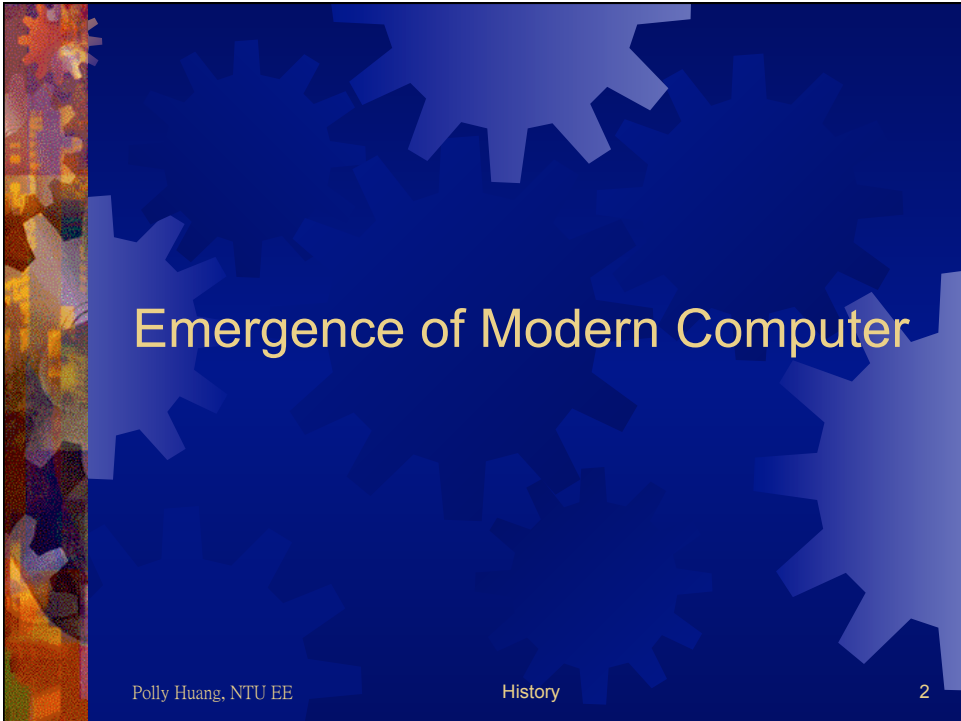


Introduction to Computer Science

Polly Huang
NTU EE
<http://homepage.ntu.edu.tw/~pollyhuang>
pollyhuang@ntu.edu.tw

Polly Huang, NTU EE History 1



Emergence of Modern Computer

Polly Huang, NTU EE History 2

What's a Computer?

com·put·er

Pronunciation: kâm-'pyü-ter

Function: *noun*

Usage: *often attributive*

Date: 1646

: one that computes; *specifically* : a programmable electronic device that can store, retrieve, and process data

(Source: Merriam-Webster, <http://www.m-w.com/>)

Calculator

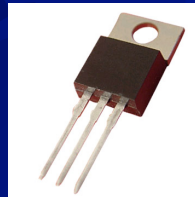
- ☀ Subject: numbers
- ☀ Manipulation: arithmetic, functions
- ☀ Limited use

Modern Computer

- ☀ Subject: data
 - number, text, audio/visual
- ☀ Manipulation: programmable
 - storing, retrieving, all sorts of processing
- ☀ General purpose

Making a Long Story Short

- ☀ 30,000 BC to 20,000 BC Carving notches into bones
- ☀ 1500 AD Leonardo da Vinci's mechanical calculator
- ☀ 1900 AD John A. Fleming invented the **vacuum tube**
- ☀ 1926 AD First patent for a semiconductor transistor
- ☀ 1937 AD Alan Turing invented the **Turing Machine**



Alan Turing

- His **theoretical work** lays the foundation of computers science.
- Emerged from his **practical work** is the first (with strong evidence) programmable, digital, electronic computer that solved real-world problems.

