The exam will consist of two parts:
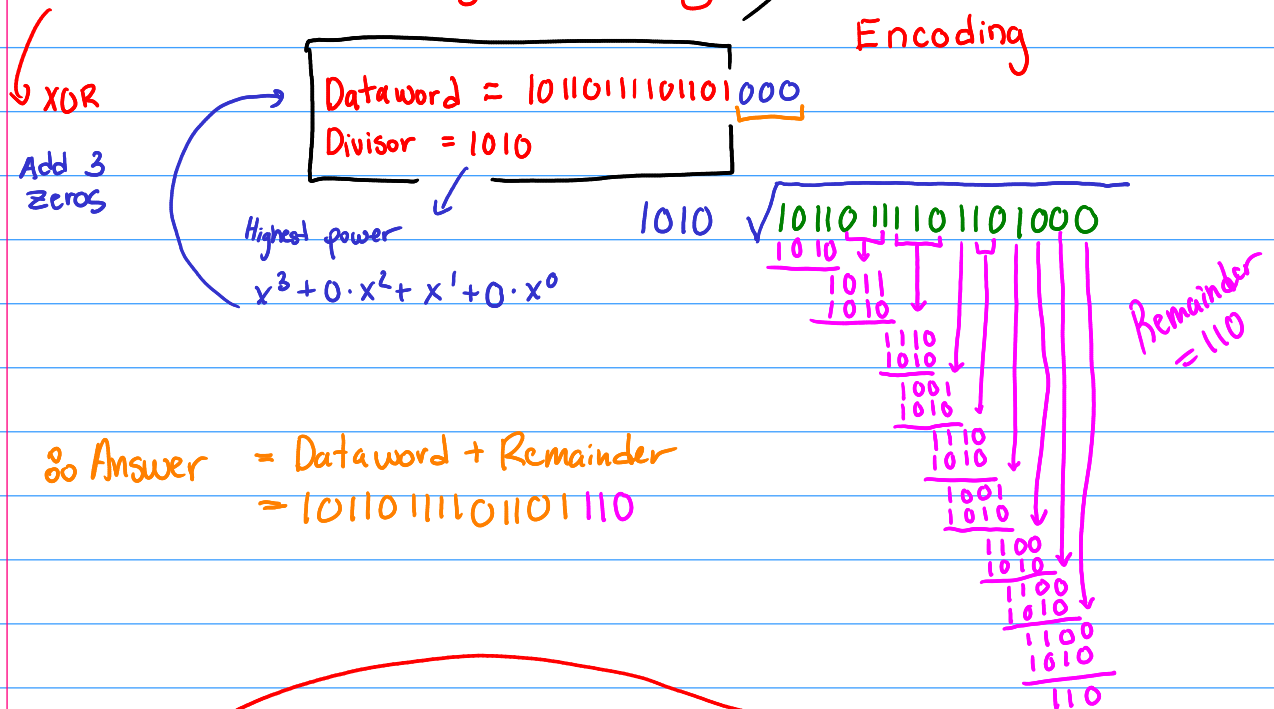
Part 1: 20 Multiple-Choice Questions (MCQs)

- Modules 1-12
- Questions will be of the same level of complexity as the NetAcad checkpoints. Review them carefully.
- Excludes all CLI commands related to the configuration of Cisco devices

