

The computer that found its memory



1930: Massachusetts Institute of Technology. **Vannevar Bush** builds the **differential analyzer** – a mechanical device used to predict complex behaviour of objects, such as aircraft moving under gravity – and ushers in start of modern computer age



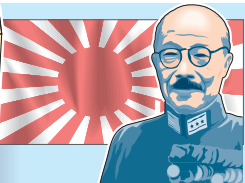
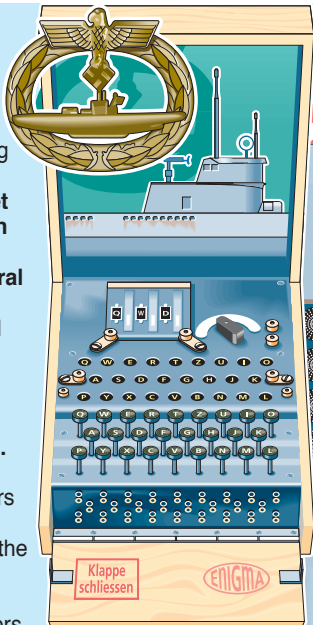
1936: Cambridge University. **Alan Turing** writes his seminal paper '**On Computable Numbers**', describing programmable computers which can perform logical operations



1941: Germany. **Konrad Zuse** uses telephone switches – electromechanical relays – to build a computer which uses the two-digit binary system of ones and zeros

1939-1945: Battle of the Atlantic. German U-Boats sink more than 2,000 allied ships, claiming the lives of 30,000 seamen. **Top-secret messages** between Hitler's submarine commander, Admiral Dönitz, and his U-Boats are coded using the **Enigma cipher machine**

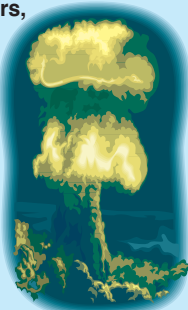
1940: Bletchley Park, near London. Led by Alan Turing, British code-breakers build **Bombe computers** – each the equivalent of twelve **Enigmas** – to crack German naval ciphers



Dec 7, 1941: Hawaii. Japan attacks Pearl Harbour killing 2,300 Americans and drawing the United States into World War II. U.S. Army uses Bush's **differential analyzer** to help prepare artillery firing-tables, but massive number-crunching power is needed

1941-1945: Operation ULTRA: British and American code-breakers use dozens of **Bombes**. From 1943 a new computer, **Colossus**, cracks German codes. **Operation ULTRA** shortens the war by an estimated two years, saves millions of lives

1943: University of Pennsylvania. Work begins on the **ENIAC** high-speed computer which uses more than 17,000 vacuum tubes instead of electromechanical relays. **ENIAC** is used in 1945 to help design the hydrogen bomb



How Baby's memory worked

Electron gun:

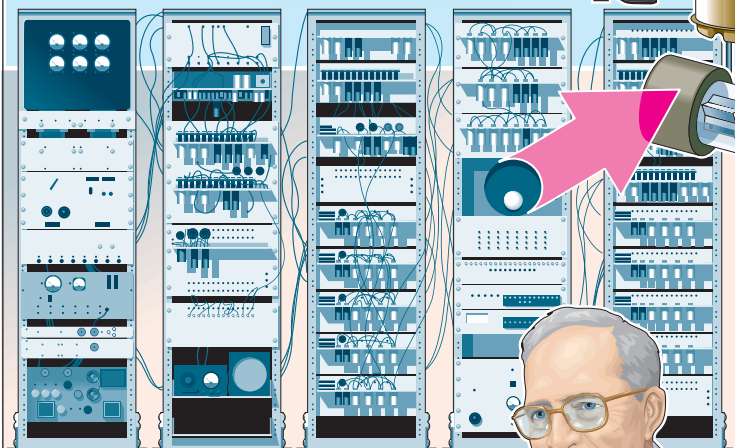
Beam of electrons pulses on and off, producing spots of light on screen corresponding to ones and zeros of binary code

Cathode-ray tube

Screen

Memory: Each spot of light, which represents a number, is regenerated 33 times a second, creating a temporary memory of the number

Electrodes: Sensors close to screen detect exact location of each spot and enable program to read value of stored number



1948: Manchester University. Team headed by **Max Newman** builds **Baby** – world's first computer with random access memory (RAM). **Tom Kilburn** (right) writes first program to run on **Baby**, storing binary numbers and then referring back to them to perform calculations

