Tutorial-4: Exam Review

AbdulWahab Kabani

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Objectives

- Look at some Practice questions for the midterm
- Discuss common mistakes

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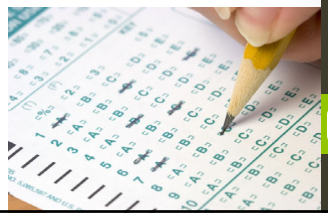
About the Midterm

- Covers the following:
  - Chapter-1
  - Chapter-2
  - Chapter-3



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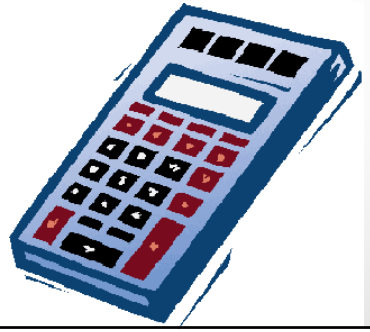
About the Midterm

- Calculators are **NOT** allowed on the exam.



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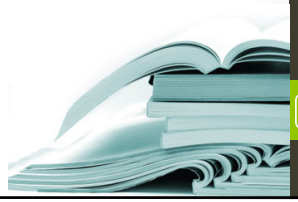
How to use this tutorial

- Questions will be presented and discussed today
- **Warning**: there are lots of material that is not covered in this tutorial.
- You should **NOT** rely only on this tutorial to prepare for the exam.



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Topics

- Number Systems: Conversion
- Number Systems: Sign systems
- ***IEEE-754*** floating-point
- Circuits
- Assembly
- Computer Architecture

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Topics

- **Number Systems: Conversion**
- Number Systems: Sign systems
- ***IEEE-754*** floating-point
- Circuits
- Assembly
- Computer Architecture

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Number Systems: Conversion

From	To	Method
Base 10	Anything*	Division
Anything*	Base 10	Positional
Binary	Bases: 4,8,16	Grouping
Bases: 4,8,16	Binary	Grouping

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Number Systems: Conversion

- **Question-1**: The decimal number 11 would be represented in base 12 by the digit:
  a) A
  b) B
  c) C
  d) D
  e) None of the above

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Number Systems

- Convert the number from base 10 to base 12

Base 10	Base 12
0	0
1	1
2	2
:	:
:	:
9	9
10	A
11	**B**

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Number Systems: Conversion

- **Question-1**: The decimal number 11 would be represented in base 12 by the digit:
  a) A
  b) B
  c) C
  d) D
  e) None of the above

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Number Systems: Conversion

- **Question-2**: The decimal number 13 would be represented in base 12 by:

a) A
b) B
c) C
d) D
e) None of the above

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Number Systems: Conversion

- Using the division method, find 13_{10} in base 12:
  - 13/12 = 1 → Remainder=1
  - 1/12 = 0 → Remainder=1
- Answer: 11_{12}
- What if the question was the other way around?
  - Use positional representation:

$11_{12} = (1X12^1)+(1X12^0)$

$= 12 + 1$

$= 13_{10}$

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Number Systems: Conversion

- **Question-2**: The decimal number 13 would be represented in base 12 by:

a) A
b) B
c) C
d) D
e) None of the above

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Number Systems: Conversion

- **Question-3**: The number 321 in base 4 converts to what number in base 8?

a) 311
b) 57
c) 71
d) 17
e) None of the above

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Number Systems: Conversion

- Convert the number from base 4 to base 2
- Convert the number from base 2 to base 8

Base 4	Base 2
0	0
1	01
2	10
3	11

- $321_4 = 11\ 10\ 01_2$

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Number Systems: Conversion

- $321_4 = 11\ 10\ 01_2$
- $8 = 2^3$ → Create groups of 3 elements

Base 2	Base 8
001	1
111	7

- $321_4 = 111\ 001_2 = 71_8$

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Number Systems: Conversion

- **Question-3**: The number 321 in base 4 converts to what number in base 8?

a) 311
b) 57
c) 71
d) 17
e) None of the above

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Number Systems: Conversion

- **Question-4**: The number 77 in base 8 converts to what decimal number?

a) 63
b) 115
c) 77
d) 70
e) None of the above

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Number Systems: Conversion

- Using positional representation:

$77_8 = (7 \times 8^1) + (7 \times 8^0)$
$= (7 \times 8) + (7 \times 1)$
$= 56 + 7$
$= 63_{10}$

