

An Introduction to
**Computer
Science**

計算機概論

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淺談 QR Code

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QR Code 的起源與架構



計算機概論

什麼是QR Code ?

- 於1994年由日本 DENSO WAVE 公司發明
- 研發負責人：原昌宏
- QR 來自英文「Quick Response」的縮寫
 - 原本是用來記錄工廠生產線資訊的一種二維條碼
 - 在2000年獲得ISO 國際標準採用
 - ◆ ISO/IEC 18004:2006

DENSO



原昌宏



QR Code 基本架構

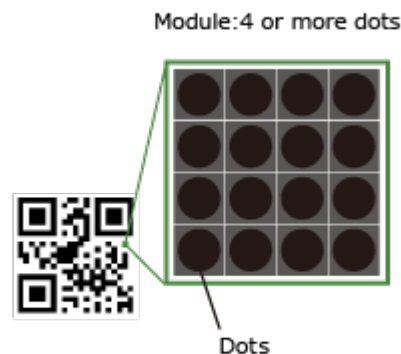
- 定位圖案(position detection patterns)
 - 目的地是快速在影像中找到 QR Code 的位置



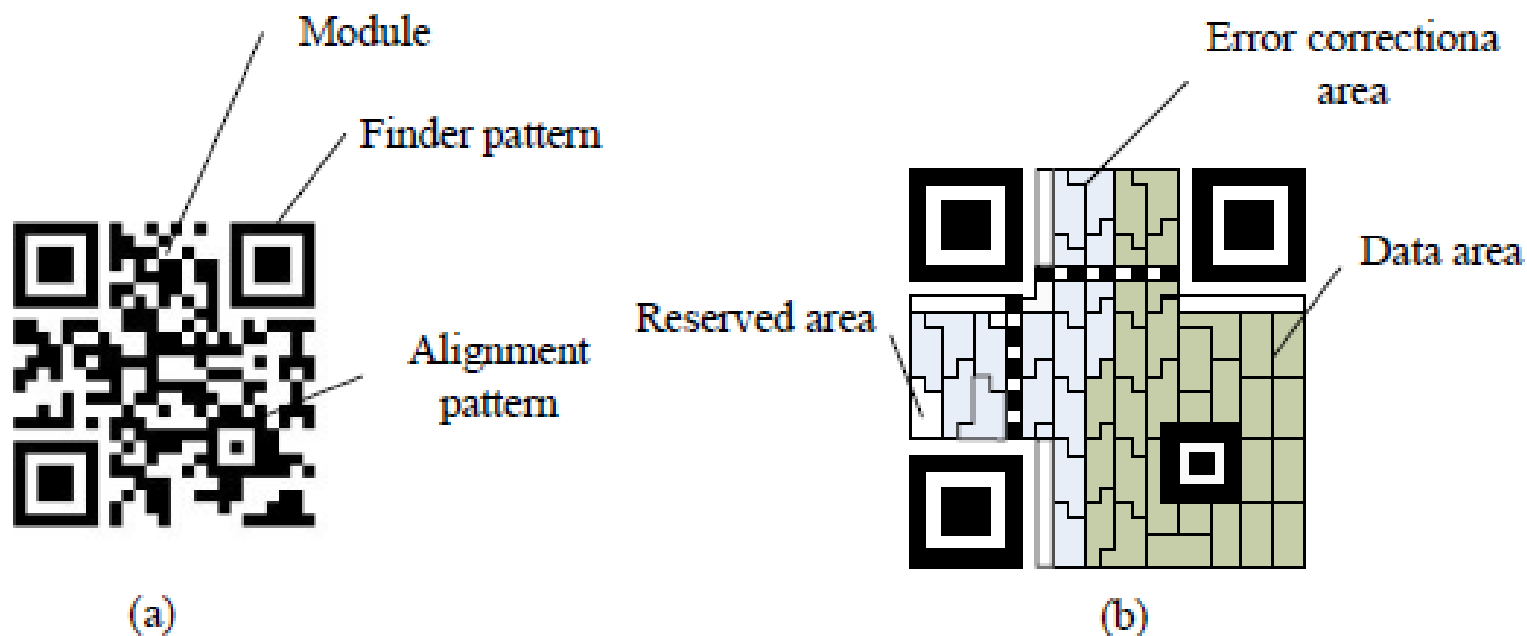
QR Code 基本架構

■ 碼元(module)

