

IDK0310
AUTOMATED AND
SYSTEMATISED LEGAL
PROCESS

Introducton

- What is Artificial Intelligence (AI)?
- How this is connected to law?

Artificial Intelligence and law

- Discipline is broadly named also or „AI and law“
 - ▣ Artificial intelligence (AI) is the intelligence of machines and robots and the branch of computer science that aims to create it.
 - ▣ *the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.*

Artificial Intelligence

- AI is the simulation of human intelligence processes by machines, especially computer systems.
 - ▣ These processes include
 - learning (the acquisition of information and rules for using the information),
 - reasoning (using the rules to reach approximate or definite conclusions), and
 - self-correction.
 - ▣ Particular applications of AI include expert systems, speech recognition and machine vision.

Law, and AI

- Legislation as a set of rules can be viewed as a big knowledge base.
- Knowledge is represented in the form of rules to follow

AI and law problems?

- Artificial Intelligence and law is a subfield of AI mainly concerned with applications of AI to legal informatics problems and original research of those problems
 - ▣ Information retrieval related to law (manual, automated systems)
 - ▣ Information access issues (government information accessibility in different ways)
 - ▣ Practice issues (support for every day issues)
 - ▣ Law and policy (privacy, copyright, security etc)

History of Artificial Intelligence

- Where it started?
- Who were significant developers?

History of Artificial Intelligence

- People have long imagined machines with human abilities:
 - ▣ automata that move and devices that reason...

Ramon Llull (circa 1235{1316),

- a debating tool for winning Muslims to the Christian faith through logic and reason:



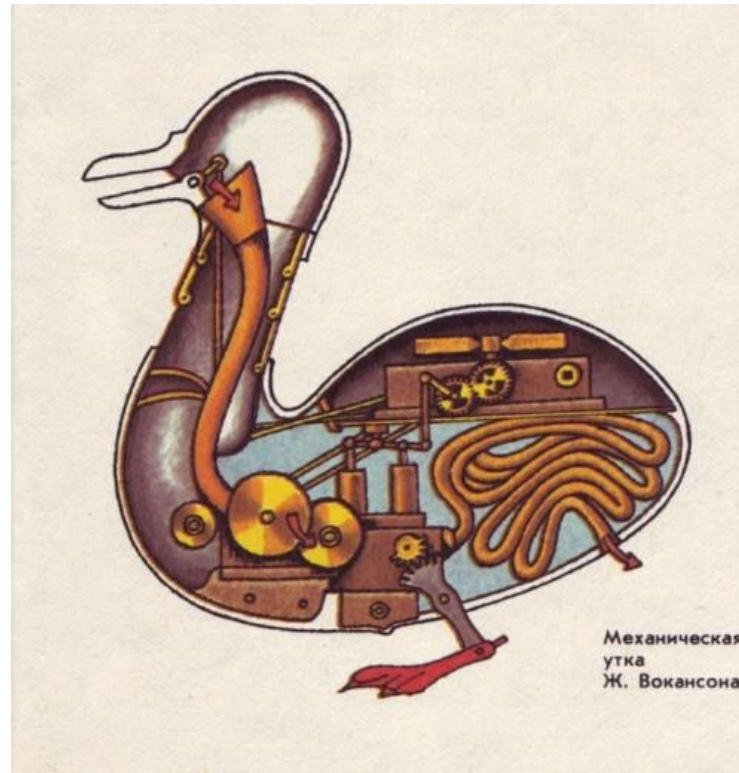
Leonardo Da Vinci (~1495)

- designs for a humanoid robot in the form of a medieval knight



Jacques de Vaucanson (1709 -1782)

- the mechanical duck



Karel Capek, 1920.

- A play called R.U.R. (Rossum's Universal Robots)
- First use of the word Robot, derived from „robotnik„- a peasant or serf.
- According to play mass-produced using a chemical substitute for protoplasm

Isaac Asimov 1938

- Wrote stories about “positronic” robots;
- Introduced laws about behaviour:
 - ▣ First Law: A robot may not injure a human being, or, through inaction, allow a human being to come to harm.
 - ▣ Second Law: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
 - ▣ Third Law: A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.
 - ▣ Zeroth Law: A robot may not injure humanity, or, through inaction, allow humanity to come to harm.

