

Bevezetés a matematikába

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Ezek a programok csak szemléltetésre szolgálnak.

- ▶ 1. Halmazok
- ▶ 2. Természetes számok
- ▶ 3. A számfogalom bővítése
- ▶ 4. Véges halmazok
- ▶ 5. Végtelen halmazok
- ▶ 6. Számelmélet
- ▶ 7. Gráfelmélet
- ▶ 8. Algebra
- ▶ 9. Kódolás
- ▼ 10. Algoritmusok

- ▼ 10.1. Számítási modellek

- [> restart;

- ▶ 10.1.1. Számítási modellek

- ▼ 10.1.2. Példa.

- [> f:=proc();
if nargs<2 then args else
if nargs>2 then
if args[3]=2 then
if args[2]=0 then args[1] else args[1],args[2],3 fi;

```

else args[2],args[1] mod args[2],2 fi;
else args[1],args[2],2 fi;
fi; end;
f:=proc()
if nargs < 2 then
args
else
if 2 < nargs then
if args[3] = 2 then
if args[2] = 0 then
args[1]
else
args[1],
args[2], 3
end if
else
args[2], mod(args[1],
args[2]), 2
end if
else
args[1], args[2], 2
end if
end if
end proc

```

(10.1.2.1)

```

> 172,62; f(%); f(%); f(%); f(%); f(%); f(%); f(%); f(%); f(%); f(%); f
(%); f(%); f(%);
172, 62
172, 62, 2
172, 62, 3
62, 48, 2
62, 48, 3
48, 14, 2
48, 14, 3
14, 6, 2
14, 6, 3
6, 2, 2
6, 2, 3
2, 0, 2
2

```

► **10.1.3. Szimulálás.**

▼ **10.1.4. Példa.**

```
> f:=proc();
  if nargs=3 then args else
    if nargs<3 then args[1],1,0,args[2],0,1,0,2
    else
      if args[8]=2 then
        if args[4]=0 then args[1..3] else args[1..7],"3.1"
      fi;
    else
      if args[8]="3.1" then args[1..6],floor(args[1]/args
[4]),"3.2"
      else args[4],args[5],args[6],args[1]-args[7]*args[4],
args[2]-args[7]*args[5],args[3]-args[7]*args[6],args[7],2
      fi;
    fi;
  fi;
fi; end;
```

```
>
f:=proc()
  if nargs = 3 then
```

(10.1.4.1)

```
  args
else
  if nargs < 3 then
    args[1], 1,
    0, args[2], 0, 1, 0, 2
  else
    if args[8] = 2 then
      if args[4] = 0 then
        args[1..3]
      else
        args[1..7], "3.1"
      end if
    else
      if args[8] = "3.1" then
        args[1..6],
        floor(args[1] / args[4]), "3.2"
      else
        args[4],
```

```

        args[5], args[6], args[1] - args[7]*args[4],
        args[2] - args[7]*args[5],
        args[3] - args[7]*args[6], args[7], 2
    end if
end if
end if
end if
end proc
> 172,62; f(%); f(%); f(%); f(%); f(%); f(%); f(%); f(%); f(%); f(%); f
(%); f(%); f(%); f(%); f(%); f(%); f(%); f(%);
    172, 62
    172, 1, 0, 62, 0, 1, 0, 2
    172, 1, 0, 62, 0, 1, 0, "3.1"
    172, 1, 0, 62, 0, 1, 2, "3.2"
    62, 0, 1, 48, 1, -2, 2, 2
    62, 0, 1, 48, 1, -2, 2, "3.1"
    62, 0, 1, 48, 1, -2, 1, "3.2"
    48, 1, -2, 14, -1, 3, 1, 2
    48, 1, -2, 14, -1, 3, 1, "3.1"
    48, 1, -2, 14, -1, 3, 3, "3.2"
    14, -1, 3, 6, 4, -11, 3, 2
    14, -1, 3, 6, 4, -11, 3, "3.1"
    14, -1, 3, 6, 4, -11, 2, "3.2"
    6, 4, -11, 2, -9, 25, 2, 2
    6, 4, -11, 2, -9, 25, 2, "3.1"
    6, 4, -11, 2, -9, 25, 3, "3.2"
    2, -9, 25, 0, 31, -86, 3, 2
    2, -9, 25
    2, -9, 25

```

(10.1.4.2)

- ▶ **10.1.5. Szimulációk sebességének összehasonlítása.**
- ▶ **10.1.6. Ordó.**
- ▶ **->10.1.7. Feladat.**
- ▼ **->10.1.8. Feladat.**
- ▶ **10.1.9. Feladat.**
- ▶ **10.1.10. Algoritmus.**

▼ 10.1.11. Turing-gépek.

```
> T1:=proc(b,a) [h,a,"="] end; T1(h,"x");  
      T1:=proc(b,a) [h,a,"="] end proc  
           [h,"x","="] (10.1.11.1)
```

```
> T2:=proc(b,a) if b=h then [h,a,"="] else [b," ","<"] fi;  
end;  
T2("s","x");
```

```
T2:=proc(b,a)  
  if b = h then  
    [h,a,"="]  
  else  
    [b," ","<"]  
  end if  
end proc  
           ["s"," ","<"] (10.1.11.2)
```

```
> T3:=proc(b,a) if b="h" then ["h",a,"="]  
  elif a<>" " then ["s",a,"<"] else ["h",a,">"] fi; end;
```

```
T3("s","1"); T3("s","2"); T3("s"," ");  
T3:=proc(b,a)  
  if b = "h" then  
    ["h",a,"="]  
  elif a<>" " then  
    ["s",a,  
    "<"]  
  else  
    ["h",a,">"]  
  end if  
end proc  
           ["s","1","<"]  
           ["s","2","<"]  
           ["h"," ",">"] (10.1.11.3)
```

▼ 10.1.12. Turing-gép, mint számítási eljárás; bemenet és kimenet.

```
> with(StringTools):
```

```

> space:=" ";start:="s";halt:="h";llength:=30;rlength:=30;
Ts:=proc(T::procedure) global space,start,halt,llength,
rlength;
local k,i,L,LL,LLL,wl,wm,wr,w;
if type(nargs,odd) or nargs<4 then
  error "odd number of words",nargs-2; fi;
k:=(nargs-2)/2;L:=[args[2]];lprint(Fill(" ",llength+
rlength));
for i to k do
  wl:=args[2*i+1]; wr:=args[2*i+2];
  if length(wl)=0 then wm:=space; else wm:=wl[-1]; fi;
  while length(wl)>0 do
    if wl[1]<>space then break; else wl:=wl[2..-1]; fi;
  od;
  while length(wr)>0 do
    if wr[-1]<>space then break; else wr:=wr[1..-2]; fi;
  od;
  if length(wl)>llength then w:=wl[-llength..-1];
  else w:=cat(Fill(space,llength-length(wl)),wl); fi;
  if length(wr)>rlength then w:=cat(w,wr[1..rlength]);
  else w:=cat(w,wr,Fill(space,rlength-length(wr))); fi;
  lprint(w);
  L:=[op(L),wm];
od;
w:=cat(Fill(" ",llength-1),"^",L[1]);
if length(L[1])<rlength then w:=cat(w,Fill(" ",rlength-
length(L[1]))); fi; lprint(w);
LL:=T(op(L)); LLL:=[T,LL[1]];
for i to k do
  wl:=args[2*i+1]; wr:=args[2*i+2];
  if length(wl)>0 then wl:=wl[1..-2]; fi;
  if length(wr)>0 then wm:=wr[1]; wr:=wr[2..-1]; else wm:=
space fi;
  if LL[k+1+i]="=" then wl:=cat(wl,LL[i+1]); wr:=cat(wm,wr)
; fi;
  if LL[k+1+i]="<" then wr:=cat(LL[i+1],wm,wr); fi;
  if LL[k+1+i]=">" then wl:=cat(wl,LL[i+1],wm); fi;
  LLL:=[op(LLL),wl,wr];
od; op(LLL); end;

```

space:= " "
start:= "s"
halt:= "h"
llength:= 30
rlength:= 30

Ts:= proc(T:procedure)

(10.1.12.1)

local k, i, L, LL, LLL, wl, wm, wr, w;

```

global space, start, halt, llength, rlength,
if type(nargs,
odd) or nargs < 4 then
    error "odd number of words",
    nargs - 2
end if;
k := 1 / 2 * nargs - 1;
L := [args[2]];
lprint(StringTools.-Fill(" ", llength + rlength));
for i to k do
    wl := args[2 * i + 1];
    wr := args[2 * i + 2];
    if length(wl) = 0 then
        wm := space
    else
        wm := wl[-1]
    end if;
    while 0 < length(wl) do
        if wl[1] <> space then
            break
        else
            wl := wl[2..-1]
        end if
    end do;
    while 0 < length(wr) do
        if wr[-1] <> space then
            break
        else
            wr := wr[1..-2]
        end if
    end do;
    if llength < length(wl) then
        w := wl[-llength..-1]
    else
        w := cat(StringTools.-Fill(space, llength - length(wl)),
        wl)
    end if;
    if rlength < length(wr) then

```

```

        w:= cat(w,
        wr[1..rlength])
    else
        w:= cat(w, wr,
        StringTools-Fill(space, rlength - length(wr)))
    end if;
    lprint(w);
    L:= [op(L), wm]
end do;
w:= cat(StringTools-Fill(" ", llength - 1), "^", L[1]);
if length(L[1]) < rlength then
    w:= cat(w, StringTools-Fill(" ",
    rlength - length(L[1])))
end if;
lprint(w);
LL:= T(op(L));
LLL:= [T, LL[1]];
for i to k do
    wl:= args[2 * i + 1];
    wr:= args[2 * i + 2];
    if 0 < length(wl) then
        wl:= wl[1..-2]
    end if;
    if 0 < length(wr) then
        wm:= wr[1];
        wr:= wr[2..-1]
    else
        wm:= space
    end if;
    if LL[k + 1 + i] = "=" then
        wl:= cat(wl, LL[i + 1]);
        wr:= cat(wm, wr)
    end if;
    if LL[k + 1 + i] = "<" then
        wr:= cat(LL[i + 1], wm, wr)
    end if;
    if LL[k + 1 + i] = ">" then
        wl:= cat(wl, LL[i + 1], wm)

```



```

    end if;
    LLL := [op(LLL), wl, wr]
  end do;
  op(LLL)
end proc
> T3, "s", "123", "";Ts(%):Ts(%):Ts(%):Ts(%):Ts(%):Ts(%):
    T3, "s", "123", ""
"
"          123          "
"          ^s          "
"          123          "
"          ^s          "
"          123          "
"          ^s          "
"          123          "
"          ^s          "
"          123          "
"          ^s          "
"          123          "
"          ^h          "
"          123          "
"          ^h          "

```

► 10.1.13. Megjegyzés.

▼ 10.1.14. Példák.

```

> T1, "h", "abc", "def";Ts(%):Ts(%):Ts(%):
    T1, "h", "abc", "def"
"
"          abcdef      "
"          ^h          "
"          abcdef      "
"          ^h          "
"          abcdef      "
"          ^h          "
> T2, "s", "abc", "def";Ts(%):Ts(%):Ts(%):Ts(%):Ts(%):
    T2, "s", "abc", "def"
"
"          abcdef      "
"          ^s          "

```

```

"
"
"          ab def
"          ^s
"
"          a  def
"          ^s
"
"          def
"          ^s
"
"          def
"          ^s
"
> T3, "s", "123", "";Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):
    T3, "s", "123", ""
"
"          123
"          ^s
"
"          123
"          ^s
"
"          123
"          ^s
"
"          123
"          ^s
"
"          123
"          ^h
"
"          123
"          ^h
"
> T4:=proc(b,a) if b="s" then ["0","a",>"]
  elif b="0" then ["1","b",>"]
  elif b="1" then ["2","r",>"]
  elif b="2" then ["3","a",>"]
  elif b="3" then ["4","k",>"]
  elif b="4" then ["5","a",>"]
  elif b="5" then ["6","d",>"]
  elif b="6" then ["7","a",>"]
  elif b="7" then ["8","b",>"]
  elif b="8" then ["9","r",>"]
  elif b="9" then ["h","a","="]
  elif b="h" then ["h","a","="] fi; end;
T4:=proc(b, a)
  if b = "s" then
    ["0", "a", ">"]

```

(10.1.14.1)

```

elifb = "0" then
    ["1",
     "b", ">"]
elifb = "1" then
    ["2", "r", ">"]
elifb = "2" then
    ["3",
     "a", ">"]
elifb = "3" then
    ["4", "k", ">"]
elifb = "4" then
    ["5",
     "a", ">"]
elifb = "5" then
    ["6", "d", ">"]
elifb = "6" then
    ["7",
     "a", ">"]
elifb = "7" then
    ["8", "b", ">"]
elifb = "8" then
    ["9",
     "r", ">"]
elifb = "9" then
    ["h", "a", "="]
elifb = "h" then
    ["h",
     "a", "="]
end if
end proc

```

> T4, "s", "", "";Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):Ts
 (:):Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):

T4, "s", "", ""

"		"
"		"
"	^s	"
"		"
"	a	"
"	^0	"

```

"
"
"          ab
"          ^1
"
"          abr
"          ^2
"
"          abra
"          ^3
"
"          abrak
"          ^4
"
"          abraka
"          ^5
"
"          abrakad
"          ^6
"
"          abrakada
"          ^7
"
"          abrakadab
"          ^8
"
"          abrakadabr
"          ^9
"
"          abrakadabra
"          ^h
"
"          abrakadabra
"          ^h

```

```

> T5:=proc(b,a1,a2)
  if b="s" then
    if a1<>" " then ["s",a1,a2,"<","="] else ["c",a1,a1,">","<"] fi;
  elif b="c" then
    if a1<>" " then ["c",a1,a1,">","<"] else ["r",a1,a1,"<",">"] fi;
  elif b="r" then
    if a2<>" " then ["r",a1,a2,"=",">"] else ["h",a1,a2,"=","<"] fi;
  else ["h",a1,a2,"=","="] fi; end;

```

```
T5:=proc(b, a1, a2)
```

(10.1.14.2)

```

  if b = "s" then
    if a1 <> " " then

```


"		"
"	^s	"
"		"
"	abcd	"
"		"
"	^c	"
"		"
"	abcd	"
"	a	"
"	^c	"
"		"
"	abcd	"
"	ba	"
"	^c	"
"		"
"	abcd	"
"	cba	"
"	^c	"
"		"
"	abcd	"
"	dcba	"
"	^c	"
"		"
"	abcd	"
"	dcba	"
"	^r	"
"		"
"	abcd	"
"	dcba	"
"	^r	"
"		"
"	abcd	"
"	dcba	"
"	^r	"
"		"
"	abcd	"
"	dcba	"
"	^r	"
"		"
"	abcd	"
"	dcba	"
"	^h	"
"		"
"	abcd	"

```

"                                     dcba                                     "
"                                     ^h                                     "
> T63:=proc(b,a1,a2,a3)
  if b="s" then
    if a1="1" and a2="1" then ["c",a1,a2,"0","<","<","<"]
    elif a1="1" or a2="1" then ["s",a1,a2,"1","<","<","<"]
    elif a1="0" or a2="0" then ["s",a1,a2,"0","<","<","<"]
    else ["b",a1,a2,a3,"=","=",">"] fi;
  elif b="c" then
    if a1="1" and a2="1" then ["c",a1,a2,"1","<","<","<"]
    elif a1="1" or a2="1" then ["c",a1,a2,"0","<","<","<"]
    elif a1="0" or a2="0" then ["s",a1,a2,"1","<","<","<"]
    else ["b",a1,a2,"1","=","=",">"] fi;
  elif b="b" then
    if a3<>" " then ["b",a1,a2,a3,"=","=",">"]
    else ["h",a1,a2,a3,"=","=","<"] fi;
  else ["h",a1,a2,a3,"=","=","="] fi; end;
T63:=proc(b, a1, a2, a3)
  if b = "s" then
    if a1 = "1" and a2 = "1" then
      ["c", a1, a2, "0", "<", "<", "<"]
    elif a1 = "1" or a2 = "1" then
      ["s", a1, a2, "1", "<", "<",
       "<"]
    elif a1 = "0" or a2 = "0" then
      ["s", a1, a2, "0", "<",
       "<", "<"]
    else
      ["b", a1, a2, a3, "=", "=", ">"]
    end if
  elif b = "c" then
    if a1 = "1" and a2 = "1" then
      ["c", a1, a2,
       "1", "<", "<", "<"]
    elif a1 = "1" or a2 = "1" then
      ["c", a1,
       a2, "0", "<", "<", "<"]
    elif a1 = "0" or a2 = "0" then
      ["s",
       a1, a2, "1", "<", "<", "<"]
    else
      ["s",
       a1, a2, "1", "<", "<", "<"]
    end if
  else
    ["h", a1, a2, a3, "=", "=", "<"]
  fi; end;

```

(10.1.14.3)

```

    ["b", a1, a2, "1", "=", "=",
    ">"]
end if
elif b = "b" then
    if a3 <> " " then
        ["b", a1, a2,
        a3, "=", "=", ">"]
    else
        ["h", a1, a2, a3, "=", "=", "<"]
    end if
else
    ["h", a1, a2, a3, "=", "=", "="]
end if
end proc
> T63, "s", "10111", "", "1011", "", "", "", "":Ts(:):Ts(:):Ts(:):Ts(:)
:Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):Ts
(:):
"
"
"          10111
"          1011
"
"          ^s
"
"          10111
"          1011
"          0
"          ^c
"
"          10111
"          1011
"          10
"          ^c
"
"          10111
"          1011
"          010
"          ^c
"
"          10111
"          1011
"          0010
"          ^c
"
"          10111
"
```



```

"          1011          "
"          00010        "
"          ^c           "
"          "            "
"          10111        "
"          1011         "
"          100010       "
"          ^b           "
"          "            "
"          10111        "
"          1011         "
"          100010       "
"          ^b           "
"          "            "
"          10111        "
"          1011         "
"          100010       "
"          ^b           "
"          "            "
"          10111        "
"          1011         "
"          100010       "
"          ^b           "
"          "            "
"          10111        "
"          1011         "
"          100010       "
"          ^b           "
"          "            "
"          10111        "
"          1011         "
"          100010       "
"          ^b           "
"          "            "
"          10111        "
"          1011         "
"          100010       "
"          ^h           "
"          "            "
"          10111        "
"          1011         "
"          100010       "
"          ^h           "

```

```

> T62:=proc(b,a1,a2)
  if b="s" then
    if a1="1" and a2="1" then ["c",a1,"0","<","<"]
    elif a1="1" or a2="1" then ["s",a1,"1","<","<"]
    elif a1="0" or a2="0" then ["s",a1,"0","<","<"]

```

```

else ["b",a1,a2,"=",">"] fi;
elif b="c" then
  if a1="1" and a2="1" then ["c",a1,"1","<","<"]
  elif a1="1" or a2="1" then ["c",a1,"0","<","<"]
  elif a1="0" or a2="0" then ["s",a1,"1","<","<"]
  else ["b",a1,"1","=",">"] fi;
elif b="b" then
  if a2<>" " then ["b",a1,a2,"=",">"]
  else ["h",a1,a2,"=","<"] fi;
else ["h",a1,a2,"=","="] fi; end;
T62:=proc(b, a1, a2)
  if b = "s" then
    if a1 = "1" and a2 = "1" then
      ["c", a1, "0", "<", "<"]
    elif a1 = "1" or a2 = "1" then
      ["s", a1,
       "1", "<", "<"]
    elif a1 = "0" or a2 = "0" then
      ["s", a1, "0",
       "<", "<"]
    else
      ["b", a1, a2, "=", ">"]
    end if
  elif b = "c" then
    if a1 = "1" and a2 = "1" then
      ["c", a1, "1",
       "<", "<"]
    elif a1 = "1" or a2 = "1" then
      ["c", a1, "0", "<",
       "<"]
    elif a1 = "0" or a2 = "0" then
      ["s", a1, "1", "<", "<"]
    else
      ["b", a1, "1", "=", ">"]
    end if
  elif b = "b" then
    if a2<>" " then
      ["b", a1, a2, "=", ">"]
    else
      ["h", a1, a2, "=", "<"]
    end if
  end if
end proc;

```

(10.1.14.4)

```

    end if
  else
    ["h", a1, a2, "=", "="]
  end if
end proc
> T62,"s","11","", "11", "":Ts(:):Ts(:):Ts(:):Ts(:):Ts(:):Ts(:)
:Ts(:):Ts(:):
"
"          11          "
"          11          "
"          ^s          "
"
"          11          "
"          10          "
"          ^c          "
"
"          11          "
"          10          "
"          ^c          "
"
"          11          "
"          110         "
"          ^b          "
"
"          11          "
"          110         "
"          ^b          "
"
"          11          "
"          110         "
"          ^b          "
"
"          11          "
"          110         "
"          ^h          "
"
"          11          "
"          110         "
"          ^h          "

```

- ▶ -> 10.1.15. Feladat.
- ▼ -> 10.1.16. Feladat.
- ▼ -> 10.1.17. Feladat.
- ▼ 10.1.18. Feladat.
- ▼ 10.1.19. Feladat.

