

## DNA STORAGE

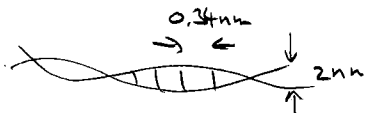
DATA: 000110110111....  
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ENCODING: A C G T C T....

$\Rightarrow$  N BYTES =  $8 \cdot N/2$  NUCLEOTIDES (1 BYTE = 8 bits)

90 min MOVIE  $\sim$  2.5 GB =  $10 \cdot 10^9$  nt

WHAT VOLUME DOES THIS TAKE UP?



$$V = \pi r^2 \cdot L = \pi (1 \text{ nm})^2 \cdot 10^{10} \cdot 0.34 \text{ nm} =$$

$$\sim \frac{10^{-18} \cdot 10^{10} \text{ nm}^3}{10^{-8} \text{ nm}^2} =$$

$$\approx \underbrace{3.14 \cdot 0.34}_{1} \cdot 10^{10} \text{ nm}^3 = 10^{10} (10^{-3} \mu\text{m})^3 = 10 \mu\text{m}^3$$

$$\text{DATA DENSITY: } \frac{2.5 \text{ GB}}{10 \mu\text{m}^3} \sim \frac{10^3 \text{ GB}}{10 \cdot 10^{-9} \text{ mm}^3} \sim 10^3 \text{ GB/mm}^3 \sim 1 \text{ EB/mm}^3$$

MAGNETIC TAPE: 100 GB/mm<sup>3</sup> (7 ORDERS OF MAGNITUDE LESS!)

HOW LONG CAN DNA LAST?

DNA FRAGMENTS RECOVERED FROM FOSSILS  $\sim$  100K YRS OLD!

HOW MUCH WOULD IT COST TO STORE OUR MOVIE?

CUSTOM ARRAY:  $10^5$  100-mers FOR \$5K

$25 \cdot 10^5$  BYTES  $\sim$  2.5 MB FOR \$5K

$\Rightarrow$  1 GB  $\sim$  1000  $\cdot$  \$5000 = \$5M

1 GB THUMB DRIVE  $\sim$  \$5

$\Rightarrow$  DNA IS  $10^6 \times$  TOO EXPENSIVE!