<table>
<tr><td>Problem:</td><td>In Part II, Chapter 2, Question 9: "Why there are three spatial dimensions", the explanation is incomplete. It does not include the number of objects in each Boxel, which increases with the number of Dimensions.</td></tr>
<tr><td>Correction:</td><td>
Part I, Chapter 6 – The Simulation Cycle, Step 1, indicates:

For all particles in all OSUs in all Boxels, consider:

• Interactions between all objects in the same or adjacent Boxels with respect to …

So, for all objects, the number of potential interacting objects to consider is:

$$[number\ of\ objects\ in\ each\ Boxel]\ X\ [number\ of\ same\ or\ adjacent\ Boxels]$$

The number of objects that can fit inside a Boxel of dimension N increases as follows:

<table>
<tr><td>Dimensions</td><td>Objects Within</td></tr>
<tr><td>1</td><td>P</td></tr>
<tr><td>2</td><td>P x P</td></tr>
<tr><td>3</td><td>P x P x P</td></tr>
<tr><td>N</td><td>P^N</td></tr>
</table>

The number of adjacent Boxels is given in the text in Table 14 and included below:

<table>
<tr><td>Dimensions</td><td>Adjacent Boxels</td></tr>
<tr><td>1</td><td>2</td></tr>
<tr><td>2</td><td>8</td></tr>
<tr><td>3</td><td>26</td></tr>
<tr><td>4</td><td>80</td></tr>
<tr><td>N</td><td>3^N-1</td></tr>
</table>

As there is always one current Boxel, the number of current or adjacent Boxels is 3^N-1+1 or 3^N.

Back to our original formula, which tells us the number of potential interaction objects to consider:

$$[number\ of\ objects\ in\ each\ Boxel]\ X\ [number\ of\ same\ or\ adjacent\ Boxels]$$

Replace both of the terms with the formulas provided above shows that the number of potential interactions to consider for N dimensions is:

$$(P^N)\ x\ (3^N)$$

Or

$$(3P)^N$$

Thus, the simulation logic will consider $(3P)^N$ potential interacting objects in each simulation cycle. The time required to perform this step increases exponentially with the number of dimensions, N.

So, as the number of spatial dimensions increases, the simulation time required for this step increases exponentially. In order to obtain the results of a simulation as quickly as possible, keep the number of spatial dimensions to the minimum value needed, or suffer from a dramatically increasing delay.
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