Lecture 5: Intro to Parallel Programming

CMSE 822: Parallel Computing

Prof. Sean M. Couch

Things are tough….

Have some puppy video!

Amalie “Millie” Couch

Named for Amalie Emmy Noether

Be sure to post PCA questions!

Response rate for PCA4 pretty low…

- Expectations: *Everyone* either POSTS a new question for UPVOTES someone else's question.

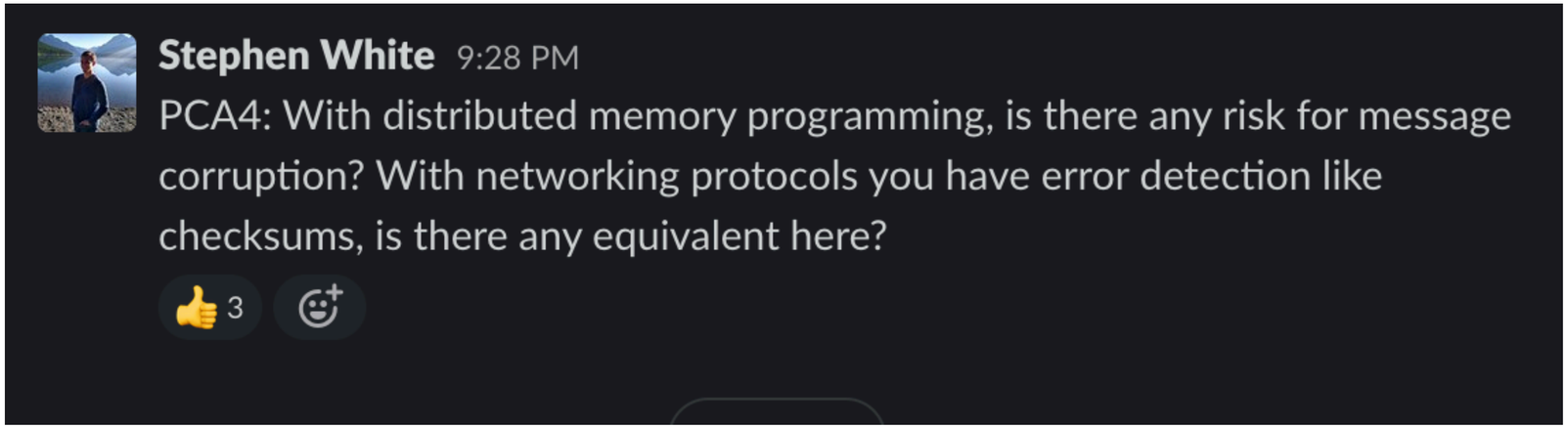
Today

Intro to programming in parallel

- More time to work on on Homework 3!
- No programming needed for HW3
- Goal is to answer all exercises (if not complete the write-ups) by end of class!

PCA Question

“Fault tolerance”