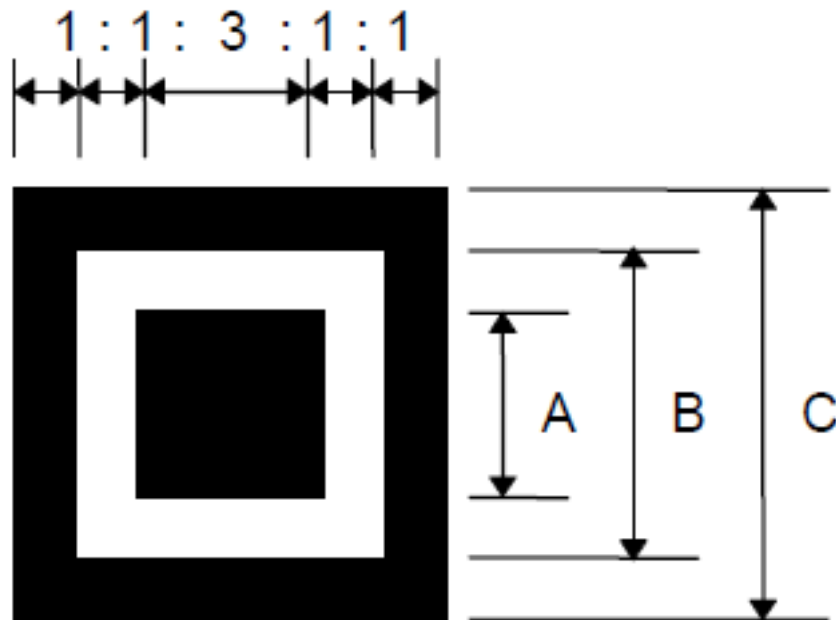
- QR Code中最小的基本單位，黑色表示 1，白色表示 0



QR Code 基本架構



Structure of finder pattern



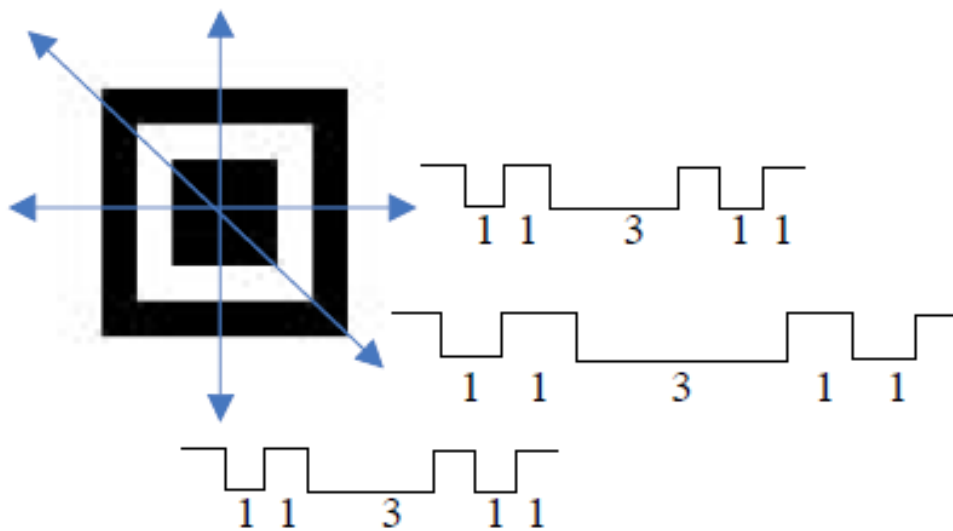
A: 3 modules

B: 5 modules

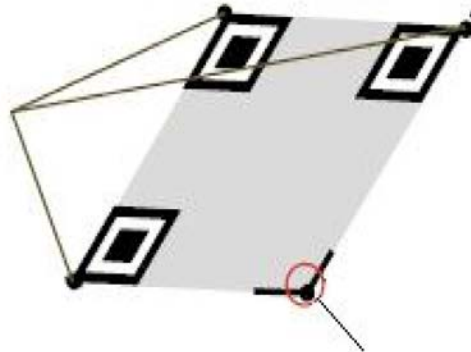
C: 7 modules



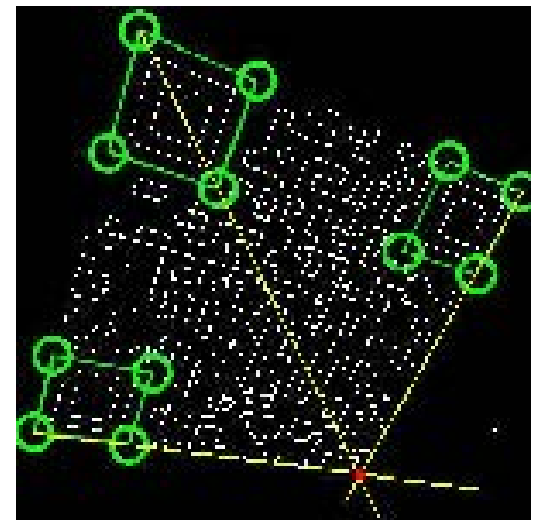
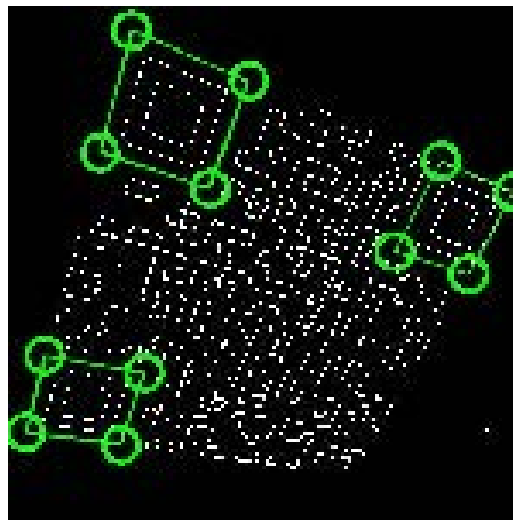
即使拍照時沒對正也能找到



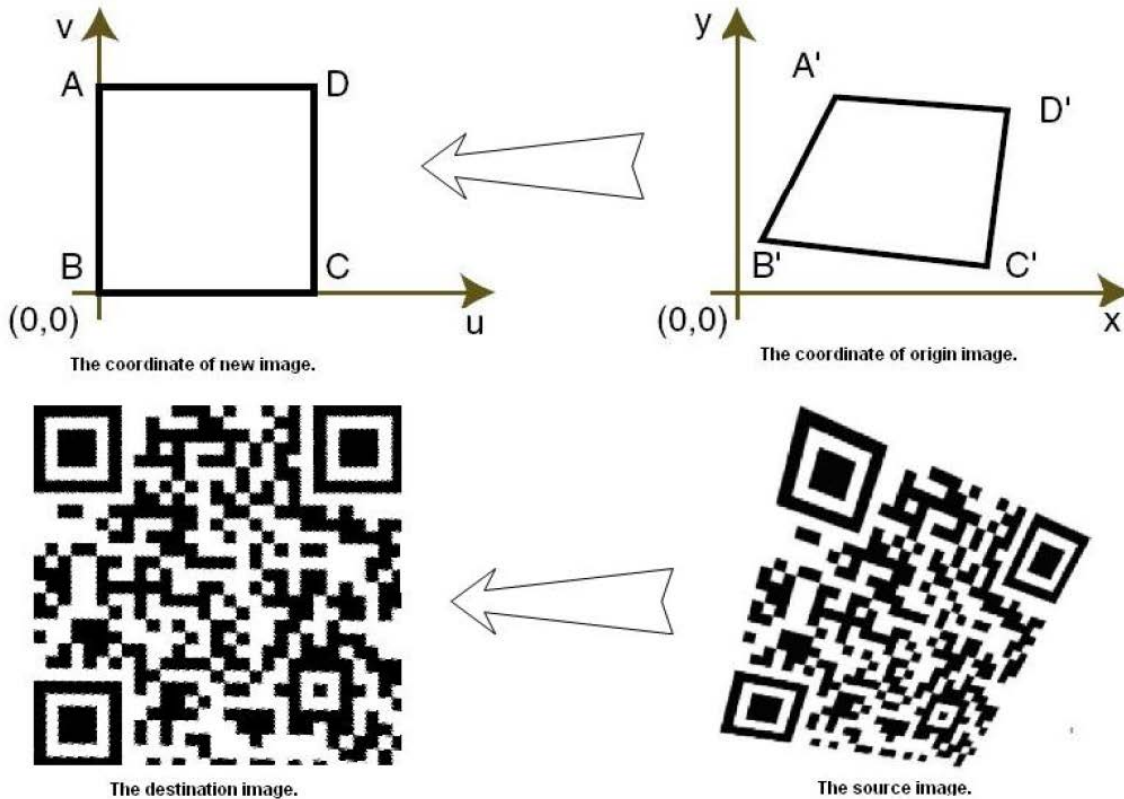
Three real existing corner points.

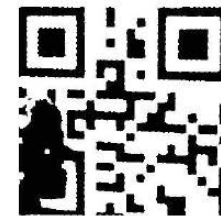


This corner point is usually a virtual one.



Inverse perspective transformation





(a)

(b)

(c)



