

Solutions

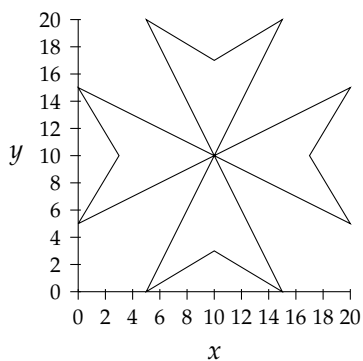
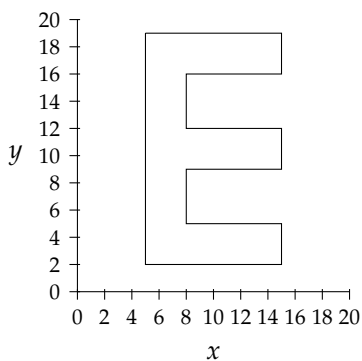
Chapter 1

1

For the diamond, if we start on the left hand side, we have $(2,10)$ — $(10,18)$ — $(18,10)$ — $(10,2)$ — $(2,10)$. For the star, if we start at the bottom left point, we have $(3,3)$ — $(10,19)$ — $(17,3)$ — $(1,13)$ — $(19,13)$ — $(3,3)$.

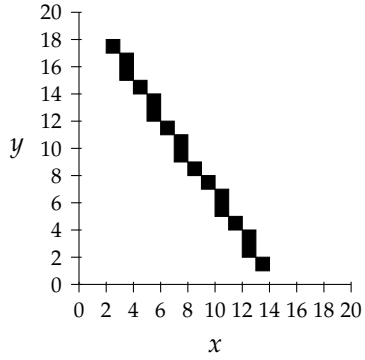
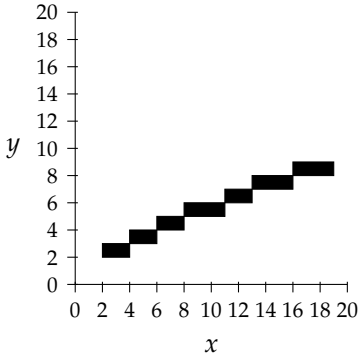
2

We see a crude representation of the letter E, and the Maltese cross.



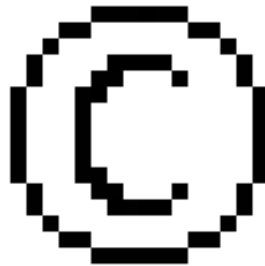
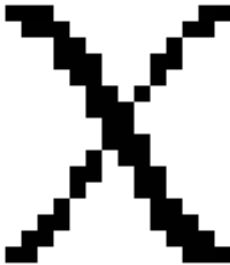
3

For example:



4

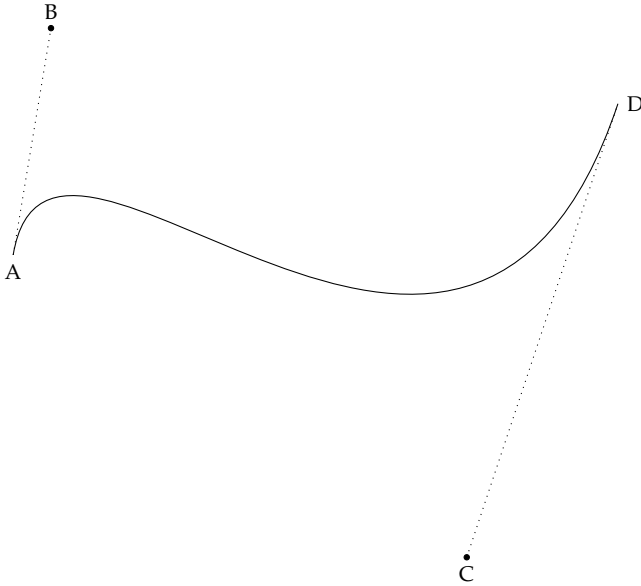
For example:



