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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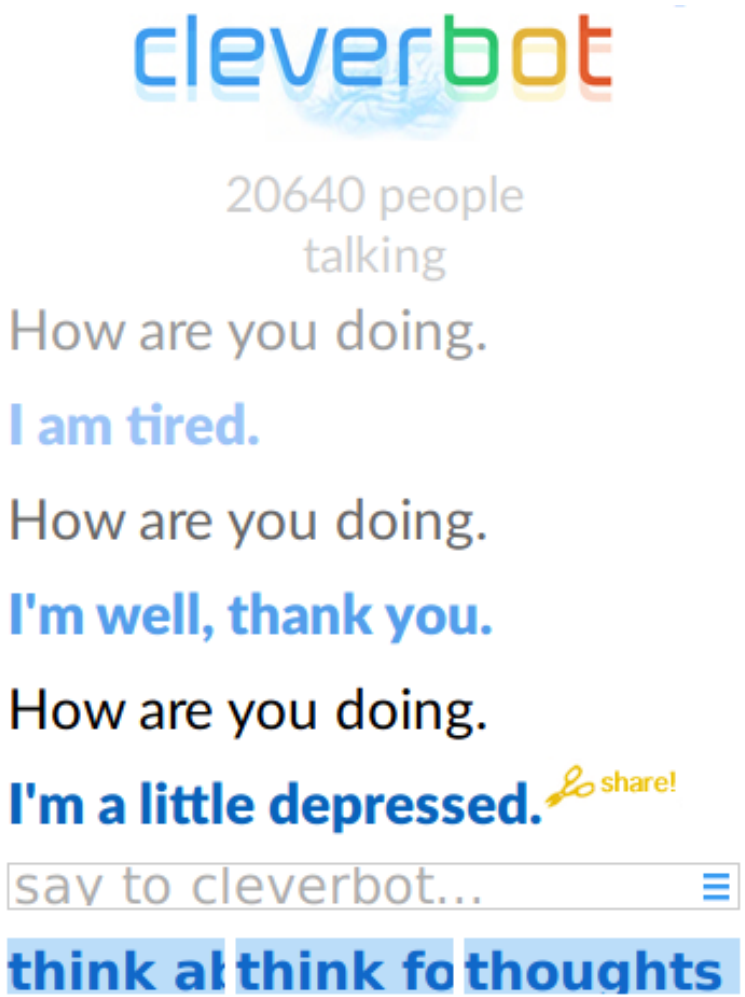
Let's Try Some of This...

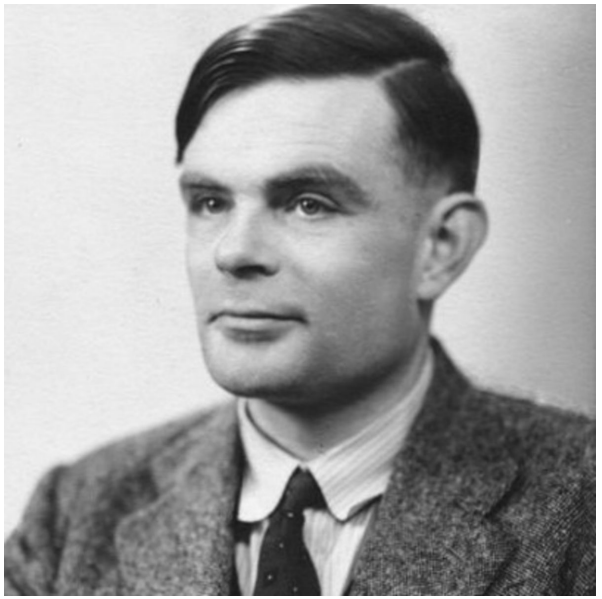
Cleverbot: http://www.cleverbot.com/



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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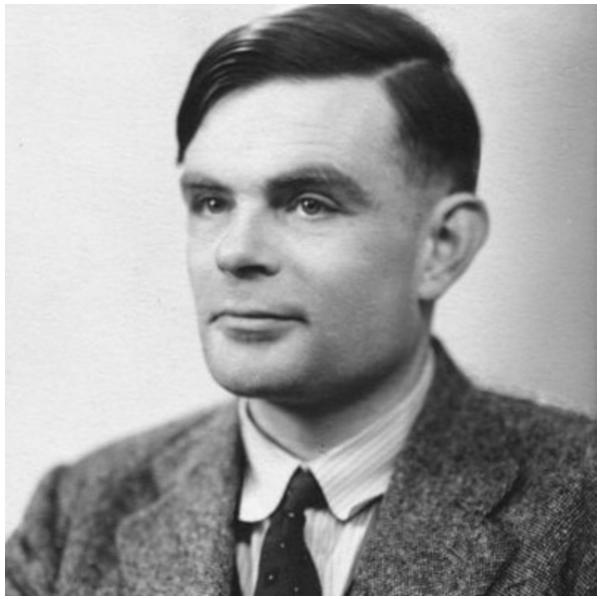