Part 2: Development Questions

- up to 4 questions:
  1. CRC – Encoding and decoding
  2. Checksum – Simple calculation in HEX or binary, encoding or decoding
  3. Scenario-based: Subnetting a Class A,B or C address
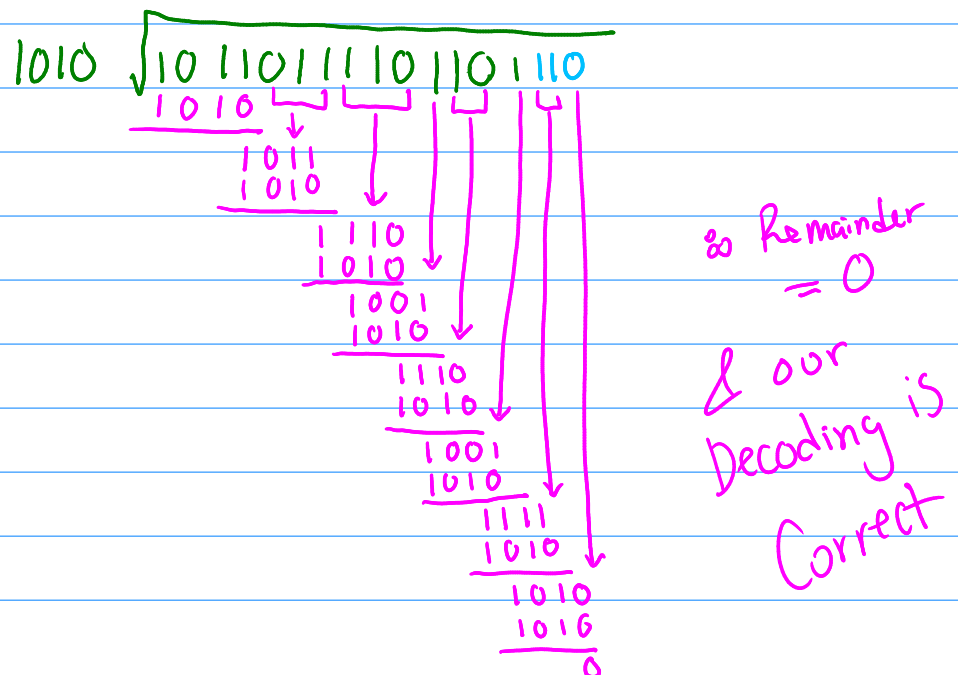 4. Scenario-based: Subnetting using CIDR notation

This will be a closed-book exam. An appendix will be provided with the format of the Ethernet, IPv4, IPv6, protocol data units.

CRC — Encoding + Decoding → Question

XOR

Add 3 zeros

Encoding

Dataword = 10110111101101000
Divisor = 1010

Highest power

$$x^3 + 0 \cdot x^2 + x^1 + 0 \cdot x^0$$

```
        _____
1010  / 10110 11110 1101 000
        1010 ↓
        1011
        1010
         1110
         1010
          1001
          1010
           1110
           1010
            1001
            1010
             1100
             1010
              1100
              1010
               1100
               1010
                110
```

Remainder = 110

∴ Answer = Dataword + Remainder
= 10110 11110 1101 110

Decoding

```
        _____
1010  / 10 1101 11 10 110 1 110
        1010
         1011
         1010
          1110
          1010
           1001
           1010
            1110
            1010
             1001
             1010
              1111
              1010
               1010
               1010
                0
```

divisor √ Answer

∴ Remainder = 0

& our Decoding is Correct

CHECKSUM

Basic Theory:

$$D1 + D2 + D3 = 1111\ 1111$$

Encoding

$$1101\ 1000 + 1111\ 0101 \quad XXXX\ XXXX$$

```
  1101 1000
  1111 0101
  ─────────
   1100 1101   ←+1
+ 0000 0001
  ─────────
  1100 1110
```

1's comp

0011 0001

Decoding

D2 10110000   1110 1010
Solve for D7

```
  1011 0000
  1110 1010
  ─────────
  1001 1010 +1
  0000 0001
  ─────────
  1001 1011
```

1' comp

$D_1 = 0110\ 0100$

CLASS.

A	B	C
255.0.0.0	255.255.0.0	255.255.255.0
2^{24} Host	2^{16} Host	2^8 Host
|||| ||||.0.0.0	|||||| ||.|||| ||||.0.0	|||| ||||.||| |||.|||||||.0

GIVEN IP & (Subnet or User Amount)

4. **[10 points]** A Canadian company named MapleSys is assigned a **Class B network address** of 172.60.0.0. The company needs at least **128 usable** hosts per subnet.
- What subnet mask should be used?
- Show the first 3 subnets created.
- Assign the first 5 usable IP addresses from subnet 2 to computers.
- Show your calculations clearly.

