Language & Technology

Lecture 2: Dialog Systems and the Turing Test

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Dialog Systems

- system for talking with user
- colloquial term: **chatbot**

Possible Uses

- 24h phone and online support
  Optimum help chat?
- telemarketing
  Samantha West for health insurance
- video games
  Façade, event[0]

The First and Most Famous Chatbot: ELIZA

- developed by Joseph Weizenbaum (MIT) 1964–1966
- pretends to be psychotherapist
- fooled a surprising number of test subjects

ELIZA Effect

- The tendency of humans to assume computer behavior is analogous to human behavior.
- Reading human intentionality into mechanistic symbol manipulations.

Try it yourself:
`http://www.manifestation.com/neurotoys/eliza.php3`

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How Chatbots "Cheat"

- text only, no speech
- restricted topic of conversation
  medical advise, weather forecast, ...
- formulaic or specialized discourse
  ordering train tickets, room reservation, ...
- grammar with few distinct word forms, restricted word order
  English VS German VS Hungarian

Why Chatbots Need to Cheat

- Dialog is arguably the **hardest problem in NLP**.
- **Requires:**
  - perfect command of English grammar
  - analysis of meaning
  - rich world knowledge
  - ability to keep track of discourse
    save new information, recall established facts
  - correct turn taking
  - understanding non-literal speech
    indirect speech acts, humor, ...
  - sophisticated reasoning
    developing and following arguments

Strategies for Detecting Chatbots

1. **Be annoying**
   Ask the same thing over and over again.
   Do you get contradicting replies?
2. **Be a giant douche**
   Say something that is completely beyond the pale.
   Do you get a scolding or shocked reply?
3. **Be a polyglot**
   Randomly switch languages.
   Do you get replies in a matching language,
   without any mention of the language change?
4. **Be recent**
   Incorporate recent events that a human would be aware of.
   Do you get a meaningful reply?
5. **Be insane**
   Ignore all rules of language (word order, grammar, etc.).
   Do you get a surprisingly normal reply?

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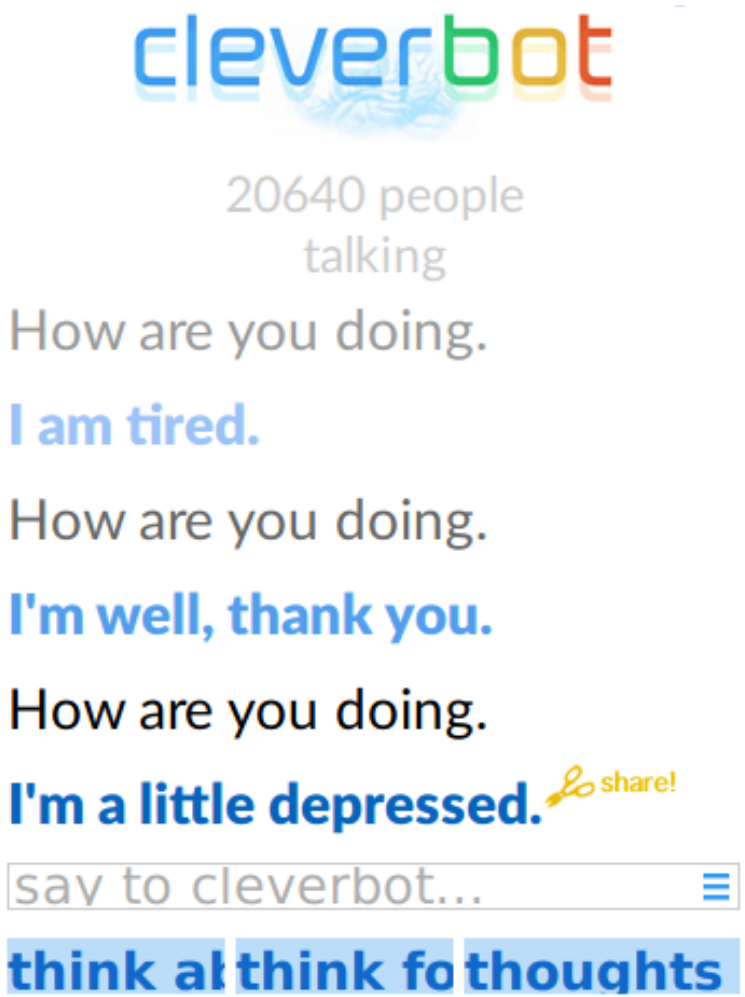
Let's Try Some of This...

