

It's SIMD All Over Again! *

By

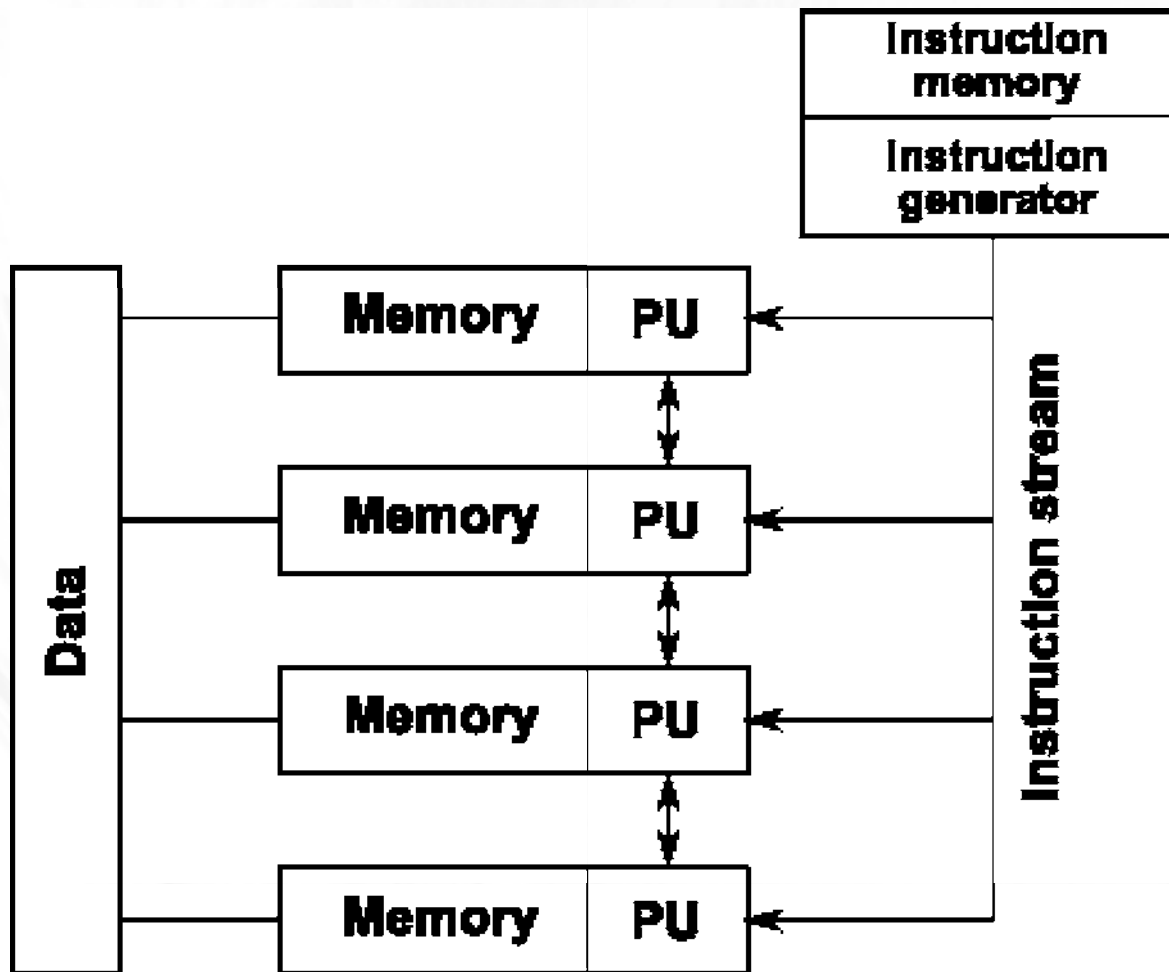
