The Introduction To Artificial Intelligence

Yuni Zeng yunizeng@zstu.edu.cn

2025-2026-1

The Introduction to Artificial Intelligence

- Teaching hours: 32 hours
- Assessment:

Assessment Methods	Assessment Requirements	Assessment Weighting
Homework	4-6 times (50%)	50% of grade
Literature review	Presentation, Q&A (50%)	
in-class tests	-	10% of grade
Final exam	Open-book examination	40% of grade

- No Copy! No Plagiarize!

The Introduction to Artificial Intelligence

- Part I Brief Introduction to AI & Different AI tribes
- Part II Knowledge Representation & Reasoning

OUTLINE

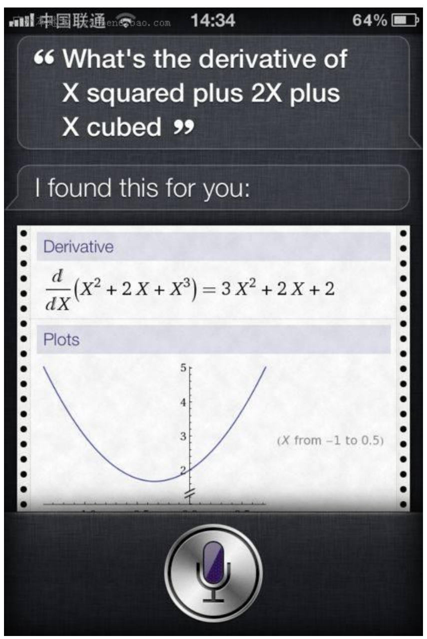
- *1.1 Brief Review*
- 1.2 Knowledge Representation & Reasoning

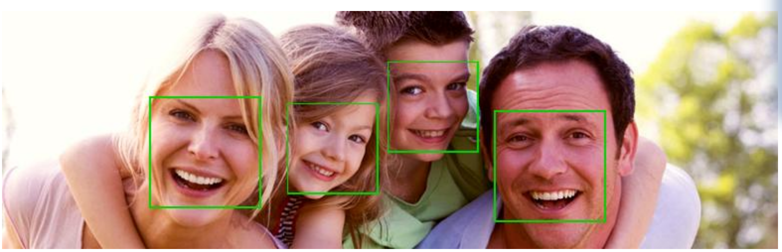
1.1 Brief Review

What Is Artificial Intelligence?

Actually,

artificial intelligence is intelligence exhibited by machines.





1.1 Brief Review

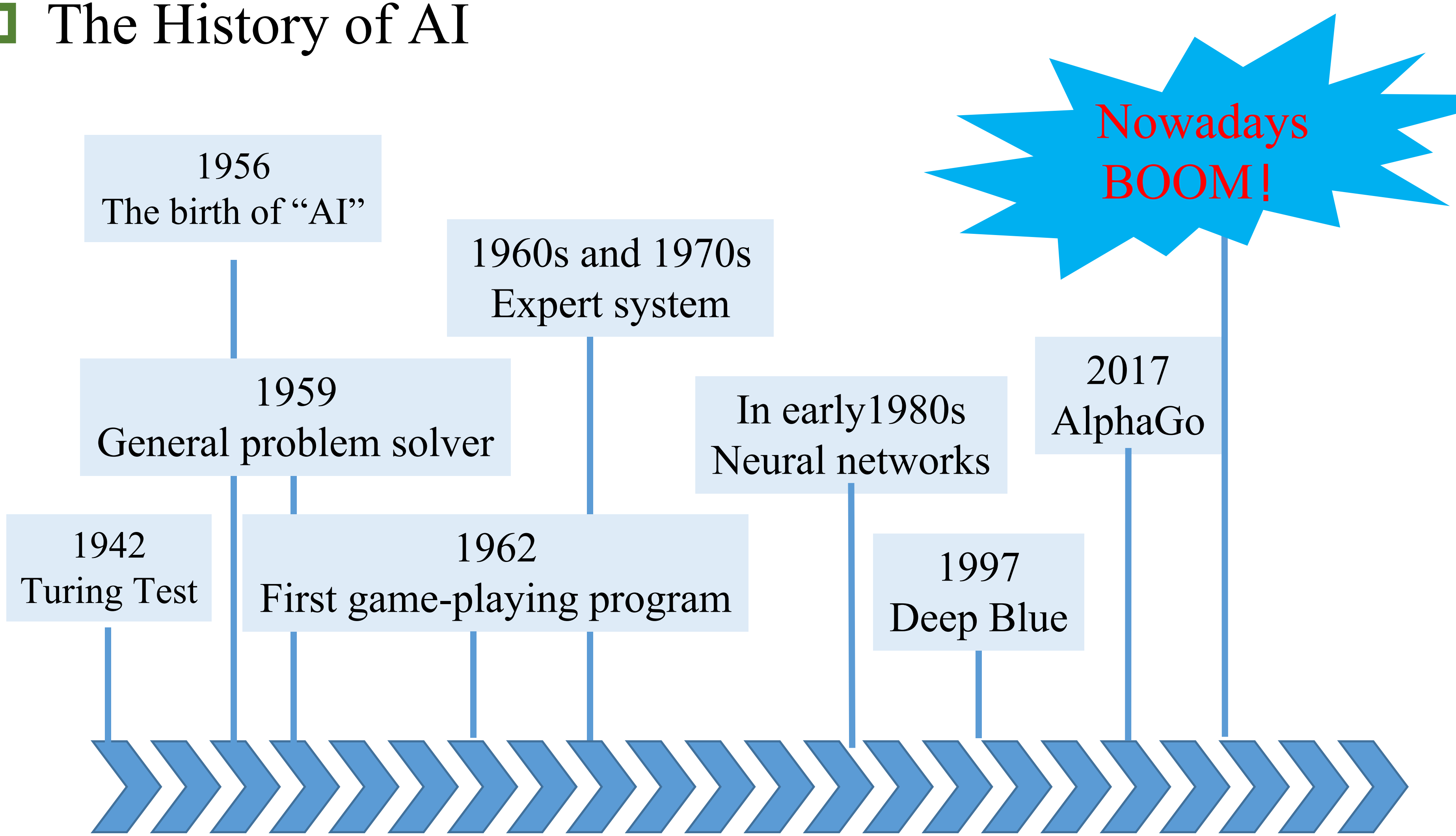
What Is Artificial Intelligence?