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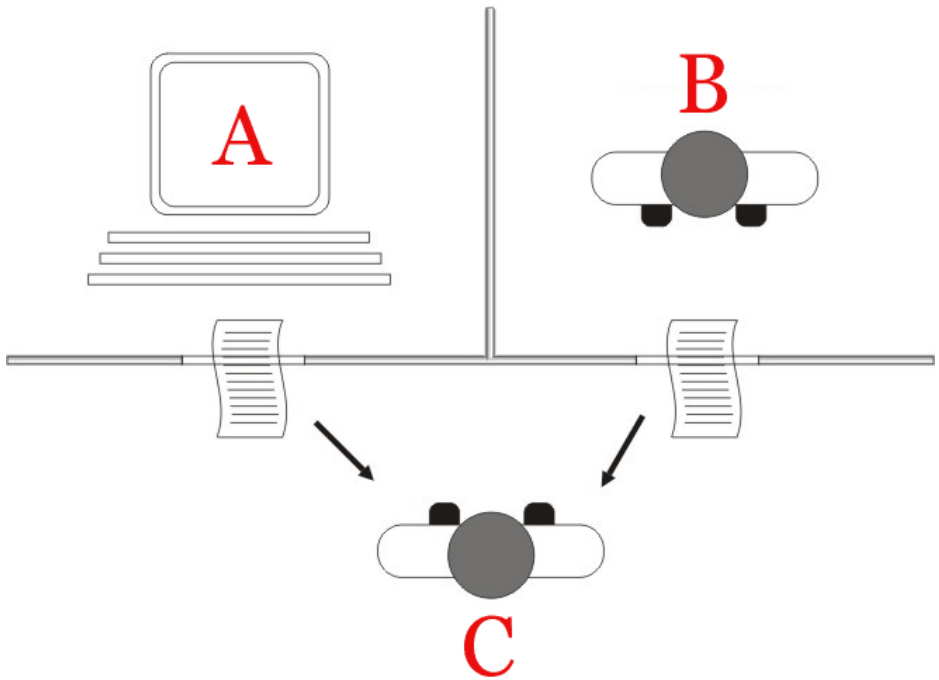
Artificial Intelligence and the Turing Test

