STUDENTS IDENTIFICATION:

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2.1 Simple execution, without data forwarding techniques

f)	Clock cycles	174
	Instructions	61
	Average CPI	2.852

Stalls: - Data	107+0+0=101
- Structural	0
- Branch Taken	2 HOURS

Branch not taken, visto que é sempre realizado o fetch da instrução SW \$9, mutt(\$0), mesmo quendo o branch é realizado.

2.2 Application of data forwarding techniques

c)	Clock cycles	136
	Instructions	61
	Average CPI	2.230

Stalls: - Data	63+0+0=63
- Structural	9
- Branch Taken	8 100 Can

SpeedUp = 2.852x61 ~ 1.2789

Houve uma melhoria em termos de performance.

2.3 Source code optimization: minimization of data and structural hazards

a) Attach a copy of the new assembly program.

Cádigo em anexo (Pizog3)

c)	Clock cycles	AM 127
	Instructions	61
	Average CPI	N. S. C. 34 2 . 082

Stalls: - Data	45+0-10-4
- Structural	9
- Branch Taken	8

SpeedUp = $\frac{2.852 \text{ M}}{2.082 \text{ M}}$ 1.3698 Houve uma melhoria face ao anterciól.

2.4 Source code optimization: loop unrolling

a) Attach a copy of the new assembly program.

Clock cycles	97
Instructions	43
Average CPI	2.256

Código em anao (Prog4)

Stalls: - Data	69+0+0=69
- Structural	9
- Branch Taken	2

d)

c)

SpeedUp =
$$\frac{2.852 \times 61}{2.256 \times 43} = 1.7934$$

House uma melhoria a qualquer outro anteria

2.5 Source code optimization: branch delay slot

a) Attach a copy of the new assembly program. Odian em an om (Ame)

Clock cycles 110 Instructions 61 Average CPI 1.803

wago em an	MO (Hags)
Stalls: - Data	36+0+0=36
- Structural	9

- Branch Taken

e)

d)

Table 1: Pipeline time diagram, with data forwarding techniques.

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Table 2: Pipeline time diagram, with minimization techniques to reduce the data and structural hazards.

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Table 3: Pipeline time diagram: usage of loop unrolling minimization techniques to reduce the control hazards.

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Table 4: Pipeline time diagram: usage of branch delay slot techniques to reduce the control hazards.

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