We agree with that:

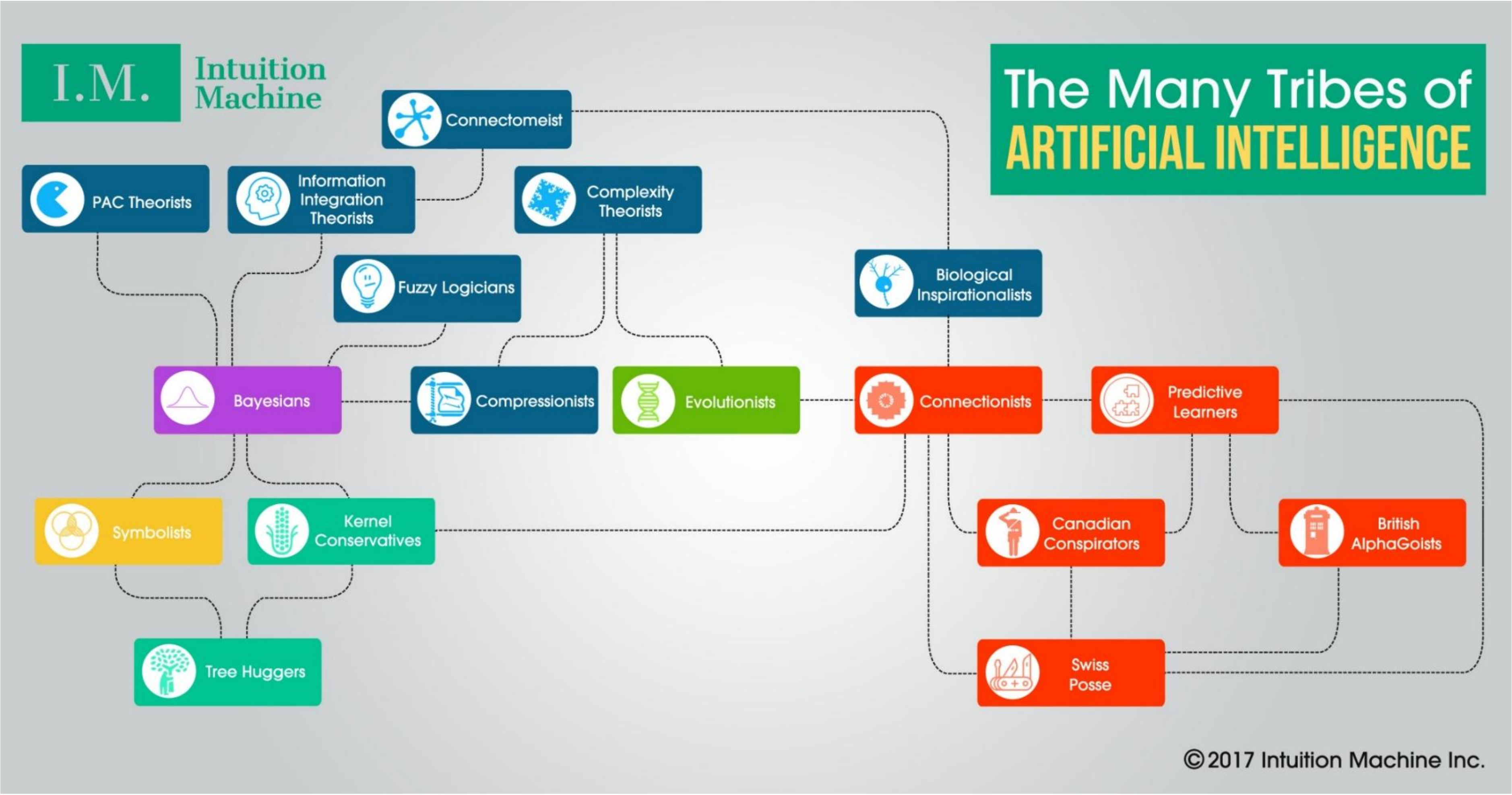
Intelligence is the ability to learn or understand or to deal with new or trying situations;
the ability to apply knowledge to manipulate one's environment or to think abstractly.

