Constraint Programming Techniques for Compiler Optimization

Part-II

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What is left to do

- For Local Scheduling and not for Global Scheduling

- Current Model assumes that register allocation has been done.

- Assumes about load/store instruction latency

Global Scheduling

- Reasons for global instruction scheduling
  - Number of instructions in a basic block is small
  - Local scheduling does not expose enough Instruction Level Parallelism
- Scheduling techniques
  - Control flow plays an important part
  - Depends upon the regions
    - Acyclic Regions
    - Cyclic Regions

Acyclic Regions

- Linear Regions: Straight line scheduling
- Current Approaches :
  - Trace Scheduling
  - Super Basic Blocks
- Mechanism: Basic scheduling across basic blocks
  - Move down to adjacent basic blocks
  - Move up to adjacent basic blocks
  - Move up/down across basic blocks

Cyclic Regions

- Loops
- Mainly important in Scientific Programs
- There are two main steps:
  - Loop unrolling
    - Mainly preprocessing step
  - Software pipelining
    - It's the main step where we are planning to apply Constraint Programming techniques

Software Pipelining

- Try to overlap multiple iterations so that the slots will be filled
- Find the steady-state window so that:
  - All the instructions of the loop are executed
  - But from different iterations
- *CSP model for getting the steady-state window subject to resource and dependence constraints*

Register Allocation

- It is part of instruction scheduling
- Phases of Instruction scheduling
  - Before and after register allocation
- Instruction scheduling integrated with register allocation
- The main constraints are number of registers, liveliness of variables.

Cost Function

- Effectiveness of Optimization: How well can we optimize?
  - Impact on running time of the compiled code determined by the compilation time
- Efficiency of Optimization: How fast can we optimize?
  - Impact on the time it takes to compile or cost for gaining the benefit of code with fast running time
- Effectiveness and Efficiency with respect to Power Reduction
  - Instruction scheduling for Power Reduction

Final Words

- Results from Local Scheduling with single and multiple issue instructions are encouraging

- We are optimistic about the encouraging results for global scheduling problem as well

- Register allocation problem with constraint programming techniques