

Computer realization of the simplest self-printing Turing machine in Matlab

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clear all
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Progr_J=["a1","in1","a1","J1_1","1";"a1","in2","a1","J2_1","1";"a1","in3","a1","J3_1","1";"a1","in4","a1","J4_1","1";"a1","in5","a1","J5_1","1";"a2","in1","a2","J1_2","1";"a2","in2","a2","J2_2","1";"a2","in3","a2","J3_2","1";"a2","in4","a2","J4_2","1";"a2","in5","a2","J5_2","1"];
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for i=3:2:284
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Progr_J=[Progr_J;[strcat("a",num2str(i)),"in1",strcat("a",num2str(i)),"J1_1","1";strcat("a",num2str(i)),"in2",strcat("a",num2str(i)),"J2_1","1";strcat("a",num2str(i)),"in3",strcat("a",num2str(i)),"J3_1","1";strcat("a",num2str(i)),"in4",strcat("a",num2str(i)),"J4_1","1";strcat("a",num2str(i)),"in5",strcat("a",num2str(i)),"J5_1","1";strcat("a",num2str(i+1)),"in1",strcat("a",num2str(i+1)),"J1_2","1";strcat("a",num2str(i+1)),"in2",strcat("a",num2str(i+1)),"J2_2","1";strcat("a",num2str(i+1)),"in3",strcat("a",num2str(i+1)),"J3_2","1";strcat("a",num2str(i+1)),"in4",strcat("a",num2str(i+1)),"J4_2","1";strcat("a",num2str(i+1)),"in5",strcat("a",num2str(i+1)),"J5_2","1"]];
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end
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Progr_type_0=["in1","*", "in2","in1","1";"in2","*", "in3","in2","1";"in3","*", "in4","in3","1";"in4","*", "in5","in4","1";"in5","*", "1","a1","1"];
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Progr_type_1=["1","*", "2","in1","1";"2","*", "3","in2","1";"3","*", "4","in3","1";"4","*", "5","in4","1";"5","*", "6","in5","1";"6","*", "7","16","1";"7","*", "8","10","1";"8","*", "9","16","1";"9","*", "10","in1","1";"10","*", "11","2","1";"11","*", "12","16","1";"12","*", "13","12","1";"13","*", "14","16","1";"14","*", "15","in2","1";"15","*", "16","2","1";"16","*", "17","16","1";"17","*", "18","13","1";"18","*", "19","16","1";"19","*", "20","in3","1";"20","*", "21","2","1";"21","*", "22","16","1";"22","*", "23","14","1";"23","*", "24","16","1";"24","*", "25","in4","1";"25","*", "26","2","1";"26","*", "27","16","1";"27","*", "28","15","1";"28","*", "29","16","1";"29","*", "30","in5","1";"30","*", "31","2","1";"31","*", "32","16","1";"32","*", "33","11","1";"33","*", "34","16","1";"34","*", "35","-1","1";"35","*", "36","2","1";"36","*", "37","16","1";"37","*", "38","2","1";"38","*", "39","16","1";"39","*", "40","1","1";"40","*", "41","2","1";"41","*", "42","16","1";"42","*", "43","-1","1";"43","*", "44","16","1";"44","*", "45","2","1";"45","*", "46","2","1";"46","*", "47","16","1";"47","*", "48","3","1";"48","*", "49","16","1";"49","*", "50","3","1";"50","*", "51","2","1";"51","*", "52","16","1";"52","*", "53","1","1";"53","*", "54","16","1";"54","*", "55","4","1";"55","*", "56","2","1";"56","*", "57","16","1";"57","*", "58","4","1";"58","*", "59","16","1";"59","*", "60","5","1";"60","*", "61","2","1";"61","*", "62","16","1";"62","*", "63","5","1";"63","*", "64","16","1";"64","*", "65","6","1";"65","*", "66","2","1";"66","*", "67","16","1";"67","*", "68","6","1";"68","*", "69","16","1";"69","*", "70","7","1";"70","*", "71","2","1";"71","*", "72","16","1";"72","*", "73","7","1";"73","*", "74","16","1";"74","*", "75","8","1";"75","*", "76","2","1";"76","*", "77","16","1";"77","*", "78","8","1";"78","*", "79","16","1";"79","*", "80","9","1";"80","*", "81","2","1";"81","*", "82","16","1";"82","*", "83","9","1";"83","*", "84","16","1";"84","*", "85","10","1";"85","*", "86","2","1";"86","*", "87","9","1";"87","*", "88","11","1";"88","*", "89","9","1";"89","*", "90","3","1";"90","*", "91","2","1";"91","*", "92","9","1";"92","*", "93","1","1";"93","*", "94","9","1";"94","*", "95","7","1";"95","*", "96","2","1";"96","*", "97","9","1";"97","*", "98","