# COMPUTER BRAILLE CODE
## SUPPLEMENT

## FLOWCHART DESIGN
## FOR
## APPLICABLE BRAILLE CODES

Compiled Under the Authority of the
BRAILLE AUTHORITY OF
NORTH AMERICA

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# FOREWORD

With the adoption of the *Computer Braille Code* in 1987, the Braille Authority of North America (BANA) recognized the need for rules for the transcription of flowcharts. Accordingly, the BANA Mathematics and BANA Computer Technical Committees were charged to work together to develop a system of transcription that would be relevant to all braille codes.

The code presented here is based on the *Provisional Braille Code for Computer Notation, 1972*. Changes and additions reflect the adoption of the *Computer Braille Code* and new flowcharting techniques in current use.


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# PREFACE

Flowcharts, the graphic representations of the steps of procedures, are no longer confined to the literature of computers and/or engineering. Today, books as diverse as texts on mathematics and business administration, books for students in elementary school and for the professional programmer, contain flowcharts.

In the following braille system, print flowcharts are represented symbolically through the use of standard braille characters. The rules for the transcription of flowcharts may be used whether the flowcharts are found in mathematics books, where the primary code is *The Nemeth Braille Code for Mathematics and Science Notation, 1972 Revision* (Nemeth), or computer programming and other textbooks, where the primary code is *English Braille American Edition* (literary).

The rules described herein are intended as a secondary code for use by transcribers. The *Computer Braille Code* (CBC) and *The Guidelines for Mathematical Diagrams* (GMD) are other secondary codes that are used with this system.

Appendix A contains lists of flowcharting shapes and braille indicators and symbols. Examples of print flowcharts and their complete transcriptions are shown in Appendix B.

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# COMPUTER BRAILLE CODE SUPPLEMENT

# FLOWCHART DESIGN FOR APPLICABLE BRAILLE CODES

## I. DESCRIPTION OF A FLOWCHART AND ITS ELEMENTS

A. DEFINITION.  A flowchart is defined as a graphic representation that shows a progression or flow of activities.  Flowcharts contain any or all of the following items:

1. Boxes of various shapes,

2. Arrows joining boxes,

3. Arrows pointing to other arrows.  (Examples 1, 6, 7, 12)

B. ENTRY AND EXIT POINTS.  In braille it is important to show the beginning and end of the path(s) of the flow of the diagram between the boxes and arrows.

1. Entry Points.  The transcriber can determine an entry point to a flowchart from any one of the following characteristics:

    (a) A box with no arrows leading to it,
        (Examples 3, 5, 7, 8)

    (b) An arrow coming from nowhere leading to a box.
        (Examples 10, 13)

    There may be several entry points in a flowchart.

2. Exit Points.  The transcriber can determine an exit point of a flowchart from any one of the following characteristics:

    (a) A box with no arrows leading from it,   (Example 1)

    (b) An arrow coming from a box but leading nowhere.
        (Example 13)

    There may be several exit points in a flowchart.

C.  BOXES

    1.  Boxes typically contain directions for what is to be done, or questions on which a decision must be made. Various shapes are encountered; examples of common shapes are included in Appendix A.

    2.  Decision Boxes.  A decision box is defined as a box with more than one arrow leading from it.

    3.  Connectors.  In print the logical link or flow between boxes usually is shown by arrows.  Sometimes a flowchart designer will choose not to draw arrows but instead will use an equivalent device called a connector.  The sections of the flowchart joined by these connectors may appear to be separated; they may even be on separate pages.  The entire display should be treated as a single entity.  (Examples 3, 11)

       A connector is a group of two or more boxes, usually of the same shape, that all contain the same *identification*. Exactly one of these boxes must be an entry box and all others must be exit boxes.  The implied flow is from the exit box or boxes to the entry box.

       (a) An *enter* connector is an entry box to which there corresponds at least one exit point with the same identification.