▼ 10.1.20. Feladat.

▼ 10.1.21. Turing-gép szimulálása csökkentett jelkészlettel.

```
> T3unary:=proc(b,a)
  if b="s" then
    if a=" " then ["sb",a,"<"] else ["sI",a,"<"] fi;
  elif b="sb" then
    if a=" " then ["s0"," ",">"] else ["s2","I",">"] fi;
  elif b="sI" then
    if a=" " then ["s1"," ",">"] else ["s3","I",">"] fi;
  elif b="s0" then ["s0>"," ",">"]
  elif b="s1" then ["s1<","I","<"]
  elif b="s2" then ["s2<"," ","<"]
  elif b="s3" then ["s3<","I","<"]
  elif b="s0>" then ["h",a,">"]
  elif b="s1<" then ["s",a,"<"]
  elif b="s2<" then ["s",a,"<"]
  elif b="s3<" then ["s",a,"<"]
  else ["h",a,"="] fi; end;
```

T3unary:= proc(b, a)

(10.1.21.1)

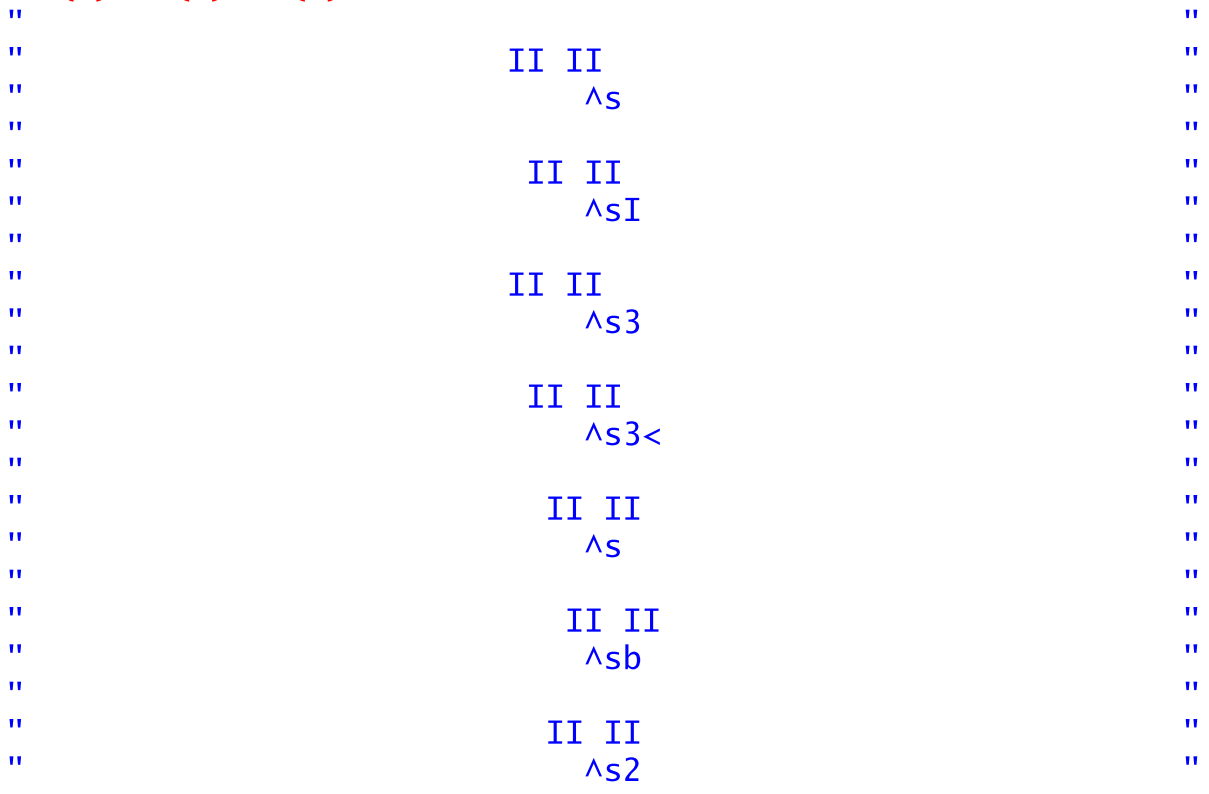
```
  if b = "s" then
    if a = " " then
      ["sb", a, "<"]
    else
      ["sI", a, "<"]
    end if
  elif b = "sb" then
    if a = " " then
      ["s0", " ", ">"]
    else
      ["s2", "I", ">"]
    end if
  elif b = "sI" then
    if a = " " then
      ["s1", " ", ">"]
    else
      ["s3", "I", ">"]
    end if
  elif b = "s0" then
    ["s0>", " ", ">"]
  elif b = "s1" then
    ["s1<", "I", "<"]
  elif b = "s2" then
    ["s2<", " ", "<"]
  elif b = "s3" then
    ["s3<", "I", "<"]
  else
    ["h", a, "="]
  fi; end;
```

```

    ["s1<",
    "I", "<"]
elifb = "s2" then
    ["s2<", " ", "<"]
elifb = "s3" then
    ["s3<", "I", "<"]
elifb = "s0>" then
    ["h", a, ">"]
elifb = "s1<" then
    ["s", a, "<"]
elifb = "s2<" then
    ["s", a,
    "<"]
elifb = "s3<" then
    ["s", a, "<"]
else
    ["h", a, "="]
end if
end proc

```

> T3unary, "s", " II II", "" :Ts(%) :Ts(%) :Ts(%) :Ts(%) :Ts(%) :Ts(%)
 :Ts(%) :Ts(%) :Ts(%) :Ts(%) :Ts(%) :Ts(%) :Ts(%) :Ts(%) :Ts(%) :Ts(%) :Ts(%) :
 (%):Ts(%) :Ts(%) :




```

elif b="r" then
  if a<>" " then ["r",a,">"] else ["h",a,"<"] fi;
elif b="h" then ["h",a,"="]
else if a<>" " then [cat("s",a),b[2],"<"] else ["b",b[2],
">"] fi; fi;
end;

```

TO1 := **proc**(*b*, *a*)

(10.1.23.1)

```

if b = "s" then
  if a<>" " then
    ["sb", a, "<"]
  else
    ["r", a, ">"]
  end if
elif b = "sb" then
  if a<>" " then
    [cat("s",
a), " ", "<"]
  else
    ["bb", " ", ">"]
  end if
elif b = "b" then
  if a<>" " then
    ["b", a, ">"]
  else
    ["bb", a, ">"]
  end if
elif b = "bb" then
    [cat("b", a), a, "<"]
elif b[1] = "b" then
    ["s", b[2], "<"]
elif b = "r" then
  if a<>" " then
    ["r", a, ">"]
  else
    ["h", a, "<"]
  end if
elif b = "h" then
    ["h", a, "="]
else

```


"		^b	"
"			"
"		1 233	"
"		^bb	"
"			"
"		1 233	"
"		^b2	"
"			"
"		12233	"
"		^s	"
"			"
"		12233	"
"		^sb	"
"			"
"		12233	"
"		^bb	"
"			"
"		12233	"
"		^b1	"
"			"
"		112233	"
"		^s	"
"			"
"		112233	"
"		^r	"
"			"
"		112233	"
"		^r	"
"			"
"		112233	"
"		^r	"
"			"
"		112233	"
"		^r	"
"			"
"		112233	"
"		^r	"
"			"
"		112233	"
"		^r	"
"			"
"		112233	"
"		^h	"
"			"
"		112233	"

```

"                                     ^h                                     "
> T02:=proc(b,a)
  if b="s" then
    if a<>" " then [cat("s",a)," ",">"] else [ ">",a,">"] fi;
  elif b=">" then
    if a<>" " then [ ">",a,">"] else ["h",a,"<"] fi;
  elif b="h" then ["h",a,"="]
  elif length(b)=2 then
    if a=" " then [cat(b,"<"),b[2],"<"] else [b,a,">"] fi;
  else
    if a=" " then ["s",b[2],"<"] else [b,a,"<"] fi;
  fi; end;
T02:=proc(b, a)                                     (10.1.23.2)
  if b = "s" then
    if a <> " " then
      [cat("s", a), " ",
       ">"]
    else
      [ ">", a, ">"]
    end if
  elif b = ">" then
    if a <> " " then
      [ ">", a, ">"]
    else
      ["h", a, "<"]
    end if
  elif b = "h" then
    ["h", a, "="]
  elif length(b) = 2 then
    if a = " " then
      [cat(b, "<"), b[2], "<"]
    else
      [b, a, ">"]
    end if
  else
    if a = " " then
      ["s", b[2], "<"]
    else
      [b, a, "<"]
    end if
  end if
end if

```


"	123	"
"	^1	"
"		"
"	123	"
"	^r	"
"		"
"	1 3	"
"	^r2	"
"		"
"	1 3	"
"	^>2+	"
"		"
"	1 3	"
"	^>2+	"
"		"
"	1 3	"
"	^w2+	"
"		"
"	1 32	"
"	^<	"
"		"
"	1 32	"
"	^<	"
"		"
"	1 32	"
"	^r	"
"		"
"	32	"
"	^r1	"
"		"
"	32	"
"	^>1-	"
"		"
"	32	"
"	^>1-	"
"		"
"	32	"
"	^>1-	"
"		"
"	32	"
"	^w1-	"
"		"
"	32	"
"	^w1-	"
"		"
"	321	"
"	^h	"
"		"


```

    ["0", a, "<"]
else
    [">1", a, ">"]
end if
elif b = "0" then
    if a <> " " then
        ["1", a, "<"]
    else
        [">0", "1",
">"]
    end if
elif b = ">0" or b = ">1" then
    if a = " " then
        [cat("=", b[2]), a, ">"]
    else
        [b, a, ">"]
    end if
elif b = "=0" or b = "=1" then
    ["?", b[2], "<"]
elif b = "?" then
    ["??", a, "<"]
elif b = "??" then
    if a = " " then
        [">>", a, ">"]
    else
        ["d1", " ", "<"]
    end if
elif b = ">>" then
    [">", a, ">"]
elif b = ">" then
    if a <> " " then
        [">", a, ">"]
    else
        ["h", a, "<"]
    end if
elif b = "d1" then
    ["d0", a, "<"]
elif b = "d0" then

```


:Ts(%) :Ts(%) :Ts(%) :

"			"
"		11111	"
"		^s	"
"			"
"		11111	"
"		^=	"
"			"
"		11111	"
"		^==	"
"			"
"		1111	"
"		^1	"
"			"
"		1111	"
"		^0	"
"			"
"		1111	"
"		^1	"
"			"
"		1111	"
"		^0	"
"			"
"		1111	"
"		^1	"
"			"
"		1111	"
"		^0	"
"			"
"		1111	"
"		^1	"
"			"
"		1111	"
"		^>1	"
"			"
"		1111	"
"		^>1	"
"			"
"		1111	"
"		^>1	"
"			"
"		1111	"
"		^>1	"
"			"
"		1111	"
"		^>1	"
"			"
"		1111	"
"		^=1	"
"			"
"		1111 1	"
"		^?	"
"			"
"		1111 1	"

"		^??	"
"			"
"		111 1	"
"		^d1	"
"			"
"		111 1	"
"		^d0	"
"			"
"		1 1 1	"
"		^d1	"
"			"
"		1 1 1	"
"		^d0	"
"			"
"		1 1 1	"
"		^t	"
"			"
"		1 1	"
"		^t>	"
"			"
"		11 1	"
"		^t=	"
"			"
"		11 1	"
"		^t<	"
"			"
"		11 1	"
"		^t<	"
"			"
"		11 1	"
"		^t	"
"			"
"		1 1	"
"		^t>	"
"			"
"		1 1	"
"		^t>	"
"			"
"		11 1	"
"		^t=	"
"			"
"		11 1	"
"		^=	"
"			"
"		11 1	"
"		^==	"
"			"
"		1 1	"

"		^1	"
"			"
"		1 1	"
"		^0	"
"			"
"		11 1	"
"		^>0	"
"			"
"		11 1	"
"		^>0	"
"			"
"		11 1	"
"		^=0	"
"			"
"		11 01	"
"		^?	"
"			"
"		11 01	"
"		^??	"
"			"
"		1 01	"
"		^d1	"
"			"
"		1 01	"
"		^d0	"
"			"
"		1 01	"
"		^t	"
"			"
"		01	"
"		^t>	"
"			"
"		1 01	"
"		^t=	"
"			"
"		1 01	"
"		^=	"
"			"
"		1 01	"
"		^==	"
"			"
"		01	"
"		^1	"
"			"
"		01	"
"		^>1	"
"			"
"		01	"

```

"                ^=1                "
"
"                101                "
"                ^?                  "
"
"                101                "
"                ^??                 "
"
"                101                "
"                ^>>                 "
"
"                101                "
"                ^>                  "
"
"                101                "
"                ^>                  "
"
"                101                "
"                ^>                  "
"
"                101                "
"                ^>                  "
"
"                101                "
"                ^h                   "
"
"                101                "
"                ^h                   "

```

```

> T05:=proc(b,a)
  if b="s" then
    if a=" " then ["h",a,"="] else ["s<",a,"<"] fi;
  elif b="s<" then
    if a=" " then ["??",a,">"] else [b,a,"<"] fi;
  elif b="??" then
    if a=" " then ["==",a,"<"] else ["=",a,"<"] fi;
  elif b=="==" then ["h",a,"<"]
  elif b=="=" then ["d",a,"<"]
  elif b="d" then
    if a=" " then [ ">",a,">"] else ["dd",a,"<"] fi;
  elif b="dd" then
    if a=" " then [ ">","1",">"] else ["d<"," ","<"] fi;
  elif b="d<" then
    if a<>" " then [b,a,"<"] else ["d>","1",">"] fi;
  elif b="d>" then
    if a<>" " then [b,a,">"] else ["d","1","<"] fi;
  elif b=">" then
    if a<>" " then [b,a,">"] else ["?","1",">"] fi;
  elif b="?" then

```

```

    if a="1" then ["??", " ", ">"] else ["0<", " ", "<"] fi;
  elif b="0<" then
    if a<>" " then [b,a,"<"] else ["0=",a,">"] fi;
  elif b="0=" then ["0>", " ", ">"]
  elif b="0>" then
    if a<>" " then [b,a,">"] else ["??",a,">"] fi;
  else ["h",a,"="] fi end;

```

TO5:= proc(b, a)

(10.1.23.5)

```

  if b = "s" then
    if a = " " then
      ["h", a, "="]
    else
      ["s<", a, "<"]
    end if
  elif b = "s<" then
    if a = " " then
      ["??", a,
      ">"]
    else
      [b, a, "<"]
    end if
  elif b = "??" then
    if a = " " then
      ["==", a, "<"]
    else
      ["=", a, "<"]
    end if
  elif b = "==" then
    ["h", a, "<"]
  elif b = "=" then
    ["d", a, "<"]
  elif b = "d" then
    if a = " " then
      [">", a, ">"]
    else
      ["dd", a, "<"]
    end if
  elif b = "dd" then
    if a = " " then

```

```

        [">", "1", ">"]
    else
        ["d<",
         " ", "<"]
    end if
elif b = "d<" then
    if a <> " " then
        [b, a,
         "<"]
    else
        ["d>", "1", ">"]
    end if
elif b = "d>" then
    if a <> " " then
        [b, a, ">"]
    else
        ["d", "1", "<"]
    end if
elif b = ">" then
    if a <> " " then
        [b, a, ">"]
    else
        ["?", "1", ">"]
    end if
elif b = "?" then
    if a = "1" then
        ["??", " ", ">"]
    else
        ["0<", " ", "<"]
    end if
elif b = "0<" then
    if a <> " " then
        [b,
         a, "<"]
    else
        ["0=", a, ">"]
    end if
elif b = "0=" then

```


"		"
"	10101	"
"	^?	"
"		"
"	1 101	"
"	^0<	"
"		"
"	1 101	"
"	^0<	"
"		"
"	1 101	"
"	^0=	"
"		"
"	101	"
"	^0>	"
"		"
"	101	"
"	^??	"
"		"
"	101	"
"	^=	"
"		"
"	101	"
"	^d	"
"		"
"	101	"
"	^>	"
"		"
"	1101	"
"	^?	"
"		"
"	1 01	"
"	^??	"
"		"
"	1 01	"
"	^=	"
"		"
"	1 01	"
"	^d	"
"		"
"	1 01	"
"	^dd	"
"		"
"	11 01	"
"	^>	"
"		"
"	11 01	"
"	^>	"

