DOCUMENTATIE

MIPS16 CICLU UNIC

UNIVERSITATEA
TEHNICĂ
DIN CLUJ-NAPOCA

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CUPRINS

Instructiuni suplimentare alese

→ Tip R

- **Exclusive OR (XOR)**
    - Generic: **xor $rd, $rs, $rt**
    - Operatie de baza: **RF[rd] ← RF[rs] XOR RF[rt]**
    - PC la urmatoarea instructiune: **PC← PC + 1**
    - OPCODE: **000**
    - Func: **110**
    - Reprezentare:

OPCODE	RS	RT	RD	SA	FUNC
000					**110**
15 14 13	**12 11 10**	**9 8 7**	**6 5 4**	**3**	**2 1 0**

- **Shift Right Arithmetic (SRA)**
    - Generic: sra $rd, $rs,sa
    - Operatie de baza: **RF←RF[rs] XOR RF[rt]**
    - PC la urmatoarea instructiune: **PC ← PC +1**
    - OPCODE: **110**
    - Func: **111**

OPCODE	RS	RT	RD	SA	FUNC
000					**111**
15 14 13	**12 11 10**	**9 8 7**	**6 5 4**	**3**	**2 1 0**

→ Tip I

- **Branch if not equal (BNE)**
    - Adresare: Relativa la PC
    - RTL Abstract:
        - **if(RF[rs] == RF[rt]) then**
        - **PC ← PC + 4 + S_EXT(imm)**
        - **else**
        - **PC ← PC + 1**

OPCODE	RS	RT	IMMEDIATE
101			
15 14 13	**12 11 10**	**9 8 7**	**6 5 4 3 2 1 0**

-
    - Resurse necesare:
        - **[IF]** PC,Memorie de instuctiuni,sumator
        - **[ID]** Bloc de registre, Extensie, UC

- **[EX]** ALU, UC Alu → sumator,circuit de deplasare, MUX

Semnale de constol MIPS16 ciclu unic

Instr	OPCODE	RegDst	ExtOp	ALUSRC	Branch	Jump	MemWrite	MemToReg	RegWrite	ALUOp	Func	ALUCtrl
Tip R												
ADD	000	1	X	0	0	0	0	0	1	000	000	0000
SUB	000	1	X	0	0	0	0	0	1	001	001	0001
SLL	000	X	X	X	0	0	0	0	1	010	010	0010
SRL	000	X	X	X	0	0	0	0	1	011	011	0011
AND	000	1	X	0	0	0	0	0	1	100	100	0100
OR	000	1	X	0	0	0	0	0	1	101	101	0101
XOR	000	1	X	0	0	0	0	0	1	110	110	0110
SRA	000	1	X	0	0	0	0	0	1	111	111	0111
Tip I												
ADDI	001	0	1	1	0	0	0	0	1	001	X	0000
LW	010	0	1	1	0	0	0	1	1	010	X	0000
SW	011	X	1	1	0	0	1	X	0	011	X	0000
BEQ	100	X	1	0	1	0	0	X	0	100	X	0001
BNE	101	0	1	0	0	0	0	X	0	101	X	0001
SLTI	110	0	0	1	0	0	0	X	0	110	x	1000
Tip J												
J	111	X	X	x	x	1	0	x	0	111	0	1111

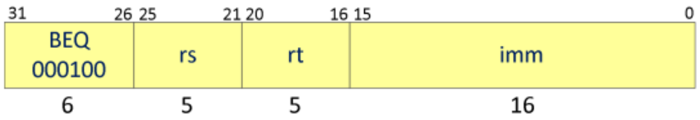
Descriere cod

- **Este implementat un algoritm ce foloseste un loop pentru a calcula suma elementelor de pe indicii pari si cea de pe indicii impari, la final verificand daca acestea sunt egale**

