# 16.317: Microprocessor Systems Design I

Spring 2014

Lecture 12: Key Questions
February 24, 2014

1. Explain the operation of the rotate instructions (ROL, ROR, RCL, RCR).

2. **Example:** Given AL = 43H, CL = 04H, and CF = 0, show the state of AL after each instruction in the sequence below:

```
ROR AL, 2
ROL AL, CL
RCR AL, 3
RCL AL, 4
```

3. Explain the operation of the bit test instructions (BT, BTR, BTS, BTC)

4. Explain the operation of the bit scan instructions (BSF, BSR).

5. **Example:** Given the following initial state, list all changed registers and/or memory locations and their new values. Where appropriate, you should also list the state of the carry flag (CF).

Initial state:

EAX: 00000000H
EBX: 0000000AH
ECX: 00000000H
EDX: 00000000H
CF: 0
ESI: 00000008H
EDI: FFFF0000H
EBP: 00000400H
ESP: 00002000H
DS: 2110H
SS: 1000H

| **Address** | | | | |
|---|---|---|---|---|
| 21100H | 04 | 00 | 10 | 10 |
| 21104H | 89 | 01 | 20 | 40 |
| 21108H | 02 | 00 | 00 | 16 |
| 2110CH | 17 | 03 | FF | 00 |
| 21110H | 1E | 00 | 06 | 00 |
| 21114H | 08 | 00 | 0A | 00 |

Instructions:

```
BT    WORD PTR [02H], 4
BTC   WORD PTR [10H], 1
BTS   WORD PTR [04H], 1
BSF   CX, WORD PTR [0EH]
BSR   DX, WORD PTR [09H]
```