The Origin

- 1912, Paddington London
- To an upper-mid-class family
- Foster-homed until 1926
- Proud but lacking communication skill

The Daisy Days

- ☀ Conscious but troubled
- ☀ Neglected but encouraged
- ☀ Looking for a simple crisp rule for everything

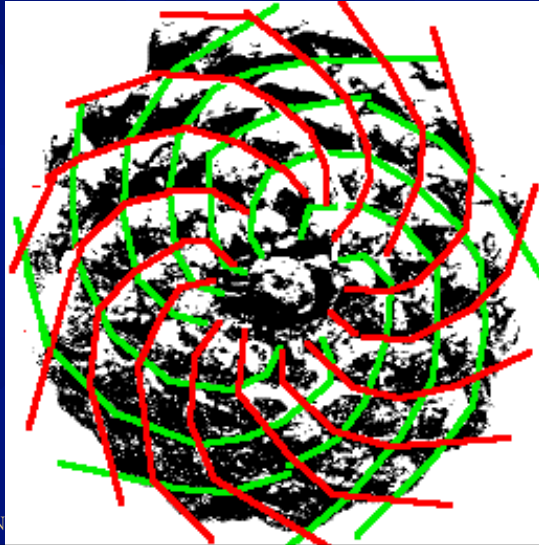


(Source: Alan Turing Scrapbook, <http://www.turing.org.uk/turing/scrapbook/early.html>)

Sunflower



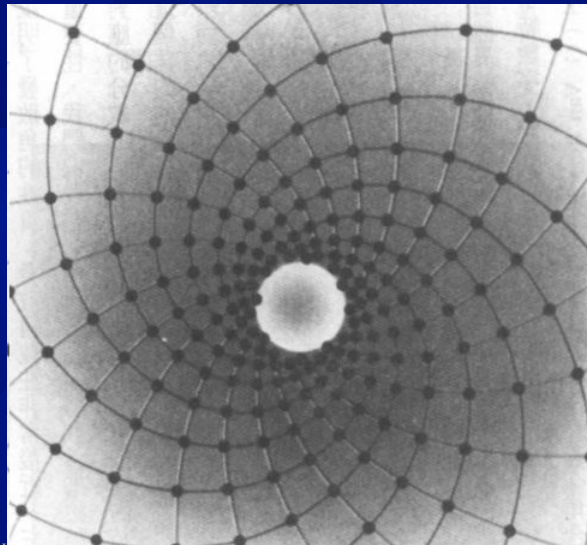
Tracing the Pattern



Polly Huang, N

11

The Model



Polly Huang, NTU EE

History

12

Patterns

☀ 1, 2, 3, 4, 5, 6, 7, ?

$$X_{i+1} = X_i + 1$$

☀ 1, 3, 5, 7, 9, ?

$$X_{i+1} = X_i + 2$$

☀ 1, 2, 4, 8, 16, ?

$$X_{i+1} = 2X_i$$

☀ 0, 1, 1, 2, 3, 5, 8, 13, ?

