

Human Representation and Manipulation of Information

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Representation and Manipulation of Information

- **Representation** – biological neural connections, symbolic characters, position of objects, chemical structure, voltage levels, shape of smoke signal
- **Manipulation** – transmission/reception or communication; transforming from one form to another or computation; acquisition, sensing or measuring

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Introduction to Quantum Informatics

- **Informatics** - a branch of information engineering that covers the practice of information processing and engineering of information systems; an applied form of “information science”
- **Quantum Informatics** – (aka, Quantum Information Science, QIS); area of study based on the idea that information science depends on quantum effects in physics. Includes theoretical issues in computational/communication models as well as experimental topics in quantum physics concerning what can and cannot be accomplished with quantum information.
- **Common Concept** – “Information”

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 - 5) (ECE/CS) Processed, stored, or transmitted data; an interpretation of data; data converted to a useful or intelligible form

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 - 6) (CS) A sequence of one's and zero's that represent a fact
 - 7) (Physics) Attributes and characteristics of a physical system; the information contained in a physical system; can be "confused" with "knowledge," a human characteristic to store information

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Information Examples

- 1) Words on a written page that convey worthy facts to a human
- 2) Stored electrical voltage sequences inside a smartphone
- 3) Protein pairs in a DNA sequence
- 4) Measurement outcome in the form of a numerical quantity associated with a standard unit in a physical system (gallons of gas to travel 10 miles)
- 5) Theoretical implication of a model of a physical system; analyses of a model of a physical system

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Is Information Physical?

Maxwell's Demon

<https://www.youtube.com/watch?v=2AvIOzVJMCM>

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Information in Quantum Physics

- ASSUME: Information is a true fact or attribute of a physical system
- LET: The physical system be a particle or wave modeled as a mathematical “wave function,” Ψ
 - Wave function, Ψ , contains terms for every possible or potential outcome of an experiment or observation
- In QM postulates/theory there is intrinsic variability/uncertainty associated with a given outcome of a wave function measurement
- In QM the behavior of the wave function is governed by the famous wave equation known as Schrödinger's equation

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Representation and Computation of Information

