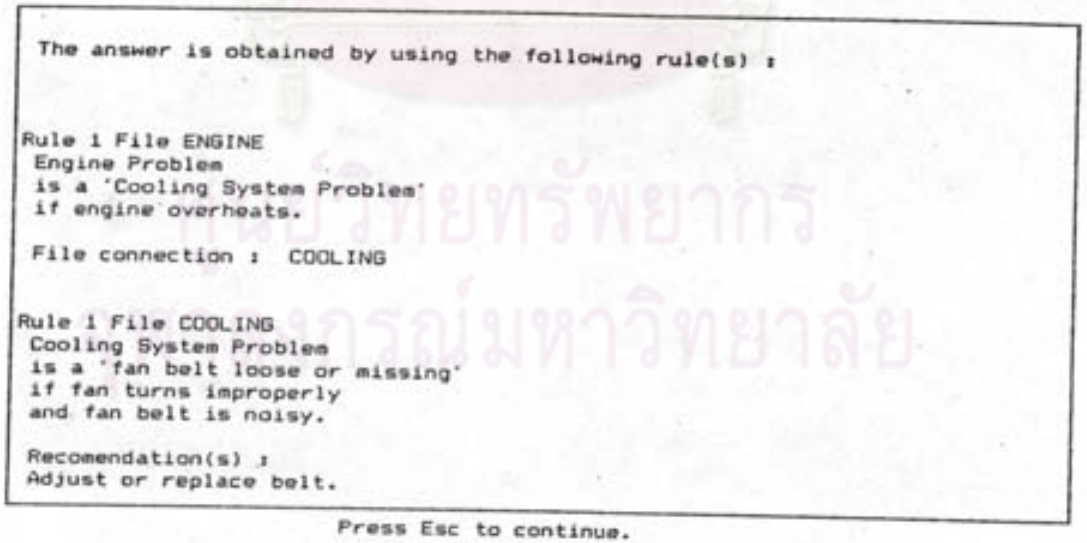
รูปที่ 7.9 จอภาพแสดงการซักถามข้อมูลเพิ่มเติมขณะทำการปรึกษา



รูปที่ 7.10 จอภาพแสดงเหตุผลสำหรับคำถาม "why"



รูปที่ 7.11 จอภาพแสดงคำตอบคำปรึกษาจากการวินิจฉัย



รูปที่ 7.12 จอภาพแสดงที่มาของคำตอบสำหรับคำถาม "how"

1.3.3 ทำการแก้ไขข้อความต่าง ๆ ตามต้องการ โดยใช้คีย์ต่าง ๆ คล้าย ๆ กับการทำงานในโปรแกรมประมวลผลคำ (Word processor) ทั่ว ๆ ไป

1.3.4 กด F10 เมื่อเสร็จการแก้ไขระบบจะถามว่า "ต้องการจัดเก็บข้อมูลที่แก้ไขหรือไม่" ให้ตอบ "y" ไฟล์ฐานความรู้ที่ถูกแก้ไขใหม่แล้วนี้ก็จะถูกจัดเก็บแทนไฟล์ฐานความรู้เก่า

ในการแก้ไขฐานความรู้ ผู้ใช้จะต้องสังเกตุการจัดรูปในการจัดเก็บข้อมูลความรู้ กฎต่าง ๆ ให้ดีก่อน กฎต่าง ๆ ถูกจัดอยู่ในรูปแบบเรียงกัน ดังนี้ (ดูรูปที่ 7.8 ประกอบ)

```
rule("domain","subdomain",[No.of recomendations],
     [No.of conditions],"file connection")
```

Recomendations และ Conditions จะจัดเก็บไว้โดยใช้ตัวเลขอ้างอิง และแยกเก็บข้อความออกมาเป็น

```
cond(No.of condition,"condition")
rec(No.of recomendation,"recomendation")
```

จากขั้นตอนปฏิบัติตามที่กล่าวมาจนถึงขณะนี้ ก็จะได้ฐานความรู้ใหม่สำหรับระบบผู้เชี่ยวชาญ 2 ไฟล์ คือ ENGINE ประกอบด้วยกฎ 1 กฎ และ COOLING ประกอบด้วยกฎความรู้ 3 กฎ พร้อมที่จะนำไปใช้ในการให้คำปรึกษาต่อไป

2. <u>การให้คำปรึกษา</u>

ในการให้คำปรึกษาระบบจะต้องเรียกใช้ฐานความรู้ในเรื่องที่จะให้คำปรึกษานั้น ซึ่งอาจจะได้จากการสร้างฐานความรู้ขึ้นมาในขณะนั้น หรือการเรียกใช้ไฟล์ฐานความรู้ที่ได้สร้างไว้แล้วตามขั้นตอนที่ได้กล่าวผ่านมา ในที่นี้จะยกตัวอย่างโดยใช้ฐานความรู้ที่ได้สร้างไว้ในขั้นตอนตัวอย่างการสร้างระบบผู้เชี่ยวชาญที่ผ่านมา คือเรื่องข้อขัดข้องของเครื่องยนต์ ซึ่งมีลำดับขั้นตอนการให้คำปรึกษาและการปฏิภาคกับผู้ใช้ขณะให้คำปรึกษาเป็นดังนี้

2.1 เลือกเมนู A. Select Knowledge Base เพื่อเลือกฐานความรู้

ที่เกี่ยวข้องกับเรื่องที่จะปรึกษา

2.2 เลือกเมนู B. Start Consultation เพื่อเริ่มการปรึกษา ระบบก็จะถามข้อมูลเพิ่มเติม จะปรากฏจอภาพ ดังรูป 7.9 บรรทัดแรก

2.3 หากข้อมูลนั้นถูกต้อง ให้ผู้ใช้ตอบ "yes" ระบบก็จะไปค้นหาคำตอบ แม้ว่ายังไม่ได้คำตอบ แต่ระบบรู้ขอบเขตของปัญหาที่แคบลงคือ Cooling System Problem ระบบจึงเรียกใช้ไฟล์ COOLING แล้วถามคำถามเพิ่มเติม ปรากฏจอภาพ ดังรูปที่ 7.9

2.4 หากผู้ใช้ต้องการทราบเหตุผล ก็จะถาม "why" ระบบก็จะแสดงเหตุผลทางจอภาพ ดังรูปที่ 7.10 ต่อไปให้กด Esc เพื่อกลับมาสู่คำถามเดิม

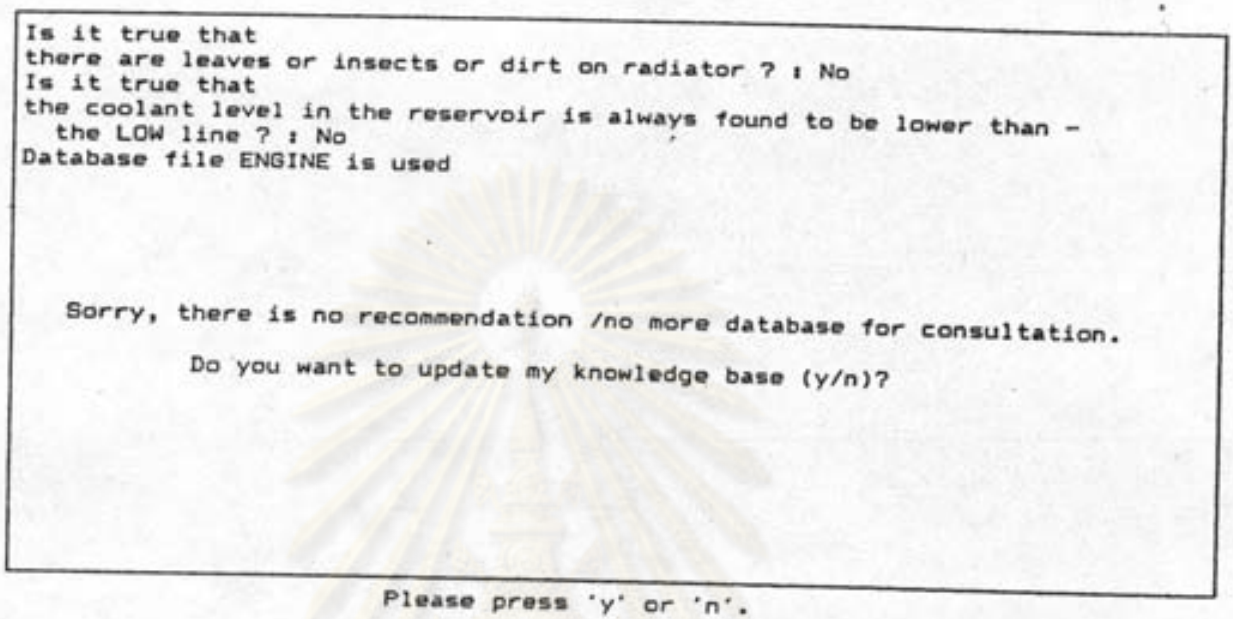
2.5 หากคำถามนั้นเป็นจริง ให้ผู้ใช้ตอบ "yes" แต่เงื่อนไขที่ต้องพิสูจน์ยังไม่ครบ ระบบจึงถามคำถามเพิ่มเติมอีก หากผู้ใช้ตอบ "yes" ก็จะได้คำตอบดังแสดงในรูปที่ 7.11