12","1";"98","*", "99","9","1";"99","*", "100","6","1";"100","*", "101","2","1";"101","*", "102","9","1";"102","*", "103","13","1";"103","*", "104","9","1";"104","*", "105","5","1";"105","*", "106","2","1";"106","*", "107","9","1";"107","*", "108","14","1";"108","*", "109","9","1";"109","*", "110","4","1";"110","*", "111","2","1";"111","*", "112","9","1";"112","*", "113","15","1";"113","*", "114","9","1";"114","*", "115","9","1";"115","*", "116","2","1";"116","*", "117","9","1";"117","*", "118","16","1";"118","*", "119","9","1";"119","*", "120","10","1";"120","*", "121","2","1";"121","*", "122","12","1"];
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2","10","1";122","*","123","8","1";123","*","124","10","1";124","*","125","in1"
,"1";125","*","126","2","1";126","*","127","10","1";127","*","128","7","1";128
","*","129","10","1";129","*","130","in2","1";130","*","131","2","1";131","*","
132","10","1";132","*","133","6","1";133","*","134","10","1";134","*","135","in
3","1";135","*","136","2","1";136","*","137","10","1";137","*","138","5","1";1
38","*","139","10","1";139","*","140","in4","1";140","*","141","2","1";141","*","
,"142","10","1";142","*","143","4","1";143","*","144","10","1";144","*","145","
in5","1";145","*","146","2","1";146","*","147","10","1";147","*","148","3","1";
"148","*","149","10","1";149","*","150","-
1","1";150","*","151","2","1";151","*","152","10","1";152","*","153","2","1";1
53","*","154","10","1";154","*","155","1","1";155","*","156","2","1";156","*","
157","17","1";157","*","158","-
1","1";158","*","159","17","1";159","*","160","2","1";160","*","161","2","1";1
61","*","162","17","1";162","*","163","3","1";163","*","164","17","1";164","*","
,"165","11","1";165","*","166","2","1";166","*","167","17","1";167","*","168","1
","1";168","*","169","17","1";169","*","170","15","1";170","*","171","2","1";1
71","*","172","17","1";172","*","173","4","1";173","*","174","17","1";174","*","
,"175","14","1";175","*","176","2","1";176","*","177","17","1";177","*","178","5
","1";178","*","179","17","1";179","*","180","13","1";180","*","181","2","1";1
81","*","182","17","1";182","*","183","6","1";183","*","184","17","1";184","*","
,"185","12","1";185","*","186","2","1";186","*","187","17","1";187","*","188","7
","1";188","*","189","17","1";189","*","190","10","1";190","*","191","2","1";1
91","*","192","17","1";192","*","193","8","1";193","*","194","17","1";194","*","
,"195","16","1";195","*","196","2","1";196","*","197","17","1";197","*","198","9
","1";198","*","199","17","1";199","*","200","17","1";200","*","201","2","1";2
01","*","202","10","1";202","*","203","11","1";203","*","204","10","1";204","*","
,"205","11","1";205","*","206","2","1";206","*","207","10","1";207","*","208","
1","1";208","*","209","10","1";209","*","210","12","1";210","*","211","2","1";
211","*","212","10","1";212","*","213","12","1";213","*","214","10","1";214","*","
,"215","13","1";215","*","216","2","1";216","*","217","10","1";217","*","218","
,"13","1";218","*","219","10","1";219","*","220","14","1";220","*","221","2","1"
;221","*","222","10","1";222","*","223","14","1";223","*","224","10","1";224","
*","225","15","1";225","*","226","2","1";226","*","227","10","1";227","*","228
","15","1";228","*","229","10","1";229","*","230","16","1";230","*","231","2","
1";231","*","232","10","1";232","*","233","16","1";233","*","234","10","1";234
","*","235","17","1";235","*","236","2","1";236","*","237","3","1";237","*","23
8","9","1";238","*","239","9","1";239","*","240","2","1";240","*","241","2","1"
;241","*","242","3","1";242","*","243","10","1";243","*","244","10","1";244","
*","245","2","1";245","*","246","2","1";246","*","247","9","1";247","*","248","
17","1";248","*","249","2","1";249","*","250","10","1";250","*","251","2","1";
251","*","252","10","1";252","*","253","17","1";253","*","-1","2","1"];