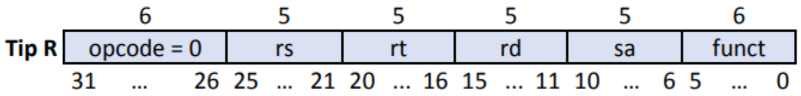
- b"001_000_001_0000001", -- 2081 0. addi $1,$0,1 --i=1
- b"001_000_010_0000101" ,-- 2105 1. addi $2,$0,5 --j=5 -- la 5 se opreste (functioneaza ca while)
- b"001_000_011_0000000", -- 2180 2. addi $3,$0,0 --sum1=0
- b"001_000_100_0000000", -- 2200 3. addi $4,$0,0 --sum2=0
- b"000_010_001_101_0_000", -- 08D0 4. add $5,$2,$1 --n = i+j
- b"000_000_101_101_1_011", -- 02DB 5. srl $5,$5,1 --n/2 -- marchez jumatatea vectorului
- b"100_010_001_0001100", -- 8888 6. loop_st: beq $1,$2,loop_end = 8 -- deschide bucla
- b"001_000_110_0000001",-- 2301 13. addi $6,$0,1 -- $6=0001
- b"000_110_001_111_0_100", -- 18F4 4. and $7,$6,$1 $7 = 1 daca e i impar, 0 altfel
- b"100_111_000_0000100", -- 9C82 9. beq $7,$0,par=2 -- verifica daca i par
- b"010_001_101_0000000", --4780 lw $5, $1
- b"000_101_000_101_0_000", -- 1C70 4. add $5,$5,$0 --n = i+j
- b"000_011_101_011_0_000", -- eb0 12. impar: add $3,$3,$5
- b"111_0000000010001", -- E011 14. jmp incr = 17
- b"010_001_101_0000000", --4780 lw $5, $1
- b"000_101_000_101_0_000", -- 1C70 4. add $5,$5,$0 --n = i+j
- b"000_100_101_100_0_000", -- 12C0 12. par: add $4,$4,$5
- b"001_001_001_0000001",-- 2481 13. incr: addi $1,$1,1
- b"111_0000000000110", -- E006 14. jmp 6 --loop_st
- b"100_011_100_0000010", -- 8E01 15. loop_end: beq $3,$4, equal
- b"001_000_001_0000000",-- 2080 13. addi $1,$0,0 -- $6=0001
- b"111_0000000010111", -- E017 14. jmp done
- b"001_000_001_0000001",-- 2081 13. addi $1,$0,1 -- $6=0001
- b"000_001_000_001_0_000", -- 410 4. --done add $1,$1,$0 --n = i+j
    - b"100_001_001_0000100", --8484 sw $1, $1

```
int i = 1;
int j = 5;
int sum1=0;
int sum2=0;
int n = (i+j)/2; -- nu e folosit la nimic
for(i = i ; i < j; i++)
{
if(i&"0001"==0)
{
sum2+=v[i];
}
else
{
sum3+=v[i];
} }
If(sum1==sum2)
{
result = 1 ;
}
else
{
result=0;
}
```

Tip I : op $rt, $rs, imm **op $rd,$rs,$rt**



31 … 26	25 … 21	20 … 16	15 … 0
BEQ 000100	rs	rt	imm
6	5	5	16



	6	5	5	5	5	6
Tip R	opcode = 0	rs	rt	rd	sa	funct
	31 … 26	25 … 21	20 … 16	15 … 11	10 … 6	5 … 0

