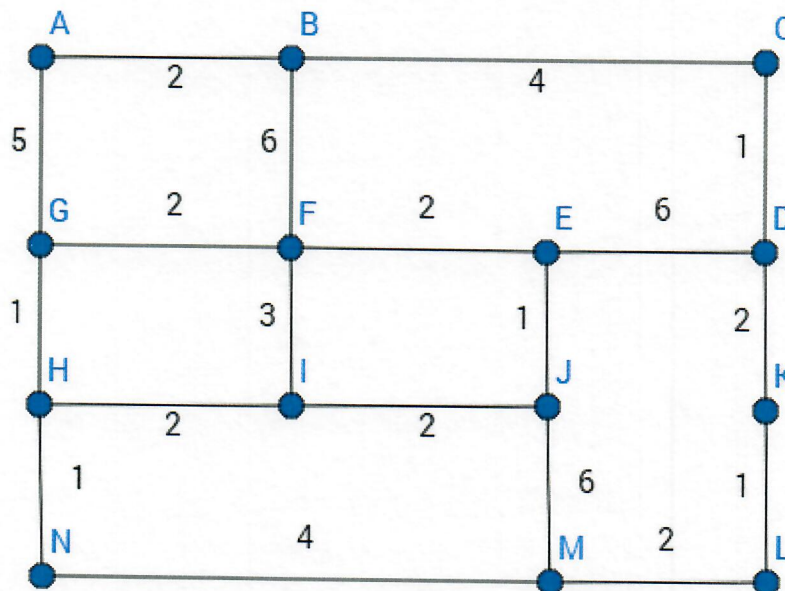
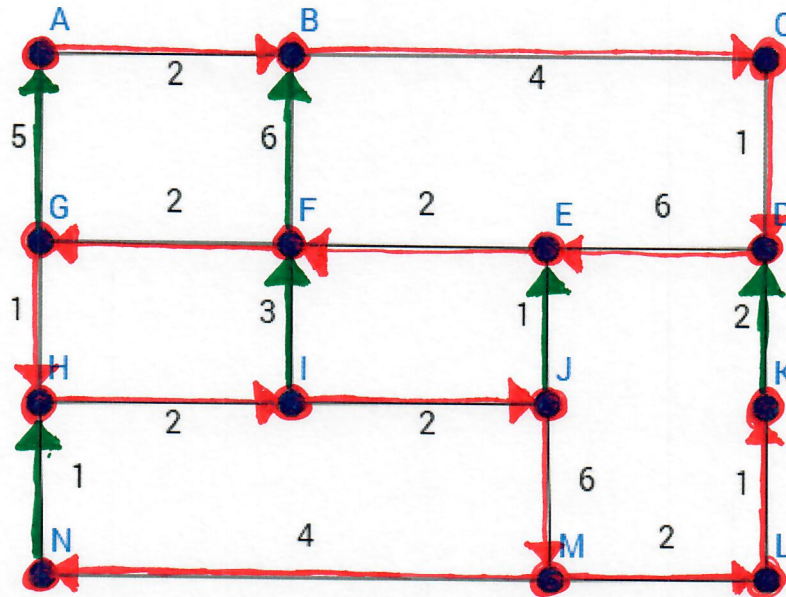




2. Due to heavy traffic in a downtown area, city planners need to take the existing network of roads and make them all one-way only.
- a. Use the **depth-first search algorithm** on the graph below (start with vertex A and clearly label each edge with the appropriate directions) to determine the direction of each edge so that this task can be accomplished.

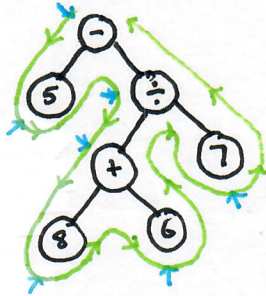


- b. What type of graph has now been constructed?