1.1 Brief Review

The History of AI

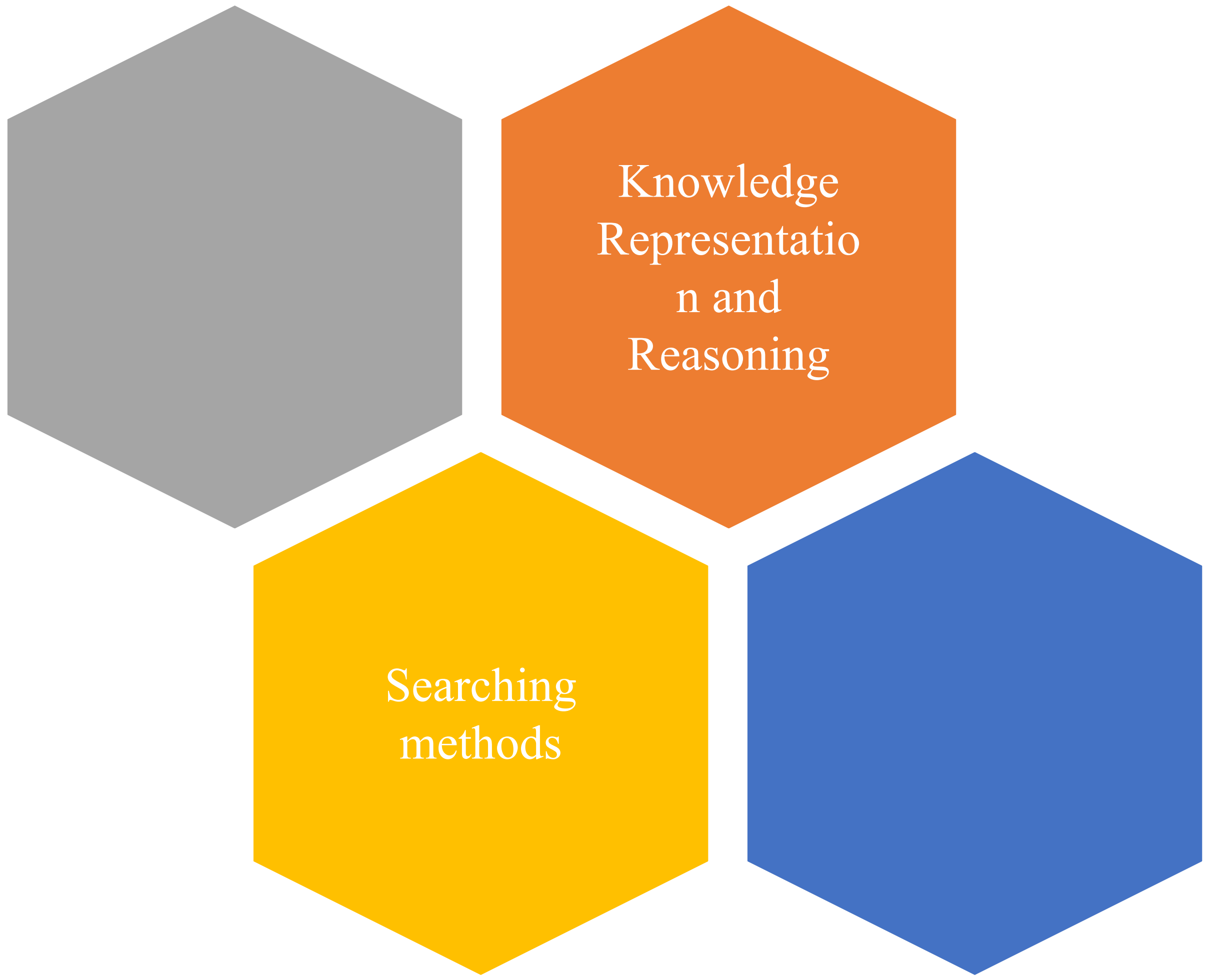


1.2 Different Tribes of AI



1.2 Brief Review

Traditional AI Methods



OUTLINE

- 1.1 Brief Review
- 1.2 *Knowledge Representation & Reasoning*

1.2 Knowledge Representation & Reasoning

- *What is knowledge representation?*
- Propositional Logic
- Predicate Logic
- Production-rule System
- Frame-Based System
- State Space System
- Knowledge graph

1.3 Knowledge Representation & Reasoning

Puzzle Time

- An island has two kinds of inhabitants, *knights*, who always tell the truth, and *knaves*, who always lie.
- You go to the island and meet A and B.
  - A says "B is a knight."
  - B says "The two of us are of opposite types."

Example: What are the types of A and B?

How to represent the problem and solve it by computer?

Knowledge representation and reasoning

1.3 Knowledge Representation & Reasoning

Knowledge

- The information, understanding and skills accumulated in long-term life and social practice, scientific research and experiments.

- Knowledge reflects the relationship between things in the objective world.

Example:

1. The snow is in white. --- Facts
2. If you have a headache and a runny nose, you might have a cold. --- Rule

1.3 Knowledge Representation & Reasoning

Characteristic of Knowledge

- **Relative correctness**

Any knowledge is produced under certain conditions, and is correct under such conditions.