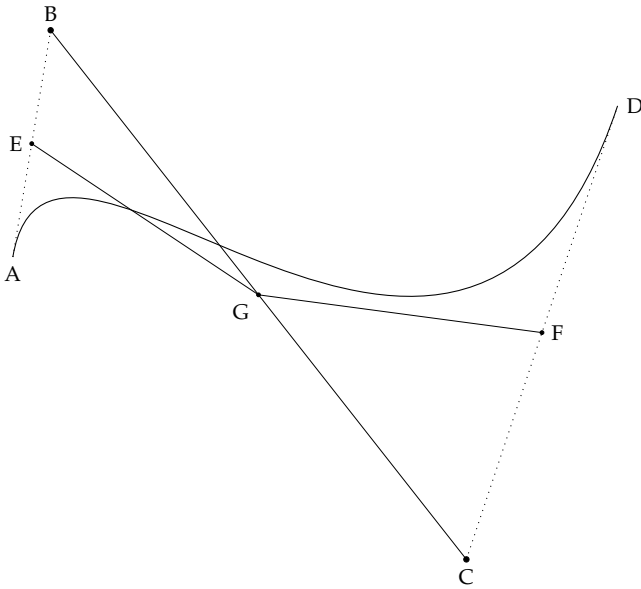
Chapter 2

1

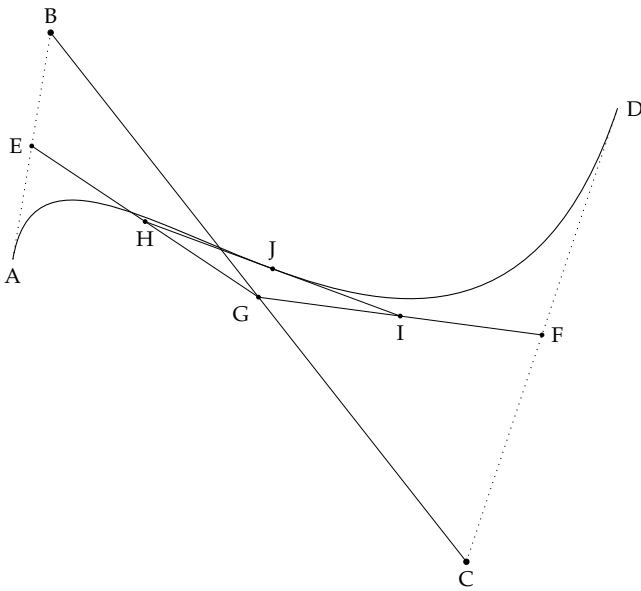
We assign the letters ABCD as in the chapter text:



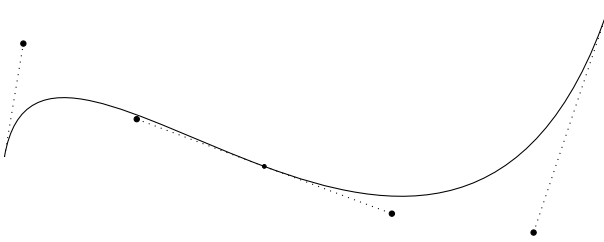
Now, we continue the construction as before, making sure we are not confused by the fact that the line BC now crosses the curve:



Finally, we finish the construction all the way to J, so our diagram looks like this:



So we have the new Bézier curves AEHJ and JIFD as before:



3

With the even-odd rule:



With the non-zero rule:



Chapter 3

1

32-11-42-54-23-11-14-11-31-24-44-44-31-15-31-11-32-12. There are 18 characters in the message, and so 36 numbers to transmit (though in Polybius's system of torches, these would be done two at a time, so just 18 distinct actions). We might use Z for the space character, since it doesn't appear often in normal text. We could use ZZZ for end of message.

2

We have 32 rows:

Bits	Number	Letter	Bits	Number	Letter
00000	0	A	10000	16	Q
00001	1	B	10001	17	R
00010	2	C	10010	18	S
00011	3	D	10011	19	T
00100	4	E	10100	20	U
00101	5	F	10101	21	V
00110	6	G	10110	22	W
00111	7	H	10111	23	X
01000	8	I	11000	24	Y
01001	9	J	11001	25	Z
01010	10	K	11010	26	<i>space</i>
01011	11	L	11011	27	.
01100	12	M	11100	28	,
01101	13	N	11101	29	:
01110	14	O	11110	30	;
01111	15	P	11111	31	?

Here, we choose the capital letters and the punctuation *space* . , ; ? and hope this covers most useful messages.

3

Treason is very much a matter of habit, Smiley decided.

4

84 104 101 109 111 114 101 105 100 101 110 116 105 116 105 101 115
 97 109 97 110 104 97 115 44 116 104 101 109 111 114 101 116 104 101
 121 101 120 112 114 101 115 115 116 104 101 112 101 114 115 111 110
 116 104 101 121 99 111 110 99 101 97 108 46

5

a) The love of money is the root of *all* evil.

- b) The love of `\$\$\$` is the root of all evil.
- c) The love of `$$\$\$` is the root of all evil.
- d) The love of `*\$\$\$\$*` is the root of all evil.

Chapter 4

1

- a) The pattern does not match.
- b) The pattern matches at position 17.
- c) The pattern matches at positions 28 and 35.
- d) The pattern matches at position 24.

2

- a) The texts aa, aaa, and aaa etc. match.
- b) The texts ac and abc only match.
- c) The texts ac, abc, and abbc etc. match.
- d) The texts ad, abd, acd, abbd, accd, abcd, acbd, and abbbd etc. match.

3

- a) The pattern matches at positions 16 and 17.
- b) The pattern matches at positions 0 and 24.
- c) The pattern matches at positions 0, 1, 24, and 25.
- d) The pattern matches at positions 0, 1, 24, and 25.

