

Why study Electronics?

Like no other discipline in engineering, electronics has revolutionized our lives. In fact, micro-electronic circuits have become such an integral part of our lives that many tasks we perform on a daily basis could not be accomplished without the help of tiny specks of silicon housing millions of transistors.

How would **your life** be affected if there were no **microchips**?



What is Electronics?

Electronics is derived from *electron*, the name of a fundamental subatomic particle carrying a negative electric unit charge of

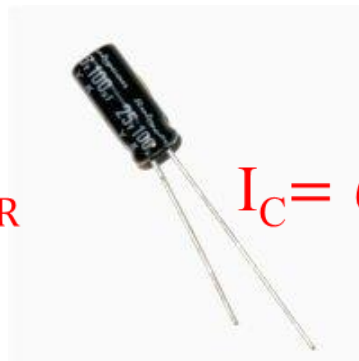
$$q = -1.6 \times 10^{-19} \text{ As.}$$

Therefore, we can think of electronic circuits as means to *tame or control* electrons. To do so, we utilize a few distinct *circuit elements*; each of which performs a very specific function.

What type of circuit elements have you encountered so far and what are the functions they perform?



$$V_R = R I_R$$

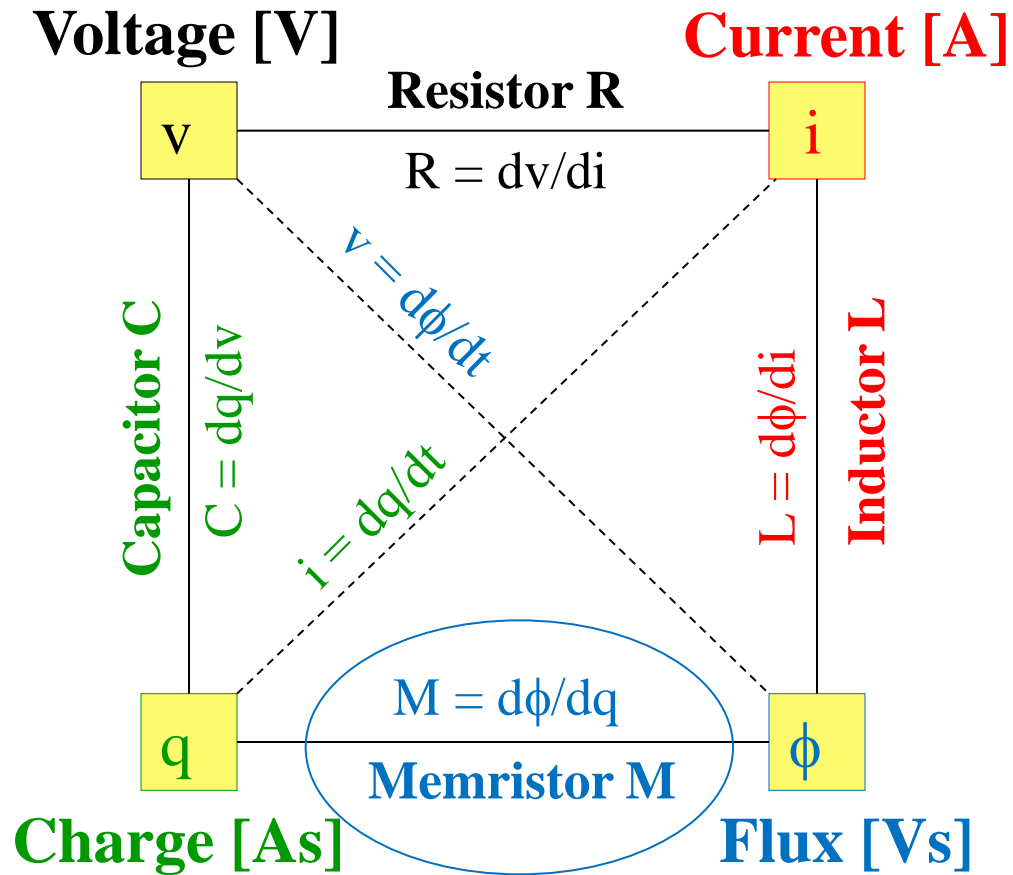


$$I_C = C \frac{dV_C}{dt}$$

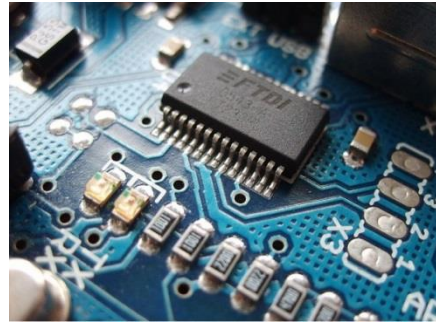


$$V_L = L \frac{dI_L}{dt}$$

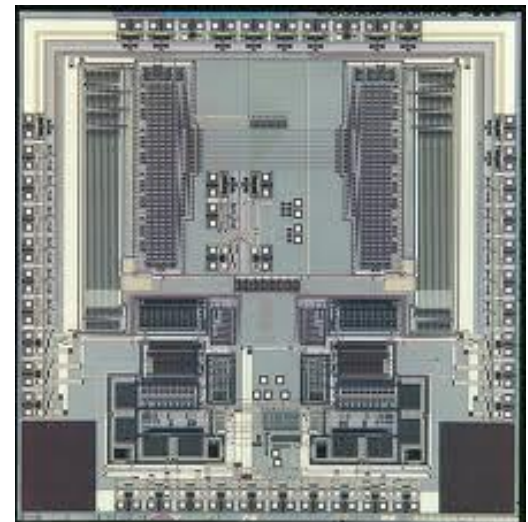
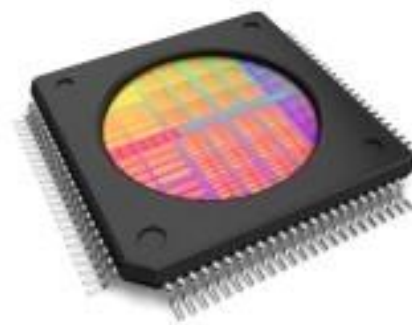
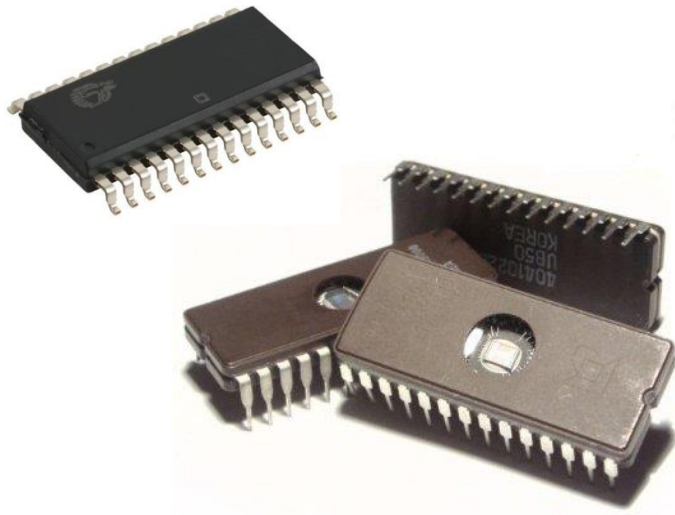
Basic Circuit Elements



Printed Circuit Boards (PCBs)



Integrated Circuits (ICs)