- $77_8 = 63_{10}$

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Number Systems: Conversion

- **Question-4**: The number 77 in base 8 converts to what decimal number?

a) **63**
b) 115
c) 77
d) 70
e) None of the above

Topics

- **Number Systems: Conversion**
- **Number Systems: Sign systems**
- ***IEEE-754*** floating-point
- Circuits
- Assembly
- Computer Architecture

Number Systems: The Sign

System	Description
Mag	0→ positive + magnitude 1 → negative+ magnitude
2's	0 → positive → all other bits same as unsigned 1 → negative → all other bits are opposite of unsigned+1

Number Systems: The Sign

System	Example (2_{10})	Example (-2_{10})
Mag	$0000\ 0010_2$	$1000\ 0010_2$
2's	$0000\ 0010_2$	$1111\ 1110_2$

Number Systems: The Sign

- **Example:** How is the number -6 represented in 2's complement?
- **Step-1:** The unsigned representation of 6 is 110_2
- **Step-2:** We need an extra bit for the sign.
  - We know that +6 = $\mathbf{0}110_2$
- **Step-3:** Flip all bits of +6:
  - $\mathbf{0}110_2 \rightarrow \mathbf{1}001_2$
- **Step-4:** Add 1_2 to the flipped bits:
  - $\mathbf{1}001_2 + 1_2 \rightarrow \mathbf{1}010_2$

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Number Systems: The Sign

- **Example:** Find the 2's complement of the number: 1101.11011_2
- **Step-1:** The unsigned representation is 1101.11011_2
- **Step-2:** We need an extra bit for the sign.
  - **0** 1101.11011_2
- **Step-3:** Flip all bits:
  - **1** 0010.00100_2
- **Step-4:** Add 1_2 to the flipped bits:
  - **1** $0010.00100_2 + 1_2 \rightarrow$ **1** 0010.00101_2

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Number Systems: The Sign

- **Question-5**: If the binary value 10000110 is interpreted as an unsigned number, it represents the decimal value:
  a) 122
  b) 134
  c) -122
  d) 86
  e) None of the above

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Number Systems: The Sign

- Use positional representation directly:

$1000\ 0110_2 = 2^7 + 2^2 + 2^1$

$= 128+4+2$

$= 134_{10}$

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Number Systems: The Sign

- **Question-5**: If the binary value 10000110 is interpreted as an unsigned number, it represents the decimal value:
  a) 122
  b) 134
  c) -122
  d) 86
  e) None of the above

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Number Systems: The Sign

- **Question-6**: In a system that uses 2's complement representation for signed integers, the largest positive integer that can be represented in 9 bits is:

a) 9
b) 255
c) 256
d) 511
e) None of the above

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Number Systems: The Sign

- In 2's complement, the largest positive integer in 9 bits:
  - **0 1111 1111**
- This is equal to 1 0000 0000 – 1 = 2^8 – 1 = 256-1 = 255

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Number Systems: The Sign

- **Question-6**: In a system that uses 2's complement representation for signed integers, the largest positive integer that can be represented in 9 bits is:

a) 9
b) 255
c) 256
d) 511
e) None of the above

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Number Systems: The Sign

- **Question-7**: In which system(s) is the negative of a number formed by flipping the sign bit?

a) signed magnitude system
b) unsigned system
c) 2's complement system
d) two of the above systems
e) all of the above systems

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Number Systems: The Sign

- **Question-7**: In which system(s) is the negative of a number formed by flipping the sign bit?

a) signed magnitude system
b) unsigned system
c) 2's complement system
d) two of the above systems
e) all of the above systems

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Number Systems: The Sign

- **Question-8**: In which system(s) is there more than one representation for the value zero?

a) signed magnitude system
b) unsigned system
c) 2's complement system
d) two of the above systems
e) all of the above systems

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Number Systems: The Sign

- **Question-8**: In which system(s) is there more than one representation for the value zero?

a) signed magnitude system:
- **0000 0000 and 1000 0000**

b) unsigned system
c) 2's complement system
d) two of the above systems
e) all of the above systems

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Topics

- **Number Systems: Conversion**
- **Number Systems: Sign systems**
- ***IEEE-754* floating-point**
- Circuits
- Assembly
- Computer Architecture

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IEEE-754 floating-point format