Chapter 6

1

Letter	Frequency	Code	Letter	Frequency	Code
<i>space</i>	41	111	u	5	110100
e	18	100	v	4	110011
o	14	1011	w	4	110010
t	14	0111	f	4	110001
a	13	0110	'	4	010111
h	12	0100	y	3	010101
r	11	0011	.	3	01010000
n	11	0010	,	3	01010001
s	10	0000	p	2	01010010
i	9	11011	I	2	01010011
c	8	10101	q	1	01011000
m	6	10100	E	1	01011001
l	6	00011	S	1	01011010
g	6	110101	T	1	01011011

So we have:

```

'      I          h  a  v     e     a
010111 01010011 111 0100 0110 110011 100 111 0110 111
t  h  e  o  r  y          w  h  i
0111 0100 100 1011 0011 010101 111 110010 0100 11011
c  h          I          s  u          s  p
10101 0100 111 01010011 111 0000 110100 0000 01010010
e  c  t          i  s          r  a  t  h
100 10101 0111 111 11011 0000 111 0011 0110 0111 0100
e  r          i  m  m  o  r  a  l
100 0011 111 11011 10100 10100 1011 0011 0110 00011
,          '          S          m  i  l  e  y
01010001 010111 111 01011010 10100 11011 00011 100 010101
w          e  n  t          o  n  ,
111 110010 100 0010 0111 111 1011 0010 01010001 111
m  o  r  e          l  i  g  h  t
10100 1011 0011 100 111 00011 11011 110101 0100 0111
l  y          .
00011 010101 01010000

```


2

There are moments which are made up of too much stuff for them to be lived at the time they occur.

3

The lengths and colours are:

Colour	Length	Code	Colour	Length	Code
White	37	00010110	White	10	00111
White	5	1100	White	2	0111
Black	2	11	Black	8	000101
White	7	1111	White	3	1000
Black	7	00011	Black	2	11
White	7	1111	White	5	1100
Black	6	0010	Black	3	10
White	3	1000	White	2	0111
White	4	1011	Black	2	11
Black	4	011	White	10	00111
White	5	1100	White	2	0111
Black	9	000100	Black	8	000101
White	4	1011	White	3	1000
Black	9	000100	Black	2	11
White	2	0111	White	6	1110
White	4	1011	Black	2	11
Black	4	011	White	2	0111
White	5	1100	Black	2	11
Black	2	11	White	7	1111
White	5	1100	Black	2	11
Black	3	10	White	1	0000111
White	3	1000	White	1	0000111
Black	2	11	Black	3	10
White	5	1100	White	4	1011
Black	3	10	Black	3	10
White	1	0000111	White	2	0111
White	4	1011	Black	2	11

Black	5	0011	White	6	1110
White	4	1011	Black	2	11
Black	2	11	White	2	0111
White	6	1110	Black	3	10
Black	2	11	White	6	1110
White	2	0111	Black	2	11
Black	2	11	White	1	0000111
White	7	1111	White	1	0000111
Black	2	11	Black	2	11
White	1	0000111	White	6	1110
White	3	1000	Black	2	11
Black	2	11	White	2	0111
White	2	0111	Black	2	11
Black	2	11	White	6	1110
White	4	1011	Black	2	11
Black	2	11	White	3	1000
White	5	1100	Black	2	11
Black	3	10	White	5	1100
White	2	0111	Black	3	10
Black	2	11	White	1	0000111
White	10	00111	White	1	0000111
White	3	1000	Black	2	11
Black	2	11	White	6	1110
White	2	0111	Black	3	10
Black	2	11	White	1	0000111
White	4	1011	Black	10	0000100
Black	9	000100	White	3	1000
White	3	1000	Black	9	000100
Black	2	11	White	2	0111
White	10	00111	Black	2	11
White	2	0111	White	8	1011
Black	3	10	Black	2	11
White	2	0111	White	2	0111
Black	3	10	Black	7	00011
White	3	1000	White	6	1110

Black	9	000100	Black	7	00011
White	3	1000	White	3	1000
Black	2	11	White	37	00010110

So we have:

```
000101101100111111000111111001010001011011110000010
010110001000111101101111001111001010001111001100001
110110011101111110110111111111100001111000110111
010101111110010011111001111000110111111011000100100
011001110111100111101000000100100011001110111000101
100011111011011111111111000011100001111010111010111
11110111000111110110000111000011111110110111111110
111000111100100000111000011111111010000011100001011
000000100011111101111011100011111000010110000001011
0
```

4

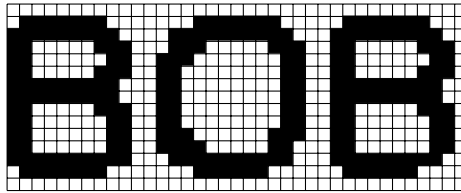
The codes are:

Code	Length	Colour	Code	Length	Colour
00010110	37	White	000100	9	Black
0000111	1	White	0111	2	White
00011	7	Black	11	2	Black
1111	7	White	1100	5	White
00011	7	Black	10	3	Black
1100	5	White	0111	2	White
00011	7	Black	11	2	Black
1000	3	White	1011	8	White
000100	9	Black	11	2	Black
1011	4	White	0111	2	White
0000100	10	Black	11	2	Black
1000	3	White	1100	5	White
000100	9	Black	10	3	Black
0111	2	White	0000111	1	White
11	2	Black	11	2	Black
1100	5	White	1110	6	White
10	3	Black	11	2	Black

