

Coding practices and Optimization for lattice QCD

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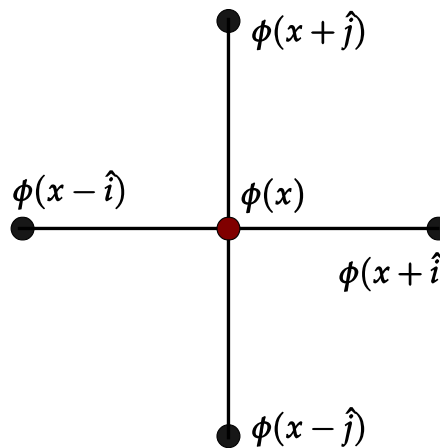


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Example: stencil operations

- The discrete laplacian operator in 2D



$$\frac{1}{1 + 4\sigma} \{ \phi(x) + \sigma [\phi(x + \hat{i}) + \phi(x - \hat{i}) + \phi(x + \hat{j}) + \phi(x - \hat{j})] \}$$

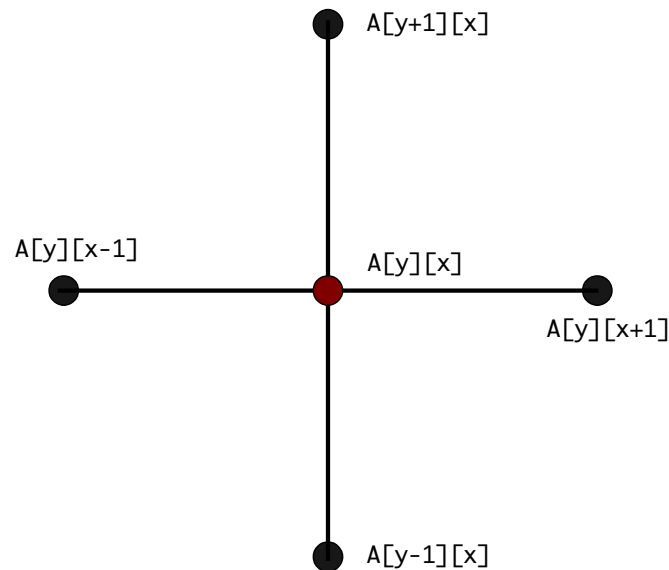
Example: stencil operations

$$B[y+0][x+0] = a * A[y+0][x+0] + b * (A[y+0][x+1] + A[y+0][x-1] + A[y+1][x+0] + A[y-1][x+0])$$