- Convert $(32.625)_{10}$ to the ***IEEE-754*** floating-point
- Using the division method, find 32_{10} in base 2:
  - 32/2 = 16→ Remainder=0
  - 16/2 = 8 → Remainder=0
  - 8/2 = 4 → Remainder=0
  - 4/2 = 2 → Remainder=0
  - 2/2 = 1→ Remainder=0
  - 1/2 = 0→ Remainder=1
- Answer: 32_{10} ➔ 100000_2

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IEEE-754 floating-point format

- Convert $(32.625)_{10}$ to the ***IEEE-754*** floating-point
- Using the multiplication method, find 0.625_{10} in base 2:
  - 0.625 * 2 = 1.25→ Whole number=1
  - 0.25 * 2 = 1.5 → Whole number=0
  - 0.5 * 2 = 1.0 → Whole number=1
- Answer: 0.625_{10} ➔ 0.101_2

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IEEE-754 floating-point format

- Convert $(32.625)_{10}$ to the ***IEEE-754*** floating-point
- 32.625_{10} ➔ 100000.101_2➔ $1.00000101_2 * 2^5$

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IEEE-754 floating-point format

- 32.625_{10} ➔ 100000.101_2 ➔ $1.00000101_2 * 2^5$
- Unbiased exponent ➔ 5
- Biased exponent ➔ 5 + 127 ➔ 132 ➔ $1000\ 0100_2$
- Significand ➔ 1.00000101_2
- Normalized Significant ➔ 0.00000101_2
- Sign ➔ 0_2
- Answer ➔ 0 1000 0100 0000 0101 0000 0000 0000 000
- Answer ➔ 0100 0010 0000 0010 1000 0000 0000 0000
- Answer ➔ 42028000_{16}

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IEEE-754 floating-point format

- Convert 42028000_{16} from the *IEEE-754* floating-point to decimal

- 42028000_{16} ➔ 0100 0010 0000 0010 1000 0000 0000 0000
- ➔ 0 1000 0100 0000 0101 0000 0000 0000 000
- Biased exponent ➔ $1000\ 0100_2$ ➔ 132
- Unbiased exponent ➔ 132 – 127 ➔ 5
- Normalized Significant ➔ $0.00000101\ 0000\ 0000\ 0000\ 000_2$
- Significand ➔ 1.00000101_2
- Sign ➔ 0_2
- Answer ➔ 42028000_{16} ➔ $+1.00000101_2 * 2^5$
- ➔ 100000.101_2 ➔ 32.625_{10}

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IEEE-754 floating-point format

- When representing a negative number with IEEE-754, you should **NOT** use 2's complement.
- You cannot add 2 IEEE-754 representations, directly (bit-by-bit). You should convert to numbers before you can add.

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Topics

- **Number Systems: Conversion**
- **Number Systems: Sign systems**
- ***IEEE-754* floating-point**
- **Circuits**
- Assembly
- Computer Architecture

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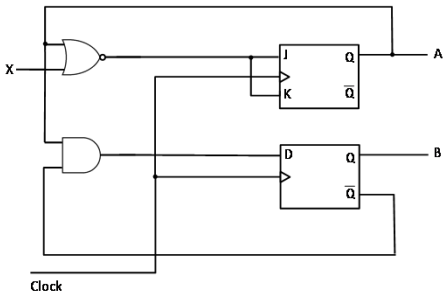
Analyzing a Sequential circuit



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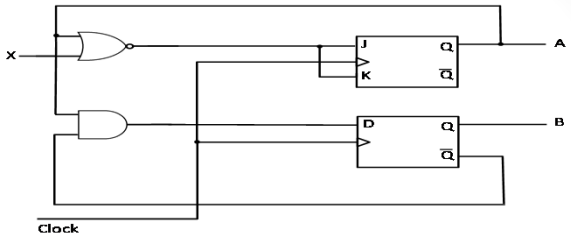

A	B	X	B'	A Nor X	A and B'	JK-Q+	D-Q+
0	0	0	1	1	0	1	0
0	0	1	1	0	0	0	0
0	1	0	0	1	0	1	0
0	1	1	0	0	0	0	0
1	0	0	1	0	1	1	1
1	0	1	1	0	1	1	1
1	1	0	0	0	0	1	0
1	1	1	0	0	0	1	0

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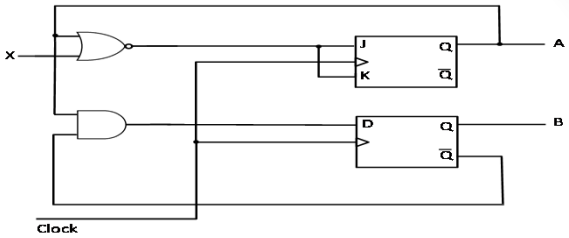

