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)

\[
\begin{align*}
\text{no overlap:} & \quad \text{read} & \quad \text{CPU} \\
\text{overlap:} & \quad \text{read} & \quad \text{CPU}
\end{align*}
\]
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 un**compressed byte**

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

large sequential scan of 1 GB *uncompressed* data

10 GB/s sequential read bandwidth

=> 0.1 sec read time

3 GHz CPU (full overlap)

=> 0.3 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

=> 0.025 sec read time

=> factor 4 faster

=> up to 0.025*3G = 0.075G clock ticks to burn

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

=> 0.075 clock ticks per **uncompressed byte**
Lightweight Compression

goal:
\[
\text{compression + write} < \text{write}
\]
\[
\text{decompression + read } \text{compressed} < \text{read } \text{uncompressed}
\]
\[
\text{CPU} \quad \text{I/O} \quad \text{I/O}
\]
Lightweight Compression

goal:

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

features:

"CPU-friendly"

lossless vs. lossy

\begin{itemize}
\item \textbf{1)} lossy
\item \textbf{2)} precise values
\end{itemize}
Compression Granularities

<table>
<thead>
<tr>
<th></th>
<th>Accessibility</th>
<th>Compression Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>attribute values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tuples</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>horizontal partitions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>databases</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>