Study of Multimedia Applications

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Characteristics

- Intensive computation for highly regular operations
- Data locality (Spatial and Temporal)
- Frequent encounter of small integer operands
- Usually demand real-time processing capabilities
Custom Hardware Support

• Application specific processors (DSPs)
• General Purpose Processors with Media coprocessors (Imagine).
• Adding Multimedia Instructions to the ISA (Intel MMX, Sun VIS, MIPS MDMX)
Benchmarks

- MediaBench+
  - Video: MPEG-2, MPEG-4, H.263
  - Audio: ADPCM coder
  - Graphics: Mesa
  - Image: JPEG, EPIC, Ghostscript
  - Security: PGP, Pegwit
  - Speech: GSM, G.271, Rasta
    - Also includes MPEG-4 and H.263 as a representative of emerging video applications
Instruction Mix Comparison

[Bar Chart]

- Spec Int
- Spec Fp
- Multimedia

%age of Instruction mix

Legend:
- Memory
- Integer Alu
- FP ops
- Branch
- Other
Branches

• The branches mainly due to loops.
  • Static branch prediction performs nearly as well as dynamic branch prediction (Fritts et al.)
Memory Access Patterns

– Load small amount of data at a time that can fit inside a cache, processes it, then throws it away
  • Most of the data is used before ejected from the cache
– Good spatial as well as reasonably good temporal locality
  • Prefetching techniques will work well since branches are also predictable
  • Stream buffers beneficial
Memory Access Patterns (contd)

- Multimedia applications generate fewer or equal data memory references per instruction as compared to SPEC Int95 applications.
- They have a slightly lower or equal cache miss rate.
- They do not place more stringent memory requirement than other applications.
Instruction Cache Miss Ratios

- The graph shows the relationship between cache size (KB) and instruction cache miss ratios.
- As the cache size increases, the miss ratio decreases significantly.
- The x-axis represents cache size in KB, ranging from 1 to 4096 KB.
- The y-axis represents the miss ratio, ranging from 0.00 to 0.06.
- The data points indicate a clear trend of decreasing miss ratios with increasing cache size.
Parallelism

- **Thread Level: Video (De)compression**
  - coarse grained - suitable for CMPs

- **Instruction Level: Image Processing**
  - Fine grained – Superscalar/Wide Issue
  - Average Basic Block Size: 8

- **Data Level: Graphics Applications**
  - Producer Consumer locality – suitable for stream architectures.
  - Compiler support in identifying data parallelism can boost performance (Vector processors)
Future Trends

• MPEG-4: Less processing regularity and high data rate

• Graphics Application:
  – Lots of floating point ops
  – High memory bandwidth
  – Distributed frame buffers is one proposed solution (one processor per frame buffer)
    • Communication overhead, high network bandwidth