"		"
"	11101	"
"	^?	"
"		"
"	111 1	"
"	^0<	"
"		"
"	111 1	"
"	^0<	"
"		"
"	111 1	"
"	^0<	"
"		"
"	111 1	"
"	^0<	"
"		"
"	111 1	"
"	^0=	"
"		"
"	11 1	"
"	^0>	"
"		"
"	11 1	"
"	^0>	"
"		"
"	11 1	"
"	^0>	"
"		"
"	11 1	"
"	^??	"
"		"
"	11 1	"
"	^=	"
"		"
"	11 1	"
"	^d	"
"		"
"	11 1	"
"	^dd	"
"		"
"	1 1	"
"	^d<	"
"		"
"	1 1 1	"
"	^d>	"
"		"
"	111 1	"
"	^d	"


```

    if a=" " then [b,"I",">"] else ["ds"," ","<"] fi;
  elif b="ds" then ["m<"," ","<"]
  elif b="m<" then
    if a<>" " then [b,a,"<"] else ["a",a,"<"] fi;
  elif b="a" then ["a<"," ","<"]
  elif b="a<" then
    if a<>" " then [b,a,"<"] else ["a<<","a","<"] fi;
  elif b="a<<" then
    if a<>" " then [b,a,"<"] else ["a>","I",">"] fi;
  elif b="a>" then
    if a<>" " then [b,a,">"] else ["a?","a",">"] fi;
  elif b="a?" then
    if a<>" " then ["a>>","a",">"] else ["ra","I",">"] fi;
  elif b="a>>" then
    if a<>" " then [b,a,">"] else ["a",a,"<"] fi;
  elif b="ra" then
    if a=" " then [b,"I",">"] else ["rr",a,"<"] fi;
  elif b="rr" then ["m>"," ",">"]
  elif b="m>" then
    if a<>" " then [b,a,">"] else ["md",a,"<"] fi;
  elif b="md" then ["m?"," ","<"]
  elif b="m?" then
    if a<>" " then ["m<","a","<"] else ["ad"," ","<"] fi;
  elif b="ad" then
    if a<>" " then [b," ","<"] else ["h",a,"<"] fi;
  else ["h",a,"="] fi; end;

```

TO6:= proc(b, a)

(10.1.23.6)

```

  if b = "s" then
    if a = " " then
      ["h", a, "="]
    else
      ["s>", a, ">"]
    end if
  elif b = "s>" then
    ["ss", " ", ">"]
  elif b = "ss" then
    ["s<", "I", "<"]
  elif b = "s<" then
    ["d", " ",
     "<"]
  elif b = "d" then
    ["d<"," ","<"]
  elif b = "d<" then

```

```
if a <> " " then
    [b, a, "<"]
else
    ["d<<", a, "<"]
end if
elif b = "d<<" then
    if a <> " " then
        [b, a, "<"]
    else
        ["d>",
         "I", ">"]
    end if
elif b = "d>" then
    if a <> " " then
        [b, a,
         ">"]
    else
        ["d?", a, ">"]
    end if
elif b = "d?" then
    if a <> " " then
        ["d>>", a, ">"]
    else
        ["r", "I", ">"]
    end if
elif b = "d>>" then
    if a <> " " then
        [b, a, ">"]
    else
        ["d", a,
         "<"]
    end if
elif b = "r" then
    if a = " " then
        [b, "I", ">"]
    else
        ["ds", " ", "<"]
    end if
```

```
elifb = "ds" then
    ["m<", " ", "<"]
elifb = "m<" then
    if a <> " " then
        [b, a, "<"]
    else
        ["a", a,
         "<"]
    end if
elifb = "a" then
    ["a<", " ", "<"]
elifb = "a<" then
    if a <> " " then
        [b, a, "<"]
    else
        ["a<<", a,
         "<"]
    end if
elifb = "a<<" then
    if a <> " " then
        [b, a, "<"]
    else
        ["a>", "I", ">"]
    end if
elifb = "a>" then
    if a <> " " then
        [b, a, ">"]
    else
        ["a?", a, ">"]
    end if
elifb = "a?" then
    if a <> " " then
        ["a>>", a, ">"]
    else
        ["ra",
         "I", ">"]
    end if
elifb = "a>>" then
```

```
if a <> " " then
    [b, a,
    ">"]
else
    ["a", a, "<"]
end if
elif b = "ra" then
    if a = " " then
        [b, "I", ">"]
    else
        ["rr", a, "<"]
    end if
elif b = "rr" then
    ["m>", " ", ">"]
elif b = "m>" then
    if a <> " " then
        [b, a, ">"]
    else
        ["md", a, "<"]
    end if
elif b = "md" then
    ["m?", " ", "<"]
elif b = "m?" then
    if a <> " " then
        ["m<", a, "<"]
    else
        ["ad", " ", "<"]
    end if
elif b = "ad" then
    if a <> " " then
        [b, " ", "<"]
    else
        ["h", a,
        "<"]
    end if
else
    ["h", a, "="]
end if
```


"	I	I	"
"	$\wedge d <$		"
"			"
"	I	I	"
"	$\wedge d <<$		"
"			"
"	I	I	"
"	$\wedge d <<$		"
"			"
"	II	I	"
"	$\wedge d >$		"
"			"
"	II	I	"
"	$\wedge d >$		"
"			"
"	II	I	"
"	$\wedge d ?$		"
"			"
"	II I I		"
"	$\wedge r$		"
"			"
"	II II I		"
"	$\wedge r$		"
"			"
"	II IIII		"
"	$\wedge r$		"
"			"
"	II III		"
"	$\wedge ds$		"
"			"
"	II II		"
"	$\wedge m <$		"
"			"
"	II II		"
"	$\wedge m <$		"
"			"
"	II II		"
"	$\wedge m <$		"
"			"
"	II II		"
"	$\wedge a$		"
"			"
"	I II		"
"	$\wedge a <$		"
"			"
"	I II		"
"	$\wedge a <$		"
"			"

"		I II	"
"		$\wedge a <<$	"
"			"
"		I I II	"
"		$\wedge a >$	"
"			"
"		I I II	"
"		$\wedge a ?$	"
"			"
"		I I II	"
"		$\wedge a >>$	"
"			"
"		I I II	"
"		$\wedge a$	"
"			"
"		I II	"
"		$\wedge a <$	"
"			"
"		I II	"
"		$\wedge a <<$	"
"			"
"		I II	"
"		$\wedge a <<$	"
"			"
"		II II	"
"		$\wedge a >$	"
"			"
"		II II	"
"		$\wedge a >$	"
"			"
"		II II	"
"		$\wedge a ?$	"
"			"
"		II I II	"
"		$\wedge r a$	"
"			"
"		II II II	"
"		$\wedge r a$	"
"			"
"		II IIIII	"
"		$\wedge r a$	"
"			"
"		II IIIII	"
"		$\wedge r r$	"
"			"
"		II II II	"
"		$\wedge m >$	"
"			"
"			"

"	II II II	"
"	$\wedge m >$	"
"		"
"	II II II	"
"	$\wedge m >$	"
"		"
"	II II II	"
"	$\wedge m d$	"
"		"
"	II II I	"
"	$\wedge m ?$	"
"		"
"	II II I	"
"	$\wedge m <$	"
"		"
"	II II I	"
"	$\wedge a$	"
"		"
"	II I I	"
"	$\wedge a <$	"
"		"
"	II I I	"
"	$\wedge a <$	"
"		"
"	II I I	"
"	$\wedge a <<$	"
"		"
"	II I I	"
"	$\wedge a <<$	"
"		"
"	II I I	"
"	$\wedge a <<$	"
"		"
"	III I I	"
"	$\wedge a >$	"
"		"
"	III I I	"
"	$\wedge a >$	"
"		"
"	III I I	"
"	$\wedge a >$	"
"		"
"	III I I	"
"	$\wedge a ?$	"
"		"
"	III I I	"
"	$\wedge a >>$	"
"		"

"	III I I	"
"	^a	"
"		"
"	III I	"
"	^a<	"
"		"
"	III I	"
"	^a<<	"
"		"
"	III I	"
"	^a<<	"
"		"
"	III I	"
"	^a<<	"
"		"
"	III I	"
"	^a<<	"
"		"
"	IIII I	"
"	^a>	"
"		"
"	IIII I	"
"	^a>	"
"		"
"	IIII I	"
"	^a>	"
"		"
"	IIII I	"
"	^a>	"
"		"
"	IIII I	"
"	^a?	"
"		"
"	IIII I I	"
"	^ra	"
"		"
"	IIII II I	"
"	^ra	"
"		"
"	IIII IIII	"
"	^ra	"
"		"
"	IIII IIII	"
"	^rr	"
"		"
"	IIII II I	"
"	^m>	"
"		"

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"          IIII II I          "
"                ^m>          "
"          IIII II I          "
"                ^md          "
"          IIII II           "
"                ^m?          "
"          IIII II           "
"                ^ad          "
"          IIII I            "
"                ^ad          "
"          IIII              "
"                ^ad          "
"          IIII              "
"                ^h           "
"          IIII              "
"                ^h           "
"          IIII              "
"                ^h           "
"          IIII              "
"                ^h           "

```

```

> T07:=proc(b,a)
  if b="s" then
    if a=" " then ["h",a,"="] else ["s<",a,"<"] fi;
  elif b="s<" then
    if a<>" " then [b,a,"<"] else ["ss"," ","<"] fi;
  elif b="ss" then ["d","I","="]
  elif b="d" then ["d<"," ","<"]
  elif b="d<" then
    if a<>" " then [b,a,"<"] else ["d<<",a,"<"] fi;
  elif b="d<<" then
    if a<>" " then [b,a,"<"] else ["d>","I",">"] fi;
  elif b="d>" then
    if a<>" " then [b,a,">"] else ["d?",a,">"] fi;
  elif b="d?" then
    if a<>" " then ["d>>",a,">"] else ["r","I",">"] fi;
  elif b="d>>" then
    if a<>" " then [b,a,">"] else ["d",a,"<"] fi;
  elif b="r" then
    if a=" " then [b,"I",">"] else ["mm",a,"<"] fi;
  elif b="mm" then ["m<"," ","<"]
  elif b="m<" then
    if a<>" " then [b,a,"<"] else ["a",a,"<"] fi;

```

```

elif b="a" then ["a<"," ","<"]
elif b="a<" then
  if a<>" " then [b,a,"<"] else ["a<<","a,"<"] fi;
elif b="a<<" then
  if a<>" " then [b,a,"<"] else ["a>","I",">"] fi;
elif b="a>" then
  if a<>" " then [b,a,">"] else ["a?","a,">"] fi;
elif b="a?" then
  if a<>" " then ["a>>","a,">"] else ["ra","I",">"] fi;
elif b="a>>" then
  if a<>" " then [b,a,">"] else ["a",a,"<"] fi;
elif b="ra" then
  if a=" " then [b,"I",">"] else ["rr","a,"<"] fi;
elif b="rr" then ["m>"," ",">"]
elif b="m>" then
  if a<>" " then [b,a,">"] else ["md","a,"<"] fi;
elif b="md" then ["m?"," ","<"]
elif b="m?" then
  if a<>" " then ["m<","a,"<"] else ["rm"," ",">"] fi;
elif b="rm" then
  if a=" " then [b,"I",">"] else ["rrm","a,"<"] fi;
elif b="rrm" then ["c<<"," ","<"]
elif b="c<<" then
  if a<>" " then [b,a,"<"] else ["c<<<","a,"<"] fi;
elif b="c<<<" then
  if a<>" " then [b,a,"<"] else ["c<<<<","a,"<"] fi;
elif b="c<<<<" then
  if a<>" " then [b,a,"<"] else ["cd","a,">"] fi;
elif b="cd" then ["c?"," ",">"]
elif b="c?" then
  if a<>" " then ["c>","a,">"] else ["i>","a,">"] fi;
elif b="c>" then
  if a<>" " then [b,a,">"] else ["c>>","a,">"] fi;
elif b="c>>" then
  if a<>" " then [b,a,">"] else ["c>>>","a,">"] fi;
elif b="c>>>" then
  if a<>" " then [b,a,">"] else ["c>>>>"," ",">"] fi;
elif b="c>>>>" then
  if a=" " then [b,a,">"] else ["c??"," ",">"] fi;
elif b="c??" then
  if a<>" " then ["c<","a,"<"] else ["h<","a,"<"] fi;
elif b="c<" then
  if a=" " then [b,a,"<"] else ["c<<","a,"<"] fi;
elif b="h<" then
  if a=" " then [b,a,"<"] else ["h<<","a,"<"] fi;
elif b="h<<" then
  if a<>" " then [b,a,"<"] else ["h<<<","a,"<"] fi;
elif b="h<<<" then

```

```

    if a<>" " then [b,a,"<"] else ["h<<<<",a,"<"] fi;
  elif b="h<<<<" then
    if a<>" " then [b,a,"<"] else ["h>",a,">"] fi;
  elif b="h>" then
    if a<>" " then [b," ",">"] else ["h>>",a,">"] fi;
  elif b="h>>" then
    if a<>" " then [b," ",">"] else ["hd",a,">"] fi;
  elif b="hd" then ["h>>>"," ",">"]
  elif b="h>>>" then
    if a<>" " then [b,a,">"] else ["h",a,"<"] fi;
  elif b="i" then
    if a<>" " then [b," ",">"] else ["i>>","I",">"] fi;
  elif b="i>>" then
    if a<>" " then [b,a,">"] else ["rs",a,">"] fi;
  elif b="rs" then
    if a=" " then [b,"I",">"] else ["s<<",a,"<"] fi;
  elif b="s<<" then
    if a<>" " then [b,a,"<"] else ["d",a,"<"] fi;
  else ["h",a,"="] fi; end;

```

TO7:= proc(b, a)

(10.1.23.7)

```

  if b = "s" then
    if a = " " then
      ["h", a, "="]
    else
      ["s<", a, "<"]
    end if
  elif b = "s<" then
    if a <> " " then
      [b, a,
       "<"]
    else
      ["ss", " ", "<"]
    end if
  elif b = "ss" then
    ["d", "I",
     "="]
  elif b = "d" then
    ["d<", " ", "<"]
  elif b = "d<" then
    if a <> " " then
      [b, a, "<"]

```



```

else
    ["d<<", a, "<"]
end if
elif b = "d<<" then
    if a <> " " then
        [b, a, "<"]
    else
        ["d>",
         "I", ">"]
    end if
elif b = "d>" then
    if a <> " " then
        [b, a,
         ">"]
    else
        ["d?", a, ">"]
    end if
elif b = "d?" then
    if a <> " " then
        ["d>>", a, ">"]
    else
        ["r", "I", ">"]
    end if
elif b = "d>>" then
    if a <> " " then
        [b, a, ">"]
    else
        ["d", a,
         "<"]
    end if
elif b = "r" then
    if a = " " then
        [b, "I", ">"]
    else
        ["mm", a, "<"]
    end if
elif b = "mm" then
    ["m<", " ", "<"]

```

```
elifb = "m<" then
  if a<> " " then
    [b, a, "<"]
  else
    ["a", a,
     "<"]
  end if
elifb = "a" then
  ["a<", " ", "<"]
elifb = "a<" then
  if a<> " " then
    [b, a, "<"]
  else
    ["a<<", a,
     "<"]
  end if
elifb = "a<<" then
  if a<> " " then
    [b, a, "<"]
  else
    ["a>", "I", ">"]
  end if
elifb = "a>" then
  if a<> " " then
    [b, a, ">"]
  else
    ["a?", a, ">"]
  end if
elifb = "a?" then
  if a<> " " then
    ["a>>", a, ">"]
  else
    ["ra",
     "I", ">"]
  end if
elifb = "a>>" then
  if a<> " " then
    [b, a,
```

```

    ">"]
else
    ["a", a, "<"]
end if
elif b = "ra" then
    if a = " " then
        [b, "I", ">"]
    else
        ["rr", a, "<"]
    end if
elif b = "rr" then
    ["m>", " ", ">"]
elif b = "m>" then
    if a <> " " then
        [b, a, ">"]
    else
        ["md", a, "<"]
    end if
elif b = "md" then
    ["m?", " ", "<"]
elif b = "m?" then
    if a <> " " then
        ["m<", a, "<"]
    else
        ["rm", " ", ">"]
    end if
elif b = "rm" then
    if a = " " then
        [b, "I", ">"]
    else
        ["rrm", a,
        "<"]
    end if
elif b = "rrm" then
    ["c<<", " ", "<"]
elif b = "c<<" then
    if a <> " " then
        [b, a, "<"]

```

```
else
    ["c<<<<", a, "<"]
end if
elif b = "c<<<<" then
    if a <> " " then
        [b, a, "<"]
    else
        ["c<<<<<<", a, "<"]
    end if
elif b = "c<<<<<<" then
    if a <> " " then
        [b, a, "<"]
    else
        ["cd",
         a, ">"]
    end if
elif b = "cd" then
    ["c?", " ", ">"]
elif b = "c?" then
    if a <> " " then
        ["c>", a, ">"]
    else
        ["i>", a,
         ">"]
    end if
elif b = "c>" then
    if a <> " " then
        [b, a, ">"]
    else
        ["c>>", a, ">"]
    end if
elif b = "c>>" then
    if a <> " " then
        [b, a, ">"]
    else
        ["c>>>", a, ">"]
    end if
elif b = "c>>>" then
```

```

if  $a <> ""$  then
    [ $b, a, ">"$ ]
else
    [ $"c>>>>", "", ">"$ ]
end if
elif  $b = "c>>>>"$  then
    if  $a = ""$  then
        [ $b, a, ">"$ ]
    else
        [ $"c??", "", ">"$ ]
    end if
elif  $b = "c??"$  then
    if  $a <> ""$  then
        [ $"c<", a, "<"$ ]
    else
        [ $"h<",$ 
         $a, "<"$ ]
    end if
elif  $b = "c<"$  then
    if  $a = ""$  then
        [ $b, a, "<"$ ]
    else
        [ $"c<<", a, "<"$ ]
    end if
elif  $b = "h<"$  then
    if  $a = ""$  then
        [ $b, a, "<"$ ]
    else
        [ $"h<<", a, "<"$ ]
    end if
elif  $b = "h<<"$  then
    if  $a <> ""$  then
        [ $b, a, "<"$ ]
    else
        [ $"h<<<", a, "<"$ ]
    end if
elif  $b = "h<<<"$  then
    if  $a <> ""$  then

```

