Artificial Intelligence

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What is AI?

- How does the human brain work?
- What is intelligence?
- How do we emulate the human brain?
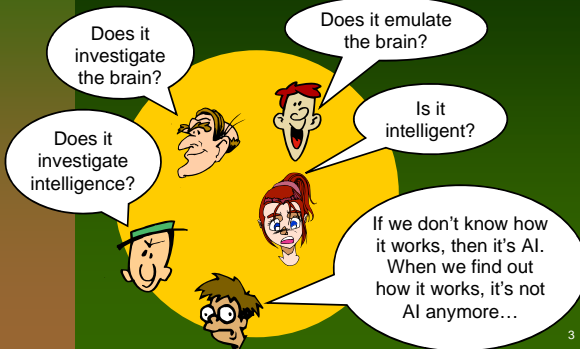- How do we create intelligence?
- Who cares? Let's do some cool and useful stuff!

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How do we classify research as AI?

- Does it investigate the brain?
- Does it emulate the brain?
- Does it investigate intelligence?
- Is it intelligent?
- If we don't know how it works, then it's AI. When we find out how it works, it's not AI anymore…

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Approaches to AI

- Learning
- Rule-Based Systems
- Search
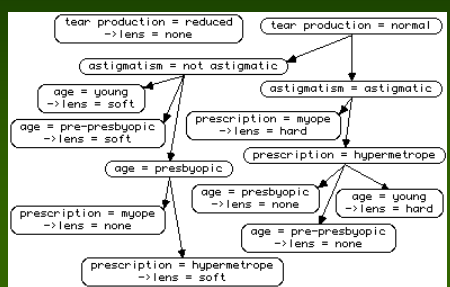- Planning
- Ability-Based Areas
- Robotics
- Agents

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Learning

- Explanation
  - Discovery
  - Data Mining
- No Explanation
  - Neural Nets
  - Case Based Reasoning

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Learning: Explanation

- Cases to rules

tear production = reduced -> lens = none

tear production = normal

astigmatism = not astigmatic

age = young -> lens = soft

astigmatism = astigmatic

age = pre-presbyopic -> lens = soft

prescription = myope -> lens = hard

age = presbyopic

prescription = hypermetrope

prescription = myope -> lens = none

age = presbyopic -> lens = none

age = young -> lens = hard

age = pre-presbyopic -> lens = none

prescription = hypermetrope -> lens = soft

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Learning: No Explanation
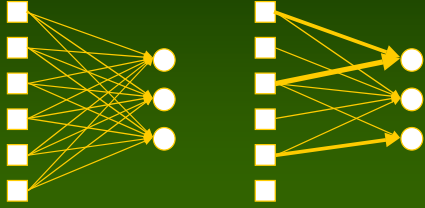
- Neural nets

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Rule-Based Systems

- Logic Languages
  - Prolog, Lisp
- Knowledge bases
- Inference engines

Rule-Based Languages: Prolog

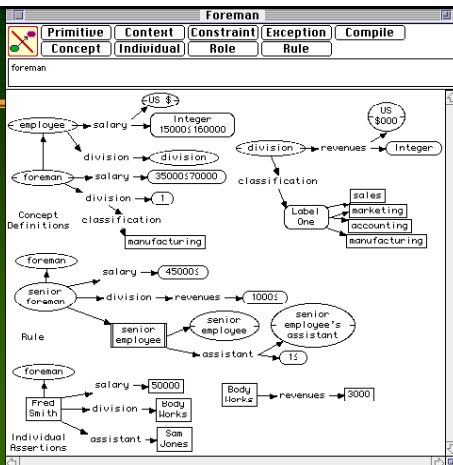|	
Father(abraham, isaac).	Male(isaac).
Father(haran, lot).	Male(lot).
Father(haran, milcah).	Female(milcah).
Father(haran, yiscah).	Female(yiscah).

Son(X,Y) ← Father(Y,X), Male(X).
Daughter(X,Y) ← Father(Y,X), Female(X).

Son(lot, haran)?

Rule Based Systems

- KRS

Approaches to AI

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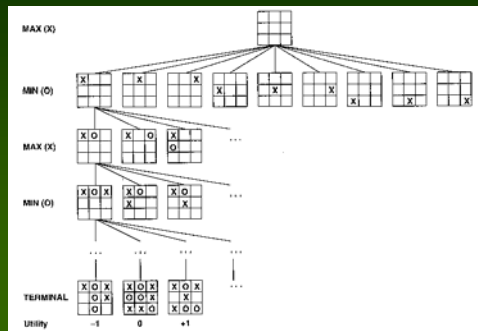- Ability-Based Areas
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Search

- "All AI is search"
  - Game theory
  - Problem spaces
- Every problem is a "virtual" tree of all possible (successful or unsuccessful) solutions.
- The trick is to find an efficient search strategy.

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Search: Game Theory

$9!+1 = 362,880$

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Approaches to AI

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Approaches to AI

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Ability-Based Areas

- Computer vision
- Natural language recognition
- Natural language generation
- Speech recognition
- Speech generation
- Robotics

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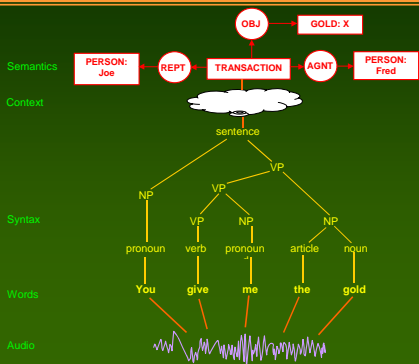
Natural Language: Translation

"The spirit is strong, but the flesh is weak."

