Technological issues

Space | time | energy implications of making computers more powerful
$\rightsquigarrow$ increasing number of components per chip | reducing signal propagation delays $\rightarrow$ higher packaging density | shorter distances among components
$\rightsquigarrow$ higher packaging density and higher clock rates $\rightarrow$ reduced heat dissipation of individual components $\rightarrow$ more energy efficiency
$\rightsquigarrow$ component size shrinks to few atoms | few electrons per unit of information (1 bit)

an example of current memory technology :
$\rightsquigarrow$ 256 $MBit$ per chip on 2 cm^2 of real estate of which 75% are storage cells | rest is wiring and logic
$\rightsquigarrow$ $30 * 10^{-15}$ $farad$ electrical capacity per cell ($1\ farad = 1\ As/V$ | $10^{-15}\ farad = 1\ picofarad$)
$\rightsquigarrow$ the electrical charge per cell is given as $q = C * U$ | with $U = 5V \rightarrow 1.5 * 10^{-13}\ As$
$\rightsquigarrow$ with $e = 1.6 * 10^{-19}\ As$ as the charge of a single electron $\rightarrow$ 10^5 electrons per cell
$\rightsquigarrow$ linear reduction in cell size by 1/2 every 18 month results in a reduction in 20 years by a factor of $2^{-(240/18)} = 2^{-15} \approx 10^{-5}$
$\rightsquigarrow$ leading to one electron per cell by year 2020

$\rightarrow$ quantum mechanical effects take over with some 10 . . . 100 electrons per cell