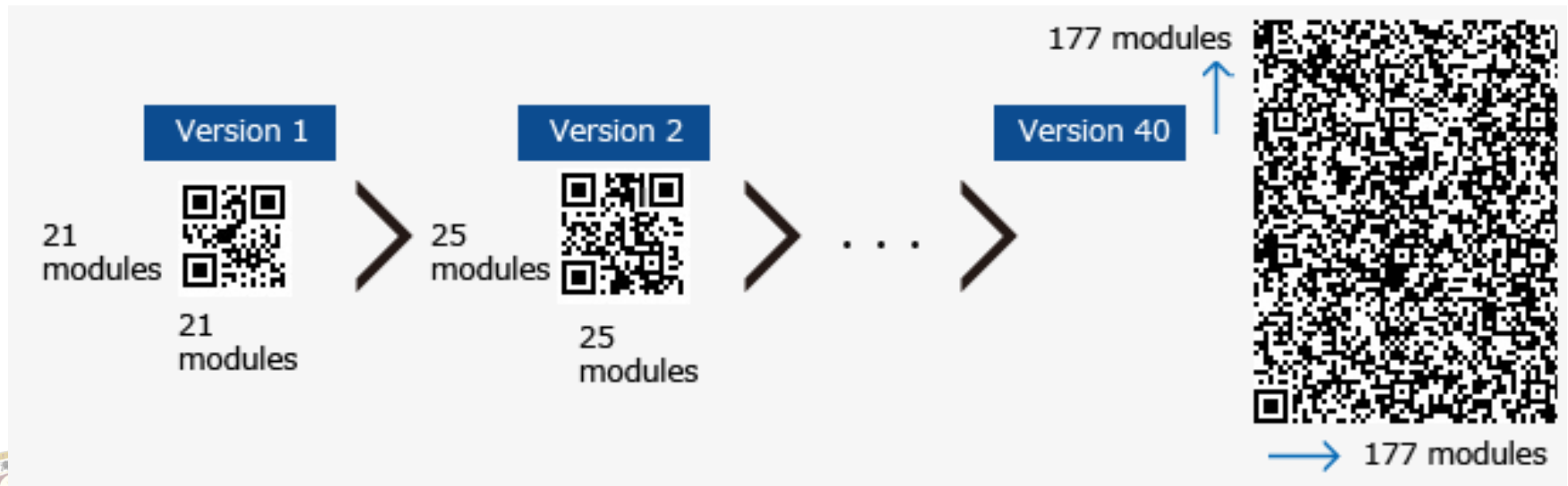
Alignment Pattern



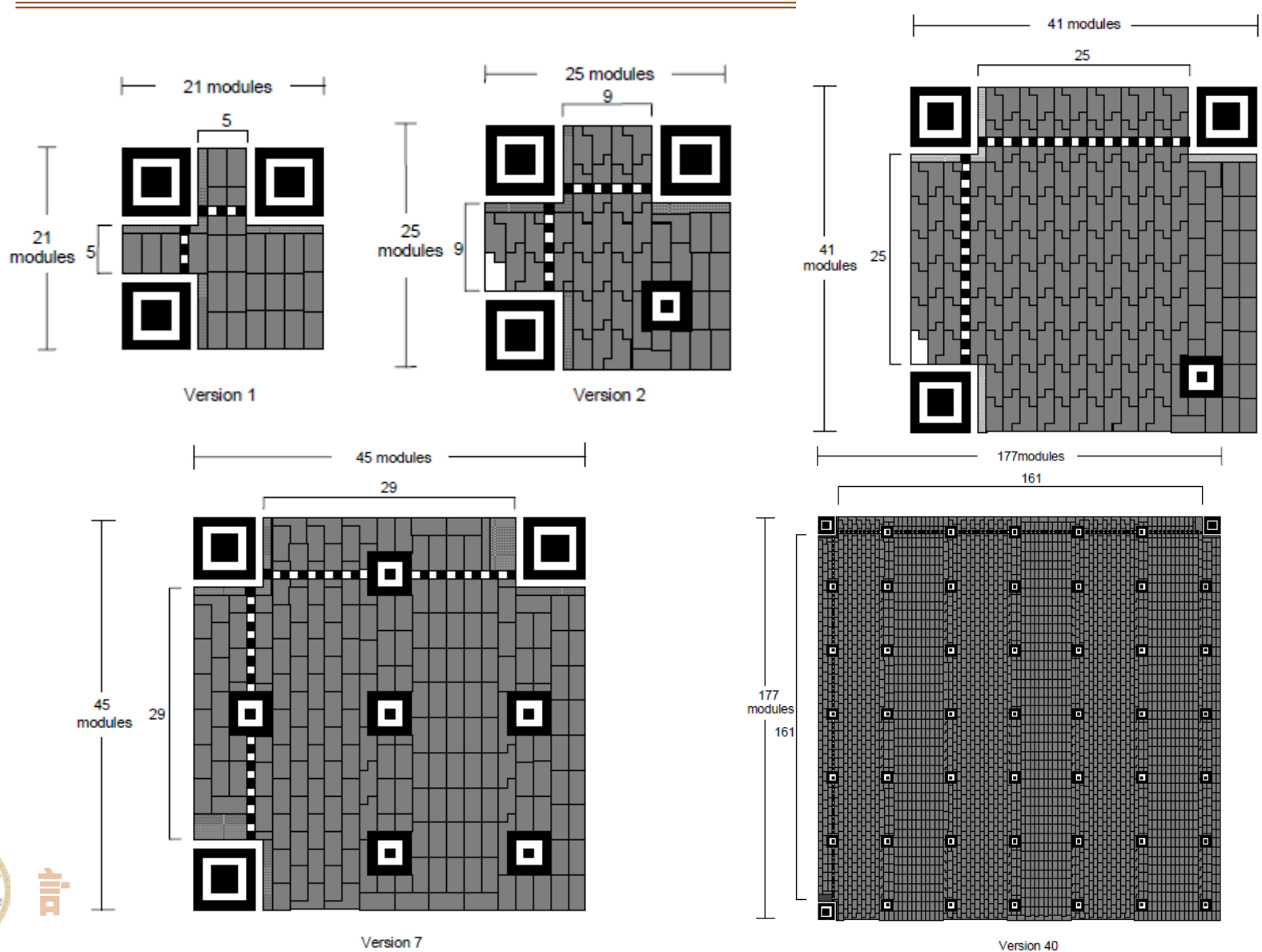
各種不同的版本

■ 共 40 個 Version

- 最小 Version 1 (21×21 modules)
- 最大 Version 40 (177×177 modules)
- 每1個 Version 增加 4 個 modules



各種不同的版本

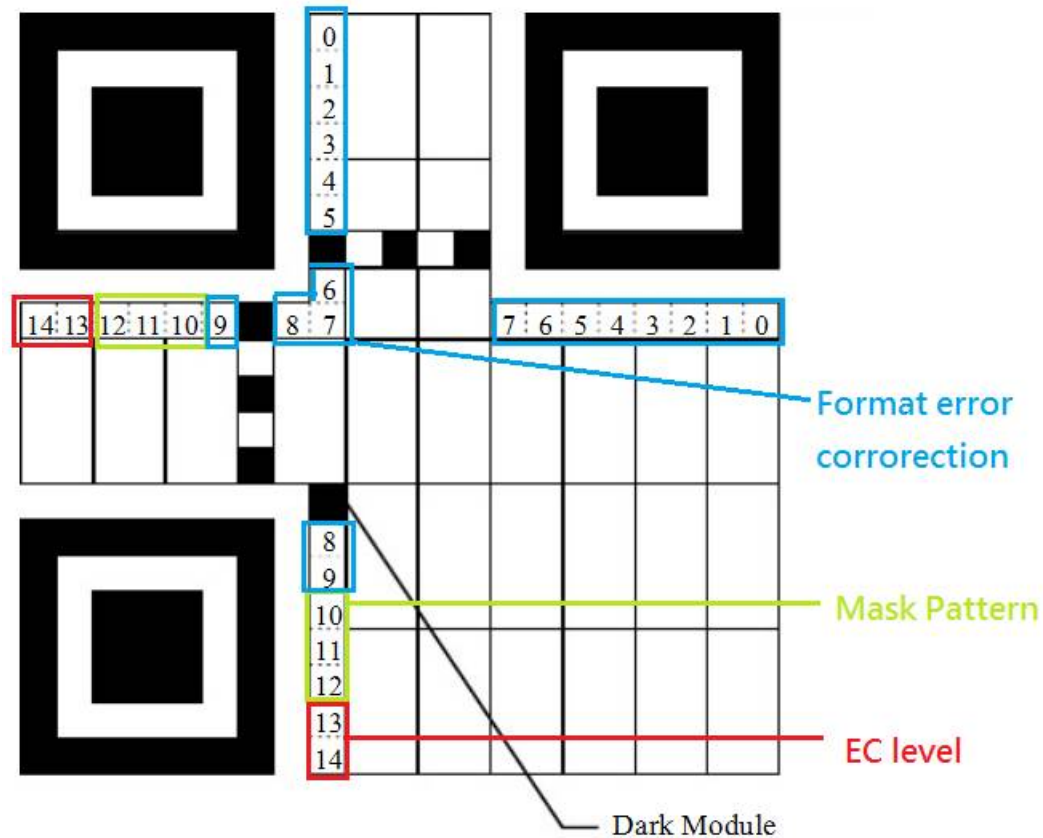


音

Version 7

Version 40

QR Code 資訊位置



EC LEVEL Mask pattern

Format error correction



容錯等級

二進制表示	容錯等級	容錯率
01	L	7%
00	M	15%
11	Q	25%
10	H	30%



QR Code資料容量

資料型別	編號位元串例	可儲存容量
數字	0001	7089字元
英數字	0010	4296字元
位元組	0100	2953字元
日語漢字	1000	1817字元



英數字

Char.	Value	Char.	Value	Char.	Value	Char.	Value	Char.	Value	Char.	Value	Char.	Value	Char.	Value
0	0	6	6	C	12	I	18	O	24	U	30	SP	36	.	42
1	1	7	7	D	13	J	19	P	25	V	31	\$	37	/	43
2	2	8	8	E	14	K	20	Q	26	W	32	%	38	:	44
3	3	9	9	F	15	L	21	R	27	X	33	*	39		
4	4	A	10	G	16	M	22	S	28	Y	34	+	40		
5	5	B	11	H	17	N	23	T	29	Z	35	-	41		