Connected Digraph

3. Evaluate the following expressions:

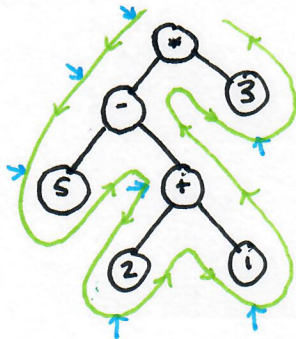
a. Preorder:  $- 5 \div + 8 6 7$



$$(5) - ((8) + (6)) \div (7)$$

**3**

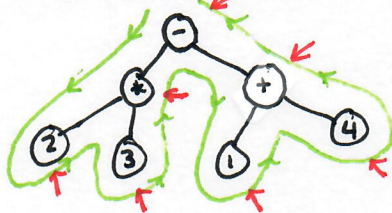
b. Preorder:  $* - 5 + 2 1 3$



$$((5) - ((2) + (1))) * (3)$$

**6**

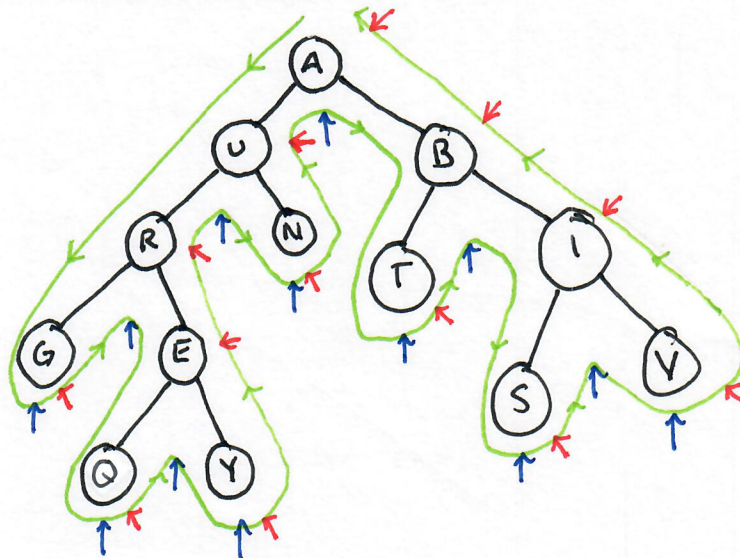
c. Postorder:  $2 3 * 1 4 + -$



$$((2) * (3)) - ((1) + (4))$$

**1**

4. Construct a binary tree for which the postorder listing of vertices is GQYERNUTSVIBA and the inorder listing of vertices is GRQEYUNATBSIV.



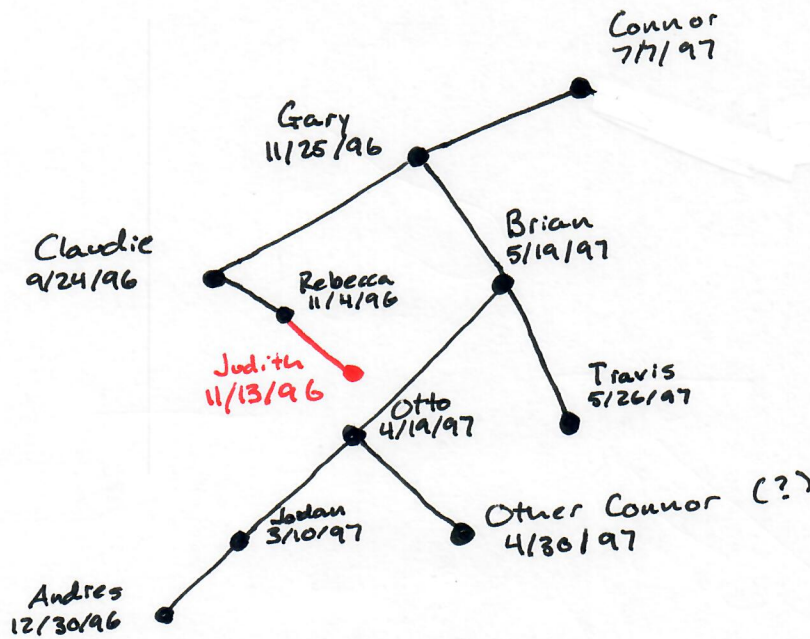
5. The school district stores student records by birthdate. The following students are in their database:

Connor	07.07.97
Gary	11.25.96
Brian	05.19.97
Travis	05.26.97
Claudie	09.24.96
Otto	04.19.97
Jordan	03.10.97
Rebecca	11.04.96
Andres	12.30.96
Connor	04.30.97

- a. If these records were to be sorted, what is the maximum number of comparisons that would need to be made.

$$10 \text{ records: } \frac{10 \cdot 9}{2} = \boxed{45}$$

- b. Construct the binary search tree for this scenario.

