Homework 5 CSCI 451

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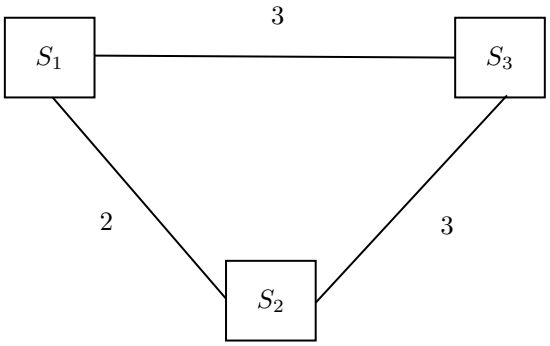
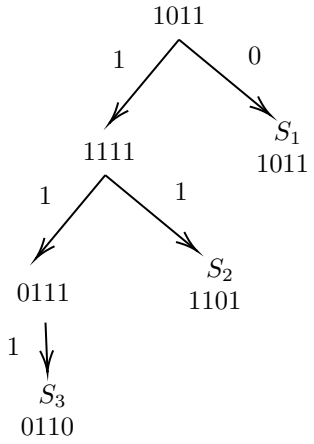
due: 03 December 2019

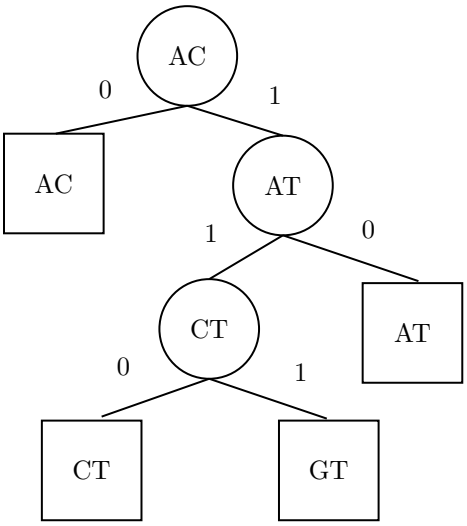
1 Exercise 7.6.1 (pg 193)





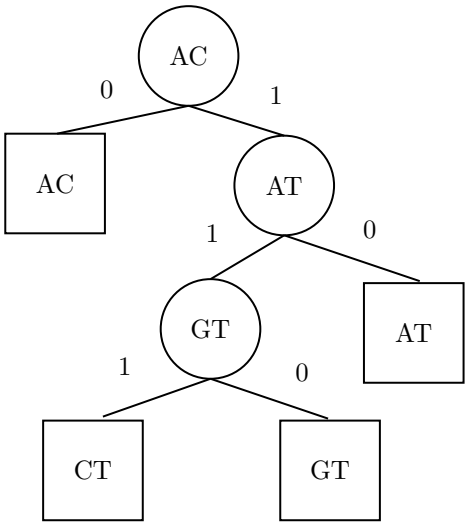
This does appear to be one of the maximum parsimony trees as S_3 is an equal number of changes from both S_1 and S_2.