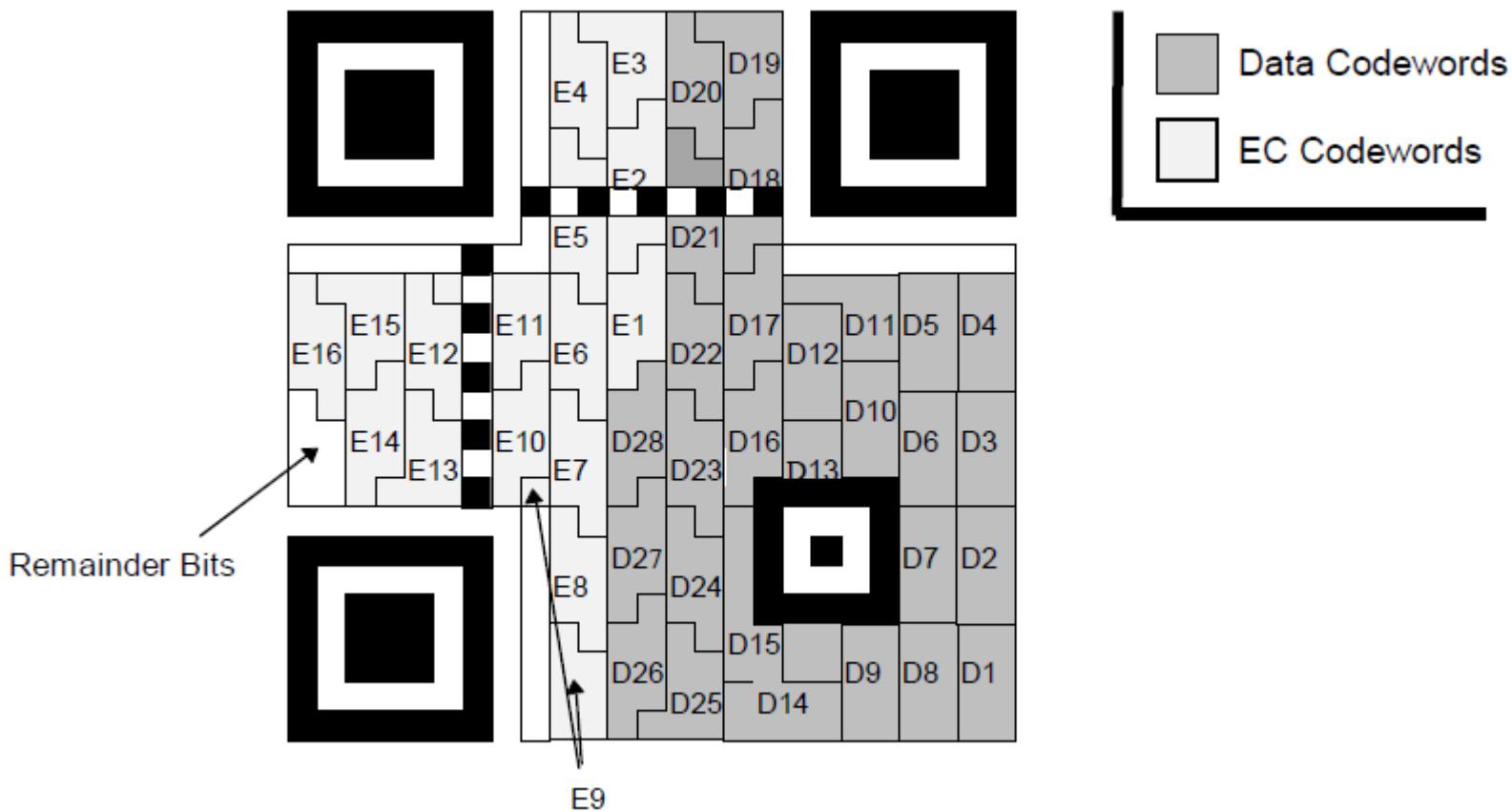


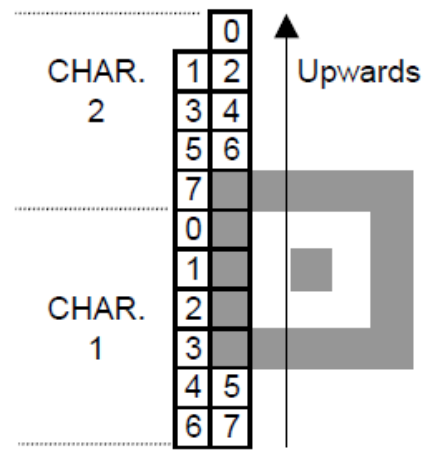
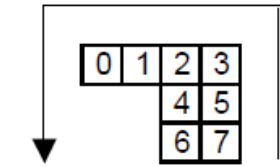
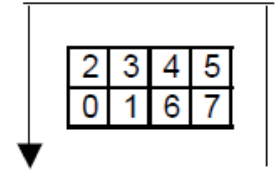
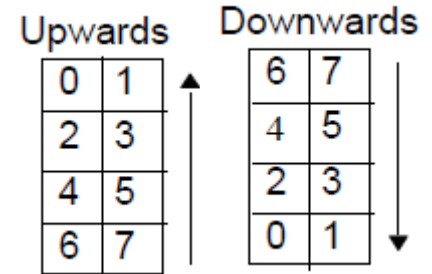
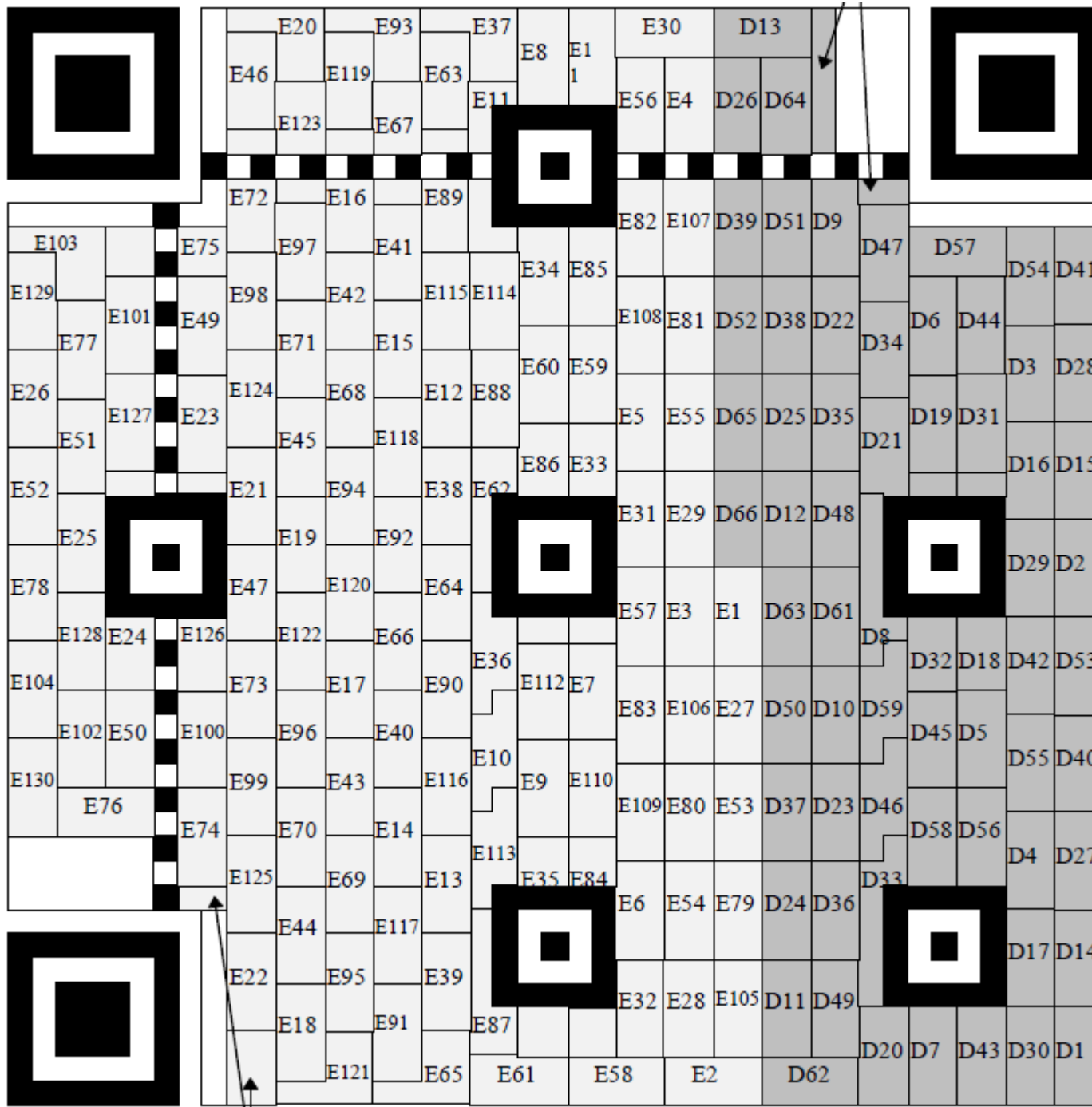
資料區及錯誤修正區排列

	Data codewords					Error correction codewords				
Block 1	D_1	D_2	.....	D_{11}		E_1	E_2	.....	E_{22}
Block 2	D_{12}	D_{13}	.....	D_{22}		E_{23}	E_{24}	.....	E_{44}
Block 3	D_{23}	D_{24}	.....	D_{33}	D_{34}	E_{45}	E_{46}	.....	E_{66}
Block 4	D_{35}	D_{36}	.....	D_{45}	D_{46}	E_{67}	E_{68}	.....	E_{88}