A	B	X	B'	A Nor X	A and B'	JK-Q+	D-Q+
0	0	0	1	1	0	1	0
0	0	1	1	0	0	0	0
0	1	0	0	1	0	1	0
0	1	1	0	0	0	0	0
1	0	0	1	0	1	1	1
1	0	1	1	0	1	1	1
1	1	0	0	0	0	1	0
1	1	1	0	0	0	1	0

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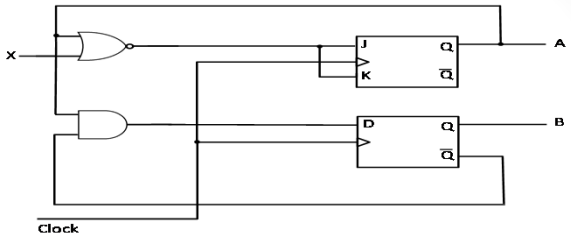

A	B	X	B'	A Nor X	A and B'	JK-Q+	D-Q+
0	0	0	1	1	0	1	0
0	0	1	1	0	0	0	0
0	1	0	0	1	0	1	0
0	1	1	0	0	0	0	0
1	0	0	1	0	1	1	1
1	0	1	1	0	1	1	1
1	1	0	0	0	0	1	0
1	1	1	0	0	0	1	0

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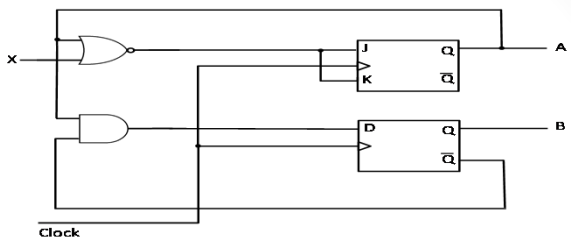
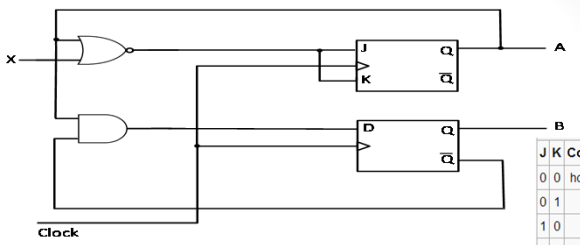
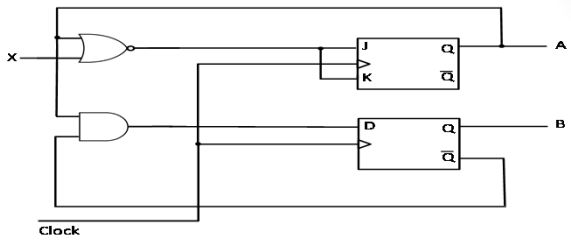


A	B	X	B'	A Nor X	A and B'	JK-Q+	D-Q+
0	0	0	1	1	0	1	0
0	0	1	1	0	0	0	0
0	1	0	0	1	0	1	0
0	1	1	0	0	0	0	0
1	0	0	1	0	1	1	1
1	0	1	1	0	1	1	1
1	1	0	0	0	0	1	0
1	1	1	0	0	0	1	0



J	K	Comment	Q_{next}
0	0	hold state	Q
0	1	reset	0
1	0	set	1
1	1	toggle	$\overline{Q}$

A	B	X	B'	A Nor X	A and B'	JK-Q+	D-Q+
0	0	0	1	1	0	1	0
0	0	1	1	0	0	0	0
0	1	0	0	1	0	1	0
0	1	1	0	0	0	0	0
1	0	0	1	0	1	1	1
1	0	1	1	0	1	1	1
1	1	0	0	0	0	1	0
1	1	1	0	0	0	1	0



C	D	Q^+
0	0	Q
0	1	Q
1	0	0
1	1	1

A	B	X	B'	A Nor X	A and B'	JK-Q+	D-Q+
0	0	0	1	1	0	1	0
0	0	1	1	0	0	0	0
0	1	0	0	1	0	1	0
0	1	1	0	0	0	0	0
1	0	0	1	0	1	1	1
1	0	1	1	0	1	1	1
1	1	0	0	0	0	1	0
1	1	1	0	0	0	1	0

Topics

- Number Systems: Conversion
- Number Systems: Sign systems
- *IEEE-754* floating-point
- Circuits
- Assembly
- Computer Architecture