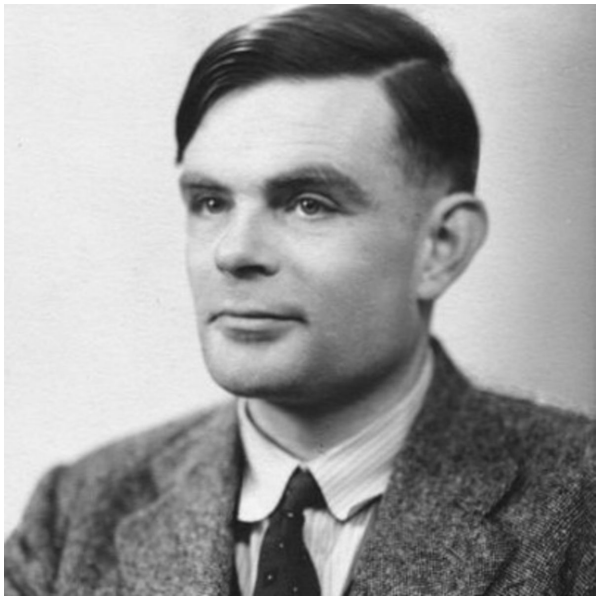
Cleverbot: http://www.cleverbot.com/



The Turing Test

Alan Turing (1912–1954)

- British mathematician/computer scientist
- cracked the *Enigma* in WW2
- father of computation (Turing machine)
- defined artificial intelligence (Turing test)
- extreme long-distance runner (40+ miles)



- Turing was interested in the possibility of artificial intelligence.
- What does it mean for a machine to be **intelligent**?
- **Turing's proposal**
  A machine is intelligent if humans **cannot distinguish it from a human**.

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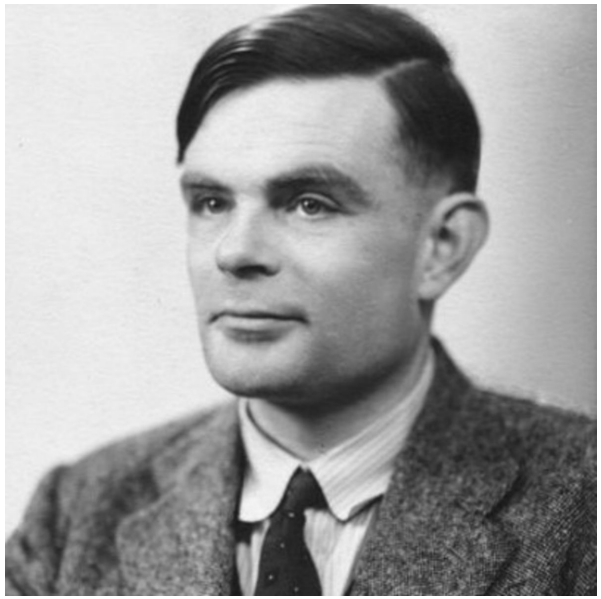

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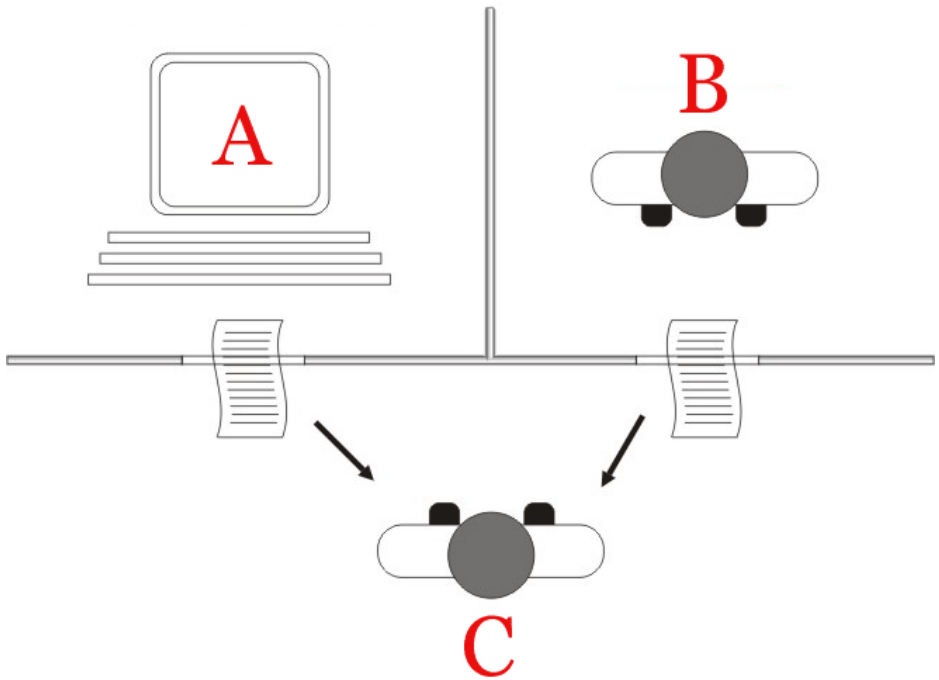
Artificial Intelligence and the Turing Test