2.6 ระบบจะถามผู้ใช้ว่า "ต้องการทราบว่าได้ข้อสรุปนั้นมาอย่างไรหรือไม่" หากผู้ใช้กด y ระบบก็จะแสดงที่มาของคำตอบ ดังแสดงในรูปที่ 7.12 แล้วกด Esc

2.7 ระบบจะถามว่า ต้องการหาคำตอบอื่น ๆ อีกหรือไม่ หากต้องการกด y ก็จะถามคำถามเพื่อพิสูจน์เงื่อนไขของเป้าหมายอื่น ๆ อีก หากเงื่อนไขเป็นจริงครบก็จะแสดงคำตอบหรือข้อสรุปนั้น ๆ ตามรูปแบบที่กล่าวมาอีก หากไม่ต้องการคำตอบอื่นอีกก็กด n กลับเข้าสู่เมนูหลัก

2.8 ในกรณีที่ทำการพิสูจน์เป้าหมายต่าง ๆ แล้วไม่บรรลุผลสำเร็จ คือเงื่อนไขไม่เป็นจริงจะปรากฏจอภาพ ดังรูปที่ 7.13 ถามว่าต้องการเพิ่มเติมฐานความรู้อีกหรือไม่ หากต้องการเพิ่มกด y ระบบก็จะบอกไฟล์ที่กำลังติดต่ออยู่ชื่อไฟล์อะไร จากนั้นผู้ใช้ก็เพิ่มเติมฐานความรู้ตามวิธีที่ได้กล่าวมาแล้วในหัวข้อการเพิ่มเติมฐานความรู้ หากไม่ต้องการเพิ่มกด n เข้าสู่เมนูหลัก พร้อมที่จะทำงานอื่นต่อไป

การให้คำปรึกษาที่ยกตัวอย่างนี้เป็นเพียงไฟล์เล็ก ๆ เพื่อให้เห็นถึงขั้นตอนการใช้และการปฏิภาคกับผู้ใช้ของระบบเท่านั้น ส่วนการให้คำปรึกษาที่สมบูรณ์ที่ได้สร้างไว้คือการวินิจฉัยข้อขัดข้องของเครื่องคอมพิวเตอร์ส่วนบุคคล ซึ่งประกอบด้วยกฎความรู้กว่า 100 กฎ ครอบคลุมปัญหาต่าง ๆ ของเครื่องคอมพิวเตอร์ทุกอุปกรณ์และการวินิจฉัยข้อขัดข้องของรถยนต์ ซึ่งได้พัฒนาไว้เป็นบางส่วนเพื่อเป็นตัวอย่างและเป็นการเริ่มต้นให้ผู้ใช้หรือผู้เชี่ยวชาญทางด้านรถยนต์ได้สร้างฐานความรู้เพิ่มเติมได้ต่อไป



รูปที่ 7.13 จอภาพแสดงการหมดข้อมูลความรู้ในฐานความรู้

ภาคผนวก ค

ฐานความรู้สำหรับการวินิจฉัยเครื่องไมโครคอมพิวเตอร์

ไฟล์ COMPUTER

```
Rule 1 File COMPUTER
 Computer Problem
 is a 'Startup Problem'
 if you have a startup problem.
 File connection :  STARTUP

Rule 2 File COMPUTER
 Computer Problem
 is a 'Run Problem'
 if you have a run problem.
 File connection :  RUNPROB

Rule 3 File COMPUTER
 Computer Problem
 is a 'Display Problem'
 if you have a display problem.
 File connection :  DISPLAY

Rule 4 File COMPUTER
 Computer Problem
 is a 'Keyboard Problem'
 if you have a keyboard problem.
 File connection :  KEYBOARD
```

```
Rule 5 File COMPUTER
 Computer Problem
 is a 'Printer Problem'
 if you have a printer problem.
 File connection :  PRINTER
```

ไฟล์ STARTUP

```
Rule 1 File STARTUP
 Startup Problem
 is a 'System won't boot problem'
 if the system won't boot
 and nothing works and screen blank.

Rule 2 File STARTUP
 Startup Problem
 is a 'POST FAILS ( with beep ) problem'
 if the system shows error during startup ( POST FAILS )
 and there is (are) beep(s).

Rule 3 File STARTUP
 Startup Problem
 is a 'POST FAILS ( with error code ) problem'
 if the system shows error during startup ( POST FAILS )
 and an error message is displayed.

Rule 4 File STARTUP
 Startup Problem
 is a 'No Boot Problem ( POST WORKS OK )'
 if POST works okay but no boot.
```

Rule 5 File STARTUP

Startup Problem

is a 'defective internal power supply'

if the system shows error during startup (POST FAILS)

and there is no beep and nothing happens.

Recomendation(s) :

Check power supply and internal power supply cables.

Rule 6 File STARTUP

Startup Problem

is a 'defective memory chips in the system board or an adapter board'

if not the memory test does succeed.

Recomendation(s) :

Be sure all memory chips are firmly seated in there sockets -

and no pins are outside of sockets.

Use a diagnostic, if necessary, to locate the specific chip -

at fault.

Rule 7 File STARTUP

System won't boot problem

is a 'loss of AC power'

if not power is getting to the computer.

Recomendation(s) :

Check power cord, surge protector and outlets.

Rule 8 File STARTUP

System won't boot problem

is a 'on/off switch or power supply problem'

if power is getting to the computer.

```
 Recomendation(s) :
 Check on/off switch on system unit and internal power supply.

Rule 9 File STARTUP
 System won't boot problem
 is a 'defective power supply or power supply connectors'
 if there is no power light.
 Recomendation(s) :
 Check internal power supply cables.
 Check microprocessor chip and ROM chip.
 Possible system board problem.

Rule 10 File STARTUP
 POST FAILS ( with beep ) problem
 is a 'defective internal power supply'
 if there is one continuous beep.
 Recomendation(s) :
 Check power supply and internal power supply cables.

Rule 11 File STARTUP
 POST FAILS ( with beep ) problem
 is a 'defective system board'
 if there is one long and one short beep.
 Recomendation(s) :
 Repair or replace the system board.

Rule 12 File STARTUP
 POST FAILS ( with beep ) problem
 is a 'defective display or display cable'
```

if there is one long and two short beeps.

Recomendation(s) :

Repair or replace the defective cable.

Rule 13 File STARTUP

POST FAILS (with beep) problem

is a 'defective display or display cable'

if there is one short beep and a blank or incorrect display.

Recomendation(s) :

Repair or replace the defective cable.

Rule 14 File STARTUP

POST FAILS (with beep) problem

is a 'defective internal power supply'

if there is a repeating short beep.

Recomendation(s) :

Check power supply and internal power supply cables.

Rule 15 File STARTUP

POST FAILS (with beep) problem

is a 'defective or disconnected floppy disk drive or controller'

if there is one short beep and BASIC OK prompt.

Recomendation(s) :

Replace or connect the drive and controller.

Rule 16 File STARTUP

POST FAILS (with beep) problem

is a 'Floppy Disk Boot Problem'

if there is one short beep and the disk light.

File connection : FLOPDISK

Rule 17 File STARTUP

POST FAILS (with error code) problem

is a 'defective system board or wrong system board switches'

if the memory test does succeed

and error message 101 or 131 or 1XX is displayed.

Recomendation(s) :

Check switch or replace system board.

Rule 18 File STARTUP

POST FAILS (with error code) problem

is a 'defective memory chips in the system board or an adapter board'

if the memory test does succeed

and error message 201 or XXXX201 Parity Check X or 20X or XX20X - is displayed.

