Project Report 2

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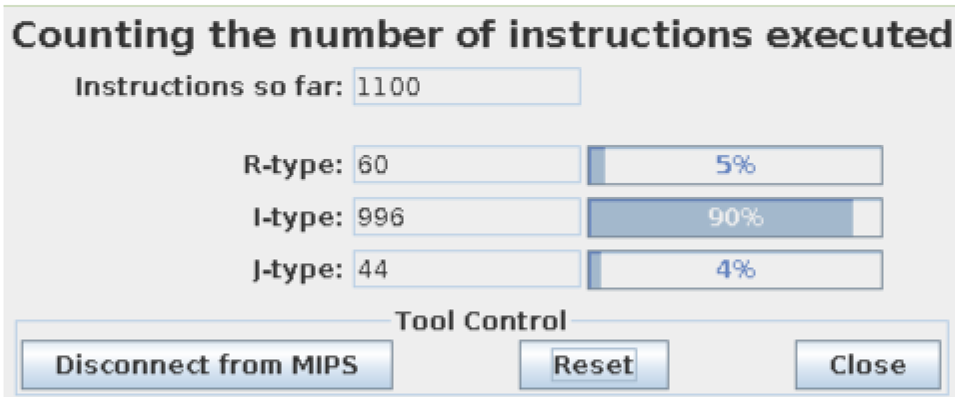
EEL3801: Computer Organization

Due Date: 7th July, 2025
Submission Date: 6th July, 2025

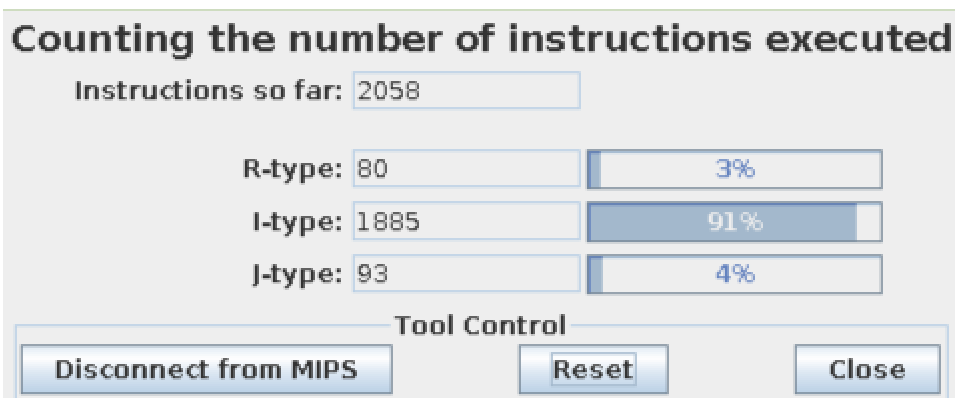
1.0 Pre-Optimization

1.1 Number of Instructions Executed

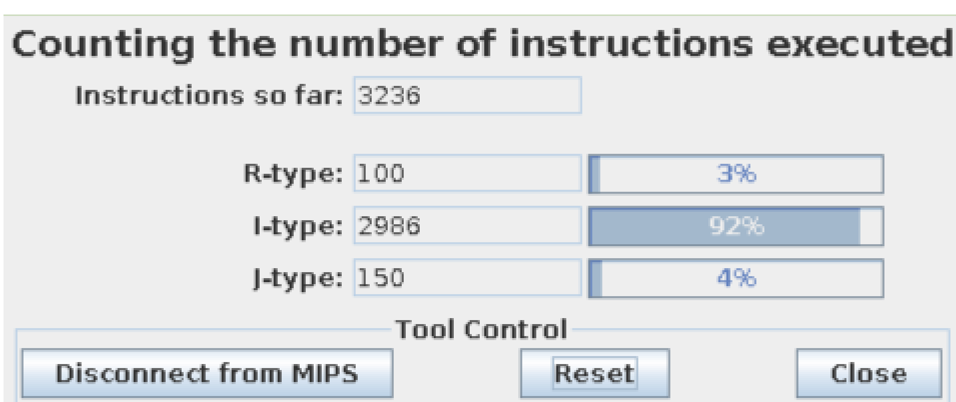
Sentence 1: DeMara finds logic beautiful.



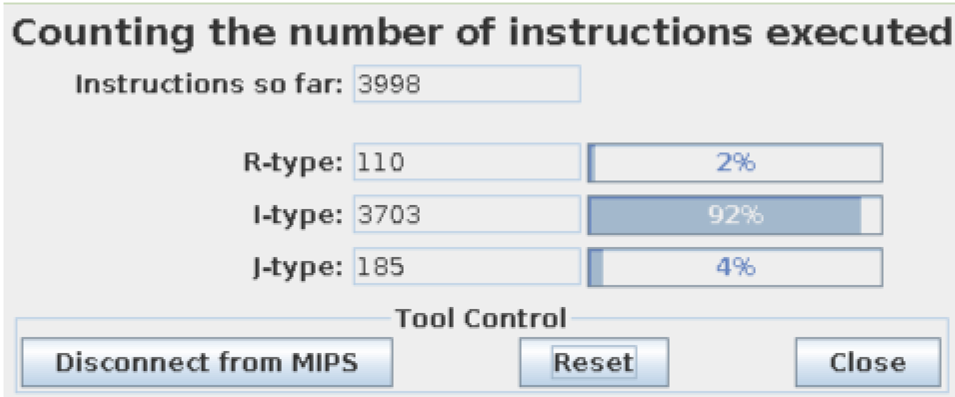
Sentence 2: He coolly sketches hypothetical CPU architectures for fun.



