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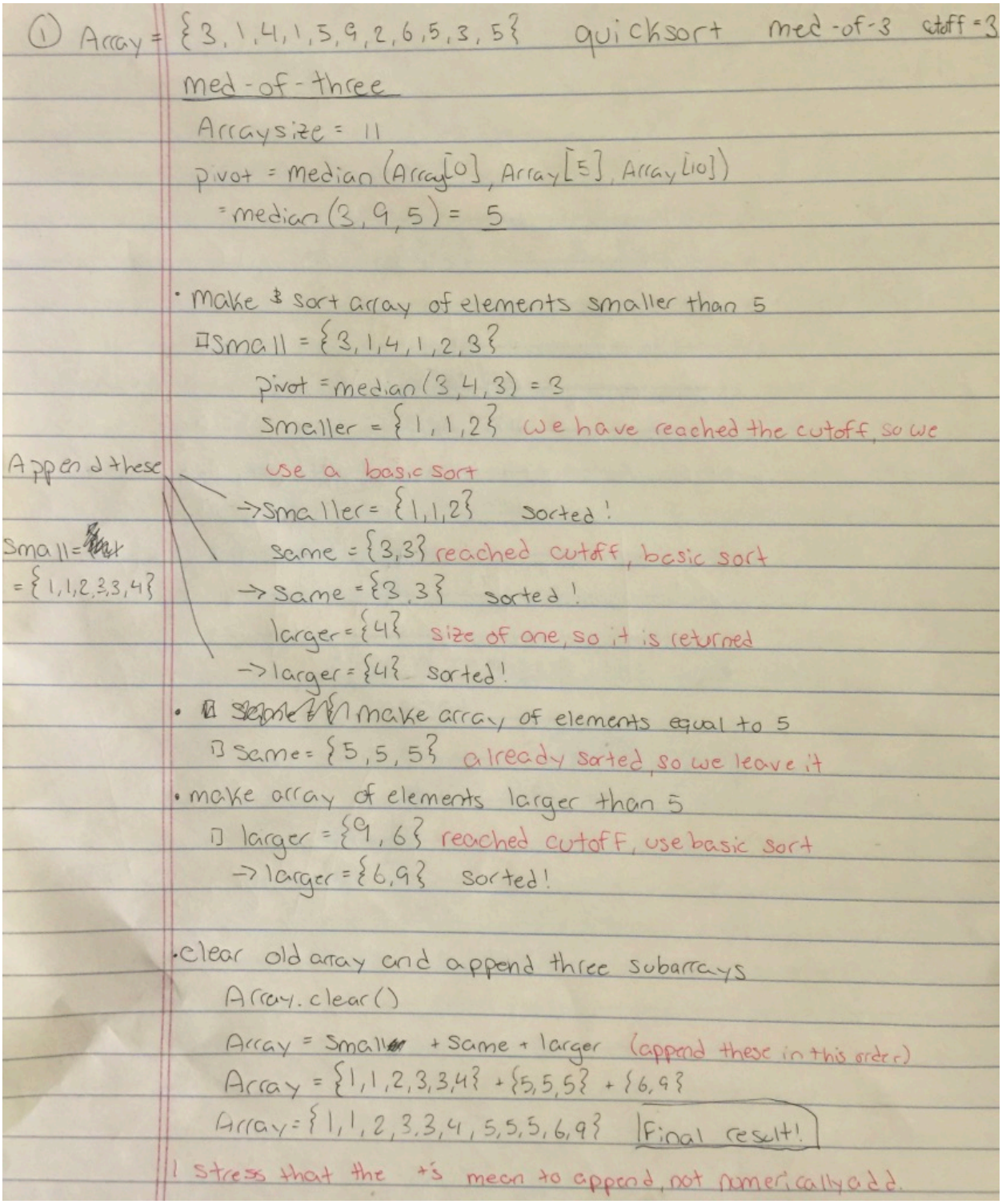
Data Structures hmk5