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Progr_type_1_comma=["-1","*","-1","-1","-1"];

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Progr_type_2=["-1","in1","-1","in1","-1";-1","in2","-1","in2","-1";-1","in3","-
1","in3","-1";-1","in4","-1","in4","-1";-1","in5","-1","in5","-1";-1","-1","-
1","-1","-1";-1","1","-1","1","-1";-1","2","-1","2","-1";-1","3","-1","3","-
1";-1","4","-1","4","-1";-1","5","-1","5","-1";-1","6","-1","6","-1";-
1","7","-1","7","-1";-1","8","-1","8","-1";-1","9","-1","9","-1";-1","10","-
1","10","-1";-1","11","-1","11","-1";-1","12","-1","12","-1";-1","13","-
1","13","-1";-1","14","-1","14","-1";-1","15","-1","15","-1";-1","16","-
1","16","-1";-1","17","-1","17","-1"];

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Progr_type_5_comma=["a283","*","1","a284","1";a284","*","0","1","1"];

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Progr_type_end=["0","*","0","*","0"];

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Progr_types_specially_printed=[Progr_type_0;Progr_type_1;Progr_type_1_comma;Progr_
type_2;Progr_type_5_comma];

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for i=1:length(Progr_J(:,1))/5
Progr_J((i-1)*5+1,4)=Progr_types_specially_printed(i,1);

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Progr_J((i-1)*5+2,4)=Progr_types_specially_printed(i,2);
Progr_J((i-1)*5+3,4)=Progr_types_specially_printed(i,3);
Progr_J((i-1)*5+4,4)=Progr_types_specially_printed(i,4);
Progr_J((i-1)*5+5,4)=Progr_types_specially_printed(i,5);
end

for i=1:284
Progr_type_3(i,:)=["-1",strcat("a",num2str(i)),strcat("a",num2str(i)),"1","1"];
end

Progr_type_4=["a1",-
1,"a1","2","1";"a1","1","a1","4","1";"a1","2","a1","1","1";"a1","3","a1","3","1";
"a1","4","a1","5","1";"a1","5","a1","6","1";"a1","6","a1","7","1";
"a1","7","a1","8","1";"a1","8","a1","9","1";"a1","9","a1","10","1";"a1","10","a1",
"in1","1";"a1","11","a1",-
1,"1";"a1","12","a1","in2","1";"a1","13","a1","in3","1";"a1","14","a1","in4","1";
"a1","15","a1","in5","1";"a1","16","a1","a1","1";"a1","17","a1","a2","1";"a2",-
1,"a2","a3","1";"a2","1","a2","12","1";"a2","2","a2","1","1";"a2","3","a2",-
1,"1";"a2","4","a2","in5","1";
"a2","5","a2","in4","1";"a2","6","a2","in3","1";"a2","7","a2","in2","1";"a2","8","
a2","in1","1";"a2","9","a2","a1","1";"a2","10","a2","a2","1";"a2","11","a2","11","
1";"a2","12","a2","13","1";
"a2","13","a2","14","1";"a2","14","a2","15","1";"a2","15","a2","16","1";"a2","16",
"a2","17","1";"a2","17","a2","*","1"];