Recomendation(s) :

Be sure all memory chips are firmly seated in there sockets - and no pins are outside of sockets.

Rule 19 File STARTUP

POST FAILS (with error code) problem

is a 'disconnected or defective keyboard'

if the memory test does succeed

and error message 301 or XX301 or Keybord not functional or 30X - or XX30X is displayed.

Recomendation(s) :

Connect keyboard or replace.

Rule 20 File STARTUP

POST FAILS (with error code) problem

is a 'defective or disconnected floppy disk drive or controller'

if the memory test does succeed

and error message 601 or 6XX is displayed.

Recomendation(s) :

Replace or connect the drive and controller.

Rule 21 File STARTUP

POST FAILS (with error code) problem

is a 'disconnected or defective monochrome monitor'

if the memory test does succeed

and error message 4XX is displayed.

Recomendation(s) :

Check monitor, adapter card and monitor cables.

Rule 22 File STARTUP

POST FAILS (with error code) problem

is a 'disconnected or defective color monitor'

if the memory test does succeed

and error message 5XX is displayed.

Recomendation(s) :

Check monitor, adapter card and monitor cables.

Rule 23 File STARTUP

POST FAILS (with error code) problem

is a 'disconnected or defective printer'

if the memory test does succeed

and error message 9XX is displayed.

Recomendation(s) :

Check printer, printer adapter card and cables.

Rule 24 File STARTUP

POST FAILS (with error code) problem

is a 'disconnected or defective game adapter'

if the memory test does succeed

and error message 13XX is displayed.

Recomendation(s) :

Check game adapter, game adapter card and cables.

Rule 25 File STARTUP

POST FAILS (with error code) problem

is a 'defective internal power supply'

if the memory test does succeed

and error message 14XX or Printer Problems is displayed.

Recomendation(s) :

Check power supply and internal power supply cables.

Rule 26 File STARTUP

POST FAILS (with error code) problem

is a 'disconnected or defective hard disk'

if the memory test does succeed

and error message 1701 or 17XX is displayed.

Recomendation(s) :

Check disk controller card, disk and power to disk.

Rule 27 File STARTUP

POST FAILS (with error code) problem

is a 'disconnected or defective expansion unit'
if the memory test does succeed
and error message 1801 or 18XX is displayed.
Recomendation(s) :
Check to be sure expansion unit is connected and turned on.
If everyting is on and connected, check for a defective cable -
or expansion unit.
You should still be able to boot from a floppy disk drive -
or any hard disk in the main unit.

Rule 28 File STARTUP
POST FAILS (with error code) problem
is a 'defective internal power supply'
if the memory test does succeed
and error message 02X is displayed.
Recomendation(s) :
Check power supply and internal power supply cables.

Rule 29 File STARTUP
No Boot Problem (POST WORKS OK)
is a 'Floppy Disk Boot Problem'
if not you are trying to boot from a hard disk.
File connection : FLOPDISK

Rule 30 File STARTUP
No Boot Problem (POST WORKS OK)
is a 'Floppy Disk Boot Problem'
if you are trying to boot from a hard disk
and not try to boot a system from a floppy disk is succesful (be -

sure it is a good disk with a good copy of DOS).

File connection : FLOPDISK

Rule 31 File STARTUP

No Boot Problem (POST WORKS OK)

is a 'Hard Disk Boot Problem'

if you are trying to boot from a hard disk

and try to boot a system from a floppy disk is succesful (be -

sure it is a good disk with a good copy of DOS).

File connection : HARDDISK

ไฟล์ RUNPROB

Rule 1 File RUNPROB

Run Problem

is a 'air temperature near the computer is too high'

if the ambient temperature near the computer is above 90 F.

Recomendation(s) :

The air temperature near the computer should be no more than 90 F.

Rule 2 File RUNPROB

Run Problem

is a 'air temperature near the computer is too low'

if the ambient temperature near the computer is below 60 F.

Recomendation(s) :

The air temperature near the computer should be no less than 60 F.

Rule 3 File RUNPROB

Run Problem

is a 'defective fan or blocked fan vent'

if it is overheating.

Recomendation(s) :

Be sure fan turns and clean fan filter if necessary.

Be sure you are not putting too many or too power-intensive - adapter cards in the system.

Rule 4 File RUNPROB

Run Problem

is a 'failure of a memory chip or any hardware that use parity error interupt'

if parity error messages are displayed

and not the ambient temperature near the computer is above 90 F

and not the ambient temperature near the computer is below 60 F.

Recomendation(s) :

This chip can be located with a good memory diagnotic.

If you recently installed some new hardware or software, be - suspicious of it creating the parity error interrupt message.

Rule 5 File RUNPROB

Run Problem

is a 'power surge, static electricity, defective power supply or system board'

if computer drops power, turning itself off

and not the ambient temperature near the computer is above 90 F

and not the ambient temperature near the computer is below 60 F.

Recomendation(s) :

Install a surge protector if you do not have one.

Add a static mat if necessary.

If this does not work, check the power supply, then the system -

board.

Rule 6 File RUNPROB

Run Problem

is a 'hardware or software driver, bug, system board or power supply problem'

if computer crashes when turning on peripheral

and not the ambient temperature near the computer is above 90 F

and not the ambient temperature near the computer is below 60 F.

Recomendation(s) :

Isolate these causes and repair as necessary.

Rule 7 File RUNPROB

Run Problem

is a 'power surge, static electricity, defective power supply or system board'

if there is erratic operation or intermittent failure

and not the ambient temperature near the computer is above 90 F

and not the ambient temperature near the computer is below 60 F

and not it does always fail with the same program when you do the - same thing.

Recomendation(s) :

Install a surge protector if you do not have one.

Add a static mat if necessary.

If this does not work, check the power supply, then the system - board.

Rule 8 File RUNPROB

Run Problem

is a 'erratic program'

if there is erratic operation or intermittent failure
and not the ambient temperature near the computer is above 90 F
and not the ambient temperature near the computer is below 60 F
and it does always fail with the same program when you do the -
same thing.
Recomendation(s) :
Check for conflicts with resident programs.
If there are no conflicts, try creating a new copy of the -
program from the master.
Check with the program manufacturer if the problem persists.

Rule 9 File RUNPROB
Run Problem
is a 'DOS problem'
if it has problems in operating one specific program
and not the ambient temperature near the computer is above 90 F
and not the ambient temperature near the computer is below 60 F
and it is a DOS program.
Recomendation(s) :
Look up the error message in the DOS manual and follow the -
suggested procedure.

Rule 10 File RUNPROB
Run Problem
is a 'application software problem'
if it has problems in operating one specific program
and not the ambient temperature near the computer is above 90 F
and not the ambient temperature near the computer is below 60 F
and not it is a DOS program .

Recomendation(s) :

Contact the software company by letter or phone for help.

Rule 11 File RUNPROB

Run Problem

is a 'Computer locks up (Power stays up) problem'

if computer locks up but power stays up, keyboard is dead

and not the ambient temperature near the computer is above 90 F

and not the ambient temperature near the computer is below 60 F.

Rule 12 File RUNPROB

Computer locks up (Power stays up) problem

is a 'busy computer'

if the computer is executing other program.

Recomendation(s) :

If this is a problem for you, get a faster computer or one -

that supports the multitasking program execution.

Rule 13 File RUNPROB

Computer locks up (Power stays up) problem

is a 'unplugged keyboard or cables fualty'

if not the computer is executing other program

and not all cables are okay and plugged into the system.

Recomendation(s) :

Reroute or change cables to protect against the problem again.

Rule 14 File RUNPROB

Computer locks up (Power stays up) problem

is a 'defective system board, bad keyboard or memory chip'

if not the computer is executing other program
and all cables are okay and plugged into the system
and not the reboot is eventually successful, when try to reboot again
and DOS is okay.
Recomendation(s) :
Substitute a good keyboard to check if the old keyboard is good.

Rule 15 File RUNPROB
Computer locks up (Power stays up) problem
is a 'special program problem'
if not the computer is executing other program
and all cables are okay and plugged into the system
and the reboot is eventually successful, when try to reboot again
and the computer locked up again, when you try to repeat the same order.
Recomendation(s) :
If the program is new and use special hardware, there may -
be an interrupt conflict.
See the DOS technical manual for how the interrupts are used.

Rule 16 File RUNPROB
Computer locks up (Power stays up) problem
is a 'power line surge or static electricity problem'
if not the computer is executing other program
and all cables are okay and plugged into the system
and the reboot is eventually successful, when try to reboot again
and not the computer locked up again, when you try to repeat the same order.