Turing Test

- human C joins remote/online chat
- must decide whether they are talking to human B or machine A
- machine A passes test if human C believes it is human

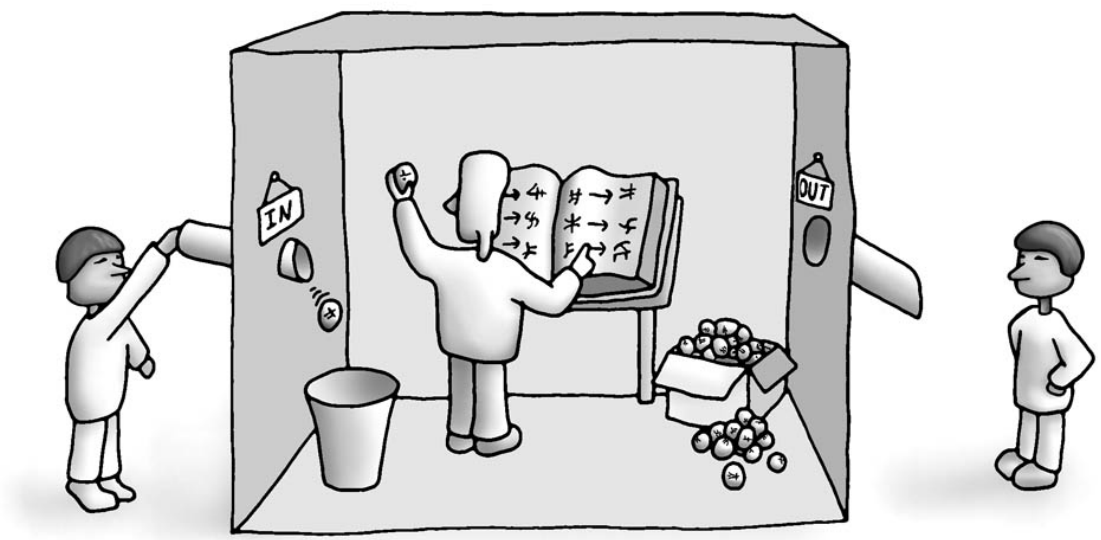


Criticism of the Turing Test

Some believe the Turing test is **too weak**.

Searle's Chinese Room

- Suppose a person who doesn't speak Chinese is locked into a room full of Chinese phrase books.
- To the outsider, the person seems proficient in Chinese.
- appearing intelligent $\neq$ being intelligent



A Different View

I believe the Turing test is **too strong**.

- intelligence $\neq$ human intelligence
- AIs have very different memory and computation abilities.
- We should not expect them to think like humans.
- Also, humans can fail/differ in various aspects of intelligence.
  Autism, Williams syndrome, ...

The Pragmatic Viewpoint

- In the end, all of this only matters for establishing AI rights.
- An AI that is autonomous enough to demand rights is sufficiently intelligent to deserve them.