       (b) An *exit* connector is an exit point which corresponds exactly to one entry box with the same identification.  (Example 3)

D.  ARROWS.  Arrows are used to indicate the flow of activity. In many flowcharts only lines connect the boxes.  These lines are equivalent to arrows with the arrowhead implied.  Flow generally proceeds from top to bottom and left to right. (Examples 4, 12, 15)

## II.  ANALYSIS AND PREPARATION OF THE FLOWCHART

A.  NUMBERING THE BOXES

    1.  The transcriber must assign a number to each box in the flowchart in order to provide for a systematic method of transcribing it.  The numbers are assigned according to the steps in Section D below and become part of the identifier in the transcription.  (See Section III.E.) (Example 3)

    2.  Flowchart information is not always displayed in boxes. (Example 16)  In such cases, the numbering proceeds as if the information or questions were in boxes.  It may be helpful to draw boxes around the flowchart elements in order to aid in the numbering process.

B.  AUTHOR'S LABELS

    1.  An author's label is a number or letter, outside or inside a box, usually for reference to a discussion in the text.  (Example 2)

    2.  In the course of assigning numbers to the flowchart boxes, whenever <u>any</u> box is encountered with an author's label, the correspondence between the transcriber's number and the author's label must be noted on a Correspondence Worksheet as described below.

C.  WORKSHEETS

    1.  A <u>Correspondence Worksheet</u> is used to correlate the author's labels with the transcriber-assigned numbers. This worksheet is unnecessary if the author has not assigned labels to any of the boxes. If needed, it is divided into two columns.  (Example 2)

        (a) Column 1 is headed:  Author's Label.  Labels assigned by the author must appear in this column in the following sequence:  A-Z, 0-9, and/or special symbols in the order in which they first appear.

(b) Column 2 is headed: Transcriber's Number. The corresponding numbers assigned by the transcriber are entered in this column.

2. A <u>Decision Box Worksheet</u> is used to determine the sequence of the numbers assigned by the transcriber. (See step D.2 below.) (Examples 1, 3)

3. A <u>Connector Worksheet</u> is used to list each connector and show its exit and entry points. This worksheet is unnecessary if there are no connectors. (Examples 3, 11, 13)

    (a) Column 1 is headed:   Connector.
        Column 2 is headed:   Exit.
        Column 3 is headed:   Enter.

        If the author uses terms other than *enter* and *exit*, substitute the author's terms.

    (b) List each entry point which is an *enter* connector in the "Connector" column by <u>drawing</u> the box, and include the contents. The alphabetic label assigned by the transcriber in Section D. should not be used on the worksheet. (Example 3)

    (c) The other columns are completed according to Section D. below.

4. The Correspondence and/or Connector Worksheets are transcribed as tables according to Section III.D.

D. STEPS FOR ASSIGNING BOX NUMBERS. Locate all entry points and label them alphabetically beginning with the letter A. Assign the number 1 to entry box A and cross out the A on the flowchart. (Example 3)

1. Continue to number the boxes in the order in which the arrows lead until either a decision box, an exit point, or a previously numbered box is encountered.

2. If a decision box is reached:

    (a) Number it on the flowchart and put this number on the Decision Box Worksheet. (Examples 1, 3)

(b) Starting at the point at which the current decision box was originally entered, proceed in a counter-clockwise direction around the box and locate the first outgoing arrow that leads to a box that has not yet been numbered.

(c) If this is the last outgoing arrow from the decision box, cross this decision box number off the Decision Box Worksheet before proceeding along this path.

(d) Continue numbering until another decision box, an exit point, or a previously numbered box is reached.

(e) If another decision box is reached, go back to the beginning of step 2 and continue with the next out-going path. If an exit point or a previously num-bered box is reached, go to step 3 below.

3. If an exit point or a previously numbered box is reached:

(a) If the exit point is a connector, find it in the "Connector" column of the Connector Worksheet, assign the next number, and write this assigned number in the "Exit" column of that row. Proceed as in (b) below.

(b) If the exit point is not a connector, or you have reached a previously numbered box, refer to the Deci-sion Box Worksheet to determine whether there are any more available numbers. If so, find the next deci-sion box number still available on the worksheet and go back to step 2(b) above. If not, go to step 4.

4. When all decision box numbers have been crossed off the Decision Box Worksheet, refer to the flowchart to see whether there are any entry boxes whose originally assigned letters A, B, C, ... have not been crossed out. If so, choose the next in the series, cross out the assigned letter and assign the next number.

(a) If this entry point is an *enter* connector, find it in the "Connector" column of the Connector Worksheet and write its assigned number in the "Enter" column of that row. Then go to D.1 above.