A historical viewpoint

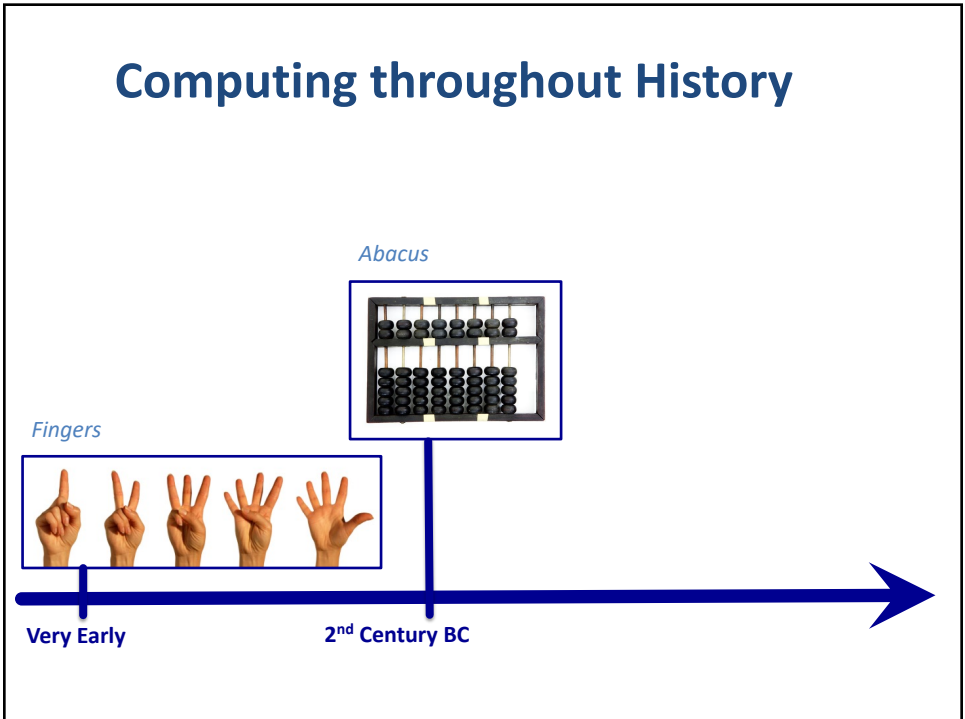
15

Computing throughout History

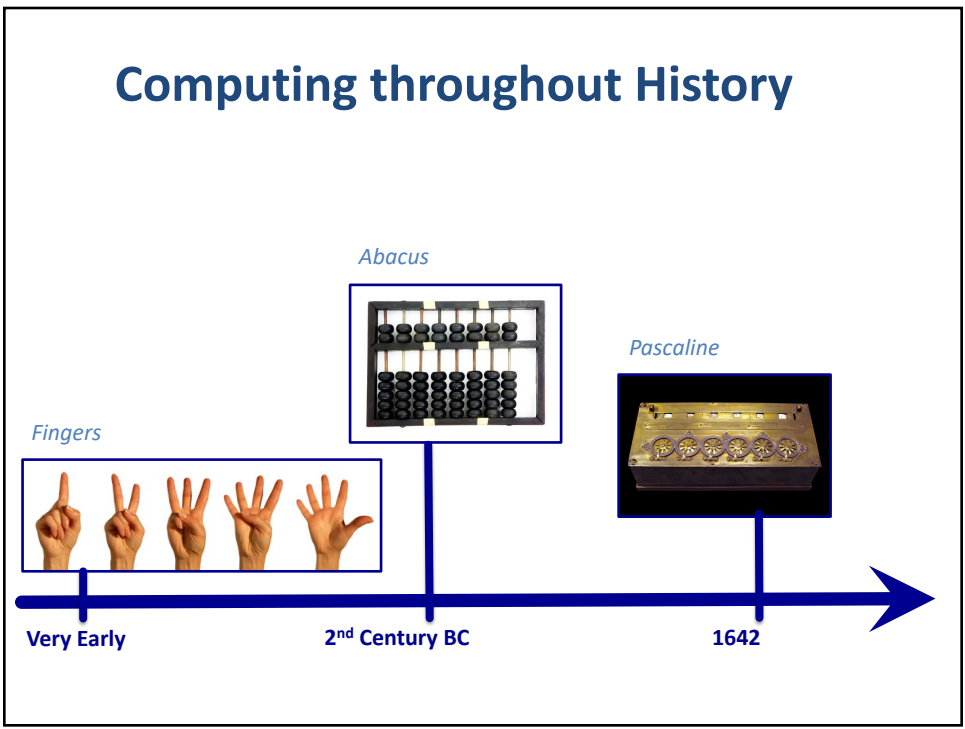
Fingers

The diagram illustrates the use of fingers for counting. It features five hands, each showing a different number of fingers extended: one, two, three, four, and five. These hands are arranged horizontally and enclosed in a blue rectangular box. Below the box is a thick blue arrow pointing to the right. A vertical blue line segment intersects the arrow at its starting point, with the text "Very Early" written below it.