```

    [b, a, "<"]
else
    ["h<<<<", a, "<"]
end if
elif b = "h<<<<" then
    if a <> " " then
        [b, a, "<"]
    else
        ["h>", a, ">"]
    end if
elif b = "h>" then
    if a <> " " then
        [b,
         " ", ">"]
    else
        ["h>>", a, ">"]
    end if
elif b = "h>>" then
    if a <> " " then
        [b, " ", ">"]
    else
        ["hd", a, ">"]
    end if
elif b = "hd" then
    ["h>>>", " ", ">"]
elif b = "h>>>" then
    if a <> " " then
        [b, a, ">"]
    else
        ["h", a, "<"]
    end if
elif b = "i>" then
    if a <> " " then
        [b, " ", ">"]
    else
        ["i>>",
         "I", ">"]
    end if

```


"		$\wedge m <$	"
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"		I I III	"
"		$\wedge m <$	"
"			"
"		I I III	"
"		$\wedge a$	"
"			"
"		I III	"
"		$\wedge a <$	"
"			"
"		I III	"
"		$\wedge a <<$	"
"			"
"		I I III	"
"		$\wedge a >$	"
"			"
"		I I III	"
"		$\wedge a ?$	"
"			"
"		I I I III	"
"		$\wedge r a$	"
"			"
"		I III III	"
"		$\wedge r a$	"
"			"
"		I III III	"
"		$\wedge r r$	"
"			"
"		I I I III	"
"		$\wedge m >$	"
"			"
"		I I I III	"
"		$\wedge m >$	"
"			"
"		I I I III	"
"		$\wedge m d$	"
"			"
"		I I III	"
"		$\wedge m ?$	"
"			"
"		I I III	"
"		$\wedge r m$	"
"			"
"		I I I III	"
"		$\wedge r m$	"
"			"
"		I I IIIII	"

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"			"
"	I I	IIIII	"
"		^rrm	"
"			"
"	I I I	III	"
"		^c<<	"
"			"
"	I I I	III	"
"		^c<<	"
"			"
"	I I I	III	"
"		^c<<<	"
"			"
"	I I I	III	"
"		^c<<<	"
"			"
"	I I I	III	"
"		^c<<<<	"
"			"
"	I I I	III	"
"		^c<<<<	"
"			"
"	I I I	III	"
"		^cd	"
"			"
"	I I	III	"
"		^c?	"
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"		^i>	"
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"	I	III	"
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"		^i>>	"
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"					IIII	II	I	III	"
"					^md				"
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"					^rm				"
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"					^rrm				"
"					IIII	II	II	III	"

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"				$\wedge c <<$	"
"					"
"			IIII	II II III	"
"				$\wedge c <<$	"
"					"
"			IIII	II II III	"
"				$\wedge c <<<$	"
"					"
"			IIII	II II III	"
"				$\wedge c <<<$	"
"					"
"			IIII	II II III	"
"				$\wedge c <<<<$	"
"					"
"			IIII	II II III	"
"				$\wedge c <<<<$	"
"					"
"			IIII	II II III	"
"				$\wedge c <<<<$	"
"					"
"			IIII	II II III	"
"				$\wedge c <<<<$	"
"					"
"			IIII	II II III	"
"				$\wedge c <<<<$	"
"					"
"			IIII	II II III	"
"				$\wedge cd$	"
"					"
"			III	II II III	"
"				$\wedge c ?$	"
"					"
"			III	II II III	"
"				$\wedge c >$	"
"					"
"			III	II II III	"
"				$\wedge c >$	"
"					"
"			III	II II III	"
"				$\wedge c >$	"
"					"
"			III	II II III	"

"		^C<<<<	"
"			"
"		III II II II	"
"		^C<<<<	"
"			"
"		III II II II	"
"		^C<<<<	"
"			"
"		III II II II	"
"		^C<<<<	"
"			"
"		III II II II	"
"		^cd	"
"			"
"		II II II II	"
"		^C?	"
"			"
"		II II II II	"
"		^C>	"
"			"
"		II II II II	"
"		^C>	"
"			"
"		II II II II	"
"		^C>>	"
"			"
"		II II II II	"
"		^C>>	"
"			"
"		II II II II	"
"		^C>>	"
"			"
"		II II II II	"
"		^C>>>	"
"			"
"		II II II II	"
"		^C>>>	"
"			"
"		II II II II	"
"		^C>>>>	"
"			"
"		II II II II	"
"		^C>>>>	"
"			"
"		II II II I	"

"				$\wedge c??$	"
"					"
"			II II II	I	"
"				$\wedge c<$	"
"					"
"			II II II	I	"
"				$\wedge c<$	"
"					"
"			II II II	I	"
"				$\wedge c<$	"
"					"
"			II II II	I	"
"				$\wedge c<<$	"
"					"
"			II II II	I	"
"				$\wedge c<<<$	"
"					"
"			II II II	I	"
"				$\wedge c<<<<$	"
"					"
"			II II II	I	"
"				$\wedge c<<<<$	"
"					"
"			II II II	I	"
"				$\wedge c<<<<$	"
"					"
"			II II II	I	"
"				$\wedge c<<<<$	"
"					"
"			II II II	I	"
"				$\wedge cd$	"
"					"
"			I II II	I	"
"				$\wedge c?$	"
"					"
"			I II II	I	"
"				$\wedge c>$	"
"					"
"			I II II	I	"

"					^C>>	"
"						"
"				I	II II I	"
"					^C>>	"
"				I	II II I	"
"					^C>>	"
"				I	II II I	"
"					^C>>>	"
"				I	II II I	"
"					^C>>>	"
"				I	II II I	"
"					^C>>>>	"
"				I	II II I	"
"					^C>>>>	"
"				I	II II I	"
"					^C>>>>	"
"				I	II II I	"
"					^C>>>>	"
"				I	II II	"
"					^C??	"
"				I	II II	"
"					^h<	"
"				I	II II	"
"					^h<	"
"				I	II II	"
"					^h<	"
"				I	II II	"
"					^h<	"
"				I	II II	"
"					^h<	"
"				I	II II	"
"					^h<	"
"				I	II II	"
"					^h<<	"
"				I	II II	"
"						"

"		^h<<	"
"			"
"	I II II		"
"		^h<<<	"
"			"
"	I II II		"
"		^h<<<	"
"			"
"	I II II		"
"		^h<<<	"
"			"
"	I II II		"
"		^h<<<<	"
"			"
"	I II II		"
"		^h>	"
"			"
"	II II		"
"		^h>	"
"			"
"	II II		"
"		^h>>	"
"			"
"	I II		"
"		^h>>	"
"			"
"	II		"
"		^h>>	"
"			"
"	II		"
"		^hd	"
"			"
"	I		"
"		^h>>>	"
"			"
"	I		"
"		^h>>>	"
"			"
"	I		"
"		^h	"
"			"
"	I		"
"		^h	"

▼ 10.1.24. Szavak kódolása számmá és vissza.

```

> Digits36:="0123456789abcdefghijklmnopqrstuvwxy"; length(%)
;
digit2number:=proc(d::string) searchtext(d,Digits36)-1 end;
digit2number("a");
  Digits36:="0123456789abcdefghijklmnopqrstuvwxy"
  36
digit2number:= proc(d::string)
  searchtext(d, Digits36) - 1
end proc
  10 (10.1.24.1)

```

```

> string2number:=proc(s::string,r::posint) local i,n; n:=0;
for i to length(s) do n:=n*r+digit2number(s[i]) od; n; end;
string2number("f0",16); string2number("eg",16);
string2number:= proc(s::string, r::posint)
  local i, n;
  n:= 0;
  for i to length(s) do
    n:= n* r + digit2number(s[i])
  end do;
  n
end proc
  240
  240 (10.1.24.2)

```

```

> number2string:=proc(n::nonnegint,r::posint) local nn,nnn,s;
s:=""; nn:=n;
while nn>0 do
  nnn:=irem(nn,r); nn:=iquo(nn,r); s:=cat("",Digits36
[nnn+1],s);
od; s; end;
number2string(240,16);
number2string:= proc(n::nonnegint, r::posint)
  local nn, nnn, s;
  s:= "";
  nn:= n;
  while 0 < nn do
    nnn:= irem(nn, r);
    nn:= iquo(nn, r);
    s:= cat("", Digits36[nnn + 1], s)
  end do;
  s

```

```

end proc
                                "f0"
                                (10.1.24.3)
> number2stringnon0:=proc(n::nonnegint,r::posint) local nn,
  nnn,s;
  s:=""; nn:=n;
  while nn>0 do
    nnn:=irem(nn-1,r)+1; nn:=iquo(nn-1,nnn,r); s:=cat("",
  Digits36[nnn+1],s);
  od; s; end;
  number2stringnon0(240,16);
number2stringnon0:=proc(n::nonnegint, r::posint)
  local nn, nnn,
  s;
  s:="";
  nn:=n;
  while 0 < nn do
    nnn:=irem(nn-1,r)+1;
    nn:=iquo(nn-1,nnn,r);
    s:=cat("", Digits36[nnn+1], s)
  end do;
  s
end proc
                                "eg"
                                (10.1.24.4)

```

▼ 10.1.25. Turing-gép szimulálása egy szalaggal.

```

> # In the general Turing One-tape simulator:
  # T is the Turing-machine to simulate;
  # k is the number of the tapes of T;
  # x a character, not <, >, = and not in the tape ABC of T.

T0simul:=proc(b,a) local i,j,ii,xx,bb,bbb,L;
global k,T,x; xx:=cat(x$j=1..k);
if b=start then [cat("<h1", " "$j=1..k,start, " "$j=1..2*k),
a,"="]
elif b=halt then [halt,a,"="]
elif b[1..2]="<h" then i:=digit2number(b[3]); ii:=Digits36
[i+2];
  if i<k then
    if a<>" " then
      [cat("<h",ii,b[4..2+i],a,b[4+i..-1])," ","<"]
    elif b[3+i]<>" " and b[3+i]<>x then
      [cat("<h",ii,b[4..2+i],x,b[4+i..-1]),b[3+i],"<"]

```

```

else
    [cat("<h",ii,b[4..-1]),a,"<"] fi;
else
    if a<>" " then
        [cat("<a1",b[4..2+i],a,b[4+i..-1])," ","<"]
    elif b[3+i]<>" " and b[3+i]<>x then
        [cat("<a1",b[4..2+i],x,b[4+i..-1]),b[3+i],"<"]
    else
        [cat("<a1",b[4..-1]),a,"<"] fi;
fi;
elif b[1..2]="<a" then i:=digit2number(b[3]); ii:=Digits36
[i+2];
if i<k then
    if b[3+i]<>" " and b[3+i]<>x then
        [cat("<a",ii,b[4..-2*k+i-2],a,b[-2*k+i..-1]),a,"<"]
    else [cat("<a",ii,b[4..-1]),a,"<"] fi;
else
    if b[3+i]<>" " and b[3+i]<>x then
        bb:=cat("<h1",b[4..-2*k+i-2],a,b[-2*k+i..-1])
    else bb:=cat("<h1",b[4..-1]) fi;
    if bb[4..3+k]=xx then ii:=Digits36[k+1];
        L:=T(bb[4+k..-2*k-1],bb[j]$j=-2*k..-k-1);
        [cat(">a",ii," "$j=1..k,op(L)),a,"="]
    else
        [bb,a,"<"]
    fi;
fi;
elif b[1..2]=">a" then i:=digit2number(b[3]); ii:=Digits36
[i];
if i>1 then
    if b[3+i]<>" " and b[3+i]<>x and b[-2*k+i-1]<>x then
        [cat(">a",ii,b[4..-2*k+i-2],x,b[-2*k+i..-1]),b[-2*k+i
-1],">"]
    else [cat(">a",ii,b[4..-1]),a,">"] fi;
else ii:=Digits36[k+1];
    if b[3+i]<>" " and b[3+i]<>x and b[-2*k+i-1]<>x then
        [cat(">h",ii,b[4..-2*k+i-2],x,b[-2*k+i..-1]),b[-2*k+i
-1],">"]
    else [cat(">h",ii,b[4..-1]),a,">"] fi;
fi;
elif b[1..2]=">h" then i:=digit2number(b[3]); ii:=Digits36
[i];
if i>1 then if i=k then bbb:="" else bbb:=bb[-k+i..-1]
fi;
if b[3+i]=space and a<>space then
    bb:=cat(">h",ii,b[4..2+i],a,b[4+i..-1]);
    if bb[-k+i-1]="<" then
        [bb,a,">"]

```



```

else [bb,space,">"] fi;
elif b[3+i]<>space and b[3+i]<>x then
  if b[-k+i-1]="<" then
    bb:=cat(">h",ii,b[4..2+i],x,b[4+i..-1]);
    [cat(bb[1..-k+i-2],space,bbb),space,">"]
  elif b[-k+i-1]="=" then
    bb:=cat(">h",ii,b[4..2+i],x,b[4+i..-1]);
    [cat(bb[1..-k+i-2],space,bbb),b[3+i],">"]
  elif b[-k+i-1]=">" then
    bb:=cat(">h",ii,b[4..-1]);
    [cat(bb[1..-k+i-2],x,bbb),space,">"]
  else
    bb:=cat(">h",ii,b[4..2+i],x,b[4+i..-1]);
    [cat(bb[1..-k+i-2],space,bbb),b[3+i],">"] fi;
else
  [cat(">h",ii,b[4..-1]),space,">"] fi;
else ii:=Digits36[k+1]; if i=k then bbb:="" else bbb:=b[-
k+i..-1] fi;
  if b[3+i]=space and a<>space then
    bb:=cat(">a",ii,b[4..2+i],a,b[4+i..-1]);
    if bb[-k+i-1]="<" then
      L:=[bb,a,">"]
    else L:=[bb,space,">"] fi;
  elif b[3+i]<>space and b[3+i]<>x then
    if b[-k+i-1]="<" then
      bb:=cat(">a",ii,b[4..2+i],x,b[4+i..-1]);
      L:=[cat(bb[1..-k+i-2],space,bbb),space,">"]
    elif b[-k+i-1]="=" then
      bb:=cat(">a",ii,b[4..2+i],x,b[4+i..-1]);
      L:=[cat(bb[1..-k+i-2],space,bbb),b[3+i],">"]
    elif b[-k+i-1]=">" then
      bb:=cat(">a",ii,b[4..-1]);
      L:=[cat(bb[1..-k+i-2],x,bbb),space,">"]
    else
      bb:=cat(">a",ii,b[4..2+i],x,b[4+i..-1]);
      L:=[cat(bb[1..-k+i-2],space,bbb),b[3+i],">"] fi;
  else
    L:=[cat(">a",ii,b[4..-1]),space,">"] fi;
  bb:=L[1];
  if bb[4..3+k]=xx then
    if bb[4+k]=halt then [halt,a,"<"] else
      [cat("<h1", " "$j=1..k,bb[4+k..-2*k-1], " "$j=1..2*k)
,a,"="] fi;
    else L fi;
  fi;
fi; end;

```

*T*Osimul:= proc(*b*, *a*)

(10.1.25.1)

local *i*, *j*, *ii*, *xx*, *bb*, *bbb*, *L*;

```

global k, T, x;
xx := cat( ` $ `(x, j = 1..k));
if b = start then
    [cat("<h1",
        ` $ `(" ", j = 1..k), start, ` $ `(" ", j = 1..2 * k)), a, "="]
elif b = halt then
    [halt, a, "="]
elif b[1..2] = "<h" then
    i := digit2number(b[3]);
    ii := Digits36[i + 2];
    if i < k then
        if a <> " " then
            [cat("<h", ii, b[4..i + 2], a, b[4 + i..-1]), " ",
                "<"]
            elif b[3 + i] <> " " and b[3 + i] <> x then
                [cat("<h", ii, b[4..i + 2], x, b[4 + i..-1]), b[3 + i],
                    "<"]
            else
                [cat("<h", ii, b[4..-1]), a, "<"]
            end if
        else
            if a <> " " then
                [cat("<a1", b[4..i + 2], a, b[4 + i..-1]), " ",
                    "<"]
                elif b[3 + i] <> " " and b[3 + i] <> x then
                    [cat("<a1", b[4..i + 2], x, b[4 + i..-1]), b[3 + i], "<"]
                else
                    [cat("<a1", b[4..-1]), a, "<"]
                end if
            end if
        elif b[1..2] = "<a" then
            i := digit2number(b[3]);
            ii := Digits36[i + 2];
            if i < k then
                if b[3 + i] <> " " and b[3 + i] <> x then
                    [cat("<a", ii,
                        b[4..-2 * k + i - 2], a, b[-2 * k + i..-1]), a, "<"]
                else

```

```

    [cat("<a", ii, b[4..-1]), a, "<"]
end if
else
if b[3 + i] <> " " and b[3 + i] <> x then
    bb := cat("<h1",
    b[4..-2*k + i - 2], a, b[-2*k + i..-1])
else
    bb := cat("<h1", b[4..-1])
end if;
if bb[4..3 + k] = xx then
    ii := Digits36[k + 1];
    L := T(bb[4 + k..-2*k - 1], `\$`(bb[j],
    j = -2*k..-k - 1));
    [cat(">a", ii, `\$`(" ", j = 1..k),
    op(L)), a, "="]
else
    [bb, a, "<"]
end if
end if
elif b[1..2] = ">a" then
    i := digit2number(b[3]);
    ii := Digits36[i];
    if 1 < i then
        if b[3 + i] <> " " and b[3 + i] <> x
        and b[-2*k + i - 1] <> x then
            [cat(">a", ii,
            b[4..-2*k + i - 2], x, b[-2*k + i..-1]),
            b[-2*k + i - 1], ">"]
        else
            [cat(">a", ii, b[4..-1]),
            a, ">"]
        end if
    else
        ii := Digits36[k + 1];
        if b[3 + i] <> " " and b[3 + i] <> x
        and b[-2*k + i - 1] <> x then
            [cat(">h", ii,
            b[4..-2*k + i - 2], x, b[-2*k + i..-1]),

```

```

        b[-2 * k + i - 1], ">"]
    else
        [cat(">h", ii, b[4..-1]),
        a, ">"]
    end if
end if
elif b[1..2] = ">h" then
    i := digit2number(b[3]);
    ii := Digits36[i];
    if 1 < i then
        if i = k then
            bbb := ""
        else
            bbb := bb[-k + i..-1]
        end if;
        if b[3 + i] = space and a <> space then
            bb := cat(">h",
            ii, b[4..i + 2], a, b[4 + i..-1]);
            if bb[-k + i - 1] = "<" then
                [bb, a, ">"]
            else
                [bb,
                space, ">"]
            end if
        end if
    end if
elif b[3 + i] <> space and b[3 + i] <> x then
    if b[-k + i - 1] = "<" then
        bb := cat(">h", ii, b[4..i + 2],
        x, b[4 + i..-1]);
        [cat(bb[1..-k + i - 2], space,
        bbb), space, ">"]
    elif b[-k + i - 1] = "=" then
        bb := cat(">h", ii, b[4..i + 2], x, b[4 + i..-1]);
        [cat(bb[1..-k + i - 2], space, bbb), b[3 + i], ">"]
    elif b[-k + i - 1] = ">" then
        bb := cat(">h", ii,
        b[4..-1]);
        [cat(bb[1..-k + i - 2], x, bbb),
        space, ">"]
    end if
end if

```