Gottfried Wilhelm Leibniz (1646-1716)

- wanted to mechanize reasoning
- speculated that the propositions that constitute knowledge could be built from a smaller number of primitive ones
 - ▣ just as all words can be built from letters in an alphabetic language.
- attempted to design an univesral language in which all human knowledge could be formulated

Gottfried Wilhelm Leibniz (1646-1716)

- *lingua characteristica* would consist of primitive propositions; an *alphabet for human thoughts*.
- The alphabet would serve as the basis for automatic reasoning (*calculus ratiocinator*)
 - ▣ if the items in the alphabet were represented by numbers
 - ▣ complex proposition could be obtained from its primitive constituents
 - ▣ Arithmetic operations could then be used to determine whether or not the complex proposition was true or false

Gottfried Wilhelm Leibniz (1646-1716)

- The main problem: how to discover the components of the primitive “alphabet”.
- Still provided clues to how reasoning might be mechanized:
 - ▣ Invent an alphabet of simple symbols and
 - ▣ the means for combining them into more complex expressions.

Example of alphabet

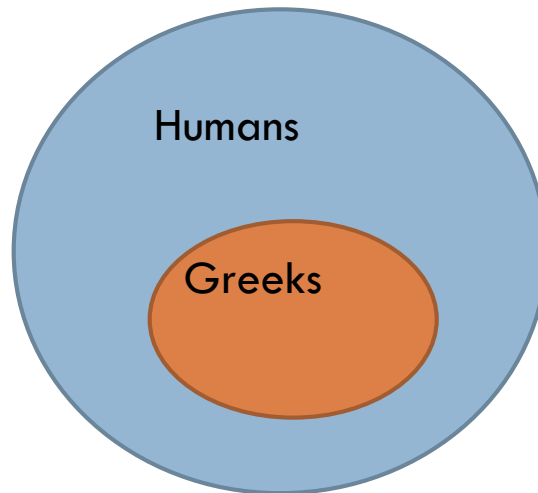
- If to line up all the possible letter combinations:

a	b	c	...	aa	ab	ac	...	aab	aba
1	2	3		72	73	74		181	182

- Then word „ABBA“ could be represented combination of these sequence numbers
 - 1 and 73 and 1
 - Or
 - 73 and 2 and 1

Aristotle

- Logic reasoning attempt, syllogism:
 1. All humans are mortal. (stated)
 2. All Greeks are humans. (stated)
 3. All Greeks are mortal. (result)



Aristotle

Logic reasoning, syllogism:

1. All humans are mortal. (stated)
2. All Greeks are humans. (stated)
3. All Greeks are mortal. (result)

In universal form:

