→ existence proofs

- construct a network with human-chosen weights that is able to solve a problem

exhaustive,
so no consideration of generalization

- does not shine light on how we should find out those weights

1.1 1

a) P : have reading assigment

Q : have HW problems

R : have a test

$$(P \vee Q) \wedge (\neg(Q \wedge R))$$

b) P : go skiing

Q : there is snow

$$(\neg P) \vee (P \wedge \neg Q)$$

c) P : $\sqrt{7} \leq 2$

$\neg P$

core : existence proofs

· construct a network with human-chosen weights that is able to solve a problem

exhaustive, so no consideration of generalization

• does not shine light on how we should find out those weigh

1.1

4)

a) P : Ralph is tall

Q : Ed is tall

R : Ralph is handsome

S : Ed is handsome

$(P \land Q) \lor (R \land S)$

b) $(P \lor R) \land (Q \lor S)$

c) $(\neg(P \lor R)) \land (\neg(Q \lor S))$

d) $\neg((P \land R) \lor (Q \land S))$

1.1 6)

a) $\neg(P \land \neg S)$ (by De Morgan's law)

$= \neg P \lor S$

I will not buy pants or I will by shirts

b) $\neg P \land \neg S = \neg(P \lor S)$ (by De Morgan's law)

I will not buy pants or shirt.

c) $\neg P \lor \neg S = \neg(P \land S)$ (by De Morgan's law)

I will not buy pants and shirt.

→ every class's decision boundary ...
and is a hyperplane

...abilities

...ork

...igmoidal act.

→ core : existence proofs

· construct a network with human-chosen weights that is able to solve a problem

...for training

...al and estimate

Limitations

- usually exhaustive, so no consideration of generalization
- does not shine light on how we should find out those weights

1.2

1. a) $\neg P \vee Q$

P	Q	$\neg P$	$\neg P \vee Q$ (or)
T	T	F	T
T	F	F	F
F	T	T	T
F	F	T	T

b) $(S \vee G) \wedge (\neg S \vee \neg G)$ (or, and, or)

S	G	$S \vee G$	$\neg S$	$\neg G$	$\neg S \vee \neg G$ (or)	$(S \vee G) \wedge (\neg S \vee \neg G)$ (and)
T	T	T	F	F	F	F
T	F	T	F	T	T	F
F	T	T	T	F	T	T
F	F	F	T	T	T	F

1.2 4

$P \vee G$ (or)

According to De Morgan's law

$$P \vee G = \neg(\neg P) \vee \neg(\neg G) = \neg(\neg P \wedge \neg G)$$

Truth tables

- $P \vee G$

P	G	$P \vee G$
T	T	T
T	F	T
F	T	T
F	F	F

- $\neg(\neg P \wedge \neg G)$

$\neg P$	$\neg G$	$\neg P \wedge \neg G$ (and)	$\neg(\neg P \wedge \neg G)$
F	F	F	T
F	T	F	T
T	F	F	T
T	T	T	F

orks → convex (see page 81)

→ every class's decision boundary must touch (see page 80) and is a hyperplane

abilities

ork → core : existence proofs

sigmoidal act.

- construct a network with human-chosen weights that is able to solve a problem

for training

Limitations

- usually exhaustive, so no consideration of generalization
- does not shine light on how we should find out those weigh'

val and estimate

ive

ot

1.2 87)

a) $(P \land Q) \lor (\neg P \land \neg Q)$

b) $\neg P \lor Q$

c) $(P \lor \neg Q) \land (Q \lor \neg P)$

d) $\neg(P \lor Q)$

e) $(Q \land P) \lor \neg P$

a)

P	Q	P∧Q (&)	¬P	¬Q	¬P∧¬Q (&)	(P∧Q)∨(¬P∧¬Q) (or)
T	T	T	F	F	F	T
T	F	T	F	T	F	T
F	T	T	T	F	F	T
F	F	F	T	T	T	T

Using truth tables, we see that b) & e) are equivalent.

b)

P	Q	¬P	¬P∨Q (or)
T	T	F	T
T	F	F	F
F	T	T	T
F	F	T	T

&

$(P \lor \neg Q) \land (Q \lor \neg P)$

c)

P	Q	¬Q	P∨¬Q (or)	¬P	Q∨¬P	∧
T	T	F	T	F	T	T
T	F	T	T	F	F	F
F	T	F	F	T	T	F
F	F	T	T	T	T	T

d)

P	Q	P∨Q (or)	¬(P∨Q)
T	T	T	F
T	F	T	F
F	T	T	F
F	F	F	T

e)

P	Q	Q∧P (&)	¬P	(Q∧P)∨¬P (or)
T	T	T	F	T
T	F	F	F	F
F	T	F	T	T
F	F	F	T	T

→ core : existence proofs

act.