P2=[];

for i=2:2:282
P=Progr_type_4;
P(find(Progr_type_4(1:36,:)=="a1"))=strcat("a",num2str(i+1));
P(find(Progr_type_4(1:36,:)=="a2"))=strcat("a",num2str(i+2));
P(find(Progr_type_4(1:36,:)=="a3"))=strcat("a",num2str(i+3));
P2=[P2;P];
end

Progr_type_4=[Progr_type_4;P2];
Progr_type_4(max(find(Progr_type_4(:,4)=="*")),4) = "0";
Progr_type_4(max(find(Progr_type_4(:,4)=="a285")),4) = "0";
clear P P2;

Progr_type_4=[Progr_type_4;Progr_J];

for i=1:282
Progr_type_5(i,:)=[strcat("a",num2str(i)),"*", "1",strcat("a",num2str(i+1)),"1"];
end

Progr=[Progr_types_specially_printed;Progr_type_3;Progr_type_4;Progr_type_5;Progr_
type_end];

% Checking if there are no contradicting (or only multiple) lines in the program
("Progr") of the Turing machine: %
for i=1:length(Progr(:,1))
Program_check_count=i
num_of_Progr_lines(i)=length(find(and(Progr(:,1)==Progr(i,1),Progr(:,2)==Progr(i,2)
))));
end

if isempty(find(num_of_Progr_lines>1))==1
else
error ('Error Progr')
end % End of program checking. (If there is no error message, the program is
right. This code continues running.) %

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Tape=["*", "*", "*", "*", "*"; "*", "*", "*", "*", "*"]';

for i=1:15 % This number (now 15) should be such high that the number of (*)
characters in the here defined "Tape" (now 5*65536=327680) is higher than the
maximum value of the variable "step" below (now 220000). %
Tape=[Tape,Tape];
end

position=1; state="in1";

for step=1:220000 % This must be a satisfactorily high number for complete
running. (Higher than 5+255*284*3 is enough.) %
step_and_position=[step,position]
read=Tape(position);
progr_line=find(and(Progr(:,1)==state,Progr(:,2)==read));
state=Progr(progr_line,3);
Tape(position)=Progr(progr_line,4);
    if Progr(progr_line,5)=="1"
        position=position+1;
    elseif Progr(progr_line,5)=="-1"
        position=position-1;
    else
        position=position;
    end
end

Tape=Tape';
a=find(and(Tape(:,1)=="*",Tape(:,2)=="*"));
Tape(a(2):length(Tape(:,1)),:)=[];

% Checking if all lines of the program ("Progr") of the Turing machine can be
found in the output ("Tape") without contradiction: %
Progr=[Progr_types_specially_printed;Progr_type_3;Progr_type_4;Progr_type_5];
for i=1:length(Progr(:,1))
Output_check_count=i
num_of_Progr_lines_in_output(i)=length(find(and(Tape(:,1)==Progr(i,1),Tape(:,2)==P
rogr(i,2))));
index=find(and(Tape(:,1)==Progr(i,1),Tape(:,2)==Progr(i,2)));
    if num_of_Progr_lines_in_output(i)==0
        error ('Error in output, missing program line')
    else
        for j=1:num_of_Progr_lines_in_output(i)
            if Tape(index(j),3)==Progr(i,3) && Tape(index(j),4)==Progr(i,4) &&
                Tape(index(j),5)==Progr(i,5)
            else
                error ('Error in output, contradiction')
            end
        end
    end
end % End of the checking. (If there is no error message, the output is right.) %

```