Reason 1: Less Storage Space

compression goal: less storage space
Reason 2: Bandwidth!

compression goal: less bandwidth
Example: Scanning from Disk

large sequential scan of 1 GB **uncompressed** data

100 MB/s sequential read bandwidth

=> 10 sec read time

3 GHz CPU (full overlap)
Example: Scanning from Disk

large sequential scan of 1 GB **uncompressed** data

100 MB/s sequential read bandwidth

=> 10 sec read time

3 GHz CPU (full overlap)

=> 30 clock ticks to burn for every single **uncompressed byte** in the input
Let’s compress it:

1:4 compression ratio => 0.25 GB **compressed** data

=> 2.5 sec read time

=> factor 4 faster

=> up to 2.5*3G = 7.5G clock ticks to burn

=> on average up to 7.5G/0.25G = 30 clock ticks to **uncompress and process** for each **compressed byte**!!

=> 7.5 clock ticks per **uncompressed byte**

\[
\begin{align*}
40 & \Rightarrow 10 G \text{ clock ticks} \\
10/3 & = 3.3
\end{align*}
\]
Example: Scanning from DRAM

- Large sequential scan of 1 GB **uncompressed** data
- 10 GB/s sequential read bandwidth
- \( \Rightarrow \) 0.1 sec read time

- 3 GHz CPU (full overlap)
- \( \Rightarrow \) 0.3 clock ticks to burn **for every single uncompressed byte** in the input
Let's compress it:

1:4 compression ratio $\Rightarrow$ 0.25 GB compressed data

$\Rightarrow$ 0.025 sec read time

$\Rightarrow$ factor 4 faster

$\Rightarrow$ up to $0.025 \times 3G = 0.075G$ clock ticks to burn

$\Rightarrow$ on average up to $0.075G/0.25G = 0.3$ clock ticks to uncompress and process for each compressed byte!!

$\Rightarrow$ 0.075 clock ticks per uncompressed byte
Lightweight Compression

Goal:
\[
\text{compression + write} < \text{write} \\
\text{decompression + read compressed} < \text{read uncompressed}
\]

\[
\text{CPU} \quad \text{I/O} \quad \text{I/O}
\]
Lightweight Compression

goal:

decompression + read \textit{compressed} < read \textit{uncompressed}

features:

“CPU-friendly“

lossless vs. lossy

\begin{itemize}
\item \textit{lossy}
\item \textit{precise values}
\end{itemize}
<table>
<thead>
<tr>
<th>Compression Granularities</th>
<th>Accessibility</th>
<th>Compression Ratio</th>
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