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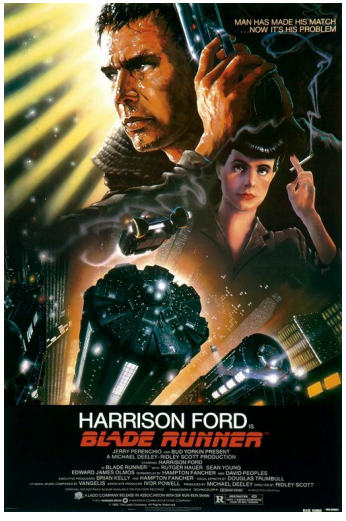
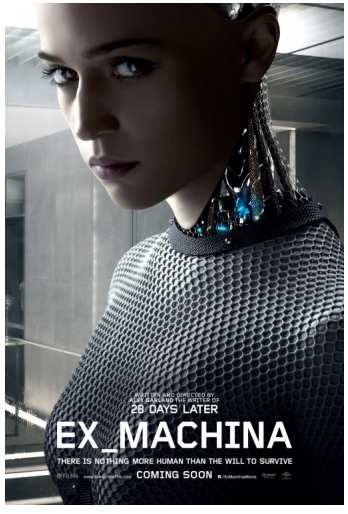
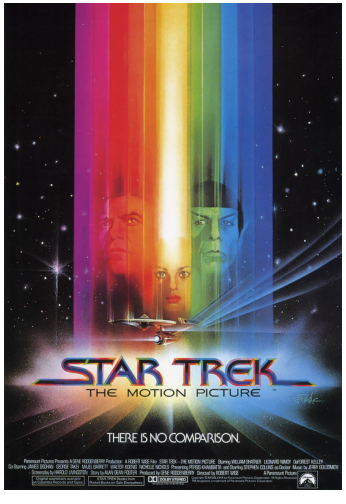
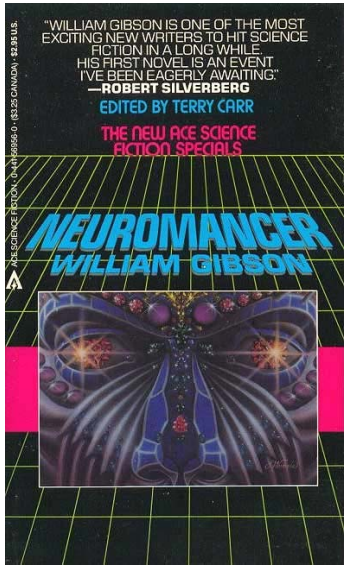
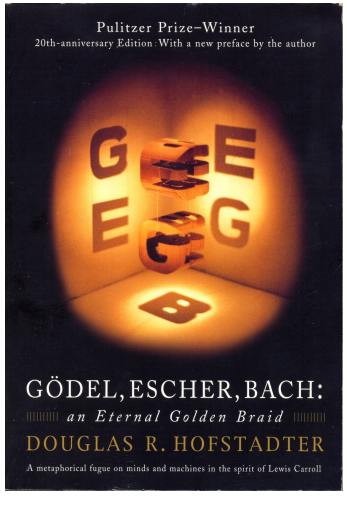
(Artificial) Intelligence in the Media











A Real-World Turing Test: Loebner Prize

- Loebner Prize: $3,000 for chatbot that fools human judges
- meant as a real-world Turing test
- Loebner Prize has been won several times
- **But:** all of the chatbots are just **tweaked versions of Eliza**
- How is this possible?

Analyzing ELIZA

- ELIZA uses pattern matching.
- Specific constructions provide specific responses.

Example

```
1 if 'you' in user_input:
2     print('We were discussing you, not me.')
3 if 'feel' in user_input:
4     print('Tell me more about such feelings.')
```

- Responses can reuse user input with **regular expressions** (more on that in a later lecture)

ELIZA's Legacy

- ELIZA is a simplistic solution for a very complex problem.
- With enough tweaking, chatbots work incredibly well for restricted domains.
- Almost all chatbots nowadays thus follow the ELIZA model.
- This is a shame, as dialogue systems were meant to be the vanguard of artificial intelligence.

Experiment: A Mini Turing Test

- We can't play with Loebner Prize chatbots.
  Most of them are not available online.
- But we can do a mini-experiment with similar technology:
  poetry generators

Haiku

- A very short form of Japanese poetry;
- three phrases of 5, 7, and 5 syllables;
- an example by Basho.

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初しぐれ猿も小蓑をほしげ也
はつしぐれさるもこみのをほしげなり

the first cold shower
even the monkey seems to want
a little coat of straw

Evaluation

Liked This?