$1+1=2$ (decimal system)
$1+1=10$ (binary system)

1.3 Knowledge Representation & Reasoning

Characteristic of Knowledge

➢ Uncertainty: True, False, state between True and False

- Uncertainty caused by randomness
- Uncertainty caused by ambiguity
- Uncertainty caused by experience
- Uncertainty caused by incompleteness

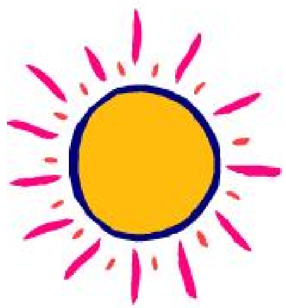
Example:

1. If you have a headache and a runny nose, you might have a cold.
2. Li is very high.

1.3 Knowledge Representation & Reasoning

Characteristic of Knowledge

- Uncertainty caused by ambiguity



天气冷热

雨的大小

风的强弱

人的胖瘦

年龄大小

个子高低

--- A vague concept

1.3 Knowledge Representation & Reasoning

Characteristic of Knowledge

- Representability and Exploitability

Representability of knowledge: Knowledge can be expressed in appropriate forms, such as language, writing, graphics, neural networks, etc.

Exploitability of Knowledge : Knowledge can be utilized

1.3 Knowledge Representation & Reasoning

Knowledge Representation

- Formalize or model human knowledge.
- a description of knowledge, or a set of conventions, a data structure that a computer can accept to describe knowledge.
- Principles for selecting knowledge representation methods:
  - Fully express domain knowledge. （充分表示领域知识。）
  - Conducive to the use of knowledge. （有利于对知识的利用。）
  - Easy to organize, maintain and manage. (便于对知识的组织、维护与管理。)
  - Easy to understand and implement. (便于理解与实现。)

1.3 Knowledge Representation & Reasoning

- What is knowledge representation?
- *Propositional Logic*
- Production-rule System
- Frame-Based System
- State Space System
- Knowledge graph

1.3 Knowledge Representation & Reasoning

What is propositional logic

Proposition:

A := The street is wet.

B := It is raining.

A **proposition** is a statement that is either true or false but not *both.*

- Atomic formulas are denoted by letters A, B, C, etc.
- Each atomic formula is assigned a truth value: true (1) or false (0).

1.3 Knowledge Representation & Reasoning

What is propositional logic

- A *proposition* is a declarative sentence that is either true or false.
- Examples of propositions:
  a) The Moon is made of green cheese.
  b) Beijing is the capital of China.
  c) Hangzhou is the capital of Canada.
  d) $1 + 0 = 1$
  e) $0 + 0 = 2$
- Examples that are not propositions.
  a) Sit down!
  b) What time is it?
  c) $x + 1 = 2$
  d) $x + y = z$

1.3 Knowledge Representation & Reasoning

What is propositional logic

- It is possible to determine whether any given statement is a proposition by prefixing it with
- *It is true that . . .*
- and seeing whether the result **makes grammatical sense.**

  - What is the time?
  - 2 + 3 = 5
  - “Phone” has five letters.
  - 2 + 3 = 6
  - Oh dear!
  - I like AI class.

1.3 Knowledge Representation & Reasoning

What is propositional logic

- Have a try…
  - 您去电影院吗? 不是命题
  - 2 + 3 = 5 命题
  - 看花去! 不是命题
  - 这句话是谎言。 不是命题
  - X=2 不是命题
  - 两个奇数之和是奇数。 命题
  - 李白要么擅长写诗，要么擅长喝酒。 命题

1.3 Knowledge Representation & Reasoning

What is propositional logic

Proposition:

A := The street is wet.

B := It is raining.

" Propositional logic is not the study of truth, but of the relationship between the truth of one statement and that of another"

——Hedman 2004

We can connect the two propositions A and B:

If it is raining, the street is wet.

Written more formally

It is raining. → The street is wet.

$A \rightarrow B$

1.3 Knowledge Representation & Reasoning

What is propositional logic

- Constructing Propositions
  - Propositional Variables: $p, q, r, s, \ldots$
  - The proposition that is always true is denoted by **T** and the proposition that is always false is denoted by **F**.
  - Compound Propositions: constructed from logical connectives and other propositions
    - Negation $\neg$ （否定联结词）
    - Conjunction $\wedge$ （合取联结词）
    - Disjunction $\vee$ （析取联结词）
    - Implication $\rightarrow$ （蕴涵联结词）
    - Biconditional $\leftrightarrow$ （等价联结词）

1.3 Knowledge Representation & Reasoning

Syntax of logical connectives

- Conjunction （合取）: And $\wedge$
- Disjunction （析取）: Or $\vee$
- Negation （否定）: Not $\neg$
- Implication （蕴涵）: Implies $\rightarrow$ (if… then…)
- Biconditional （等价）: Iff $\leftrightarrow$ (if and only if)

1.3 Knowledge Representation & Reasoning

AND（∧）

读作：“A并且B” “A与B”
称为：A与B的合取式
记作：$A \wedge B$

- The *conjunction* ‘A AND B’, written $A \wedge B$, of two propositions is true when both A and B are true, false otherwise.