```

else
    bb := cat(">h", ii, b[4..i+2], x,
    b[4+i..-1]);
    [cat(bb[1..-k+i-2], space,
    bbb), b[3+i], ">"]
end if
else
    [cat(">h", ii,
    b[4..-1]), space, ">"]
end if
else
    ii := Digits36[k+1];
    if i = k then
        bbb := ""
    else
        bbb := b[-k+i..-1]
    end if;
    if b[3+i] = space and a <> space then
        bb := cat(">a",
        ii, b[4..i+2], a, b[4+i..-1]);
        if bb[-k+i-1] = "<" then
            L := [bb, a, ">"]
        else
            L := [bb, space, ">"]
        end if
    elif b[3+i] <> space and b[3+i] <> x then
        if b[-k+i-1] = "<" then
            bb := cat(">a", ii, b[4..i+2],
            x, b[4+i..-1]);
            L := [cat(bb[1..-k+i-2],
            space, bbb), space, ">"]
        elif b[-k+i-1] = "=" then
            bb := cat(">a", ii,
            b[4..i+2], x, b[4+i..-1]);
            L := [cat(bb[1..-k+i-2], space, bbb), b[3+i],
            ">"]
        elif b[-k+i-1] = ">" then
            bb := cat(">a",

```



```
"          11ff11          "
```

```
"          ^>h2  c10<<    "
```

```
"          "
```

```
"          11ff11          "
```

```
"          ^>h1  fc10<<   "
```

```
"          "
```

```
"          11ff11          "
```

```
"          ^>a2ffc10<<    "
```

```
"          "
```

```
"          11ff01          "
```

```
"          ^>a1ffc1.<<    "
```

```
"          "
```

```
"          11ff01          "
```

```
"          ^>h2ffc..<<   "
```

```
"          "
```

```
"          11ff01          "
```

```
"          ^>h1f.c..<    "
```

```
"          "
```

```
"          11ff01          "
```

```
"          ^<h1  c        "
```

```
"          "
```

```
"          11ff01          "
```

```
"          ^<h2  c        "
```

```
"          "
```

```
"          11ff01          "
```

```
"          ^<a1  c        "
```

```
"          "
```

```
"          11ff01          "
```

```
"          ^<a2  c        "
```

```
"          "
```

```
"          11ff01          "
```

```
"          ^<h1  c        "
```

```
"          "
```

```
"          11f 01          "
```

```
"          ^<h2f c       "
```

```
"          "
```

```
"          11 01          "
```

```
"          ^<a1ffc       "
```

```
"          "
```

```
"          11 01          "
```

```
"          ^<a2ffc1      "
```

```
"          "
```

```
"          11 01          "
```

```
"          ^<h1ffc11     "
```

```
"          "
```

```
"          f11 01          "
```

```
"          ^<h2.fc11     "
```

```
"          "
```



```
"          ff11  01          "
```

```
"          ^<a1..c11          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^<a2..c11          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^>a2  c11<<          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^>a1  c11<<          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^>h2  c11<<          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^>h1 fc11<<          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^>a2ffc11<<          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^>a1ffc1.<<          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^>h2ffc..<<          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^>h1f.c..<          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^<h1  c          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^<h2  c          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^<a1  c          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^<a2  c          "
```

```
"          "
```

```
"          ff11  01          "
```

```
"          ^<h1  c          "
```

```
"          "
```

```
"          f 11  01          "
```

```
"          ^<h2f c          "
```

```
"          "
```

"	11 01	"
"	^<a1ffc	"
"		"
"	11 01	"
"	^<a2ffc	"
"		"
"	11 01	"
"	^<h1ffc	"
"		"
"	f 11 01	"
"	^<h2.fc	"
"		"
"	ff 11 01	"
"	^<a1..c	"
"		"
"	ff 11 01	"
"	^<a2..c	"
"		"
"	ff 11 01	"
"	^>a2 b 1=>	"
"		"
"	ff 11 01	"
"	^>a1 b 1=>	"
"		"
"	ff 11 01	"
"	^>h2 b 1=>	"
"		"
"	f 11 01	"
"	^>h1 fb 1=>	"
"		"
"	11 01	"
"	^>a2ffb 1=>	"
"		"
"	1 11 01	"
"	^>a1ffb .=>	"
"		"
"	1 11 01	"
"	^>h2ffb..=>	"
"		"
"	1 11 01	"
"	^>h1ffb..=.	"
"		"
"	1 f11 01	"
"	^>a2.fb.. .	"
"		"
"	1 f11 01	"
"	^>a1.fb.. .	"
"		"

"	1	f11	01	"
"			^>h2.fb... .	"
"				"
"	1	f11f	01	"
"			^>h1..b..	"
"				"
"	1	f11f	01	"
"			^<h1 b	"
"				"
"	1	f11f	01	"
"			^<h2 b	"
"				"
"	1	f11	01	"
"			^<a1 fb	"
"				"
"	1	f11	01	"
"			^<a2 fb	"
"				"
"	1	f11	01	"
"			^<h1 fb 1	"
"				"
"	1	11	01	"
"			^<h2ffb 1	"
"				"
"	1	f	11 01	"
"			^<a1f.b 1	"
"				"
"	1	f	11 01	"
"			^<a2f.b 1	"
"				"
"	1	f	11 01	"
"			^<h1f.b 1	"
"				"
"	f1	f	11 01	"
"			^<h2..b 1	"
"				"
"	f1	f	11 01	"
"			^<a1..b 1	"
"				"
"	f1	f	11 01	"
"			^<a2..b 1	"
"				"
"	f1	f	11 01	"
"			^>a2 b 1=>	"
"				"
"	f1	f	11 01	"
"			^>a1 b 1=>	"
"				"

```

"          f1 f 11  01          "
"          ^>h2  b 1=>          "
"
"          f1 f 11  01          "
"          ^>h1  b 1=>          "
"
"          1 f 11  01          "
"          ^>a2f b 1=>          "
"
"          1 f 11  01          "
"          ^>a1f b 1=>          "
"
"          1 f 11  01          "
"          ^>h2f b.1=>        "
"
"          1  11  01          "
"          ^>h1ffb.1=>        "
"
"          1 f11  01          "
"          ^>a2.fb.1 >        "
"
"          1 f11  01          "
"          ^>a1.fb.. >        "
"
"          1 f11  01          "
"          ^>h2.fb.. >        "
"
"          1 f11  01          "
"          ^>h1.fb.. .        "
"
"          1 f11  01          "
"          ^>a2.fb.. .        "
"
"          1 f11  01          "
"          ^>a1.fb.. .        "
"
"          1 f11  01          "
"          ^>h2.fb.. .        "
"
"          1 f11  01f          "
"          ^>h1..b..          "
"
"          1 f11  01f          "
"          ^<h1  b            "
"
"          1 f11  01f          "
"          ^<h2  b            "
"

```

```

"      1  f11  01      "
"          ^<a1 fb      "
"      "
"      1  f11  01      "
"          ^<a2 fb      "
"      "
"      1  f11  01      "
"          ^<h1 fb 0    "
"      "
"      1  f11  01      "
"          ^<h2 fb 0    "
"      "
"      1  f11f 01      "
"          ^<a1 .b 0    "
"      "
"      1  f11f 01      "
"          ^<a2 .b 0    "
"      "
"      1  f11f 01      "
"          ^<h1 .b 0    "
"      "
"      1  11f 01      "
"          ^<h2f.b 0    "
"      "
"      1  11f 01      "
"          ^<a1f.b 0    "
"      "
"      1  11f 01      "
"          ^<a2f.b 0    "
"      "
"      1  11f 01      "
"          ^<h1f.b 0    "
"      "
"      f1  11f 01      "
"          ^<h2..b 0    "
"      "
"      f1  11f 01      "
"          ^<a1..b 0    "
"      "
"      f1  11f 01      "
"          ^<a2..b 0    "
"      "
"      f1  11f 01      "
"          ^>a2  b 0=>   "
"      "
"      f1  11f 01      "
"          ^>a1  b 0=>   "
"      "

```

```

"          f1  11f 01          "
"          ^>h2  b 0=>          "
"
"          f1  11f 01          "
"          ^>h1  b 0=>          "
"
"          1   11f 01          "
"          ^>a2f b 0=>          "
"
"          1   11f 01          "
"          ^>a1f b 0=>          "
"
"          1   11f 01          "
"          ^>h2f b.0=>         "
"
"          1   11f 01          "
"          ^>h1f b.0=>         "
"
"          1  f11f 01          "
"          ^>a2. b.0 >         "
"
"          1  f11f 01          "
"          ^>a1. b.0 >         "
"
"          1  f11f 01          "
"          ^>h2. b.0 >         "
"
"          1  f11  01          "
"          ^>h1.fb.0 >         "
"
"          1  f11  01          "
"          ^>a2.fb.0 >         "
"
"          1  f11  01          "
"          ^>a1.fb.. >         "
"
"          1  f11  01          "
"          ^>h2.fb.. >         "
"
"          1  f11  01          "
"          ^>h1.fb.. .         "
"
"          1  f11  01          "
"          ^>a2.fb.. .         "
"
"          1  f11  01          "
"          ^>a1.fb.. .         "
"

```

```

"           1 f11 01           "
"           ^>h2.fb... .      "
"
"           1 f11 01 f        "
"           ^>h1..b..         "
"
"           1 f11 01 f        "
"           ^<h1 b            "
"
"           1 f11 01 f        "
"           ^<h2 b            "
"
"           1 f11 01          "
"           ^<a1 fb           "
"
"           1 f11 01          "
"           ^<a2 fb           "
"
"           1 f11 01          "
"           ^<h1 fb           "
"
"           1 f11 01          "
"           ^<h2 fb           "
"
"           1 f11 01f         "
"           ^<a1 .b           "
"
"           1 f11 01f         "
"           ^<a2 .b           "
"
"           1 f11 01f         "
"           ^<h1 .b           "
"
"           1 f11 01f         "
"           ^<h2 .b           "
"
"           1 f11 01f         "
"           ^<a1 .b           "
"
"           1 f11 01f         "
"           ^<a2 .b           "
"
"           1 f11 01f         "
"           ^<h1 .b           "
"
"           1 11 01f          "
"           ^<h2f.b           "
"

```

```

"      1  11  01f      "
"      ^<a1f.b          "
"
"      1  11  01f      "
"      ^<a2f.b          "
"
"      1  11  01f      "
"      ^<h1f.b          "
"
"      f1  11  01f      "
"      ^<h2..b         "
"
"      f1  11  01f      "
"      ^<a1..b          "
"
"      f1  11  01f      "
"      ^<a2..b          "
"
"      f1  11  01f      "
"      ^>a2  h  =<      "
"
"      f1  11  01f      "
"      ^>a1  h  =<      "
"
"      f1  11  01f      "
"      ^>h2  h  =<      "
"
"      f1  11  01f      "
"      ^>h1  h  =<      "
"
"      1  11  01f      "
"      ^>a2f h  =<      "
"
"      1  11  01f      "
"      ^>a1f h  =<      "
"
"      1  11  01f      "
"      ^>h2f h. =<      "
"
"      1  11  01f      "
"      ^>h1f h. =<      "
"
"      1  f11  01f      "
"      ^>a2. h.  <      "
"
"      1  f11  01f      "
"      ^>a1. h.  <      "
"

```



```

"          1 f11 01f          "
"                ^>h2. h. <  "
"          "                  "
"          1 f11 01f          "
"                ^>h1. h. <  "
"          "                  "
"          1 f11 01f          "
"                ^>a2. h. <  "
"          "                  "
"          1 f11 01f          "
"                ^>a1. h. <  "
"          "                  "
"          1 f11 01f          "
"                ^>h2. h. <  "
"          "                  "
"          1 f11 01f          "
"                ^>h1.fh. <  "
"          "                  "
"          1 f11 01f          "
"                ^>a2.fh. <  "
"          "                  "
"          1 f11 01f          "
"                ^>a1.fh.. <  "
"          "                  "
"          1 f11 01f          "
"                ^>h2.fh.. <  "
"          "                  "
"          1 f11 01f          "
"                ^>h1..h..  "
"          "                  "
"          1 f11 01f          "
"                ^h         "
"          "                  "
"          1 f11 01f          "
"                ^h         "

```

► 10.1.26. Megjegyzés.

▼ 10.1.27. Feladat.

▼ 10.1.28. Szemétgyűjtés.

```

> # In the general garbage collection:
# T is the original Turing-machine;
# k is the number of the tapes of T;
# x a character, not <,>,,space and start and not in the
tape ABC of T.

```

```

Tgarbage:=proc() local i,ii,j,k,b,a,L,LL; global T,x;

```

```

k:=nargs-1; b:=args[1]; a:=args[2..k+1];
if b=start then [cat(start,start),a,"="$j=1..k]
elif b=halt then [halt,a,"="$j=1..k]
elif b[1]=start and b[2..-1]<>halt then
  L:=[a]; LL:=[];
  for i to k do
    if L[i]=x then LL:=[op(LL),space] else LL:=[op(LL),L[i]
] fi;
  od;
  L:=T(b[2..-1],op(LL));
  LL:=[cat(start,L[1])];
  for i to k do
    if L[i+1]=space then LL:=[op(LL),x] else LL:=[op(LL),L
[i+1]] fi;
  od;
  [op(LL),op(L[k+2..-1])]
elif b=cat(start,halt) then [cat(x,"1",x),a,">","="$j=2..k]
elif b[1]=x and b[3..-1]=x then
  i:=digit2number(b[2]);
  [cat(b,">"),a[1..i-1],x,a[i+1..-1],"="$j=1..i-1,">","=
"$j=i+1..k]
elif b[1]=x and b[3..-1]=cat(x,">") then
  i:=digit2number(b[2]);
  if a[i]<>space then
    [b,a[1..i-1],space,a[i+1..-1],"="$j=1..i-1,">","="$j=
i+1..k]
  else
    [cat(b[1..3],"="),a[1..i-1],space
    ,a[i+1..-1],"="$j=1..i-1,"<","="$j=i+1..k] fi;
elif b[1]=x and b[3..-1]=cat(x,"=") then
  i:=digit2number(b[2]);
  if a[i]<>x then
    [b,a[1..i-1],space,a[i+1..-1],"="$j=1..i-1,"<","="$j=
i+1..k]
  else
    [cat(b[1..3],"<"),a[1..i-1],space,
    a[i+1..-1],"="$j=1..i-1,"<","="$j=i+1..k] fi;
elif b[1]=x and b[3..-1]=cat(x,"<") then
  i:=digit2number(b[2]);
  if a[i]=space then
    [cat(b[1..2],space,"<"),a[1..i-1],x,
    a[i+1..-1],"="$j=1..i-1,"<","="$j=i+1..k]
  elif a[i]=x then
    [cat(b[1..2],space,"<"),a[1..i-1],x,
    a[i+1..-1],"="$j=1..i-1,"<","="$j=i+1..k]
  else
    [b,a,"="$j=1..i-1,"<","="$j=i+1..k] fi;
elif b[1]=x and b[3..-1]=cat(space,"<") then

```

```

i:=digit2number(b[2]);
if a[i]=space then
  [cat(b[1..2], ">", x), a[1..i-1], space,
  a[i+1..-1], "=" $j=1..i-1, "<", "=" $j=i+1..k]
else
  [b, a[1..i-1], space, a[i+1..-1], "=" $j=1..i-1, "<", "=" $j=
i+1..k] fi;
elif b[1]=x and b[3..-1]=cat(">", x) then
  i:=digit2number(b[2]);
  if a[i]=x then
    [b[1..3], a[1..i-1], space, a[i+1..-1], "=" $j=1..i-1, ">", "="
"$j=i+1..k]
  else
    [b, a[1..i-1], space, a[i+1..-1], "=" $j=1..i-1, ">", "=" $j=
i+1..k] fi;
else
  i:=digit2number(b[2]); ii:=Digits36[i+2];
  if a[i]=space then
    if i=k then
      [halt, a[1..i-1], space, a[i+1..-1], "=" $j=1..i-1, "<", "="
"$j=i+1..k]
    else
      [cat(x, ii, x), a[1..i-1], space,
      a[i+1..-1], "=" $j=1..i-1, "<", ">", "=" $j=i+2..k] fi;
    else
      [b, a, "=" $j=1..i-1, ">", "=" $j=i+1..k] fi;
  fi; end;

```

Tgarbage := **proc**()

(10.1.28.1)

```

local i, ii, j, k, b, a, L, LL;
global T, x;
k := nargs - 1;
b := args[1];
a := args[2..k+1];
if b = start then
  [cat(start, start), a, ` $ `("=", j = 1..k)]
elif b = halt then
  [halt, a, ` $ `("=", j = 1..k)]
elif b[1] = start and b[2..-1] <> halt then
  L := [a];
  LL := [ ];
  for i to k do
    if L[i] = x then
      LL := [op(LL), space]

```

```

    else
        LL := [op(LL), L[i]]
    end if
end do;
L := T(b[2..-1], op(LL));
LL := [cat(start, L[1])];
for i to k do
    if L[i + 1] = space then
        LL := [op(LL), x]
    else
        LL := [op(LL), L[i + 1]]
    end if
end do;
[op(LL),
op(L[k + 2..-1])]
elif b = cat(start, halt) then
    [cat(x, "1",
x), a, ">", `\$`("=", j = 2..k)]
elif b[1] = x and b[3..-1] = x then
    i := digit2number(b[2]);
    [cat(b, ">"), a[1..i - 1], x,
a[i + 1..-1], `\$`("=", j = 1..i - 1), ">", `\$`("=",
j = i + 1..k)]
elif b[1] = x and b[3..-1] = cat(x, ">") then
    i := digit2number(b[2]);
    if a[i] <> space then
        [b, a[1..i - 1],
space, a[i + 1..-1], `\$`("=", j = 1..i - 1), ">", `\$`("=",
j = i + 1..k)]
    else
        [cat(b[1..3], "="), a[1..i - 1], space,
a[i + 1..-1], `\$`("=", j = 1..i - 1), "<", `\$`("=",
j = i + 1..k)]
    end if
elif b[1] = x and b[3..-1] = cat(x,
"=") then
    i := digit2number(b[2]);
    if a[i] <> x then

```