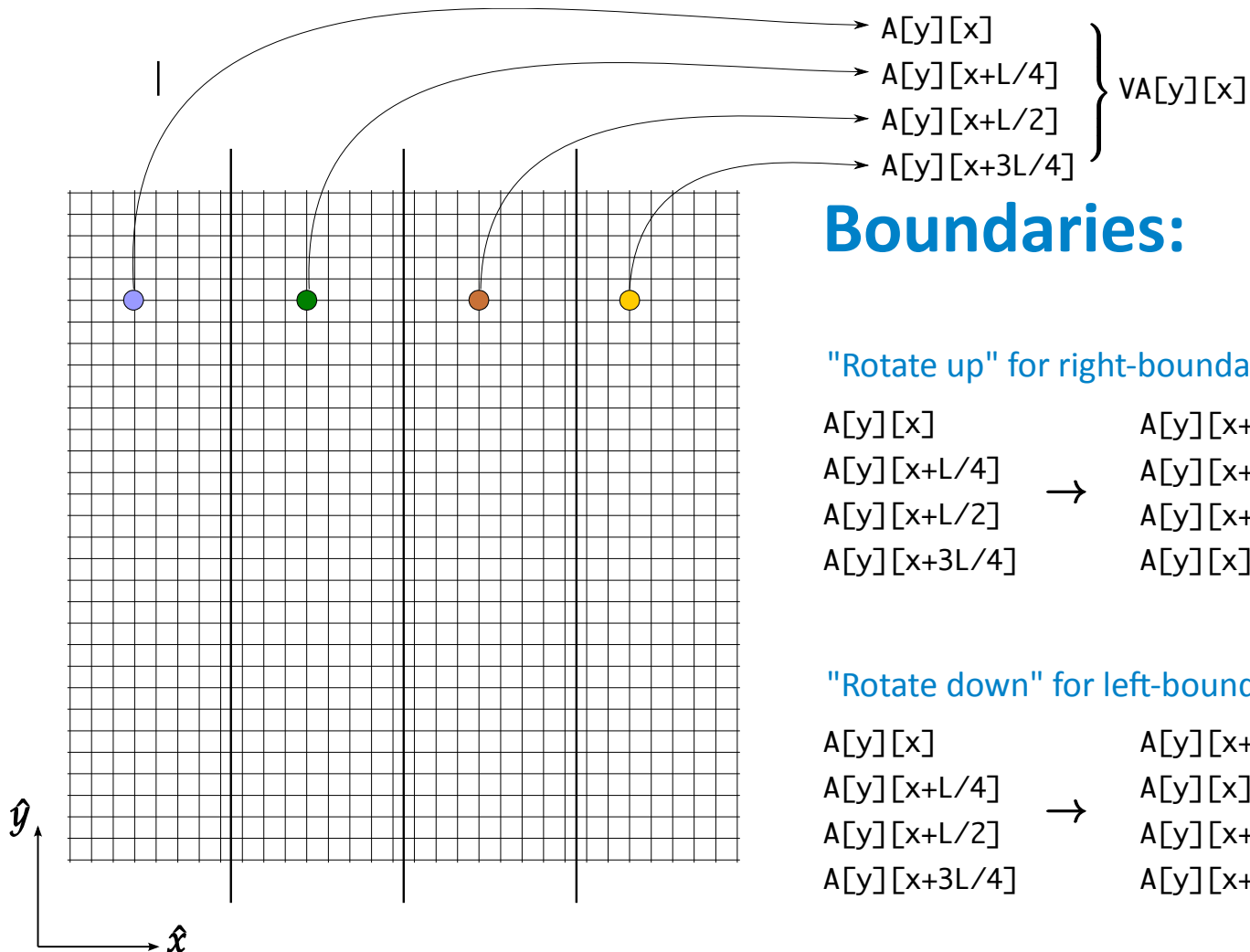
$$B[y+0][x+1] = a * A[y+0][x+1] + b * (A[y+0][x+2] + A[y+0][x+0] + A[y+1][x+1] + A[y-1][x+1])$$

$$B[y+0][x+2] = a * A[y+0][x+2] + b * (A[y+0][x+3] + A[y+0][x+1] + A[y+1][x+2] + A[y-1][x+2])$$

$$B[y+0][x+3] = a * A[y+0][x+3] + b * (A[y+0][x+4] + A[y+0][x+2] + A[y+1][x+3] + A[y-1][x+3])$$



Example: stencil operations



Boundaries:

"Rotate up" for right-boundary

$A[y][x]$	$\rightarrow$	$A[y][x+L/4]$
$A[y][x+L/4]$		$A[y][x+L/2]$
$A[y][x+L/2]$		$A[y][x+3L/4]$
$A[y][x+3L/4]$		$A[y][x]$

"Rotate down" for left-boundary

$A[y][x]$	$\rightarrow$	$A[y][x+3L/4]$
$A[y][x+L/4]$		$A[y][x]$
$A[y][x+L/2]$		$A[y][x+L/4]$
$A[y][x+3L/4]$		$A[y][x+L/2]$

Exercise

- Ex7 implements the laplacian in both the unoptimized case, and in an optimized case in which the data layout is reordered as explained in the previous slide
- Read the comments in the files
- Run for various lattice sizes and numb. of OMP threads (you need to create an input with the python script)
- The script `run.sh` runs for various problem sizes. You can then plot using the provided gnuplot script as in previous exercises