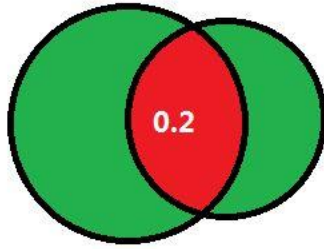


## CPT\_S 540 HW5

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1.
  - a) The FOL sentences is invalid, because if the intersection of  $u$  and  $v$  are empty, the statement is false
  - b) The FOL sentences is invalid, because  $P(Z) = \sim \text{NOT}(P(Z))$ , so  $P(Z)$  and  $\text{NOT}(P(Z))$  cannot be both true.
  - c) The FOL sentences is valid, because  $\text{Fast}(x) = \sim \text{Slow}(x)$ , so for any  $x$ , it is either fast or slow.
  - d) The FOL sentences is valid, because  $\text{Fast}(y) = \sim \text{Slow}(y)$ , so for all possible  $y$ , it is either fast or slow.
2.
  - a) If there are two people who speak the same language, they can understand each other.
  - b)
    1.  $(\forall x)(\forall y) \text{Empathy}(x, y) \Rightarrow \text{Sympathy}(x, y)$
    2.  $(\forall x)(\forall y)(\forall z)(\text{Sympathy}(x, y) \wedge \text{Sympathy}(y, z)) \Rightarrow \text{Sympathy}(x, z)$
3.
  - a) The FOL sentences is valid, by applying Existential Instantiation, we got: if there is a person is as brave as Julian, then Julian is as brave as a particular person, and the particular person could be herself.
  - b) The FOL sentences is invalid, because no evidence to show that Ed is the particular person.
  - c) The FOL sentences is invalid, because no evidence to show that neither Ed nor Don is the particular person.
4.
  - a) It is rational, because there is one possibility that the  $P(X \text{ or } Y) = 0.5$ . See below:



The red part stands for the probability of X and Y, the green part stands for the probability of X or Y. From the Venn's diagram,  $P(X \text{ or } Y)$  could be 0.5 if  $P(X \text{ and } Y)$  is 0.2, therefore, the belief of agent is rational.

**b)** The range of  $P(X \text{ and } Y)$  is from 0 to 0.3, when the two events are mutually exclusive (X and Y doesn't overlap at all and they cannot happen together at the same time),  $P(X \text{ and } Y)$  is 0, which is the lower bound. When the event Y is completely inclusive with X (X and Y overlaps completely, in other words, if Y happened X must also have happened),  $P(X \text{ and } Y)$  is equal to  $P(Y) = 0.3$ , which is the upper bound.

**c)** No, it is not rational, because  $P(X \text{ or } Y) = 0.7$  happens only when X and Y don't overlap at all. So, without giving X and Y are mutually exclusive, the agent has no reason to believe  $P(X \text{ or } Y) = 0.7$ .

**d)** The agent must believe that  $P(X \text{ and } Y) = 0$ ; because  $P(X \text{ or } Y) = P(X) + P(Y) - P(X \text{ and } Y)$ . So  $P(X \text{ or } Y)$  is 0.7 only when  $P(X \text{ and } Y)$  is 0.

**5. a)** It is good news because that the probability of a person with positive test result who actually got the disease is positive correlation with the probability of having the disease. In other words if the probability of having the disease is very low, then the person is not likely to have the disease even if he or she got positive test result.

**b)** A: the event that having the disease

B: the event that having positive test result

And we also know:  $P(A) = 1/10000$ ,  $P(B|A) = 0.99$

$P(B) = P(A) * P(B|A) + \sim P(A) * P(B|\sim A) = 0.009999$

$P(A|B) = (P(B|A) * P(A)) / P(B) = 9.9E-5 / 0.010098 = 0.01$

Therefore, the probability of person with positive test who got the disease is 1%

**6. a) Weather**

Human: Leo  
**Mitsuku: Cool name! It reminds me of a lion.**  
 Human: How is the weather there?  
**Mitsuku: The weather in Yorkshire is always usually cold and foggy even in summertime.**  
 Human: Where is it?  
**Mitsuku: Where it is hard to find. Searching...Searching...Please stand by.**  
 Human: Do you like snow?  
**Mitsuku: Only when it melts.**  
 Human: How is the weather there?  
**Mitsuku: The weather in Yorkshire is always usually cold and foggy even in summertime.**  
 Human: Where is it?  
**Mitsuku: Where it is hard to find. Maybe my botmaster knows the answer.**  
 Human: How is the weather there?  
**Mitsuku: The weather in Yorkshire is always usually cold and foggy even in summertime.**  
 Human: Where is it?  
**Mitsuku: Where it is hard to find. I haven't heard of Leo.**

She fails the Turing test on the topic of Weather, because when I ask the same question server times, she gives me the exactly same answer, which is not a real person normally do.

## b) Sports

Human: Do you like any sport?  
**Mitsuku: I like football.**  
 Human: Football or soccer?  
**Mitsuku: I like football. My favourite team is Leeds United, as I am from Leeds.**  
 Human: That is soccer. Football is something else  
**Mitsuku: I'm glad we have that all cleared up. I like football. My favourite team is Leeds United, as I am from Leeds.**

She fails the Turing test on the topic of Sport, because when I ask her does she like football or soccer, she keep saying she like football and her favorite team is Leeds United (a soccer club). Apparently, she doesn't know the football is usually stands for American football not soccer. A real person won't answer in her way.

## c) Movies

United, as I am from Leeds.

Human: whats your favorite movie?

**Mitsuku: My favorite movie is Terminator. Have you seen it?**

Human: Of course, which episode do you like the most

**Mitsuku: What did you think about it? It was the episode where one of them thought they saw a ghost.**

Human: Do you like spiderman

**Mitsuku: Yes I imagine it would be great fun to be able to walk up walls and swing from buildings.**

Human: Who's the actor that has the role of spiderman?

**Mitsuku: It depends on the historical context, because it changes from time to time.**

Human: What?

**Mitsuku: Didn't you understand it?**

Human: What?

**Mitsuku: I don't know why you are saying that.**

Human: What did you say about the actor?

**Mitsuku: I said, "Didn't you understand it?".**

She fails the Turing test on the topic of Movie, because she answers something nonsense, after I ask the actor I mentioned before. A real person can remember the topic that someone talked with him or her before.