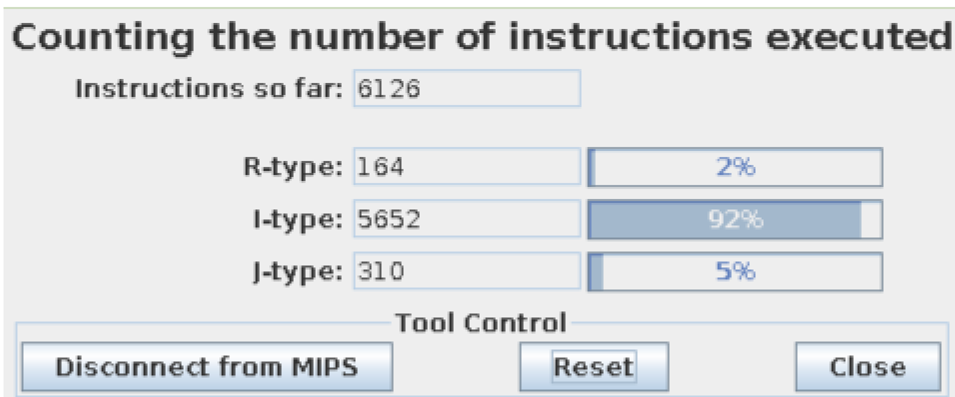
Sentence 3: While others see tangled wires, he perceives the elegant, hierarchical structure of a computer.



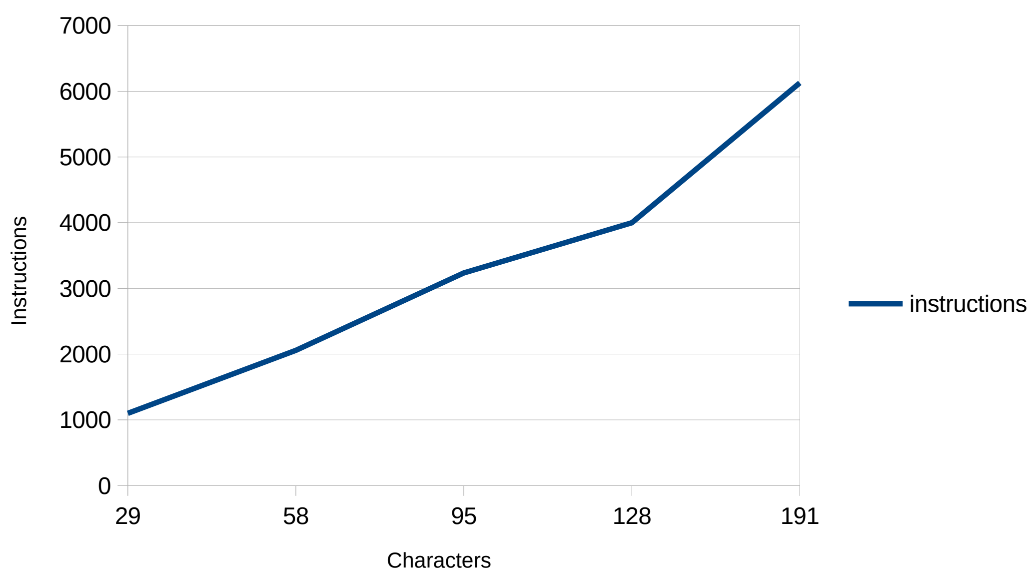
Sentence 4: His focus is so absolute that he once debugged a complex pipeline hazard in a simulated processor during a loud concert.



Sentence 5: This calm and quiet mastery over the fundamental principles of how a machine truly functions gives him an unshakable confidence that many people around him often mistake for simple aloofness.



Subsequent Graph:



1.2 CPI Calculations

Sentence 1: $\frac{6*60+4*996+3*44}{1100}=4.069$

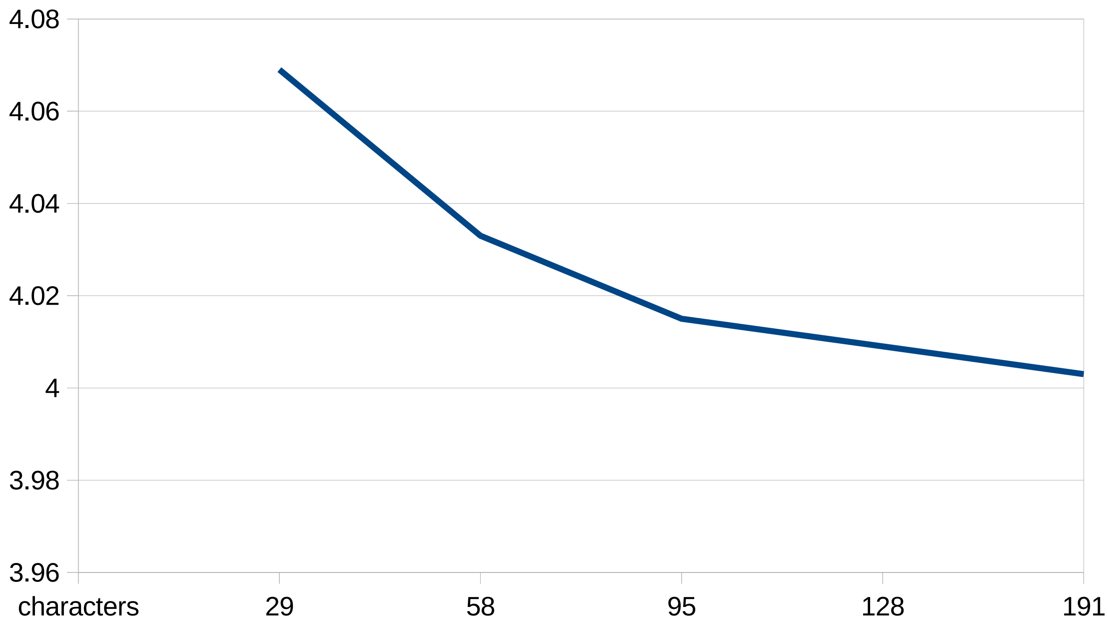
Sentence 2: $\frac{6*80+4*1885+3*93}{2058}=4.033$

