

## Assignment week 4

1.  $P(x)$ : word  $x$  contains character  $a$

a)  $P(\text{orange}) = \text{True}$       b)  $P(\text{lemon}) = \text{False}$

c)  $P(\text{True}) = \text{False}$       d)  $P(\text{False}) = \text{True}$

2. If  $P(x)$  then  $x := 1$ ,  $P(x)$ :  $x > 1$

a)  $x = 0$

b)  $x = 1$

c)  $x = 2$

$P(0) = F$

$P(1) = F$

$P(2) = T$

$x = 0$

$x = 1$

$x = 1$

3.  $N(x)$ :  $x$  has visited North Dakota, domain: students in this class

a)  $\exists x N(x)$ : At least one student in this class has visited North Dakota

b)  $\forall x N(x)$ : All students in this class has visited North Dakota

c)  $\neg \exists x N(x)$ : No student in this class has visited North Dakota.

d)  $\exists x \neg N(x)$ : At least one student in this class has not visited North Dakota

e)  $\forall x \neg N(x)$ : Not all students in this class has visited North Dakota.

f)  $\forall x N(x)$ : All student in this class has not visited North Dakota.



4)  $R(x)$ :  $x$  is a rabbit,  $H(x)$ :  $x$  hops, domain: all ~~people~~ animals

a)  $\forall x (R(x) \rightarrow H(x))$ : Every rabbit hops

b)  $\forall x (R(x) \wedge H(x))$ : Every animal is a rabbit and hops

c)  $\exists x (R(x) \rightarrow H(x))$ : There is at least one animal such that if it is a rabbit, then it hops

d)  $\exists x (R(x) \wedge H(x))$ : There is at least one animal such that it is a rabbit and it hops.

5)  $C(x)$ :  $x$  has a cat,  $D(x)$ :  $x$  has a dog,  $F(x)$ :  $x$  has a ferret, Domain: all student in your class

a) A student in your class has a cat, a dog, and a ferret

$$\exists x (C(x) \wedge D(x) \wedge F(x))$$

b) All student in your class has a cat, a dog, and a ferret

$$\forall x (C(x) \wedge D(x) \wedge F(x))$$

c) Some student in your class has a cat, a ferret, but no dog

$$\forall x (C(x) \wedge F(x) \wedge \neg D(x))$$

d) No student in your class has a cat, a dog, and a ferret

$$\neg \forall x (C(x) \wedge D(x) \wedge F(x))$$

e) For each of the three animals, there is a student in your class who has this animal as a pet

$$\forall x (C(x)) \wedge \forall x (D(x)) \wedge \forall x (F(x))$$



6)  $Q(x): x+1 > 2x$ , domain: All integer

a)  $Q(0) = T$  b)  $Q(-1) = T$  c)  $Q(1) = F$  d)  $\exists x Q(x) = T$

e)  $\forall x Q(x) = F$  f)  $\exists x \neg Q(x) = T$  g)  $\forall x \neg Q(x) = F$

7) domain: All real number

a)  $\exists x (x^3 = -1) = T$   $(-1)^3 = -1$

b)  $\exists x (x^4 < x^2) = T$   $(\frac{1}{2})^4 < (\frac{1}{2})^2$

c)  $\forall x ((-x)^2 = x^2) = T$  Common sense

d)  $\forall x (2x > x) = F$   $2x(-1) < -1$

8) find a true domain and a false domain

a) Everyone speaks Hindi

Domain: Everyone who use Hindi, Everyone in the world

b) There is someone older than 21 years old.

Domain: Everyone in the world, every new birth baby

c) Every two people have the same first name

Domain: Everyone with first name "Alan", everyone in the world.

d) Someone knows more than two other people

Domain: Everyone in the world, Animals



9) domain: all integer, express All multiples of the number 5 end up with a 0 or a 5

$$\forall x ((x \% 5 = 0) \wedge [(x \% 10 = 0) \vee (x \% 10 = 5)])$$

$\uparrow$                        $\uparrow$                        $\uparrow$   
x is multiples of 5    end with 0            end with 5

% means division remainder in CS, I don't know if there is a such symbol in math or not...

10) domain: all integer, express there exist an even number that is prime

Let  $P(x)$  be "x is a prime"

$$\exists x ((x \% 2 = 0) \wedge P(x))$$

$\uparrow$                        $\uparrow$   
x is even            x is prime