→ Translate to Russian
← Translate back to English
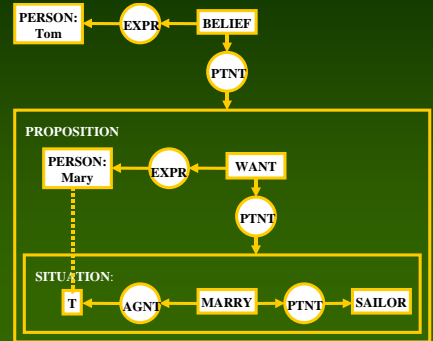
"The vodka is great, but the meat is rancid!"

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Natural Language Recognition

Semantics

Context

Syntax

Words

Audio

OBJ — GOLD: X

PERSON: Joe — REPT — TRANSACTION — AGNT — PERSON: Fred

sentence

VP

NP — VP — VP — NP — NP

pronoun — verb — pronoun — article — noun

You — **give** — **me** — **the** — **gold**

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Natural Language Recognition

"Tom believes Mary wants to marry a sailor."

PERSON: Tom — EXPR — BELIEF

PTNT

PROPOSITION

PERSON: Mary — EXPR — WANT

PTNT

SITUATION:

T — AGNT — MARRY — PTNT — SAILOR

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- Ability-Based Areas
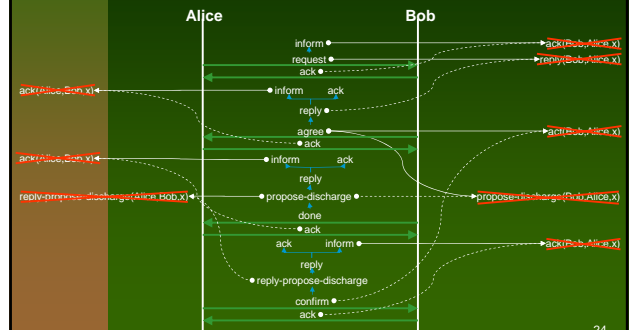- Robotics
- Agents

RoboCup Challenge   RoboCup Game

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Agent Communication

Alice   Bob

Can you attend this meeting?

(performative: request, content: attend(Bob,x))

Sure...

(performative: agree, content: attend(Bob,x))

(nod)

(performative: ack, content: attend(Bob,x))

I'm here

(nod)

(performative: inform, content: attend(Bob,x))

(performative: ack, content: attend(Bob,x))

Thanks for coming.

(performative: confirm, content: attend(Bob,x))

(nod)

(performative: ack, content: attend(Bob,x))

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Agent Communication

Alice   Bob

inform — ack(Bob,Alice,x)

request — reply(Bob,Alice,x)

ack

ack(Alice,Bob,x) — inform — ack

reply

agree — ack(Bob,Alice,x)

ack

ack(Alice,Bob,x) — inform — ack

reply

reply-propose-discharge(Alice,Bob,x) — propose-discharge — propose-discharge(Bob,Alice,x)

done

ack

ack — inform — ack(Bob,Alice,x)

reply

reply-propose-discharge

confirm

ack

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Intelligence

- *Turing Test*: A human communicates with a computer via a teletype. If the human can't tell he is talking to a computer or another human, it passes.
  - Natural language processing
  - knowledge representation
  - automated reasoning
  - machine learning
- Add vision and robotics to get the total Turing test.
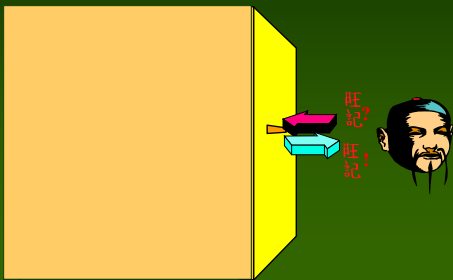
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Weak and Strong AI Claims

- Weak AI:
  - Machines can be made to act *as if* they were intelligent.
- Strong AI:
  - Machines that act intelligently have real, conscious minds.
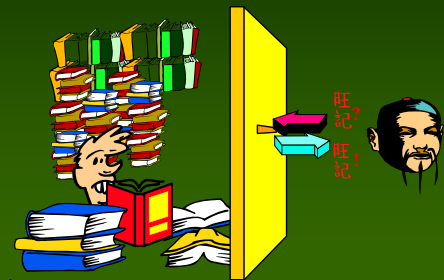
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What is Intelligence?

- The Chinese Room
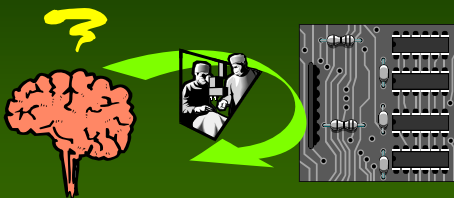

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What is Intelligence?

- The Chinese Room

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What is Intelligence?

- Replacing the brain

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How far have we got?

- Our best systems have the intelligence of a frog

- Mind you, how many frogs spend all their intelligence controlling a nuclear power plant?