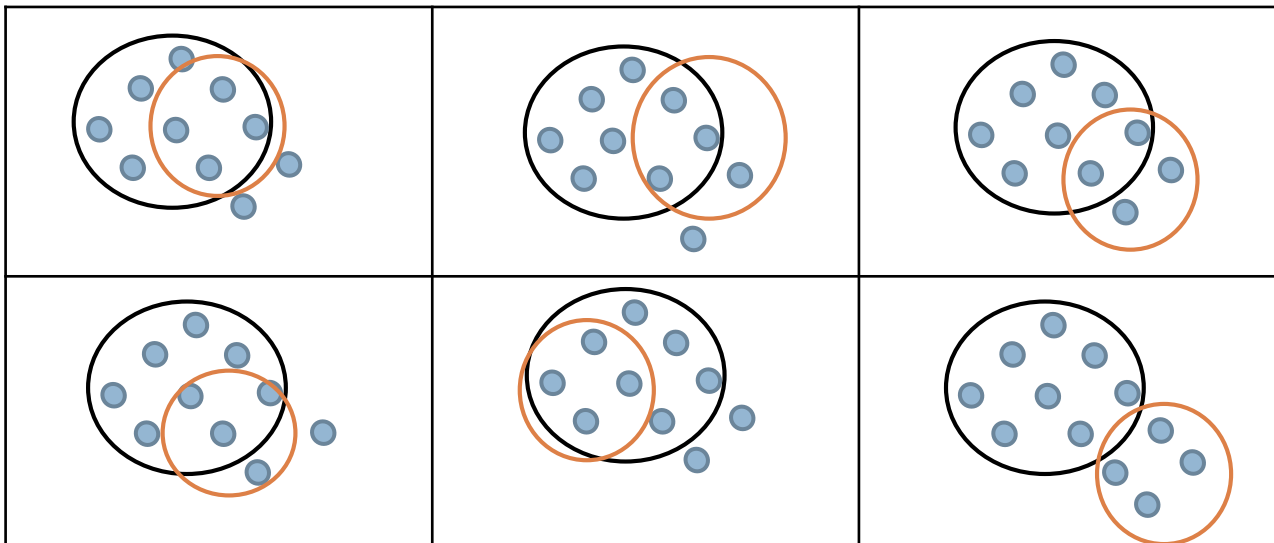
1. All B's are A. (stated)
2. All C's are B's. (stated)
3. All C's are A. (result)

Two clues how to automate reasoning:

- ▣ can be represented as forms or templates.
- ▣ Replacing general symbols against ones presenting specific problem, is possible to get an answer

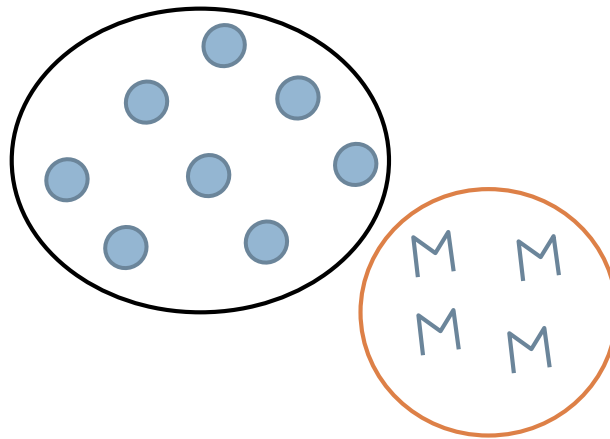
Charles Stanhope ~1780

- built and experimented devices for solving simple problems in logic and probability:
 - Eight of ten A's are B's; Four of ten A's are C's;
 - Therefore, at least two B's are C's.
 - Which illustrations satisfy the Stanhope logic:



Charles Stanhope ~1780

- Another syllogism solved with his device:
 - No M is A; All B is M;
 - Therefore, No B is A.



George Boole (1815-1864)

- Considered various logical principles of human reasoning and represented them in mathematical form:
 - „it is impossible for any being to possess a quality, and at the same time not to possess it.“

$$x (x - I) = 0$$

x - any class of objects,

$(I - x)$ - contrary or supplementary class of objects,

0 - does not exist.

George Boole (1815-1864)

- In Boolean algebra,

- 0 represents falsehood,

$$1 + 0 = 1$$

- 1 represents truth.

$$1 \times 0 = 0$$

- Two operations in logic,

$$1 + 1 = 1$$

- OR is represented „+“

$$1 \times 1 = 1$$

- AND is represented „x“

$$0 + 0 = 0$$

$$0 \times 0 = 0$$

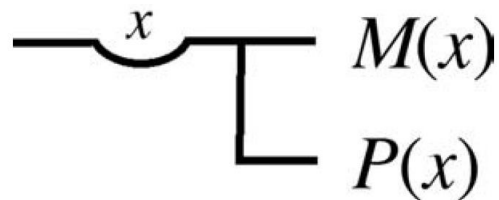
- Therefore:

George Boole (1815-1864)

- Proved logical reasoning could be performed by manipulating equations representing logical propositions.
- is called the „propositional logic“
- plays a very important role in artificial intelligence.
- Problems: propositions p , q , and so on were „atomic“.
 - „Jack is human“ by p , and „Jack is mortal“ by q , there is nothing in p or q to indicate that the Jack who is human is the very same Jack who is mortal.