(b) If there are no more entry points on the flowchart, the flowchart will have been completely numbered. Then, go to Section III.  (Examples 1, 3, 6)

## III.  <u>TRANSCRIPTION OF THE FLOWCHART</u>

A.  FORMAT

1.  Flowcharts should be placed in the text according to the rules of *Guidelines for Mathematical Diagrams.*

2.  A blank line should precede and follow a flowchart.

3.  The label (e.g., Figure 3.12) is placed at the margin and is followed directly by the caption, if any.  Runovers are indented to cell 3.  (Examples 1, 8, 9, 11, 12)

4.  The identifying label, if it is one of a sequentially numbered series, should be centered on line 25 of every page on which any part of the flowchart appears.  No blank line is necessary between this label and any part of the flowchart.  (Examples 1, 8, 9, 11, 12)

5.  If possible, a flowchart and its accompanying table(s) should be placed on one braille page.  If that is not possible, but the flowchart itself will fit on one braille page, place the table(s) on one page and the flowchart on the succeeding page.  (Example 2)  If a flowchart must be run over onto subsequent braille page(s), no blank line is required between the continuation of the flowchart and the running head (where present).  (Example 1)

6.  If the flowchart is too large to fit on one braille page, start it on the same braille page as the table(s). (Example 3)

7.  When a tactile drawing of the flowchart is included, it should precede the transcription of the flowchart and any accompanying table(s).  The boxes in the tactile drawing should be labeled with the transcriber-assigned numbers. The author (or publisher) may make the flowchart horizontal, or vertical, or a mixture of both in order to fit it on the print page.  The arrangement of the boxes is not significant.  Only the direction of flow is important. It follows that the tactile drawing need not conform exactly to print.  The boxes must, however, proceed in the same sequence.

B. CAPITALIZATION

1. When the primary code is literary, or literary with CBC as a secondary code, and all words and letters in a flowchart are upper case, the transcriber may elect to use lower case exclusively. This usage must be explained in a transcriber's note preceding the usage. (Example 10)

2. When the primary code is Nemeth, single letters and mathematical expressions are transcribed according to the author's capitalization _even_ _if_ the Nemeth code is initiated as part of a CBC transcription. (Example 4) If all words are fully capitalized, the transcriber may use lower case for the words as in 1. above.

3. If a flowchart contains a combination of fully-capitalized, singly-capitalized, and/or uncapitalized words or letters, follow the print capitalization. This usage applies regardless of the primary code. (Example 5)

C. TRANSCRIBER'S NOTES. Any transcriber's note necessary for the understanding of the flowchart must be placed before the flowchart proper. Transcriber's notes _must_ _not_ be placed in the body of the flowchart.

D. TABLES. If, in the course of numbering the flowchart, a Connector Worksheet or a Correspondence Worksheet has been used, the information on that sheet must appear as a transcriber's note preceding the flowchart itself. If both worksheets have been used, the information on the Correspondence Worksheet must be transcribed first. (See Section II.C.)

1. The Correspondence Worksheet is transcribed as a table headed CORRESPONDENCE TABLE. (Example 2)

2. The Connector Worksheet is transcribed as a table headed CONNECTOR TABLE. The shape of each connector box followed directly by its contents (identification) and the transcriber-assigned numbers with their appropriate start or stop indicators must be included in the table. (Examples 3, 11, 13)

3. The Decision Box Worksheet is not transcribed. It may be discarded after the transcriber assigns numbers to the boxes.

E. THE IDENTIFIER. Transcribe all boxes sequentially. Begin at the left margin and transcribe the identifier, which may consist of four unspaced parts, in the following order:

1. Start indicator or stop indicator.

   (a) A start indicator, dots 4-6, must be used as the first symbol to identify an entry point or an entry connector.

   (b) A stop indicator, dots 4-5-6, must be used as the first symbol to identify an exit point or an exit connector.

   (c) Otherwise, these indicators must not be used.

2. Transcriber-assigned number.

   (a) This number is to be transcribed using literary braille numbers.

   (b) If the primary code is literary, a transcriber's note (on the transcriber's note page or before the flowchart) should explain that the numbers preceding and unspaced from the box shape are transcriber assigned and that all other numbers are the author's numbers. (Example 5)

3. The shape of the box. (See Appendix A.)

   (a) The shape representation follows the transcriber-assigned number without a space.