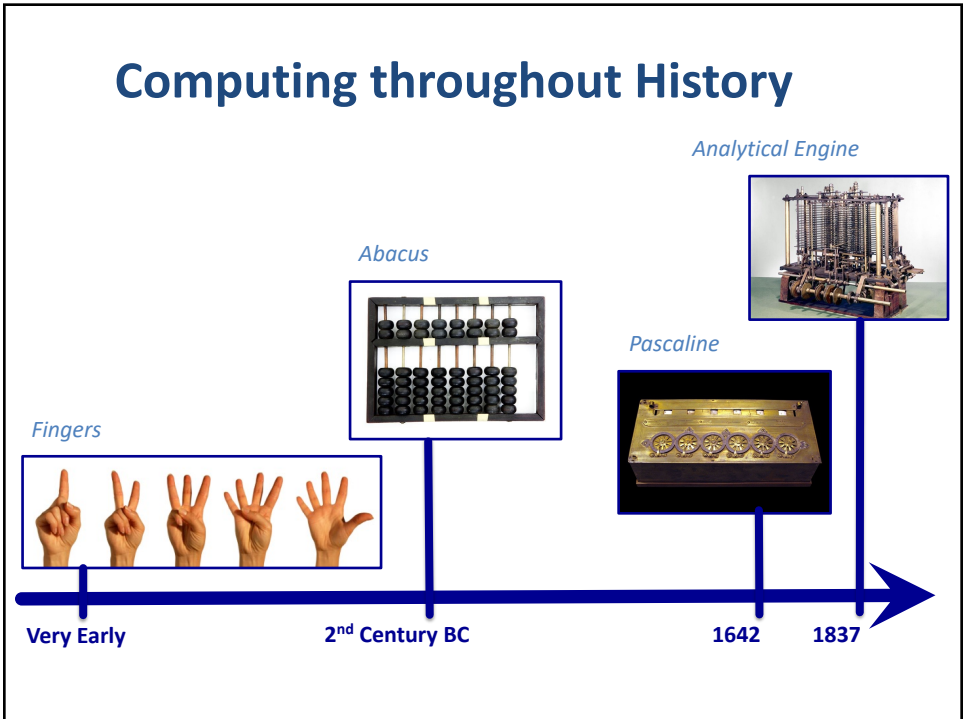
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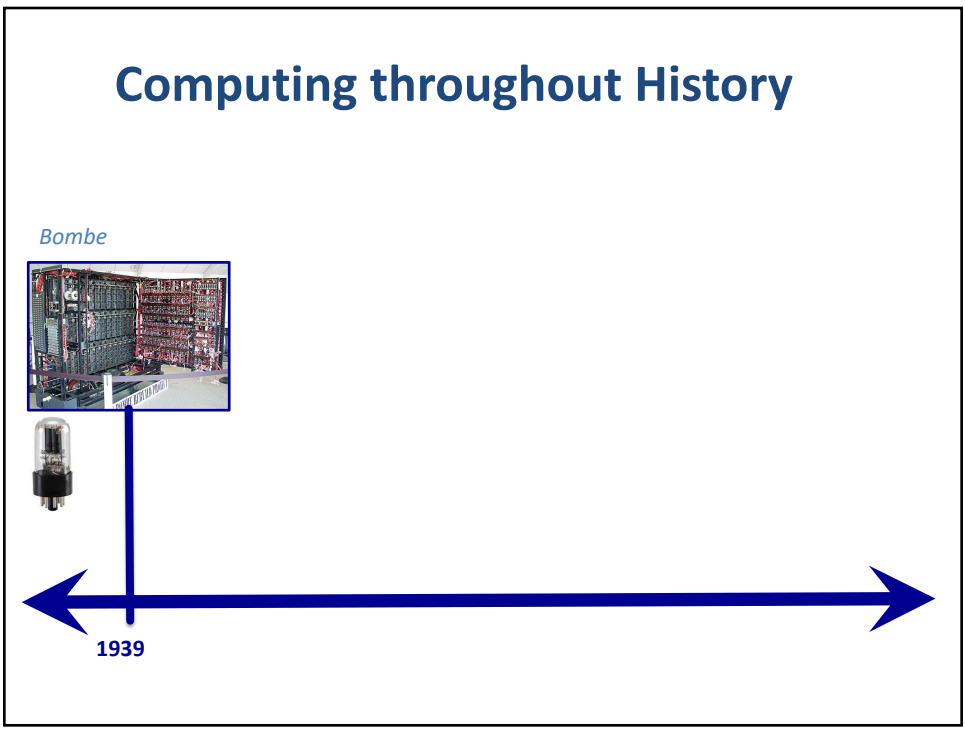
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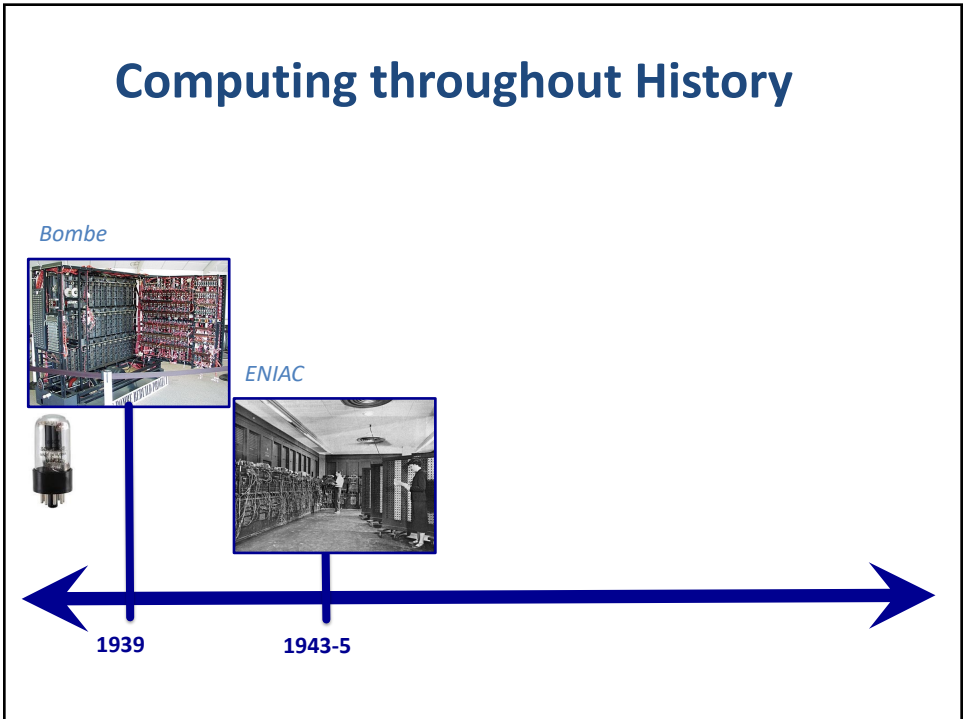