```

    [b,
    a[1..i-1], space, a[i+1..-1], `$( "=", j = 1..i-1),
    "<", `$( "=", j = i+1..k)]
else
    [cat(b[1..3], "<"),
    a[1..i-1], space, a[i+1..-1], `$( "=", j = 1..i-1),
    "<", `$( "=", j = i+1..k)]
end if
elif b[1] = x and b[3..-1] = cat(x, "<") then
    i := digit2number(b[2]);
    if a[i] = space then
        [cat(b[1..2],
        space, "<"), a[1..i-1], x, a[i+1..-1], `$( "=",
        j = 1..i-1), "<", `$( "=", j = i+1..k)]
    elif a[i] = x then
        [cat(b[1..2], space, "<"), a[1..i-1], x, a[i+1..-1],
        `$( "=", j = 1..i-1), "<", `$( "=", j = i+1..k)]
    else
        [b,
        a, `$( "=", j = 1..i-1), "<", `$( "=", j = i+1..k)]
    end if
elif b[1] = x and b[3..-1] = cat(space, "<") then
    i := digit2number(b[2]);
    if a[i] = space then
        [cat(b[1..2], ">",
        x), a[1..i-1], space, a[i+1..-1], `$( "=",
        j = 1..i-1), "<", `$( "=", j = i+1..k)]
    else
        [b,
        a[1..i-1], space, a[i+1..-1], `$( "=", j = 1..i-1),
        "<", `$( "=", j = i+1..k)]
    end if
elif b[1] = x and b[3..-1] = cat(">", x) then
    i := digit2number(b[2]);
    if a[i] = x then
        [b[1..3], a[1..i-1],
        space, a[i+1..-1], `$( "=", j = 1..i-1), ">", `$( "=",
        j = i+1..k)]

```


"	*	"
"	110*	"
"	^*1*<	"
"		"
"	*	"
"	110*	"
"	^*1 <	"
"		"
"	*	"
"	110*	"
"	^*1>*	"
"		"
"	*	"
"	110*	"
"	^*1>*	"
"		"
"	*	"
"	110*	"
"	^*1>*	"
"		"
"		"
"	110*	"
"	^*1>	"
"		"
"		"
"	110*	"
"	^*2*	"
"		"
"		"
"	110*	"
"	^*2*>	"
"		"
"		"
"	110*	"
"	^*2*=	"
"		"
"		"
"	110	"
"	^*2*<	"
"		"
"		"
"	110	"
"	^*2*<	"
"		"
"		"
"	110	"
"	^*2*<	"
"		"


```

if a3<>" " then
  if a2=" " then ["h",a1,a2,a3,"=","=","="]
  elif a2=a3 then ["s",a1,a2,a3,"=","<","<"]
  else ["t0",a1,a2,a3,"=","<","<"] fi;
else ["s1",a1,a2,a3,"=","=","="] fi;
elif b="s1" then
  if a1=a2 then ["v0",a1,a2,a3,"=","<",">"]
  else ["t1",a1,a2,a3,"=","<",">"] fi;
elif b="t0" then
  if a3<>" " then ["t0",a1,a2,a3,"=","<","<"]
  else ["t1",a1,a2,a3,"=","<",">"] fi;
elif b="t1" then
  if a3<>" " then ["t1",a1,a2,a3,"=","<",">"]
  else ["t2",a1,a2,a3,"=","<","<"] fi;
elif b="t2" then ["s",a1,a2,a3,"=","<","="]
elif b="v0" then
  if a3<>" " then ["v0",a1,a2,a3,"=","=",">"]
  else ["e0",a1,a2,a3,"=","=","<"] fi;
elif b="e0" then
  if a3<>" " then ["e0",a1,a2,a2,"=","<","<"]
  else ["e1",a1,a2,a3,"=","=","="] fi;
elif b="e1" then ["e2",a2,a2,a3,"=","<","="]
elif b="e2" then
  if a2=" " then ["v1",a1,a2,a3,"=",">",">"]
  elif a2="0" then ["v1",a1,a2,a3,"<",">",">"]
  else ["v1",a1,a2,a3,">",">",">"] fi;
elif b="v1" then ["v2",a1,a2,a3,"=",">","="]
elif b="v2" then
  if a2=" " and a3<>" " then ["v4",a1,a2,a3,"=","<","="]
  elif a3<>" " then ["v2",a1,a2,a3,"=",">",">"]
  else ["v3",a1,a2,a3,"=",">","<"] fi;
elif b="v3" then
  if a3<>" " then ["v3",a1,a2,a3,"=",">","<"]
  else ["v1",a1,a2,a3,"=",">",">"] fi;
elif b="v4" then
  if a2=" " then ["v4",a1,a2,a3,"=","<","="]
  else ["v5",a1,a2,a3,"=","=","="] fi;
elif b="v5" then
  if a3<>" " then ["v5",a1,a2,a3,"=","=",">"]
  else ["s",a1,a2,a3,"=","=","<"] fi;
else ["h",a1,a2,a3,"=","=","="] fi; end;

```

UT:= **proc**(*b*, *a1*, *a2*, *a3*)

(10.1.29.1)

if *b* = "s" **then**

if *a3*<>" " **then**

if *a2* = " " **then**

```

        ["h", a1, a2, a3, "=", "=", "="]
    elif a2 = a3 then
        ["s", a1, a2, a3, "=", "<", "<"]
    else
        ["t0", a1, a2, a3, "=", "<", "<"]
    end if
else
    ["s1", a1, a2,
     a3, "=", "=", "="]
end if
elif b = "s1" then
    if a1 = a2 then
        ["v0", a1, a2, a3, "=", "<", ">"]
    else
        ["t1", a1, a2, a3, "=",
         "<", ">"]
    end if
elif b = "t0" then
    if a3 <> " " then
        ["t0",
         a1, a2, a3, "=", "<", "<"]
    else
        ["t1", a1, a2, a3, "=", "<",
         ">"]
    end if
elif b = "t1" then
    if a3 <> " " then
        ["t1", a1,
         a2, a3, "=", "<", ">"]
    else
        ["t2", a1, a2, a3, "=", "<", "<"]
    end if
elif b = "t2" then
    ["s", a1, a2, a3, "=", "<", "="]
elif b = "v0" then
    if a3 <> " " then
        ["v0", a1, a2, a3, "=", "=",
         ">"]
    end if
end if

```

```

else
    ["e0", a1, a2, a3, "=", "=", "<"]
end if
elifb = "e0" then
    if a3 <> " " then
        ["e0", a1, a2, a2, "=", "<",
        "<"]
    else
        ["e1", a1, a2, a3, "=", "=", "="]
    end if
elifb = "e1" then
    ["e2", a2, a2, a3, "=", "<", "="]
elifb = "e2" then
    if a2 = " " then
        ["v1", a1, a2, a3, "=", ">",
        ">"]
    elif a2 = "0" then
        ["v1", a1, a2, a3, "<", ">", ">"]
    else
        ["v1", a1, a2, a3, ">", ">", ">"]
    end if
elifb = "v1" then
    ["v2", a1, a2, a3, "=", ">", "="]
elifb = "v2" then
    if a2 = " " and a3 <> " " then
        ["v4", a1, a2, a3, "=", "<", "="]
    elif a3 <> " " then
        ["v2", a1, a2, a3, "=", ">", ">"]
    else
        ["v3", a1, a2, a3, "=", ">", "<"]
    end if
elifb = "v3" then
    if a3 <> " " then
        ["v3", a1, a2, a3, "=", ">", "<"]
    else
        ["v1", a1,
        a2, a3, "=", ">", ">"]
    end if

```

```

elif  $b = "v4"$  then
  if  $a2 = " "$  then
    ["v4",  $a1$ ,  $a2$ ,  $a3$ , "=", "<", "="]
  else
    ["v5",  $a1$ ,
      $a2$ ,  $a3$ , "=", "=", "="]
  end if
elif  $b = "v5"$  then
  if  $a3 <> " "$  then
    ["v5",  $a1$ ,  $a2$ ,  $a3$ , "=", "=", ">"]
  else
    ["s",  $a1$ ,
      $a2$ ,  $a3$ , "=", "=", "<"]
  end if
else
  ["h",  $a1$ ,  $a2$ ,  $a3$ , "=", "=",
   "="]
end if
end proc

> # A one-tape Turing machine: delete one letter from left
  hand side
  T:=proc( $b, a$ )
    if  $b = "s"$  then
      if  $a = " "$  then ["d", " ", ">"] else ["s",  $a$ , "<"] fi;
    elif  $b = "d"$  then ["b", " ", ">"]
    elif  $b = "b"$  then
      if  $a <> " "$  then ["b",  $a$ , ">"] else ["h",  $a$ , "<"] fi;
    else ["h",  $a$ , "="] fi end;
  T:= proc( $b, a$ )
    if  $b = "s"$  then
      if  $a = " "$  then
        ["d", " ", ">"]
      else
        ["s",
          $a$ , "<"]
      end if
    elif  $b = "d"$  then
      ["b", " ", ">"]
    elif  $b = "b"$  then
      if  $a <> " "$  then

```

(10.1.29.2)


```
"          ^t1          "
"
"          01          "
"1001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1        "
"
"          01          "
"01001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1        "
"
"          01          "
"001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t2        "
"
"          01          "
"0001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^s         "
"
"          01          "
"00001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t0        "
"
"          01          "
"000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t0        "
"
"          01          "
"0000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1        "
"
"          01          "
"00000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1        "
"
"          01          "
"000000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1        "
"
"          01          "
```



```

"
"
"      01
" 1 01 00000000001001001 10 011 100011 101010 11 101010010"
"      00
"      ^t0
"
"
"      01
" 1 01 00000000001001001 10 011 100011 101010 11 10101001"
"      00
"      ^t1
"
"
"      01
" 1 01 00000000001001001 10 011 100011 101010 11 1010100"
"      00
"      ^t1
"
"
"      01
" 1 01 00000000001001001 10 011 100011 101010 11 101010"
"      00
"      ^t1
"
"
"      01
" 1 01 00000000001001001 10 011 100011 101010 11 10101"
"      00
"      ^t2
"
"
"      01
" 1 01 00000000001001001 10 011 100011 101010 11 1010"
"      00
"      ^s
"
"
"      01
" 1 01 00000000001001001 10 011 100011 101010 11 101"
"      00
"      ^s
"
"
"      01
" 1 01 00000000001001001 10 011 100011 101010 11 10"
"      00
"      ^s
"
"
"      01
" 1 01 00000000001001001 10 011 100011 101010 11 10"
"      00
"      ^s1
"
"
"      01
" 1 01 00000000001001001 10 011 100011 101010 11 1"

```



```
"          ^v3          "
"
"          01          "
" 1 01 0000000001001001 10 011 100011 101010 11 10101001011"
"          00          "
"          ^v3          "
"
"          01          "
" 1 01 0000000001001001 10 011 100011 101010 11 10101001011"
"          00          "
"          ^v3          "
"
"          01          "
"1 01 0000000001001001 10 011 100011 101010 11 1010100101110"
"          00          "
"          ^v1          "
"
"          01          "
" 01 0000000001001001 10 011 100011 101010 11 10101001011101"
"          00          "
"          ^v2          "
"
"          01          "
"01 0000000001001001 10 011 100011 101010 11 101010010111011"
"          00          "
"          ^v2          "
"
"          01          "
"1 0000000001001001 10 011 100011 101010 11 1010100101110110"
"          00          "
"          ^v2          "
"
"          01          "
" 0000000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^v3          "
"
"          01          "
"0000000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^v3          "
"
"          01          "
"0000000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^v3          "
"
"          01          "
```



```
"
"
"01001 10 011 100011 101010 11 1010100101110110
"
"00
"
" ^v2
"
"
"01
"1001 10 011 100011 101010 11 1010100101110110
"
"00
"
" ^v3
"
"
"01
"001 10 011 100011 101010 11 1010100101110110
"
"00
"
" ^v3
"
"
"01
"01 10 011 100011 101010 11 1010100101110110
"
"00
"
" ^v3
"
"
"01
"1 10 011 100011 101010 11 1010100101110110
"
"00
"
" ^v1
"
"
"01
" 10 011 100011 101010 11 1010100101110110
"
"00
"
" ^v2
"
"
"01
"10 011 100011 101010 11 1010100101110110
"
"00
"
" ^v2
"
"
"01
"0 011 100011 101010 11 1010100101110110
"
"00
"
" ^v2
"
"
"01
" 011 100011 101010 11 1010100101110110
"
"00
"
" ^v3
"
"
"01
"011 100011 101010 11 1010100101110110
"
```

"	00	"
"	$\wedge v3$	"
"		"
"	01	"
"11 100011 101010 11 1010100101110110		"
"	00	"
"	$\wedge v3$	"
"		"
"	01	"
"1 100011 101010 11 1010100101110110		"
"	00	"
"	$\wedge v1$	"
"		"
"	01	"
" 100011 101010 11 1010100101110110		"
"	00	"
"	$\wedge v2$	"
"		"
"	01	"
"100011 101010 11 1010100101110110		"
"	00	"
"	$\wedge v2$	"
"		"
"	01	"
"00011 101010 11 1010100101110110		"
"	00	"
"	$\wedge v2$	"
"		"
"	01	"
"0011 101010 11 1010100101110110		"
"	00	"
"	$\wedge v3$	"
"		"
"	01	"
"011 101010 11 1010100101110110		"
"	00	"
"	$\wedge v3$	"
"		"
"	01	"
"11 101010 11 1010100101110110		"
"	00	"
"	$\wedge v3$	"
"		"
"	01	"
"1 101010 11 1010100101110110		"
"	00	"
"	$\wedge v1$	"
"		"

"		01	"
"	101010 11 1010100101110110		"
"		00	"
"		$\wedge v2$	"
"			"
"		01	"
"1	101010 11 1010100101110110		"
"		00	"
"		$\wedge v4$	"
"			"
"		01	"
"11	101010 11 1010100101110110		"
"		00	"
"		$\wedge v4$	"
"			"
"		01	"
"011	101010 11 1010100101110110		"
"		00	"
"		$\wedge v4$	"
"			"
"		01	"
"011	101010 11 1010100101110110		"
"		00	"
"		$\wedge v5$	"
"			"
"		01	"
"011	101010 11 1010100101110110		"
"		00	"
"		$\wedge v5$	"
"			"
"		01	"
"011	101010 11 1010100101110110		"
"		00	"
"		$\wedge v5$	"
"			"
"		01	"
"011	101010 11 1010100101110110		"
"		00	"
"		$\wedge s$	"
"			"
"		01	"
"0011	101010 11 1010100101110110		"
"		00	"
"		$\wedge s$	"
"			"
"		01	"
"00011	101010 11 1010100101110110		"
"		00	"

```
"          ^t0          "
"
"          01          "
"100011 101010 11 1010100101110110  "
"          00          "
"          ^t1        "
"
"          01          "
" 100011 101010 11 1010100101110110  "
"          00          "
"          ^t1        "
"
"          01          "
"1 100011 101010 11 1010100101110110  "
"          00          "
"          ^t1        "
"
"          01          "
"11 100011 101010 11 1010100101110110  "
"          00          "
"          ^t2        "
"
"          01          "
"011 100011 101010 11 1010100101110110  "
"          00          "
"          ^s         "
"
"          01          "
" 011 100011 101010 11 1010100101110110  "
"          00          "
"          ^s         "
"
"          01          "
"0 011 100011 101010 11 1010100101110110  "
"          00          "
"          ^t0        "
"
"          01          "
"10 011 100011 101010 11 1010100101110110  "
"          00          "
"          ^t1        "
"
"          01          "
" 10 011 100011 101010 11 1010100101110110  "
"          00          "
"          ^t1        "
"
"          01          "
```

```
"1 10 011 100011 101010 11 1010100101110110      "  
"                                00                  "  
"                                ^t1                 "  
"                                01                  "  
"01 10 011 100011 101010 11 1010100101110110      "  
"                                00                  "  
"                                ^t2                 "  
"                                01                  "  
"001 10 011 100011 101010 11 1010100101110110     "  
"                                00                  "  
"                                ^s                   "  
"                                01                  "  
"1001 10 011 100011 101010 11 1010100101110110    "  
"                                00                  "  
"                                ^s                   "  
"                                01                  "  
"01001 10 011 100011 101010 11 1010100101110110   "  
"                                00                  "  
"                                ^t0                  "  
"                                01                  "  
"001001 10 011 100011 101010 11 1010100101110110  "  
"                                00                  "  
"                                ^t1                  "  
"                                01                  "  
"1001001 10 011 100011 101010 11 1010100101110110 "  
"                                00                  "  
"                                ^t1                  "  
"                                01                  "  
"01001001 10 011 100011 101010 11 1010100101110110 "  
"                                00                  "  
"                                ^t1                  "  
"                                01                  "  
"001001001 10 011 100011 101010 11 1010100101110110 "  
"                                00                  "  
"                                ^t2                  "  
"                                01                  "  
"0001001001 10 011 100011 101010 11 1010100101110110 "  
"                                00                  "  
"                                ^s                   "
```

```
"
"
"00001001001 10 011 100011 101010 11 1010100101110110"
"
"
"
"
"
"000001001001 10 011 100011 101010 11 1010100101110110"
"
"
"
"
"
"0000001001001 10 011 100011 101010 11 1010100101110110"
"
"
"
"
"
"00000001001001 10 011 100011 101010 11 1010100101110110"
"
"
"
"
"
"000000001001001 10 011 100011 101010 11 1010100101110110"
"
"
"
"
"
"0000000001001001 10 011 100011 101010 11 1010100101110110"
"
"
"
"
"
"00000000001001001 10 011 100011 101010 11 1010100101110110"
"
"
"
"
"
"1 00000000001001001 10 011 100011 101010 11 1010100101110110"
"
"
"
"
"
"01 00000000001001001 10 011 100011 101010 11 101010010111011"
```

```
"          00          "
```

```
"          ^t1         "
```

```
"          01          "
```

```
" 01 00000000001001001 10 011 100011 101010 11 10101001011101"
```

```
"          00          "
```

```
"          ^t1         "
```

```
"          01          "
```

```
"1 01 00000000001001001 10 011 100011 101010 11 1010100101110"
```

```
"          00          "
```

```
"          ^t1         "
```

```
"          01          "
```

```
" 1 01 00000000001001001 10 011 100011 101010 11 101010010111"
```

```
"          00          "
```

```
"          ^t2         "
```

```
"          01          "
```

```
" 1 01 00000000001001001 10 011 100011 101010 11 10101001011"
```

```
"          00          "
```

```
"          ^s          "
```

```
"          01          "
```

```
" 1 01 00000000001001001 10 011 100011 101010 11 1010100101"
```

```
"          00          "
```

```
"          ^t0         "
```

```
"          01          "
```

```
" 1 01 00000000001001001 10 011 100011 101010 11 101010010"
```

```
"          00          "
```

```
"          ^t0         "
```

```
"          01          "
```

```
" 1 01 00000000001001001 10 011 100011 101010 11 10101001"
```

```
"          00          "
```

```
"          ^t1         "
```

```
"          01          "
```

```
" 1 01 00000000001001001 10 011 100011 101010 11 1010100"
```

```
"          00          "
```

```
"          ^t1         "
```

```
"          01          "
```

```
" 1 01 00000000001001001 10 011 100011 101010 11 101010"
```

```
"          00          "
```

```
"          ^t1         "
```

```
"          01          "
" 1 01 00000000001001001 10 011 100011 101010 11 10101"
"          00          "
"          ^t2         "
"          01          "
" 1 01 00000000001001001 10 011 100011 101010 11 1010"
"          00          "
"          ^s         "
"          01          "
" 1 01 00000000001001001 10 011 100011 101010 11 101"
"          00          "
"          ^s         "
"          01          "
" 1 01 00000000001001001 10 011 100011 101010 11 10"
"          00          "
"          ^s         "
"          01          "
" 1 01 00000000001001001 10 011 100011 101010 11 10"
"          00          "
"          ^s1        "
"          01          "
" 1 01 00000000001001001 10 011 100011 101010 11 1"
"          00          "
"          ^t1        "
"          01          "
" 1 01 00000000001001001 10 011 100011 101010 11 "
"          00          "
"          ^t1        "
"          01          "
" 1 01 00000000001001001 10 011 100011 101010 11"
"          00          "
"          ^t1        "
"          01          "
" 1 01 00000000001001001 10 011 100011 101010 1"
"          00          "
"          ^t2        "
"          01          "
" 1 01 00000000001001001 10 011 100011 101010 "
"          00          "
```