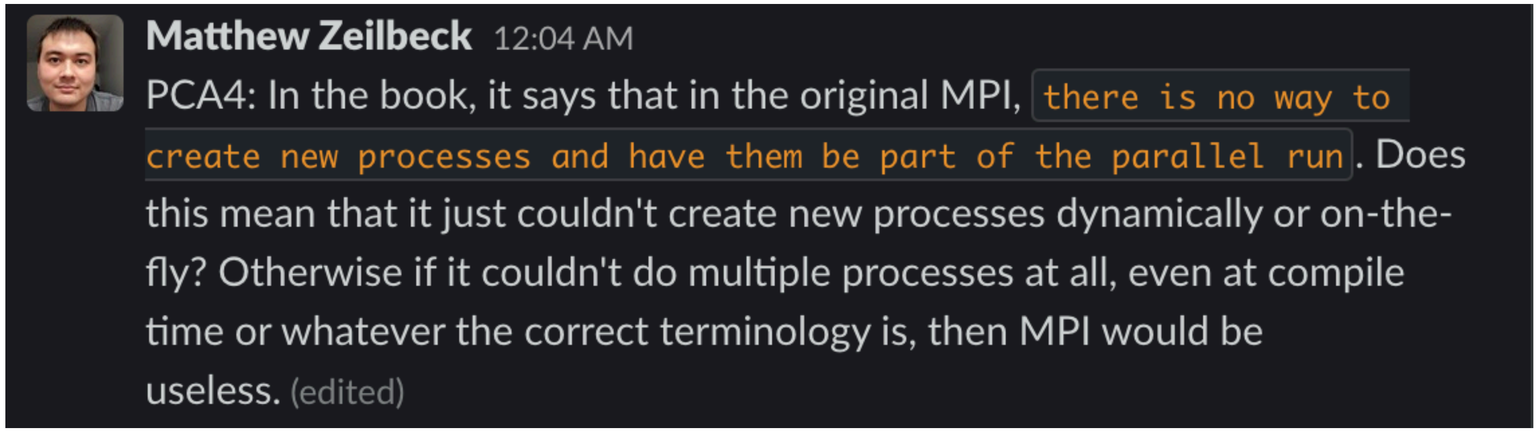


Yes! See https://www.christian-engelmann.info/publications/fiala12detection2.pdf and https://sites.google.com/site/ftxsworkshop/

