# DEPARTMENT OF ELECTRONIC AND TELECOMMUNICATION UNIVERSITY OF MORATUWA

EN3030: CIRCUITS AND SYSTEMS DESIGN



# INSTRUCTION SET ARCHITECTURE

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# 1. INSTRUCTION SET

#### 1.1. PROGRAM CONTROL

#### START/INITIALIZE

- 1.  $PC \leftarrow 0$
- 2.  $IR \leftarrow 0$

#### **FETCH**

- 1. AR  $\leftarrow$  PC
- 2. DR  $\leftarrow$ M, PC  $\leftarrow$ PC+1
- 3. IR  $\leftarrow$  DR, AR  $\leftarrow$  PC

## NOP

**IDLE** processor

#### CLAC

1. AC  $\leftarrow$  0, Z=1

#### **ENDOP**

End all operations

#### **JUMP INSTRUCTIONS**

#### **JUMP**

- 1. READ
- 2. AC  $\leftarrow$  IM( $\tau$ )
- 3.  $PC \leftarrow AC$

#### *JMPZ*

- 1. READ
- 2. AC  $\leftarrow$  IM( $\tau$ )

- 3. PC ← AC
- 4. PC ←PC+1
- 5. READ

#### <u>JMPNZ</u>

- 1. AC  $\leftarrow$  IM( $\tau$ )
- 2. PC ← AC
- 3. PC ←PC+1

#### 1.2. LOAD AND STORE INSTRUCTIONS

#### LDIAC

- 1. MEM READ
- 2. AC  $\leftarrow$  IM( $\tau$ )
- 3. PC ←PC+1



#### **LDAC**

- 1.  $AC \leftarrow AC$
- 2. READ

**MOVE INSTRUCTIONS** 

#### MOVR

1.  $R \leftarrow AC$ 

#### MOVACR1

1.3.

1. R1 ← AC

- 3. DR  $\leftarrow$  M( $\tau$ )
- 4. AC  $\leftarrow$  DR

#### STAC

- 1. READ AC to bus
- 2. AR  $\leftarrow$  AC
- 3.  $M \leftarrow AC$



# *MOVACR2*

1. R2 ← AC

#### MOVACR3

1. R3 ← AC

#### MOVACR4

1. R4 ← AC

#### MOVACR5

1. R5 ← AC

#### *MOVRAC*

AC ← R

#### *MOVR1AC*

AC ← R1

#### MOVR2AC

AC ← R2

#### MOVR3AC

1. AC ← R3

#### MOVR4AC

AC ← R4

#### *MOVR5AC*

AC ← R5

#### <u>MOVAC</u>

PC ← AC

2. AR  $\leftarrow$  PC

#### 1.4. ARITHMETIC AND LOGICAL OPERATIONS

#### ALU BASED

#### ADD

1. AC  $\leftarrow$  AC+R

#### SUB

AC ← AC-R

#### **MULTIPLY**

AC ← AC\*R

#### DIVIDE

AC ← AC/R

#### AND

1. AC ← AC & R

#### XOR

AC ← AC XOR R

#### OR

1.  $AC \leftarrow AC|R$ 

#### NOT

1. AC  $\leftarrow \overline{AC}$ 

#### LSHIFT

AC ← AC<<R</li>

#### **RSHIFT**

1. AC ← AC>>R

#### **DEDICATED ADDER BASED**

#### **INCREMENT PC**

1. PC ← PC+1

#### **INCREMENT AC**

1. AC ← AC+1



#### **INCREMENT** R

1. PC ← PC+1

#### **INCREMENT R1**

1. R1 ← R1+1

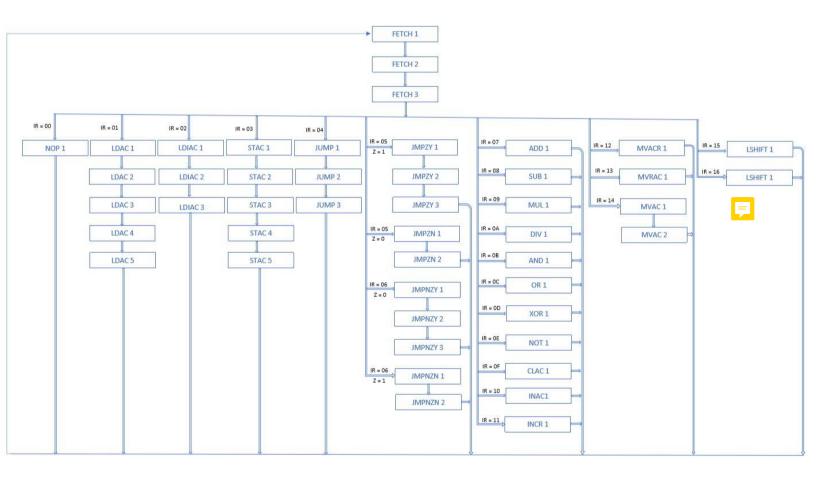
### **INCREMENT R2**

1. R2 ← R2+1

#### **INCREMENT R3**

1. R3← R3+1

# 2. STATE DIAGRAM



# 3. DATA PATH

