

Source File: ~/4301/10/lab10.(C|CPP|cpp|c++|cc|cxx|cp)
Input: Under control of main function
Output: Under control of main function
Value: 3

For $\Sigma = \{a, b, 0, 1, =, \sqcup\}$, construct a Turing machine for the following:

$$\left\{ \begin{array}{l} (x =, x = ans) \mid x \in \{a, b\}^*, \\ ans = \begin{cases} 1, & \text{if there are the same number of } a\text{'s as } b\text{'s and} \\ & \text{as read from left to right, never has more } b\text{'s than } a\text{'s} \\ 0, & \text{otherwise} \end{cases} \end{array} \right\}$$

This assignment will use the same header file and sample main function used for Lab 09. A sample execution sequence is shown in Figure 1. To use the Makefile as distributed in class, add a target of lab10 to targets2srcfiles.

Additional notes:

- As each input line is read in, the main function creates the initial tape contents as follows: ten blanks followed by the original input line followed by more blanks.
- The halt state is 0 and the start state is 1.

```

1  newuser@csunix ~> cd 4301
2  newuser@csunix ~/4301> ./getlab.ksh 10
3      * Checking to see if a folder exists for Lab 10. . .No
4      * Creating a folder for Lab 10
5      * Checking to see if Lab 10 has sample input and output files. . .Yes
6      * Copying input and output files for Lab 10
7          from folder /usr/local/4301/data/10 to folder ./10
8      * Checking to see if /usr/local/4301/src/lab10main.C exists. . .Yes
9      * Copying file /usr/local/4301/src/lab10main.C to folder ./10
10     * Checking to see if /usr/local/4301/include/lab10.h exists. . .No
11     * Copying file /usr/local/4301/src/Makefile to folder ./10
12     * Adding a target of lab10 to targets2srcfiles
13     * Touching file ./10/lab10.cpp
14     * Edit file ./10/lab10.cpp in Notepad++
15  newuser@csunix ~/4301> cd 10
16  newuser@csunix ~/4301/10> ls
17  01.dat      01.out      Makefile    lab10.cpp   lab10main.C
18  newuser@csunix ~/4301/10> make lab10
19  g++ -g -Wall -std=c++11 -c lab10main.C -I/usr/local/4301/include -I.
20  g++ -g -Wall -std=c++11 -c lab10.cpp -I/usr/local/4301/include -I.
21  g++ -o lab10 lab10main.o lab10.o -L/usr/local/4301/lib -lm
22  newuser@csunix ~/4301/10> cat 01.dat
23  =
24  a=
25  b=
26  aa=
27  ab=
28  ba=
29  bb=

```

Figure 1. Commands to Compile, Link, & Run Lab 10 (Part 1 of 5)

```
30 aaa=  
31 aab=  
32 aba=  
33 abb=  
34 baa=  
35 bab=  
36 bba=  
37 bbb=  
38 aaaa=  
39 aaab=  
40 aaba=  
41 aabb=  
42 abaa=  
43 abab=  
44 abba=  
45 abbb=  
46 baaa=  
47 baab=  
48 baba=  
49 babb=  
50 bbaa=  
51 bbab=  
52 bbba=  
53 bbbb=  
54 aaabbb=  
55 aababb=  
56 aabbab=  
57 abaabb=  
58 ababab=  
59 abaaabbabb=  
60 abaabbba=  
61 newuser@csunix ~/4301/10> cat 01.dat | ./lab10  
62 Your Name  
63 CS 4301  
64 Lab 10  
65 {(x=, x=ans) | x is in {a,b}* and  
66         ans = 1 if there are the same number of a's as b's and  
67         as read from left to right, never has more b's than a's, and  
68         ans = 0 otherwise}  
69  
70 Input:  =  
71 Output:      =1  
72  
73 Input:  a=  
74 Output:      a=0  
75  
76 Input:  b=  
77 Output:      b=0  
78
```

Figure 1. Commands to Compile, Link, & Run Lab 10 (Part 2 of 5)

```
79 Input: aa=
80 Output:      aa=0
81
82 Input: ab=
83 Output:      ab=1
84
85 Input: ba=
86 Output:      ba=0
87
88 Input: bb=
89 Output:      bb=0
90
91 Input: aaa=
92 Output:      aaa=0
93
94 Input: aab=
95 Output:      aab=0
96
97 Input: aba=
98 Output:      aba=0
99
100 Input: abb=
101 Output:      abb=0
102
103 Input: baa=
104 Output:      baa=0
105
106 Input: bab=
107 Output:      bab=0
108
109 Input: bba=
110 Output:      bba=0
111
112 Input: bbb=
113 Output:      bbb=0
114
115 Input: aaaa=
116 Output:      aaaa=0
117
118 Input: aaab=
119 Output:      aaab=0
120
121 Input: aaba=
122 Output:      aaba=0
123
124 Input: aabb=
125 Output:      aabb=1
126
```

Figure 1. Commands to Compile, Link, & Run Lab 10 (Part 3 of 5)

```
127 Input: abaa=  
128 Output:      abaa=0  
129  
130 Input: abab=  
131 Output:      abab=1  
132  
133 Input: abba=  
134 Output:      abba=0  
135  
136 Input: abbb=  
137 Output:      abbb=0  
138  
139 Input: baaa=  
140 Output:      baaa=0  
141  
142 Input: baab=  
143 Output:      baab=0  
144  
145 Input: baba=  
146 Output:      baba=0  
147  
148 Input: babb=  
149 Output:      babb=0  
150  
151 Input: bbaa=  
152 Output:      bbaa=0  
153  
154 Input: bbab=  
155 Output:      bbab=0  
156  
157 Input: bbba=  
158 Output:      bbba=0  
159  
160 Input: bbbb=  
161 Output:      bbbb=0  
162  
163 Input: aaabbb=  
164 Output:      aaabbb=1  
165  
166 Input: aababb=  
167 Output:      aababb=1  
168  
169 Input: aabbab=  
170 Output:      aabbab=1  
171  
172 Input: abaabb=  
173 Output:      abaabb=1  
174
```

Figure 1. Commands to Compile, Link, & Run Lab 10 (Part 4 of 5)

```
175 Input: ababab=  
176 Output:          ababab=1  
177  
178 Input: abaaabbabb=  
179 Output:          abaaabbabb=1  
180  
181 Input: abaabbba=  
182 Output:          abaabbba=0  
183  
184 newuser@csunix ~/4301/10> cat 01.dat | ./lab10 > my.out  
185 newuser@csunix ~/4301/10> diff 01.out my.out  
186 newuser@csunix ~/4301/10>
```

Figure 1. Commands to Compile, Link, & Run Lab 10 (Part 5 of 5)