Generally hope for hardware solutions to this

PCA Question

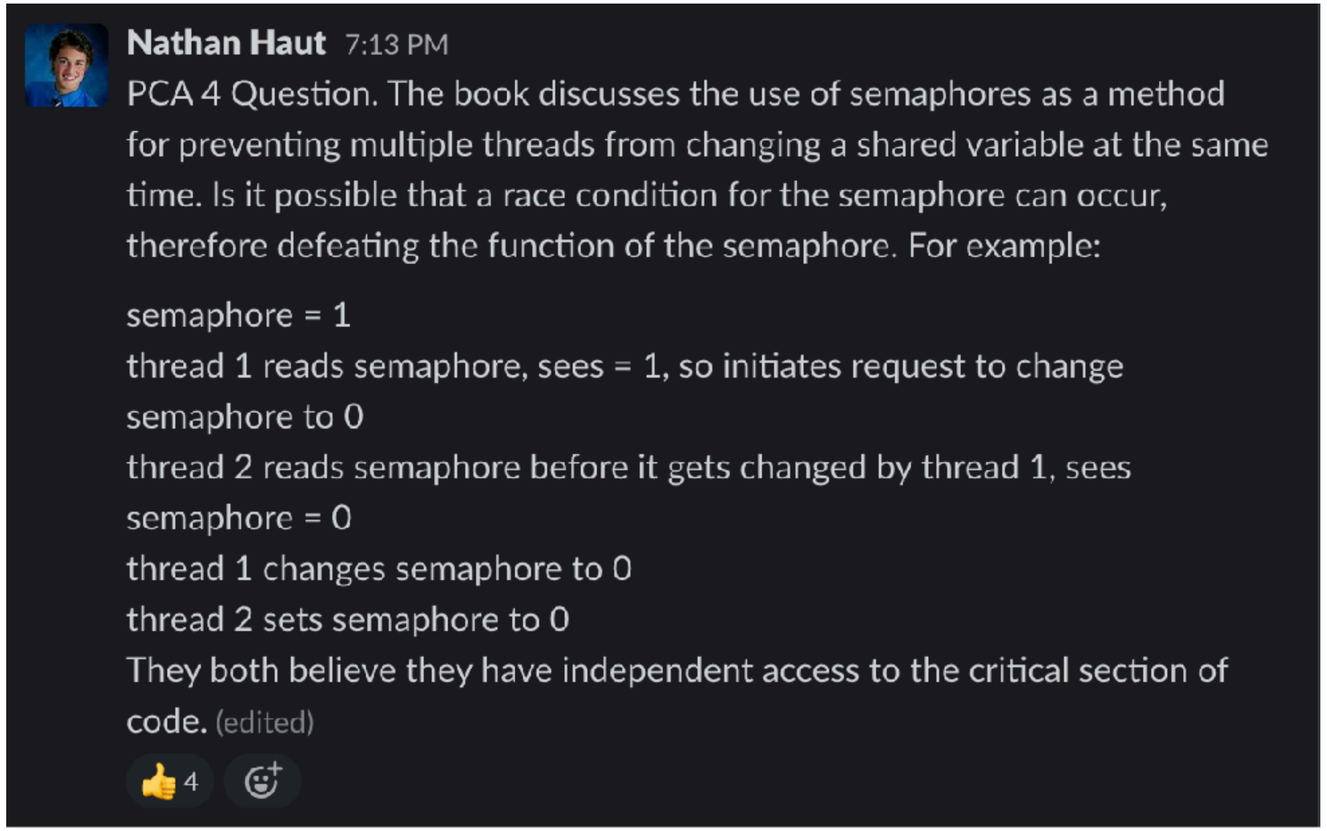
MPI Dynamics Process Management



Yes, at runtime. For MPI-2 and newer, dynamic process management is implemented: https://wgropp.cs.illinois.edu/bib/papers/pdata/1995/sanantonio.pdf

PCA Question

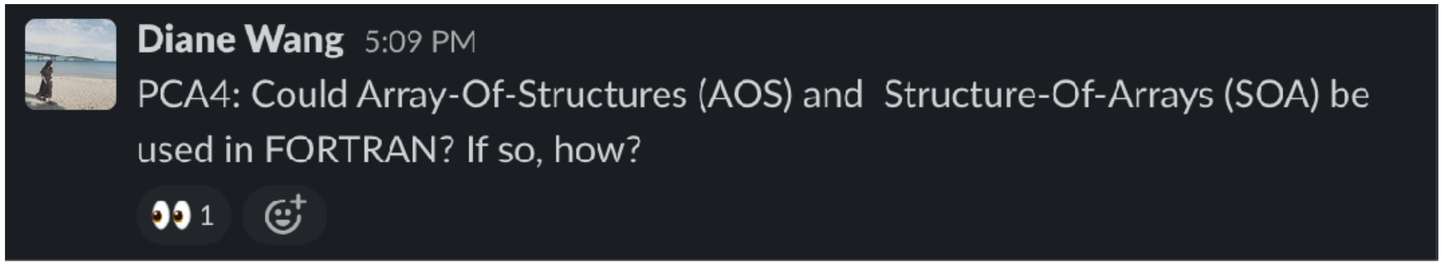
Semaphores and race conditions



If implemented correctly, no. Hardware should enforce *atomic* update of semaphore (only one thread at a time).

PCA Question

Fortran Array-of-structures



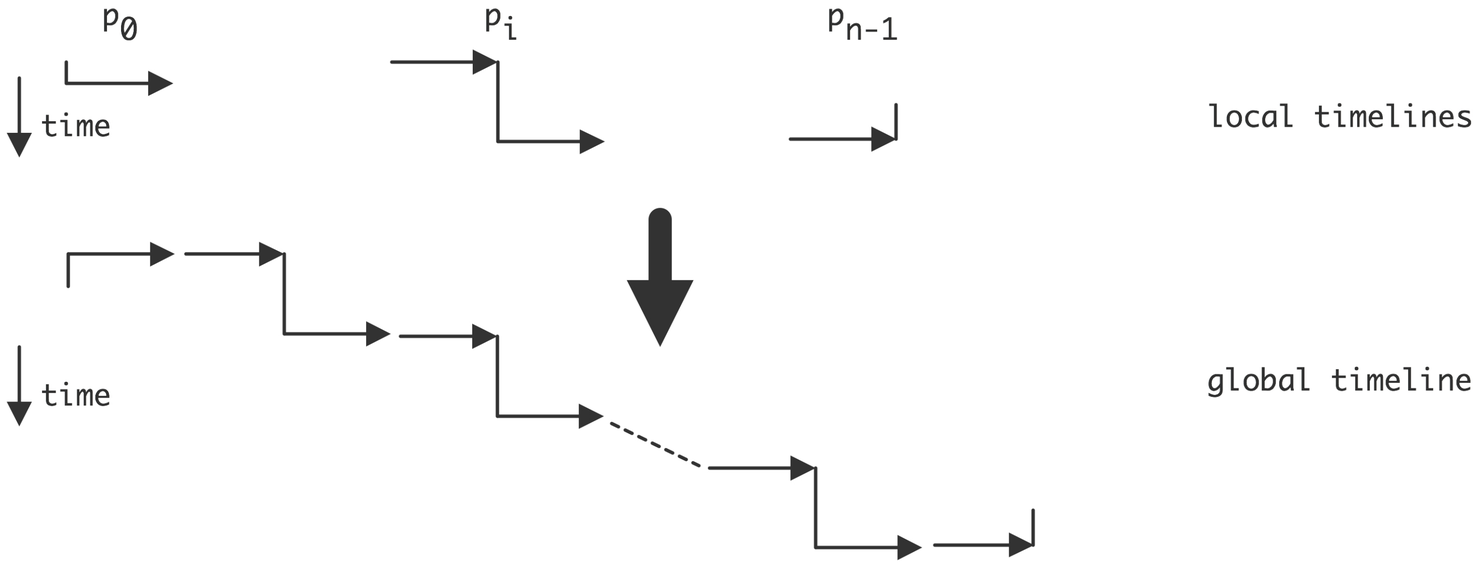
Yes! Fairly easy with object-orientation in Modern Fortran. Use user-defined `types` to do this. See, e.g., https://stackoverflow.com/questions/38461099/how-to-implement-structures-of-arrays-instead-of-arrays-of-structures-in-fortran