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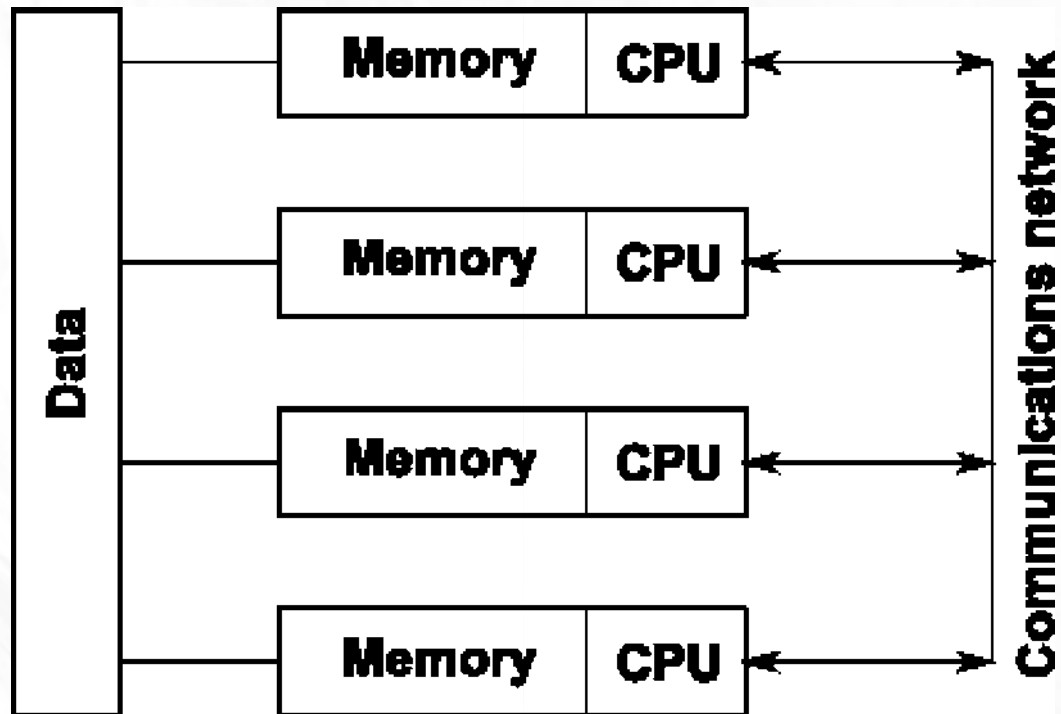
* with apologies to Yogi Berra