$$X_{i+1} = X_i + X_{i-1}$$

Opposite Attraction

☀ Alan Turing



- Isolated
- Awkward
- Misunderstood prodigy

☀ Christoph Morcom



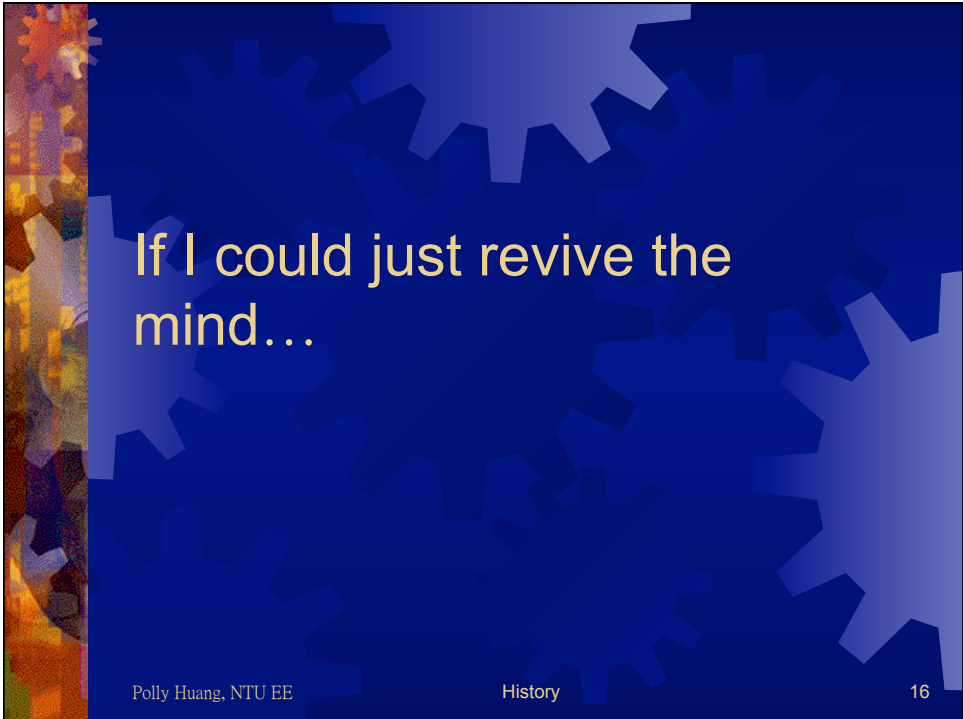
- Social
- Knowledgeable
- Renown prodigy

(Source: Alan Turing Scrapbook, <http://www.turing.org.uk/turing/scrapbook/spirit.html>)



Special Companionship

- ☀ First to break the ice
- ☀ Inspirational
- ☀ Unspeakable, perhaps
- ☀ Tragic end



If I could just revive the
mind...



So, how does the mind work?

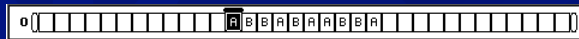
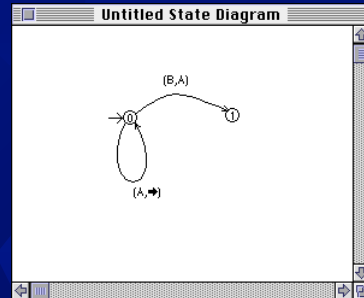


Turing Machine

- ☀ Reduce to the simplest and the most abstract form
- ☀ States of mind
 - think photos
- ☀ Transitions from one state to another
 - think movies

Theory and Practice

- The theoretical part
 - state machine
- The practical part
 - head and tape



(Source: Turing's World, <http://www-csli.stanford.edu/hp/Turing1.html>)

Real-Life Example

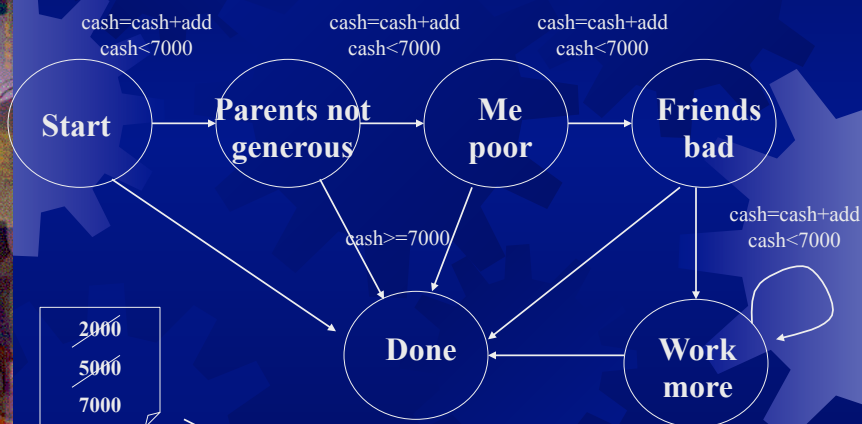
- Suppose you want to buy the hottest mp3 player in the market
- It costs about NT\$7000
- What is the thinking process involved here to collect the NT\$7000?

Getting NT\$7000

- Ask parents
- If not enough, check bank saving
- If not enough, borrow from friends
- If not enough, get a part-time job
- ...

