Dataflow Analysis for MPI Programs in ROSE
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Objective
- To perform dataflow analysis on MPI programs
- Detect communication pattern statically

Dataflow Analysis
- Dataflow analysis is useful to discover program properties and enables program optimizations
- Operates on control-flow graph of the program
- Maintains an abstract program state for each control-flow graph node
- Abstract states are modified based on the semantics of the statement
- Program execution by the analysis is a sequence of abstract states

Dataflow Analysis for MPI
- Requires extension to sequential control-flow graph
- Replicated control-flow graph for each MPI process due to SPMD model
- Edges between MPI operations to model communication
- Requires static determination of concrete values for destination expressions in communication operations

Approach
- Run the analysis as a MPI application
- Each MPI process is an analysis instance
- Each analysis instance gets a rank id
- Propagate this rank value to variables and expressions in target MPI code
- On reaching a communication operation each analysis instance sends/receives program state information to/from another process using regular MPI calls
- Implemented in ROSE compiler framework

Application of the Analyses
- Transform the detected communication pattern to Group Operation Assembly Language (GOAL)
- GOAL optimizes the communication for the underlying network
- Limitations: cannot currently support path-sensitivity in analysis and data-sensitive communication patterns

Types of Analyses
- Each analysis instance runs the following sequence of analyses to detect communication pattern

References & Acknowledgements

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