Jalen Powell 09/05/21

Elec 2200

Hw 2

2.1.2:

2. a.) $\exists x : (x + x = 1)$

$x + x = 1$

$= 2x = 1 = x = \frac{1}{2} \notin \mathbb{Z}$

$\boxed{\text{false statement}}$

b.) $\exists x : (x + 2 = 1)$

$x + 2 = 1$

$x = -1$ $\boxed{\text{true statement}}$

c.) $\forall x\ (x^2 - x \neq 1)$

$x = 0$

$= 0^2 - 0 \neq 1$ $\boxed{\text{true statement}}$

d.) $\forall x\ (x^2 - x \neq 0)$

$x = 1$

$= 1^2 - 1 = 0$ $\boxed{\text{false statement}}$

e.) $\forall x\ (x^2 > 0)$

$x = 0 \rightarrow x^2 = 0^2 = 0 \not> 0$ $\boxed{\text{false statement}}$

f.) $\exists x : (x^2 > 0)$

$x = -1$

$(-1)^2 = 1 > 0$ $\boxed{\text{true statement}}$

#2.1.4

4. a.) $\forall x\, P(x)$ = true, all inputs are True

b.) $\exists x\ P(x)$ True because there are some inputs for which P is true

c.) $\forall x\ Q(x)$ = False, majority of inputs are false

d.) $\exists x\, Q(x)$ = True, only one input is True

e.) $\forall x\ R(x)$ = False, R is never True

f.) $\exists x\ R(x)$ = False, R is never True

2.2.2

a.) $\exists x : E(x)$

b.) $\forall x \ E(x) \wedge T(x)$

c.) $\exists x \ T(x) \wedge E(x)$

d.) $\exists x \ E(x) \wedge \neg T(x)$

#2.2.4

a.) $\exists_x\ S(x)$

b.) $\forall x\ (\neg S(x) \wedge W(x))$

c.) $\forall x\ (S(x) \rightarrow \neg W(x))$

d.) $\exists x\ (S(x) \wedge W(x))$

e.) $\forall x\ (\neg W(x) \rightarrow S(x))$

f.) $\forall x\ (\neg W(x) \rightarrow (S(x) \vee V(x)))$

g.) $\exists x\ (\neg W(x) \wedge \neg S(x) \wedge \neg V(x))$

h.) $\forall x\ (\neg W(x) \rightarrow (S(x) \vee V(x))$

#2.3.1

a.) $\neg \exists x \; P(x)$
$= \forall y \; \neg P(x)$

b.) $\neg \exists x \, [P(x) \vee Q(x)]$
$= \forall x \; \neg [P(x) \vee Q(x)]$
$= \forall x \; [\neg P(x) \vee \neg Q(x)]$

c.) $\neg \forall x \, [P(x) \wedge Q(x)]$
$= \exists x \; \neg [P(x) \wedge Q(x)]$
$= \exists x \; [\neg P(x) \wedge \neg Q(x)]$

d.) $\forall x \, [P(x) \wedge [Q(x) \vee R(x)]$
$= \exists x \; \neg [P(x) \wedge [Q(x) \vee R(x)]]$
$= \exists x \; [\neg P(x) \wedge \neg [Q(x) \vee R(x)]]$
$= \exists x \; [\neg P(x) \wedge [\neg Q(x) \vee \neg R(x)]]$

#2.3.2

a.) $x\ (D(x))$
negation $\neg x\ (D(x))$
DeMorgan law $px(\neg D(x))$
English: No patient given medicine

b.) $\forall x\ (D(x) \vee P(x))$
Negation: $\neg(\forall (x)(D(x) \vee P(x))$
$= \exists x\ \neg(D(x) \vee P(x))$
DeMorgan $= \exists x\ (\neg D(x) \vee \neg P(x))$
English: There is a patient who was not given any medicine or placebo

c.) $\exists x\ (D(x) \wedge M(x)$
Negation $\neg \exists x\ (D(x) \wedge M(x))$
$\forall x \neg (D(x) \wedge M(x))$
DeMorgan $\forall (x) \neg D(x) \vee \neg M(x))$

English: Everyone either not given medicine or not given migraines or both

d.) $\forall x\ (P(x) \Rightarrow M(x)$
Negation $\exists x\ \neg(\neg P(x)) \wedge \neg M(x)$
De Morgan $\exists x\ P(x) \wedge \neg M(x)$
English: There is a person who took Placebo and not having migraines

e.) $\exists x\ (M(x) \wedge P(x))$
Negation $\neg \exists x (M(x) \wedge P(x))$
De Morgans $\forall x\ (\neg M(x) \vee \neg P(x)$
Every patient had no migranies or not given placebo

2.4.1

a.) $M(1,1)$ is a proposition
True

b.) $\forall y\ M(x,y)$ is not a proposition as the value of x is not defined
Truth value not obtainable

c.) $\exists x\ M(x,3)$ is a proposition
Truth value is true

d.) $\exists x\ \exists y\ M(x,y)$ is a proposition
True

e.) $\exists x\ \forall y\ M(x,y)$ is a proposition
False

f.) $M(x,2)$ is not a proposition
Truth value is not obtainable

g.) $\exists y\ \forall x\ M(x,y)$ is a proposition
True

#2.4.3

a.) False
b.) True
c.) True
d.) False
e.) True
f.) True
g.) False
h.) True
i.) True
j.) False
k.) False

#2.5.1

a.) $\forall x \forall y\, M(x,y)$ = False
As for $x=2$ and $y=2$ (False)
$x=3$ and $y=3$ (False

b.) $\forall x \forall y ((x \neq y) \rightarrow M(x,y)$ = True
$x \neq y$ (True)

c.) $\exists x\ \exists y\, \neg M(x,y)$ = True
exist some x and some y, $M(x,y)$ is not true

d.) $\exists x\ \exists y ((x \neq y) \wedge \neg M(x,y)$ = False
There doesn't exist any $x \neq y$, $M(x,y)$
is not true

e.) $\forall x\ \exists y\ \neg M(x,y)$ = False
$x=1$, there exist no y, not true
$x=2$, $y=2$ exist $M(x,y)$ not true
$x=3$ and $y=3$, $M(x,y)$ is not true

f.) $\exists x\ \forall y\, M(x,y)$ = True
$y=1$, there exist
$y=2$, also ~~x~~exist
$y=3$, also exist