For more of this, go to *bot or not* at `botpoet.com`

- Writing convincing poems is **easier** because
  - there is no interactivity
  - poems can be gibberish
- But it is also **harder** because
  - there is meter and rhyme,
  - you need greater stylistic diversity,
  - you cannot reuse user input.
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Recent Loebner Prize Winner: Eugene Goostman

- pretends to be 13 year old boy from Ukraine
- explains:
  - broken English
  - no knowledge of American culture
  - uncooperative conversation (stubborn child)
  - random topic changes

The Trick

- Loebner prize winners fail standards of human intelligence.
- Instead, they use social engineering to lower expectations.

The Loebner Prize Misses the Point

- The Turing test is meant as a means for testing whether a very sophisticated machine is truly intelligent.
- The chatbots competing for the Loebner prize are obviously not intelligent since they are just Eliza on steroids.
- Passing the Turing test is pointless if
  - we already know that the machines aren't intelligent,
  - passing depends on lowering the evaluation standards.
- Scientifically, the **Loebner prize is completely worthless**.

Stuart Shieber's Pogo Stick Analogy

- Suppose you have a competition for building the first human-powered flying machine.
- The ambitious flying machines do not get off the ground, while a pogo stick manages to stay in the air for a few seconds.
- So from then on people keep improving pogo sticks.
- But obviously even the best pogo stick will never allow you to fly.

Reference

`http://www.eecs.harvard.edu/~shieber/Biblio/Papers/loebner-rev-html/loebner-rev-html.html`

Leaving Pogo Sticks Behind

- A machine that can pass the Turing test needs **genuine understanding of language and the world**.
- We are still many years away from that (probably hundreds).
- But we can do better than current technology:
  - better computational machinery
  - more linguistic know-how

Appendix

More on Alan Turing

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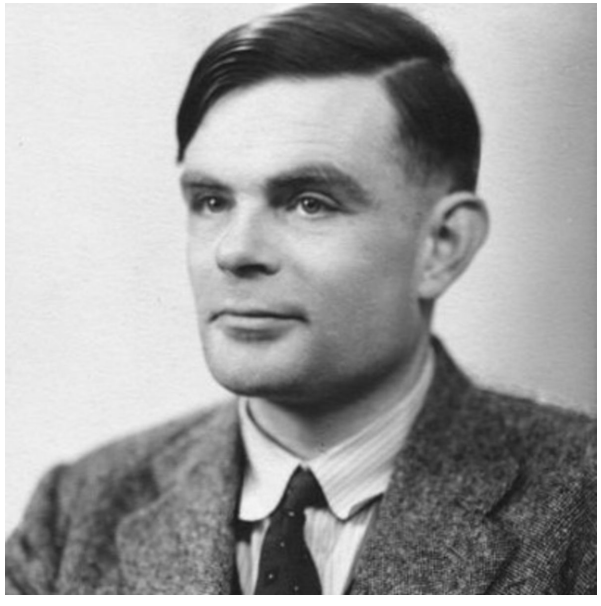
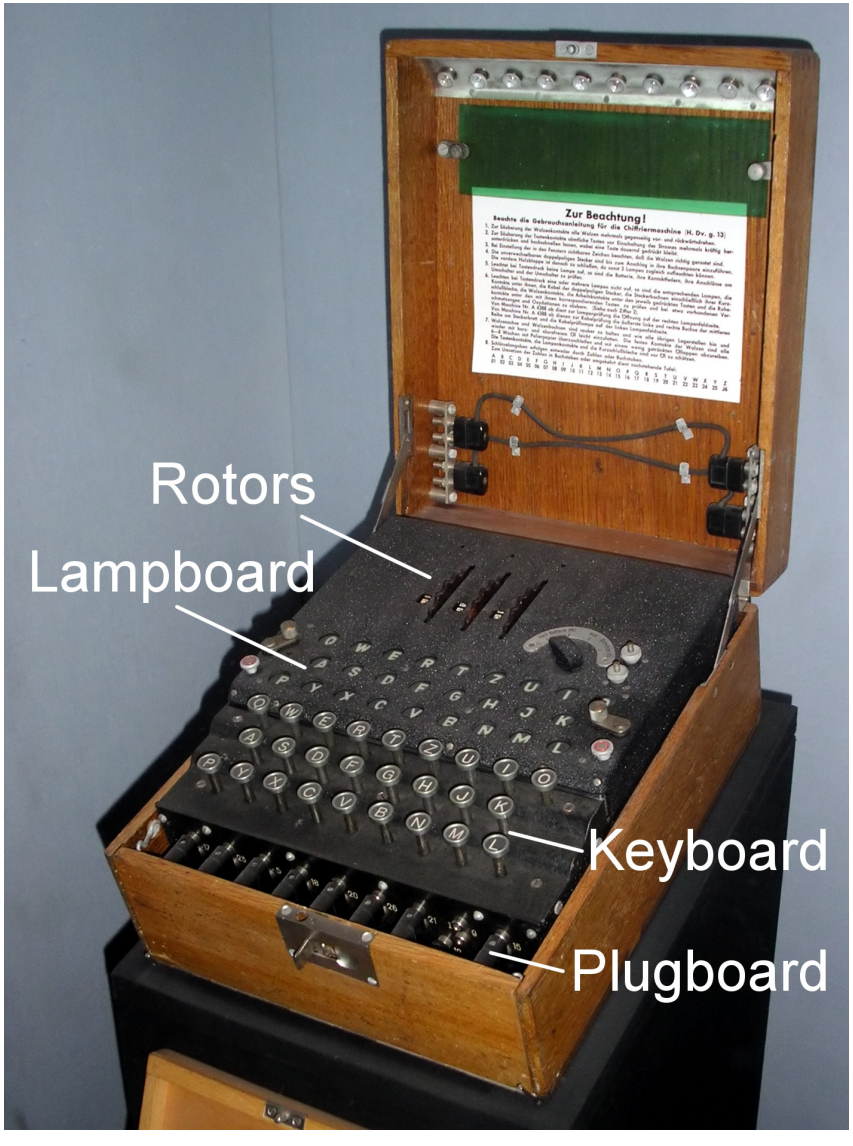