Friedrich Ludwig Gottlob Frege (1848-1925)

- invented a system in which propositions,
 - ▣ along with their internal components,
 - ▣ could be written down in a kind of graphical form



- In modern language $(\forall x)P(x) \supset M(x)$
 - ▣ „for all x , if x is a person, then x is mortal“

Reverend Thomas Bayes (1702-1761)

- Bayes rule

$$p(x | y) = p(y | x)p(x) / p(y)$$

- Calculates probability of probabilities
 - ▣ During a court case witness is describing the suspect
 - Having two arms
 - Having two legs
 - Having birth mark in front of head like Harry Potter
 - ▣ Which characterisation helps us to decide whether the suspect is the one pointed out by witness?

History of artificial reasoner- a computer

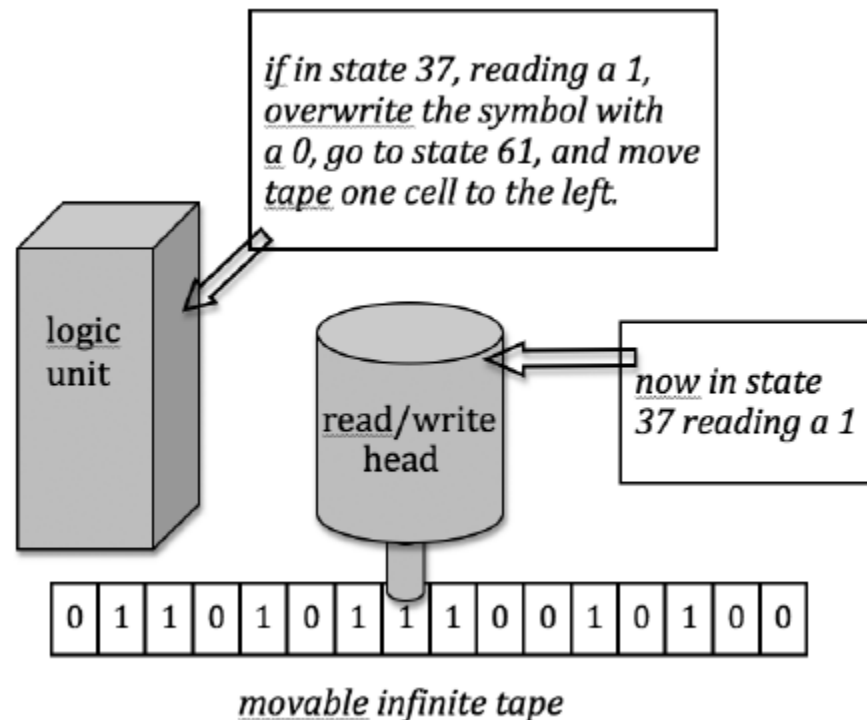


Mechanical computers

- First ones were able to do arithmetic calculations, but were not programmable.
 - ▣ Wilhelm Schickard (1592-1635) built one of the first of these in 1623
 - ▣ 1642 Blaise Pascal (1623-1662) created the first of about fifty of his computing machines
 - ▣ Attempt on 1822 by Charles Babbage (1791-1871)

Electronic computers

- Alan Turing (1912-1954) proposed „logical computing machine (LCM)“



Claude Shannon (1916-2001)

- 1937 showed that
 - Boolean algebra and
 - binary arithmetic
- could be used to simplify telephone switching circuits.

Computer memory inventors

- It is hard to decide whether it was
 - ▣ Konrad Zuse (1910-1995)
 - Z3 was the first fully functional, program controlled (freely programmable) computer of the world,
 - presented on May 12, 1941, to an audience of scientists in Berlin?
 - used 2,400 electromechanical relays.
 - was destroyed by an Allied air raid on December 21, 1943
 - created the first programming language, called the Plankalkül?
 - ▣ J. Presper Eckert (1919-1995)
 - ▣ John W. Mauchly (1907-1980)