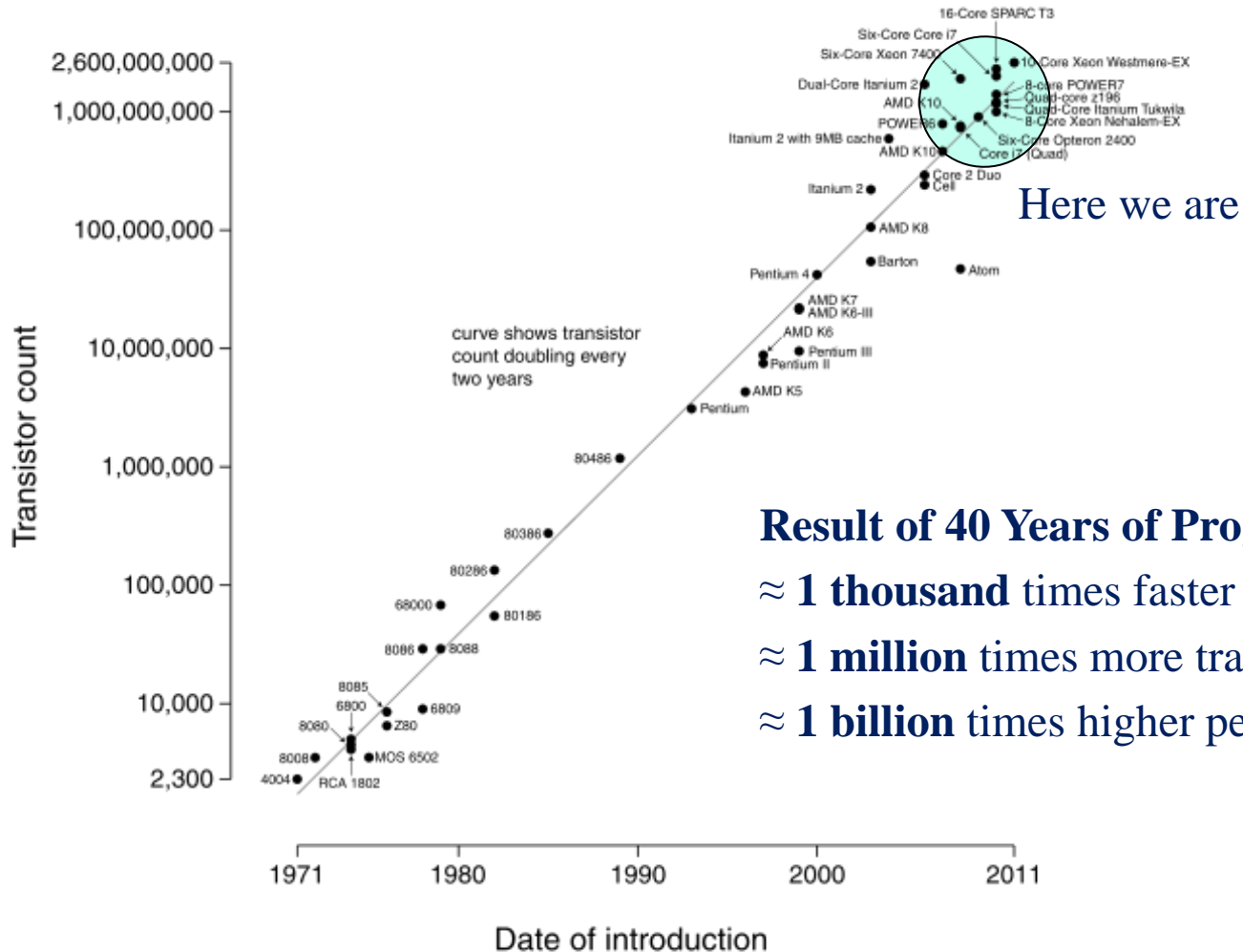


Everything requires Electronic Circuits



The Microelectronic R-evolution

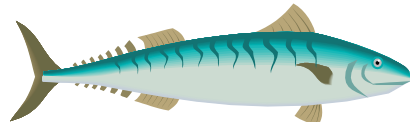
Microprocessor Transistor Counts 1971-2011 & Moore's Law



