

CDS130 Mid-term exam

- Write your name at the top of your answer page.
- This is a closed book exam.
- You may not use a calculator.
- You may not use MATLAB during exam except the last two problems.
- Absolutely no interaction between students is allowed.
- Partial credit may be awarded ONLY if work is shown.
- Duration for this exam: 75 minutes.

Q1. (5 points) Base 3 representation of numbers is called “ternary”, and uses only digits 0 through 2. Give the following equivalent numbers for ternary 2012 in each binary, decimal, and hexadecimal representation:

Binary: _____ **111011** _____

Decimal: _____ **59** _____ $2 \times 3^3 + 1 \times 3^1 + 2 \times 3^0 = 59$ _____

Hexadecimal: _____ **3B** _____

Q2. (5 points)

$(-7)_{10} = (\quad)_2$ (using the excess-127 method with 8 bits).

Answer:

In the excess-127 method, 0000 0000 represents -127. To represent -7, we use the unsigned bit pattern for $(-7 + 127 = 120)$, which is

1111000

Q3. (5 points) Convert decimal -127 to 8-bit binary using the two's complement method.

Answer:

step 1: convert its positive counterpart 127 to binary: **01111111**

step 2: flip all bits. **10000000**

step 3: add 1, we have **10000001**

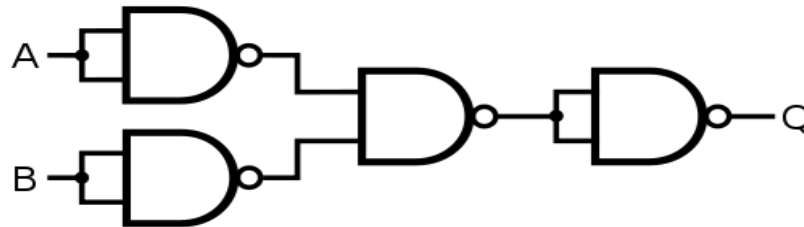
Q4. (5 points) How many bits are needed to generate 2047 bit-patterns?

Answer:

11 bits can generate $2^{11} = 2048$ bit patterns, but 10 bits can only generate $2^{10} = 1024$ bit patterns

So, 11 bits are needed.

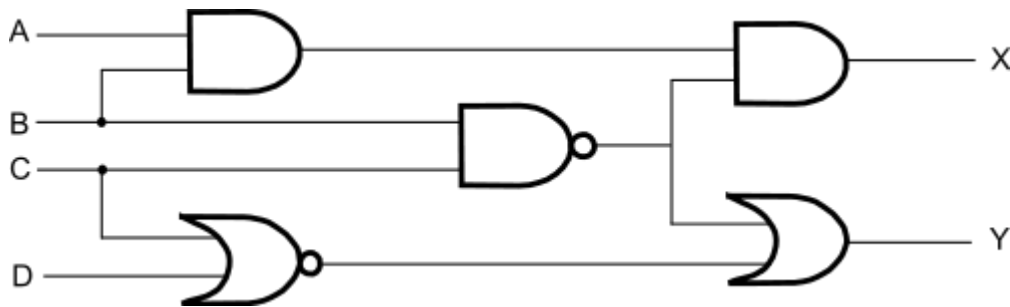
Q10. What one logic gate is equivalent to the logic circuit shown below? Draw the logic gate.



Nor gate

$$Q = \bar{A} * \bar{B} = \overline{(A + B)}$$

Q11. (5 points) For the logic circuit given below



- A. Output X = 1 and Y = 0 cannot be computed
- B. Output X = 1 and Y = 1 cannot be computed
- C. Output X = 0 and Y = 0 cannot be computed
- D. Output X = 0 and Y = 1 cannot be computed
- E. All four outputs can be computed

Answer: A (see homework solution).

Q12. (10 points) Without running matlab, provide answer to the following matlab build in functions

- (1) floor(-4.2)
- (2) ceil (3.02)
- (3) sqrt(round(3.5))
- (4) 4.0/2.0/2.0^2.0
- (5) mod (4, 3)

answer:

- (1) -5.0
- (2) 4
- (3) 2
- (4) 0.5
- (5) 1

Q13. (10 points) What is the output after executing the following MATLAB code:

```
clear all;
first_variable = round(pi);
first_variable = first_variable +1;
second_variable = 3;
third_variable = mod(second_variable, first_variable);
first_variable
second_variable
third_variable
```

answer:

```
first_variable =
               4
second_variable =
               3
third_variable =
               1
```

Q14. (10 points) An anonymous function defined in matlab is a function that is not stored in a program file, but associated with a variable.

$$f(x, y) = \sin^2(x^2) + \cos^2(y^2) + e^{x-y}$$

Calculate the values of $f(f(0.3, 0.4), f(0.2, 0.1))$ using the defined anonymous function in Matlab.

Answer:

```
>> f = @(x,y) (sin(x^2))^2 + (cos(y^2))^2 + exp(x-y)
```

```
>> f(f(0.3,0.4), f(0.2,0.1))
```

```
ans =
    1.0438
```

Q15. (15 points)

(1) write a matlab script to define a function `my_logarithm(x,y,z)` to evaluate the value of $\log_{10}(x^y + y^z + z^x)$

(2) use user-provided values to test the results of `my_logarithm(0.1, 0.2, 0.3)`.

Answer:

(1) Write a matlab script named `my_logarithm.m` in matlab.

```
function f = my_logarithm(x,y,z)
    log10(x^y + y^z + z^x)
end
```

(2) `>> my_logarithm(0.1, 0.2, 0.3)`

```
ans =
    0.3293
```