Programming of Supercomputers

Assignment 3:
MPI Point-to-Point and One-Sided Communication

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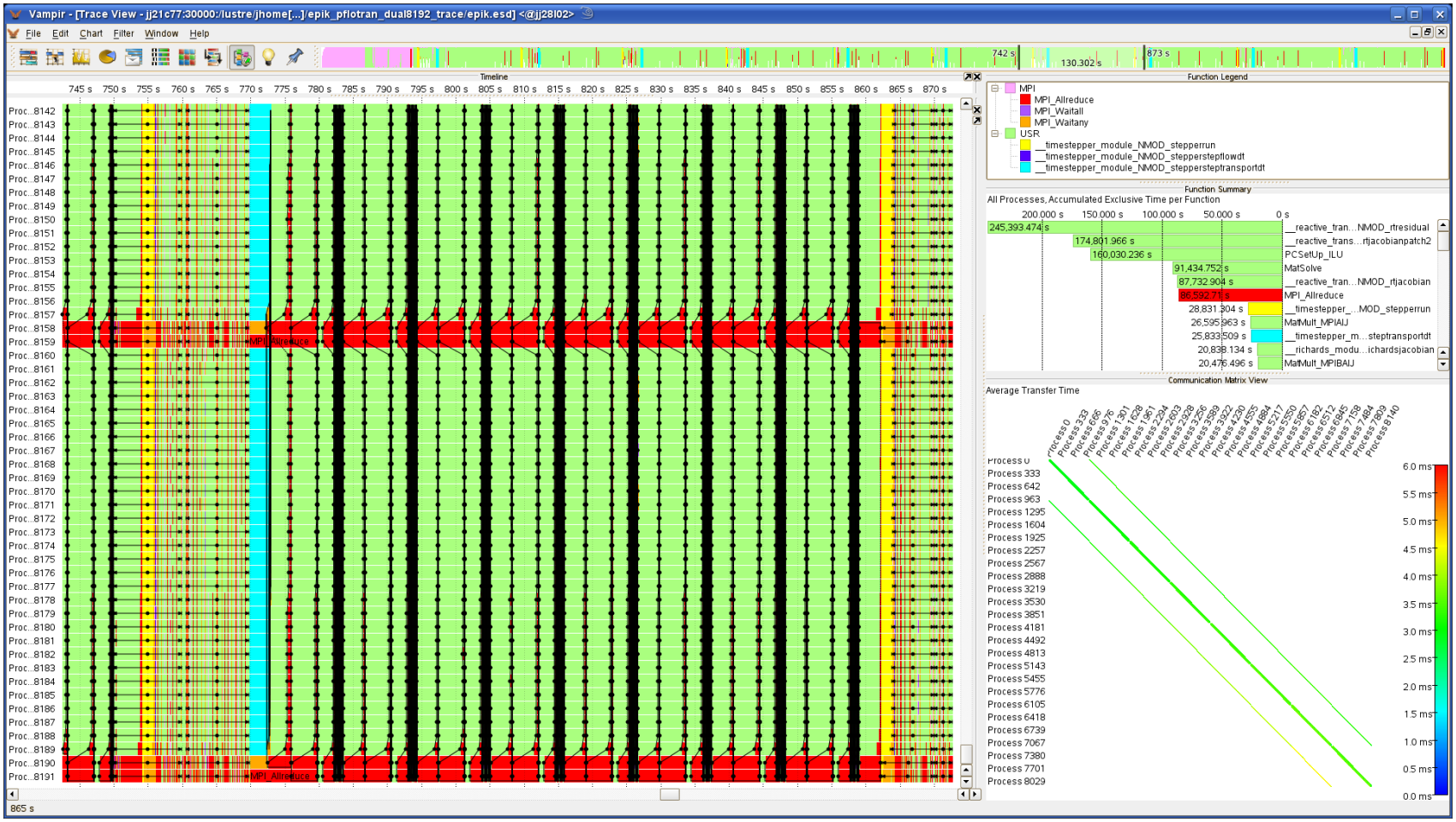
Schedule Updates

- **Assignment 2:**
  - Video's percentage of the score will be kept at 20% (not 30%)
  - We want to give you more time to take our feedback into account
    - Deadline extended to Tuesday night.
- **Assignment 3 and 4:**
  - Core programming and optimization assignments
  - Schedule remains the same.
  - Video's percentage will be kept at 20% (not at 40%)
- **Assignment 3 materials:**
  - Instructions and source code will be provided by next Tuesday

Assignment 2 Discussions

- Bugs in parallel programming
  - Were you familiar with them?
  - What did you learn about floating point arithmetic?
  - Are all of them parallel programming specific?
- What do you think about TotalView?
  - Is it worth learning?
  - Good OpenMP support?
  - Good MPI support?
  - Did you explore more than what was in the assignment?

Vampir Trace and Score-P Introduction



MPI Point-to-Point Communication

- Covered in the Parallel Programming lecture
- Large set of operations in the standard
  - Send, receive and combined operations
    - Receives matching sends
  - Blocking and non-blocking
    - Wait and probe
  - Buffered, ready, synchronous

- Part 1 of the assignment
  - Focus on blocking and non-blocking communication
  - Convert blocking to non-blocking communication
  - Try to achieve overlap
    - Perfect overlap is the target
    - Theoretical double performance

MPI One-Sided Communication

- Also covered in the Parallel Programming lecture
- Remote Memory Access (RMA)
- Operations are non-blocking
  - Remote process not blocked during transfer
  - Possible overlap with theoretical double performance
- No need for matching operations at the receiver
- Also a large set of operations in the standard
  - Put and get operations
  - Direct access to memory of other processes through windows
- Multiple benefits vs. point to point communication
  - Aim to reduce synchronization with bulk transfers and no direct matching
  - Aim to reduce data movement by eliminating intermediate buffering
  - Can simplify programming since only one side of the communication is specified
  - Can better benefic for RMA hardware features in some NICs

Cannon's Matrix-Matrix Multiplication

- Distributed Matrix-Matrix multiply algorithm
  - Works well in 2D meshes
  - Constant storage requirements
  - Each process stores its own block
  - Cycle operand blocks
- Implementation given
  - MPI blocking point-to-point
  - Cartesian topology
- Tasks:
  - Convert to non-blocking
  - Convert to one-sided
- Scale of the programming task
  - 4 nodes
  - 64 processes
  - Large generated matrices