EECS 645 Computer Architecture

Homework 1

Download the homework file and extract the files. Compile them using the included makefile and run the z80 executable. It should run a simple test that results in output like the following:

./z80

PC: 0100, AF: 01b0, BC: 0804, DE: 0201, HL: 0000, SP: fffe

totalClockCycles at 00000000

instruction = 003c

PC: 0101, AF: 02b0, BC: 0804, DE: 0201, HL: 0000, SP: fffe

 $total Clock Cycles \ at \ 00000004$

instruction = 003c

PC: 0102, AF: 03b0, BC: 0804, DE: 0201, HL: 0000, SP: fffe

totalClockCycles at 00000008

instruction = 003c

PC: 0103, AF: 04b0, BC: 0804, DE: 0201, HL: 0000, SP: fffe

totalClockCycles at 00000012

instruction = 0080

PC: 0104, AF: 0cb0, BC: 0804, DE: 0201, HL: 0000, SP: fffe

totalClockCycles at 00000016

instruction = 0076

PC: 0105, AF: 0cb0, BC: 0804, DE: 0201, HL: 0000, SP: fffe

totalClockCycles at 00000017

Total Clock Cycles: 17

Instruction 0x3c count is 0003

Instruction 0x76 count is 0001

Instruction 0x80 count is 0001

Halting now.

This verifies you have the example program working.

Implement the set of instructions listed below using the existing instructions in the decode case statement as a reference to give more capabilities to our Z80 processor.

You will find some macros defined that may be useful for byte manipulation.

Test your implementations by modifying the registers initial states, and adding your new instructions to the loadTest routine. Don't forget to add the cycle counts to initMemory routine for each of your instructions.