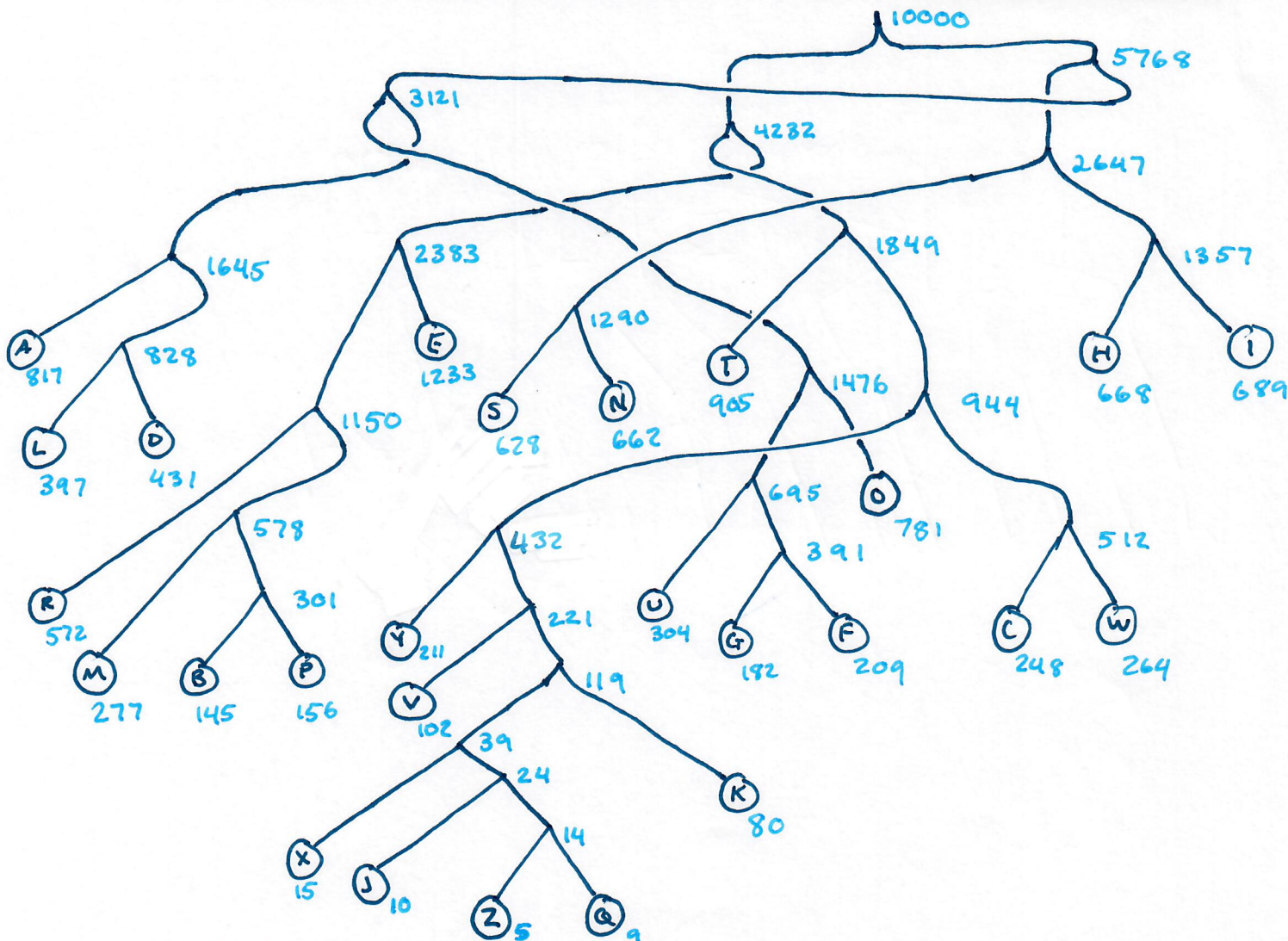


- c. On your tree above, show where the following student would be added:

Judith	11.13.96
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6. a. The letters in the English alphabet are shown below with their expected usage rates. Find an optimal binary tree to assign codes of shortest length to each character. (In the construction of the tree, use as the left child the vertex of smaller weight or the vertex with more children if the two vertices have equal weight.)

Letter	Frequency	Code	Letter	Frequency	Code	Letter	Frequency	Code
A	817	1110	J	10	00101010	S	628	1000
B	145	010110	K	80	0010111	T	905	000
C	248	00110	L	397	11110	U	304	11000
D	431	11111	M	277	01010	V	102	001010
E	1233	011	N	662	1001	W	264	0011
F	209	110011	O	781	1101	X	15	00101100
G	182	110010	P	156	010111	Y	211	00100
H	668	1010	Q	9	001010111	Z	5	0010110110
I	689	1011	R	572	0100			



- b. Based on this information, decode the following phrase:

001110111110010001110001100010010011011101000000

WEARESUNCAST