

# Machine Intelligence

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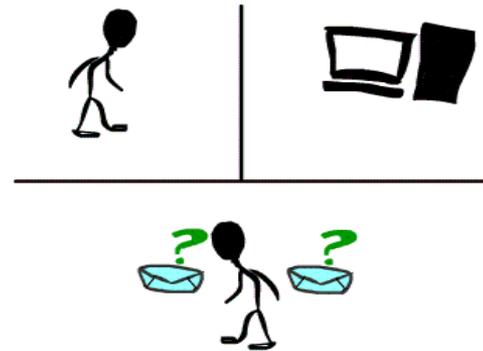
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# What is it?

Machine Intelligence is the science and engineering of building **intelligent** machines, that is, ones that can perform at levels comparable to human beings

- Turing test



# “Programming a robot”



# Can you pour me coffee?

- Vici should
  - Hear
  - Understand
  - Figure out that this is a request
  - Decide on action
  - Perform

# Can you pour me coffee?

- Salient entities
  - You
  - Me
  - Coffee
- Action
  - Pour
    - Coffee (substance being poured)
    - In the cup (container to pour into)
    - Agent (pourer)

# Can you pour me coffee?

- Context and Environment
  - Having breakfast
  - Cup and coffee are on the table in a carafe
- Commonsense reasoning
  - This is a request
  - The coffee goes from the carafe to the cup
  - Stop when the cup is full?

# Can you pour me coffee?

- **Actions**
  - Lift the carafe
  - Locate the cup
  - Pour the coffee
  - Place carafe back on the table

# Question answering

<b>Question</b>	<b>Aspect of intelligence</b>
Yes/No questions	Factual
What/where/when?	Factual, require attribute knowledge
How?	Understanding
How to?	Problem solving
Why?	Reasoning
What if?	Predicting, imagining

# Overview

- Abilities of an autonomous intelligent agent
  - Sensing the environment
  - Extracting and representing knowledge
  - Understanding natural language
  - Reasoning and deducing
  - Interacting with the environment
  - Social and emotional intelligence

# Knowledge representation

- Entity representation
  - *That is a butterfly.*
  - *Burj Khalifa is the world's tallest building.*
- Relationship representation
  - *Barack Obama is married to Michelle Obama.*
  - *Washington D.C. is the capital of the United States.*

# Knowledge representation

- Temporal representation
  - *If you eat ice cream after getting wet in the rain, you will catch a cold*

