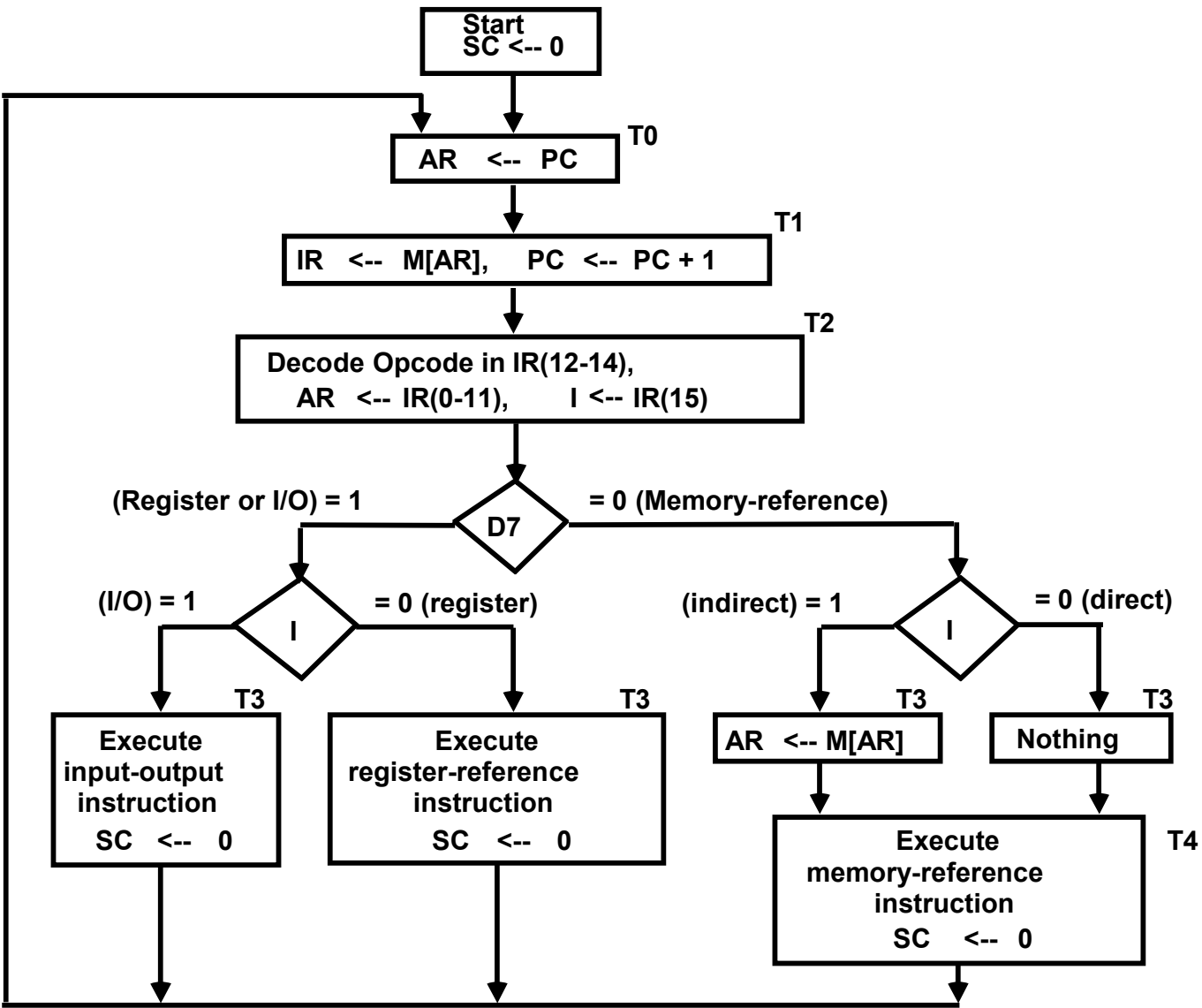


# Overview

- Instruction Codes
- Computer Registers
- Computer Instructions
- Timing and Control
- **Instruction Cycle**
- Memory Reference Instructions
- Input-Output and Interrupt
- Complete Computer Description

# Flow Chart (Instruction Cycle)



# Determining Type of Instruction

- **D'7IT<sub>3</sub>:  $AR \leftarrow M[AR]$**
- **D'7I'T<sub>3</sub>: Nothing**
- **D7I'T<sub>3</sub>: Execute a register-reference instr.**
- **D7IT<sub>3</sub>: Execute an input-output instr.**

# Register Reference Instruction

Register Reference Instructions are identified when

- $D_7 = 1, I = 0$
- Register Ref. Instr. is specified in  $b_0 \sim b_{11}$  of IR
- Execution starts with timing signal  $T_3$

$r = D_7 \text{ I}'T_3 \Rightarrow$  Register Reference Instruction  
 $B_i = IR(i), i=0,1,2,...,11$

	<b>r:</b>	<b><math>SC \leftarrow 0</math></b>
<b>CLA</b>	<b><math>rB_{11}</math>:</b>	<b><math>AC \leftarrow 0</math></b>
<b>CLE</b>	<b><math>rB_{10}</math>:</b>	<b><math>E \leftarrow 0</math></b>
<b>CMA</b>	<b><math>rB_9</math>:</b>	<b><math>AC \leftarrow AC'</math></b>
<b>CME</b>	<b><math>rB_8</math>:</b>	<b><math>E \leftarrow E'</math></b>
<b>CIR</b>	<b><math>rB_7</math>:</b>	<b><math>AC \leftarrow shr\ AC, AC(15) \leftarrow E, E \leftarrow AC(0)</math></b>
<b>CIL</b>	<b><math>rB_6</math>:</b>	<b><math>AC \leftarrow shl\ AC, AC(0) \leftarrow E, E \leftarrow AC(15)</math></b>
<b>INC</b>	<b><math>rB_5</math>:</b>	<b><math>AC \leftarrow AC + 1</math></b>
<b>SPA</b>	<b><math>rB_4</math>:</b>	<b>if <math>(AC(15) = 0)</math> then <math>(PC \leftarrow PC+1)</math></b>
<b>SNA</b>	<b><math>rB_3</math>:</b>	<b>if <math>(AC(15) = 1)</math> then <math>(PC \leftarrow PC+1)</math></b>
<b>SZA</b>	<b><math>rB_2</math>:</b>	<b>if <math>(AC = 0)</math> then <math>(PC \leftarrow PC+1)</math></b>
<b>SZE</b>	<b><math>rB_1</math>:</b>	<b>if <math>(E = 0)</math> then <math>(PC \leftarrow PC+1)</math></b>
<b>HLT</b>	<b><math>rB_0</math>:</b>	<b><math>S \leftarrow 0</math> (S is a start-stop flip-flop)</b>