1000	3	White	0111	2	White
10	3	Black	11	2	Black
1100	5	White	1011	8	White
10	3	Black	11	2	Black
0111	2	White	0111	2	White
11	2	Black	11	2	Black
1100	5	White	1110	6	White
10	3	Black	11	2	Black
0000111	1	White	0000111	1	White
11	2	Black	11	2	Black
1110	6	White	1110	6	White
11	2	Black	11	2	Black
0111	2	White	0111	2	White
10	3	Black	10	3	Black
1111	7	White	1110	6	White
11	2	Black	10	3	Black
0111	2	White	0111	2	White
11	2	Black	11	2	Black
1110	6	White	1110	6	White
11	2	Black	11	2	Black
0000111	1	White	0000111	1	White
11	2	Black	11	2	Black
1100	5	White	1110	6	White
10	3	Black	11	2	Black
0111	2	White	0111	2	White
11	2	Black	011	4	Black
1011	8	White	1100	5	White
11	2	Black	11	2	Black
0111	2	White	1000	3	White
11	2	Black	11	2	Black
1100	5	White	1110	6	White
10	3	Black	11	2	Black
0000111	1	White	0000111	1	White
000100	9	Black	0000100	10	Black
1000	3	White	1000	3	White

11	2	Black	0000100	10	Black
1011	8	White	1000	3	White
11	2	Black	000100	9	Black
0111	2	White	0111	2	White
000100	9	Black	0000111	1	White
0111	2	White	00011	7	Black
000100	9	Black	1111	7	White
1000	3	White	0010	6	Black
11	2	Black	1110	6	White
1011	8	White	0010	6	Black
11	2	Black	1011	4	White
0111	2	White	00010110	37	White

So we have the image:



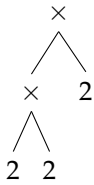
Chapter 7

1

a)

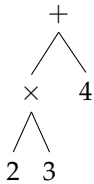
$$\begin{array}{c}
 + \\
 \swarrow \quad \searrow \\
 + \quad 1 \\
 \swarrow \quad \searrow \\
 1 \quad 1
 \end{array}
 \quad \Rightarrow \quad
 \begin{array}{l}
 (1 + 1) + 1 \\
 \underline{2 + 1} \\
 3
 \end{array}$$

b)



$$\begin{aligned}
 & \Rightarrow \frac{(2 \times 2) \times 2}{} \\
 & \Rightarrow \frac{4 \times 2}{} \\
 & \Rightarrow 8
 \end{aligned}$$

c)



$$\begin{aligned}
 & \Rightarrow \frac{(2 \times 3) + 4}{} \\
 & \Rightarrow \frac{6 + 4}{} \\
 & \Rightarrow 10
 \end{aligned}$$

2

a)

$$\begin{aligned}
 & x \times x \times y \\
 & \Rightarrow \frac{4 \times 4 \times 5}{} \\
 & \Rightarrow \frac{16 \times 5}{} \\
 & \Rightarrow 80
 \end{aligned}$$

$$\begin{aligned}
 & z \times y + z \\
 & \Rightarrow \frac{100 \times 5 + 100}{} \\
 & \Rightarrow \frac{500 + 100}{} \\
 & \Rightarrow 600
 \end{aligned}$$

b)

$$\begin{aligned}
 & z \times z \\
 & \Rightarrow \frac{100 \times 100}{} \\
 & \Rightarrow 10000
 \end{aligned}$$

3

a)

$$\begin{aligned} & \underline{f\ 4\ 5} \\ \implies & \underline{4 \times 5} \times 4 \\ \implies & \underline{20} \times 4 \\ \implies & \underline{80} \end{aligned}$$

b)

$$\begin{aligned} & f(\underline{f\ 4\ 5})\ 5 \\ \implies & \underline{f\ 80\ 5} \\ \implies & \underline{80 \times 5} \times 80 \\ \implies & \underline{400 \times 80} \\ \implies & 32000 \end{aligned}$$

c)

$$\begin{aligned} & f(\underline{f\ 4\ 5})\ (\underline{f\ 4\ 5}) \\ \implies & \underline{f\ 80\ 80} \\ \implies & \underline{80 \times 80} \times 80 \\ \implies & \underline{32000 \times 80} \\ \implies & 512000 \end{aligned}$$

4

a)

$$\begin{aligned} & \underline{f\ 5\ 4} = \underline{f\ 4\ 5} \\ \implies & \underline{80} = \underline{80} \\ \implies & \text{true} \end{aligned}$$

b)

$$\begin{aligned} & \text{if } \underline{1 = 2} \text{ then } 3 \text{ else } 4 \\ \implies & \text{if } \underline{\text{false}} \text{ then } 3 \text{ else } \underline{4} \\ \implies & \underline{4} \end{aligned}$$

c)

$\text{if } (\text{if } 1 = 2 \text{ then false else true}) \text{ then } 3 \text{ else } 4$
 $\implies \text{if true then } 3 \text{ else } 4$
 $\implies 3$

5

a)

$\text{head } [2, 3, 4]$
 $\implies 2$

b)

$\text{tail } [2]$
 $\implies []$

c)