Tragic Death

- Turing was gay, a criminal offense in 50s UK.
- Turing was sentenced to undergo hormone treatment, which rendered him impotent and caused severe depression.
- Two years later he died of cyanide poisoning (probably suicide).

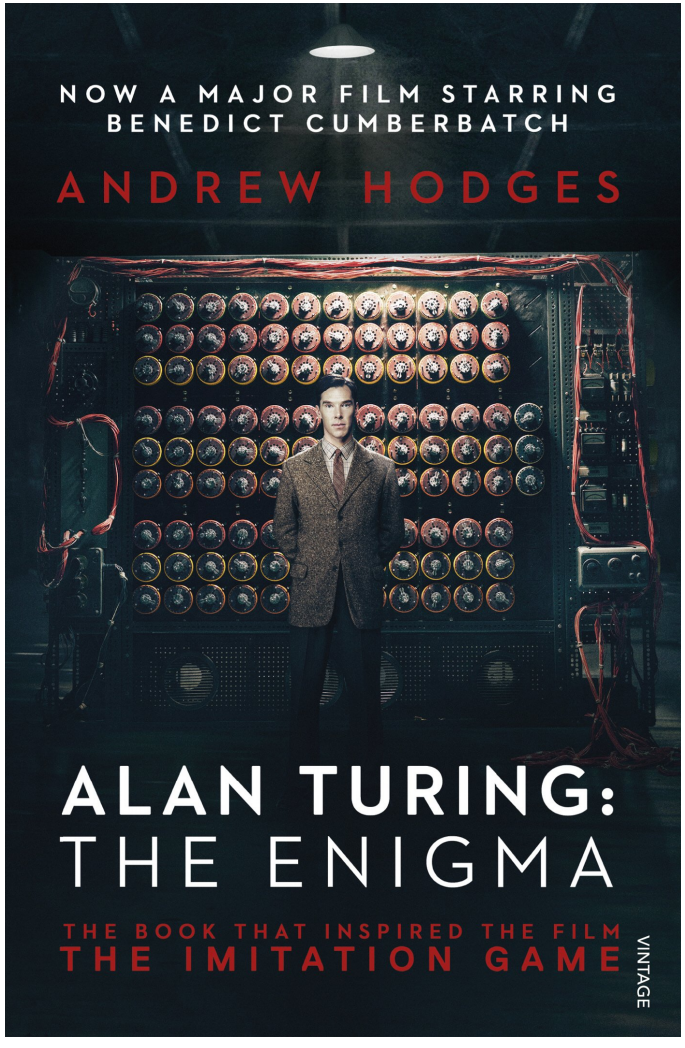
Enigma

- Nazi encryption device.
- Based on automatic key substitution
- Substitution table changed after every key press.
- **Crucial weakness**
  Substitutions depend on plugboard configuration
  $\Rightarrow$
  messages with same configuration use same substitutions



Book/Movie Recommendation

- long time out of print
- recent reprint thanks to movie *The Imitation Game*
- get it while it lasts



Turing as the Founding Father of Computer Science

On Computable Numbers, with an Application to the Entscheidungs Problem (1936)

What is a Turing Machine?

