

- Determining if machines can think should not be answered using the typical definition of words like “machine” and “think,” but instead described in a game called the **Imitation Game**.

The Imitation Game

- Played with 3 people
 - Man, woman, interrogator (either sex)
 - Interrogator is in a separate room, and must determine who is the man and who the woman
 - The two are simply labelled “X” and “Y”
- The interrogator is allowed to ask questions to both the man and woman
- One person being interrogated must attempt to convince the interrogator they are the other person
 - Answers are typewritten to avoid easy tone recognition
 - Or the questions and answers can be repeated through a middleman
- The other person must attempt to help the interrogator

What happens if a machine takes the part of the first person instead?

Defining “Machine”

- Any engineering technique can be used
- Machine is able to be constructed without the engineers knowing how exactly it functions because of experimental methods
- Excludes machines made in a “typical” manner
 - In particular, only digital computers must be permitted
- We are not simply examining if every computer/present computer would do well at the game, but rather if there are imaginable computers who would

Digital Computers

- Intended to carry out any operations done by a human (computer)
- Regarded as consisting of three parts
 - Store
 - Store of information
 - Similar to a human using paper + his memory (Whether it be the set of rules the human follows or the calculations they make)
 - Executive unit
 - Carries out the operations involved in the calculation
 - Varies from machine to machine
 - Control
 - Sees that instructions are followed in the right order
- Information in the store is broken up into packets of medium size
 - Conditional instructions are required to avoid repetition
- Another variant of a digital computer is one with a random element

- Ex: Throw die, put number into store 1000
- Machine may be described as having free will (Turing does not think so)

Infinite Capacity Computers

- Idea of a computer with unlimited store
- Only a finite store can be used, and only a finite amount can be constructed
 - Theoretically can be built upon infinitely

Electricity is not vital in the notion of digital computers, as Charles Babbage's computer was made mechanically, and still functioned as said computer

Universality of Digital Computers

- Digital computers from prior section can be called **discrete state machines**
 - Move with sudden jumps, from one state to another
 - States are sufficiently distinguishable from each other
 - Technically everything is continuous, but we can readily assume this definition

Discrete State Machines

- Only have a finite number of possible states
- Digital computers fall into this definition
 - Possesses a large number of states
- Digital computers are thus able to mimic any discrete state machine
 - Since it is very trivial to predict what it will do with a table
 - Thus we can play the imitation game with the digital computer and the finite state machine
 - This property lends digital computers to be called universal machines
 - Thus we only require one digital computer to perform the tasks required by multiple FSMs

Replace "Can machines think?" from above with "Are there imaginable digital computers which would do well in the imitation game?"

- More generally - Are there imaginable digital computers that would do well at the imitation game?
- With the universality property, both questions simplify to
 - Take one digital computer C
 - If you modify C to have sufficient storage, speed and appropriate programs, can C be successfully used in place of the first "person" in the imitation game, with the second person being a man?
 - Computer takes the role of the "fooler"

Contrary Views on the Main Question

- The Theological Objection

- Thinking is a function of man's soul - which is immortal
 - Every man or woman has such a soul, but not animals or machines
 - Therefore, no machines or animals can think
- Turing considered the argument more convincing if animals were grouped along with men
 - Wider divide between animate and inanimate
 - Takes a similar view but given a Christian lense
 - What if they considered the Moslem view that women have no souls
- The primary argument, Turing believes, is restrictive on God's omnipotence
 - Aside from laws of nature why can he not give an animal a soul?
 - Simply give the elephant the appropriate faculties to hold such a soul
 - Do the same but to a machine?
- Gives example of past unsatisfactory theological arguments
 - Galileo
 - Past theories proven to be obsolete due to current knowledge
- The 'Heads in the Sand' Objection
 - Machines thinking would be too scary, hope it doesn't happen
 - Human's like to believe they're superior to everything else
 - Best if the superiority was shown as a necessity to cement mindset
 - This objection is strongly tied with the superiority mindset
 - More prevalent in intelligent people
- The Mathematical Objection
 - Mathematical logic can be used to describe limitations with discrete state machines
 - Best known is Godel's theorem
 - Shows that in any sufficiently powerful logical system, statements can be made which can't be proven or disproven with said system, unless the system itself is inconsistent
 - Another is due to *Church, Kleene, Rosser, and Turing*
 - More convenient to consider - directly refers to machines compared to other theorems, which may require some method of describing logical systems in terms of machines and vice versa
 - Theoretical machine - essentially a digital computer with infinite memory
 - States that there are some things such a machine can't do
 - If it is set up to be used in the imitation game, it may give some wrong answers or not give one at all
 - However, another machine might be able to
 - Note these are yes or no questions only
 - Questions that may not be able to be answered are ones that ask the machine to consider another one in standard form