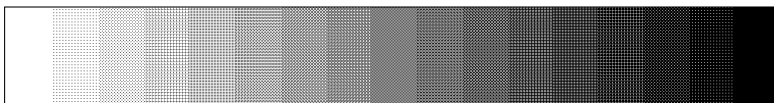
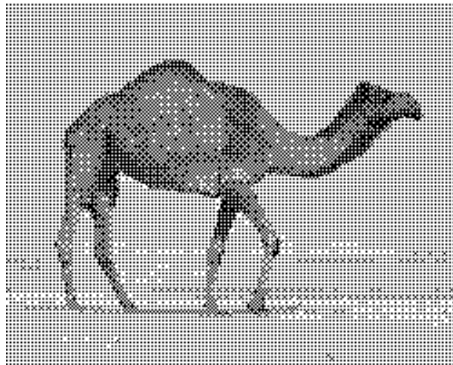
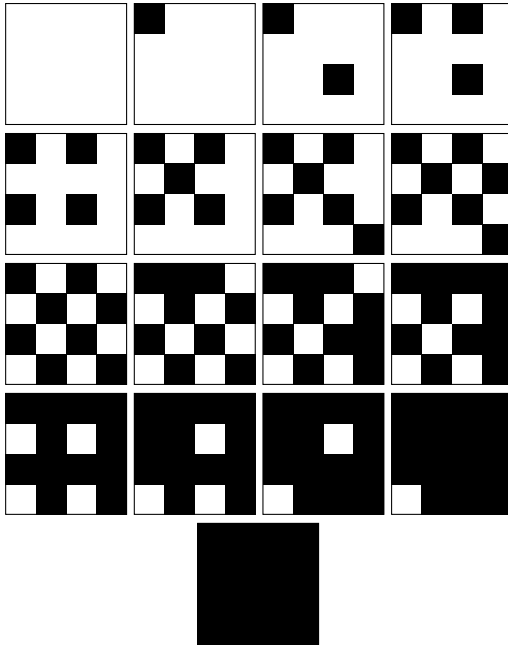
$\text{head } [2, 3, 4] \bullet [2, 3, 4]$
 $\implies [2] \bullet [2, 3, 4]$
 $\implies [2, 2, 3, 4]$

6

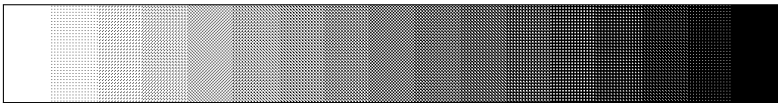
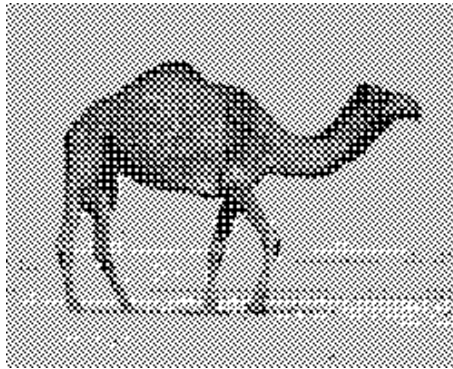
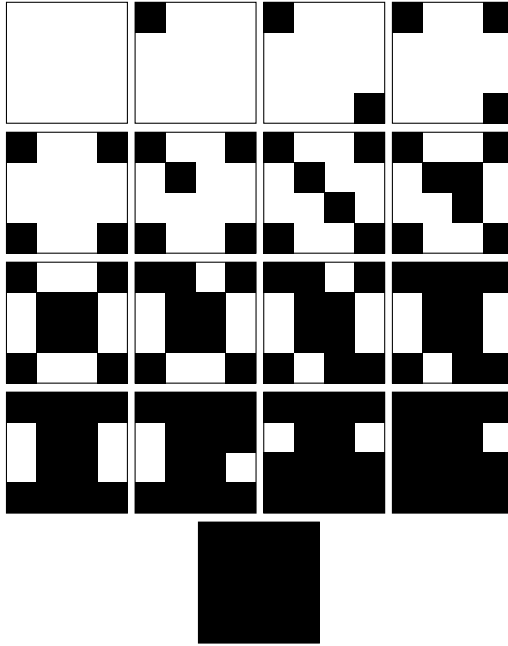
a) $[]$ (first if)b) $[1]$ (second if)c) $[1, 3]$ (via $1 \bullet \text{odds } []$)

Chapter 8

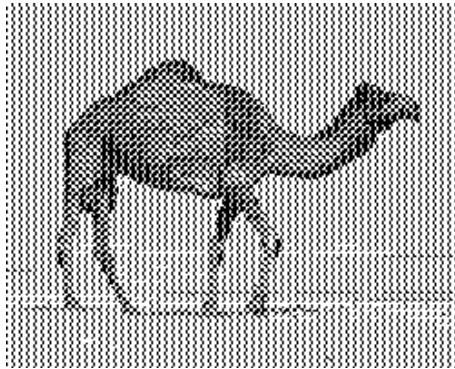
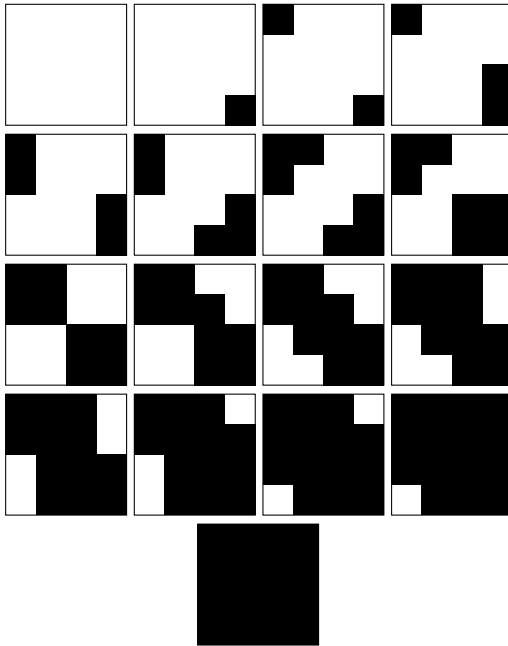
1