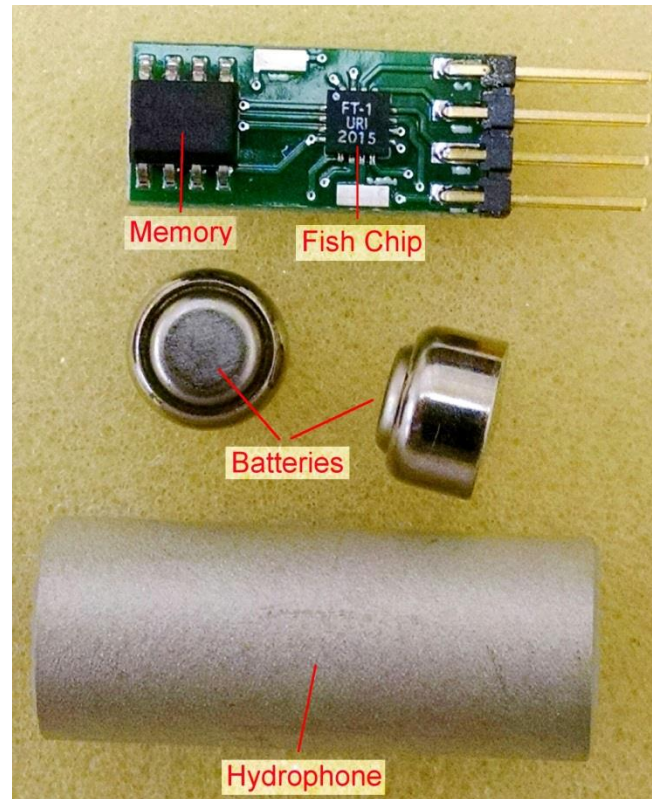
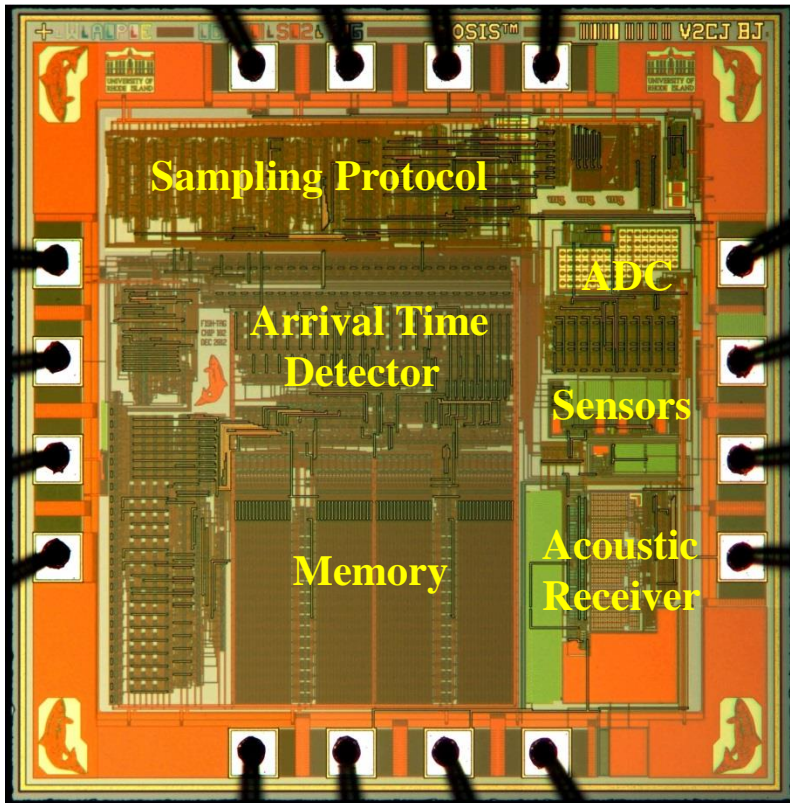
Result of 40 Years of Progress:
≈ **1 thousand** times faster
≈ **1 million** times more transistors
≈ **1 billion** times higher performance

IC Application: An Acoustic Data Storage Tag for Long Range Fish Tracking in the Ocean

ASIC



Tag Assembly



How do we analyze Circuits?

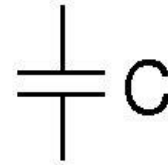
Approach 1: By utilizing the known current-voltage relationship of each circuit element combined with the two Kirchhoff circuit laws (KCL & KVL), we can mathematically derive a solution for all variables of interest.

Approach 2: By utilizing an *approximate linear* current-voltage relationship for each circuit element combined with KCL and KVL, we can find an *approximate solution* for all variables of interest.

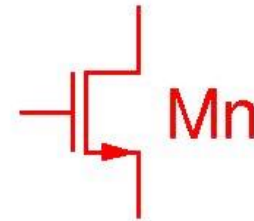
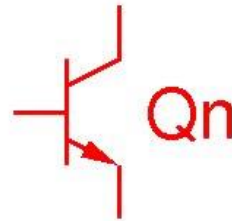
Note: While the second approach simplifies matters considerably, its results are only valid as long as the applied approximations represent a *reasonably good description* of the actual voltage-current relationships of the circuit elements.

Circuit Elements – old & new

old



new



new