A	B	A ∧ B
t	t	t
t	f	f
f	t	f
f	f	f

Translation of sentences to propositions

A:= It’s Monday.
B:= It’s raining.

It’s Monday and it’s raining.
It’s Monday but it’s raining.
It’s Monday. It’s raining.

A ∧ B

1.3 Knowledge Representation & Reasoning

Translation of propositions to sentences

- In propositional logic :
- $A \land B$ and $B \land A$ should always have the same meaning.
- But…
- A:=She became sick .
- B:= she went to the doctor.

Logically the same!

- She became sick and she went to the doctor.
- and
- She went to the doctor and she became sick.

Different!

1.3 Knowledge Representation & Reasoning

OR （∨）

读作：“A或者B”
称为：A与B的析取式
记作：$A \vee B$

- Also called *disjunction*.
- The disjunction "*A OR B*", written $A \vee B$, of two propositions is true when A or B (or both) are true, false otherwise.

A	B	A ∨ B
t	t	t
t	f	t
f	t	t
f	f	f

Translation of sentences to propositions

A:= It's Monday.
B:= It's raining.

It's Monday or it's raining. $A \vee B$

1.3 Knowledge Representation & Reasoning

NOT

- Also known as *negation*
- The negation “NOT A” of a proposition (or $\neg A$) is true when A is false and is false otherwise.
- $\neg A$ may be read that it is
- false that A.

读作：“非A”
称为：A的否定式
记作：$\neg A$

A	¬A
t	f
f	t

Translation of sentences to propositions

A:= AI is easy.

It is false that AI is easy.
It is not the case that AI is easy. $\neg$ A
AI is not easy.

1.3 Knowledge Representation & Reasoning

If . . . Then ($\rightarrow$)

读作： “如果A则B”
称为：A与B的蕴涵式
记作： $A \rightarrow B$

- Also known as **implication**
- The implication “A IMPLIES B”, written $A \rightarrow B$, of two propositions is true when either A is false or B is true, and false otherwise.

A	B	$A \rightarrow B$
t	t	t
t	f	f
f	t	t
f	f	t

A:= I study hard.
B:= I get rich.

If I study hard then I get rich.
Whenever I study hard, I get rich.
That I study hard implies I get rich.
I get rich, if I study hard.

$A \rightarrow B$

1.3 Knowledge Representation & Reasoning

If . . . Then ($\rightarrow$)

- In $p \rightarrow q$ there does not need to be any connection between the antecedent or the consequent.
- The "meaning" of $p \rightarrow q$ depends only on the truth values of p and q.

- These implications are perfectly fine, but would not be used in ordinary English.
  - "If the moon is made of green cheese, then I have more money than Bill Gates. "
  - "If the moon is made of green cheese then I'm on welfare."

1.3 Knowledge Representation & Reasoning

- Different Ways of Expressing $p \rightarrow q$

if p, **then** q	p **implies** q
if p, q	p **only if** q
q **unless** $\neg p$	q **when** p
q **if** p	
q **whenever** p	p **is sufficient for** q
q **follows from** p	q **is necessary for** p

a necessary condition for p **is** q

a sufficient condition for q **is** p

1.3 Knowledge Representation & Reasoning

Converse, Contrapositive, and Inverse

- From $p \to q$ we can form new conditional statements .
  - $q \to p$ is the **converse** of $p \to q$ （逆命题）
  - $\neg q \to \neg p$ is the **contrapositive** of $p \to q$ （逆否命题）
  - $\neg p \to \neg q$ is the **inverse** of $p \to q$ （否命题）

Example: Find the converse, inverse, and contrapositive of “It’s raining is a sufficient condition for my not going to town.”

Solution:

converse: ?

inverse: ?

contrapositive: ?

1.3 Knowledge Representation & Reasoning

Converse, Contrapositive, and Inverse

- From $p \to q$ we can form new conditional statements .
  - $q \to p$ is the **converse** of $p \to q$
  - $\neg q \to \neg p$ is the **contrapositive** of $p \to q$
  - $\neg p \to \neg q$ is the **inverse** of $p \to q$

Example: Find the converse, inverse, and contrapositive of "It's raining is a sufficient condition for my not going to town."

Solution: → "If it is raining, I do not go town."

converse: If I do not go to town, then it is raining.

inverse: If it is not raining, then I will go to town.

contrapositive: If I go to town, then it is not raining.

1.3 Knowledge Representation & Reasoning

Biconditional

读作：“A当且仅当B”
称为：A与B的等价式
记作：$A \leftrightarrow B$

- Also known as iff or the biconditional.

The biconditional, written as $A \leftrightarrow B$, of two propositions is true when both A and B are true or when both A and B are false, and false otherwise.

A	B	A ↔ B
t	t	t
t	f	f
f	t	f
f	f	t

If p denotes “I am at home.” and q denotes “It is raining.” then $p \leftrightarrow q$ denotes “I am at home if and only if it is raining.”

1.3 Knowledge Representation & Reasoning

Semantics

- Example:

A := The street is wet.

B := It is raining.

If A is true, and B is true, then A ∧ B is true.