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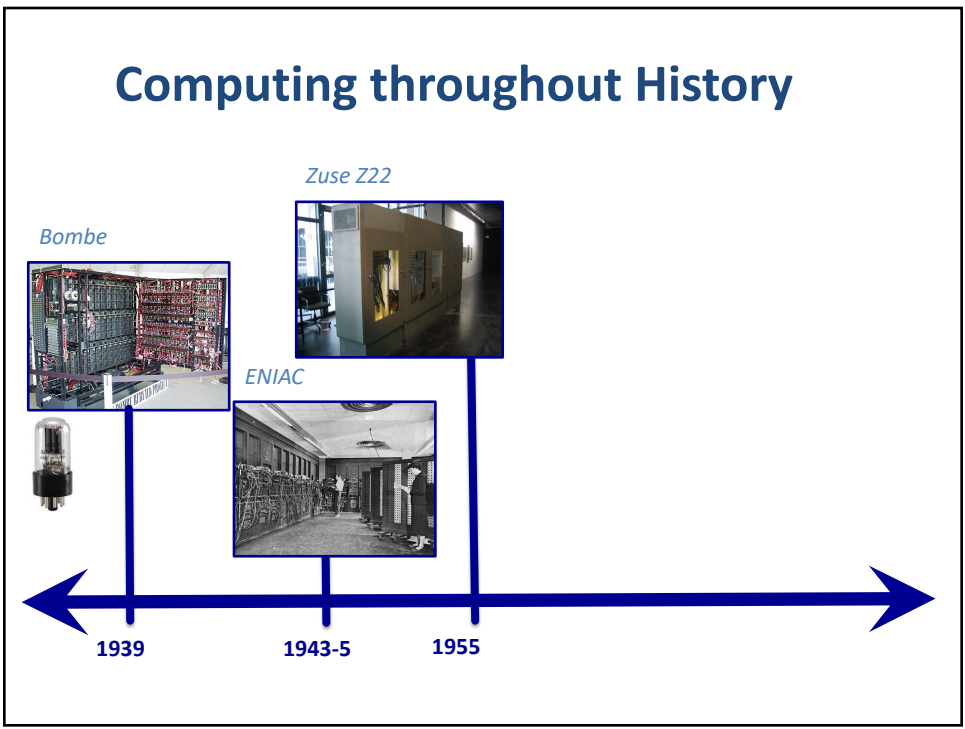
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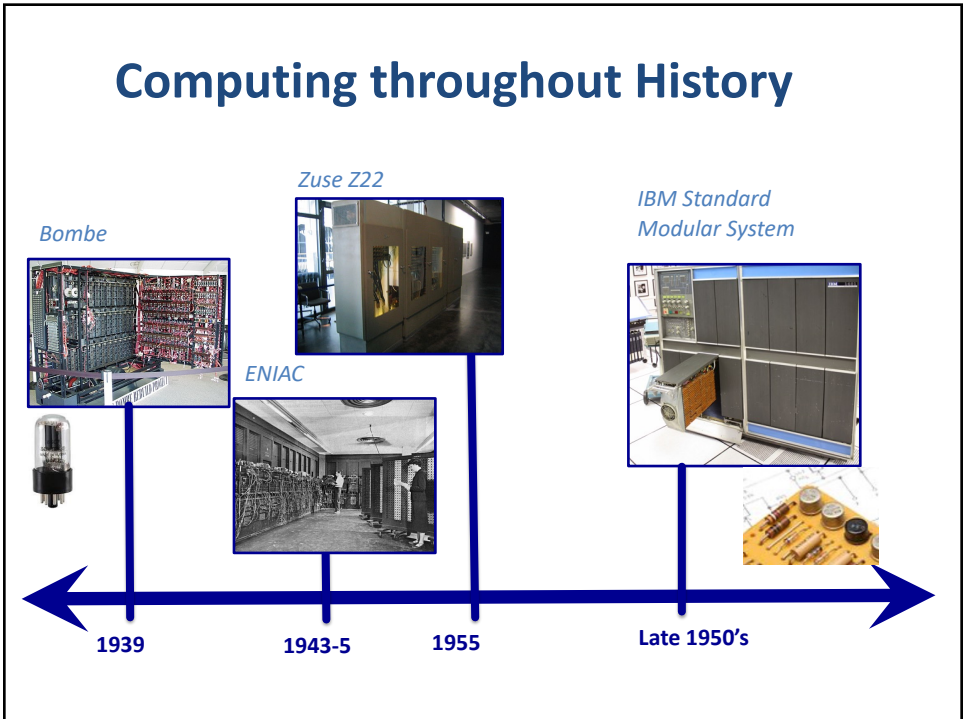