QR Code 資料區塊排列





實際例子

Content: 20160329

Mode: 0001

Length: 0000001000

Data: 0011001001 1001011011 0011101

terminator: 0000

padding to 8 bits: 000

pad codewords: 11101100 00010001

D1=00010000

D2=00100000

D3=11001001

D4=10010110

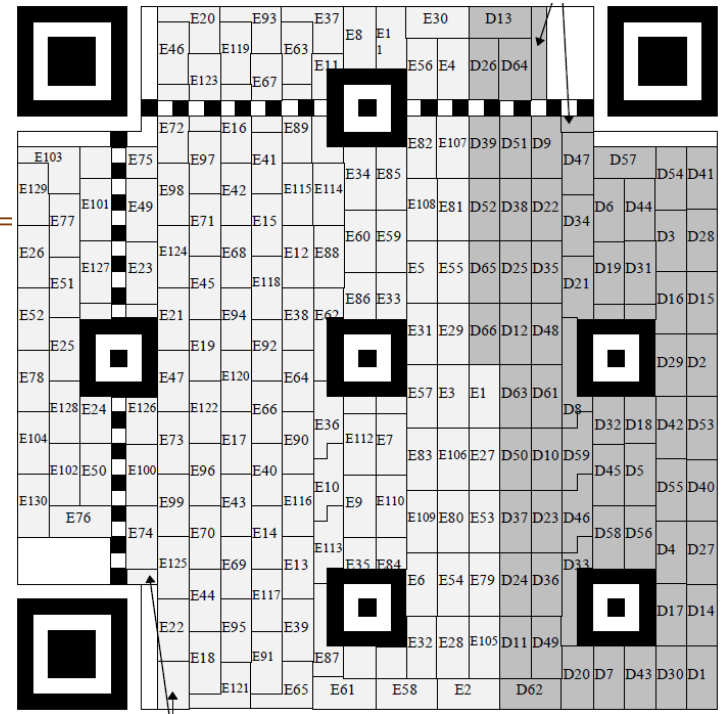
D5=11001110

D6=10000000

D7=11101100

D8=00010001

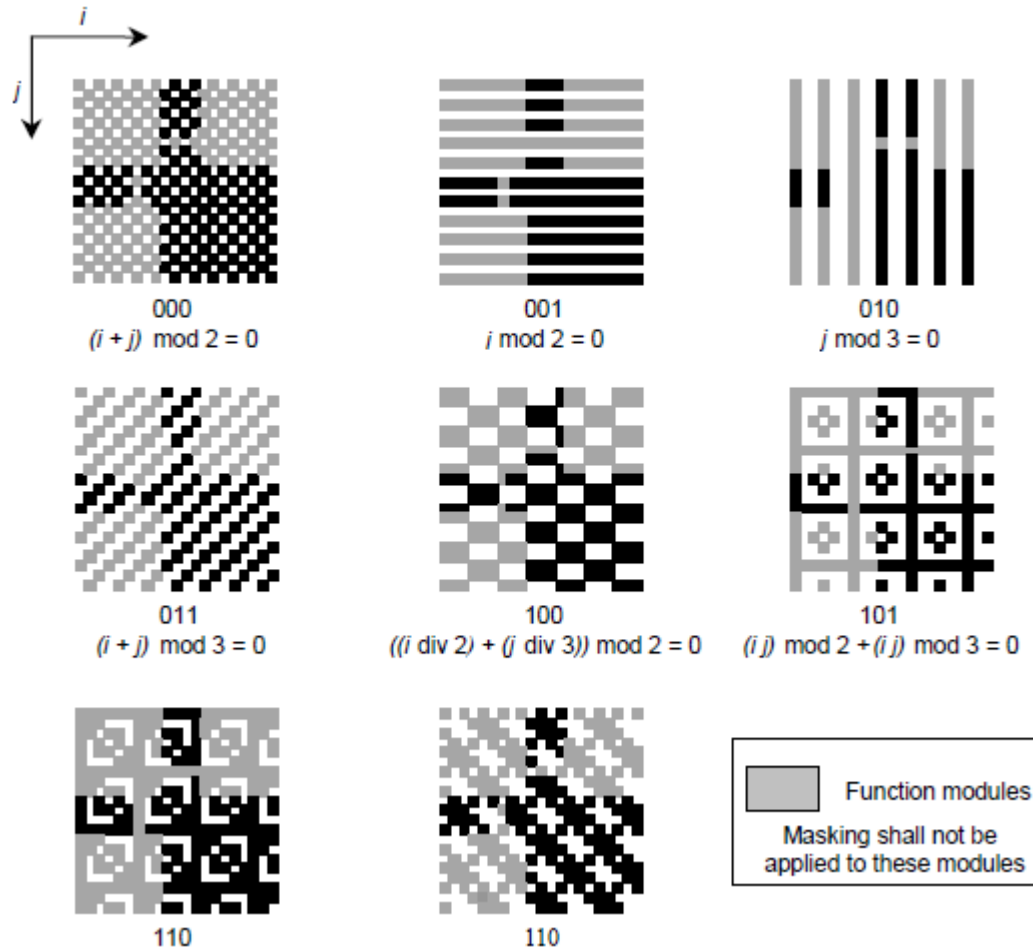




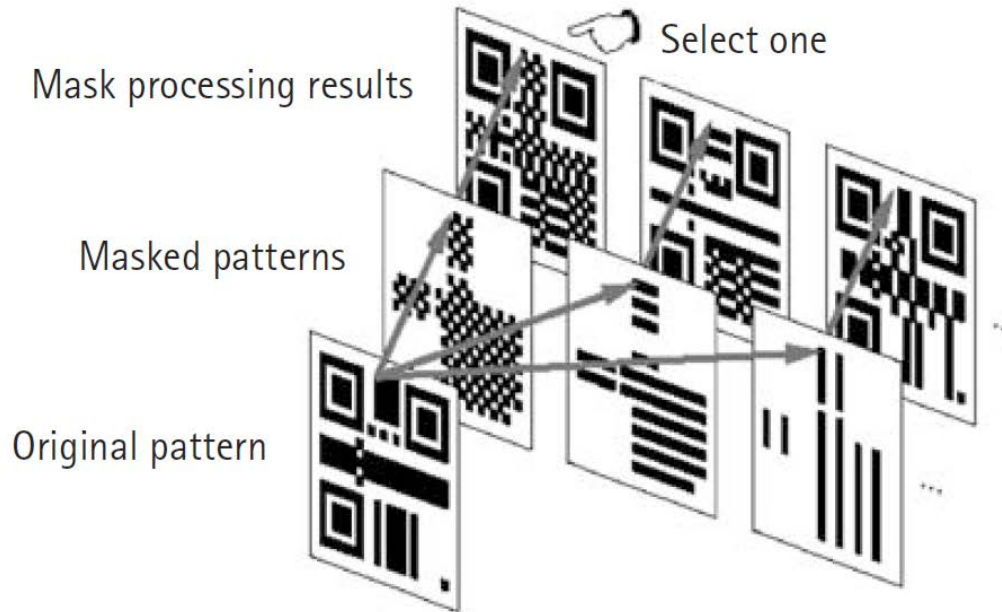
- D1=00010000
- D2=00100000
- D3=11001001
- D4=10010110
- D5=11001110
- D6=10000000
- D7=11101100
- D8=00010001

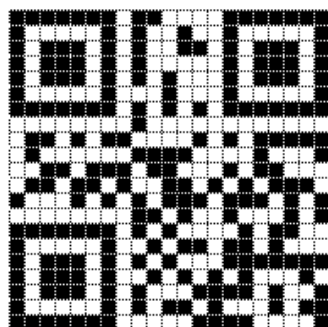


Mask Pattern

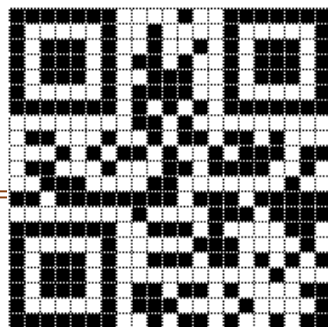


Mask Pattern

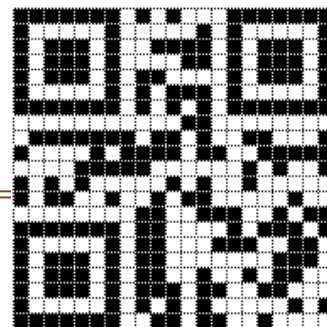




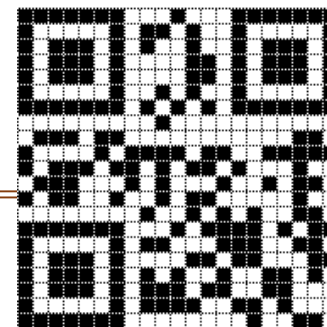
Mask Pattern 0
 Penalty 1: 180
 Penalty 2: 90
 Penalty 3: 80
 Penalty 4: 0
 Total: 350