and https://software.intel.com/content/www/us/en/develop/documentation/fortran-compiler-developer-guide-and-reference/top/language-reference/a-to-z-reference/t-to-z/type-statement-derived-types.html

PCA Question

Deadlocks and serialization

$$\begin{cases} y_i \leftarrow y_i + x_{i-1} & i > 0 \\ y_i \text{ unchanged} & i = 0 \end{cases}$$



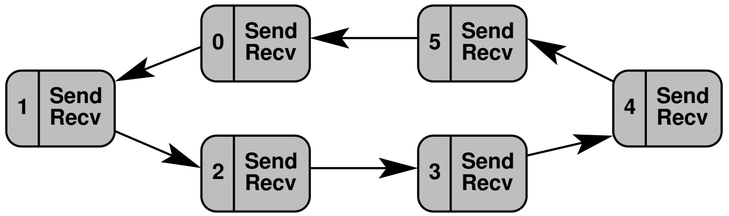


Figure 2.11: Local and resulting global view of an algorithm for sending data to the right

PCA Question

Deadlocks and serialization

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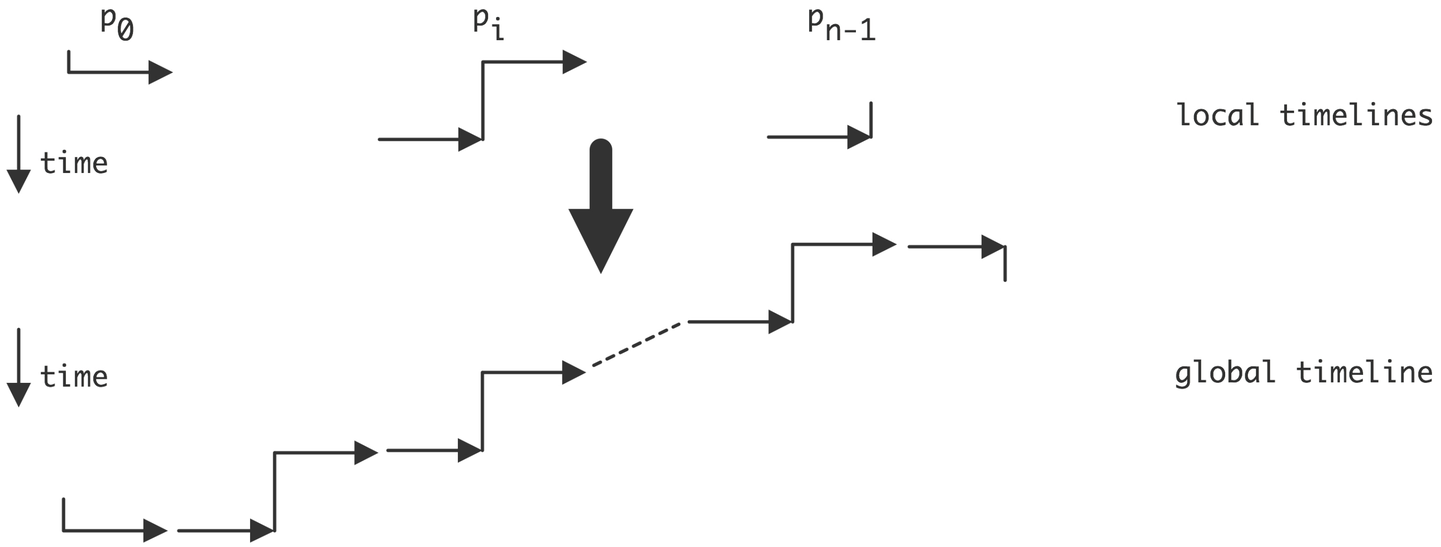

