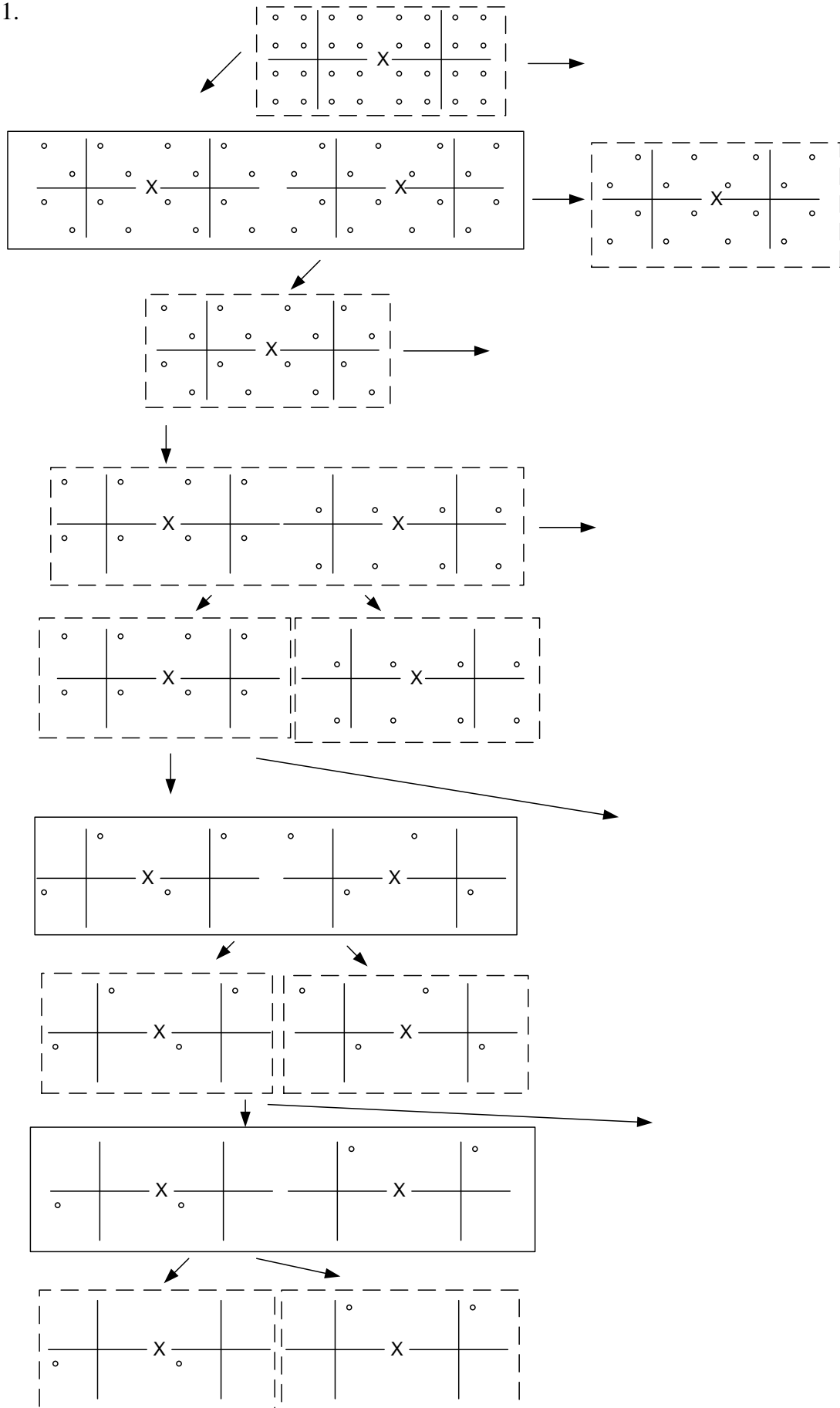


2007 Advanced Coding Theorem Hw3 solution

1.