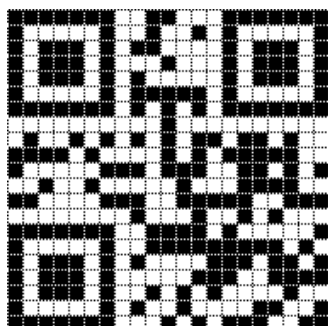
Mask Pattern 1
 Penalty 1: 172
 Penalty 2: 129
 Penalty 3: 120
 Penalty 4: 0
 Total: 421



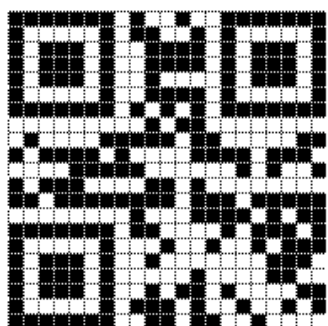
Mask Pattern 2
 Penalty 1: 206
 Penalty 2: 141
 Penalty 3: 160
 Penalty 4: 0
 Total: 507



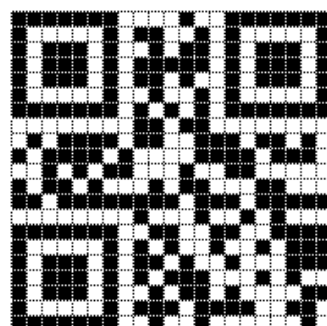
Mask Pattern 3
 Penalty 1: 180
 Penalty 2: 141
 Penalty 3: 120
 Penalty 4: 2
 Total: 443



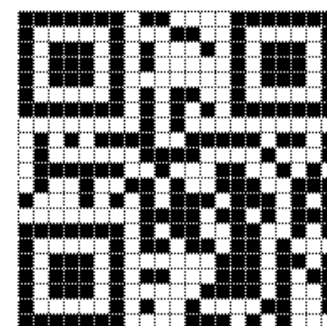
Mask Pattern 4
 Penalty 1: 195
 Penalty 2: 138
 Penalty 3: 200
 Penalty 4: 0
 Total: 553



Mask Pattern 5
 Penalty 1: 189
 Penalty 2: 156
 Penalty 3: 200
 Penalty 4: 2
 Total: 547



Mask Pattern 6
 Penalty 1: 171
 Penalty 2: 102
 Penalty 3: 80
 Penalty 4: 4
 Total: 357














Mask Pattern 7
 Penalty 1: 197
 Penalty 2: 123
 Penalty 3: 200
 Penalty 4: 0
 Total: 520



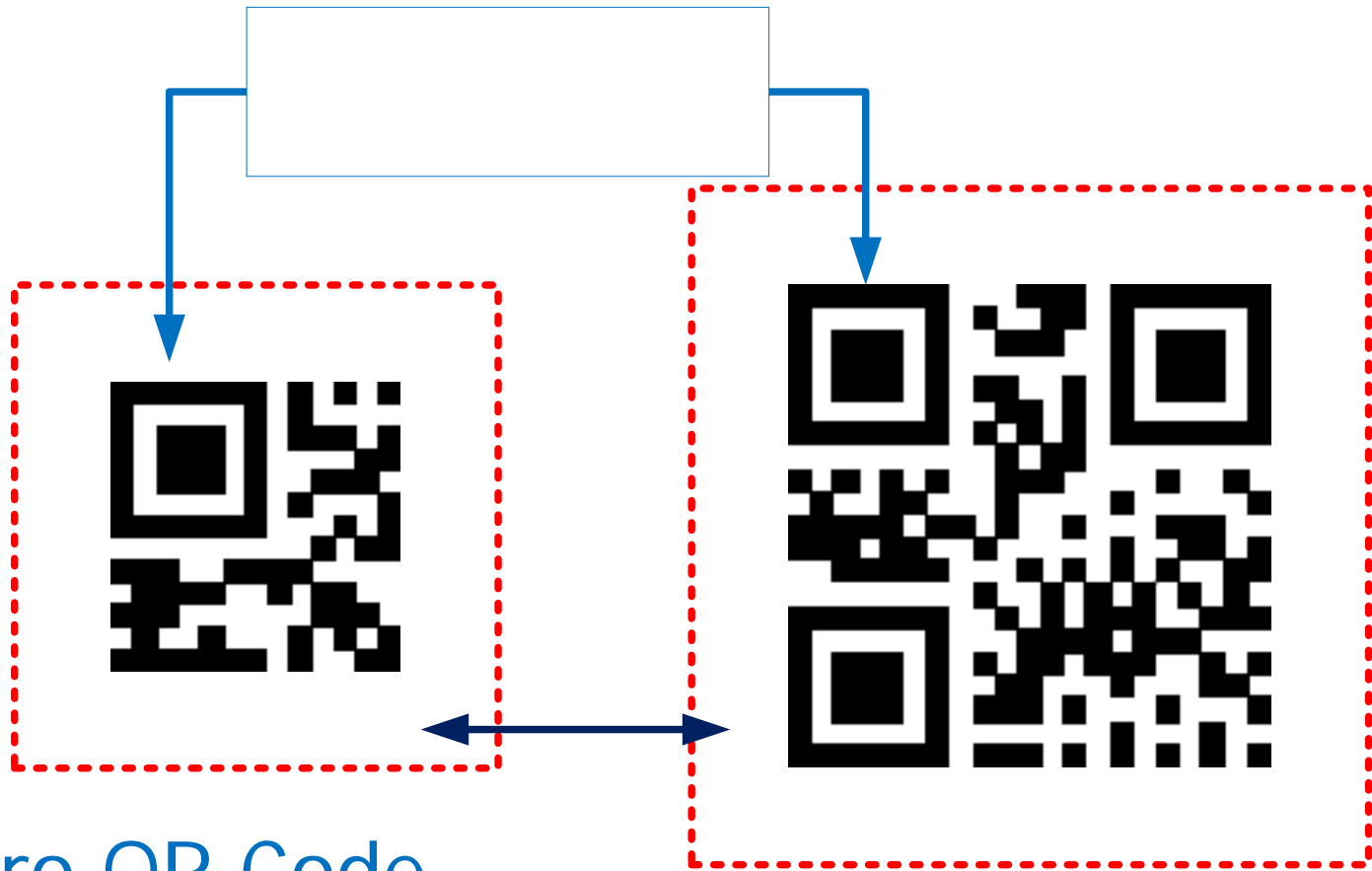
QR-Code 的發展

- Micro QR Code (1998)
- Security QR Code (2007)
- iQR Code (2008)

 QR Code Model 1 and Model 2	 Micro QR Code	 iQR Code	 SQRC	 Frame QR
		 		



Micro QR Code



Micro QR Code

QR Code



SQRC

■ Security QR Code



1. 一般 QR Code



2. Security QR Code



SQRC 應用

①發出腕帶

在入院時發出一個含有SQRC的腕帶



②手術時身份核對

口頭確認困難時，做更進一步的核對

③用藥指示

防止用藥錯誤



SQRC內容編碼

編號：900177

名稱：洪阿滿

性別：女

年齡：55

血型：B

加解密部分



iQR Code

	iQR Code	QR Code (Micro QR)
Type	Square, Rectangle	Square
Version	Square : 1(9x9 Cell)~61(422x422 Cell)	QR Code: 1(21x21 Cell)~40(177x177 Cell)
	Rectangle : R1(5x19 Cell)~R15(43x131 Cell)	Micro QR: M1(11x11 Cell)~M4(17x17 Cell)
Incorrection Modification	L(7%),M(15%),Q(25%),H(30%), S(50%)	L(7%),M(15%),Q(25%),H(30%)
Character	Numeric,Alphabet, Text (Mode A/B/C), Kanji,Binary	Numeric, Alphabet, Kanji, Binary
Combination	16 Division (Only Square)	16 Division (Only QR Code)
Type	Square, Rectangle	Square
Special Code	Two Sides Inversion , White Black Inversion, Dot Pattern	White Black Inversion, Dot Pattern
Others	GS1 Support , Data Compression	GS1 Support
Margin	2 Cell	4 Cell(Micro QR: 2 Cell)



