

Name of the Student: _____

4 questions in 150 minutes

Question 1 (20%)

Given the following information:

If wisdom and patience are useful, then there is hope.

If there is hope, there is trouble.

Patience is useful and there is no trouble.

What about wisdom, can we decide whether it is useful or not? Motivate your answer by constructing a truth-tree.

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Question 2

Definition:

Given a set A and a relation $R \subseteq A \times A$. We say that R is *connected* if and only if for every *distinct* x and y in A , (x,y) or (y,x) or both are in R .

- (a) (5%) Given $A = \{1, 2, 3, 4\}$, what is the smallest number of elements a connected relation R on A can have. Give such an example relation.
- (b) (5%) Given $A = \{1\}$, is the relation $R = \emptyset$ connected or not?
- (c) (10%) Below is a recursive function that takes two arguments. The first argument, `baseset`, is a list of integers without repetitions; therefore it represents a set. The second argument, `relation`, is a binary relation defined over `baseset`. Binary relations are represented as lists of two element lists. An example call of the function below would be `connected([1, 2, 3, 4], [[1, 3], [3, 1]])`. The code needs some corrections to be able to work properly. What are they?

```
def connected(baseset, relation):
    if baseset == []:
        return False
    else:
        first = baseset[0]
        for x in baseset[1:]:
            if not ([first, x] in relation or [x, first] in relation):
                return False
        return connected(baseset, relation)
```

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Question 3 (30%)

Write a two argument function `rotate` that takes a list `s` and an integer `n` and rotates the list `s` `n` places.

By rotation what we mean is this:

$[1, 2, 3, 4]$ rotated 1 place is $[2, 3, 4, 1]$

$[1, 2, 3, 4]$ rotated 2 places is $[3, 4, 1, 2]$

[1, 2, 3, 4] rotated 5 place is [2, 3, 4, 1]

and so on.

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Question 4 (30%)

Write a function that takes a possibly nested list and returns a non-nested list. It gives `[1, 2, 3, 4, 5]` for `[[1, 2], 3, [4], 5]`, or `[1, 2, 3]` for `[[1], [[2]], [[3]]]`, and so on.

Assume you have a function `is_list()`, which takes a single argument and returns `True` if the argument is a list, and `False` otherwise. Take this function as given; you do NOT have to write it.

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