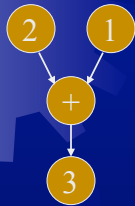
The Machine

- Ask parents
- If not enough, check bank saving
- If not enough, borrow from friends
- If not enough, get a part-time job
- ...

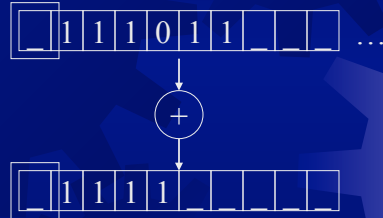


Computer Example: an Adder

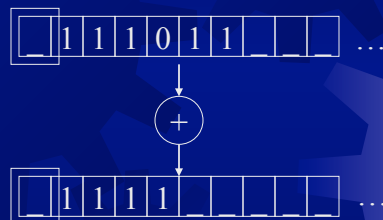
$$2+1=3$$



Let n be represented by $(n+1)$ 1's

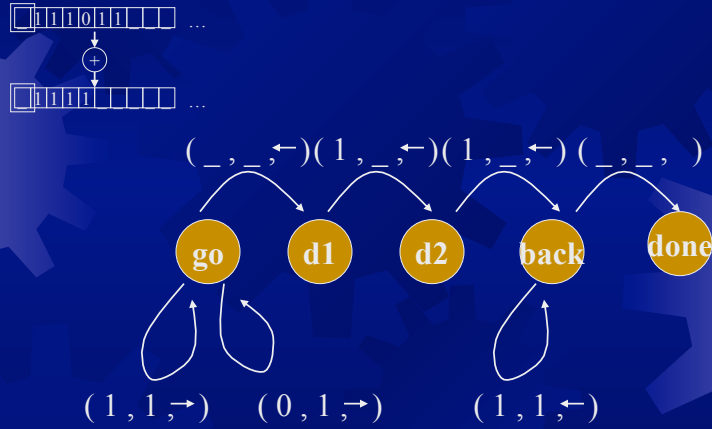


One Solution



- Turn the 0 to 1
- Erase the two 1's at the end

State Diagram for the Solution

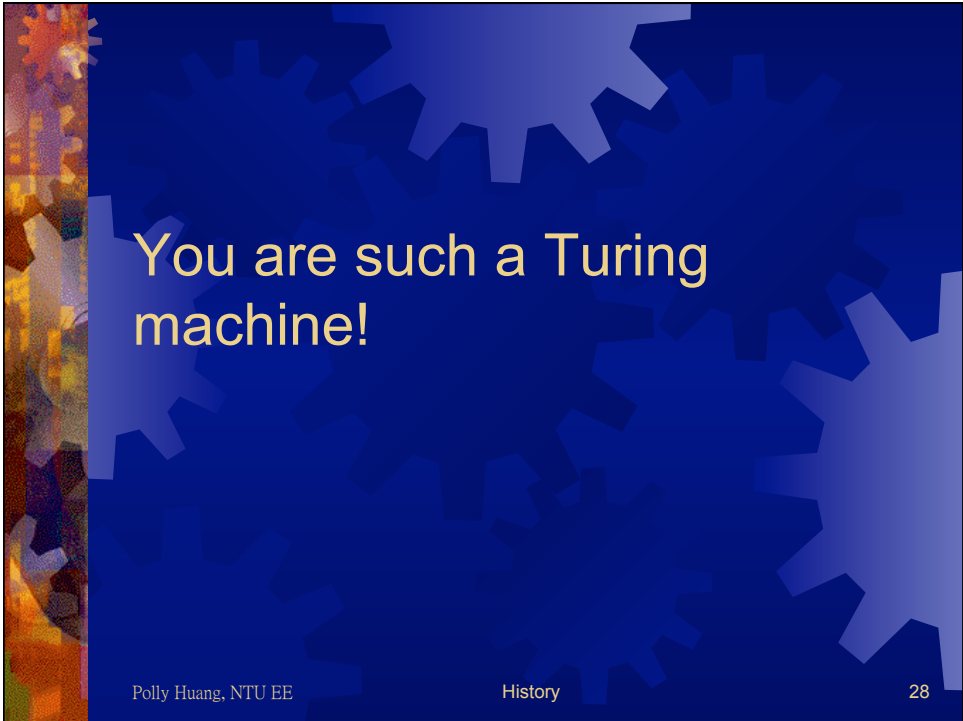


@!*#\$%&@...