Recomendation(s) :

Using a surge protector to protect against future surges.

Static mats and special antistatic sprays can prevent static - problems.

Rule 17 File RUNPROB

Run Problem

is a 'Hard Disk Run Problem'

if you have a hard disk problem.

File connection : HARDDISK

Rule 18 File RUNPROB

Run Problem

is a 'Floppy Disk Run Problem'

if you have a floppy disk problem.

File connection : FLOPDISK

ไฟล์ DISPLAY

Rule 1 File DISPLAY

Display Problem

is a 'defective vedio cable or monitor'

if there is no display

and monitor has power and is on

and brightness control is turned up.

Recomendation(s) :

Check for defective vedio cable or monitor.

Rule 2 File DISPLAY

Display Problem

is a 'defective power'

if the display fades in and out

and the display stills fade in and out with another substitute monitor.

Recomendation(s) :

Repair as necessary.

Rule 3 File DISPLAY

Display Problem

is a 'defective monitor'

if the monitor is overheating

and nothing is blocking monitor ventilation.

Recomendation(s) :

Check and repair monitor.

Rule 4 File DISPLAY

Display Problem

is a 'defective monitor or adapter card'

if there is no vertical synchronization

and you have already adjusted vertical hold.

Recomendation(s) :

Check for defective monitor or adapter card.

Rule 5 File DISPLAY

Display Problem

is a 'defective monitor or adapter card'

if there is no horizontal synchronization

and you have already adjusted horizontal hold.

Recomendation(s) :

Check for defective monitor or adapter card.

Rule 6 File DISPLAY

Display Problem

is a 'defective keyboard'

if garbage is displayed

and display is all right during boot

and wrong characters displayed when you enter from the keyboard.

Recomendation(s) :

Check for defective keyboard by substituting for a good one.

Rule 7 File DISPLAY

Display Problem

is a 'bad monitor adapter or bad memory'

if garbage is displayed

and keyboard is not defective.

Recomendation(s) :

Check for bad monitor adapter or bad memory by substituting -
a good one.

Rule 8 File DISPLAY

Display Problem

is a 'adapter card problem'

if it is bad or no color on color monitor

and the color controls are adjusted properly and working.

Recomendation(s) :

Check adapter card and repair as necessary.

ไฟล์ DISPLAY

Rule 1 File KEYBOARD

Keyboard Problem

is a 'bad keyboard cable, bad keyboard or bad system board'

if the computer should boot

and the display should show the proper starting messages

and keyboard does not do anything.

Recomendation(s) :

Check for bad keyboard cable, bad keyboard or bad system board -

by substituting a good one.

Rule 2 File KEYBOARD

Keyboard Problem

is a 'defective keyboard'

if keyboard input wrong characters

and there is no stuck key

and charecters on display are right on starting.

Recomendation(s) :

Check for defective keyboard by substituting a good one.

Rule 3 File KEYBOARD

Keyboard Problem

is a 'key contact problem'

if one or more key don't work

and it can work after electronic contact was cleaned.

Recomendation(s) :

Blow air under keys to clear out any debris.

Use electronic contact cleaner to clear key switches.

Rule 4 File KEYBOARD

Keyboard Problem

is a 'keyboard electronics problem'

if one or more key don't work

and not it can work after electronic contact was cleaned.

Recomendation(s) :

Check keyboard electronics and repair as necessary.

Rule 5 File KEYBOARD

Keyboard Problem

is a 'Key contact problem'

if when you press a key, two or more characters appear

and not the key is held down for a few seconds

and it can work after electronic contact was cleaned.

Recomendation(s) :

Blow air under keys to clear out any debris.

Use electronic contact cleaner to clear key switches.

Rule 6 File KEYBOARD

Keyboard Problem

is a 'keyboard electronics problem'

if when you press a key, two or more characters appear

and not the key is held down for a few seconds

and not it can work after electronic contact was cleaned.

Recomendation(s) :

Check keyboard electronics and repair as necessary.

Rule 7 File KEYBOARD

Keyboard Problem

is a 'dirty keyboard'

if a foreign object was dropped into the keyboard

and it can work after electronic contact was cleaned.

Recomendation(s) :

Blow air under keys to clear out any debris.

Use electronic contact cleaner to clear key switches.

Rule 8 File KEYBOARD

Keyboard Problem

is a 'keyboard electronics problem'

if a foreign object was dropped into the keyboard

and not it can work after electronic contact was cleaned.

Recomendation(s) :

Check keyboard electronics and repair as necessary.

Rule 9 File KEYBOARD

Keyboard Problem

is a 'keyboard spilled'

if something was spilled on the keyboard.

Recomendation(s) :

Remove power from keyboard immediately.

Soak up what you can with a rag.

Blow air under key and leave keyboard 48 hours to dry.

Check out. It may or may not need more repair.

ไฟล์ PRINTER

Rule 1 File PRINTER

Printer Problem

is a 'no power supply'

if the printer is dead

and not printer power light is on.

Recomendation(s) :

Check for defective printer power supply, fuse blown or no - voltage to printer.

Rule 2 File PRINTER

Printer Problem

is a 'defective printer'

if not printer self-test does work (see printer manual).

Recomendation(s) :

Check printer and repair as necessary.

Rule 3 File PRINTER

Printer Problem

is a 'defective cable to printer or printer adapter card'

if printer self-test does work (see printer manual)

and printer fails online.

Recomendation(s) :

Check for defective cable to printer or printer adapter card.

Rule 4 File PRINTER

Printer Problem

is a 'program printer driver was not selected properly'

if printer prints garbage

and it can prints a DIR list to the printer correctly.

Recomendation(s) :

Select the proper driver in the program.

Call program manufacturer if necessary.

Rule 5 File PRINTER

Printer Problem

is a 'band rate or other switches on printer are not set right'

if printer prints garbage

and not it can prints a DIR list to the printer correctly.

Recomendation(s) :

Reset band rate or other switches.

Rule 6 File PRINTER

Printer Problem

is a 'printer was not adjusted correctly, bad cable or dust in printer'

if printer has erratic, occasional errors.

Recomendation(s) :

Clean and adjust printer.

Check for bad cable and replace if necessary.

Rule 7 File PRINTER

Printer Problem

is a 'no ribbon, no paper or printer jammed'

if printer suddenly stops while printing

and there is no ribbon or no paper or printer jammed.

Recomendation(s) :

Check for these visual causes.

Rule 8 File PRINTER

Printer Problem

is a 'cable or printer adapter card problem'

if printer suddenly stops while printing

and not there is no ribbon or no paper or printer jammed
and self-test works (Try printer self-test).
Recomendation(s) :
Check cable and printer adapter.

Rule 9 File PRINTER
Printer Problem
is a 'carriage movement problem'
if carriage freezes up and does not move.
Recomendation(s) :
Turn off power. Check for foreign object jamming printer.
Check carriage movement.

Rule 10 File PRINTER
Printer Problem
is a 'incorrect ribbon'
if printer runs fine, but does not print anything
and not ribbon is installed correctly in the right position.
Recomendation(s) :
Correct the ribbon.

Rule 11 File PRINTER
Printer Problem
is a 'defective print head'
if printer runs fine, but does not print anything
and ribbon is installed correctly in the right position.
Recomendation(s) :
Check print head and repair as necessary.

```
Rule 12 File PRINTER
 Printer Problem
 is a 'print head jammed or ventilation blocked'
 if printer or print head overheats.
 Recomendation(s) :
 Check print head and ventilation.

Rule 13 File PRINTER
 Printer Problem
 is a 'defective wheel'
 if part of printed characters are missing
 and your printer is daisy-wheel printer.
 Recomendation(s) :
 Check for defective wheel.

Rule 14 File PRINTER
 Printer Problem
 is a 'defective print head'
 if part of printed characters are missing
 and your printer is dot-matrix printer.
 Recomendation(s) :
 Check for defective print head.
 Check for dirty printer hammer or head.
 If clean, check printer alignment.

Rule 15 File PRINTER
 Printer Problem
 is a 'incorrected adjustment'
 if characters are printed unevenly.
```

Recomendation(s) :

Printer needs adjustment.

Rule 16 File PRINTER

Printer Problem

is a 'wrong type of paper or paper is not loaded correctly'

if the paper jams.

Recomendation(s) :

Check paper path. Be sure there is no foreign objects in path.

