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

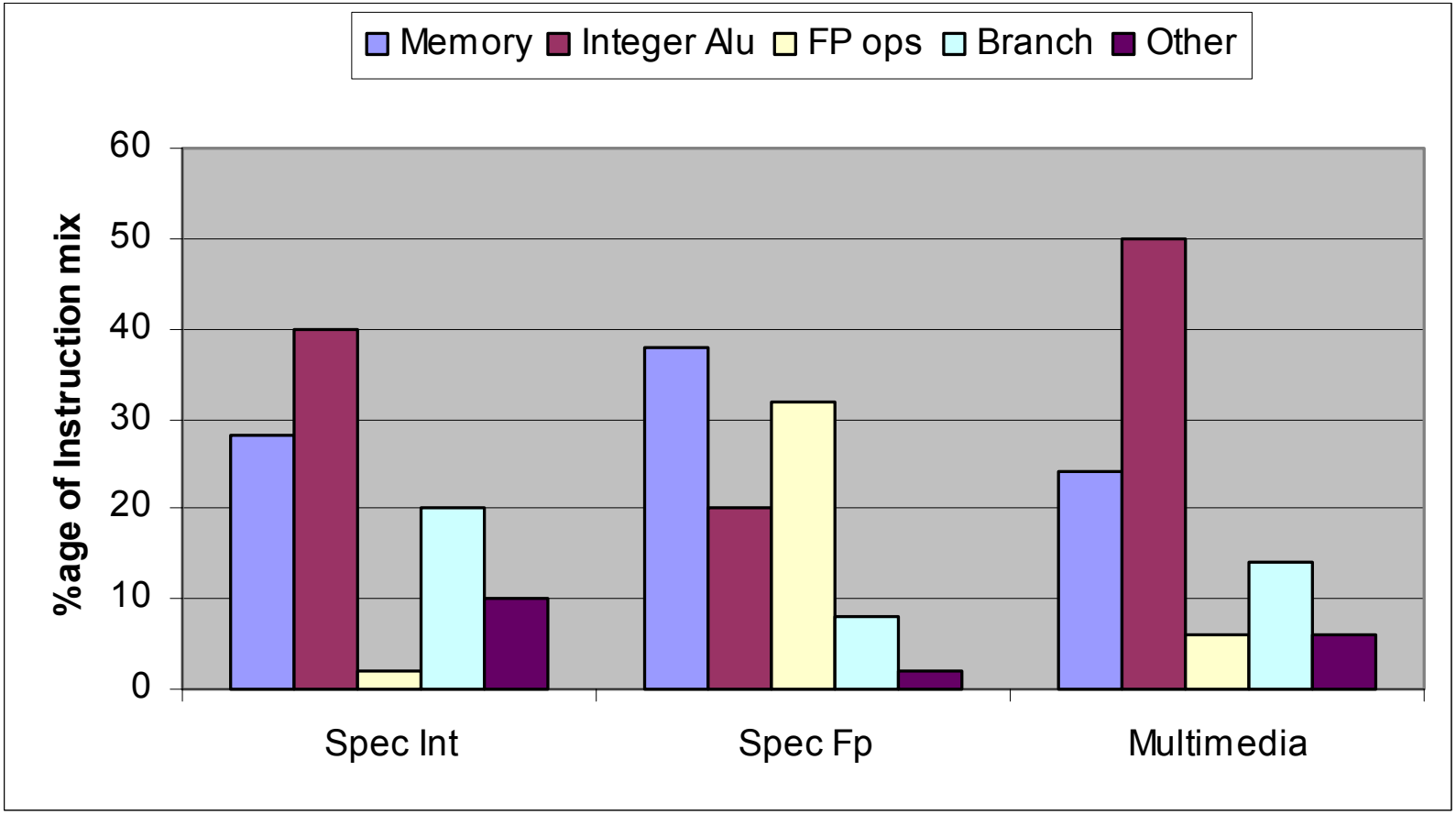
Custom Hardware Support

- 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

