Media Technology

Prof. Dr.-Ing. Andreas Schrader

Solution of Assignment 1

Solution 1.1

16 bit/sample * 44.100 samples/s = 705600 bit/s.
Stereo means 2 channels, therefore 2*705600 bit/s = 1411200 bit/s
3 min 20 s = 200 s.
The song has a data volume of 200 s*1411200 bit/s = 282240000 bit.
Using 8 bit per Byte we can also say, it has a size of 35280000 Byte.
The modem offers 7KByte/s = 7*1024 Byte/s = 7168 Byte/s.
Therefore, the song would need 35280000 Byte / 7168 Byte/s = 4921.875 s for a complete download, which equals 82.03125 min.
Downloading the song will therefore cost 82.03125 min * 100 Yen /min = 8203.125 Yen.

Solution 1.2

Let's use the following abbreviations: Father 1 (youngest) = F1, Father 2 = F2, Father 3 (oldest) = F3, Brother = B, Marsian = M.
If we use the following translations from binary values to the decimal system:

$10_2 = 1 * 2^1 + 0 * 2^0 = 2_{10}$
$11_2 = 1 * 2^1 + 1 * 2^0 = 3_{10}$
$100_2 = 1* 2^2 + 0 * 2^1 + 0 * 2^0 = 4_{10}$
$1111000_2=120_{10}$
$1010100111_2=679_{10}$

Then we get:

F1 = 3*B, F3=4*M, B+M = 120, F1+F2+F3=679, F2=2*(B+M)=240.

- ➔ 3B +4M+240=679.
- ➔ 3*(120-M)+4M+240=679
- ➔ 360-3M+4M+240=679
- ➔ M=79
- ➔ B=120-79=41
- ➔ F1=123
- ➔ F3=316

M: $79_{10} = 1001111_2$
B: $41_{10} = 101001_2$
F1: $123_{10} = 1111011_2$
F2: $240_{10} = 11110000_2$
F3: $316_{10} = 100111100_2$

Solution 1.3

Quantizer 1:

E_e = 1/10 * (6*6 + 1*1 + 4*4 + 1*1 + 4*4 + 1*1 + 6*6 + 9*9 + 5*5 + 3*3)
= 1/10 * (36+1+16+1+16+1+36+81+25+9)
= 1/10* (222)
= MSE = 22.2

E_s = 1/10 * (6*6 + 11*11 + 14*14 + 21*21 + 24*24 + 31*31 + 36*36 + 29*29 + 25*25 + 23*23)
= 1/10 * (5622)
= 562.2

SNR = $10 * \log_{10} (E_s / E_e)$
= $10 * \log_{10}$ (562.2/22.2)
= $10 * \log_{10}$ (25.324)
= 14.035 dB

Quantizer 2:

E_e = 1/10 * (1*1 + 1*1 + 4*4 + 1*1 + 4*4 + 1*1 + 1*1 + 4*4 + 0*0 + 3*3)
= 1/10 * (1+1+16+1+16+1+1+16+0+9)
= 1/10 * (62)
= 6.2

SNR = $10 * \log_{10} (E_s / E_e)$
= $10 * \log_{10}$ (562.2/6.2)
= $10 * \log_{10}$ (90.677)
= 19.575 dB

The second quantizer is obviously better, since the MSE value is smaller and the SNR value is larger.