ไฟล์ HARDDISK

Rule 1 File HARDDISK

Hard Disk Boot Problem

is a 'disconnected or defective hard disk'

if you have DOS 2.0 or later installed on the hard disk

and not motor is turning (you can feel by touching the disk panel) -

and the load light on the disk flashes during boot.

Recomendation(s) :

Check disk controller card, disk and power to disk.

Rule 2 File HARDDISK

Hard Disk Boot Problem

is a 'DOS was not installed on the hard disk'

if not you have DOS 2.0 or later installed on the hard disk.

Recomendation(s) :

Install a DOS 2.0 or later on the hard disk.

Rule 3 File HARDDISK

Hard Disk Boot Problem

is a 'Hard Disk Boot Problem (but motor works)'

if motor is turning (you can feel by touching the disk panel) -

and the load light on the disk flashes during boot.

Rule 4 File HARDDISK

Hard Disk Boot Problem (but motor works)

is a 'lost data and programs on the disk'

if not you can read the directory on the hard disk after booting -

from a floppy.

Recomendation(s) :

Try to reformat the hard disk and restore from a backup.

Rule 5 File HARDDISK

Hard Disk Boot Problem (but motor works)

is a 'defective DOS on the hard disk'

if you can read the directory on the hard disk after booting -

from a floppy

and it is successful to restore DOS to the hard disk from a floppy -

(by putting a DOS disk in drive A: and using SYS C:).

Recomendation(s) :

Now new DOS is installed already.

Rule 6 File HARDDISK

Hard Disk Boot Problem (but motor works)

is a 'something in the AUTOEXEC.BAT file prevents completion of

the boot'

if you can read the directory on the hard disk after booting -

from a floppy

and not it is successful to restore DOS to the hard disk from a floppy -

(by putting a DOS disk in drive A:and using SYS C:)

and it is successful to reboot from the hard disk after rename - the AUTOEXEC.BAT file on the hard disk to another name.

Recomendation(s) :

Be particularly suspicious of anything added recently to the file.

Create a new suitable AUTOEXEC.BAT file.

Rule 7 File HARDDISK

Hard Disk Boot Problem (but motor works)

is a 'something in the CONFIG.SYS file prevents completion of the boot'

if you can read the directory on the hard disk after booting - from a floppy

and not it is successful to restore DOS to the hard disk from a floppy -

(by putting a DOS disk in drive A:and using SYS C:)

and not it is successful to reboot from the hard disk after rename - the AUTOEXEC.BAT file on the hard disk to another name

and it is a successful to reboot from the hard disk after rename - the CONFIG.SYS file on the hard disk to another name.

Recomendation(s) :

Be particularly suspicious of anything added recently to the file.

Create a new suitable CONFIG.SYS file.

Rule 8 File HARDDISK

Hard Disk Boot Problem (but motor works)

is a 'particularly suspicious of any new hardware or software installed'

if you can read the directory on the hard disk after booting - from a floppy

and not it is successful to restore DOS to the hard disk from a floppy -

(by putting a DOS disk in drive A:and using SYS C:)

and not it is successful to reboot from the hard disk after rename - the AUTOEXEC.BAT file on the hard disk to another name

and not it is successful to reboot from the hard disk after rename - the CONFIG.SYS file on the hard disk to another name.

Recomendation(s) :

Remove it and try the boot again.

Check switches on the system board.

Rule 9 File HARDDISK

Hard Disk Run Problem

is a 'Hard Disk Dead Problem'

if the hard disk is dead --no load light when accessed.

Rule 10 File HARDDISK

Hard Disk Run Problem

is a 'Hard Disk Improperly Read or Write Problem'

if the hard disk reads or writes improperly.

Rule 11 File HARDDISK

Hard Disk Run Problem

is a 'Hard Disk Write Problem'

if the hard disk reads correctly, but does not write.

```
Rule 12 File HARDDISK
 Hard Disk Run Problem
 is a 'poorly designed application program'
 if CHKDSK program generates error messages
 and CHKDSK is able to find lost clusters after running an old
 programs.
 Recomendation(s) :
 Suspect the cause to be the old program.
 New programs ( 1985 - ) take advantage of newer DOS functions -
 that eliminate the problem.

Rule 13 File HARDDISK
 Hard Disk Run Problem
 is a 'defective disk drive'
 if CHKDSK program generates error messages
 and not CHKDSK is able to find lost clusters after running an old
 programs.
 Recomendation(s) :
 Check disk drive.

Rule 14 File HARDDISK
 Hard Disk Run Problem
 is a 'bearing going out on the drive'
 if the disk makes an unusual sound .
 Recomendation(s) :
 Back up the disk immediately, then have the disk checked.

Rule 15 File HARDDISK
 Hard Disk Run Problem
```

is a 'Lost Information Problem'

if disk lost information previously stored.

Rule 16 File HARDDISK

Lost Information Problem

is a 'unparked disk drive head'

if you have physically moved the hard disk recently.

Recomendation(s) :

If necessary on your system always park head before moving.

Rewrite bad data or programs to disk from backups to recover -

this time.

Rule 17 File HARDDISK

Lost Information Problem

is a 'suspect bad drive'

if not you have physically moved the hard disk recently.

Recomendation(s) :

Back up disk immediately.

Have disk checked after backing it up.

Rule 18 File HARDDISK

Hard Disk Dead Problem

is a 'defective hard disk, power supply or power supply cable'

if the hard disk is an expansion unit

and expansion unit is on.

Recomendation(s) :

Check power supply, power supply cable and hard disk.

Rule 19 File HARDDISK

Hard Disk Dead Problem

is a 'expansion unit is off'

if the hard disk is an expansion unit

and not expansion unit is on.

Recomendation(s) :

Be sure expansion unit is on.

Rule 20 File HARDDISK

Hard Disk Dead Problem

is a 'defective hard disk, power supply or power supply cable'

if not the hard disk is an expansion unit.

Recomendation(s) :

Check power supply, power supply cable and hard disk.

Rule 21 File HARDDISK

Hard Disk Improperly Read or Write Problem

is a 'special program problem'

if it only happens with one program.

Recomendation(s) :

Some programs may have difficulties working with some disks.

Check with the program manufacturer.

Rule 22 File HARDDISK

Hard Disk Improperly Read or Write Problem

is a 'resident software problem'

if not it only happens with one program

and not the problem persists after removing all resident programs -

by starting without the AUTOEXEC.BAT.

Recomendation(s) :

Try to remove specific resident program or installing them -
in a different order.

Rule 23 File HARDDISK

Hard Disk Improperly Read or Write Problem
is a 'bad drive, controller or controller-to-drive cable'
if not it only happens with one program
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT.
Recomendation(s) :
Check cable, controller and drive.

Rule 24 File HARDDISK

Hard Disk Write Problem
is a 'special program problem'
if it only happens with one program.
Recomendation(s) :
Some programs may have difficulties working with some disks.
Check with the program manufacturer.

Rule 25 File HARDDISK

Hard Disk Write Problem
is a 'bad drive, controller or controller-to-drive cable'
if not it only happens with one program
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT.
Recomendation(s) :
Check cable, controller and drive.

Rule 26 File HARDDISK

Hard Disk Write Problem

is a 'resident software problem'

if not it only happens with one program

and not the problem persists after removing all resident programs -

by starting without the AUTOEXEC.BAT.

Recomendation(s) :

Try to remove specific resident program or installing them -

in a different order.

ไฟล์ FLOPDISK

Rule 1 File FLOPDISK

Floppy Disk Boot Problem

is a 'suspect drive has no power'

if the floppy disk drive is dead --no load light or motor (feel -

panel) during boot.

Recomendation(s) :

Check power supply and power cable to drive.

Rule 2 File FLOPDISK

Floppy Disk Boot Problem

is a 'defective drive'

if the floppy disk drive is dead --no load light or motor (feel -

panel) during boot

and drive has power.

Recomendation(s) :

Replace or repair drive.

Rule 3 File FLOPDISK

Floppy Disk Boot Problem

is a 'physical floppy disk damaged'

if the load light comes on, the motor turns but nothing else happens

and the disk is formatted and contains DOS

and not this same disk can boot on another computer.

Recomendation(s) :

Destroy it after being sure you have a backup.

Rule 4 File FLOPDISK

Floppy Disk Boot Problem

is a 'dirty read head or other foreign matter in the drive'

if the load light comes on, the motor turns but nothing else happens

and the disk is formatted and contains DOS

and this same disk can boot on another computer

and the disk load properly and the motor turn (visual check of

the drive)

and it work after cleaning a read head.