```
"          ^s          "
"
"          01          "
" 1 01 00000000001001001 10 011 100011 101010"
"          00          "
"          ^s          "
"
"          01          "
" 1 01 00000000001001001 10 011 100011 10101"
"          00          "
"          ^s          "
"
"          01          "
" 1 01 00000000001001001 10 011 100011 10101"
"          00          "
"          ^s1         "
"
"          01          "
" 1 01 00000000001001001 10 011 100011 1010"
"          00          "
"          ^v0         "
"
"          01          "
" 1 01 00000000001001001 10 011 100011 1010"
"          00          "
"          ^v0         "
"
"          01          "
" 1 01 00000000001001001 10 011 100011 1010"
"          00          "
"          ^v0         "
"
"          01          "
" 1 01 00000000001001001 10 011 100011 1010"
"          00          "
"          ^e0         "
"
"          01          "
" 1 01 00000000001001001 10 011 100011 101"
"          00          "
"          ^e0         "
"
"          01          "
" 1 01 00000000001001001 10 011 100011 10"
"          00          "
"          ^e0         "
"
"          01          "
```

```

"          1 01 00000000001001001 10 011 100011 10"
"              00"
"              ^e1"
"
"              01"
"          1 01 00000000001001001 10 011 100011 1"
"              00"
"              ^e2"
"
"              01"
"          1 01 00000000001001001 10 011 100011 10"
"              00"
"              ^v1"
"
"              01"
"          1 01 00000000001001001 10 011 100011 101"
"              00"
"              ^v2"
"
"              01"
"          1 01 00000000001001001 10 011 100011 1010"
"              00"
"              ^v2"
"
"              01"
"          1 01 00000000001001001 10 011 100011 10101"
"              00"
"              ^v2"
"
"              01"
"          1 01 00000000001001001 10 011 100011 101010"
"              00"
"              ^v3"
"
"              01"
"          1 01 00000000001001001 10 011 100011 101010 "
"              00"
"              ^v3"
"
"              01"
"          1 01 00000000001001001 10 011 100011 101010 1"
"              00"
"              ^v3"
"
"              01"
"          1 01 00000000001001001 10 011 100011 101010 11"
"              00"
"              ^v1"

```

```

"
"
"          01
"      1 01 00000000001001001 10 011 100011 101010 11 "
"          00
"          ^v2
"
"          01
"      1 01 00000000001001001 10 011 100011 101010 11 1"
"          00
"          ^v2
"
"          01
"      1 01 00000000001001001 10 011 100011 101010 11 10"
"          00
"          ^v2
"
"          01
"      1 01 00000000001001001 10 011 100011 101010 11 101"
"          00
"          ^v3
"
"          01
"      1 01 00000000001001001 10 011 100011 101010 11 1010"
"          00
"          ^v3
"
"          01
"      1 01 00000000001001001 10 011 100011 101010 11 10101"
"          00
"          ^v3
"
"          01
"      1 01 00000000001001001 10 011 100011 101010 11 101010"
"          00
"          ^v1
"
"          01
"      1 01 00000000001001001 10 011 100011 101010 11 1010100"
"          00
"          ^v2
"
"          01
"      1 01 00000000001001001 10 011 100011 101010 11 10101001"
"          00
"          ^v2
"
"          01
"      1 01 00000000001001001 10 011 100011 101010 11 101010010"

```


"		^v2	"
"			"
"		01	"
"001001 10 011 100011 101010 11 1010100101110110			"
"		00	"
"		^v2	"
"			"
"		01	"
"01001 10 011 100011 101010 11 1010100101110110			"
"		00	"
"		^v2	"
"			"
"		01	"
"1001 10 011 100011 101010 11 1010100101110110			"
"		00	"
"		^v3	"
"			"
"		01	"
"001 10 011 100011 101010 11 1010100101110110			"
"		00	"
"		^v3	"
"			"
"		01	"
"01 10 011 100011 101010 11 1010100101110110			"
"		00	"
"		^v3	"
"			"
"		01	"
"1 10 011 100011 101010 11 1010100101110110			"
"		00	"
"		^v1	"
"			"
"		01	"
" 10 011 100011 101010 11 1010100101110110			"
"		00	"
"		^v2	"
"			"
"		01	"
"10 011 100011 101010 11 1010100101110110			"
"		00	"
"		^v2	"
"			"
"		01	"
"0 011 100011 101010 11 1010100101110110			"
"		00	"
"		^v2	"
"			"
"		01	"

"	011 100011 101010 11 1010100101110110	"
"	00	"
"	^v3	"
"		"
"	01	"
"	011 100011 101010 11 1010100101110110	"
"	00	"
"	^v3	"
"		"
"	01	"
"	11 100011 101010 11 1010100101110110	"
"	00	"
"	^v3	"
"		"
"	01	"
"	1 100011 101010 11 1010100101110110	"
"	00	"
"	^v1	"
"		"
"	01	"
"	100011 101010 11 1010100101110110	"
"	00	"
"	^v2	"
"		"
"	01	"
"	100011 101010 11 1010100101110110	"
"	00	"
"	^v2	"
"		"
"	01	"
"	00011 101010 11 1010100101110110	"
"	00	"
"	^v2	"
"		"
"	01	"
"	0011 101010 11 1010100101110110	"
"	00	"
"	^v3	"
"		"
"	01	"
"	011 101010 11 1010100101110110	"
"	00	"
"	^v3	"
"		"
"	01	"
"	11 101010 11 1010100101110110	"
"	00	"
"	^v3	"

"		"
"	01	"
"1 101010 11 1010100101110110		"
"	00	"
"	^v1	"
"		"
"	01	"
" 101010 11 1010100101110110		"
"	00	"
"	^v2	"
"		"
"	01	"
"1 101010 11 1010100101110110		"
"	00	"
"	^v4	"
"		"
"	01	"
"11 101010 11 1010100101110110		"
"	00	"
"	^v4	"
"		"
"	01	"
"011 101010 11 1010100101110110		"
"	00	"
"	^v4	"
"		"
"	01	"
"011 101010 11 1010100101110110		"
"	00	"
"	^v5	"
"		"
"	01	"
"011 101010 11 1010100101110110		"
"	00	"
"	^v5	"
"		"
"	01	"
"011 101010 11 1010100101110110		"
"	00	"
"	^v5	"
"		"
"	01	"
"011 101010 11 1010100101110110		"
"	00	"
"	^s	"
"		"
"	01	"
"0011 101010 11 1010100101110110		"


```
"          00          "
```

```
"          ^s          "
```

```
"          01          "
```

```
"00011 101010 11 1010100101110110  "
```

```
"          00          "
```

```
"          ^t0         "
```

```
"          01          "
```

```
"100011 101010 11 1010100101110110  "
```

```
"          00          "
```

```
"          ^t1         "
```

```
"          01          "
```

```
" 100011 101010 11 1010100101110110  "
```

```
"          00          "
```

```
"          ^t1         "
```

```
"          01          "
```

```
"1 100011 101010 11 1010100101110110  "
```

```
"          00          "
```

```
"          ^t1         "
```

```
"          01          "
```

```
"11 100011 101010 11 1010100101110110  "
```

```
"          00          "
```

```
"          ^t2         "
```

```
"          01          "
```

```
"011 100011 101010 11 1010100101110110  "
```

```
"          00          "
```

```
"          ^s          "
```

```
"          01          "
```

```
" 011 100011 101010 11 1010100101110110  "
```

```
"          00          "
```

```
"          ^s          "
```

```
"          01          "
```

```
"0 011 100011 101010 11 1010100101110110  "
```

```
"          00          "
```

```
"          ^t0         "
```

```
"          01          "
```

```
"10 011 100011 101010 11 1010100101110110  "
```

```
"          00          "
```

```
"          ^t1         "
```

```
"          "
```

```
"          01          "
" 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1         "
"          01          "
"1 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1         "
"          01          "
"01 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t2         "
"          01          "
"001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^s          "
"          01          "
"1001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^s          "
"          01          "
"01001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t0        "
"          01          "
"001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1         "
"          01          "
"1001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1         "
"          01          "
"01001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1         "
"          01          "
"001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
```

```
"          ^t2          "
"
"          01          "
"0001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^s          "
"
"          01          "
"00001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t0         "
"
"          01          "
"000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t0         "
"
"          01          "
"0000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1         "
"
"          01          "
"00000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1         "
"
"          01          "
"000000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1         "
"
"          01          "
"0000000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t1         "
"
"          01          "
"00000000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t2         "
"
"          01          "
"000000000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^s          "
"
"          01          "
" 000000000001001001 10 011 100011 101010 11 1010100101110110 "
"          00          "
"          ^t0         "
"
"          01          "
```



```

"
"
"          01
" 1 01 00000000001001001 10 011 100011 101010 11 101010"
"          00
"          ^t1
"
"          01
" 1 01 00000000001001001 10 011 100011 101010 11 10101"
"          00
"          ^t2
"
"          01
" 1 01 00000000001001001 10 011 100011 101010 11 1010"
"          00
"          ^s
"
"          01
" 1 01 00000000001001001 10 011 100011 101010 11 101"
"          00
"          ^s
"
"          01
" 1 01 00000000001001001 10 011 100011 101010 11 10"
"          00
"          ^s
"
"          01
" 1 01 00000000001001001 10 011 100011 101010 11 10"
"          00
"          ^s1
"
"          01
" 1 01 00000000001001001 10 011 100011 101010 11 1"
"          00
"          ^t1
"
"          01
" 1 01 00000000001001001 10 011 100011 101010 11 "
"          00
"          ^t1
"
"          01
" 1 01 00000000001001001 10 011 100011 101010 11"
"          00
"          ^t1
"
"          01
" 1 01 00000000001001001 10 011 100011 101010 1"

```

```
"
"          00          "
"          ^t2        "
"
"          01          "
" 1 01 0000000001001001 10 011 100011 101010 "
"          00          "
"          ^s         "
"
"          01          "
" 1 01 0000000001001001 10 011 100011 101010"
"          00          "
"          ^s         "
"
"          01          "
" 1 01 0000000001001001 10 011 100011 10101"
"          00          "
"          ^s         "
"
"          01          "
" 1 01 0000000001001001 10 011 100011 10101"
"          00          "
"          ^s1        "
"
"          01          "
" 1 01 0000000001001001 10 011 100011 1010"
"          00          "
"          ^t1        "
"
"          01          "
" 1 01 0000000001001001 10 011 100011 101"
"          00          "
"          ^t1        "
"
"          01          "
" 1 01 0000000001001001 10 011 100011 10"
"          00          "
"          ^t1        "
"
"          01          "
" 1 01 0000000001001001 10 011 100011 1"
"          00          "
"          ^t2        "
"
"          01          "
" 1 01 0000000001001001 10 011 100011 "
"          00          "
"          ^s         "
"
```

```

"           01           "
" 1 01 00000000001001001 10 011 100011"
"           00           "
"           ^s           "
"           01           "
" 1 01 00000000001001001 10 011 10001"
"           00           "
"           ^s           "
"           01           "
" 1 01 00000000001001001 10 011 10001"
"           00           "
"           ^s1          "
"           01           "
" 1 01 00000000001001001 10 011 1000"
"           00           "
"           ^v0          "
"           01           "
" 1 01 00000000001001001 10 011 1000"
"           00           "
"           ^v0          "
"           01           "
" 1 01 00000000001001001 10 011 1000"
"           00           "
"           ^v0          "
"           01           "
" 1 01 00000000001001001 10 011 1000"
"           00           "
"           ^e0          "
"           01           "
" 1 01 00000000001001001 10 011 100"
"           01           "
"           ^e0          "
"           01           "
" 1 01 00000000001001001 10 011 10"
"           01           "
"           ^e0          "
"           01           "
" 1 01 00000000001001001 10 011 10"
"           01           "

```

```

"          ^e1          "
"
"          01          "
"          1 01 0000000001001001 10 011 1"
"          01          "
"          ^e2          "
"
"          01          "
"          1 01 0000000001001001 10 011 10"
"          01          "
"          ^v1          "
"
"          01          "
"          1 01 0000000001001001 10 011 100"
"          01          "
"          ^v2          "
"
"          01          "
"          1 01 0000000001001001 10 011 1000"
"          01          "
"          ^v2          "
"
"          01          "
"          1 01 0000000001001001 10 011 10001"
"          01          "
"          ^v2          "
"
"          01          "
"          1 01 0000000001001001 10 011 100011"
"          01          "
"          ^v3          "
"
"          01          "
"          1 01 0000000001001001 10 011 100011 "
"          01          "
"          ^v3          "
"
"          01          "
"          1 01 0000000001001001 10 011 100011 1"
"          01          "
"          ^v3          "
"
"          01          "
"          1 01 0000000001001001 10 011 100011 10"
"          01          "
"          ^v1          "
"
"          01          "

```



```

"          1 01 0000000001001001 10 011 100011 101"
"              01
"              ^v2
"
"              01
"          1 01 0000000001001001 10 011 100011 1010"
"              01
"              ^v2
"
"              01
"          1 01 0000000001001001 10 011 100011 10101"
"              01
"              ^v2
"
"              01
"          1 01 0000000001001001 10 011 100011 101010"
"              01
"              ^v3
"
"              01
"          1 01 0000000001001001 10 011 100011 101010 "
"              01
"              ^v3
"
"              01
"          1 01 0000000001001001 10 011 100011 101010 1"
"              01
"              ^v3
"
"              01
"          1 01 0000000001001001 10 011 100011 101010 11"
"              01
"              ^v1
"
"              01
"          1 01 0000000001001001 10 011 100011 101010 11 "
"              01
"              ^v2
"
"              01
"          1 01 0000000001001001 10 011 100011 101010 11 1"
"              01
"              ^v2
"
"              01
"          1 01 0000000001001001 10 011 100011 101010 11 10"
"              01
"              ^v2

```

```

"
"
"          01
"    1 01 00000000001001001 10 011 100011 101010 11 101"
"          01
"          ^v3
"
"          01
"    1 01 00000000001001001 10 011 100011 101010 11 1010"
"          01
"          ^v3
"
"          01
"    1 01 00000000001001001 10 011 100011 101010 11 10101"
"          01
"          ^v3
"
"          01
"    1 01 00000000001001001 10 011 100011 101010 11 101010"
"          01
"          ^v1
"
"          01
"    1 01 00000000001001001 10 011 100011 101010 11 1010100"
"          01
"          ^v2
"
"          01
"    1 01 00000000001001001 10 011 100011 101010 11 10101001"
"          01
"          ^v2
"
"          01
"    1 01 00000000001001001 10 011 100011 101010 11 101010010"
"          01
"          ^v2
"
"          01
"    1 01 00000000001001001 10 011 100011 101010 11 1010100101"
"          01
"          ^v3
"
"          01
"    1 01 00000000001001001 10 011 100011 101010 11 10101001011"
"          01
"          ^v3
"
"          01
"    1 01 00000000001001001 10 011 100011 101010 11 101010010111"

```

```

"          01          "
"          ^v3        "
"          "          "
"          01          "
"1 01 0000000001001001 10 011 100011 101010 11 1010100101110"
"          01          "
"          ^v1        "
"          "          "
"          01          "
" 01 0000000001001001 10 011 100011 101010 11 10101001011101"
"          01          "
"          ^v2        "
"          "          "
"          01          "
"01 0000000001001001 10 011 100011 101010 11 101010010111011"
"          01          "
"          ^v2        "
"          "          "
"          01          "
"1 0000000001001001 10 011 100011 101010 11 1010100101110110"
"          01          "
"          ^v2        "
"          "          "
"          01          "
" 0000000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^v3        "
"          "          "
"          01          "
"0000000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^v3        "
"          "          "
"          01          "
"000000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^v3        "
"          "          "
"          01          "
"00000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^v1        "
"          "          "
"          01          "
"00000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^v2        "
"          "          "

```


"		"
"	^v3	"
"		"
"	01	"
"001 10 011 100011 101010 11 1010100101110110		"
"	01	"
"	^v3	"
"		"
"	01	"
"01 10 011 100011 101010 11 1010100101110110		"
"	01	"
"	^v3	"
"		"
"	01	"
"1 10 011 100011 101010 11 1010100101110110		"
"	01	"
"	^v1	"
"		"
"	01	"
" 10 011 100011 101010 11 1010100101110110		"
"	01	"
"	^v2	"
"		"
"	01	"
"10 011 100011 101010 11 1010100101110110		"
"	01	"
"	^v2	"
"		"
"	01	"
"0 011 100011 101010 11 1010100101110110		"
"	01	"
"	^v2	"
"		"
"	01	"
" 011 100011 101010 11 1010100101110110		"
"	01	"
"	^v3	"
"		"
"	01	"
"011 100011 101010 11 1010100101110110		"
"	01	"
"	^v3	"
"		"
"	01	"
"11 100011 101010 11 1010100101110110		"
"	01	"
"	^v3	"
"		"
"	01	"

```
"1 100011 101010 11 1010100101110110      "  
"                                           01      "  
"                                           ^v1      "  
"                                           01      "  
" 100011 101010 11 1010100101110110      "  
"                                           01      "  
"                                           ^v2      "  
"                                           01      "  
"100011 101010 11 1010100101110110      "  
"                                           01      "  
"                                           ^v2      "  
"                                           01      "  
"00011 101010 11 1010100101110110      "  
"                                           01      "  
"                                           ^v2      "  
"                                           01      "  
"0011 101010 11 1010100101110110      "  
"                                           01      "  
"                                           ^v3      "  
"                                           01      "  
"011 101010 11 1010100101110110      "  
"                                           01      "  
"                                           ^v3      "  
"                                           01      "  
"11 101010 11 1010100101110110      "  
"                                           01      "  
"                                           ^v3      "  
"                                           01      "  
"1 101010 11 1010100101110110      "  
"                                           01      "  
"                                           ^v1      "  
"                                           01      "  
" 101010 11 1010100101110110      "  
"                                           01      "  
"                                           ^v2      "  
"                                           01      "  
"1 101010 11 1010100101110110      "  
"                                           01      "  
"                                           ^v4      "
```