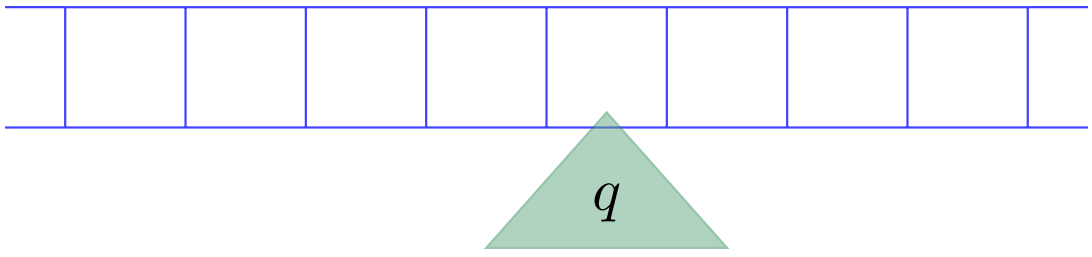
- General purpose computing machine
- **Memory:**
  infinite tape that can be filled with symbols
- **Program:**
  finite set of instructions for filling tape with symbols

Turing Machine

- Turing machine is abstract, does not specify hardware
  tape could be a line of water buckets. . .
- Function or process is computable if and only if computable by Turing machine
- Turing machines are **universal models of computation**.
- Modern-day computers = Turing machines with finite tape

Full Specification of Turing Machine

Infinite Tape with Read/Write Head and State Register



Instruction Table

state	*tape symbol*	*write action*	*move action*	*new state*
		delete symbol *or* write new symbol *or* do nothing	left *or* right *or* stay	

Example of Turing Machine

Instruction Table

state	*tape symbol*	*write action*	*move action*	*new state*
A	0	none	none	done
A	1	print(0)	$\Leftarrow$	B
B	0	none	$\Leftarrow$	C
B	1	none	$\Leftarrow$	B
C	0	print(1)	$\Rightarrow$	D
C	1	none	$\Leftarrow$	C
D	0	none	$\Rightarrow$	E
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E	0	print(1)	$\Leftarrow$	A
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C

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A	1	print(0)	$\Leftarrow$	B
B	0	none	$\Leftarrow$	C
B	1	none	$\Leftarrow$	B
C	0	print(1)	$\Rightarrow$	D
C	1	none	$\Leftarrow$	C
D	0	none	$\Rightarrow$	E
D	1	none	$\Rightarrow$	D
E	0	print(1)	$\Leftarrow$	A
E	1	none	$\Rightarrow$	E

0 0 1 0 0 1 0 0 0 0 0

A

Example of Turing Machine

Instruction Table

state	*tape symbol*	*write action*	*move action*	*new state*
A	0	none	none	done
A	1	print(0)	$\Leftarrow$	B
B	0	none	$\Leftarrow$	C
B	1	none	$\Leftarrow$	B
C	0	print(1)	$\Rightarrow$	D
C	1	none	$\Leftarrow$	C
D	0	none	$\Rightarrow$	E
D	1	none	$\Rightarrow$	D
E	0	print(1)	$\Leftarrow$	A
E	1	none	$\Rightarrow$	E

0 0 1 0 0 1 0 0 0 0 0

B

Example of Turing Machine

Instruction Table

state	*tape symbol*	*write action*	*move action*	*new state*
A	0	none	none	done
A	1	print(0)	$\Leftarrow$	B
B	0	none	$\Leftarrow$	C
B	1	none	$\Leftarrow$	B
C	0	print(1)	$\Rightarrow$	D
C	1	none	$\Leftarrow$	C
D	0	none	$\Rightarrow$	E
D	1	none	$\Rightarrow$	D
E	0	print(1)	$\Leftarrow$	A
E	1	none	$\Rightarrow$	E

