# Alan Turing - Intelligent Machinery (1948)

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### 0.1 Learned in this study

### 0.2 Things to explore

- *two categories*, is that the appropriate way to say that?
- Verify that my definitions of discrete/continuous and controlling/active are correspond with the examples given by Turing

## 1 Overview

Turing starts his paper by presenting five *reasons* as to why people have a hard time accepting that machinery could show intelligent behavior:

1. Unwillingness to accept that something could rival human intelligence
2. Building such a machine would be going against God (or playing God)
3. The inability to see past the *basic* capability of machines
4. Gödel incompleteness theorem pointing at the fact that some queries may end up with the machine unable to ever answer (see also the Entscheidungsproblem)
5. The intelligence displayed by the machine is nothing more than the intelligence of its creator

After touching on the validity of some of those reasons, Turing presents two categories of machinery:

- Discrete vs continuous
- Controlling vs active

### 1.1 Discrete vs continuous

A *discrete* machine has a finite number of possible states. Thus, the machine jumps from one state to the other.

A *continuous* machine on the other hand is more fluid, not being in any particular/exact state at any moment.

### 1.2 Controlling vs active

A *controlling* machine is one that deals only with information. It computes/decides/communicates with the rest of the environment but does not do any physical action itself.

An *active* machine produces a definite physical effect.

## 2 Notes

The following is a series of notes I've taken while I was reading Turing's paper. They are what I identified as the main points he was making throughout the paper.

There are also some things that he has written that have been said but not been detailed, as if they were left to the reader to see for himself. In these instances, I've left myself a question in bold so that I may explore those questions at a later time.

## 2.1 5. Interference with machinery. Modifiable and self-modifying machinery

- Interference: modification done to a machine

## 2.2 6. Man as a machine

- Imitation in the same sense as replication
- No need to reproduce the system exactly as long as the results are the same
- Take advantage of what you have on hand (circuits vs nerves)
- Replace all parts of a human by machinery
- Turing envision s the idea of building robots (thinking machine) as too slow and impracticable (at his time)
- Turing mentions that the brain to be built should be "preferably be restricted to branches where diagrams are not much used". **Why is that?**
- Turing thinks that l learning languages "depend rather too much on sender organs and locomotion to be feasible". **Why is that?**

## 2.3 7. Education of machinery

- Graduates have 20+ years of human experience
- They have acquired many subroutines shared by the community
- They will try new combinations and make small alterations to the routines
- A man is a machine, he is subject to very much interference
- Approximation of a machine without interference when "concentrating"

## 2.4 9. The cortex as an unorganised machine

- The cortex has been trained during childhood
- A large part of that "training" remains in the adult
- The cortex of an infant is an unorganized machine which can be organized by interference training

## 2.5 10. Experiments in organising. Pleasure-pain systems

- Organizing interference through two inputs: pleasure/reward vs pain/punishment
- Two types of expression: character-expression and situation-expression
- character-expression: the expression of someone's character
- situation-expression: the expression of someone's character in a particular situation
- The goal of pleasure/pain is to have a "teacher" which will guide the character toward a desired character

## 2.6 11. The P-Type unorganised machine

- "When a configuration is reached for which the action is undetermined, a random choice for the missing data is made and the appropriate entry is made in the description, tentatively, and is applied"
- Pain cancels the tentative entries
- Pleasure makes them permanent
- A system with a random sequence, a situation (state?), an alternative, a visible action, a stream of reward/punishment and one/multiple streams of data, called sense lines
- Turing mentions that he'd like to do more research on organized machines as well as "try out organising methods that would be more nearly analogous to our 'methods of education'."

- Investigate the result of "methods of education" by the mean of testing them out on machines and breaking in from time to time to observe the results that have been produced so far
- Incorporation of old routines into new ones

### 2.7 12. Discipline and initiative

- For an untrained infant mind to become intelligent, it must acquire both discipline and initiative. **What is it about discipline and initiative that makes those two particularly important?**
- Turing writes "So far we have been considering only discipline". **Is he referring to the punish/reward cycles or the fact that machines are mechanical?**
- He then writes "To convert a brain or machine into a universal machine is the extremest form of discipline"
- Initiative is "that which is required in addition" to discipline
- Two methods to attempt to copy initiative in man in machines
- Direct method
- Attempt to program "the machine to do every kind of job that could be done, as a matter of principle, whether it were economical to do it by machine or not."
- "Make its behaviour be the logical result of a comparatively small number of general principles"
- "To try to bring both discipline and initiative into it at once"
- Program search (searching for a program which will fit a certain specification)
- "Put a programme into [the machine] which corresponds to building in a logical system (like Russell's Principia Mathematica)."
- Instead of doing a full search, you search through values of something else
- A great concern for "searches" (how to look for things)
- "The search for new techniques must be regarded as carried out by the human community as a whole, rather than by individuals."

### 2.8 13. Intelligence as an emotion concept

- "The extent to which we regard something as behaving in an intelligent manner is determined as much by our own state of mind and training as by the properties of the object under consideration. If we are able to explain and predict its behaviour or if there seems to be little underlying plan, we have little temptation to imagine intelligence. With the same object therefore it is possible that one man would consider it as intelligent and another would not; the second man would have found out the rules of its behaviour."

## 3 References


- Turing, Alan. *Intelligent Machinery.* London: National Physical Laboratory, 1948. Ed. B. Jack Copeland. The Essential Turing. Oxford: Clarendon Press, 2004. 411-432
- "Entscheidungsproblem." https://en.wikipedia.org/wiki/Entscheidungsproblem. Web. 2015/10/09