Assembly

- **Question-9**: In order for a program to be executed on the ARM, it must be:

a) in machine language
b) written in assembly
c) stored in main memory
d) more than one of the above
e) none of the above

Assembly

- **Question-9**: In order for a program to be executed on the ARM, it must be:

a) in machine language
b) written in assembly
c) stored in main memory
d) more than one of the above
e) none of the above

Assembly

- **Question-10**: Which of the following is/are true about an assembler?

a) it is machine independent
b) it is a part of the CPU
c) it is software that translates a high-level language into assembly language
d) more than one of the above
e) none of the above

Assembly

- **Question-10**: Which of the following is/are true about an assembler?

a) it is machine independent
b) it is a part of the CPU
c) it is software that translates a high-level language into assembly language
d) more than one of the above
e) none of the above

It is translates assembly instruction into opcodes

Topics

- **Number Systems: Conversion**
- **Number Systems: Sign systems**
- ***IEEE-754* floating-point**
- **Circuits**
- **Assembly**
- **Computer Architecture**

Computer Architecture

- **Question-11**: The internal representation of information in the ARM is always in:

a) Binary
b) Octal
c) Decimal
d) Hexadecimal
e) None of the above

Computer Architecture

- **Question-11**: The internal representation of information in the ARM is always in:

a) **Binary**
b) Octal
c) Decimal
d) Hexadecimal
e) None of the above

Computer Architecture

- **Question-12**: The external representation of information in the ARM is always in:

a) Binary
b) Octal
c) Decimal
d) Hexadecimal
e) None of the above

Computer Architecture

- **Question-12**: The external representation of information in the ARM is always in:

a) Binary
b) Octal
c) Decimal
d) Hexadecimal
e) None of the above

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Computer Architecture

- **Question-13**: The character "5" typed on the keyboard, is stored internally in the keyboard buffer as:

a) the binary value 0000 0101
b) the binary value 0011 0101
c) the binary value 0101 0011
d) the binary value 0101 0000
e) none of the above

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Computer Architecture

- The ASCII value for the character "5" is 53
- Convert the ASCII value to binary:

53/2 = 26 → Remainder=1
26/2 = 13 → Remainder=0
13/2 = 6 → Remainder=1
6/2 = 3 → Remainder=0
3/2 = 1 → Remainder=1
1/2 = 0 → Remainder=1

- $53_{10} = 0011\ 0101_2$

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Computer Architecture

- **Question-13**: The character "5" typed on the keyboard, is stored internally in the keyboard buffer as:

a) the binary value 0000 0101
b) the binary value 0011 0101
c) the binary value 0101 0011
d) the binary value 0101 0000
e) none of the above

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Computer Architecture

- **Question-14**: Which of the following is/are part of the architectural specifications for a computer?

a) representation used for signed integers
b) assembly language instruction set
c) machine language instruction set
d) exactly two of the above
e) all three of (a), (b), and (c)

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Computer Architecture

- **Question-14**: Which of the following is/are part of the architectural specifications for a computer?

a) representation used for signed integers
b) assembly language instruction set
c) machine language instruction set
d) exactly two of the above
e) all three of (a), (b), and (c)

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Computer Architecture

- **Question-15**: What is the size of an ARM machine language instruction?

a) 8 bits
b) 13 bits
c) 32 bits
d) it depends on the opcode
e) none of the above

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Computer Architecture

- **Question-15**: What is the size of an ARM machine language instruction?

a) 8 bits
b) 13 bits
c) 32 bits
d) it depends on the opcode
e) none of the above

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Computer Architecture

- **Question-16**: In assembly language, a label is:

a) a symbolic name for a local variable
b) a symbolic name for the location of an instruction
c) a comment
d) more than one of the above answers
e) none of the above answers

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Computer Architecture

- **Question-16**: In assembly language, a label is:

a) a symbolic name for a local variable
b) a symbolic name for the location of an instruction
  - **User-defined identifier**
  - **May use letters, digits, underscore, may not start with a digit**
c) a comment
d) more than one of the above answers
e) none of the above answers

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Help

- ***Graduate Teaching Assistants:***
  - Abdulwahab Kabani, *akabani5@uwo.ca*
  - Mike Molnar, *mmolnar2@uwo.ca*
  - Sakif Pritom, *spritom@uwo.ca*
- Send us an email or see us after class
- Consultation Room : Middlesex College - 342

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