2



3



Chapter 9

1

Palatino

2

AVERSION

3

Conjecture

Chapter 10

1

hy-phen-a-tion

2

fund-raising

3

re-cord (the verb)

4

rec-ord (the noun)

5

a-rith-me-tic (the noun)

6

ar-ith-me-tic (the adjective)

7

dem-on-stra-tion

8

de-mon-stra-tive

9

gen-u-ine

10

moun-tain-ous

Further Reading

There follows a list of interesting books for each chapter. Some are closely related to the chapter contents, some tangentially. The level of expertise required to understand each of them varies quite a bit, but do not be afraid to read books you do not understand all of, especially if you can obtain or borrow them at little cost.

Chapter 1

Computer Graphics: Principles and Practice James D. Foley, Andries van Dam, Steven K. Fiener, and John F. Hughes. Published by Addison Wesley (second edition, 1995). ISBN 0201848406.

Contemporary Newspaper Design: Shaping the News in the Digital Age – Typography & Image on Modern Newsprint John D. Berry and Roger Black. Published by Mark Batty (2007). ISBN 0972424032.

Chapter 2

A Book of Curves E. H. Lockwood. Published by Cambridge University Press (1961). ISBN 0521044448.

Fifty Typefaces That Changed the World: Design Museum Fifty John L. Waters. Published by Conran (2013). ISBN 184091629X.

Thinking with Type: A Critical Guide for Designers, Writers, Editors, and Students Ellen Lupton. Published by Princeton Architectural Press (second edition, 2010). ISBN 1568989695.

Chapter 3

The Histories Polybius (translated by Robin Waterfield). Published by Oxford University Press under the Oxford World Classics imprint (2010). ISBN 0199534705.

Code: The Hidden Language of Computer Hardware and Software Charles Petzold. Published by Microsoft Press (2000). ISBN 0735611319.

Unicode Explained Jukka K. Korpela. Published by O'Reilly Media (2006). ISBN 059610121X.

The Decipherment of Linear B John Chadwick. Published by Cambridge University Press (second edition, 1967). ISBN 1107691761.

Chapter 4

Introduction to Algorithms T. Cormen, C. Leiserson, R. Rivest, and C. Stein. Published by MIT Press (third edition, 2009). ISBN 0262533057.

Flexible Pattern Matching in Strings: Practical On-Line Search Algorithms for Texts and Biological Sequences Gonzalo Navarro and Mathieu Raffinot. Published by Cambridge University Press (2007). ISBN 0521039932.

Google's PageRank and Beyond: The Science of Search Engine Rankings Amy N. Langville and Carl D. Meyer. Published by Princeton University Press (2012). ISBN 0691152667.

Chapter 5

The Wonderful Writing Machine Bruce Bliven, Jr. Published by Random House (1954). ISBN 600150329X.

Quirky Qwerty: The Story of the Keyboard @ Your Fingertips Torbjörn Lundmark. Published by University of New South Wales Press (2001). ISBN 0868404365.

The Iron Whim: A Fragmented History of Typewriting Darren Wershler-Henry. Published by McClelland & Stewart (2005). ISBN 0771089252.

Chapter 6

Fundamental Data Compression Ida Mengyi Pu. Published by Butterworth-Heinemann (2006). ISBN 0750663103.

The Fax Modem Sourcebook Andrew Margolis. Published by Wiley (1995). ISBN 0471950726.

Introduction to Data Compression Khalid Sayood. Published by Morgan Kaufman in The Morgan Kaufmann Series in Multimedia Information and Systems (fourth edition, 2012). ISBN 0124157963.

Chapter 7

Python Programming for the Absolute Beginner Mike Dawson. Published by Course Technology PTR (third edition, 2010). ISBN 1435455002.

OCaml from the Very Beginning John Whittington. Published by Coherent Press (2013). ISBN 0957671105.

Seven Languages in Seven Weeks: A Pragmatic Guide to Learning Programming Languages Bruce A. Tate. Published by Pragmatic Bookshelf (2010). ISBN 193435659X.

Chapter 8

How to Identify Prints Bamber Gascoigne. Published by Thames & Hudson (second edition, 2004). ISBN 0500284806.

A History of Engraving and Etching Arthur M. Hind. Published by Dover Publications (1963). ISBN 0486209547.

Prints and Printmaking: An Introduction to the History and Techniques Antony Griffiths. Published by University of California Press (1996). ISBN 0520207149.

Digital Halftoning Robert Ulichney. Published by The MIT Press (1987). ISBN 0262210096.

Chapter 9

Just My Type: A Book About Fonts Simon Garfield. Published by Profile Books (2011). ISBN 1846683025.

The Geometry of Type: The Anatomy of 100 Essential Typefaces Stephen Coles. Published by Thames and Hudson Ltd (2013). ISBN 0500241422.