Instructions to implement

Inc B	Instructions to imp	Code	Cycles	Notes
Dec B				
Inc C				
Dec C				Decrement the value in B, result in B
Inc D				
Dec D			-	
Inc E				
Dec E 1D 4 Inc H 24 4 Dec H 25 4 Inc L 2C 4 Dec L 2D 4 Inc A 3C 4 Already done for you Dec A 3D 4 And B AO 4 And B with A result in A And C A1 4 And D A2 4 And E A3 4 And H A4 4 And A A7 4 And A with A result in A Or B B0 4 Or B with A result in A Or C B1 4 4 Or B B2 4 Or B B2 4 Or B B3 4			-	
Inc H			_	
Dec H 25 4 Inc L 2C 4 Dec L 2D 4 Inc A 3C 4 Already done for you Dec A 3D 4 And B AO 4 And B with A result in A And B AO 4 And B with A result in A And C A1 4 And E And E A3 4 And H A4 And L A5 4 And A with A result in A Or B BO 4 Or B with A result in A Or C B1 4 Or B with A result in A Or E B3 4 Or A with A result in A Or L B5 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor E AB 4				
Inc L 2C 4 Dec L 2D 4 Inc A 3C 4 Already done for you Dec A 3D 4 And B AO 4 And B with A result in A And C A1 4 And D A2 4 And E A3 4 And H A4 4 And A A7 4 And A with A result in A Or B BO 4 Or B with A result in A Or C B1 4 Or B Or E B3 4 Or A with A result in A Or L B5 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor E AB 4			_	
Dec L 2D 4 Inc A 3C 4 Already done for you Dec A 3D 4 And B AO 4 And B with A result in A And C A1 4 And D A2 4 And E A3 4 And H A4 4 And A A7 4 And A with A result in A Or B BO 4 Or B with A result in A Or C B1 4 Or B with A result in A Or E B3 4 Or H B4 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4			_	
Inc A 3C 4 Already done for you Dec A 3D 4 And B AO 4 And B with A result in A And C A1 4 And D A2 4 And E A3 4 And H A4 4 And A A7 4 And A with A result in A Or B BO 4 Or B with A result in A Or C B1 4 Or D B2 4 Or B B3 4 Or B B4 4 Or B B3 4 Or D B2 4 Or B B3 4 Or B B3 4 Or B B4 4 Or B B3 4 Or B B4 4 Or B B4 4 Or C B5 4 Or A B7 4 Or A with A result in A			+	
Dec A 3D 4 And B A0 4 And B with A result in A And C A1 4 And D A2 4 And E A3 4 And H A4 4 And A A7 4 And A with A result in A Or B B0 4 Or B with A result in A Or C B1 4 Or D B2 4 Or E B3 4 Or H B4 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor E AB 4			_	Almondu dono formani
And B A0 4 And B with A result in A And C A1 4 And D A2 4 And E A3 4 And H A4 4 And L A5 4 And A A7 4 And A with A result in A Or B B0 4 Or B with A result in A Or C B1 4 Or B with A result in A Or E B3 4 Or A with A result in A Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor E AB 4			_	Aiready done for you
And C And D A2 And E A3 A And H A4 And L A5 And A A7 A And A with A result in A Or B B0 Or C B1 Or D B2 Or E B3 A Or H B4 Or L B5 A Or A B7 A Or A B7 A Or A B7 A A Or B A A A A A A A A A A A A A A A A A A A				And Built America
And D A2 4 And E A3 4 And H A4 4 And L A5 4 And A A7 4 And A with A result in A Or B B0 4 Or B with A result in A Or C B1 4 4 Or D B2 4 4 Or E B3 4 4 Or H B4 4 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4				And B with A result in A
And E A3 4 And H A4 4 And L A5 4 And A A7 4 And A with A result in A Or B B0 4 Or B with A result in A Or C B1 4 4 Or D B2 4 4 Or E B3 4 4 Or H B4 4 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4			_	
And H A4 4 And L A5 4 And A A7 4 And A with A result in A Or B B0 4 Or B with A result in A Or C B1 4 Or D B2 4 Or E B3 4 Or H B4 4 Or L B5 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4			+	
And L A5 4 And A A7 4 And A with A result in A Or B B0 4 Or B with A result in A Or C B1 4 Or D B2 4 Or E B3 4 Or H B4 4 Or L B5 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4			_	
And A A7 4 And A with A result in A Or B B0 4 Or B with A result in A Or C B1 4 Or D B2 4 Or E B3 4 Or H B4 4 Or L B5 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4			+	
Or B BO 4 Or B with A result in A Or C B1 4 Or D B2 4 Or E B3 4 Or H B4 4 Or L B5 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4			_	
Or C B1 4 Or D B2 4 Or E B3 4 Or H B4 4 Or L B5 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4		+		
Or D B2 4 Or E B3 4 Or H B4 4 Or L B5 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4				Or B with A result in A
Or E B3 4 Or H B4 4 Or L B5 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4			_	
Or H B4 4 Or L B5 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4				
Or L B5 4 Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4			+	
Or A B7 4 Or A with A result in A Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4			-	
Xor B A8 4 Xor B with A result in A Xor C A9 4 Xor D AA 4 Xor E AB 4				
Xor C A9 4 Xor D AA 4 Xor E AB 4		B7	4	
Xor D AA 4 Xor E AB 4			4	Xor B with A result in A
Xor E AB 4	Xor C	A9	4	
	Xor D	AA	4	
	Xor E	AB	4	
XOTH AC 4	Xor H	AC	4	
Xor L AD 4	Xor L	AD	4	
Xor A AF 4 Xor A with A result in A	Xor A	AF	4	Xor A with A result in A
Add B 80 4 Adds B to A result in A	Add B	80	4	Adds B to A result in A
Add C 81 4	Add C	81	4	
Add D 82 4	Add D	82	4	
Add E 83 4	Add E	83	4	

Add H	84	4	
Add L	85	4	
Add A	87	4	Adds A to A result in A
Sub B	90	4	Sub b from A result in A
Sub C	91	4	
Sub D	92	4	
Sub E	93	4	
Sub H	94	4	
Sub L	95	4	
Sub A	97	4	Sub A from A result in A

When you have completed the implementation and testing, set the initial state of the registers back to this

```
// Registers
uint16_t AF = 0x01B0; // AAAAAAAZNHCxxxx
uint16_t BC = 0x0804; // BBBBBBBBCCCCCCCC
uint16_t DE = 0x0201; // DDDDDDDDEEEEEEE
uint16_t HL = 0x0000; // HHHHHHHHLLLLLLL
uint16_t SP = 0xFFFE; // Stack Pointer
uint16_t PC = 0x0100; // Program Counter
```

Then modify the main loop and comment out loadTest, and uncomment loadFirst. Compile and run the program. Place the program output into a text file, then submit a zip/tar with your source code and the text file output.