   (b) The shape indicator, dots 1-2-4-6, begins the shape sequence. If some boxes are broken or dotted, place a letter *b* after the shape indicator. Describe this usage in the transcriber's note page or before the flowchart itself if it occurs only once. (Example 4)

      (c) Use shape symbols from the standard list in Appendix A. If there is a need to represent a shape not included in the list, select an appropriate <u>letter</u> to use with the shape indicator. Be sure that the entire construct utilized does not conflict with any existing shape symbol.

      (d) When the flowchart has no boxes, no shape indicator is used. (Example 16)

  4. The Author's Label, where present.

      (a) Use dot 5 between the shape of the box and the author's label.

      (b) If the label is a number, use numbers according to the primary code. (Example 2)

  5. Leave one space after the identifier before transcribing the contents of the box. <u>Exception</u>: the identifier of a connector <u>includes</u> the contents (identification) of the box. (Examples 3, 11, 13)

F. THE CONTENTS OF THE BOX. Although the contents of the box in print may appear as centered or otherwise set off, for the purposes of this Code, box contents are to be considered embedded.

  1. Contents of the boxes should be transcribed in the primary code, except that when the contents consist of computer notation, they must be transcribed according to the CBC. Entry and exit boxes containing such words as *start* or *stop, enter* or *end*, should be transcribed in the primary code even when they are in the same typestyle as computer notation.

  2. A box identifier and the contents of the box must appear on the same braille page. As many blank lines must be left on a page as necessary in order to accomplish this.

  3. If a runover is required, continue in cell 3 of the next and any succeeding lines. (Examples 5, 15) (For exception, see VI.A.2.)

4. If a box contains multiple lines of print representing a single item or expression (that is, a print expression is simply run over), it should be transcribed as in 3. above.   (Examples 3, 5)

5. If there is more than one item in a box and these items are aligned in print (as in a set of computer entries or a set of directions), start each entry on a new braille line beginning in cell 3.   (Examples 7, 16)

   (a) If these items must be run over, place the runover(s) in cell 5.   (Example 16)

   (b) In some instances boxes may contain extensive computer programs.  In such cases, skip a line after the identifier, transcribe the program according to CBC, skip a line and continue the flowchart.   (Example 8)

6. If the box is "empty", place the identifier at the margin in the customary manner and proceed to the next box. (Examples 4, 9)

7. If the only function of a box is to contain a label for an arrow, the box and its shape should be omitted in the transcription.  The label should be transcribed as speccified in G.2(b).   (Example 5)

G.  ARROWS

   1. An arrow must be transcribed only if:

      (a) It is labeled;

      (b) It is a broken arrow (or other texture differing from the customary arrows in the flowchart);

      (c) It comes from a decision box, whether it is labeled or not;

      (d) It points to a non-consecutive box;

      (e) It enters or exits an iteration box; (Sec. IV)

      (f) It is an entry or exit point;

(g) It carries an author's comment/explanation.

2. An arrow (dots 3-6, 3-6) must be transcribed as follows:

   (a) The arrow symbol begins at the left margin and is followed by one space. If there are two or more kinds of arrows, see 6(b) and 6(c) below. [Also see (d) below for arrow following an exit connector.]

   (b) Transcribe any arrow label(s) in the primary code, except that when the label consists of computer notation, it must be transcribed according to the CBC. Leave one space and transcribe another arrow symbol followed by one space. When a flowchart contains computer notation, arrow labels are often printed using the same typeface as the computer notation. If these labels are simply words of choice, such as *yes* or *no*, *true* or *false*, they should be transcribed in the primary code. (Example 7)

   (c) Next, transcribe the identifier of the box to which the arrow leads. The identifier includes the start/stop indicator, if present; the transcriber-assigned number; the box shape; and the author's label, if present. In the case of either an enter or exit connector, the contents of the box must be included. If there are no boxes, there will be no box shape to include.

   (d) A braille arrow must be inserted after an exit <u>con-nector</u> even though there is none in print. It is placed on the same braille line, after a blank space. The arrow must be followed, after one space, by the identifier of the corresponding entry connector and its contents. (Examples 3, 13)

   (e) If an unlabeled arrow must be transcribed, the space after the arrow is followed by the identifier of the box to which the arrow leads. [See (c) above.]