Abstract

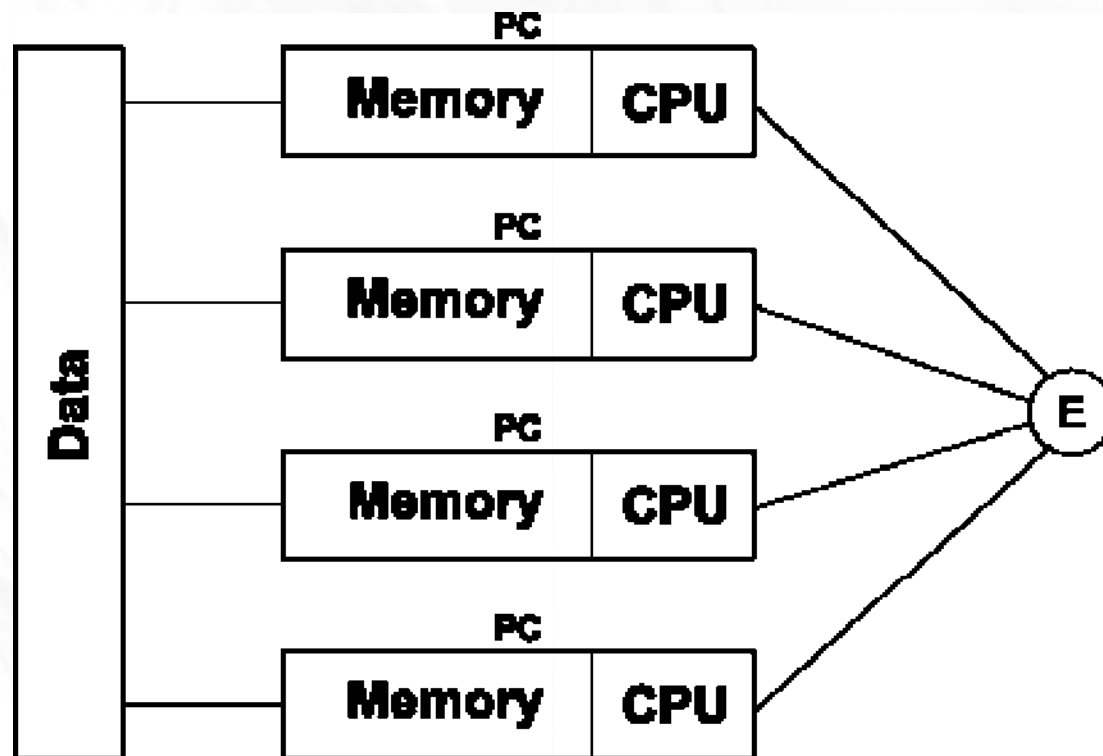
The SIMD style of parallel computing, where many processors execute the same instruction but on different data, flourished back in the days of the Connection Machine and Maspar supercomputers. However, the advent of commodity PC cluster computing, which is actually a kind of MIMD computing, effectively ended it. Now it's back! The commercial appearance of General Purpose **Graphics** Programming Units (GPGPUs) which are SIMD machines means that, once again, we must seek SIMD algorithms to solve scientific problems on this hardware. Since nature is SIMD, there is substantial hope that this will be a successful quest. We must realize, however, that these new SIMD algorithms may be quite different from those already in use and possibly less efficient.