- Argued that this proves a disability of the machine where human intellect isn't the subject
 - Only true of one particular machine, not every machine
 - Who is to say human intellect also doesn't have such limitations
- The Argument from Consciousness
 - Machines can't **feel**
 - Appears to be a denial of the test
 - Extreme form of this view is lends itself to the view that one can't really know if a machine thinks except if one becomes the machine
 - Then explains these feelings to the world
 - Of course, no one would believe
 - Taking this view, no one knows if a man thinks except by being **that** man
 - Solipsist's viewpoint
 - Hard to communicate ideas properly if one doesn't believe anyone else thinks
- Arguments from Various Disabilities
 - Take the form of:
 - Said machine can do all of **this** but not **X**
 - Often have no backing behind them
 - Formed on the principle of scientific induction
 - Man has seen many thousands of machines, each with a specific purpose, ugly, small range of behaviours, etc.
 - One must therefore conclude that all machines act like this
 - May simply be because of the small storage
 - The "Machines can't make mistakes" claim can be refuted by not making a machine's goal to get the right answer, but rather to win the imitation game
 - Therefore one can't determine if something is a machine simply be looking at its computational answers
 - There are two kinds of mistakes to consider
 - "Errors of functioning"
 - Mechanical errors, disregarded when considering theoretical machines, acts contrary to what it was designed to do
 - "Errors of conclusion"
 - Arise when meaning has been given to machine output
 - May occur sometimes
 - Claim that machines can't be the subject of its own thought can only be examined if it can be shown that there is some thought and some matter
 - Matter is trivial, whatever the machine is operating on
 - A machine can also be its own subject matter, as it may attempt to improve itself, or predict future changes in itself

- By observing itself, it may be able to make itself more efficient for future use
- Lady Lovelace's Objection
 - Provided a detailed information about Babbage's Analytical Engine
 - Turing agrees that machines currently do not exhibit properties of "learning," only what we program them to do
 - Variant
 - A machine can never do something new
 - Better objection is the fact that a machine can never take us by surprise
 - In reality, Turing states that it is quite the opposite, due to not expecting them to do certain things or as a result of his own mistakes
- Argument from Continuity in the Nervous System
 - Nervous system cannot be defined as a discrete-state machine
 - Therefore, it is unreasonable to expect to mimic the nervous system with a discrete state machine
 - Following the rules of the imitation game however, the interrogator will be unable to take advantage of this flaw
 - For example, in a game with a differential analyser vs the digital computer, the digital computer may not be able to give as exact of an answer as the analyser, but it will be able to provide a close answer
- The argument from informality of behaviour
 - Impossible to produce rules that describe what one should do under every circumstance
 - For this, one argues that we can't be machines
- The argument from extra-sensory perception
 - Viz, telepathy, clairvoyance, precognition and psycho-kinesis
 - Seem to deny scientific ideas, which seem to work quite well if we disregard the above
 - More specific example:
 - Imitation game with a man as a telepathic receiver, and a digital computer
 - Interrogator asks for example, what card he is holding in his hand
 - Man gives correct answer 130/400 times
 - Machine guesses, gets perhaps 104
 - Thus interrogator knows who is the man
 - However, suppose the digital computer has a random number generator
 - May be subject to the psycho-kinetic powers of the interrogator
 - Might cause the machine to guess right more often than wrong, so the interrogator will choose wrong
 - Opposite might also happen, interrogator may just know with ESP - with ESP anything is possible