3. An arrow is often shown going to another arrow. It is, in fact, going to the same box to which the latter arrow is pointing. (Examples 1, 6)

4. All arrows leading from a decision box, whether labeled or unlabeled, must be transcribed in counterclockwise order, one per line. (Examples 1, 2, 3, 5, 15)

5. Two-way arrows are to be transcribed as two separate arrows, one in each direction.

6. Arrows of differing texture:

   (a) If there is only one kind of arrow, use dots 3-6, 3-6. If these arrows are broken, dotted, or barred, describe that on the transcriber's note page or in a transcriber's note preceding the flowchart itself.

   (b) If two kinds of arrows are used, use the regular arrow symbol for the most prevalent; use dots 2-3-5-6, 2-3-5-6 as the first option arrow.

   (c) In the rare case where three kinds of arrows are used, use a three-cell arrow, dots 3-6, 3, 3-6, as the second option arrow. (Example 9)

   These usages, and the description of the arrows, must be included on the special symbols page.

7. Arrows that come from nowhere or go nowhere: This situation is common when flowchart segments are shown. Arrows may carry labels such as *start* or *begin*, *end* or *finish*, or an arrow may be shown entering a box containing processing information or a decision box. Transcribe such arrows as follows:

   (a) The arrow entering from nowhere will carry the start indicator, dots 4-6, and will be followed by its label, if any. The box to which the entering arrow leads will be box 1 in your numbering sequence. (Examples 10, 13)

   (b) The arrow which leads nowhere will carry the stop indicator, dots 4-5-6, and will be followed by its label, if any. (Example 13)

# IV.  ITERATION BOXES

A.  DEFINITION.  An iteration box is a box with two or more separate compartments to which, and/or from which, flow is specifically directed.  Iteration boxes are usually associated with loops.  (Example 10)

The shape symbol for the entire box is (ed)x.  (See Appendix A.)

B.  SCHEMATIC DRAWING.  In a transcriber's note preceding the first flowchart that contains an iteration box, a tactile drawing of the box must be shown.

1.  If the author includes special labels for the compartments, such labels must be included in the tactile drawing.  If these labels are circled (or otherwise emphasized with underlining, special typefaces, etc.), such distinctions must not be shown in the drawing, but the transcriber's note must explain the print distinctions.

    (a) If the labels are capital letters, use the capital sign in the schematic drawing, but not the letter sign/English letter indicator.

    (b) If the labels are lower case letters, use the letter sign/English letter indicator in the schematic drawing.

2.  Other than the compartment labels, additional contents of the iteration box are not shown in the schematic drawing.

3.  If the author never labels the compartments, the transcriber must assign lower case letter labels starting with "a" in the uppermost, leftmost compartment, and then proceed and label alphabetically in a clockwise direction.  In this circumstance, the transcriber's note must explain that the compartment labels have been added by the transcriber.

4. If the author ceases to label the compartments, the transcriber must represent the compartments as if the labels were present, using the author's labeling system. (See 1. above.)

C. TRANSCRIBING ITERATION BOXES. In the actual flowchart transcription, present the iteration box as follows:

1. In the customary manner, place the complete identifier of the entire box at the margin. On succeeding lines, in alphabetic order, place the complete identifier of each compartment beginning in cell 3. Each compartment has its own line. This compartment identifier consists of the identifier of the entire box with the compartment letter appended to the (ed)x. This letter is to be lower case and carries no letter sign/English letter indicator.

2. All arrows to and from iteration boxes must be shown.

   (a) Arrows to the iteration box must be shown leading to the specific compartment to which they point.

   (b) Arrows from the iteration box must be shown leading from the specific compartment from which they originate. These arrows must be aligned in cell 3 beneath the compartment identifiers. (Example 10)

## V.   AUTHOR'S COMMENTS/EXPLANATIONS

If comments/explanations appear parallel to or adjacent to the flowchart, they are presented as outlined below.

A.   GRAPHIC ENCLOSURE. If the author utilizes a graphic in which to enclose such comments or explanations, a tactile drawing must be inserted at the place in the text where the author discusses such a technique. (Example 12) If the author does not discuss this practice, the tactile drawing is placed in a transcriber's note prior to the first flowchart using this device. In either case, a transcriber's note should explain that the comments enclosed in the print graphic are enclosed in author's comment symbols in the transcription.

B.   TRANSCRIPTION

    1.   Author's comment symbols (open comment: dots 6, 3-6; close comment: dots 3-6, 3) are grouping symbols that enclose the comment/explanation.