Sentence 3: $\frac{6*100+4*2986+3*150}{3236}=4.015$

Sentence 4: $\frac{6*110+4*3703+3*185}{3998}=4.009$

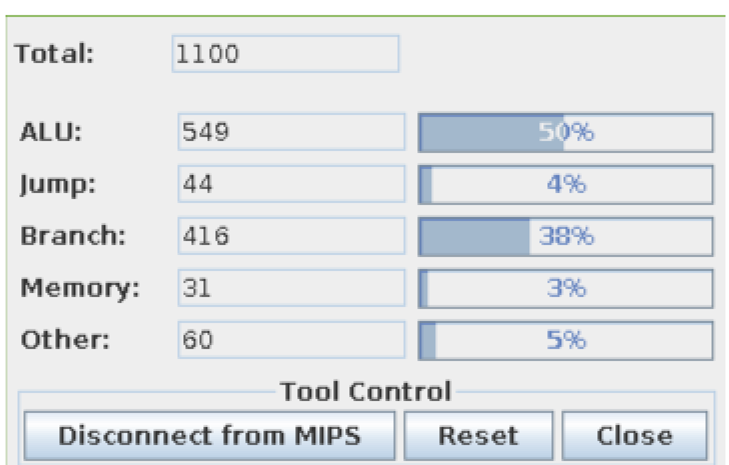
Sentence 5: $\frac{6*164+4*5752+3*310}{6126}=4.003$

Subsequent Graph:

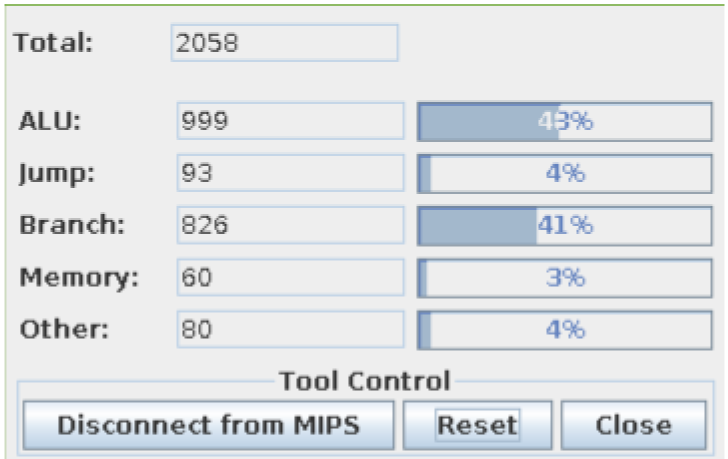


1.3 Energy Consumption

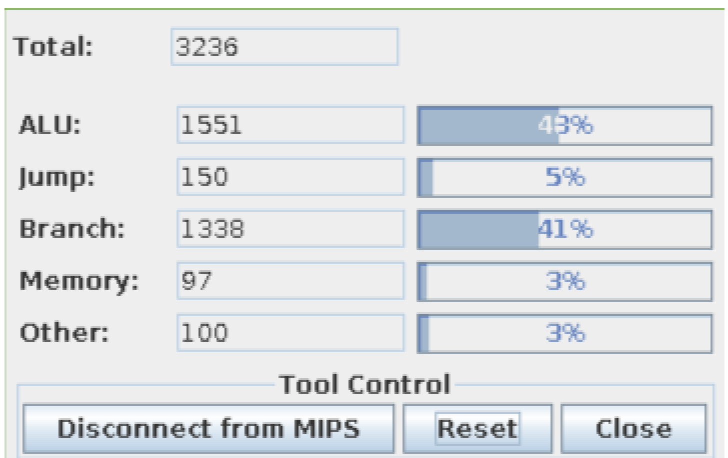
Sentence 1: DeMara finds logic beautiful.



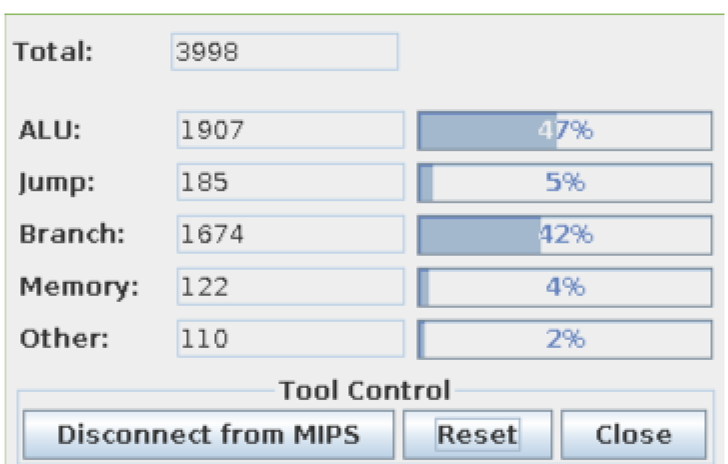
Sentence 2: He coolly sketches hypothetical CPU architectures for fun.



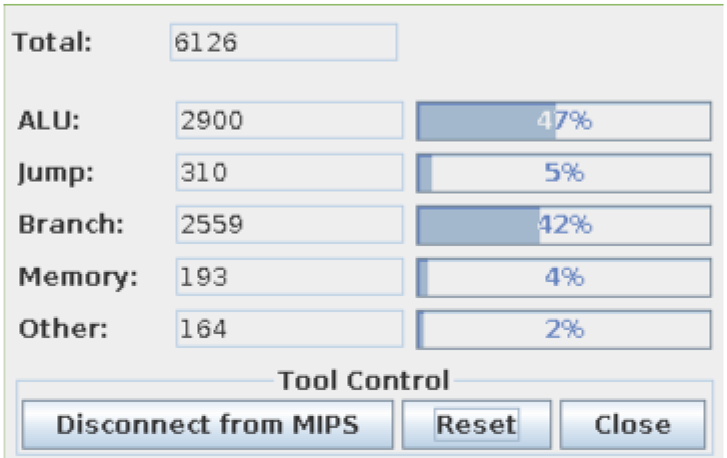
Sentence 3: While others see tangled wires, he perceives the elegant, hierarchical structure of a computer.



