

Advanced Architecture

Assignment 1

Mantha Sai Gopal

Reg.No: 23358

Problem Description

Given a few trace files containing information about the instructions and a simulator which reads a trace file and counts the total no of microoperations and macro-operations. Find the instruction mix (Category wise count of each machine instruction) of trace benchmark sets and compare the results. There are five main categories of instruction namely ALU Load & Store Branch - Conditional and Unconditional Floating point Other instructions. Plot the frequency of each category on a histogram.

Instruction Mix

S.No	Instruction Category	Dataset 1(%)	Data Set 2(%)	Data Set 3 (%)
1	ALU	36.299999	39.964001	27.806656
2	Load-Store	34	31.18	35.497322
3	Unconditional Branches	3.6	3.864	3.914558
4	Conditional Branches	15.7	14.689	12.456836
5	Float Point Instructions	0	0	0
6	Others	10.4	10.303	20.324633
	Total	100	100	100

Dataset 1 (Data.trace)

```
Processing trace...
Processed 1000 trace records.

Micro-ops: 1000
Macro-ops: 754

ALU Instructions: 363 (36.299999 %)
Load-Store Instructions: 340 (34.000000 %)
Unconditional Branches: 36 (3.600000 %)
Conditional Branches: 157 (15.700000 %)
  Taken: 73
  Not Taken: 84

Float Point Instructions: 0 (0.000000 %)
  FP Add: 0
  FP MUL: 0
  FP DIV: 0
  Other FP: 0
Other Instructions: 104 (10.400000 %)
Average CPI: 2.000000
```

Dataset 2 (data1)

```
Processing trace...
Processed 100000 trace records.

Micro-ops: 100000
Macro-ops: 76369

ALU Instructions: 39964 (39.964001 %)
Load-Store Instructions: 31180 (31.180000 %)
Unconditional Branches: 3864 (3.864000 %)
Conditional Branches: 14689 (14.689000 %)
  Taken: 6875
  Not Taken: 7814

Float Point Instructions: 0 (0.000000 %)
  FP Add: 0
  FP MUL: 0
  FP DIV: 0
  Other FP: 0
Other Instructions: 10303 (10.303000 %)
Average CPI: 2.000000
```

Dataset 3 (go.trace)

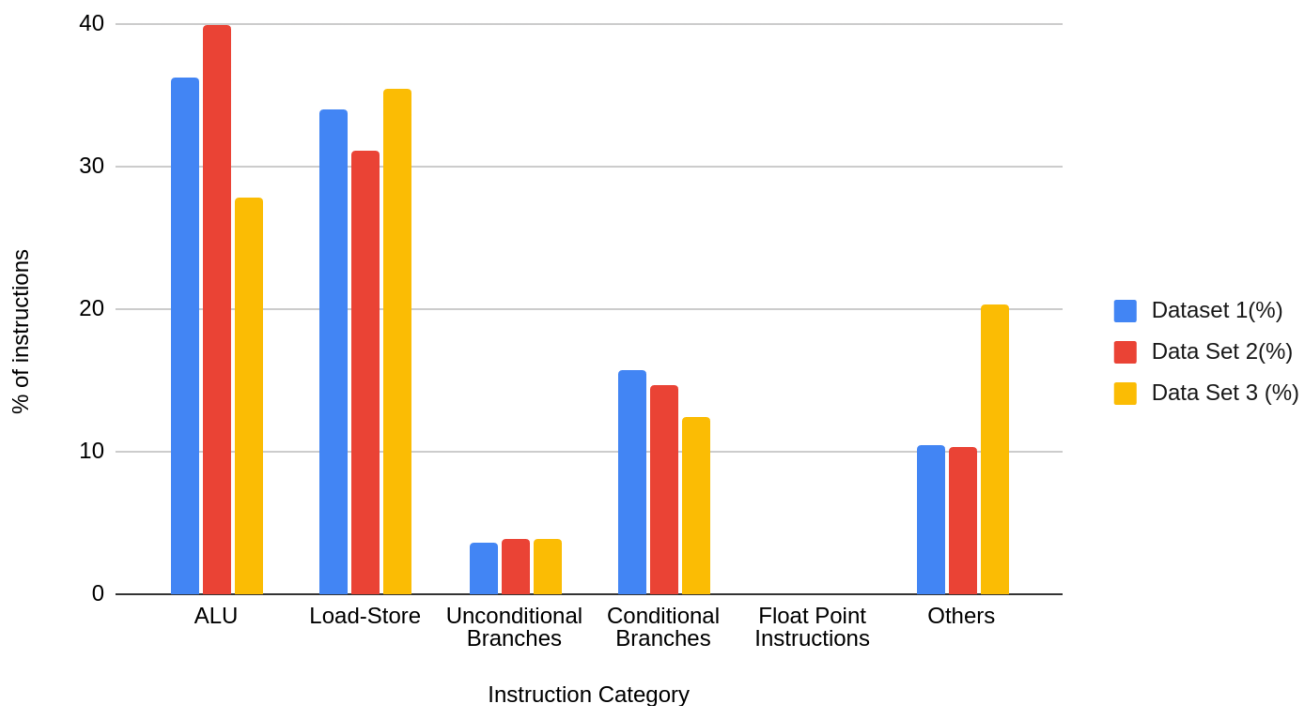
```
Processing trace...
Processed 100000002 trace records.

Micro-ops: 100000002
Macro-ops: 75961221

ALU Instructions: 27806655 (27.806656 %)
Load-Store Instructions: 35497321 (35.497322 %)
Unconditional Branches: 3914558 (3.914558 %)
Conditional Branches: 12456836 (12.456836 %)
  Taken: 6835916
  Not Taken: 5620920
Float Point Instructions: 0 (0.000000 %)
  FP Add: 0
  FP MUL: 0
  FP DIV: 0
  Other FP: 0
Other Instructions: 20324632 (20.324633 %)
Average CPI: 2.000000
```

Histogram depicting the results obtained

Instruction Mix in various data sets



Inferences

For the experiment, we have considered three datasets having 1000, 100000 and 10^8 trace records. From the above histogram plot it is evident that in almost all the datasets the ALU instructions(which handle arithmetic and logical operations) hold a major share in the total number of instructions. The load-store instructions have a balanced distribution across the datasets. In case of unconditional branches they have a small but stable representation across datasets. Floating-point instructions have no representation in any of the datasets. The “others” category represents miscellaneous instructions that do not fit in any of the specified categories. They have the highest share in the dataset3. This indicates a greater diversity in the set of instructions not covered in the main categories.

Improving performance:

To identify which instructions to optimize for better performance, we should focus on the instruction categories that have a relatively high percentage across the datasets. Thus we must primarily look for optimizing the ALU and load-store instructions. In order to optimize the ALU instructions we may consider parallel processing capabilities or using specialized hardware.