0 0 1 0 0 1 0 0 0 0 0

C

Example of Turing Machine

Instruction Table

state	*tape symbol*	*write action*	*move action*	*new state*
A	0	none	none	done
A	1	print(0)	$\Leftarrow$	B
B	0	none	$\Leftarrow$	C
B	1	none	$\Leftarrow$	B
C	0	print(1)	$\Rightarrow$	D
C	1	none	$\Leftarrow$	C
D	0	none	$\Rightarrow$	E
D	1	none	$\Rightarrow$	D
E	0	print(1)	$\Leftarrow$	A
E	1	none	$\Rightarrow$	E

0 0 1 0 0 1 0 0 0 0 0

C

Example of Turing Machine

Instruction Table

state	*tape symbol*	*write action*	*move action*	*new state*
A	0	none	none	done
A	1	print(0)	$\Leftarrow$	B
B	0	none	$\Leftarrow$	C
B	1	none	$\Leftarrow$	B
C	0	print(1)	$\Rightarrow$	D
C	1	none	$\Leftarrow$	C
D	0	none	$\Rightarrow$	E
D	1	none	$\Rightarrow$	D
E	0	print(1)	$\Leftarrow$	A
E	1	none	$\Rightarrow$	E

0 1 1 0 0 1 0 0 0 0 0

C

Example of Turing Machine

Instruction Table

state	*tape symbol*	*write action*	*move action*	*new state*
A	0	none	none	done
A	1	print(0)	$\Leftarrow$	B
B	0	none	$\Leftarrow$	C
B	1	none	$\Leftarrow$	B
C	0	print(1)	$\Rightarrow$	D
C	1	none	$\Leftarrow$	C
D	0	none	$\Rightarrow$	E
D	1	none	$\Rightarrow$	D
E	0	print(1)	$\Leftarrow$	A
E	1	none	$\Rightarrow$	E

0 1 1 0 0 1 0 0 0 0 0

D

Example of Turing Machine

Instruction Table

state	*tape symbol*	*write action*	*move action*	*new state*
A	0	none	none	done
A	1	print(0)	$\Leftarrow$	B
B	0	none	$\Leftarrow$	C
B	1	none	$\Leftarrow$	B
C	0	print(1)	$\Rightarrow$	D
C	1	none	$\Leftarrow$	C
D	0	none	$\Rightarrow$	E
D	1	none	$\Rightarrow$	D
E	0	print(1)	$\Leftarrow$	A
E	1	none	$\Rightarrow$	E

0 1 1 0 0 1 0 0 0 0 0

D

Example of Turing Machine

Instruction Table

state	*tape symbol*	*write action*	*move action*	*new state*
A	0	none	none	done
A	1	print(0)	$\Leftarrow$	B
B	0	none	$\Leftarrow$	C
B	1	none	$\Leftarrow$	B
C	0	print(1)	$\Rightarrow$	D
C	1	none	$\Leftarrow$	C
D	0	none	$\Rightarrow$	E
D	1	none	$\Rightarrow$	D
E	0	print(1)	$\Leftarrow$	A
E	1	none	$\Rightarrow$	E

0 1 1 0 0 1 0 0 0 0 0

E

Example of Turing Machine

Instruction Table

state	*tape symbol*	*write action*	*move action*	*new state*
A	0	none	none	done
A	1	print(0)	$\Leftarrow$	B
B	0	none	$\Leftarrow$	C
B	1	none	$\Leftarrow$	B
C	0	print(1)	$\Rightarrow$	D
C	1	none	$\Leftarrow$	C
D	0	none	$\Rightarrow$	E
D	1	none	$\Rightarrow$	D
E	0	print(1)	$\Leftarrow$	A
E	1	none	$\Rightarrow$	E

0 1 1 0 1 1 0 0 0 0 0

E

Example of Turing Machine

Instruction Table

state	*tape symbol*	*write action*	*move action*	*new state*
A	0	none	none	done
A	1	print(0)	$\Leftarrow$	B
B	0	none	$\Leftarrow$	C
B	1	none	$\Leftarrow$	B
C	0	print(1)	$\Rightarrow$	D
C	1	none	$\Leftarrow$	C
D	0	none	$\Rightarrow$	E
D	1	none	$\Rightarrow$	D
E	0	print(1)	$\Leftarrow$	A
E	1	none	$\Rightarrow$	E

0 1 1 0 1 1 0 0 0 0 0

A

Another Book Recommendation

- friendly intro to Turing machines
- development of computers after Turing's initial paper
- in particular origins at Manhattan project in Los Alamos