CS 4375.001 Homework 4 Due 12/02/19 Name: Jaemin Lee

1) $P(+|F_1 \wedge F_2 \wedge F_3) = \frac{P(+ \wedge F_1 \wedge F_2 \wedge F_3)}{P(F_1 \wedge F_2 \wedge F_3)} = \frac{P(F_1 \wedge F_2 \wedge F_3 | +)\, P(+)}{P(F_1 \wedge F_2 \wedge F_3|+)\, P(+) + P(F_1 \wedge F_2 \wedge F_3|-)\, P(-)}$

$= \frac{P(F_1|+) \cdot P(F_2|+) \cdot P(F_3|+) \cdot P(+)}{P(F_1 \wedge F_2 \wedge F_3|+) \cdot P(+) + P(F_1 \wedge F_2 \wedge F_3|-) \cdot P(-)}$

$P(F_1|+) = \frac{1}{2}$ $P(F_2|+) = \frac{1}{2}$, $P(F_3|+) = \frac{0}{2}$ $\Rightarrow$ add 1 to both numerator and denominator.

so $P(F_3|-) = \frac{1}{3}$.

$P(+) = \frac{2}{5}$

So, $P(+|F_1 \wedge F_2 \wedge F_3) = \frac{\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{3} \cdot \frac{2}{5}}{\left(\frac{1}{12}\right)\left(\frac{2}{5}\right) + \left(\frac{2}{27}\right)\left(\frac{3}{5}\right)} = \boxed{\frac{3}{7}}$

$P(-|F_1 \wedge F_2 \wedge F_3) = \frac{P(- \wedge F_1 \wedge F_2 \wedge F_3)}{P(F_1 \wedge F_2 \wedge F_3)} = \frac{P(F_1|-) \cdot P(F_2|-) \cdot P(F_3|-) \cdot P(-)}{P(F_1 \wedge F_2 \wedge F_3|-) \cdot P(-) + P(F_1 \wedge F_2 \wedge F_3|-) \cdot P(-)}$

$P(F_1|-) = \frac{1}{3}$, $P(F_2|-) = \frac{2}{3}$, $P(F_3|-) = \frac{1}{3}$, $P(-) = \frac{3}{5}$

So, $P(-|F_1 \wedge F_2 \wedge F_3) = \frac{\frac{1}{3} \cdot \frac{2}{3} \cdot \frac{1}{3} \cdot \frac{3}{5}}{\left(\frac{2}{27}\right)\left(\frac{3}{5}\right) + \left(\frac{1}{12}\right)\left(\frac{2}{5}\right)} = \boxed{\frac{4}{7}}$

Since $P(-|F_1 \wedge F_2 \wedge F_3) > P(+|F_1 \wedge F_2 \wedge F_3)$, the test is negative.

2)

F_1	F_2	F_3	Category	Hamming Distance
a	c	a	+	1
c	a	c	+	3
a	a	c	−	2
b	c	a	−	2
c	c	b	−	1

3 - nearest neighbor

Test: $F_1 = a$, $F_2 = c$, $F_3 = b$.

From ⊕ category, there's one hamming distance = 1.

From ⊖ category, there's one hamming distance = 1 and one hamming distance = 2.

So ⊕ ⊖ ⊖ give you ⊖ as the classification