CSCI 360 **16. Number Formats and Decimal Numbers**

There are three ways to store, or represent, numbers on the mainframe.

They are:

1. Binary Numbers
2. Zoned Decimal Numbers
3. Packed Decimal Numbers

We have already seen how binary numbers look in storage. Let's now look at the other types.

There are two formats for decimal numbers:

1. Zoned Decimal
2. Packed Decimal

Zoned Decimal Numbers

- Generally used for input/output, and is very similar to EBCDIC.

- Represents one decimal digit per byte.

- Each byte of is made up of two hex digits:

```
left  ->  zone digit       right ->  numeric digit
```

- The numeric digit is the number represented by the byte.

- The zone digit of all but the rightmost byte must be `F`.

- The zone digit of the rightmost byte is used to indicate the sign of the number:

  `F`, `A`, `C`, or `E` positive number (just remember the word "FACE")

  or

  `B` or `D` negative number

- Examples:

  `F1F2F3F4` zoned decimal representation of `+1234`

  `F1F2F3B4` zoned decimal representation of `-1234`

- Can be generated on a `DC` statement by using a storage class of `Z`:

  - the initial value can contain a sign or a decimal point.

- if the sign is omitted, assumed to be positive.

- if plus sign is specified, rightmost zone digit is `C`.

- if negative sign is specified, rightmost zone digit is `D`

- if a decimal point is specified, treated as an implied decimal point.

- Examples:

```
NUM1     DC    2Z'-1'          D1D1
NUM2     DC    Z'+2'           C2
NUM3     DC    Z'2'            C2
NUM4     DC    ZL3'4'          F0F0C4
NUM5     DC    2ZL2'-9'        F0D9F0D9
NUM6     DC    Z'1.10'         F1F1C0
```

- Maximum zoned decimal number can have 16 digits.

Packed Decimal Numbers

- Used for arithmetic.

- Each byte, except for the rightmost, represents two decimal digits.

- The rightmost byte contains a decimal digit and the sign digit:

```
left  ->  numeric digit      right ->  sign digit
```

- The sign digit is used to indicate the sign of the number

`F`, `A`, `C`, or `E` positive number

or

`B` or `D` negative number

- Can be generated on a `DC` statement by using a storage class of `P`:

  - the initial value can contain a sign or a decimal point.

  - if the sign is omitted, assumed to be positive.

  - if plus sign is specified, rightmost sign digit is `C`.

  - if negative sign is specified, rightmost sign digit is `D`.

  - if a decimal point is specified, treated as an implied decimal point.

- Examples:

```
NUM1     DC    2P'-1'          1D1D
NUM2     DC    P'+2'           2C
NUM3     DC    P'2'            2C
NUM4     DC    PL3'4'          00004C
NUM5     DC    2PL2'-9'        009D009D
NUM6     DC    P'1.10'         110C
```

- Maximum packed decimal number can have 31 digits.