iQR Code

Store **more information** with same size as current QR code

QR Code



Numeric 34 Digit



iQR Code



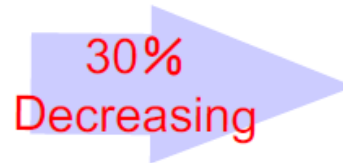
Numeric 63 Digit

Print **less space** with same sized information

QR Code



25 X 25 Cell



iQR Code



21 X 21 Cell



iQR Code

- 矩形的設計可將 iQRCode 印製在原來 barcode 的位置，或是印製在圓柱體上

<Rectangle Code>



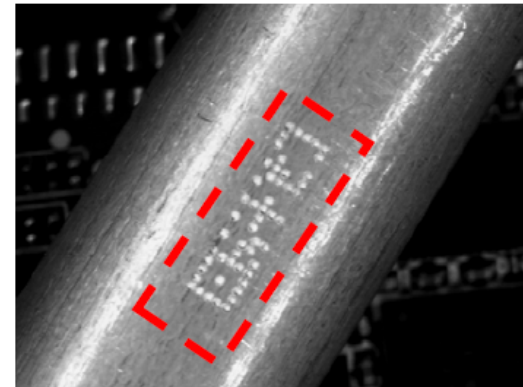
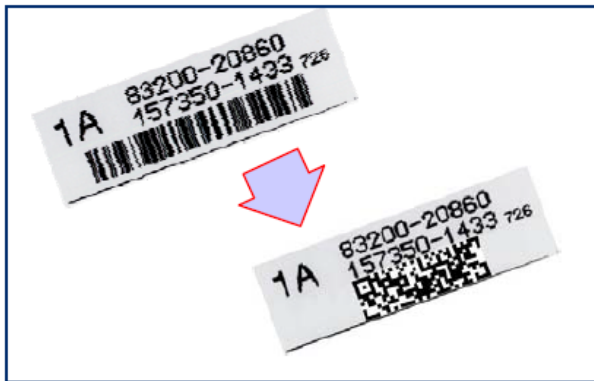
5 X 19 Cell



7 X 29 Cell



13 X 35 Cell



Beautify QR Code



(a)



(b)



(c)



(d)



(e)



(f)



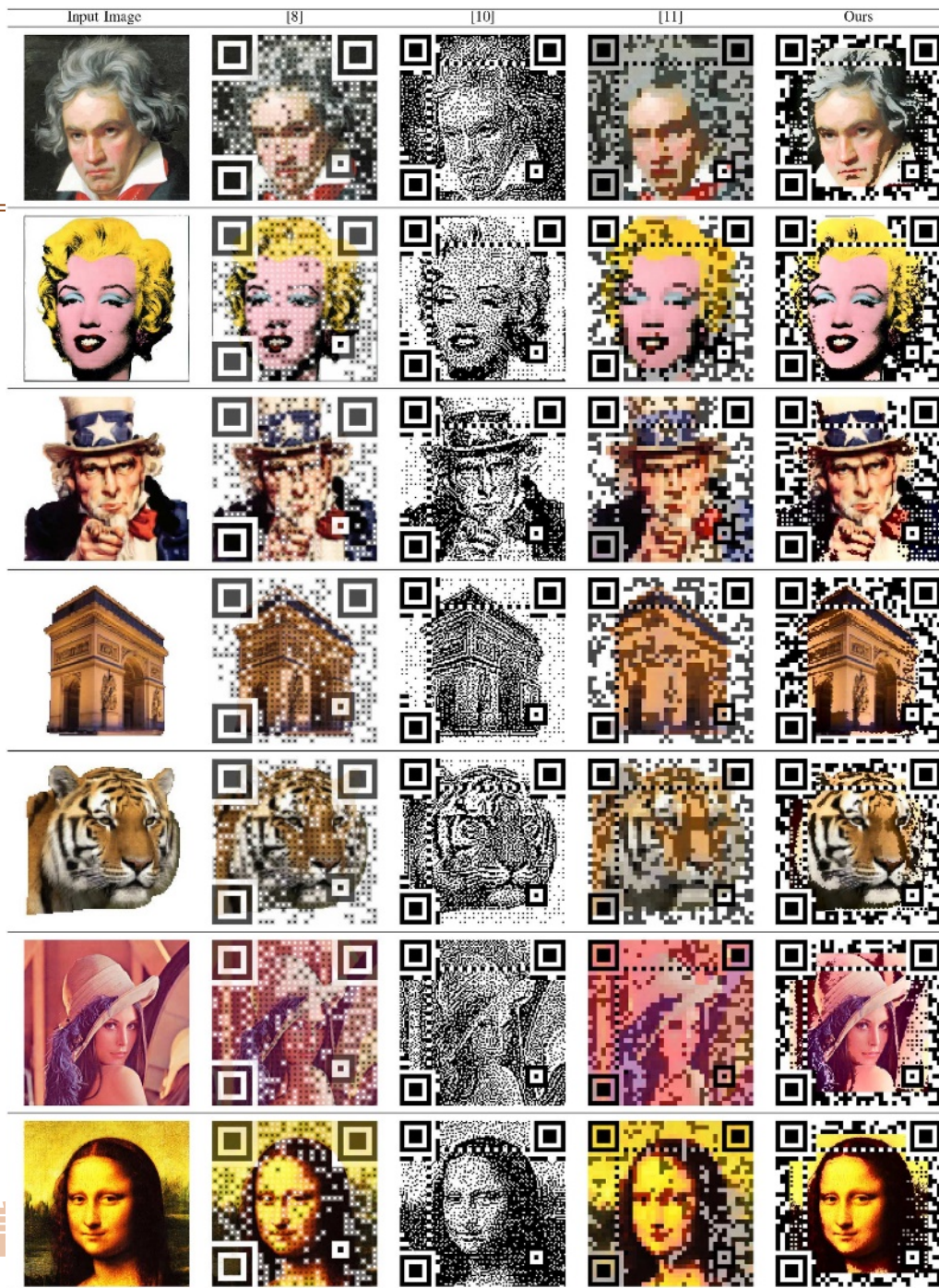
Beautify QR Code

Changing Module Shape/Color



Embedding a Picture





作業一



計算機概論

作業一

- 請以QR Code 介紹一個新的軟體、新的網路服務或構想未來QR Code的前瞻性應用
- 內容如下
 1. 官方網址
 2. 軟體名稱
 3. 介紹文字 (可中文或英文)
字數不限



