Talal Jawaid

Professor Weide Chang

CSC 137 Computer Organization

Paper Homework #4

Chapter 7 Microprogram Control Unit

Read chapter 7 in order to work through the following questions.

Work individually. Submit a COMPUTER-PRINTED hardcopy on the due

date when the class begins.

Total 36 points, answer questions:

1. For each entry in the F1 table (Table 7-1), translate it into

the actual needed signals by name. Include the two multiplexor

(call it muxA, the small one, and muxB, the big one). (1 pt/entry)

|  |  |  |  |
| --- | --- | --- | --- |
| **F1** | **Microop.** | **Symbol** | **Actual Signals** |
| **001** | **AC <- AC + DR** | **ADD** | **LD(AC), add** |
| **010** | **AC <- 0** | **CLRAC** | **CLR(AC)** |
| **011** | **AC <- AC + 1** | **INCAC** | **INC(AC)** |
| **100** | **AC <- DR** | **DRTAC** | **LD(AC),dr2ac** |
| **101** | **AR <- DR(0-10)** | **DRTAR** | **LD(AR), muxA = 1** |
| **110** | **AR <- PC** | **PCTAR** | **LD(AR), muxA =0** |
| **111** | **M[AR] <- DR** | **WRITE** | **write** |

7. Using the mapping procedure of Fig. 7-3, map out the microcode

addresses for these operation code: 0010 1011 1111 (1 pt each)

**0010 = 2**

**1011 = 11**

**1111 = 15**

11. With Table 7-1, translate these to control signals (F1, F2,

and F3 fields; and mnemonics): (1 pt each)

**Microoperations F1 F2 F3 Microoperation Mnemonics**

**a. AC<-AC+1, DR<-DR+1 011 110 000 INCAC INCDR NOP**

**b. PC<-PC+1, DR<-M[AR] 000 100 101 NOP READ INCPC**

**c. DR<-AC, AC<-DR 100 101 000 DRTAC ACTDR NOP**

12. With Table 7-1, convert these microoperation mnemonics to

register-transfer notations and binary equivalents: (1 pt each)

**Microoperation Mnemonics Register-Transfer Notions F1 F2 F3**

**a. READ, INCPC DR <- M[AR]**

**AC<-DR ? 100 101**

**b. ACTDR, DRTAC DR <- AC**

**AC <- DR 100 101 ?**

**c. ARTPC, DRTAC, WRITE PC <- AR**

**AC <- DR**

**M[AR] <- DR 100&111 ? 110**

15. With the following microcode (Sec. 7-3):

Addr Microcode

60 010 000 010 00 00 1000011

61 111 100 000 01 01 1000000

62 001 001 000 10 10 0111111

63 101 110 000 11 11 0111100

1. Translate to mnemonics (Table 7-2). (1 pt each)

**60 : CLRAC, COM U JMP INDR CTS**

**61 : WRITE, READ I CALL FETCH**

**62 : ADD, SUB S RET 63(NEXT)**

**63 : DRTAC, INCDR Z MAP 60**

1. List things logically wrong in the code. (1 pt each)

**60 : Cannot increment and complement AC at same time. Due to JMP to INDRCT, control doesn’t return to 61**

**61 : Cannot read and write at same time. The CALL behaves as a JMP since there isn’t a return from FETCH**

**62 : Cannot add and subtract at same time. Ret will be executed ignoring S**

**63 : MAP is executed regardless of Z or 60**

16. Add the following new commands to Table 7-2. (First 3.) (2 pts each)

Command Opcode Register Transfer Description

AND 0100 AC<-AC^M[AR] bitwise AND

SUB 0101 AC<-AC-M[AR] subtraction

ADM 0110 M[AR]<-M[AR]+AC add to memory

**AND : NOP I CALL INDRCT READ U JMP NEXT**

**SUB:**

|  |  |  |  |
| --- | --- | --- | --- |
| **ORG 20** |  |  |  |
| **NOP** | **I** | **CALL** | **INDRCT** |
| **READ** | **U** | **JMP** | **NEXT** |
| **SUB** | **U** | **JMP** | **FETCH** |

**ADM:**

|  |  |  |  |
| --- | --- | --- | --- |
| **ORG 24** |  |  |  |
| **NOP** | **I** | **CALL** | **INDRCT** |
| **READ** | **U** | **JMP** | **NEXT** |
| **DRTAC, ACTDR** | **U** | **JMP** | **NEXT** |
| **ADD** | **U** | **JMP** | **EXCHANGE+2** |

17. Write mnemonic code for the ISZ routine of the BC

(introduced in Chapter 5, Table 5-4). Note that DR=0

status condition is not available in the CD field of

the computer defined in Sec 7-3. However, you can exchange

AC and DR and check if AC=0. (3 pts)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ISZ:** | **NOP** | **I** | **CALL** | **INDRCT** |
|  | **READ** | **U** | **JMP** | **NEXT** |
|  | **INCDR** | **U** | **JMP** | **NEXT** |
|  | **DRTAC,ACTDR** | **U** | **JMP** | **NEXT(or past, INDRCT)** |
|  | **DRTAC,ACTDR** | **Z** | **JMP** | **ZERO** |
|  | **WRITE** | **U** | **JMP** | **FETCH** |
| **ZERO** | **WRITE,INCPC** | **U** | **JMP** | **FETCH** |

18. Write mnemonic code for BSA like the previous problem. (2 pts)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| BSA: | NOP | I | CALL | INDRCT |
|  | PCTDR,ARTPC | U | JMP | NEXT |
|  | WRITE,INCPC | U | JMP | FETCH |