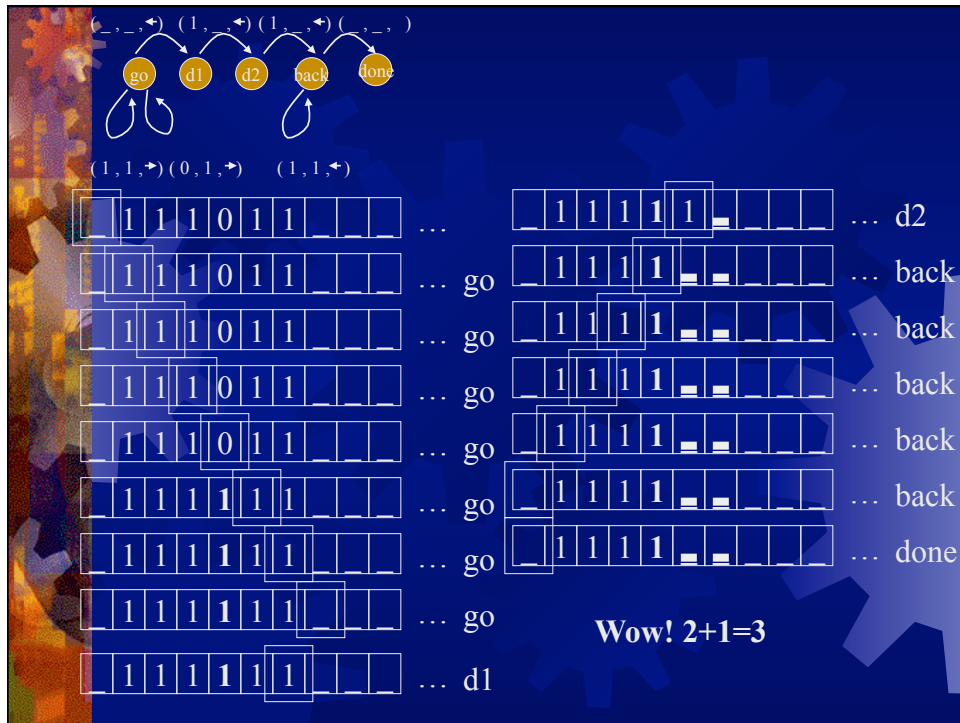


Let's play a role-playing
game.

The best way to understand
somebody is to be that
somebody...



You are such a Turing
machine!



Now, come back!
 What do you feel about being a Turing machine?
 Polly Huang, NTU EE History 30

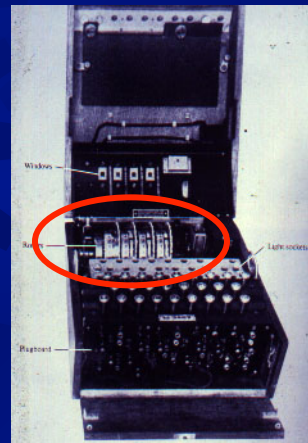
Building the Real Machine

- 1939 AD John V. Atanasoff's special-purpose electronic digital computer
- 1941 AD Konrad Zuse and his Z1, Z3, and Z4
- 1943 AD Alan Turing and COLOSSUS

Bombe

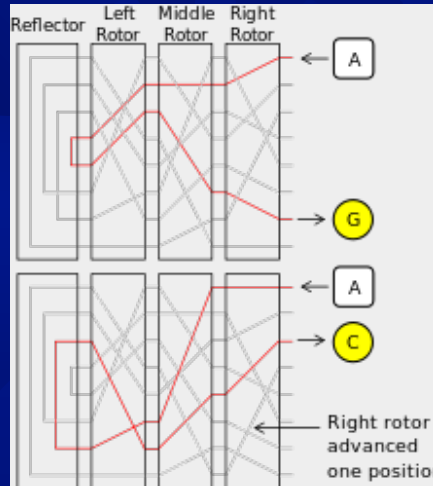
The Enigma

- German cipher machine
- Messages in, non-sense out
- Different non-sense every time
 - Avoid frequency analysis