Truth table

A	B	A ∧ B
t	t	t
t	f	f
f	t	f
f	f	f

A	B	¬ A	A ∧ B	A ∨ B	A → B	A ↔ B
t	t	f	t	t	t	t
t	f	f	f	t	f	f
f	t	t	f	t	t	f
f	f	t	f	f	t	t

Operator	precedence
¬	1
∧, ∨	2
→, ↔	3

1.3 Knowledge Representation & Reasoning

Tautologies, Contradictions, and Contingencies

- A tautology (永真式) is a proposition which is always true.
  - Example: $p \vee \neg p$
- A *contradiction* (矛盾式) is a proposition which is always false.
  - Example: $p \wedge \neg p$
- A *contingency* is a proposition which is neither a tautology nor a contradiction, such as p

1.3 Knowledge Representation & Reasoning

Logical Equivalences

- Two compound propositions p and q are logically equivalent if $p \leftrightarrow q$ is a tautology.
- We write this as $p \Leftrightarrow q$ or as $p \equiv q$ where p and q are compound propositions.
- Two compound propositions p and q are equivalent if and only if the columns in a truth table giving their truth values agree.
- This truth table shows that $\neg p \lor q$ is equivalent to $p \rightarrow q$.

p	q	$\neg p$	$\neg p \lor q$	$p \rightarrow q$
T	T	F	T	T
T	F	F	F	F
F	T	T	T	T
F	F	T	T	T

De Morgan's Laws

$$\neg(p \wedge q) \equiv \neg p \vee \neg q$$

$$\neg(p \vee q) \equiv \neg p \wedge \neg q$$

Augustus De Morgan

1806-1871

This truth table shows that De Morgan's Second Law holds.

p	q	$\neg p$	$\neg q$	$(p \vee q)$	$\neg(p \vee q)$	$\neg p \wedge \neg q$
T	T					
T	F					
F	T					
F	F					

De Morgan's Laws

$$\neg(p \land q) \equiv \neg p \lor \neg q$$

$$\neg(p \lor q) \equiv \neg p \land \neg q$$

Augustus De Morgan

1806-1871

This truth table shows that De Morgan's Second Law holds.

p	q	$\neg p$	$\neg q$	$(p \lor q)$	$\neg(p \lor q)$	$\neg p \land \neg q$
T	T	F	F			
T	F	F	T			
F	T	T	F			
F	F	T	T			

1.3 Knowledge Representation & Reasoning

De Morgan's Laws

$$\neg(p \wedge q) \equiv \neg p \vee \neg q$$

$$\neg(p \vee q) \equiv \neg p \wedge \neg q$$

Augustus De Morgan

1806-1871

This truth table shows that De Morgan's Second Law holds.

p	q	$\neg p$	$\neg q$	$(p \vee q)$	$\neg(p \vee q)$	$\neg p \wedge \neg q$
T	T	F	F	T		
T	F	F	T	T		
F	T	T	F	T		
F	F	T	T	F		

1.3 Knowledge Representation & Reasoning

De Morgan's Laws

$$\neg(p \wedge q) \equiv \neg p \vee \neg q$$

$$\neg(p \vee q) \equiv \neg p \wedge \neg q$$

Augustus De Morgan

1806-1871

This truth table shows that De Morgan's Second Law holds.

p	q	$\neg p$	$\neg q$	$(p \vee q)$	$\neg(p \vee q)$	$\neg p \wedge \neg q$
T	T	F	F	T	F	
T	F	F	T	T	F	
F	T	T	F	T	F	
F	F	T	T	F	T	

De Morgan's Laws

$$\neg(p \land q) \equiv \neg p \lor \neg q$$

$$\neg(p \lor q) \equiv \neg p \land \neg q$$

Augustus De Morgan

1806-1871

This truth table shows that De Morgan's Second Law holds.

p	q	$\neg p$	$\neg q$	$(p \lor q)$	$\neg(p \lor q)$	$\neg p \land \neg q$
T	T	F	F	T	F	F
T	F	F	T	T	F	F
F	T	T	F	T	F	F
F	F	T	T	F	T	T

1.3 Knowledge Representation & Reasoning

Key Logical Equivalences

- Identity Laws: （统一律） $p \wedge T \equiv p$ $\quad$ $p \vee F \equiv p$
- Domination Laws: （支配律，零律） $p \vee T \equiv T$ $\quad$ $p \wedge F \equiv F$
- Idempotent laws: （等幂律） $p \vee p \equiv p$ $\quad$ $p \wedge p \equiv p$
- Double Negation Law: （对合律） $\neg(\neg p) \equiv p$
- Negation Laws: （否定律） $p \vee \neg p \equiv T$, $\quad$ $p \wedge \neg p \equiv F$

Key Logical Equivalences

- Commutative Laws: （交换律） $p \vee q \equiv q \vee p, \quad p \wedge q \equiv q \wedge p$
- Associative Laws: （结合律）
$$(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$$
$$(p \vee q) \vee r \equiv p \vee (q \vee r)$$
- Distributive Laws: （分配律）
$$(p \vee (q \wedge r)) \equiv (p \vee q) \wedge (p \vee r)$$
$$(p \wedge (q \vee r)) \equiv (p \wedge q) \vee (p \wedge r)$$
- Absorption Laws: （吸收律）
$$p \vee (p \wedge q) \equiv p \quad p \wedge (p \vee q) \equiv p$$