Recomendation(s) :

Clean read head using a head cleaning kit.

Try to keep disk environment clean.

Rule 5 File FLOPDISK

Floppy Disk Boot Problem

is a 'unformatted disk or not contains DOS'

if the load light comes on, the motor turns but nothing else happens

and not the disk is formatted and contains DOS.

Recomendation(s) :

Use a formatted disk with DOS on it.

Rule 6 File FLOPDISK

Floppy Disk Boot Problem

is a 'faulty drive'

if the load light comes on, the motor turns but nothing else happens

and the disk is formatted and contains DOS

and this same disk can boot on another computer

and not it work after cleaning a read head

and you have a spare or two floppy disk drives in the unit

and you can boot from the other drive.

Recomendation(s) :

Check for broken or loose drive belt.

Rule 7 File FLOPDISK

Floppy Disk Boot Problem

is a 'controller or cable problems'

if the load light comes on, the motor turns but nothing else happens

and the disk is formatted and contains DOS

and this same disk can boot on another computer

and not it work after cleaning a read head

and you have a spare or two floppy disk drives in the unit

and not you can boot from the other drive.

Recomendation(s) :

Check cable and controller.

Rule 8 File FLOPDISK

Floppy Disk Boot Problem

is a 'disk drive, internal drive cable or controller problem'

if the load light comes on, the motor turns but nothing else happens

and the disk is formatted and contains DOS

and this same disk can boot on another computer
and not it work after cleaning a read head
and not you can boot from the other drive
and disk drive belt is not broken and motor is turning when load -
light is on.
Recomendation(s) :
Isolate cause by swapping out drive, controller and cable -
-one at a time.

Rule 9 File FLOPDISK
Floppy Disk Boot Problem
is a 'COMMAND.COM file do not on the disk'
if you get the message -Bad or missing command interpreter.
Recomendation(s) :
Use a DOS disk with a COMMAND.COM file.

Rule 10 File FLOPDISK
Floppy Disk Boot Problem
is a 'unformatted disk or does not contain DOS'
if you get the message -Non-system disk or disk erroror -Disk -
boot failure.
Recomendation(s) :
Use a formatted disk with DOS on it.

Rule 11 File FLOPDISK
Floppy Disk Boot Problem
is a 'unproperly formatted disk, or drive door open'
if you got the massage -Drive not ready.
Recomendation(s) :

Close door or replace disk.

Rule 12 File FLOPDISK

Floppy Disk Run Problem

is a 'bad disk power cable or power supply'

if the floppy disk is dead --no load light when accessed.

Recomendation(s) :

Check power cable.

Rule 13 File FLOPDISK

Floppy Disk Run Problem

is a 'Not Ready Reading Problem'

if the following message is displayed : " Not ready reading -

drive X Abort, Retry, ignore ? ".

File connection : FLOPREAD

Rule 14 File FLOPDISK

Floppy Disk Run Problem

is a 'Floppy Disk Improperly Read or Write Problem'

if the floppy disk read or write improperly.

File connection : FLOPREAD

Rule 15 File FLOPDISK

Floppy Disk Run Problem

is a 'Floppy Disk Write Problem'

if floppy disk reads correctly but does not write.

File connection : FLOPWRIT

Rule 16 File FLOPDISK

Floppy Disk Run Problem

is a 'foreign object in drive, latch problem or loose part'

if difficult to load or unload disks.

Recomendation(s) :

Check disk drive.

Rule 17 File FLOPDISK

Floppy Disk Run Problem

is a 'broken drive belt, foreign object in drive or defective drive motor'

if the disk makes an unusual sound

and the disk appear okay (visually check for physical damage).

Recomendation(s) :

Check disk drive, belt and motor.

Rule 18 File FLOPDISK

Floppy Disk Run Problem

is a 'floppy disk physical damage'

if the disk makes an unusual sound

and not the disk appear okay (visually check for physical damage).

Recomendation(s) :

Recover whatever data you can from the disk, then destroy the disk.

ไฟล์ FLOPREAD

Rule 1 File FLOPREAD

Not Ready Reading Problem

is a 'disk inserted wrong or disk door open'

if disk inserted wrong or disk door open (visually check).

Recomendation(s) :

Correct or close door.

Rule 2 File FLOPREAD

Not Ready Reading Problem

is a 'broken drive belt or defective drive'

if not disk inserted wrong or disk door open

and it does work when trying the disk on another drive or computer.

Recomendation(s) :

Check drive belt and drive.

Rule 3 File FLOPREAD

Not Ready Reading Problem

is a 'not formatted or defective disk'

if not disk inserted wrong or disk door open

and not it does work when trying the disk on another drive or computer.

Recomendation(s) :

Check floppy disk.

Rule 4 File FLOPREAD

Floppy Disk Improperly Read or Write Problem

is a 'disk damage'

if not the disk appears okay (visually check for physical damage).

Recomendation(s) :

Recover whatever data you can from the disk, then destroy the disk.

Rule 5 File FLOPREAD

Floppy Disk Improperly Read or Write Problem

is a 'resident software problem'

if the disk appear okay (visually check for physical damage)

and not the problem persists after removing all resident programs -

by starting without the AUTOEXEC.BAT.

Recomendation(s) :

Try removing specific resident program or installing them -

different order.

Rule 6 File FLOPREAD

Floppy Disk Improperly Read or Write Problem

is a 'bad disk'

if the disk appear okay (visually check for physical damage)

and the problem persists after removing all resident programs -

by starting without the AUTOEXEC.BAT

and you have a second disk drive or access to another compatible

computer

and the disk does work the same way on the other drive.

Recomendation(s) :

Recover the data you can from the disk, then reformat the -

and test it.

If it fails again, destroy the disk or replace it.

You should probably change disk brands if this happens with -

all disks of the same brand.

Rule 7 File FLOPREAD

Floppy Disk Improperly Read or Write Problem

is a 'dirty read head or foreign matter in the drive'

if the disk appear okay (visually check for physical damage)

and the problem persists after removing all resident programs -

by starting without the AUTOEXEC.BAT
and you have a second disk drive or access to another compatible computer
and not the disk does work the same way on the other drive
and the disk loads properly and the motor turns (visual check)
and it does work after cleaning read head by a head cleaning kit.
Recomendation(s) :
Try to keep disk environment clean.

Rule 8 File FLOPREAD
Floppy Disk Improperly Read or Write Problem
is a 'bad floppy drive or misalignment'
if the disk appear okay (visually check for physical damage)
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT
and you have a second disk drive or access to another compatible computer
and not the disk does work the same way on the other drive
and the disk loads properly and the motor turns (visual check)
and not it does work after cleaning read head by a head cleaning kit.
Recomendation(s) :
If the problem occurs frequently, have the drive repaired.

Rule 9 File FLOPREAD
Floppy Disk Improperly Read or Write Problem
is a 'dirty read head or foreign matter in the drive'
if the disk appear okay (visually check for physical damage)
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT

and not you have a second disk drive or access to another
compatible computer
and the disk loads properly and the motor turns (visual check)
and it does work after cleaning read head by a head cleaning kit.
Recomendation(s) :
Try to keep disk environment clean.

Rule 10 File FLOPREAD
Floppy Disk Improperly Read or Write Problem
is a 'special program problem'
if the disk appear okay (visually check for physical damage)
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT
and not you have a second disk drive or access to another compatible
computer
and not it does work after cleaning read head by a head cleaning kit
and it only happens with one program.
Recomendation(s) :
Some programs may have difficulties working with some disks.
Check with the program manufacturer.

Rule 11 File FLOPREAD
Floppy Disk Improperly Read or Write Problem
is a 'bad disk'
if the disk appear okay (visually check for physical damage)
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT
and not you have a second disk drive or access to another compatible
computer

and not it does work after cleaning read head by a head cleaning kit

and not it only happens with one program

and it always happen with one particular floppy.

Recomendation(s) :

Backup and then destroy or replace the disk.

Rule 12 File FLOPREAD

Floppy Disk Improperly Read or Write Problem

is a 'bad disk brand'

if the disk appear okay (visually check for physical damage)

and the problem persists after removing all resident programs -

by starting without the AUTOEXEC.BAT

and not you have a second disk drive or access to another compatible computer

and not it does work after cleaning read head by a head cleaning kit

and not it only happens with one program

and it always happen with floppies of one brand.

