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1.(1 pt) Fuzzy Logic is used in artificial intelligence. In fuzzy logic, a proposition has a truth value that is a number between 0 and 1 inclusive. A proposition with a truth value of 0 is false and one with truth value of 1 is true. Truth values that are between 0 and 1 indicate varying degrees of truth. For instance, the truth value 0.7 can be assigned to the statement "Fred is happy." since Fred is happy most of the time, and the truth value 0.4 can be assigned to the statement "John is happy." since John is happy slightly less than half the time.

The truth value of the negation of a proposition in fuzzy logic is 1 minus the truth value of the proposition. The truth value of a conjunction of two propositions in fuzzy logic is the minimum of the truth values of the two propositions.

What are the truth value of the statements:

(a) "Fred and John are happy."

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(b) "Neither Fred nor John is happy."

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2.(1 pt) Fuzzy sets are used in artificial intelligence. Each element in the universal set  $U$  has a degree of membership, which is a real number between 0 and 1 ( including 0 and 1 as possibilities), in a fuzzy set  $S$ . The fuzzy set  $S$  is denoted by listing

the elements with their degrees of membership (elements with 0 degree of membership are not listed).

For example, we write  $F = \{0.55 \text{ Alice}, 0.95 \text{ Brian}, 0.5 \text{ Rita}, 0.2 \text{ Oscar}, 0.1 \text{ Fred}\}$  for the (fuzzy) set  $F$  of famous people to indicate that Alice has a 0.55 degree membership to  $F$ , that Brian has a 0.95 membership to  $F$  and so on. ( for example Brian is the most famous of these people while Oscar is the least famous. )

Also suppose that  $R$  is the (fuzzy) set of rich people given by  $R = \{0.15 \text{ Alice}, 0.55 \text{ Brian}, 0.2 \text{ Rita}, 0.55 \text{ Oscar}, 0.25 \text{ Fred}\}$ . The complement of a fuzzy set  $S$  is the fuzzy set  $\bar{S}$ , where the degree of membership of an element in  $\bar{S}$  is 1 minus the degree of membership of that element in  $S$ .

Thus for example we have:

$\bar{F} = \_\_\_ \text{ Alice}, \_\_\_ \text{ Brian}, \_\_\_ \text{ Rita}, \_\_\_ \text{ Oscar}, \_\_\_ \text{ Fred}.$

The intersection of two fuzzy sets  $S$  and  $T$  is the fuzzy set  $S \cap T$ , where the degree of membership of an element in  $S \cap T$  is the minimum of the degrees of membership of this element in  $S$  and in  $T$ . Thus the fuzzy set  $F \cap R$  of the rich and famous people is:

$F \cap R = \_\_\_ \text{ Alice}, \_\_\_ \text{ Brian}, \_\_\_ \text{ Rita}, \_\_\_ \text{ Oscar}, \_\_\_ \text{ Fred}.$