2 Exercise 7.6.3 (pg 193)



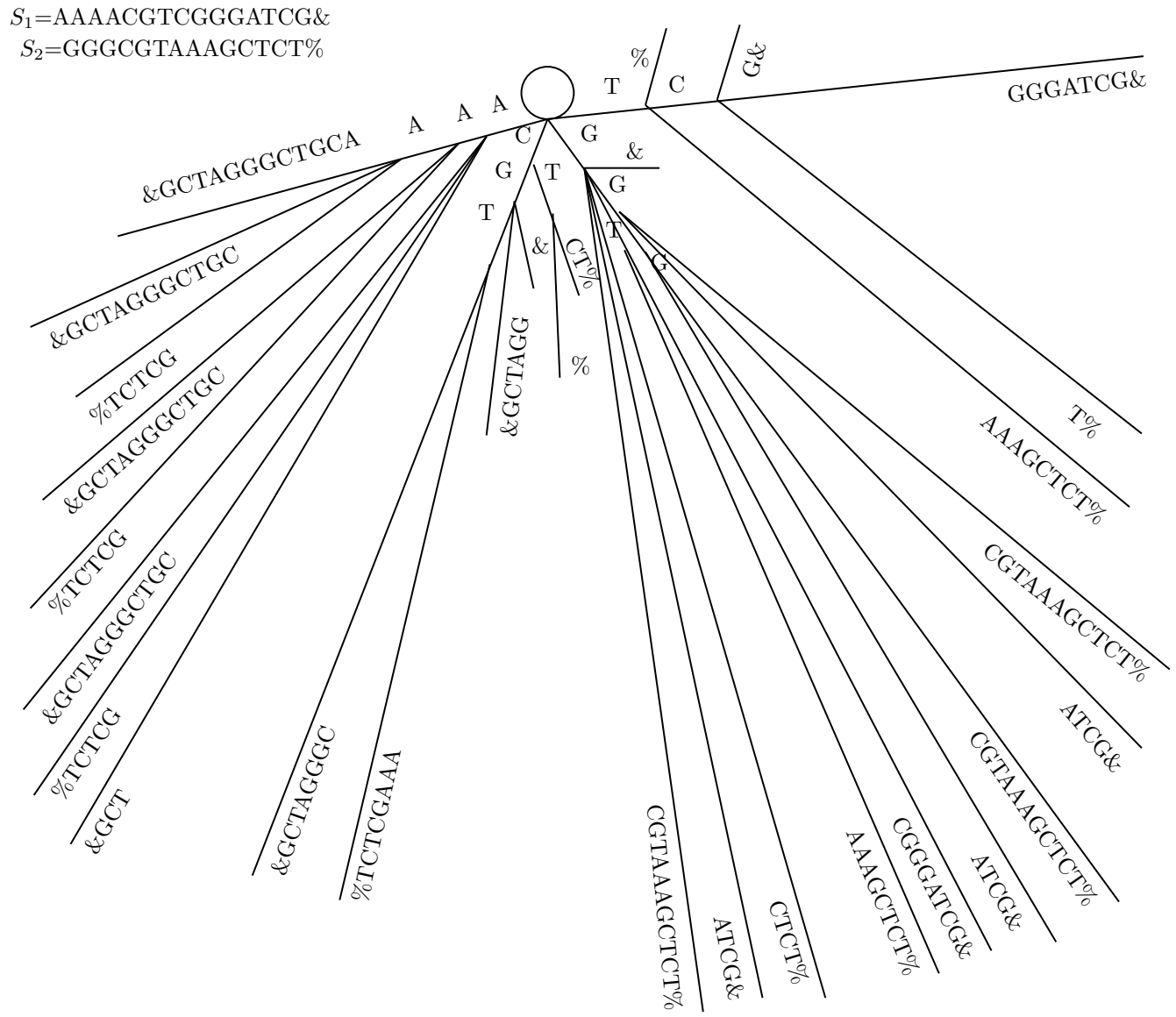
The parsimony length appears to be 3.

3 Exercise 7.6.4 (pg 194)



Note the CT internal node is now GT, PL = 3.

4 Exercise 4.8.1 (pg 105)



MUMs: CGT, GGG, AAA.

Sorry this is a bit of a mess, but AAA is directly off the left-hand side, and GGG is in the large mess under the T branch, CGT is directly to the left of the G branch. Each of these series of letters has exactly two children, one from each string and is the LCA.

5 Exercise 4.8.2 (pg 105)

MUMs: CGT, GGG

6 Sample Output

```
Fergus-SSD@Nic-SSD MINGW64 /h/Documents/Nic's School Stuffs/ComputationalBiology
/HW5 (master)
$ python RMQ.py
n: 1000000
First 20 integers of the array: [508406 863757 822437 959874 625062 469060 792340 999548 842745 237871
 858753 220706 471191 783087 853545 953368 905717  84617 700395 181185]

Beginning Pre-processing Step
Sparse Table Finished


Finding lowest between index 225431 and 830502
option1: 0 at index 481034
option2: 0 at index 754491
option1 Sparse Coords: 225431, 19
option2 Sparse Coords: 306215, 19

Lowest value in range: 0

Fergus-SSD@Nic-SSD MINGW64 /h/Documents/Nic's School Stuffs/ComputationalBiology/HW5 (master)
$ python RMQ.py
n: 1000000
First 20 integers of the array: [ 0  3  5  8  9 10 11 12 12 12 12 13 14 14 15 17 18 18 18 18]

Beginning Pre-processing Step
Sparse Table Finished


Finding lowest between index 698225 and 970978
option1: 698300 at index 698226
option2: 708962 at index 708835
option1 Sparse Coords: 698225, 18
option2 Sparse Coords: 708835, 18

Lowest value in range: 698300
```

Figure 1: Program Output