Sentence 4: His focus is so absolute that he once debugged a complex pipeline hazard in a simulated processor during a loud concert.

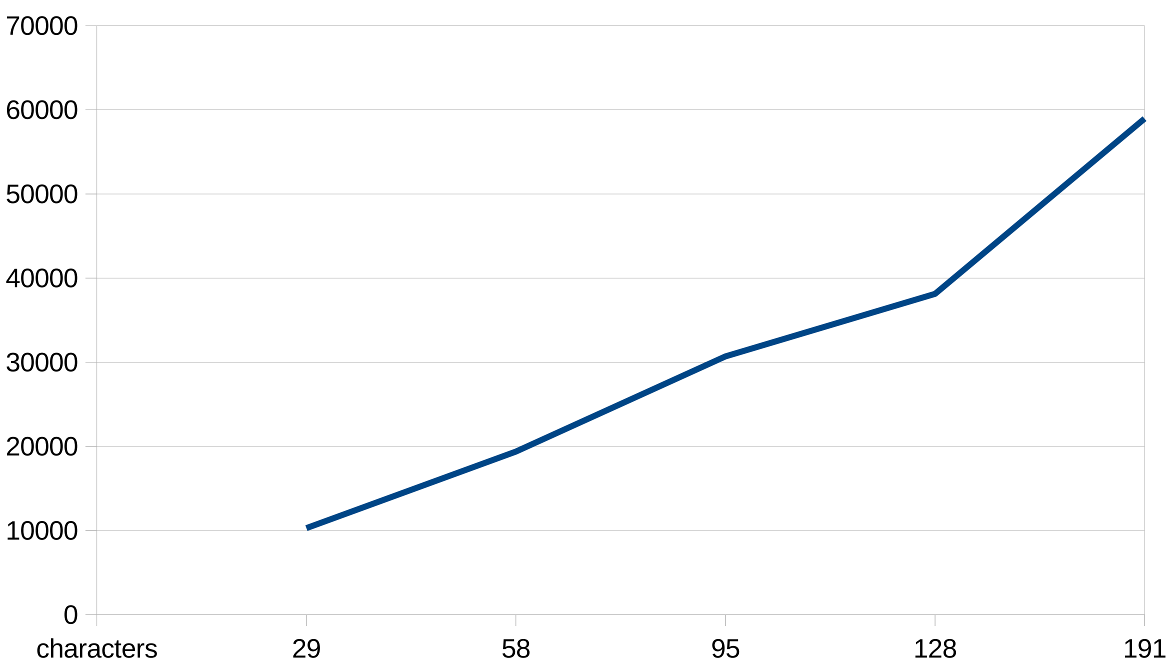


Sentence 5: This calm and quiet mastery over the fundamental principles of how a machine truly functions gives him an unshakable confidence that many people around him often mistake for simple aloofness.



Subsequent Calculations:
<u>Sentence 1:</u> $6*549+3*44+7*416+110*31+9*60=10,288\,fJ$
<u>Sentence 2:</u> $6*999+3*93+7*826+110*60+9*80=19,375\,fJ$
<u>Sentence 3:</u> $6*1551+3*150+7*1338+110*97+9*100=30,692\,fJ$
<u>Sentence 4:</u> $6*1907+3*185+7*1674+110*122+9*110=38,125\,fJ$
<u>Sentence 5:</u> $6*2900+3*310+7*2559+110*193+9*164=58,949\,fJ$

Subsequent Graph:



1.4 MIPS/mW

Required Calculations:

$$exectution\ time = clocks * clock\ cycle$$

$$MIPS = \frac{\frac{instructions}{1{,}000{,}000}}{execution\ time}$$

$$mW = \frac{1000 * energy * 10^{-15}}{execution\ time}$$

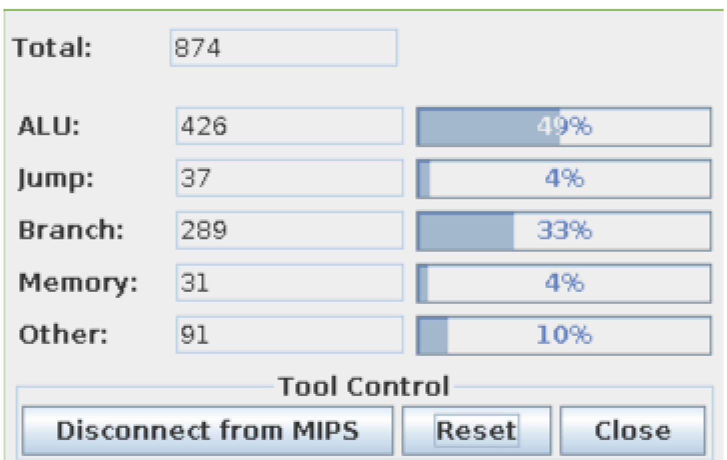
<u>Will not be done in parts, only end result will be shown, assume units are MIPS/mW:</u>

Sentence 1: 106,920.68
Sentence 2: 106,219.35
Sentence 3: 105,434.64
Sentence 4: 104,865.57
Sentence 5: 103,920.33