    2.   The comment/explanation is transcribed in the primary code.

    3.   When the comment/explanation refers to a box, the comment/explanation is blocked in cell 5, starting on a new line, after completion of the contents of the box. (Examples 5, 11, 12)

    4.   If the comment/explanation refers to an arrow, the arrow is transcribed and the comment/explanation placed as described in 3. above. (Example 11)

    5.   The placement of the comments/explanations should be explained on the transcriber's note page or before the first flowchart containing such comments.

    6.   The comment/explanation and its associated box or arrow must not be divided between braille pages.

## VI.  <u>FLOWCHARTS IN ELEMENTARY TEXTBOOKS</u>

A.  GRADES 1-4

  1.  When flowcharts appear in texts for grades 1-4, the flow-
      chart should be drawn as in print with the text inside
      the boxes.  This presentation must fit on one braille
      page.  (Example 17)

  2.  If such diagrams cannot be accommodated on a single page,
      draw the flowchart without the words and key the boxes
      with consecutive numbers according to Section II.  On the
      next page transcribe the flowchart as in this code <u>except</u>

      * do not use start/stop indicators or shape symbols;
      * do not use the flowchart arrow symbol.

      Place each box number at the margin followed by one space
      and the contents of the box.  Place runovers in cell 5.
      To represent labeled arrows place each label on a new
      line in cell 3, after the box from which it originates,
      followed by the words "Go to __".  (The dash represents
      the number of the box to which the arrow leads.)
      (Example 18)

B.  GRADES 5-8.  When flowcharts appear in texts for grades 5-8,
    make a tactile drawing of the first flowchart keyed with the
    numbers assigned by the transcriber according to Section
    II.D.  Follow it with the flowchart transcription according
    to the rules of this Supplement.  Subsequent flowcharts may
    be transcribed without tactile diagrams.

## VII.  <u>OTHER CONSIDERATIONS</u>

A.  "TUNNEL" CHARTS.  A tunnel chart is a flowchart with one
    entry point, one exit point, and no decision boxes.  (Exam-
    ples 4, 8, 14, 17)  Transcribe according to the rules of this
    code unless the presentation is for eye appeal only or the
    author's intent requires integration of the flowchart with
    adjacent text and/or figures in a spatial display. (Example
    14)

B.  REFERENCE INDICATORS AND NOTES.  Use reference indicators
    consistent with the primary code.  When information contained
    in a note is necessary for an understanding of the flowchart,
    the following transcriber's note must be inserted <u>before</u>
    beginning the flowchart.

    "The following note appears in the material below."

    Place the note itself on the next line, preceded by the
    appropriate reference indicator starting in cell 7, with
    runovers in cell 5.  (Example 15)

C.  SPECIAL SYMBOLS PAGE.  There must be a special symbols page
    showing all shapes, indicators, and symbols used from Appen-
    dix A.  Shapes from Appendix A, Section 2, as well as any
    shape(s) for which symbols had to be devised, should be shown
    as tactile drawings.

D.  TRANSCRIBER'S NOTES PAGE.  Except for *English Braille American Edi-
    tion* and the *Code of Braille Textbook Formats and Techniques*, all codes
    used in the transcription, including this supplement, must be
    listed on the transcriber's notes page along with their dates
    of adoption.

# APPENDIX A

**Section 1: Common Shapes**

**Section 2: Special Shapes**

**Section 3: Braille Indicators and Other Symbols**

## SECTION 1:  COMMON SHAPES
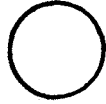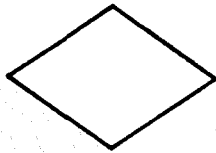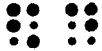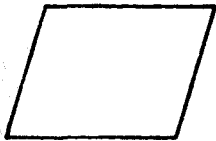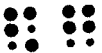
| Braille | Shape | Name |
|---|---|---|
| ⠶ ⠶ | ○ | Circle |
| ⠯ ⠯ ⠿ | (cloud) | Cloud |
| ⠫ ⠫ | ◇ | Diamond |
| ⠪ ⠪ | (parallelogram) | Parallelogram |
| ⠫ ⠫ ⠶ | (hexagon) | Hexagon |
| ⠢ ⠢ | ▽ | Inverted triangle |
| ⠮ ⠮ ⠿ | (oval) | Oval |
| ⠮ ⠪ | (rectangle) | Rectangle or square |
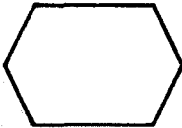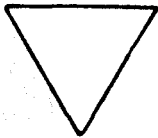
Triangle