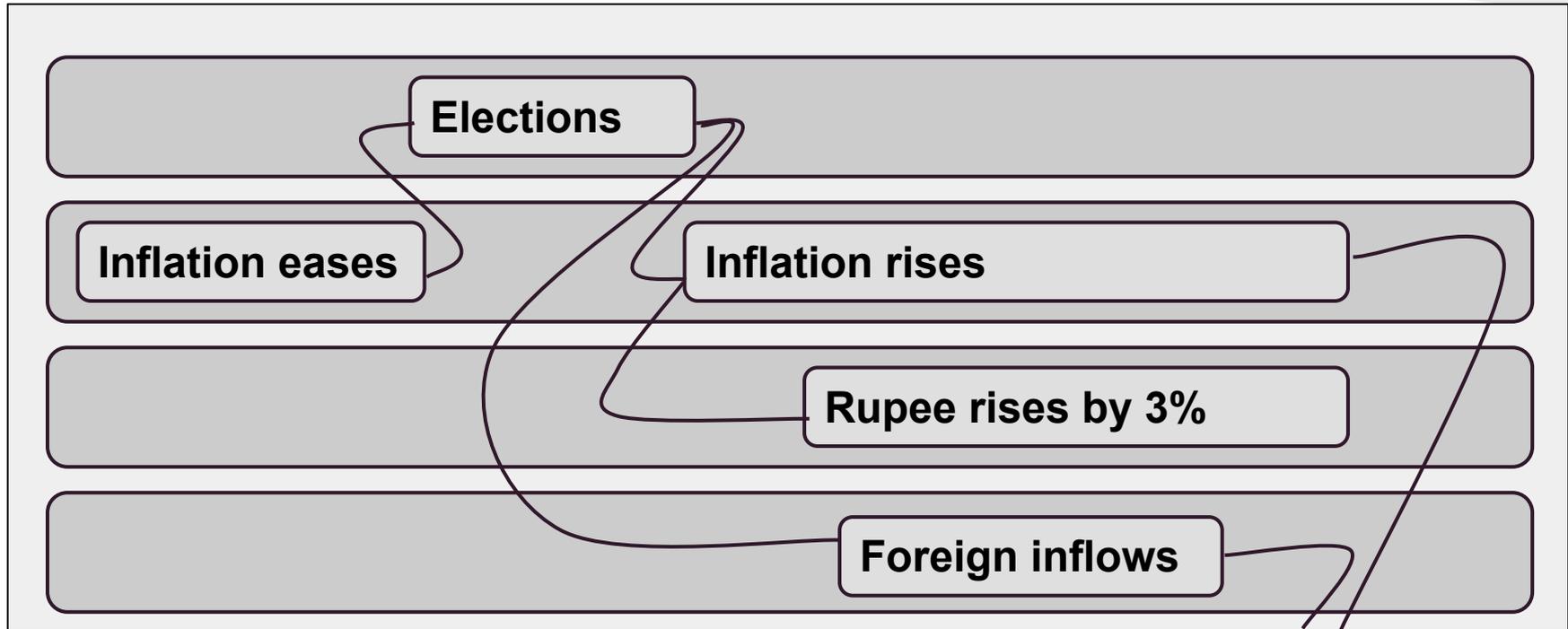


# Knowledge representation

- Temporal representation

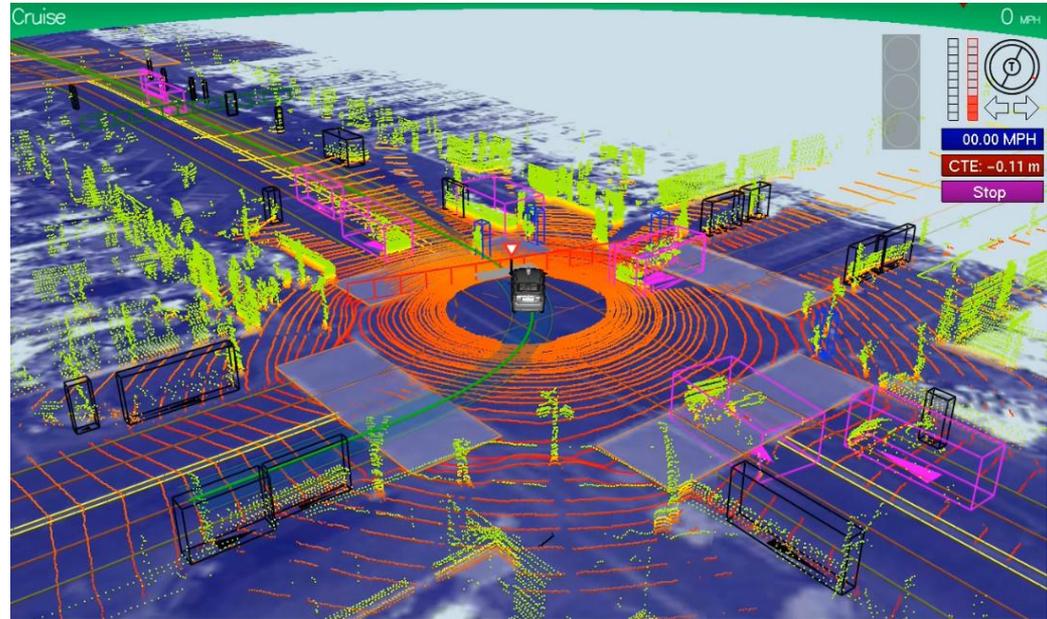
- *A study of recent years, he says, shows that GDP growth picks up gradually after an election, by as much as 1 percentage point over the next three quarters; inflation tends to ease before and rise after an election; the rupee usually appreciates by 3% on average within three quarters of an election; and foreign institutional inflows pick up by an average of half a percent of GDP*

# Knowledge representation



# Knowledge representation

- Spatial representation
  - Relative sizes
  - Relative positions
  - Relative distances
  - Layouts



# Natural language understanding

- Entity and sense disambiguation
  - *I live in San Francisco.*
  - *San Francisco beat Oakland 3-1 yesterday.*
  
  - *I'm a friend, you can bank on me.*
  - *My house is next to the bank.*
  - *There are many houses near the bank, at risk during floods.*

# Natural language understanding

- Coreference resolution

- *The doctor examined the patient. He checked to make sure the test results were correct.*
- *The doctor examined the patient. He checked to make sure he had his insurance id.*

# Natural language understanding

- Metaphors

- *Can you mend my broken heart?*
- *All religions, arts and sciences are branches of the same tree.*

- Puns

- *In much of AI, I is in the beholder.*

# Reasoning and deducing

Zack is three years old. He is getting dressed. He wants to dress by himself. So Zack puts on his pants. The zipper is in the back. He puts on his shirt. The tag is on the outside. He pulls on his socks. One sock is white. The other sock is red. Then Zack gets his shoes.

***What will Zack probably do next?***

1. put on his shoes the right way
2. tie his shoes the right way
3. put on his shoes the wrong way

# Interacting with environment

- Rationality
  - Maximize optimal state
- Autonomy
  - Build through experiences
  - React to unknowns

# Social and emotional intelligence

- Social intelligence
  - Conventions
  - Co-operation
- Emotional intelligence
  - Empathy, compassion
  - Consciousness

# Some examples

- Deep Blue
- Speech recognition
- Watson
- Siri and Google Now

A machine to do everything we discussed?



# Conclusion

*We can see only a short distance ahead,  
but we can see that much remains to be done.*

- Alan Turing, *Computing Machinery and Intelligence*

# References

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