1.3 Knowledge Representation & Reasoning

Logical Equivalences

- *The operations* $\wedge, \vee$ *are commutative and associative, and the*
- *following equivalences are generally valid*:
- $\neg A \vee B \equiv A \rightarrow B$ (implication)
- $A \rightarrow B \equiv \neg B \rightarrow \neg A$ (contraposition)
- $(A \rightarrow B) \wedge (B \rightarrow A) \equiv (A \leftrightarrow B)$ (equivalence)
- $\neg(A \wedge B) \equiv \neg A \vee \neg B$ (De Morgan's law)
- $\neg(A \vee B) \equiv \neg A \wedge \neg B$
- $A \vee (B \wedge C) \equiv (A \vee B) \wedge (A \vee C)$ (distributive law)
- $A \wedge (B \vee C) \equiv (A \wedge B) \vee (A \wedge C)$
- $A \vee \neg A \equiv t$ (tautology)
- $A \wedge \neg A \equiv f$ (contradiction)
- $A \vee f \equiv A$
- $A \vee t \equiv t$
- $A \wedge f \equiv f$
- $A \wedge t \equiv A$

1.3 Knowledge Representation & Reasoning

Logical Equivalences

- *The operations $\land$, $\lor$ are commutative and associative, and the*
- *following equivalences are generally valid:*
- $\neg A \lor B \equiv A \rightarrow B$ (implication)
- $A \rightarrow B \equiv \neg B \rightarrow \neg A$ (contraposition)

A	B	¬ A	¬A∨ B	A → B
t	t	f	t	t
t	f	f	f	f
f	t	t	t	t
f	f	t	t	t

Equivalence Proofs

Example: Show that $\neg(p \vee (\neg p \wedge q))$

is logically equivalent to $\neg p \wedge \neg q$

Solution:

Equivalence Proofs

Example: Show that $\neg(p \vee (\neg p \wedge q))$

is logically equivalent to $\neg p \wedge \neg q$

Solution:

$$
\begin{array}{llll}
\neg(p \vee (\neg p \wedge q)) & \equiv & \neg p \wedge \neg(\neg p \wedge q) & \text{by the second De Morgan law} \\
& \equiv & \neg p \wedge [\neg(\neg p) \vee \neg q] & \text{by the first De Morgan law} \\
& \equiv & \neg p \wedge (p \vee \neg q) & \text{by the double negation law} \\
& \equiv & (\neg p \wedge p) \vee (\neg p \wedge \neg q) & \text{by the second distributive law} \\
& \equiv & F \vee (\neg p \wedge \neg q) & \text{because } \neg p \wedge p \equiv F \\
& \equiv & (\neg p \wedge \neg q) \vee F & \text{by the commutative law} \\
& & & \text{for disjunction} \\
& \equiv & (\neg p \wedge \neg q) & \text{by the identity law for } \mathbf{F}
\end{array}
$$

Equivalence Proofs

Example: Show that $(p \wedge q) \rightarrow (p \vee q)$ is a tautology.

Solution:

Equivalence Proofs

Example: Show that $(p \wedge q) \rightarrow (p \vee q)$ is a tautology.

Solution:

$$
\begin{aligned}
(p \wedge q) \rightarrow (p \vee q) &\equiv \neg(p \wedge q) \vee (p \vee q) && \text{by truth table for } \rightarrow \\
&\equiv (\neg p \vee \neg q) \vee (p \vee q) && \text{by the first De Morgan law} \\
&\equiv (\neg p \vee p) \vee (\neg q \vee q) && \text{by associative and} \\
& && \text{commutative laws} \\
& && \text{laws for disjunction} \\
&\equiv T \vee T && \text{by truth tables} \\
&\equiv T && \text{by the domination law}
\end{aligned}
$$

1.3 Knowledge Representation & Reasoning

- Now, we have learned…
  - Three basic elements in proposition logic: propositions, operations, and the truth values.
  - Logical equivalences

1.3 Knowledge Representation & Reasoning

- Applications
  - 1. Translate English Sentences
  - 2. System Specifications
  - 3. Logic Puzzles

1.3 Knowledge Representation & Reasoning

Example

Problem: Translate the following sentence into propositional logic:
"You can access the Internet from campus if you are a computer science major or you are not a freshman."

Atomic propositions:

- A:= You can access the Internet from campus.
- B:= You are a computer science major .
- C:= You are a freshman.

$$(B \lor \neg C) \rightarrow A$$

1.3 Knowledge Representation & Reasoning

Example

Problem:

(1) 除非你很努力，否则你将失败。
(2) 张三或者李四都可以做这件事。

Atomic propositions:

（1）A:= 你努力。 B:=你失败。
（2）A :=张三能做事。 B:= 李四可以做这件事.

(1) $\neg A \rightarrow B$
(2) $A \land B$

1.3 Knowledge Representation & Reasoning

Consistent System Specifications （系统规范说明）

- Definition: A list of propositions is consistent if it is possible to assign truth values to the proposition variables so that each proposition in the list is true.