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

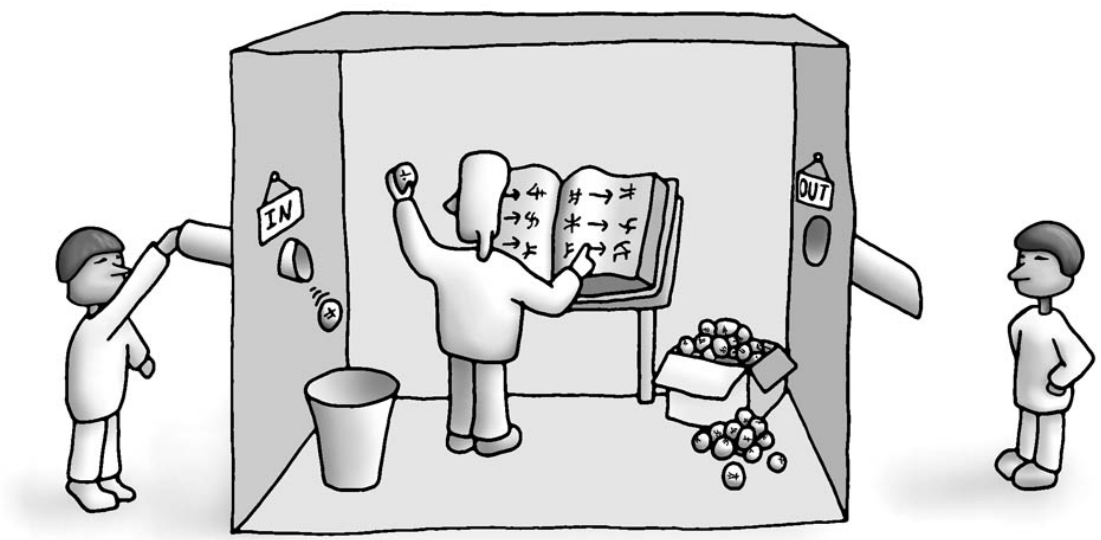


Criticism of the Turing Test

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



My Personal 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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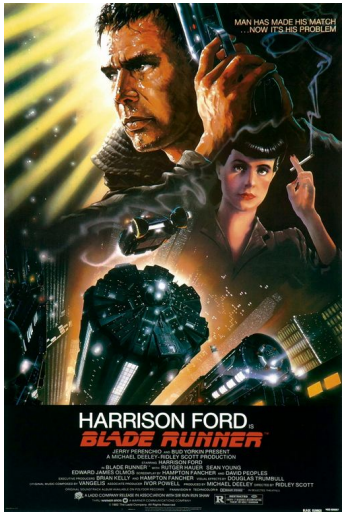
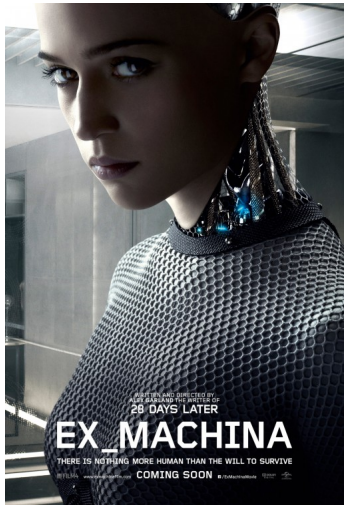
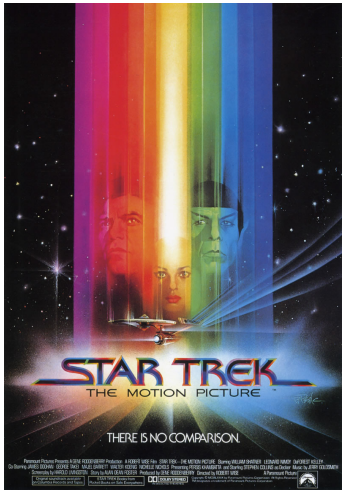
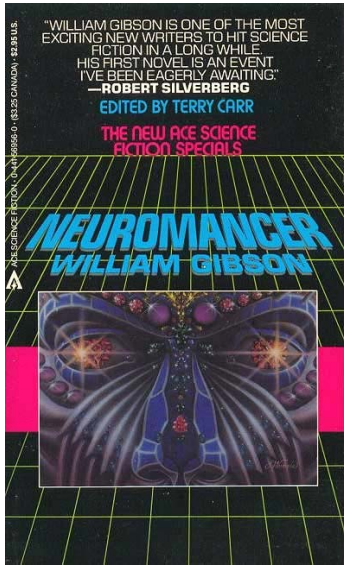
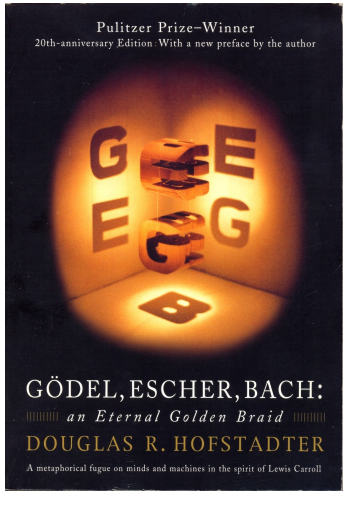
(Artificial) Intelligence in the Media











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
- The next four slides include poems and lyrics
  (sometimes only excerpts).
- For each one, guess whether it was written by a human.

Poem 1

Try to hold on
And we have survived
Try to hold on
And no one should deny
We tried to hold on to the pulse of the feedback current
Into the flow of encrypted movement
Slapback kills the ancient remnants
That try to hold on
Pop tart
You never listen
Skinned knees
Try to hold on
Stop start
What's our mission
Skinned knees
Try to hold on

Poem 2

a phoenix rising
from an extremely incriminating photo of us
friendly reminder
unrelated side note
i became pregnant with me
actually my giant face is nearly sold out of
irony, sincerity, vagueness, kafka, racism, feminism, kant,
buddhism, internet
names of mind leaping over obstacles set by adults
reality in my internal universe in transit
an exhausted observing male teenaged individual
is the intrepid orange cat

Poem 3

A wounded deer leaps highest,
I've heard the daffodil
I've heard the flag to-day
I've heard the hunter tell;
'Tis but the ecstasy of death,
And then the brake is almost done,
And sunrise grows so near
sunrise grows so near
That we can touch the despair and
frenzied hope of all the ages.