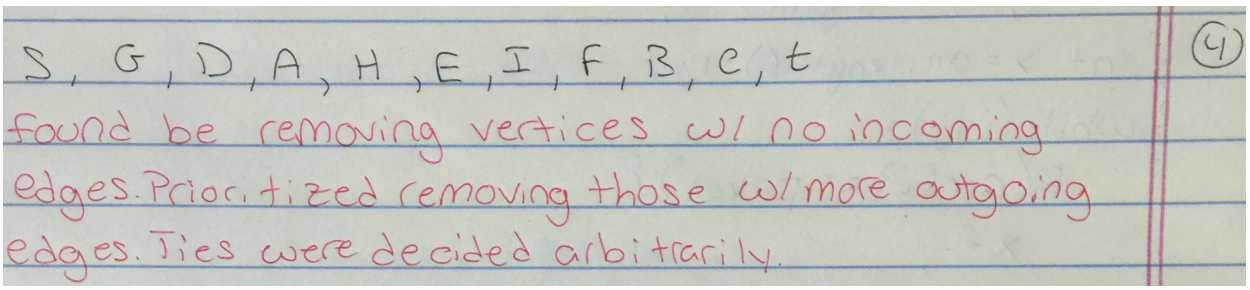
**Written:**

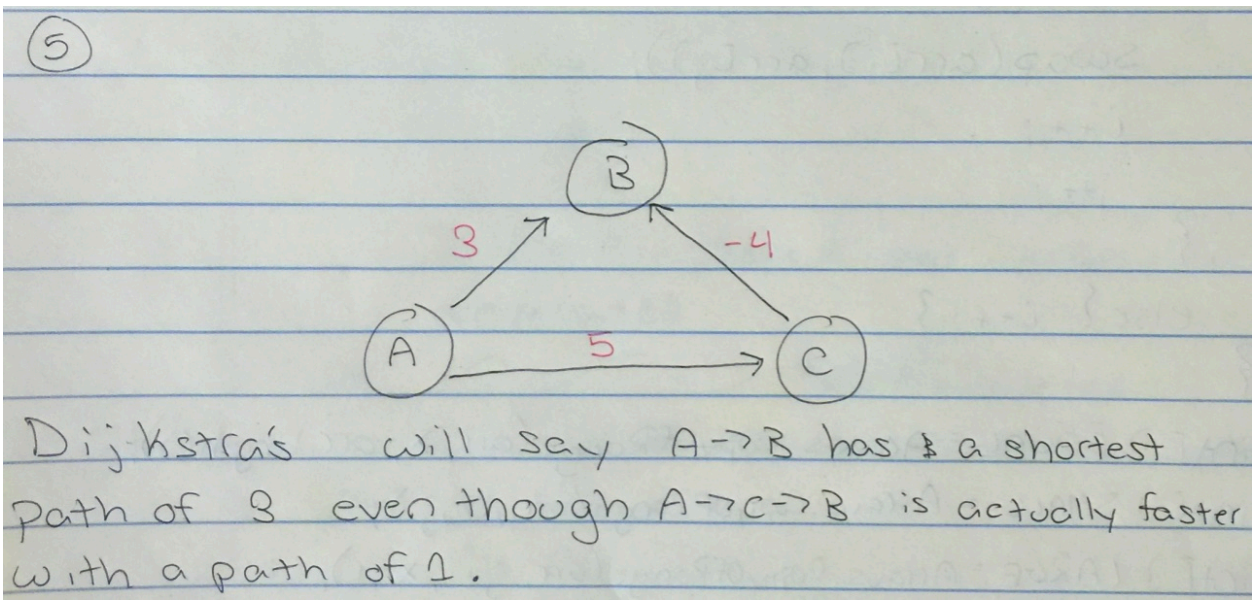


(2) It is unlikely quicksort will take quadratic time with this method. If the array is presorted, then quicksort will run best case. If the array is random then we are more likely to select a value near the median than one close to the edges (given that the array is large). Quadratic time is worst case, where the pivot is the largest or smallest value (or almost). while possible, this is highly unlikely given a large array.

3.

```
public AnyType[] sort(AnyType[] arr){
	int size=arr.length;
	int pivot_index=size/2;
	AnyType pivot=arr[pivot_index];
	swap(arr[pivot_index],arr[size-1]);
	pivot_index=size-1;

	int i=0;
	int j=arr.length-1;
	int x=arr.length-1;
	if(arr.length<=1){
		return arr;
	}
	while(i<j){
		if(arr[i].compareTo(pivot)==0){
			x--;
			swap(arr[i],arr[x]);
		}
		else if(arr[i].compareTo(arr[j])<0){
			swap(arr[i],arr[j]);
			i++;
			j++;
		}
		else{
			i++;
		}
	}
	AnyType[] EQUAL=Arrays.copyOfRange(arr, x, arr.length-1);
	AnyType[] SMALL=Arrays.copyOfRange(arr, 0, j);
	AnyType[] LARGE=Arrays.copyOfRange(arr, j, x);

	SMALL=sort(SMALL);
	LARGE=sort(LARGE);

	AnyType[] result =merge(SMALL,EQUAL,LARGE); //merges the arrays
	return result;
}

public void swap(AnyType a, AnyType b){
	return;
}
```




6.

a.

The endpoints of each stick will represent the boundaries of their respective lines. Using the two endpoints of each stick, we construct a linear line which passes through both endpoints of each stick (2 lines). We make one model for the stick in 3 dimensions, and one for just the x-y plane. We set the lines (X, Y) equal to one another and compute where they intersect on the x-y plane. If this point is within all of the bounds of both lines, they are related. If they are related we compare the z-value of each stick at the x-y point of intersection. This z value is calculated by plugging the intersection x-y values into either of the 3D equations. The stick with the higher z value is on top of the other. If the x-y lines of the sticks never intersect (or at least not within the bounds defined by the endpoints) they are unrelated.

b.

- Loop through every stick, and find its relationship with every other stick
- If every stick is related and every stick is both on top of one stick and below another, you CANNOT pick all the sticks up.
- Otherwise,
- Remove some stick which is not underneath any other stick
- Repeat until all sticks are gone