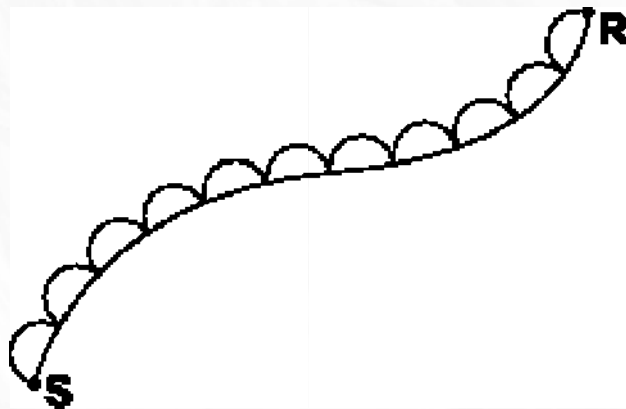
SIMD Computer Configuration



MIMD Computer Configuration



Cluster Computer Configuration



Propagation of Light from Source to Receiver

$$|\text{de}I| = 1/c$$

Eikonal (O'Connell) Equation

$$TT_i = \min(TT_j + TT_{ij}) \quad j = \text{neighbor of } i$$

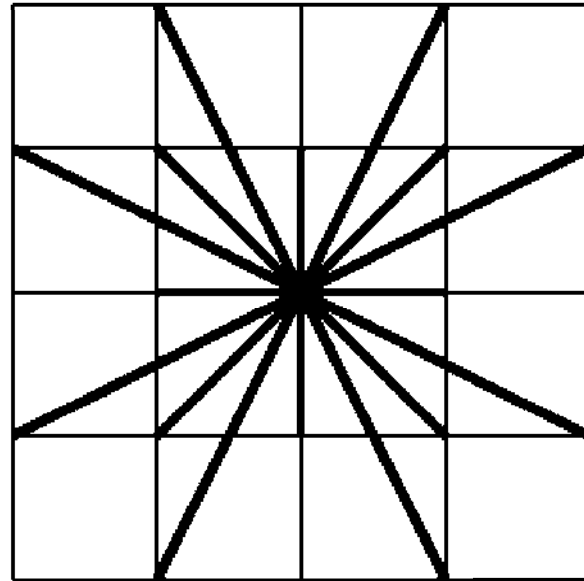
$$TT_{ij} = d_{ij} * (s_i + s_j) / 2$$

Bellman's Equations

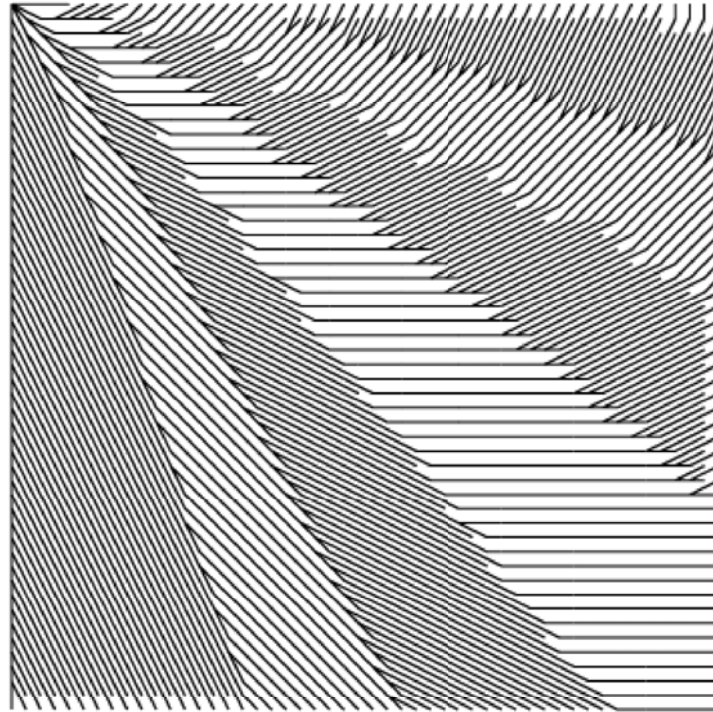
$T|_{t_s} = 0$ at source

$T|_{t_i} = \text{inf.}$ not at source

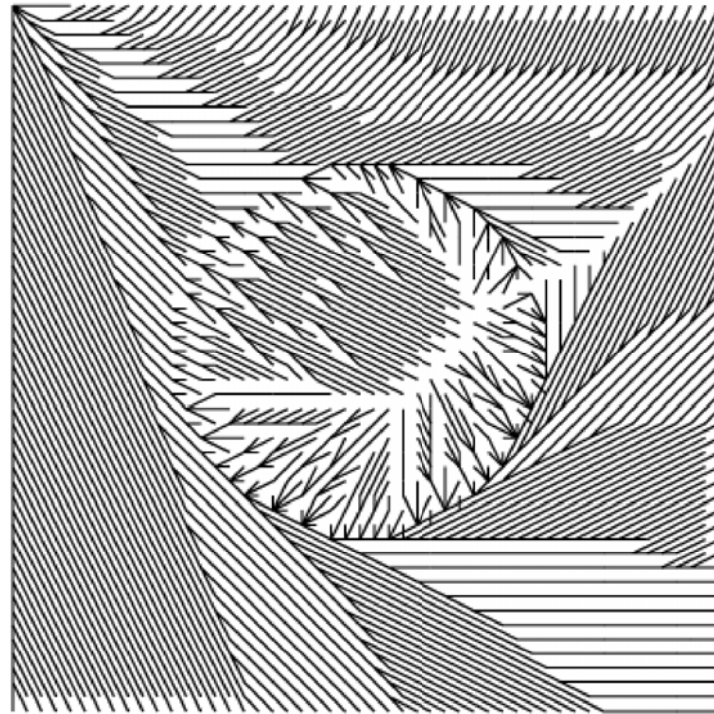
Initial Conditions



2D 16 Nearest Neighbor Case



2D Raytrace in linear velocity increase



2D raytrace in a linear velocity increase
medium with constant velocity inclusion

The future's the hardest thing to predict!

Yogi Berra