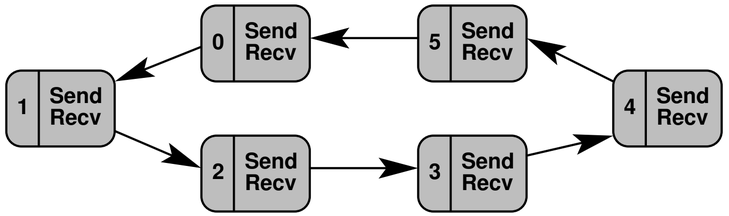

Figure 2.12: Local and resulting global view of an algorithm for sending data to the right

PCA Question

Deadlocks and serialization

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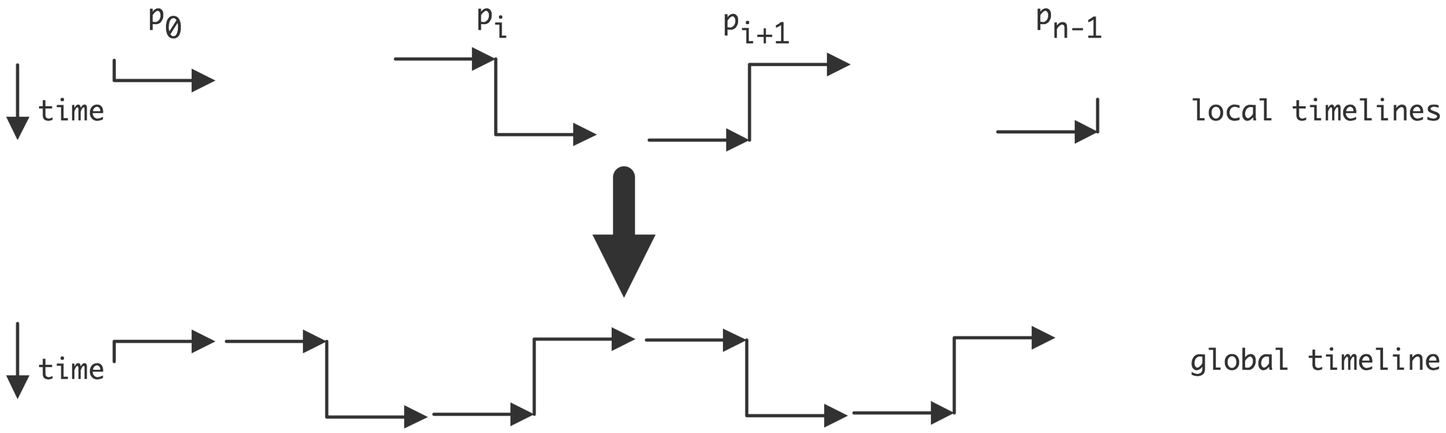

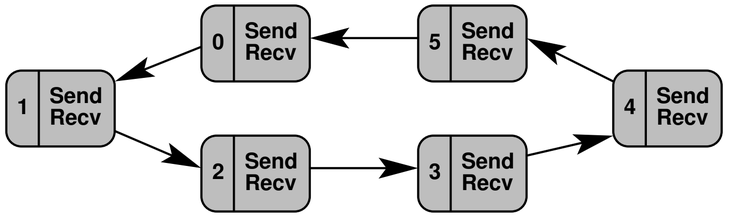

Figure 2.13: Local and resulting global view of an algorithm for sending data to the right

Group work on HW3