· construct a network with human-chosen weights that is able to solve a problem

exhaustive,
so no consideration of generalization

- does not shine light on how we should find out those weig[illegible]

ining

stimate

1.2 #9

a) $(P \vee Q) \wedge (\neg P \vee \neg Q)$

P	Q	$P \vee Q$	$\neg P$	$\neg Q$	$\neg P \vee \neg Q$	& $(P \vee Q) \wedge (\neg P \vee \neg Q)$
T	T	T	F	F	F	F
T	F	T	F	T	T	T
F	T	T	T	F	T	T
F	F	F	T	T	T	F
		T			T	

neither

b) $(P \vee Q) \wedge (\neg P \wedge \neg Q)$

contradiction

(using truth table in a))

$\neg P \wedge \neg Q$	$(P \vee Q) \wedge (\neg P \wedge \neg Q)$
F	F
F	F
F	F
T	F

c) using truths table from a)

$(P \vee Q) \vee (\neg P \vee \neg Q)$
T
T
T
T

tautology

d) tautology

or &

$[P \wedge (Q \vee \neg R)] \vee [\neg P \vee R]$

P	Q	R	$\neg R$	$Q \vee \neg R$	$P \wedge (Q \vee \neg R)$	$\neg P$	$\neg P \vee R$	√
T	T	T	F	T	T	F	T	T
T	T	F	T	T	T	F	F	T
T	F	T	F	F	F	F	T	T
T	F	F	T	T	T	F	F	T
F	T	T	F	T	F	T	T	T
F	T	F	T	T	F	T	T	T
F	F	T	F	F	F	T	T	T
F	F	F	T	T	F	T	T	T

• does not shine light on how we should find out those weight

1.2 #12

a) $\neg(\neg P \vee Q) \vee (P \wedge \neg R)$

$\cong (P \wedge \neg Q) \vee (P \wedge \neg R)$ (De Morgan's law 2)

$\cong P \wedge (\neg Q \vee \neg R)$ (distributive law)

b) $\neg(\neg P \wedge Q) \vee (P \wedge \neg R)$

$\cong (P \vee \neg Q) \vee (P \wedge \neg R)$ (De Morgan's law 1)

c) $(P \wedge R) \vee [\neg R \wedge (P \vee Q)]$

$\cong [(P \wedge R) \vee (\neg R \wedge P)] \vee (\neg R \wedge Q)$ (distribute)

$\cong P \wedge (\underbrace{R \vee \neg R}_{\text{tautology}}) \vee (\neg R \wedge Q)$

$\cong P \vee (\neg R \wedge Q)$ (absorp.)

- construct a network with human-chosen weights that is able to solve a problem

exhaustive, so no consideration of generalization

- does not shine light on how we should find out those weights

1.5 #1

a) P: gas has unpleasant smell

Q: gas is explosive

R: gas is hydrogen

$P \vee \neg Q \rightarrow \neg R$

b) P: George has fever

Q: George has headache

R: George should go to doctor

$P \wedge Q \rightarrow R$

c) using the same propositions defined in part b)

$P \vee Q \rightarrow R$

d) P: $x = 2$

Q: x is odd

R: x is prime

$\neg P \rightarrow (Q \rightarrow R)$

For question 4, see the end.

1.5 #7

a) $(P \to R) \wedge (Q \to R)$

$\cong (\neg P \vee R) \wedge (\neg Q \vee R)$ (conditional law 1)

$\cong (\neg P \wedge \neg Q) \vee R$ (distributive law)

$\cong \neg (P \vee Q) \vee R$ (De Morgan's law 2)

$\boxed{\cong (P \vee Q) \to R}$ (conditional law 1)

b) Show that $(P \to R) \vee (Q \to R) \cong (P \wedge Q) \to R$.

$(P \to R) \vee (Q \to R)$

$\cong (\neg P \vee R) \vee (\neg Q \vee R)$ (conditional law 1)

$\cong \neg P \vee \neg Q \vee R \vee R$ (commutative law)

$\cong (\neg P \vee \neg Q) \vee R$ (idempotent law)

$\cong [\neg (P \wedge Q)] \vee R$ (De Morgan's law 2)

$\boxed{\cong (P \wedge Q) \to R}$ (conditional law 1)

1.5

$\cong$

$\cong$

$\cong$

for question 8, see the end

1.5 #9

$$P \wedge Q$$

$$\cong \neg(\neg P) \wedge \neg(\neg Q)$$

$$\cong \neg(\neg P \vee (\neg Q))$$ (De Morgan's law 2)

$$\cong \neg(P \rightarrow \neg Q)$$ (conditional law 1)