1.3 Knowledge Representation & Reasoning

- Consistent System Specifications

  Example: Is this list of propositions consistent?

  - "The diagnostic message is stored in the buffer or it is retrans mitted."
  - "The diagnostic message is not stored in the buffer."
  - "If the diagnostic message is stored in the buffer, then it is ret ransmitted."

1.3 Knowledge Representation & Reasoning

Consistent System Specifications

Example: Is this list of propositions consistent?

- "The diagnostic message is stored in the buffer or it is retransmitted."
- "The diagnostic message is not stored in the buffer."
- "If the diagnostic message is stored in the buffer, then it is retransmitted."

P:= "The diagnostic message is stored in the buffer."
Q:= "The diagnostic message is retransmitted"

$$P \lor Q$$

1.3 Knowledge Representation & Reasoning

Consistent System Specifications

Example: Is this list of propositions consistent?

- "The diagnostic message is stored in the buffer or it is retransmitted."
- "The diagnostic message is not stored in the buffer."
- "If the diagnostic message is stored in the buffer, then it is retransmitted."

P:= "The diagnostic message is stored in the buffer."
Q:= "The diagnostic message is retransmitted"

$\neg P$

1.3 Knowledge Representation & Reasoning

Consistent System Specifications

Example: Is this list of propositions consistent?

- "The diagnostic message is stored in the buffer or it is retransmitted."
- "The diagnostic message is not stored in the buffer."
- "If the diagnostic message is stored in the buffer, then it is retransmitted."

P:= "The diagnostic message is stored in the buffer."
Q:= "The diagnostic message is retransmitted"

$$P \rightarrow Q$$

1.3 Knowledge Representation & Reasoning

Consistent System Specifications

Example: Is this list of propositions consistent?

- "The diagnostic message is stored in the buffer or it is retransmitted." $P \vee Q$
- "The diagnostic message is not stored in the buffer." $\neg P$
- "If the diagnostic message is stored in the buffer, then it is retransmitted." $P \rightarrow Q$

P	Q	$P \vee Q$	$\neg P$	$P \rightarrow Q$
t	t			
t	f			
f	t			
f	f			

1.3 Knowledge Representation & Reasoning

Consistent System Specifications

Example: Is this list of propositions consistent?

- "The diagnostic message is stored in the buffer or it is retransmitted."
- "The diagnostic message is not stored in the buffer."
- "If the diagnostic message is stored in the buffer, then it is retransmitted."

P	Q	$P \vee Q$	$\neg P$	$P \to Q$
t	t	t	f	t
t	f	t	f	f
f	t	t	t	t
f	f	f	t	t

When P is false and Q is true all three statements are true. So the list of propositions is consistent.

1.3 Knowledge Representation & Reasoning

Consistent System Specifications

Example: Is this list of propositions consistent?

- "The diagnostic message is stored in the buffer or it is retransm itted." $P \vee Q$
- "The diagnostic message is not stored in the buffer." $\neg P$
- "If the diagnostic message is stored in the buffer, then it is retra nsmitted." $P \rightarrow Q$
- The diagnostic message is not retranmitted. $\neg Q$

P	Q	$P \vee Q$	$\neg P$	$P \rightarrow Q$	$\neg Q$
t	t	t	f	t	
t	f	t	f	f	
f	t	t	t	t	
f	f	f	t	t	

1.3 Knowledge Representation & Reasoning

Consistent System Specifications

Example: Is this list of propositions consistent?

- "The diagnostic message is stored in the buffer or it is retransmitted." $P \vee Q$
- "The diagnostic message is not stored in the buffer." $\neg P$
- "If the diagnostic message is stored in the buffer, then it is retransmitted." $P \rightarrow Q$
- The diagnostic message is not retranmitted. $\neg Q$

The list of propositions is **not consistent!**

P	Q	$P \vee Q$	$\neg P$	$P \rightarrow Q$	$\neg Q$
t	t	t	f	t	f
t	f	t	f	f	t
f	t	t	t	t	f
f	f	f	t	t	t

1.3 Knowledge Representation & Reasoning

Logic Puzzles

Knights: t
Knaves: f

- An island has two kinds of inhabitants, *knights*, who always tell the truth, and *knaves*, who always lie.
- You go to the island and meet A and B.
  - A says "B is a knight."
  - B says "The two of us are of opposite types."

Example: What are the types of A and B?

Logic Puzzles

- **Solution:** Let p and q be the statements that A is a knight and B is a knight, respectively. So, then $\neg p$ represents the proposition that A is a knave and $\neg q$ that B is a knave.
  - If A is a knight, then p is true. Since knights tell the truth, q must also be true. Then $(p \land \neg q) \lor (\neg p \land q)$ would have to be true, but it is not. So, A is not a knight and therefore $\neg p$ must be true.
  - If A is a knave, then B must not be a knight since knaves always lie. So, then both $\neg p$ and $\neg q$ hold since both are knaves.

Homework-1

Logic Puzzles

Knights: t
Knaves: f

- An island has two kinds of inhabitants, *knights*, who always tell the truth, and *knaves*, who always lie.
- You go to the island and meet A and B.
  - A says "At least one of us is a knave."
  - B says nothing.

Example: What are the types of A and B?