Testarea executiei

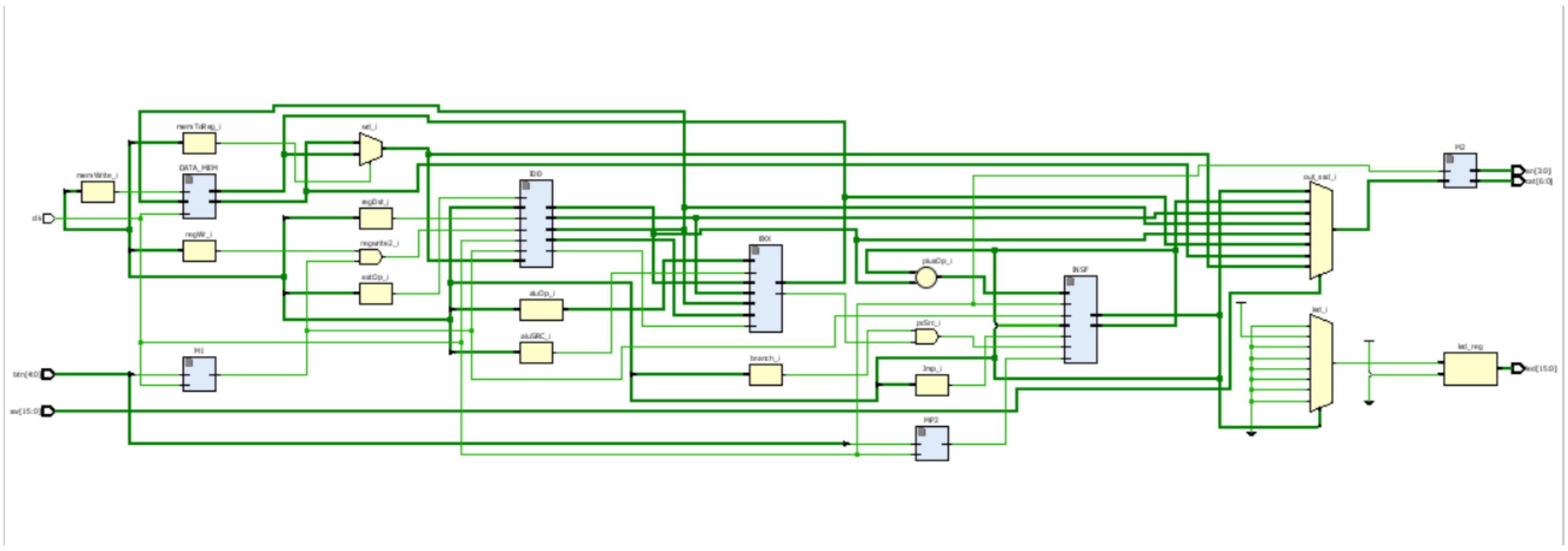
Instructiune	Instr	AluRes	RD1	RD2	Ext_imm	PC	WD
addi $1,$0,1	2180	1	0	0	1	1	1
addi $2,$0,5 --j=5	2105	5	0	0	5	2	5
addi $3,$0,0	2180	0	0	0	0	3	0
addi $4,$0,0	2200	0	0	0	0	4	0
add $5,$2,$1	08D0	6	5	1	50	5	6
srl $5,$5,1	02DB	3	0	6	5b	6	3
beq $1,$2,loop_end = 8	888C	4	5	1	c	7	4
addi $6,$0,1	2301	1	0	0	1	8	1
and $7,$6,$1	18F4	1	1	1	74	9	1
beq $7,$0,par=2	9C04	1	1	0	4	a	1
lw $5, $1	4680	1	1	3	0	b	4
add $5,$5,$0	1C70	4	4	0	50	C	4
impar: add $3,$3,$5	0eb0	3	0	4	30	d	4
jmp incr = 17	E011	0	0	0	11	e	0
lw $5, $1	4680	2	2	4	0	f	5
add $5,$5,$0	1450	5	5	0	50	10	5
par: add $4,$4,$5	12C0	5	0	5	40	11	5
incr: addi $1,$1,1	2481	2	1	1	1	12	1
jmp 6 --loop_st	E006	0	0	0	6	13	0
loop_end: beq $3,$4, equal	8E01	3	a	7	2	14	3
addi $1,$0,0	2080	0	0	5	0	15	0
jmp done	E017	0	0	0	17	16	0
addi $1,$0,1	2081	0	0	0	10	17	0
done add $1,$1,$0	0410	0	0	0	18	18	0
sw $1, $1	8484	0	0	0	4	19	0

e. Parti incomplete din laboratoarele 4-7

Nu exista parti incomplete din laboratoarele 4-7

f. Corectitudinea descrierii vhdl – RTL schematic

Nu exista erori.



g. Testare pe placa

Programul a fost testat pe placuta si functioneaza.

```
  1. b"001_000_001_0000001", -- 2081 0.        addi $1,$0,1 --i=1
  2. b"001_000_010_0000100" ,-- 2104 1.    addi $2,$0,4 --j=4
  3. b"001_000_011_0000000", -- 2180 2.    addi $3,$0,0 --sum1=0
  4. b"001_000_100_0000000", -- 2200 3.    addi $4,$0,0 --sum2=0
  5. b"000_010_001_101_0_000", -- 0CD0 4.    add $5,$2,$1 --n = i+j
  6. b"000_000_101_101_1_011", -- 02DB 5.    srl $5,$5,1 --n/2 --  marchez jumatatea vectorului
  7. b"100_010_001_0001000", --  8888 6.    loop_st: beq $1,$2,loop_end = 8 -- deschide bucla
  8. b"000_001_101_110_0_001", -- 06E1 7.    sub $6,$5,$1 -- am trecut pe prima jumatate?
  9. b"110_110_111_0000000", -- DB80 8.    slti $7,$6,0  -- daca da, retin in &7 = 1
  10. b"100_000_111_0000000", -- 8380 9.    beq $7,$0,mare=2
  11. b"000_011_001_011_0_000", -- 0CB0 10.    add $3,$3,$1
  12. b"111_0000000000110", --  E006 14.    jmp 6 --loop_st
  13. b"000_100_001_100_0_000",  -- 10C0 12.    mare: add $4,$4,$1
  14. b"001_001_001_0000001",--  2481 13.    incr: addi $1,$1,1
  15. b"111_0000000000110", --  E006 14.    jmp 6 --loop_st
  16. b"000_011_100_001_0_001", -- 0E11 15.    loop_end: sub $1,$3,$4
  17. b"001_000_111_0000001", --2381 16.        18.      addi $7,$0,1
others =>x"1110000000000011"
```

→ video ce demonstreaza functionalitatea programului (watermark-ul de jos e pus automat de o aplicatie ce inverseaza un video – am filmat invers 😊)

343713121-6121462754596326-7788004618923775649-n_EPaXS5HO.mp4