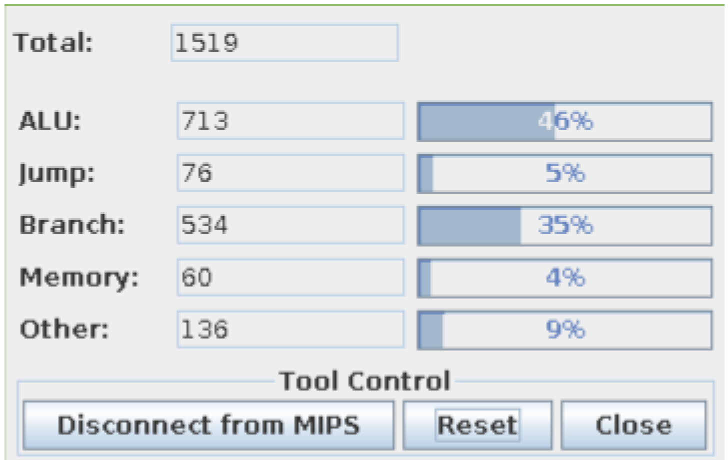
2.0 Post-Optimization

2.1 Energy Consumption

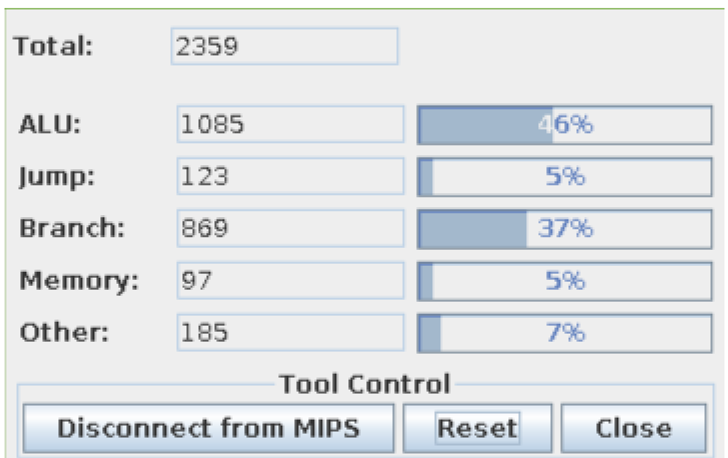
Sentence 1: DeMara finds logic beautiful.



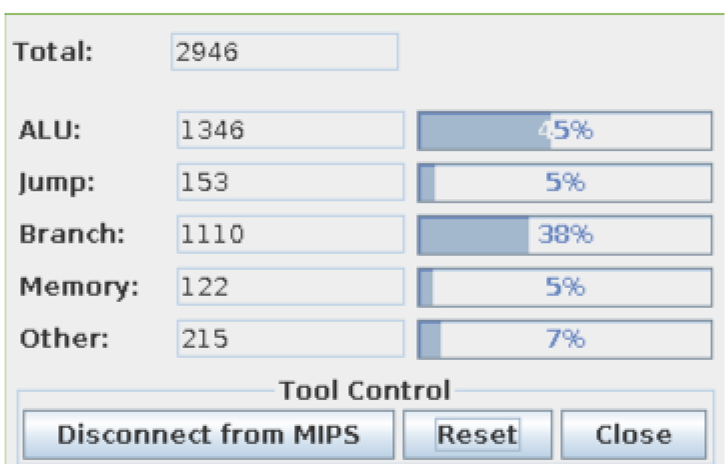
Sentence 2: He coolly sketches hypothetical CPU architectures for fun.



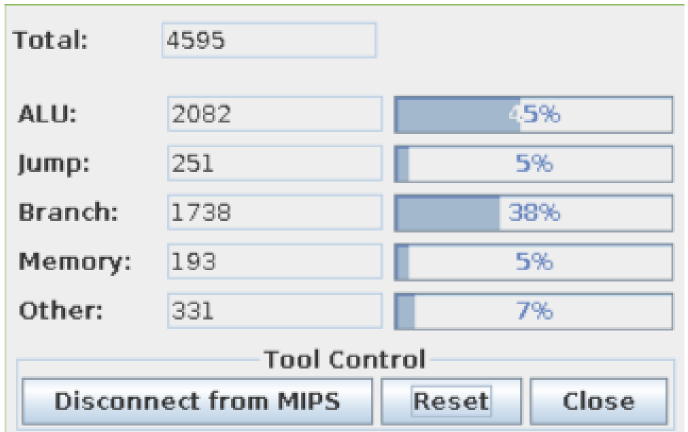
Sentence 3: While others see tangled wires, he perceives the elegant, hierarchical structure of a computer.



Sentence 4: His focus is so absolute that he once debugged a complex pipeline hazard in a simulated processor during a loud concert.



Sentence 5: This calm and quiet mastery over the fundamental principles of how a machine truly functions gives him an unshakable confidence that many people around him often mistake for simple aloofness.



Subsequent Calculations:

Sentence 1: $6*426+3*37+7*289+110*31+9*91=8{,}919\,fJ$

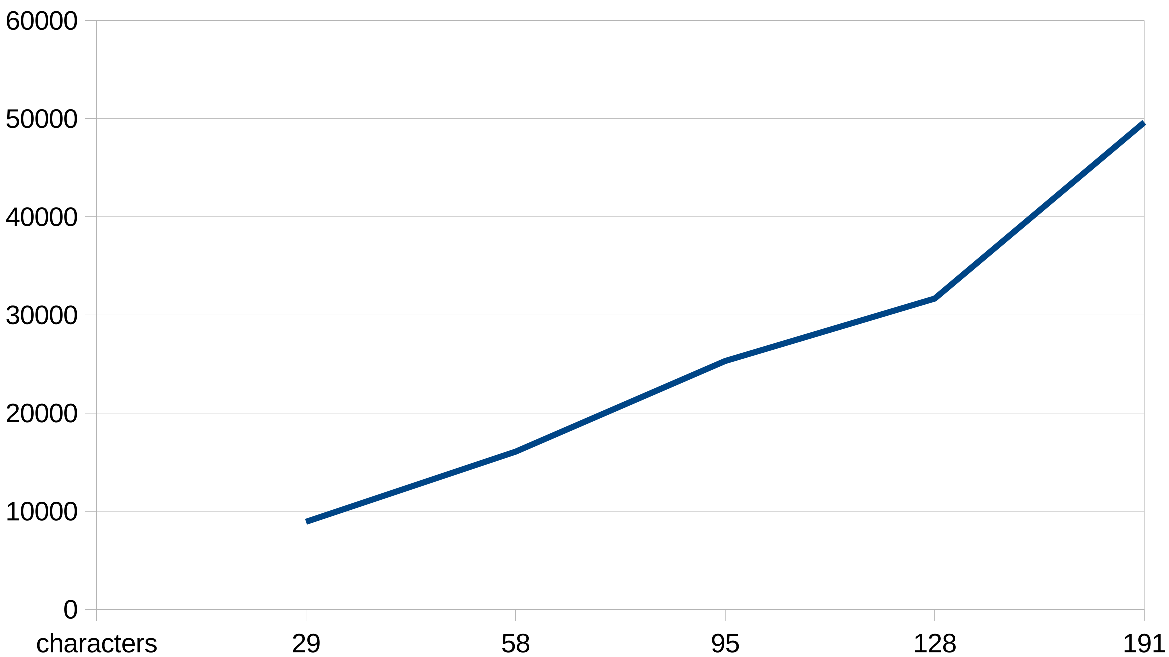
Sentence 2: $6*713+3*76+7*534+110*60+9*136=16{,}068\,fJ$

