Computer Network

Lecture-19

Dharmendra Kumar (Associate Professor)
Department of Computer Science and Engineering
United College of Engineering and Research,
Prayagraj

Error Detection and Correction

CHECKSUM

- Checksum is an error detection method.
- The checksum is used in the Internet by several protocols.
- The checksum is based on the concept of redundancy.

Internet Checksum

Internet uses 16-bit checksum. The sender calculates the checksum by following these steps.

Sender site:

1. The message is divided into 16-bit words.
2. The value of the checksum word is set to 0.
3. All words including the checksum are added using one's complement addition.
4. The sum is complemented and becomes the checksum.
5. The checksum is sent with the data.

Error Detection and Correction

The receiver uses the following steps for error detection.

Receiver site:

1. The message (including checksum) is divided into 16-bit words.
2. All words are added using one's complement addition.
3. The sum is complemented and becomes the new checksum.
4. If the value of checksum is 0, the message is accepted; otherwise, it is rejected.

Error Detection and Correction

Example: Calculate the checksum for a text of 8 characters ("Forouzan").

Solution:

1	0	1	3	Carries
4	6	6	F	(Fo)
7	2	6	F	(ro)
7	5	7	A	luz)
6	1	6	E	(an)
0	0	0	0	Checksum (initial)
8	F	C	6	Sum (partial)
			1	
8	F	C	7	Sum
7	0	3	8	Checksum (to send)

a. Checksum at the sender site

1	0	1	3	Carries
4	6	6	F	IFo)
7	2	6	F	(ro)
7	5	7	A	(uz)
6	1	6	E	(an)
7	0	3	8	Checksum (received)
F	F	F	E	Sum (partial)
			1	
F	F	F	F	Sum
0	0	0	0	Checksum (new}

b. Checksum at the receiver site

Error Detection and Correction

Some questions:

1. What is the Hamming distance for each of the following codewords:

   a. d (10000, 00000)

   b. d (10101, 10000)

   c. d (11111,11111)

   d. d (000, 000)

2. Find the minimum Hamming distance for the following cases:

   a. Detection of two errors.

   b. Correction of two errors.

   c. Detection of 3 errors or correction of 2 errors.

   d. Detection of 6 errors or correction of 2 errors.

Error Detection and Correction

3. Which of the following CRC generators guarantee the detection of a single bit error?

   a. $x^3 + x + 1$

   b. $x^4 + x$

   c. 1

   d. $x^2 + 1$

4. Sender needs to send the four data items 0x3456, 0xABCC, 0x02BC, and 0xEEEE. Answer the following:

   a. Find the checksum at the sender site.

   b. Find the checksum at the receiver site if there is no error.

   c. Find the checksum at the receiver site if the second data item is changed to 0xABCE.

   d. Find the checksum at the receiver site if the second data item is changed to 0xABCE and the third data item is changed to 0x02BA.