Poem 4

some men just want to watch the world burn

Poem 4

some men just want to watch the world burn
some men just want to watch the world learn

Poem 4

some men just want to watch the world burn
some men just want to watch the world learn
some men just want breakfast

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.
- Given these results, do you think anybody has won the Loebner prize?

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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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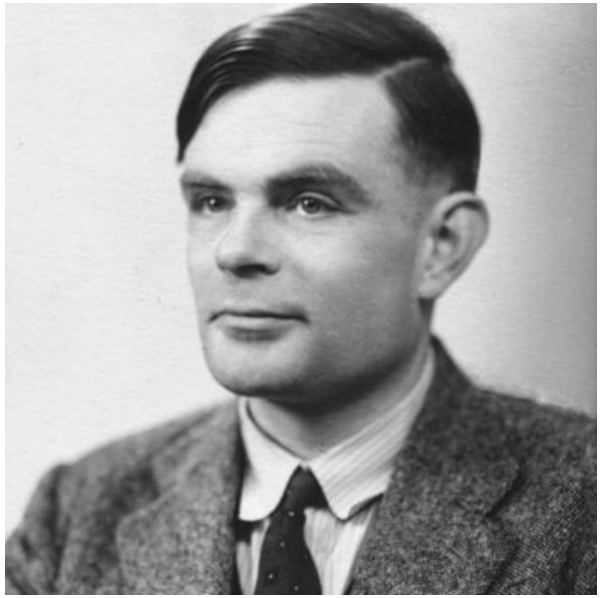
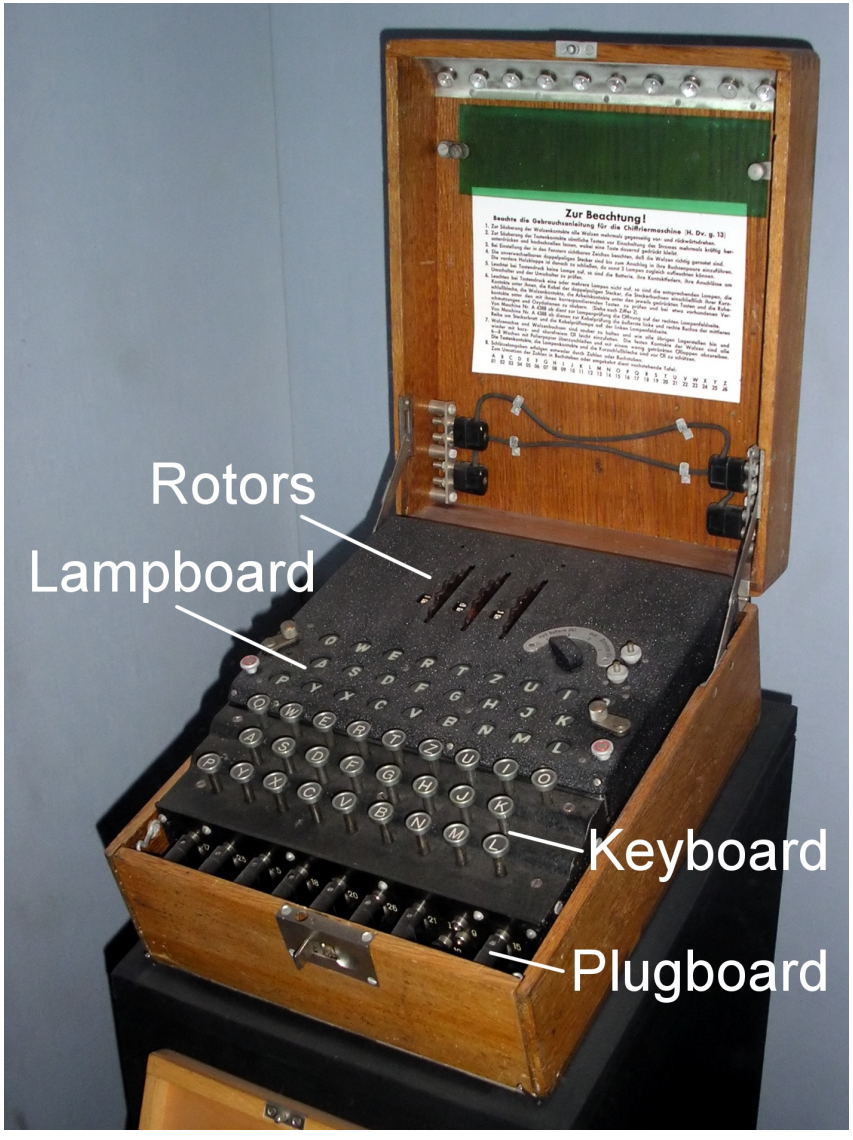