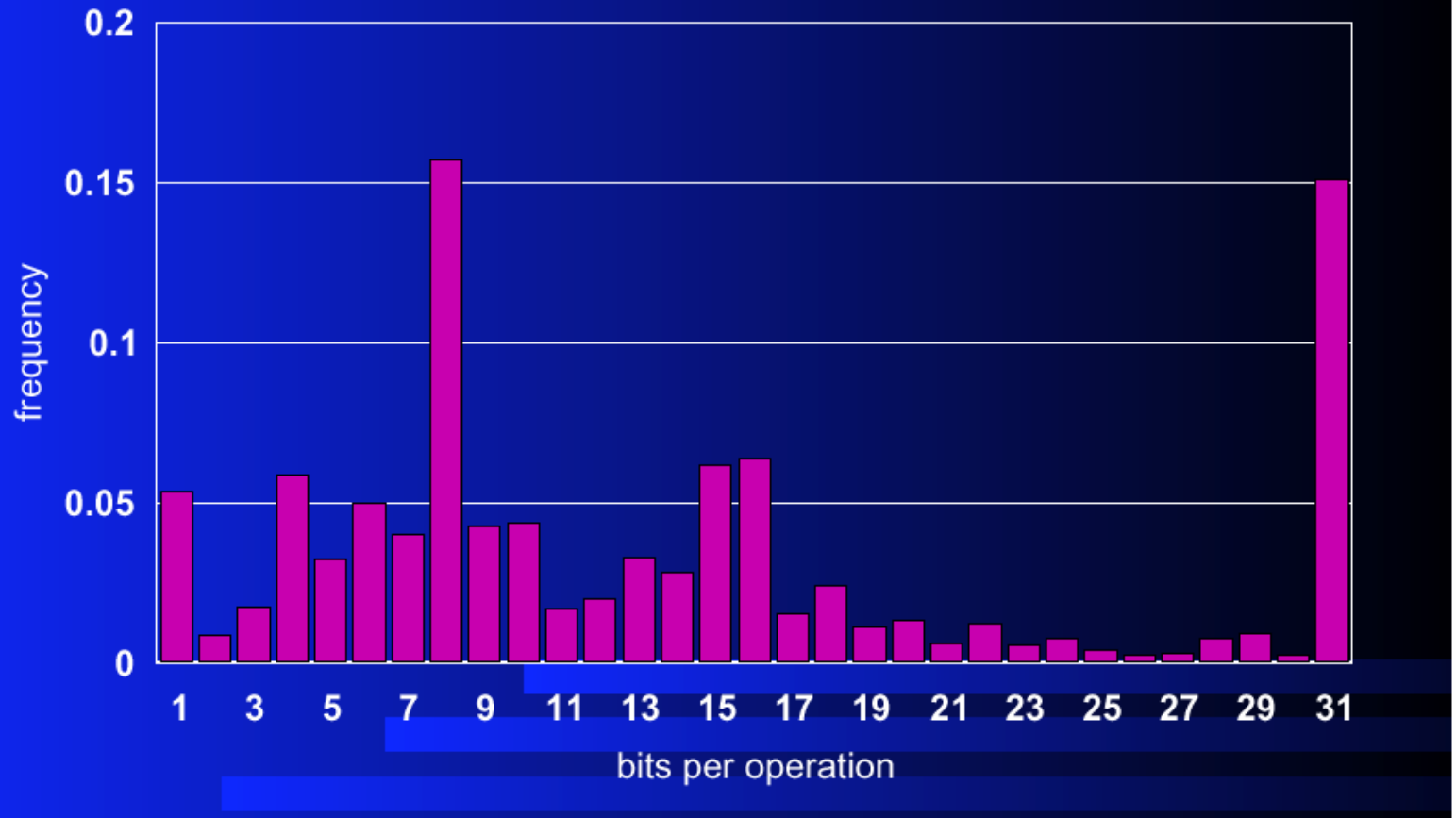


Branches

- The branches mainly due to loops.
    - Static branch prediction performs nearly as well as dynamic branch prediction

      (Fritts et al.)