```

"
"
"11 101010 11 1010100101110110 01
"
" ^v4
"
"
"011 101010 11 1010100101110110 01
"
" ^v4
"
"
"011 101010 11 1010100101110110 01
"
" ^v5
"
"
"011 101010 11 1010100101110110 01
"
" ^v5
"
"
"011 101010 11 1010100101110110 01
"
" ^v5
"
"
"011 101010 11 1010100101110110 01
"
" ^s
"
"
"0011 101010 11 1010100101110110 01
"
" ^t0
"
"
"00011 101010 11 1010100101110110 01
"
" ^t0
"
"
"100011 101010 11 1010100101110110 01
"
" ^t1
"
"
" 100011 101010 11 1010100101110110 01
"

```

```
"          01          "
```

```
"          ^t1        "
```

```
"          01          "
```

```
"1 100011 101010 11 1010100101110110 "
```

```
"          01          "
```

```
"          ^t1        "
```

```
"          01          "
```

```
"11 100011 101010 11 1010100101110110 "
```

```
"          01          "
```

```
"          ^t2        "
```

```
"          01          "
```

```
"011 100011 101010 11 1010100101110110 "
```

```
"          01          "
```

```
"          ^s         "
```

```
"          01          "
```

```
" 011 100011 101010 11 1010100101110110 "
```

```
"          01          "
```

```
"          ^t0        "
```

```
"          01          "
```

```
"0 011 100011 101010 11 1010100101110110 "
```

```
"          01          "
```

```
"          ^t0        "
```

```
"          01          "
```

```
"10 011 100011 101010 11 1010100101110110 "
```

```
"          01          "
```

```
"          ^t1        "
```

```
"          01          "
```

```
" 10 011 100011 101010 11 1010100101110110 "
```

```
"          01          "
```

```
"          ^t1        "
```

```
"          01          "
```

```
"1 10 011 100011 101010 11 1010100101110110 "
```

```
"          01          "
```

```
"          ^t1        "
```

```
"          01          "
```

```
"01 10 011 100011 101010 11 1010100101110110 "
```

```
"          01          "
```

```
"          ^t2        "
```

```
"          "
```



```
"          ^s          "
"
"          01          "
"000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^s1        "
"
"          01          "
"0000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^t1        "
"
"          01          "
"00000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^t1        "
"
"          01          "
"000000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^t1        "
"
"          01          "
"0000000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^t2        "
"
"          01          "
"00000000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^s          "
"
"          01          "
" 00000000001001001 10 011 100011 101010 11 1010100101110110 "
"          01          "
"          ^s          "
"
"          01          "
"1 00000000001001001 10 011 100011 101010 11 1010100101110110"
"          01          "
"          ^s          "
"
"          01          "
"1 00000000001001001 10 011 100011 101010 11 1010100101110110"
"          01          "
"          ^s1        "
"
"          01          "
```


"		"
"	$\wedge v2$	"
"		"
"	1	"
"00011 101010 11 1010100101110110		"
"	10	"
"	$\wedge v2$	"
"		"
"	1	"
"0011 101010 11 1010100101110110		"
"	10	"
"	$\wedge v3$	"
"		"
"	1	"
"011 101010 11 1010100101110110		"
"	10	"
"	$\wedge v3$	"
"		"
"	1	"
"11 101010 11 1010100101110110		"
"	10	"
"	$\wedge v3$	"
"		"
"	1	"
"1 101010 11 1010100101110110		"
"	10	"
"	$\wedge v1$	"
"		"
"	1	"
" 101010 11 1010100101110110		"
"	10	"
"	$\wedge v2$	"
"		"
"	1	"
"1 101010 11 1010100101110110		"
"	10	"
"	$\wedge v4$	"
"		"
"	1	"
"11 101010 11 1010100101110110		"
"	10	"
"	$\wedge v4$	"
"		"
"	1	"
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"	10	"
"	$\wedge v4$	"
"		"
"	1	"

```

"011 101010 11 1010100101110110      "
"                                     10      "
"                                     ^v5      "
"                                     1      "
"011 101010 11 1010100101110110      "
"                                     10      "
"                                     ^v5      "
"                                     1      "
"011 101010 11 1010100101110110      "
"                                     10      "
"                                     ^v5      "
"                                     1      "
"011 101010 11 1010100101110110      "
"                                     10      "
"                                     ^s      "
"                                     1      "
"0011 101010 11 1010100101110110      "
"                                     10      "
"                                     ^s      "
"                                     1      "
"00011 101010 11 1010100101110110      "
"                                     10      "
"                                     ^s      "
"                                     1      "
"00011 101010 11 1010100101110110      "
"                                     10      "
"                                     ^s1      "
"                                     1      "
"100011 101010 11 1010100101110110      "
"                                     10      "
"                                     ^v0      "
"                                     1      "
"100011 101010 11 1010100101110110      "
"                                     10      "
"                                     ^v0      "
"                                     1      "
"100011 101010 11 1010100101110110      "
"                                     10      "
"                                     ^v0

```


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"	10	"
"	$\wedge v3$	"
"		"
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"	$\wedge v3$	"
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"1 101010 11 1010100101110110		"
"	10	"
"	$\wedge v1$	"
"		"
"	1	"
" 101010 11 1010100101110110		"
"	10	"
"	$\wedge v2$	"
"		"
"	1	"
"1 101010 11 1010100101110110		"
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"	$\wedge v4$	"
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"	$\wedge v4$	"
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"	10	"
"	$\wedge v4$	"
"		"
"	1	"
"011 101010 11 1010100101110110		"
"	10	"
"	$\wedge v5$	"
"		"
"	1	"
"011 101010 11 1010100101110110		"
"	10	"
"	$\wedge v5$	"
"		"


```
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"
"          1          "
" 011 100011 101010 11 1010100101110110 "
"          10        "
"          ^s        "
"
"          1          "
"0 011 100011 101010 11 1010100101110110 "
"          10        "
"          ^s        "
"
"          1          "
"0 011 100011 101010 11 1010100101110110 "
"          10        "
"          ^s1       "
"
"          1          "
"10 011 100011 101010 11 1010100101110110 "
"          10        "
"          ^t1       "
"
"          1          "
" 10 011 100011 101010 11 1010100101110110 "
"          10        "
"          ^t1       "
"
"          1          "
"1 10 011 100011 101010 11 1010100101110110 "
"          10        "
"          ^t1       "
"
"          1          "
"01 10 011 100011 101010 11 1010100101110110 "
"          10        "
"          ^t2       "
"
"          1          "
"001 10 011 100011 101010 11 1010100101110110 "
"          10        "
"          ^s        "
"
"          1          "
"1001 10 011 100011 101010 11 1010100101110110 "
"          10        "
"          ^s        "
"
"          1          "
```


"		"
"	1	"
"01001001 10 011 100011 101010 11 1010100101110110		"
"	11	"
"	$\wedge v_1$	"
"		"
"	1	"
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"	$\wedge v_2$	"
"		"
"	1	"
"001001 10 011 100011 101010 11 1010100101110110		"
"	11	"
"	$\wedge v_2$	"
"		"
"	1	"
"01001 10 011 100011 101010 11 1010100101110110		"
"	11	"
"	$\wedge v_2$	"
"		"
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"	$\wedge v_3$	"
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"	1	"
"001 10 011 100011 101010 11 1010100101110110		"
"	11	"
"	$\wedge v_3$	"
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"	1	"
"01 10 011 100011 101010 11 1010100101110110		"
"	11	"
"	$\wedge v_3$	"
"		"
"	1	"
"1 10 011 100011 101010 11 1010100101110110		"
"	11	"
"	$\wedge v_1$	"
"		"
"	1	"
" 10 011 100011 101010 11 1010100101110110		"
"	11	"
"	$\wedge v_2$	"
"		"
"	1	"
"10 011 100011 101010 11 1010100101110110		"

"	1	"
"011 101010 11 1010100101110110		"
"	11	"
"	$\wedge v3$	"
"		"
"	1	"
"11 101010 11 1010100101110110		"
"	11	"
"	$\wedge v3$	"
"		"
"	1	"
"1 101010 11 1010100101110110		"
"	11	"
"	$\wedge v1$	"
"		"
"	1	"
" 101010 11 1010100101110110		"
"	11	"
"	$\wedge v2$	"
"		"
"	1	"
"1 101010 11 1010100101110110		"
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"	$\wedge v4$	"
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"	$\wedge v4$	"
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"	11	"
"	$\wedge v4$	"
"		"
"	1	"
"011 101010 11 1010100101110110		"
"	11	"
"	$\wedge v5$	"
"		"
"	1	"
"011 101010 11 1010100101110110		"
"	11	"
"	$\wedge v5$	"
"		"
"	1	"
"011 101010 11 1010100101110110		"
"	11	"


```
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"              ^t0    "  
"              1      "  
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"              11      "  
"              ^t1    "  
"              1      "  
" 10 011 100011 101010 11 1010100101110110      "  
"              11      "  
"              ^t1    "  
"              1      "  
"1 10 011 100011 101010 11 1010100101110110      "  
"              11      "  
"              ^t1    "  
"              1      "  
"01 10 011 100011 101010 11 1010100101110110      "  
"              11      "  
"              ^t2    "  
"              1      "  
"001 10 011 100011 101010 11 1010100101110110      "  
"              11      "  
"              ^s     "  
"              1      "  
"1001 10 011 100011 101010 11 1010100101110110      "  
"              11      "  
"              ^t0    "  
"              1      "  
"01001 10 011 100011 101010 11 1010100101110110      "  
"              11      "  
"              ^t0    "  
"              1      "  
"001001 10 011 100011 101010 11 1010100101110110      "  
"              11      "  
"              ^t1    "  
"              1      "  
"1001001 10 011 100011 101010 11 1010100101110110      "  
"              11      "  
"              ^t1    "
```

```
"
"
"01001001 10 011 100011 101010 11 1010100101110110 "
"
"
"
"
"
"001001001 10 011 100011 101010 11 1010100101110110 "
"
"
"
"
"
"0001001001 10 011 100011 101010 11 1010100101110110 "
"
"
"
"
"
"00001001001 10 011 100011 101010 11 1010100101110110 "
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"
"
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"000001001001 10 011 100011 101010 11 1010100101110110 "
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"
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"
"0000001001001 10 011 100011 101010 11 1010100101110110 "
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"
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"
"00000001001001 10 011 100011 101010 11 1010100101110110 "
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"
"
"
"000000001001001 10 011 100011 101010 11 1010100101110110 "
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"
"
"
"
"0000000001001001 10 011 100011 101010 11 1010100101110110 "
"
"
"
"
"
"00000000001001001 10 011 100011 101010 11 1010100101110110 "
```

```

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" 00000000001001001 10 011 100011 101010 11 1010100101110110 "
"          11         "
"          ^s         "
"          1          "
"1 00000000001001001 10 011 100011 101010 11 1010100101110110"
"          11         "
"          ^t0        "
"          1          "
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"          11         "
"          ^t1        "
"          1          "
" 01 00000000001001001 10 011 100011 101010 11 10101001011101"
"          11         "
"          ^t1        "
"          1          "
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"          11         "
"          ^t1        "
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 11 101010010111"
"          11         "
"          ^t2        "
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 11 10101001011"
"          11         "
"          ^s         "
"          1          "
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"          11         "
"          ^s         "
"          1          "
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"          ^t0        "
"          1          "

```

```

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"          ^t1          "
"          1          "
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"          11          "
"          ^t1          "
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 11 101010"
"          11          "
"          ^t1          "
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 11 10101"
"          11          "
"          ^t2          "
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 11 1010"
"          11          "
"          ^s          "
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 11 101"
"          11          "
"          ^t0          "
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 11 10"
"          11          "
"          ^t0          "
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 11 1"
"          11          "
"          ^t1          "
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 11 "
"          11          "
"          ^t1          "
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 11"
"          11          "

```

```
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"
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 1"
"          11          "
"          ^t2          "
"
"          1          "
" 1 01 00000000001001001 10 011 100011 101010 "
"          11          "
"          ^s          "
"
"          1          "
" 1 01 00000000001001001 10 011 100011 101010"
"          11          "
"          ^t0          "
"
"          1          "
" 1 01 00000000001001001 10 011 100011 10101"
"          11          "
"          ^t0          "
"
"          1          "
" 1 01 00000000001001001 10 011 100011 1010"
"          11          "
"          ^t1          "
"
"          1          "
" 1 01 00000000001001001 10 011 100011 101"
"          11          "
"          ^t1          "
"
"          1          "
" 1 01 00000000001001001 10 011 100011 10"
"          11          "
"          ^t1          "
"
"          1          "
" 1 01 00000000001001001 10 011 100011 1"
"          11          "
"          ^t2          "
"
"          1          "
" 1 01 00000000001001001 10 011 100011 "
"          11          "
"          ^s          "
"
"          1          "
"          1          "
```

```

"          1 01 00000000001001001 10 011 100011"
"          11
"          ^t0
"
"          1
"          1 01 00000000001001001 10 011 10001"
"          11
"          ^t0
"
"          1
"          1 01 00000000001001001 10 011 1000"
"          11
"          ^t1
"
"          1
"          1 01 00000000001001001 10 011 100"
"          11
"          ^t1
"
"          1
"          1 01 00000000001001001 10 011 10"
"          11
"          ^t1
"
"          1
"          1 01 00000000001001001 10 011 1"
"          11
"          ^t2
"
"          1
"          1 01 00000000001001001 10 011
"          11
"          ^s
"
"          1
"          1 01 00000000001001001 10 011
"          11
"          ^h
"
"          1
"          1 01 00000000001001001 10 011
"          11
"          ^h
"
"          >

```

▼ *10.1.30. Egyszalagos univerzális Turing-gép.

▶ 10.1.31. Feladat.

- ▼ 10.1.32. *Félszalagos Turing-gépek.*
- ▼ 10.1.33. *Félszalagos Turing-gép szimulálása Turing-gépen.*
- ▼ 10.1.34. *Turing-gép szimulálása félszalagos gépen.*
- ▼ 10.1.35. *Post-gép szimulálása félszalagos gépen.*
- ▼ 10.1.36. *Tétel: Post-gép szimulálása Turing-gépen.*
- ▼ 10.1.37. *Tétel: Turing-gép szimulálása Post-gépen.*
- ▼ 10.1.38. *Korlátozott gépmodellek.*
- ▼ 10.1.39. *Tétel.*
- ▼ 10.1.40. *RAM-gép.*
- ▼ 10.1.41. *RAM-gép végrehajtási ideje.*
- ▼ 10.1.42. *Példák.*
- ▼ 10.1.43. *Feladat.*
- ▼ 10.1.44. *Turing-gép szimulálása RAM-gépen.*
- ▼ 10.1.45. *Megjegyzés.*
- ▼ 10.1.46. *RAM-gép szimulálása Turing-gépen.*
- ▶ 10.1.47. *Megjegyzés.*
- ▼ 10.1.48. *Tárolt programú gép.*
- ▼ *10.1.49. *Markov-automaták.*
- ▼ *10.1.50. *Turing-gép szimulálása Markov-automatán.*
- ▼ *10.1.51. *Markov-automata szimulálása Turing-gépen.*
- ▼ *10.1.52. *Sejtautomaták.*
- ▼ *10.1.53. *Példák.*
- ▼ *10.1.54. *Sejtautomata szimulálása Turing-gépen.*
- ▼ *10.1.55. *Turing-gép szimulálása sejtautomatán.*
- ▼ *10.1.56. *Church-féle lambda-kalkulus.*
- ▼ ->10.1.57. *Feladat.*
- ▶ 10.1.58. *További feladatok.*

▼ 10.2. Kiszámíthatóság

- ▶ 10.2.1. *Kiszámítható függvények.*
- ▶ 10.2.2. *Nyelvek.*
- ▶ 10.2.3. *Eldönthető nyelvek.*
- ▶ 10.2.4. *Felsorolható nyelvek.*

- ▶ **10.2.5. Kiszámítható parciális függvények.**
- ▶ ->10.2.6. Feladat.
- ▶ ->10.2.7. Feladat.
- ▶ **10.2.8. Feladat.**
- ▼ ->10.2.9. Feladat.
- ▶ **10.2.10. Tétel.**
- ▶ **10.2.11. Megjegyzés.**
- ▶ **10.2.12. A Church-tézis.**
- ▶ **10.2.13. Tétel.**
- ▶ **10.2.14. Lemma.**
- ▶ **10.2.15. Tétel.**
- ▼ ->10.2.16. Feladat.
- ▼ **10.2.17. A megállási feladat.**
- ▶ **10.2.18. Tétel.**
- ▶ **10.2.19. Tétel.**
- ▶ **10.2.20. Tétel.**
- ▶ **10.2.21. Tétel.**
- ▶ **10.2.22. Matematikai problémák algoritmikus megoldhatatlansága.**
- ▶ **10.2.23. Diophantoszi egyenletek algoritmikus megoldhatatlansága.**
- ▶ **10.2.24. Dominó-probléma.**
- ▼ **10.2.25. Parciális rekurzív és primitív rekurzív függvények.**
- ▼ **10.2.26. Példák primitív rekurzív függvényekre.**
- ▶ ***10.2.27. Tétel.**
- ▶ ***10.2.28. Tétel.**
- ▶ ***10.2.29. Rekurzív függvények.**
- ▶ ->10.2.30. Feladat.
- ▶ ->10.2.31. Feladat.
- ▶ ->10.2.32. Feladat.
- ▶ ->10.2.33. Feladat.
- ▶ ->10.2.34. Feladat.
- ▶ ->10.2.35. Feladat.
- ▶ ->10.2.36. Feladat.

▶ *10.2.37. További feladatok.*

▼ **10.3. Idő és tár**

▼ *10.3.1. Algoritmusok idő- és tárigénye.*

▼ *10.3.2. Példák.*

▼ *10.3.3. Nemdeterminisztikus Turing-gépek.*

▶ *10.3.4. Tétel.*

▼ *10.3.5. Tanú.*

▼ *10.3.6. Példák.*

▶ *10.3.7. Tanú-tétel.*

▶ *10.3.8. Következmény.*

▶ *10.3.9. Megjegyzés.*

▶ *->10.3.10. Feladat.*

▶ *->10.3.11. Feladat.*

▼ *->10.3.12. Feladat.*

▼ *->10.3.13. Feladat.*

▶ *10.3.14. További feladatok.*