→ 255.255.255.0

$2^7 = 128$ but 2 are reserved
so 2^8 (n = 8) = 256
so we need First Octet

Classful All same size

172.60.0.0 — 172.60.0.255
172.60.1.0 — 172.60.1.255
172.60.2.0 — 172.60.2.255

172.60.0.1   (1st IP is Network IP / last is Broadcast)
172.60.0.2
172.60.0.3
172.60.0.4
172.60.0.5

All NEED TO BE SAME SIZE

CLASSLESS

5. [10 points]

A service provider is granted the address block **10.20.8.0/21**. Allocate addresses as follows:

1)
- Two organizations needing 300 addresses each
- Three organizations needing 100 addresses each
- Four organizations needing 30 addresses each

Answer the following:
- What is the total number of addresses in the block?
- Provide the range of addresses for each organization.
- Indicate any remaining unallocated address blocks with their range.

$32 - 21 = 11$ bits

so total 2^{11} Addresses

Range $\boxed{10.20.8.0}$

Keep the same   11 bits

$10.20.0000\ 1000.0$ to $10.20.0000\ 1111.1111\ 1111$

$\boxed{10.20.15.255}$

1) $2 \times 300 = 600 \longrightarrow 2^n = 300 \quad 2^9 \quad 32-9 = /23$

2) $3 \times 100 = 300$

Total $= 1020 \longrightarrow 2^n = 100 \quad 2^7 \quad 32-7 \quad /25$

so we have enough

3) $4 \times 30 = 120 \rightarrow 2^n = 30 \quad 2^5 \quad 32-5 \quad /27$

ORG	Network IP	IP Range lower	upper	Broadcast IP	Subnet mask
300	10.20.8.0	10.20.8.1	10.20.9.254	10.20.9.255	/23
300	10.20.10.1	10.20.10.1	10.20.11.254	10.20.11.255	/23
100	10.20.12.0	10.20.12.1	10.20.12.126	10.20.12.127	/25
100	10.20.12.128	10.20.12.130	10.20.12.254	10.20.12.255	/25
100	10.20.13.0	10.20.13.1	10.20.13.126	10.20.13.127	/25
30	10.20.13.128	10.20.13.130	10.20.13.158	10.20.13.159	/27
30	10.20.13.160	10.20.13.161	10.20.13.190	10.20.13.191	/27
30	10.20.13.192	10.20.13.193	10.20.13.221	10.20.13.223	/27
30	10.20.13.224	10.20.13.225	10.20.13.254	10.20.13.255	/27

Range 300, 100, 30

FRAGMENTATION

Given :   Bytes, MTU, ID, OPTIONS?

Header = 20 + OPTIONS mod 4 = 0   (Have to add till) it is

3. [10 points] A TCP segment with 7400 bytes of pure data must be transmitted over a network with an MTU of 1480 bytes. The IP packet has a header with 8 bytes of options. The datagram has an Identification field of 0x1A2B.

7400 bytes
MTU 1480 bytes
Header w 8 bytes
ID 0x1A2B

1) calc Header   20+ 8 = 28 mod 4 = 0 works

2) calc Data

$1480 - 28 = 1452 / 8 = 181.5$ floor $\rightarrow$ OFFSET $\boxed{181} \times 8$ = 1448

(we have to make it /8)

ID	Flag	Offset	Data	Total Data
1A2B	1	0	1448	1448 + 28 = 1476
1A2B	1	181	1448	1476
1A2B	1	2·181	1448	1476
1A2B	1	3·181	1448	1476
1A2B	1	4·181	1448	1476
1A2B	0	5·181	160	160 + 28 = 188

3) FIND how many segments $7400 / 1448 = 5.11$ (Round UP) = 6

4) Calc last fragment $7400 - (5 \times 1448) = 160$