(Source: Alan Turing Scrapbook, <http://www.turing.org.uk/turing/scrapbook/ww2.html>)

The Cypher Illustrated



The Rollers

- Rotates every stroke
- With the original positioning of the rollers
- Non-sense in, secrets out
- Each position represented by a letter
- The letter combination is referred to as the KEY

Guessing the Key

- ✦ Trying different mappings
- ✦ Leave the computation to Bombe

Bombe

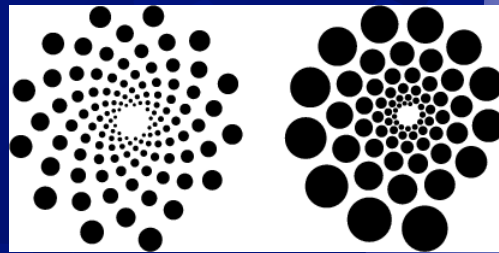
- ✦ 1,800 vacuum tubes
- ✦ It could still take weeks to crack the key
- ✦ German intelligence did not anticipate this



(Source: Alan Turing Scrapbook, <http://www.turing.org.uk/turing/scrapbook/ww2.html>)

Living in the Past

- ☀️ Chris cloning
 - Neural Networks
 - Artificial Intelligence
- ☀️ Daisy watching
 - Fibonacci series



(Source: WOLFRAM Research, <http://mathworld.wolfram.com/Daisy.html>)

0,1,1,2,3,5,8,13,...

The Moral

- ☀️ Wars create hero.
- ☀️ And by hero, I meant Bombe!

Rest of the Story

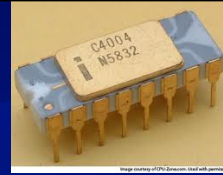
- 1943-46 AD The first general-purpose electronic computer -- ENIAC
- 1944 AD Harvard U. Mark I