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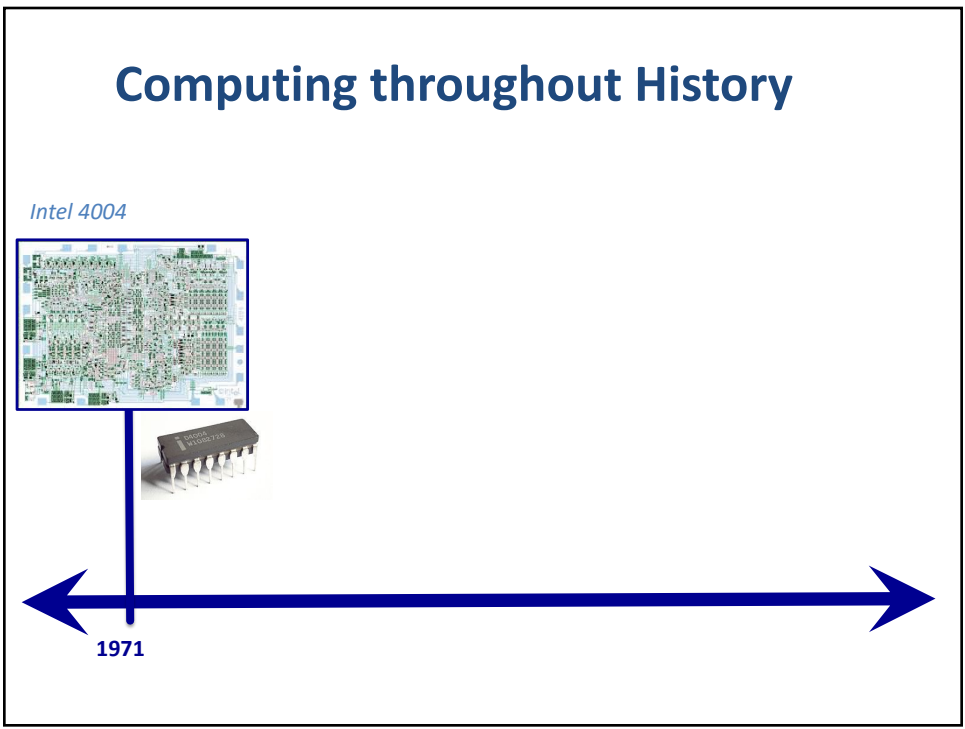
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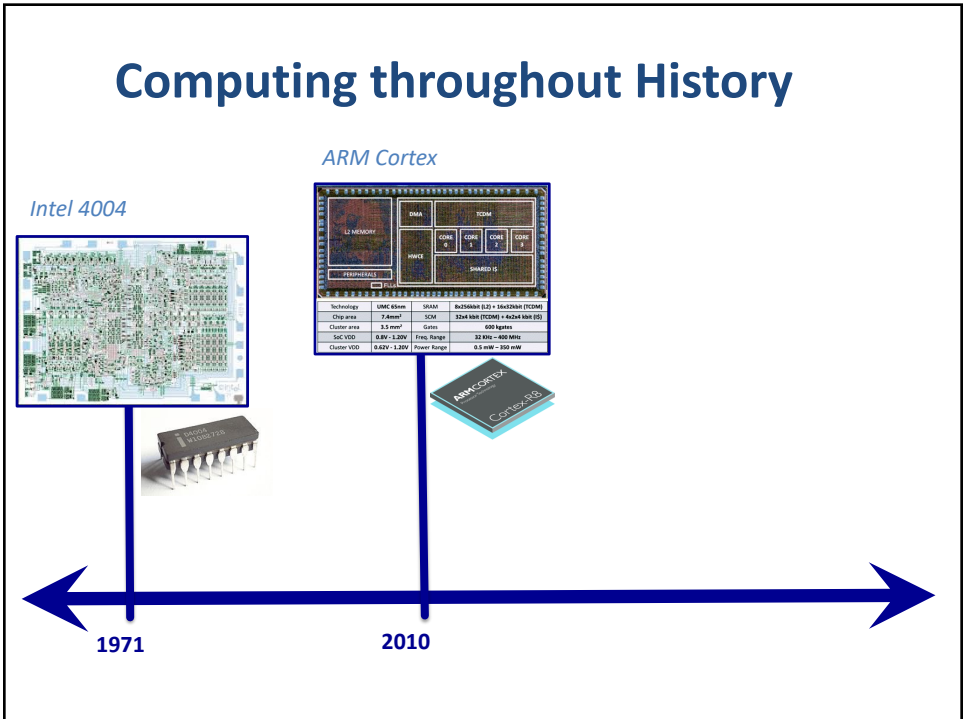
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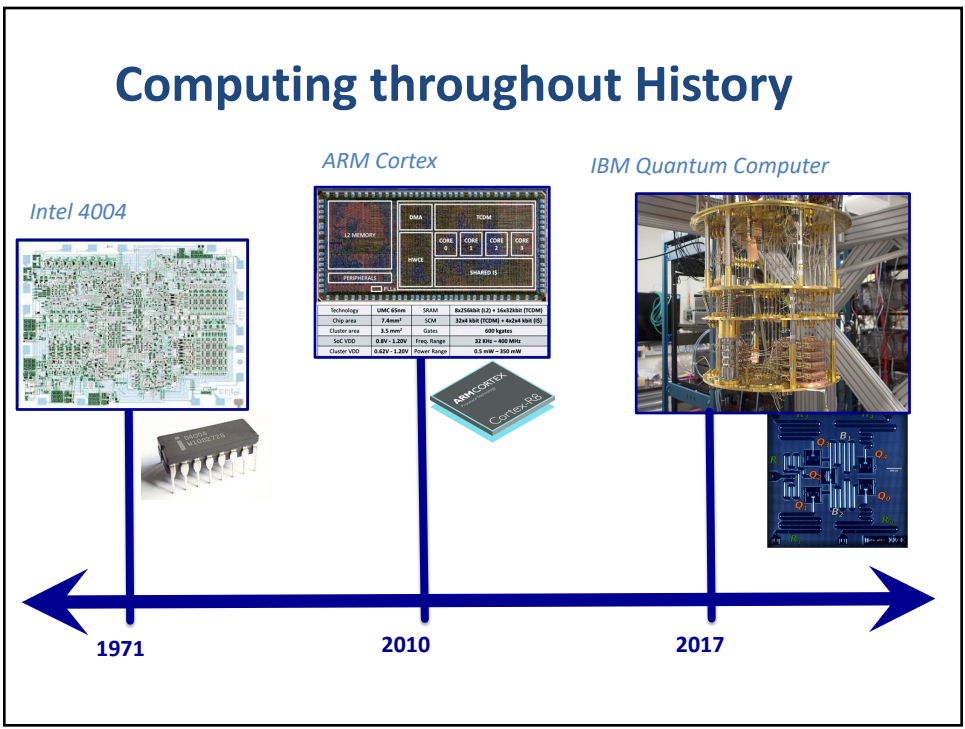
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Physical Information (9:53; 5:08)

Physical Information

https://www.youtube.com/watch?v=or8Rktj_HA4

<https://www.youtube.com/watch?v=XirbbUxOxiU>