Sentence 3: $6*1085+3*123+7*869+110*97+9*185=25{,}297\,fJ$

Sentence 4: $6*1346+3*153+7*1110+110*122+9*215=31{,}660\,fJ$

Sentence 5: $6*2082+3*251+7*1738+110*193+9*331=49{,}620\,fJ$

Subsequent Graph:



2.2 MIPS/mW

Required Calculations:

$exectution\ time = clocks * clock\ cycle$

$$MIPS = \frac{\frac{instructions}{1{,}000{,}000}}{execution\,time}$$

$$mW = \frac{1000 * energy * 10^{-15}}{execution\,time}$$

Will not be done in parts, only end result will be shown, assume units are MIPS/mW:

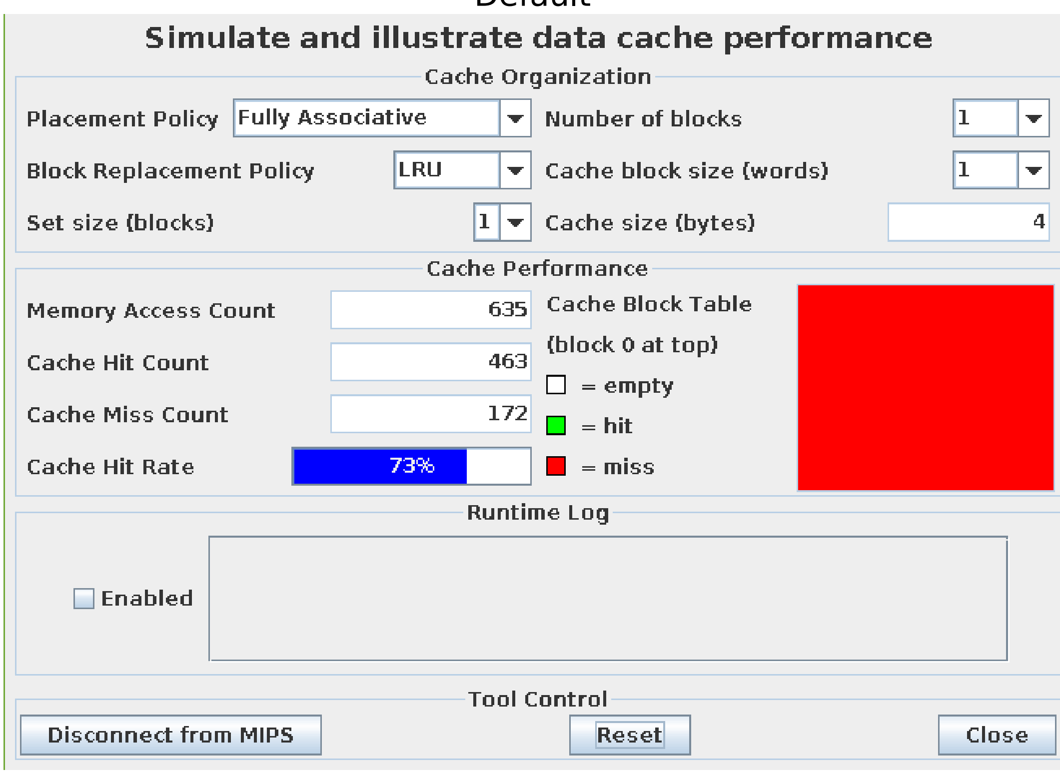
Sentence 1: 123,332.21
Sentence 2: 128,080.66
Sentence 3: 127,920.31
Sentence 4: 126,279.22
Sentence 5: 123,458.28

3.0 Data Cache Stuff

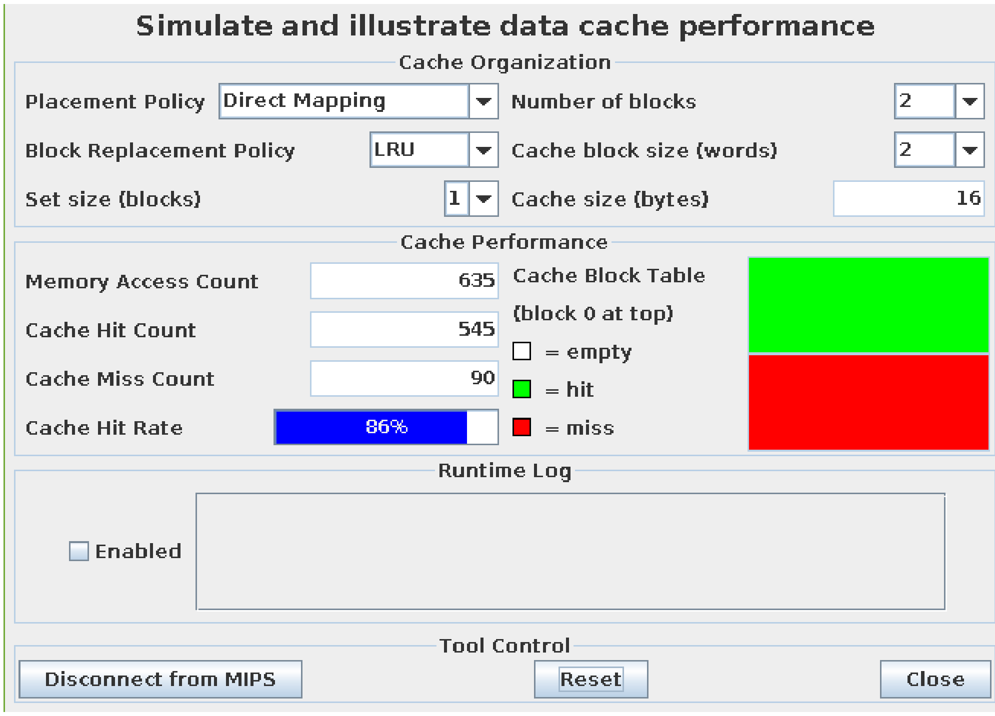
3.1 Pictures

Part B:

