Software Support for Regular and Irregular Applications in Parallel Computing

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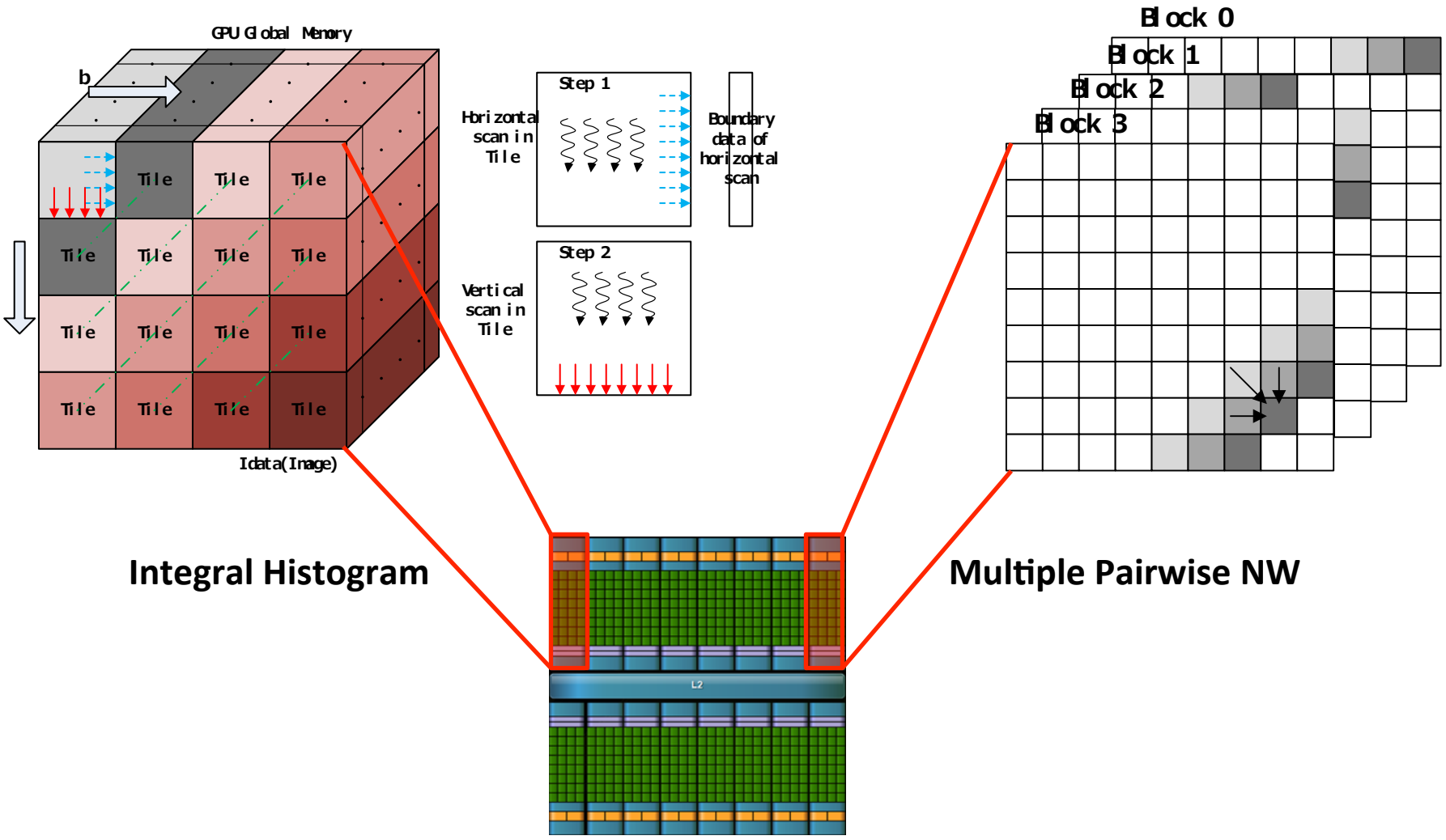
Regular & Irregular Application

- Control structures
- Data structures
- Communication patterns

Innovation from Software

- Programming model
- Runtime
- Compiler

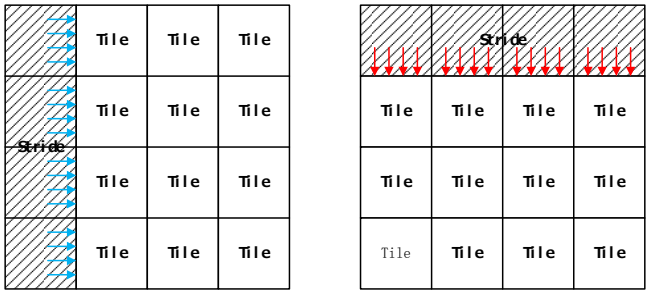
Application Specific Acceleration



Equation-based Programming Model

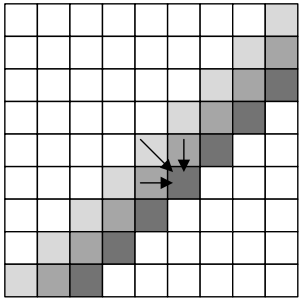
$$H(x,y,b) = \sum_{i=0}^{x}\sum_{j=0}^{y} Q((i,j),b)$$

Integral Histogram



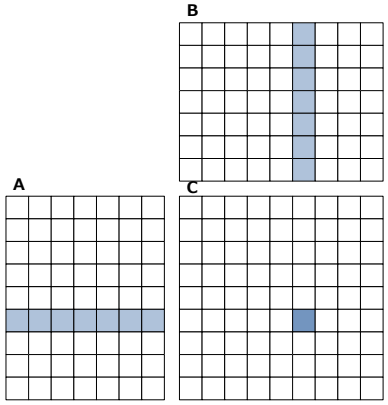
$$M(i,j) = \max\begin{cases} M(i-1,j-1) + S(x_i, y_j) \\ M(i-1,j) + G \\ M(i,j-1) + G \end{cases}$$

Needleman-Wunsch



$$C(i,j) = \sum_{k=0}^{n} A(i,k) \times B(k,j)$$

Matrix Multiplication



Adaptive Runtime for Graph Algorithm

Network	#Nodes	#Edges	Node Outdegree		
			min	max	avg
CO-road	435,666	~1M	1	8	2.4
CiteSear	434,102	~16M	1	1,188	73.9
P2p	36,692	~0.18M	0	1,383	10.0
Amazon	396,803	~1.7M	0	10	8.4
Google	739,454	~2.5M	0	456	6.9
SNS	4,308,452	~34.5M	0	20,293	16.0