Integer Data Size Histogram



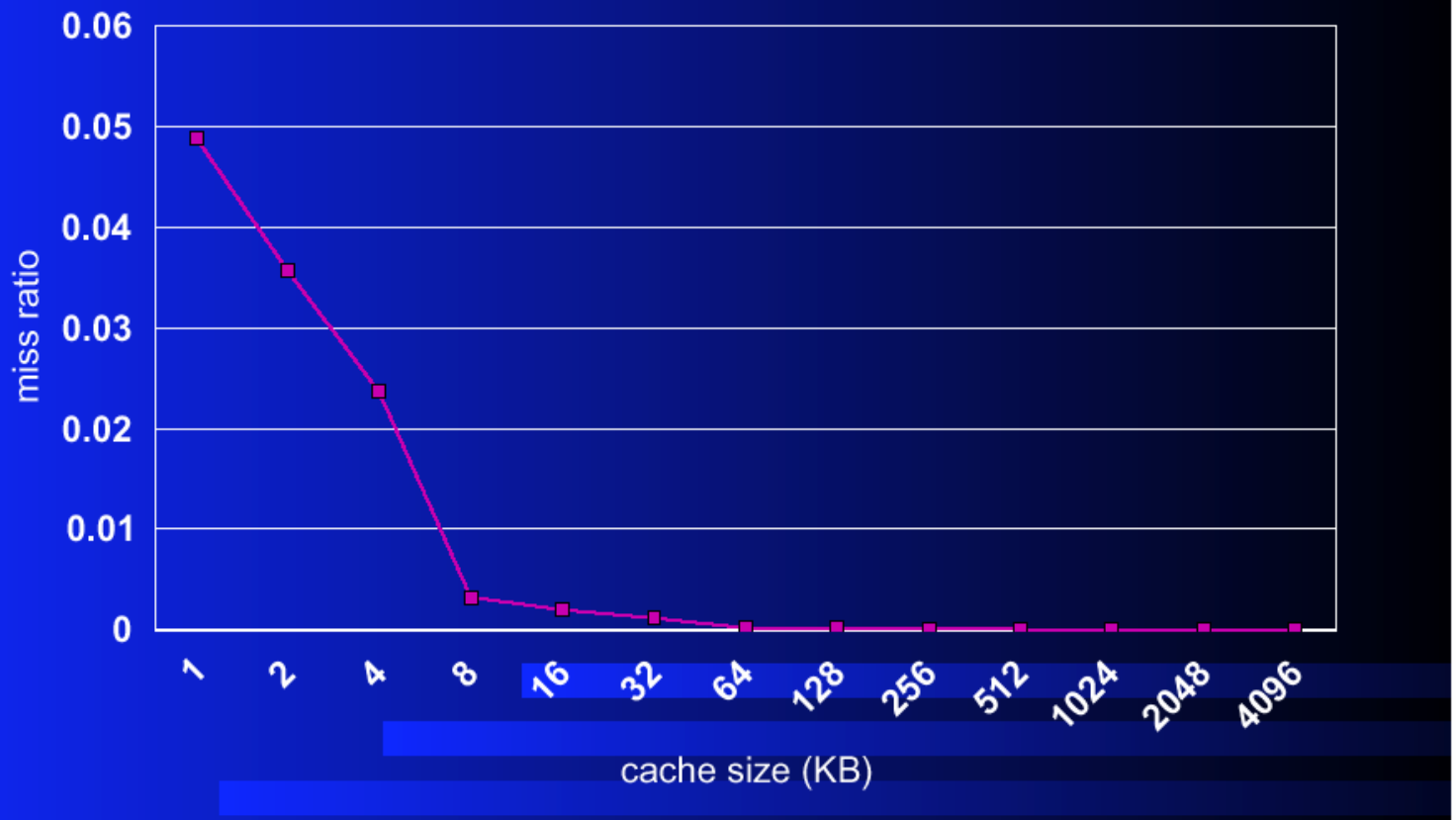
Memory Access Patterns

- 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

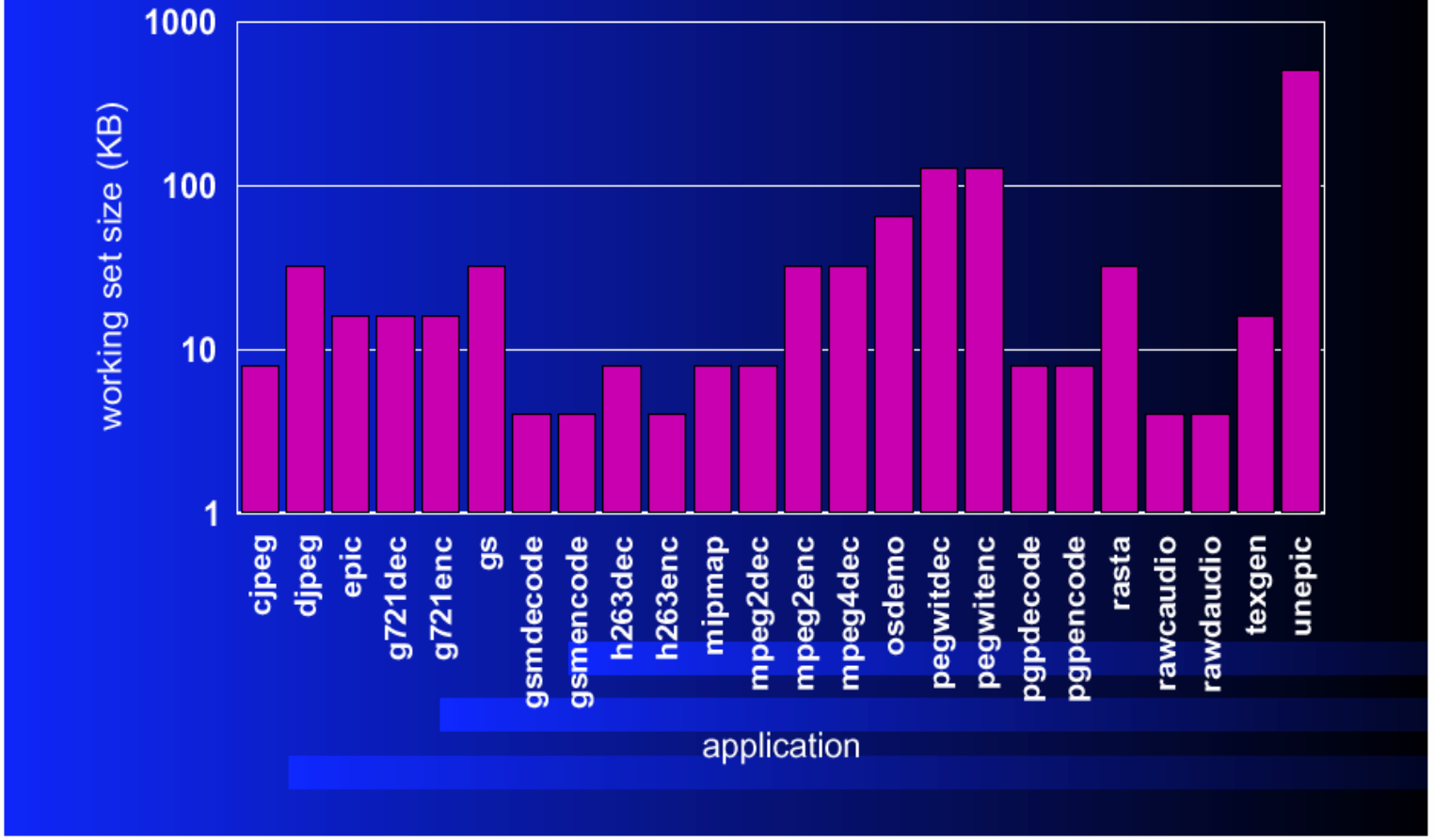
Memory Access Patterns(contd)

- Multimedia applications generate fewer or equal data memory references per instruct 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



Data Working Set Sizes



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