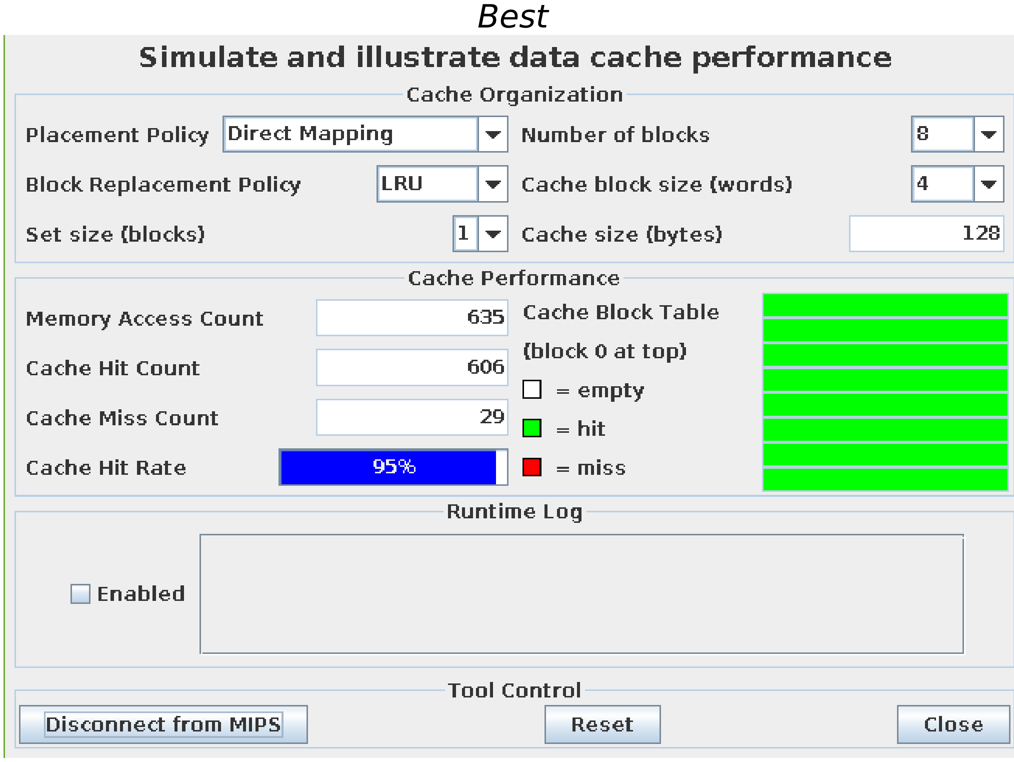
Default



Middle

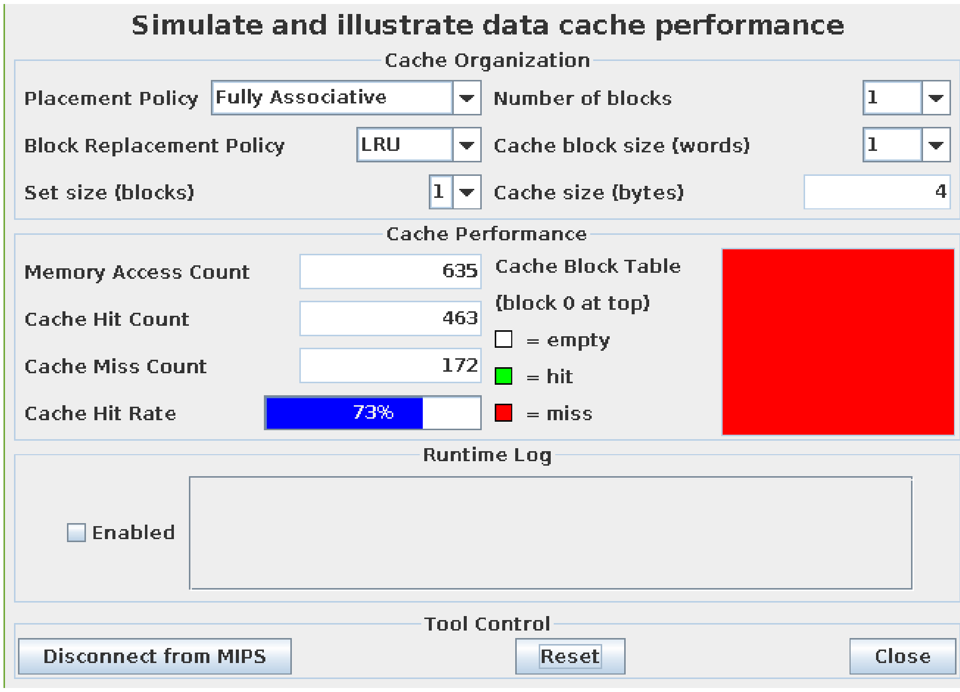

Simulate and illustrate data cache performance
Cache Organization
Placement Policy
Direct Mapping
Number of blocks
2
Block Replacement Policy
LRU
Cache block size (words)
2
Set size (blocks)
1
Cache size (bytes)
16
Cache Performance
Memory Access Count
635
Cache Block Table
(block 0 at top)
Cache Hit Count
545
= empty
Cache Miss Count
90
= hit
Cache Hit Rate
86%
= miss
Runtime Log
Enabled
Tool Control
Disconnect from MIPS
Reset
Close