Tragic Death

- 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).

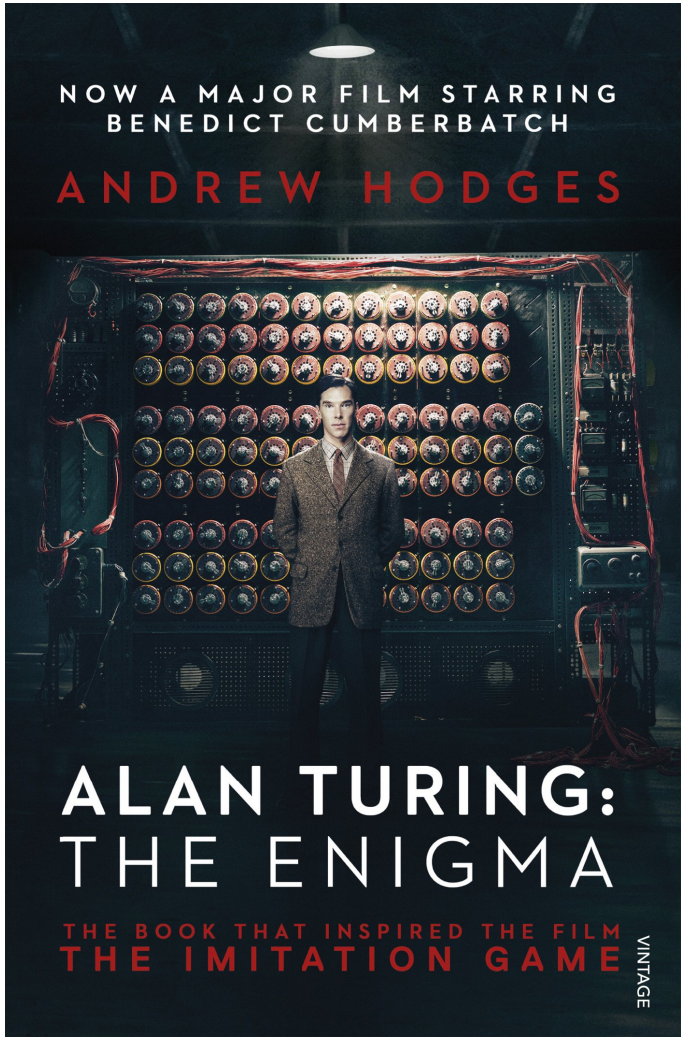
Enigma

- 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?

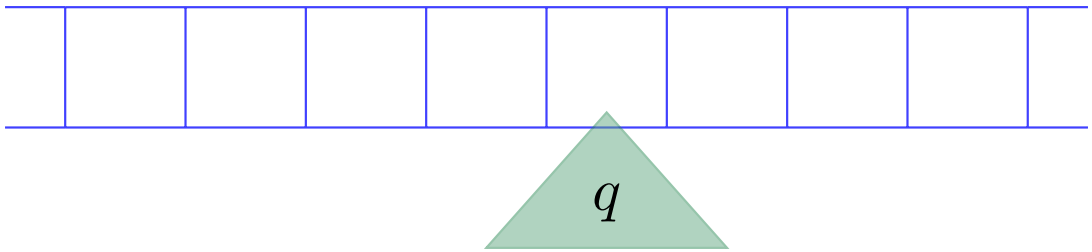
- General purpose computing machine
- **Memory:**
  infinite tape that can be filled with symbols
- **Program:**
  finite set of instructions for filling tape with symbols

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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0 0 0 0 1 1 0 0 0 0 0

A

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B

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C

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D

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E	1	none	$\Rightarrow$	E

0 0 1 0 1 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

A

Example of Turing Machine

Instruction Table

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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
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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