作業一 - 內容格式

- 將上的介紹文字內容以下面的格式製作成QR Code

```
[網址] http://xxxxx/  
[名稱] XXXXXX  
[介紹] XXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```



作業一 - 繳交方式

■ 上傳網址：

- <https://goo.gl/2XUsYX>

2017 計算機概論

作業一上傳網址，截止時間 2017/04/10 23:59

學號 Student ID *必填 required

請將說明文字儲存成 *.txt 檔後上傳 *必填 required

選擇檔案 未選擇任何檔案

將製作 QR code 的圖檔儲存成 *.jpg 或 *.png 上傳 *必填 required

選擇檔案 未選擇任何檔案

上傳



計算機概論

作業評分方式

- 評分時會將所繳交的 QR Code 顯示在螢幕上，然後再用智慧型手機拍攝，看是否能讀的出內容。
- 分數依據：
 - 內容：所介紹的內容敘述
 - 美化：美化的可看性



QRCode Generator

- <https://goo.gl/DQneUc>

Create your QR code

URL Text Phone WiFi

Website (URL)

http://www.example.www

QR Code Size



Error Correction Label

L M Q H

Border size

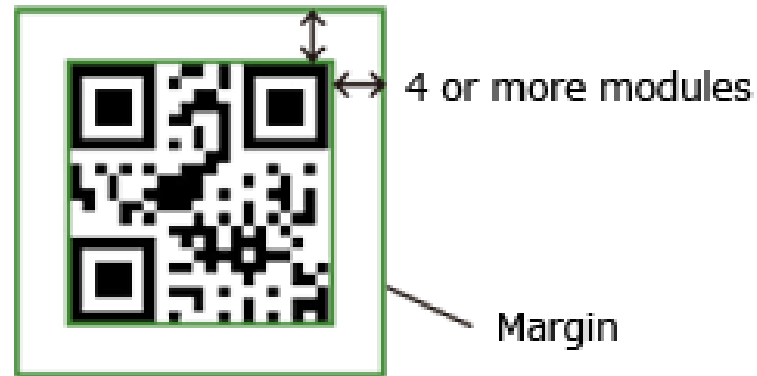
0 1 2 3 4 5



設計原則

Margin of QR Code

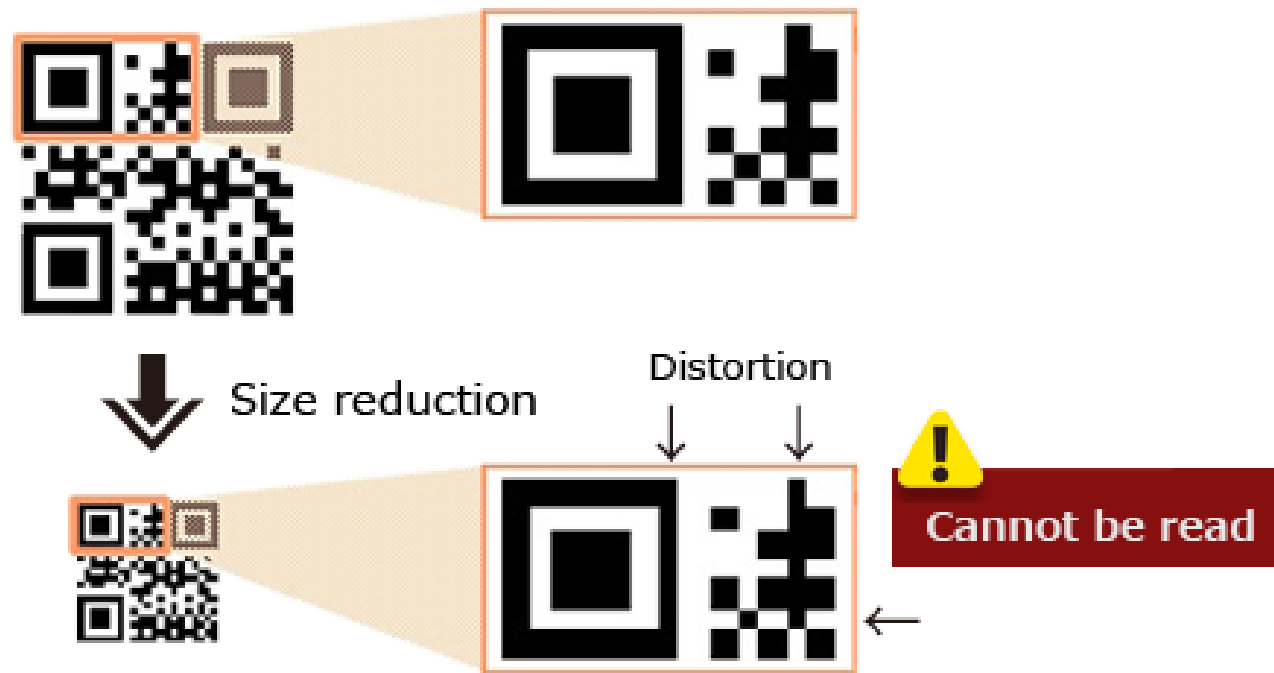
4 or more modules



4-module wide margin is required around a symbol.



設計原則



設計原則



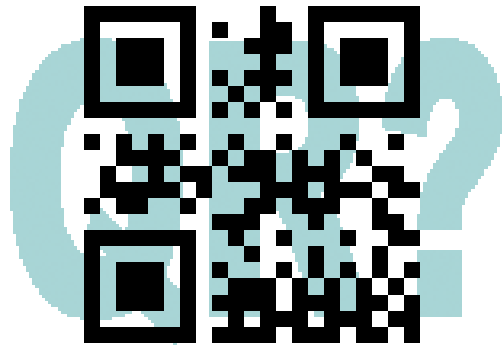
Cannot be read



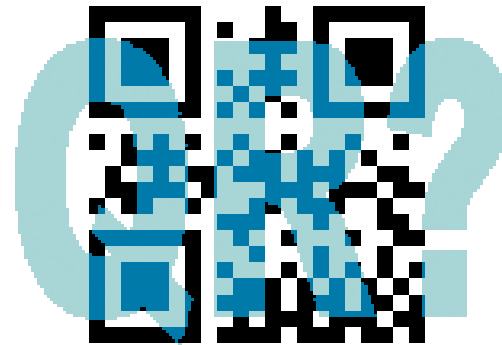
Cannot be read



設計原則



Cannot be read



Cannot be read



線上製作QR-Code

■ 彩色QR code產生器

- <http://color.quickmark.com.tw/>



■ QRHacker

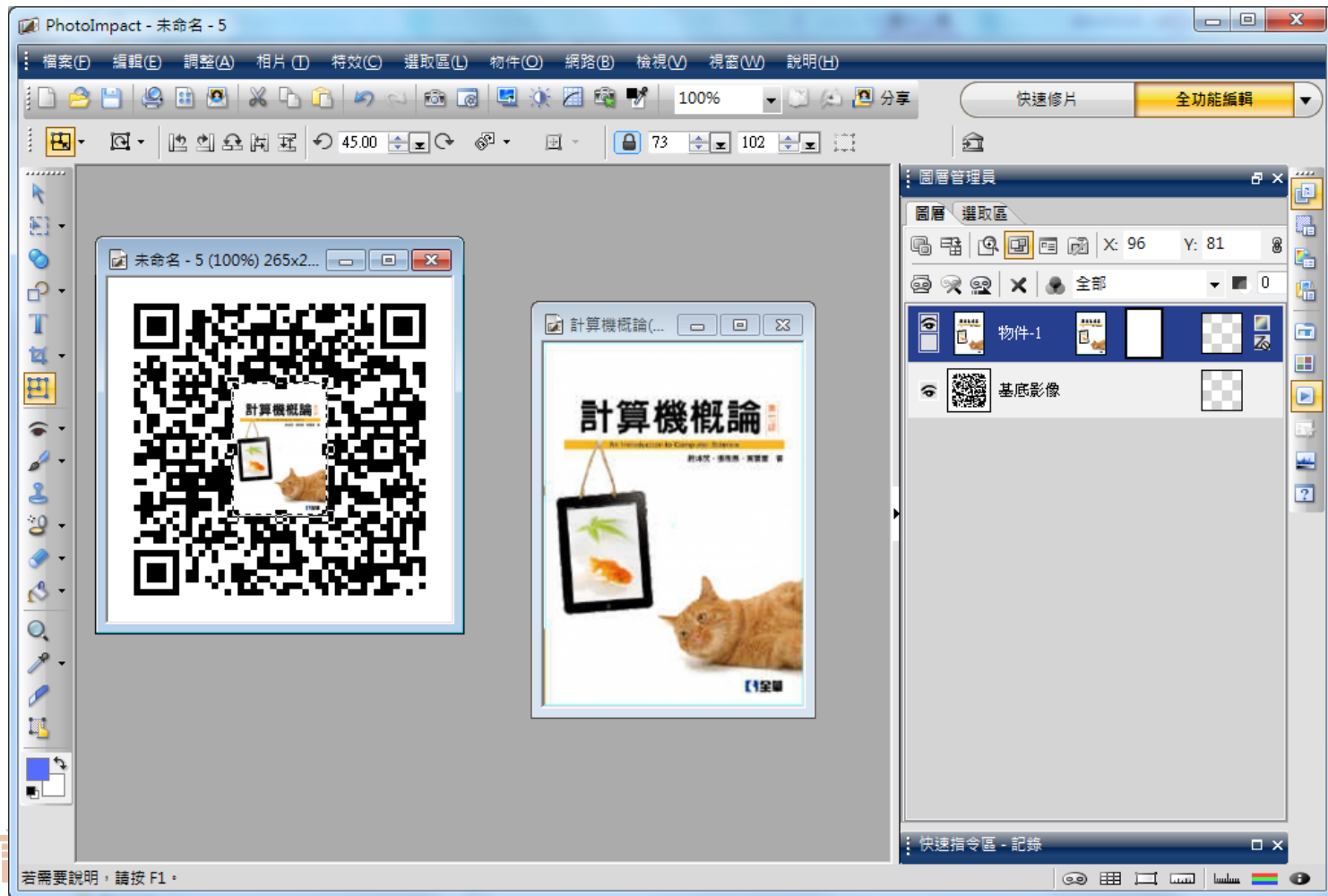
- <http://www.qrhacker.com/>



PhotoImpact

<http://download.cc.ntu.edu.tw>

請用學校信箱登入



Reference

1. ISO/IEC 18004:2006,
http://www.iso.org/iso/catalogue_detail?csnumber=43655
2. A Sun, Y Sun, C Liu, *The QR-code reorganization in illegible snapshots taken by mobile phones*, ICCSA 2007, 2007
3. Y-H Chang, C-H Chu and M-S Chen, A General Scheme for Extracting QR Code from a non-uniform background in Camera Phones and Applications, IEEEISM, 2007
4. SAMRETWIT and WAKAHARA, *Measurement of Reading Characteristics of Multiplexed Image in QR Code*, INCoS 2011, 2011
5. Garateguy, Arce, Lau and Villarreal, *QR Images: Optimized Image Embedding in QR Codes*, IEEE Trans. Image Process, 2014
6. S-S Lin, M-C Hu, C-H Lee and T-Y Lee, Efficient QR Code Beautification With High Quality Visual Content, IEEE Trans. Multimedia, 2015