The Elements of Typographic Style Robert Bringhurst. Published by Hartley & Marks (2004). ISBN 0881792065.

Chapter 10

Micro-typographic extensions to the T_EX typesetting system PhD Thesis, Hàn Thế Thành, Faculty of Informatics, Masaryk University, Brno, October 2000.

Digital Typography Donald E. Knuth. Published by the Center for the Study of Language and Information (Stanford, California) CSLI Lecture Notes, No. 78 (1999). ISBN 1575860104.

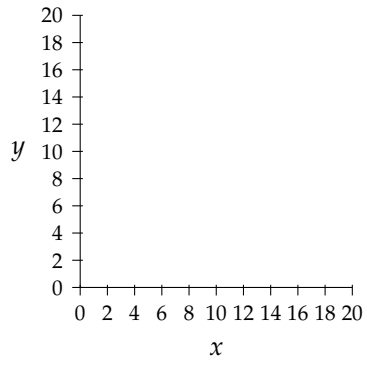
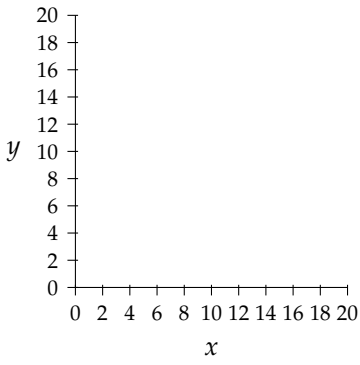
Printer's Type in the Twentieth Century: Manufacturing And Design Methods Richard Southall. Published by Oak Knoll Press (2005). ISBN 1584561552.

History of the Monotype Corporation Judith Slinn et al. Published by Vanbrugh Press (2014). ISBN 0993051005.

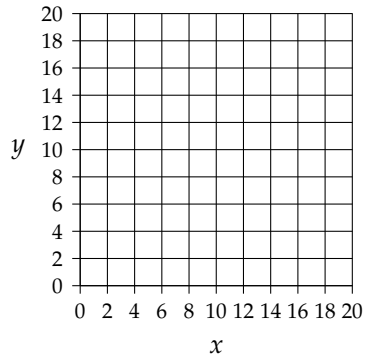
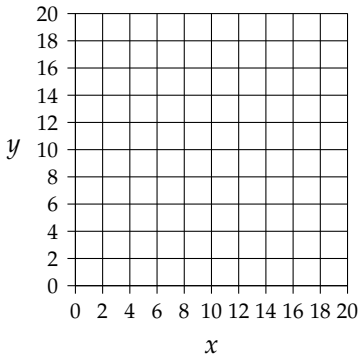
Templates

The following pages contain blank templates for answering problems 1.2, 1.3, 1.4, 2.1, 8.1, 8.2, and 8.3.

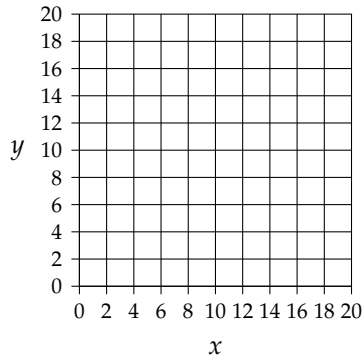
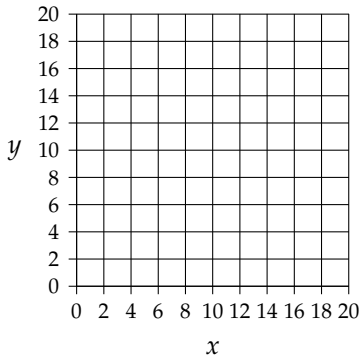
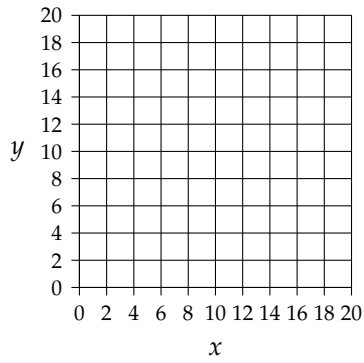
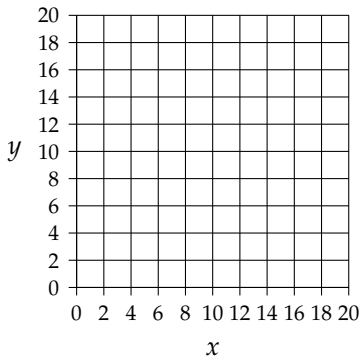
Problem 1.2