Recomendation(s) :

Switch to another brand.

Rule 13 File FLOPREAD

Floppy Disk Improperly Read or Write Problem

is a 'bad floppy drive or misalignment'

if the disk appear okay (visually check for physical damage)

and the problem persists after removing all resident programs -

by starting without the AUTOEXEC.BAT

and not you have a second disk drive or access to another compatible computer

and not it does work after cleaning read head by a head cleaning kit

and not it only happens with one program

and not it always happen with one particular floppy.

Recomendation(s) :

If the problem occurs frequently, have the drive repaired.

ไฟล์ FLOPWRIT

Rule 1 File FLOPWRIT

Floppy Disk Write Problem

is a 'write -protect disk'

if the disk appears okay (visually check for physical damage)

and not the write-protect hole on the disk is uncovered.

Recomendation(s) :

You cannot write to the disk unless the hole on the outside -

edge of the disk is uncovered.

Rule 2 File FLOPWRIT

Floppy Disk Write Problem

is a 'disk damage'

if not the disk appears okay (visually check for physical damage).

Recomendation(s) :

Recover whatever data you can from the disk, then destroy the disk.

Rule 3 File FLOPWRIT

Floppy Disk Write Problem

is a 'bad disk'

if the write-protect hole on the disk is uncovered

and the disk appears okay (visually check for physical damage)

and the problem persists after removing all resident programs -

by starting without the AUTOEXEC.BAT

and you have a second disk drive or access to another compatible computer
and the disk does work the same way on the other drive.
Recomendation(s) :
Recover the data you can from the disk, then reformat the - disk and test it.
If it fails again, destroy the disk or replace it.
You should probably change disk brands if this happens with - several disks of the same brand.

Rule 4 File FLOPWRIT
Floppy Disk Write Problem
is a 'dirty read head or foreign matter in the drive'
if the write-protect hole on the disk is uncovered
and the disk appears okay (visually check for physical damage)
and the problem persists after removing all resident programs - by starting without the AUTOEXEC.BAT
and you have a second disk drive or access to another compatible computer
and not the disk does work the same way on the other drive
and the disk load properly and the motor turn (visual check)
and it does work after cleaning read head by a head cleaning kit.
Recomendation(s) :
Try to keep disk environment clean.

Rule 5 File FLOPWRIT
Floppy Disk Write Problem
is a 'bad floppy drive or misalignment'
if the write-protect hole on the disk is uncovered

and the disk appears okay (visually check for physical damage)
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT
and you have a second disk drive or access to another compatible
computer
and not the disk does work the same way on the other drive
and the disk load properly and the motor turn (visual check)
and not it does work after cleaning read head by a head cleaning kit.
Recomendation(s) :
If the problem occurs frequently, repair the drive.

Rule 6 File FLOPWRIT
Floppy Disk Write Problem
is a 'dirty read head or foreign matter in the drive'
if the write-protect hole on the disk is uncovered
and the disk appears okay (visually check for physical damage)
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT
and not you have a second disk drive or access to another
compatible computer
and the disk load properly and the motor turn (visual check)
and it does work after cleaning read head by a head cleaning kit.
Recomendation(s) :
Try to keep disk environment clean.

Rule 7 File FLOPWRIT
Floppy Disk Write Problem
is a 'special program problem'
if the write-protect hole on the disk is uncovered

and the disk appears okay (visually check for physical damage)
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT
and not you have a second disk drive or access to another
compatible computer
and not it does work after cleaning read head by a head cleaning kit
and it only happens with one program.
Recomendation(s) :
Some programs may have difficulties working with some disks.
Check with the program manufacturer.

Rule 8 File FLOPWRIT
Floppy Disk Write Problem
is a 'bad disk'
if the write-protect hole on the disk is uncovered
and the disk appears okay (visually check for physical damage)
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT
and not you have a second disk drive or access to another
compatible computer
and not it does work after cleaning read head by a head cleaning kit
and not it only happens with one program
and it always happen with one particular floppy.
Recomendation(s) :
Backup and then destroy or replace the disk.

Rule 9 File FLOPWRIT
Floppy Disk Write Problem
is a 'bad disk brand'

if the write-protect hole on the disk is uncovered
and the disk appears okay (visually check for physical damage)
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT
and not you have a second disk drive or access to another
compatible computer
and not it does work after cleaning read head by a head cleaning kit
and not it only happens with one program
and it always happen with floppies of one brand.
Recomendation(s) :
Switch to another brand.

Rule 10 File FLOPWRIT
Floppy Disk Write Problem
is a 'bad floppy drive or misalignment'
if the write-protect hole on the disk is uncovered
and the disk appears okay (visually check for physical damage)
and the problem persists after removing all resident programs -
by starting without the AUTOEXEC.BAT
and not you have a second disk drive or access to another
compatible computer
and not it does work after cleaning read head by a head cleaning kit
and not it only happens with one program
and not it always happen with one particular floppy.
Recomendation(s) :
If the problem occurs frequently, repair the drive.

ภาคผนวก ง

ฐานความรู้สำหรับการวินิจฉัยรถยนต์บางส่วน

ไฟล์ ENGINE

```
Rule 1 File ENGINE
 Engine Problem
 is a 'Cooling System Problem'
 if the engine overheats.
 File connection :  COOLING

Rule 2 File ENGINE
 Engine Problem
 is a 'incorrect (late) ignition timing'
 if the engine overheats
 and the cooling system is alright.
 Recomendation(s) :
 Reset ignition timing.

Rule 3 File ENGINE
 Engine Problem
 is a 'Starting System Problem'
 if the engine will not crank or cranks slowly.
 File connection :  STARTING

Rule 4 File ENGINE
 Engine Problem
 is a 'no fuel, fuel line clogged or fuel pump faulty'
```

if the engine will not start or hard to start (crank OK)
and there is insufficient fuel supply to the carburettor.
Recomendation(s) :
Check fuel in tank, fuel line and fuel pump.

Rule 5 File ENGINE
Engine Problem
is a 'incorrect ignition timing'
if the engine runs after the ignition switch is turned off
and the engine overheats.
Recomendation(s) :
Reset ignition timing.

Rule 6 File ENGINE
Engine Problem
is a 'Carburettor Problem'
if the engine runs after the ignition switch is turned off
and the ignition timing okay.
File connection : CARBURET

Rule 7 File ENGINE
Engine Problem
is a 'Carburettor Problem'
if the engine will not start or hard to start (crank OK)
and the fuel supply is alright (check float level in the sight glass)
and a good spark jumps to the engine block at every cord (when -
trying the spark test).
File connection : CARBURET

```
Rule 8 File ENGINE
 Engine Problem
 is a 'Ignition Problem'
 if the engine will not start or hard to start (crank OK)
 and the fuel system is alright.
 File connection :  IGNITION

Rule 9 File ENGINE
 Engine Problem
 is a 'Carburettor Problem'
 if the engine shows rough idle or stalls
 and every cylinder works alright.
 File connection :  CARBURET

Rule 10 File ENGINE
 Engine Problem
 is a 'Ignition Problem'
 if the engine shows rough idle or stalls.
 File connection :  IGNITION

Rule 11 File ENGINE
 Engine Problem
 is a 'vacuum leaks'
 if the engine hard to start
 and the engine shows rough idle or stalls
 and the engine hesitates or has poor acceleration.
 Recomendation(s) :
 Repair vacuum system as necessary.
```

Rule 12 File ENGINE

Engine Problem

is a 'Ignition Problem'

if the engine hesitates or has poor acceleration.

File connection : IGNITION

Rule 13 File ENGINE

Engine Problem

is a 'Carburettor Problem'

if the engine hesitates or has poor acceleration

and every cylinder works alright.

File connection : CARBURET

Rule 14 File ENGINE

Engine Problem

is a 'choke valve open'

if the engine backfires (cold engine).

Recomendation(s) :

Check choke system.

Rule 15 File ENGINE

Engine Problem

is a 'throttle positioner faulty'

if muffler explosion occurs on deceleration only.

Recomendation(s) :

Check throttle positioner.

Rule 16 File ENGINE

Engine Problem

is a 'deceleration fuel cut system is always off'

if muffler explosion occurs on deceleration only

and the throttle positioner system is alright.

Recomendation(s) :

Check deceleration fuel cut system.

Rule 17 File ENGINE

Engine Problem

is a 'choke system faulty'

if muffler explosion occurs all the time

and ignition timing has been set correctly (if not,reset ignition timing).