Mark I



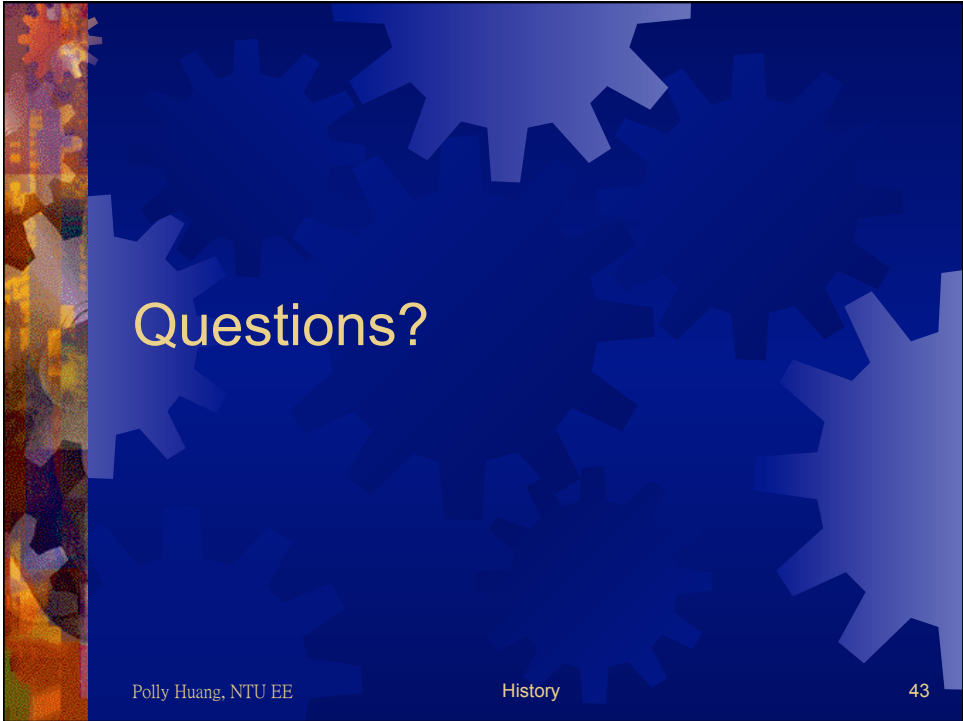
Rest of the Story

- 1943-46 AD The first general-purpose electronic computer -- ENIAC
- 1944 AD Harvard U. Mark I
- 1945 AD The "first" computer bug
- 1969 AD The first computer on the ARPANET (later grew into the Internet)
- 1971 AD The first microprocessor: the 4004
- 1975 AD The first PC, MIT Altair (Apple)



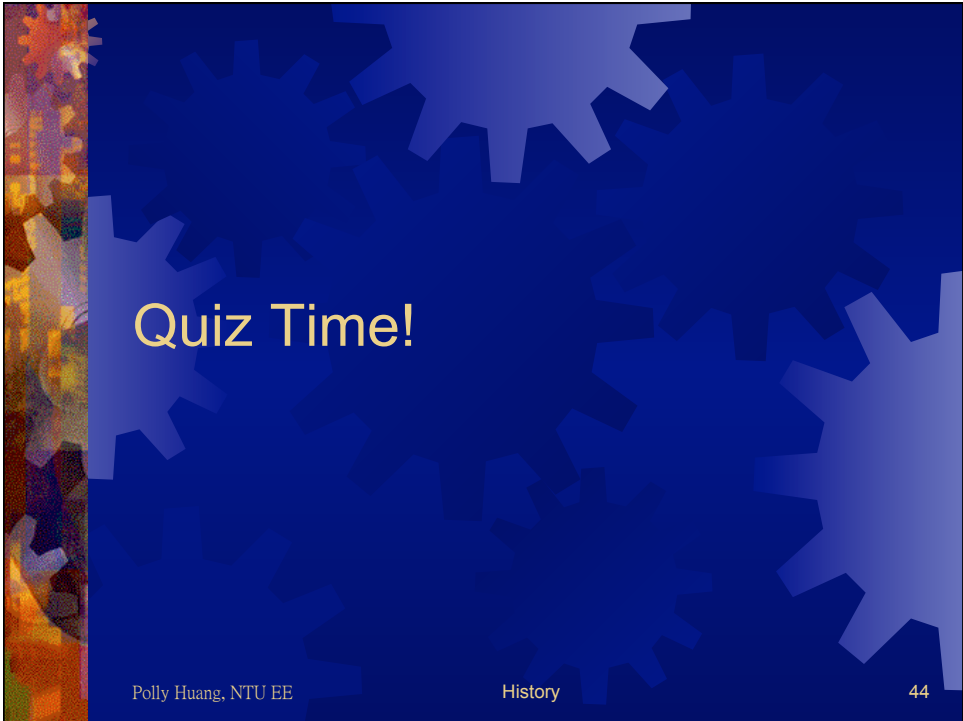
Reference

- Computer history
 - <http://www.maxmon.com/history.htm>
 - <http://www.dei.isep.ipp.pt/docs/arpa.html>
- Alan Turing, Enigma
 - <http://www.turing.org.uk/turing/>
- Turing Machine
 - <http://www.nmia.com/~soki/turing/>
 - <http://www.ams.org/new-in-math/cover/turing.html>

A presentation slide with a dark blue background featuring a pattern of interlocking gears. A vertical strip on the left side shows a close-up of colorful gears. The text "Questions?" is centered in a light yellow font. At the bottom, the text "Polly Huang, NTU EE" is on the left, "History" is in the center, and "43" is on the right.

Questions?

Polly Huang, NTU EE History 43

A presentation slide with a dark blue background featuring a pattern of interlocking gears. A vertical strip on the left side shows a close-up of colorful gears. The text "Quiz Time!" is centered in a light yellow font. At the bottom, the text "Polly Huang, NTU EE" is on the left, "History" is in the center, and "44" is on the right.

Quiz Time!

Polly Huang, NTU EE History 44