Best

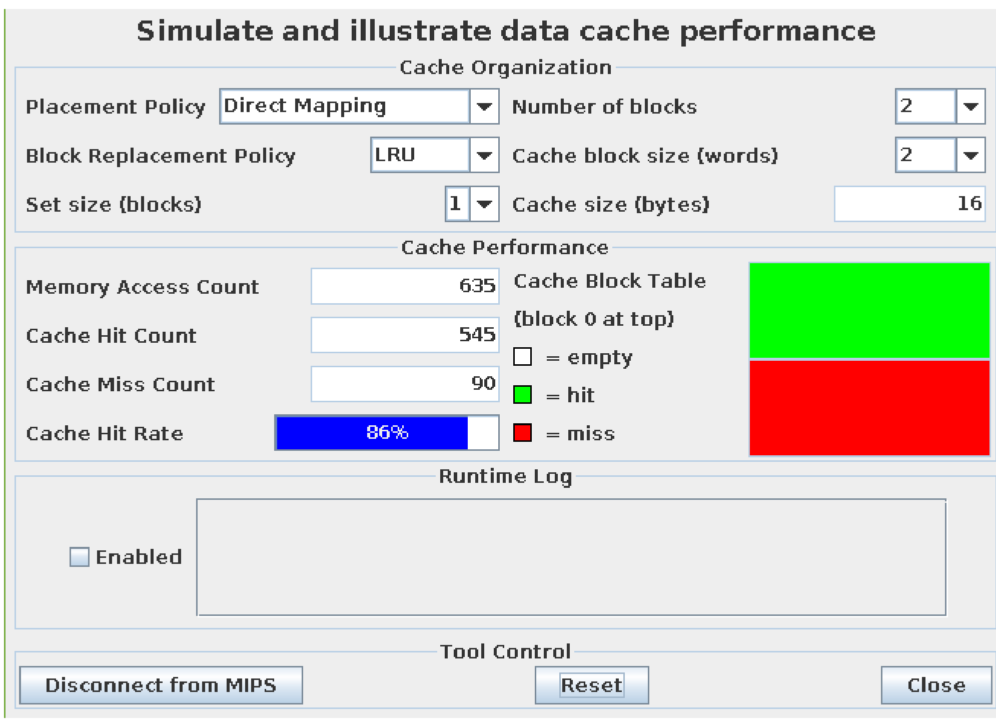

Simulate and illustrate data cache performance
Cache Organization
Placement Policy
Direct Mapping
Number of blocks
8
Block Replacement Policy
LRU
Cache block size (words)
4
Set size (blocks)
1
Cache size (bytes)
128
Cache Performance
Memory Access Count
635
Cache Block Table
(block 0 at top)
Cache Hit Count
606
= empty
Cache Miss Count
29
= hit
Cache Hit Rate
95%
= miss
Runtime Log
Enabled
Tool Control
Disconnect from MIPS
Reset
Close

Part A:

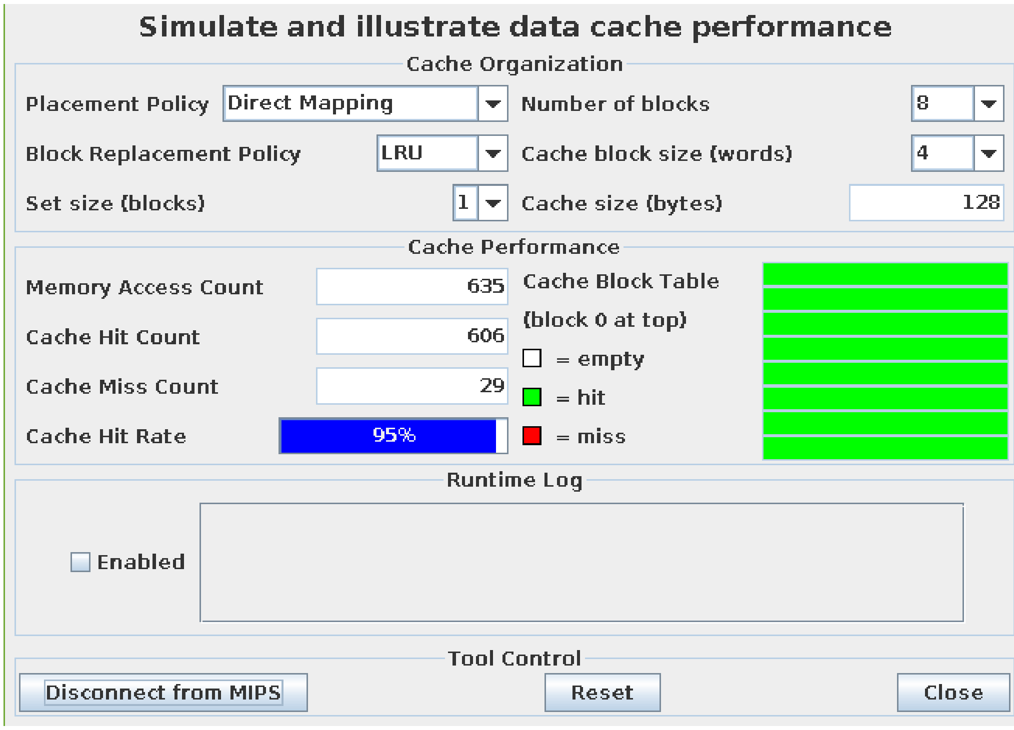
Default



Middle



Best



3.2 Explanation

The reason for the massive jump between cache hit rate is due to the fact that the increase in memory blocks and word size per block means that it can access more data at once, specifically with the characters in the inputted string.

8.0 References

8.1 MARS Simulator

The MARS Simulator for MIPS processors, available at:
http://courses.missouristate.edu/kenvollmar/mars/

and MARS syscall functions listed at:
http://courses.missouristate.edu/kenvollmar/mars/help/syscallhelp.html