

Now – during lab-afternoons

• Discuss with instructors & course participants, form groups of size *G*.

- Define project and choose supervisor: Michael, Jesper, ...
- Write very short synopsis, check with supervisor !
- Submit synopsis to supervisor before end of HPC course

Later -

- Start the work *ASAP*:
- Finish the work; Get in touch with supervisor !!
- Submit report to *supervisor*.

The report will be graded and sent back with comments; you may have to complete some parts and hand in again. *We need email and paper mail address!*

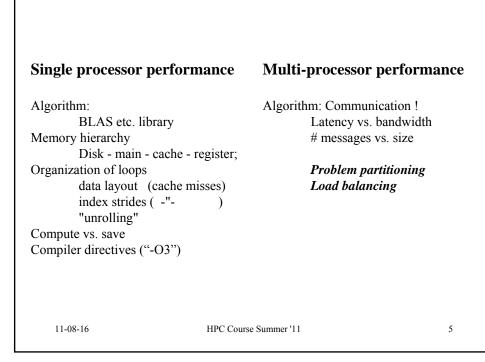
- KTH and SU students: LADOK
- Other students
 - You, for registration with PhD advisor etc.

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• NGSSC if relevant

1. Develop initial version of program; 2. Develop Performance model = theoretical prediction: time = f(problem size N,#processors P, problem partitioning parameters, ...) Try to assess the *communication* and *computation* times separately. 3. Measure performance, e.g. t = f(N, P, ...), for different problem partitionings, if relevant x = wall clock time start to finish, or CPUtime, ... 4 ... Size $\ \#$ proc 1 2 п N_1 Х Х Х х N_2 х Х Х х $N_{\rm M}$ Х Х х х 4. If suitable, plot "speedup" and/or "efficiency", MFLOPS?, ... Make several measurements to discover variations - discuss sources of variability. (interactive nodes, dedicated,...) Compare w. prediction; Interpret: Why these numbers? Identify "bottlenecks" by profiling tools; find remedy & make changes Check improvement by measurements Write report with description of problem, *algorithm*, and design decisions, pertinent graphs of measurements and profiling, "before and after". 11-08-16 HPC Course Summer '11 4



• Group size G	G = 2 recommended.	
-	ade C. A requires exceptional work	
U U	the for grade $\geq C$ increase with G.	
 Proposed sche 	•	
1	22 First iteration: status report, quick feedback from	advisors
	24 Second (final ?) iteration, results, quick feedback/	
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	10 evaluation may take a while	
	1-01 evaluation turnaround time may be very long	
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•Report:		
 Backgrou 	Ind, formulas, relevant problem sizes,:	
 Algorithr 	n, parallelization principle,	
•"Embarra	ssingly parallel" OK, but performance model (?)	
	nce model and measurements.	
• Graphs, a	and textual description of what the graphs show,	
1 /	learn from them	
	ation: WHY these numbers?	
• Interpret	HPC Course Summer '11	6

Example

Compute electric field in *N* gridpoints \mathbf{g}_{j} , radiated by photonic crystal rods located in \mathbf{r}_{k} , k = 1,...,K using *M*:th order Bessel expansion with coefficients

 $C_{km}, m = -M, ..., M$ Assumption: $MK \ll N$

- 1. Compute $\mathbf{c} = \{C_{km}\}$ to satisfy field self-consistency condition: solve (small) linear system $\mathbf{Ac} = \mathbf{s} \quad \mathbf{A}: 2(M+1)K \ge 2(M+1)K$
- 2. Compute field in the *N* gridpoints: for j = 1:N

$$E(\mathbf{g}_j) = \sum_{k=1}^{K} \left(\sum_{m=-M}^{M} C_{mk} B^m (|\mathbf{g}_j - \mathbf{r}_k|) \right)$$

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"Embarrassingly parallel" algorithm: Assign *N*/*P* gridpoints to each of the *P* processors! 1. Set up and solve Ac = s on proc 1. 2. Proc 1 sends c to all other processors ("broadcast") 3. All processors compute assigned grid points 4. All processors send their assigned gridpoints to proc. 1 5. Proc 1 plots the field Performance model: b = 2M+1, P = # processors (cores? nodes?) 4. ??? better model ??? 3. $T = c_1(bK)^3 + n\tau_F N/P + (P-1)(\tau_S + N/P \tau_b)$ Measure *T* for different = Const. + $n\tau_{\rm F}N/P + P\tau_{\rm s}$ V and P ! $P = \sqrt{\frac{n\tau_F N}{\tau_S}}$ Min. for 11-08-16 HPC Course Summer '11 8