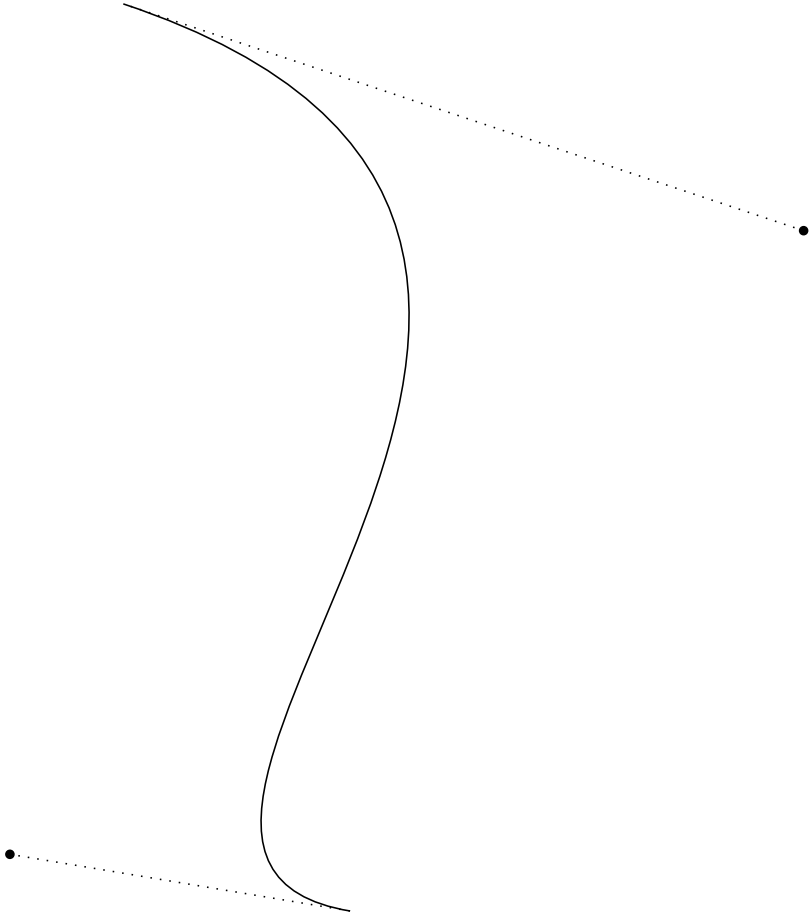
Problem 1.3



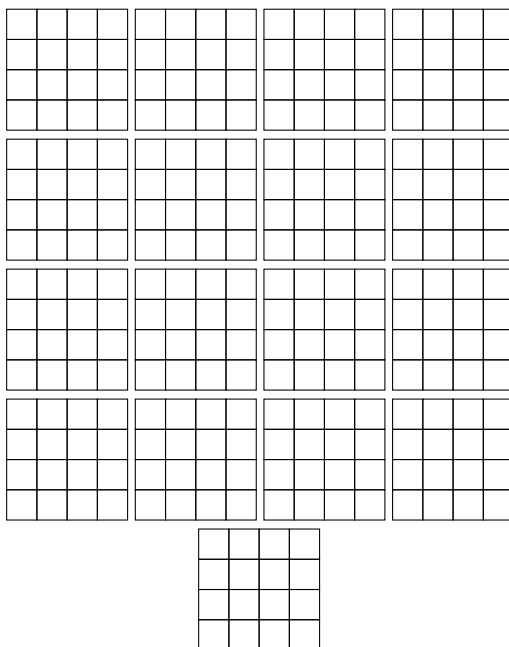
Problem 1.4



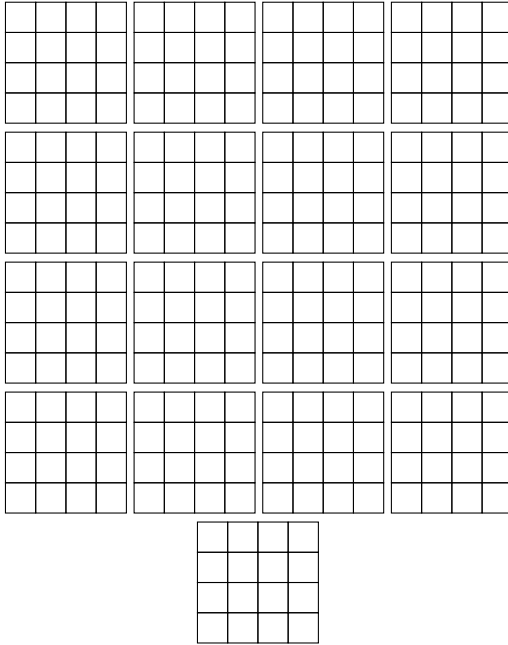
Problem 2.1



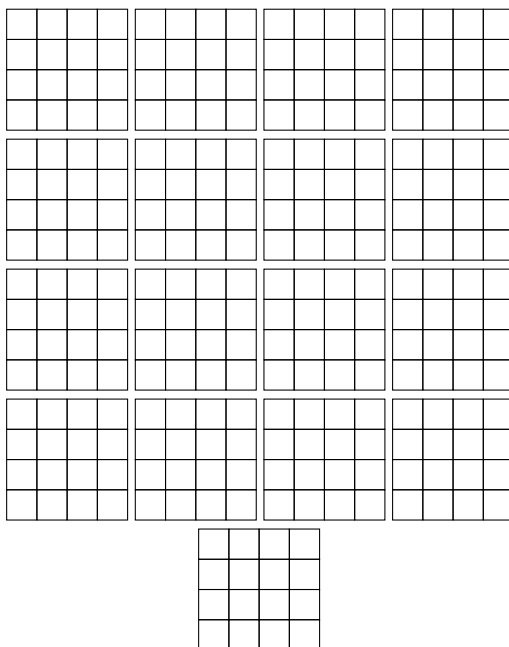
Problem 8.1



Problem 8.2



Problem 8.3



Colophon

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