Recomendation(s) :

Check choke system.

Rule 18 File ENGINE

Engine Problem

is a 'low compression'

if the engine will not start or hard to start (crank OK)

and the fuel system is alright

and the ignition system work properly.

Recomendation(s) :

Check compression pressure. Cylinder worn out might be expected.

ไฟล์ CARBURET

Rule 1 File CARBURET

Carburettor Problem

is a 'choke operation faulty'

if the engine cranks normally but will not start or hard to start

and the choke valve opens (cold engine).

Recomendation(s) :

Check choke system.

Rule 2 File CARBURET

Carburettor Problem

is a 'needle valve sticking or clogged'

if the engine cranks normally but will not start or hard to start

and float level in sight glass is low but fuel in tank and fuel line okay.

Recomendation(s) :

Check float and needle valve.

Rule 3 File CARBURET

Carburettor Problem

is a 'fuel cut solenoid valve is not open'

if the engine cranks normally but will not start or hard to start

and you should not feel a click from the solenoid valve when connect - and disconnect the valve terminal to the battery terminal.

Recomendation(s) :

Replace the solenoid valve.

Rule 4 File CARBURET

Carburettor Problem

is a 'insufficient fuel supply to carburettor'

if the engine hesitates or has poor acceleration

and float level is too low (check float level in sight glass).

Recomendation(s) :

Adjust float level.

Rule 5 File CARBURET

Carburettor Problem

is a 'accelerator pump faulty'

if the engine hesitates or has poor acceleration

and float level is at normal level

and gasoline does not spurt out from the acceleration nozzle -

(check by opening the throttle valve).

Recomendation(s) :

Repair acceleration pump.

Rule 6 File CARBURET

Carburettor Problem

is a 'choke valve closed'

if the engine hesitates or has poor acceleration (hot engine).

Recomendation(s) :

Check choke system.

Rule 7 File CARBURET

Carburettor Problem

is a 'slow jet clogged'

if the engine shows rough idle or stalls

and the idle mixture has been adjusted correctly (if not, adjust -

idle mixture)

and the idle speed has been adjusted correctly (if not, adjust -

idle speed)

and the fast idle speed has been set correctly (if not, reset -

fast idle speed).

Recomendation(s) :

Clean slow jet.

Rule 8 File CARBURET

Carburettor Problem

is a 'fuel cut solenoid faulty'

if the engine runs after the ignition switch is turned off

and the idle speed has been adjusted correctly (if not, adjust - idle speed)

and the fast idle speed has been set correctly (if not, reset - fast idle speed).

Recomendation(s) :

Check fuel cut solenoid valve.

ไฟล์ COOLING

Rule 1 File COOLING

Cooling System Problem

is a 'fan belt looses or missing'

if the fan turns improperly

and the fan belt is noisy.

Recomendation(s) :

Adjust or replace belt.

Rule 2 File COOLING

Cooling System Problem

is a 'air does not cool water'

if there are leaves, insects or dirt on radiator or condenser.

Recomendation(s) :

Clean radiator or condenser.

Rule 3 File COOLING

Cooling System Problem

is a 'leak in the cooling system'

if the coolant level in the reservoir is always found to be lower - than the LOW line.

Recomendation(s) :

Check for leak and repair as necessary.

Rule 4 File COOLING

Cooling System Problem

is a 'thermostat faulty'

if the engine is too cold.

Recomendation(s) :

Replace thermostat.

Rule 5 File COOLING

Cooling System Problem

is a 'thermostat faulty'

if the thermostat valve opening temperature or valve lift is - incorrect (test by immersing in water and heat the water.

Recomendation(s) :

Replace thermostat.

Rule 6 File COOLING

Cooling System Problem

is a 'water pump faulty'

if the water pressure from water pump is too low.

Recomendation(s) :

Repair water pump.

ไฟล์ IGNITION

Rule 1 File IGNITION

Ignition Problem

is a 'incorrect ignition timing'

if the engine cranks normally but will not start or hard to start

and a good spark jumps to the engine block at every cord (when -

trying the spark test).

Recomendation(s) :

Reset ignition timing.

Rule 2 File IGNITION

Ignition Problem

is a 'defective spark plug'

if the engine runs but misses one cylinder (test each cylinder -

by disconnecting the cord from the spark plug)

and a good spark jumps to the engine block at every cord (when -

trying the spark test).

Recomendation(s) :

Replace defective spark plug.

Rule 3 File IGNITION

Ignition Problem

is a 'defective high tension cord or distributor cap'

if the engine runs but misses one cylinder (test each cylinder -

by disconnecting the cord from the spark plug)

and a good spark does not jump to the engine block at that cylinder.

Recomendation(s) :

Check high tension cord and distributor cap.

Rule 4 File IGNITION

Ignition Problem

is a 'defective spark plugs'

if the engine runs but misses several cylinders (test each cylinder -

by disconnecting the cord from the spark plug)

and a good spark jumps to the engine block at every cord (when -

trying the spark test).

Recomendation(s) :

Replace spark plugs

Rule 5 File IGNITION

Ignition Problem

is a 'defective coil, condenser or high voltage wiring'

if the engine runs but misses several cylinders (test each cylinder -

by disconnecting the cord from the spark plug)

and not a good spark jumps to the engine block at every cord (when -

trying the spark test).

Recomendation(s) :

Check coil, condenser and high voltage wiring.

Rule 6 File IGNITION

Ignition Problem

is a 'defective coil, condenser or open circuit'

if the engine cranks normally but will not start or hard to start

and at every cords a good spark does not jump to engine block -

(when trying the spark test).

Recomendation(s) :

Check coil, condenser, connections, contact points and switch.

Rule 7 File IGNITION

Ignition Problem

is a 'incorrect ignition timing'

if the engine lacks power

and every cylinder works alright.

Recomendation(s) :

Reset ignition timing.

Rule 8 File IGNITION

Ignition Problem

is a 'incorrect ignition timing'

if the engine backfires.

Recomendation(s) :

Reset ignition timing.

Rule 9 File IGNITION

Ignition Problem

is a 'incorrect ignition timing'

if the engine shows rough idle or stalls

and every cylinder works alright.

Recomendation(s) :

Reset ignition timing.

ไฟล์ STARTING

Rule 1 File STARTING

Starting System Problem

is a 'flywheel or pinion gear teeth are broken'

if engine will not crank

and starter spins

and gears are noisy when starter is operating.

Recomendation(s) :

Replace flywheel or pinion gear.

Rule 2 File STARTING

Starting System Problem

is a 'starter faulty'

if starter spins

and starter won't engage flywheel gear.

Recomendation(s) :

Repair on replace the starter.

Rule 3 File STARTING

Starting System Problem

is a 'battery charge is low'

if engine will not crank or crank slowly

and lights become dim or go out when the starter switch is closed.

Recomendation(s) :

Charge or replace battery.

Engine may be started by pushing a car or using a jumper circuit -

from another charged battery

Rule 4 File STARTING

Starting System Problem

is a 'fusible link burned out'

if starter will not operate

and not the lights become dim or go out when the starter switch

is closed

and the starter operates normally when using a jumper circuit -

from battery terminal to starter terminal.

Recomendation(s) :

Replace fusible link.

Rule 5 File STARTING

Starting System Problem

is a 'an open circuit in cables'

if starter will not operate

and not the lights become dim or go out when the starter switch is closed

and the starter operates normally when using a jumper circuit - from battery terminal to starter terminal

and fusible link okay.

Recomendation(s) :

Eliminate open circuits, replace defective parts.

Rule 6 File STARTING

Starting System Problem

is a 'short in wiring or ignition switch faulty'

if the starter keeps running.

Recomendation(s) :

Repair wiring or replace ignition switch.

Rule 7 File STARTING

Starting System Problem

is a 'starter faulty'

if starter will not operate

and not the lights become dim or go out when the starter switch is closed

and the starter does not operate when using a jumper circuit from - another charged battery.

Recomendation(s) :

Repair on replace the starter.

ประวัติผู้เขียน

นายธวัชชัย จันทร์คง เกิดวันที่ 3 ตุลาคม พ.ศ.2507 ที่อำเภอปากพนัง จังหวัดนครศรีธรรมราช สำเร็จการศึกษาวิศวกรรมศาสตรบัณฑิต สาขาวิชาวิศวกรรมเครื่องกล จากมหาวิทยาลัยสงขลานครินทร์ เมื่อปี พ.ศ.2529