2.

$$\underline{S}_1 \oplus \underline{S}_2 = \left\{ \begin{array}{c} \left(\begin{array}{c} 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{array} \right), \left(\begin{array}{c} 1 \\ 0 \\ 1 \\ 0 \\ 0 \end{array} \right), \left(\begin{array}{c} 0 \\ 1 \\ 0 \\ 0 \\ 1 \end{array} \right), \left(\begin{array}{c} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{array} \right), \left(\begin{array}{c} 0 \\ 1 \\ 1 \\ 0 \\ 0 \end{array} \right) \end{array} \right\}$$

$\Delta_1 \quad \Delta_2 \quad \Delta_0 \quad \Delta_4 \quad \Delta_2$

For table III

$$\Delta_1^2 + \Delta_2^2 + \Delta_0^2 + \Delta_4^2 + \Delta_2^2 = 8.102$$

For table IV

$$\Delta_1^2 + \Delta_2^2 + \Delta_0^2 + \Delta_4^2 + \Delta_2^2 = 8.686$$

For table V

$$\Delta_1^2 + \Delta_2^2 + \Delta_0^2 + \Delta_4^2 + \Delta_2^2 = 6.686$$

There is no other case better than above

\therefore table IV is best for $\underline{S}_1 \oplus \underline{S}_2$

3.

(1) CER 設為 1.5, rate: 7 bits/2D

$$\Rightarrow \text{total constellation} = 2^7 \cdot 1.5 = 192$$

$$T = \frac{16}{2} = 8$$

① for $M=8$:

$$\frac{192}{8} = 24 \text{ points per region}$$

 \Rightarrow 可 encode 4 unshaped bits / 2D.

$$\text{total shaped bits: } (7-4) \cdot 8 = 24$$

$$\text{but } 8^8 = 2^{24} \Rightarrow \text{no shaping gain}$$

② for $M=7$:

$$\frac{192}{7} = 27.4 \text{ points per region}$$

 \Rightarrow 可 encode 4 unshaped bits / 2D

$$\text{total shaped bits: } (7-4) \cdot 8 = 24$$

$$\Rightarrow 7^8 < 2^{24} \quad \text{可挑選的數目大過於實際存在的組合數。}$$

③ for $M=6$:

$$\frac{192}{6} = 32 \text{ points per region}$$

 \Rightarrow 可 encode 5 unshaped bits / 2D

$$\text{total shaped bits: } (7-5) \cdot 8 = 16$$

$$\Rightarrow 6^8 > 2^{16} \quad \text{有 shaping gain.}$$

 \therefore Max. value of M : 6

for each shaping block:

16 bits for shaping.

40 unshaped bits.

(2)

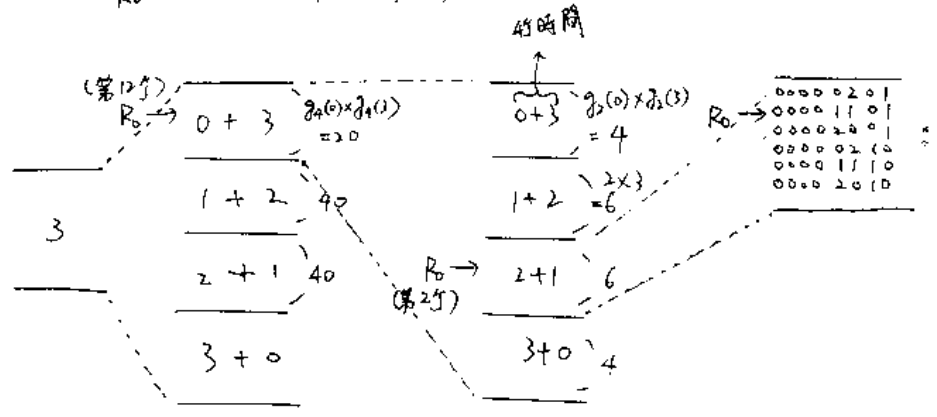
i

$g_2(0) = 1$	$g_4(0) = 1$	$g_8(0) = 1$
$g_2(1) = 2$	$g_4(1) = 4$	$g_8(1) = 8$
$g_2(2) = 3$	$g_4(2) = 10$	$g_8(2) = 36$
$g_2(3) = 4$	$g_4(3) = 20$	$g_8(3) = 120$
$g_2(4) = 5$	\vdots	\vdots
$g_2(5) = 6$	\vdots	\vdots

ii

$\overline{\text{total cost}}$ $= 0$	} $g_2(0) = 1$	
$= 1$		} $g_8(1) = 8$
$= 2$	} $g_8(2) = 36$	
$R_0 = 56 \rightarrow = 3$		} $g_8(3) = 120$

iii $R_0 = 56 \Rightarrow$ 第 57 個, 又, 由題目所附之排序順序:



\therefore The cost of each symbol: 00001101 #