## SECTION 2: SPECIAL SHAPES

Document

(To indicate any operation utilizing a
key-driven device)

Magnetic disk

Magnetic drum

Core
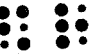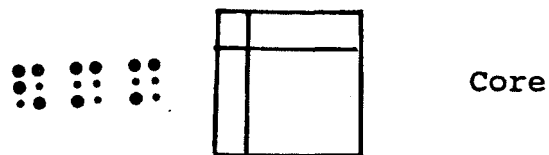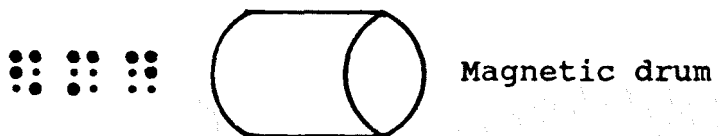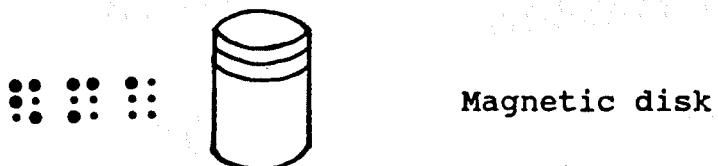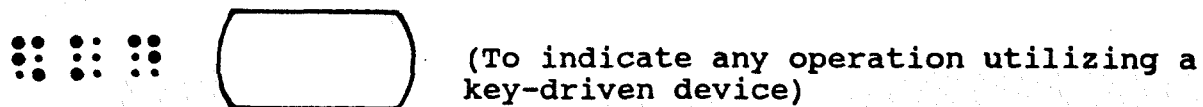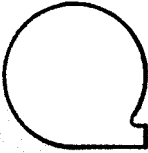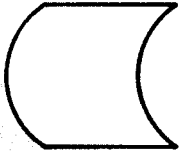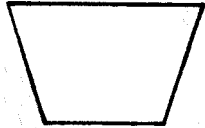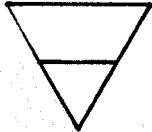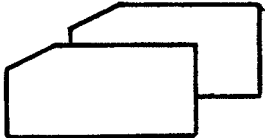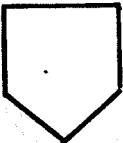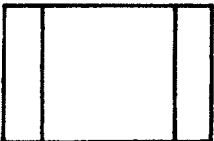
Manual operation

⠿ ⠇ ⠿     Magnetic tape

⠿ ⠇ ⠿     On-line storage

⠿ ⠇ ⠿     Manual off-line operation

⠿ ⠇ ⠿     Off-line storage

⠿ ⠇ ⠿     Punched card

⠿ ⠇ ⠿     Card file

⠿ ⠇ ⠿     Offpage connector

⠿ ⠇ ⠿     Predefined process

Card deck

Punched tape

Transmittal tape

Sort

Iteration box
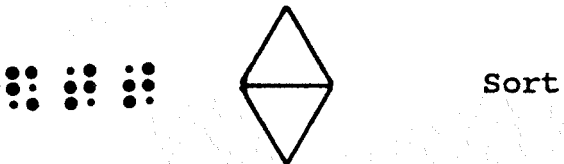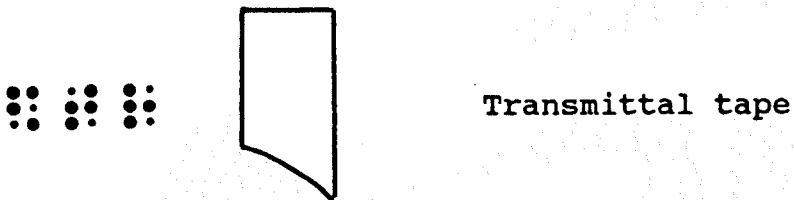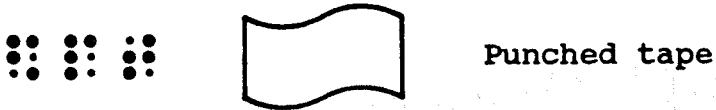
# APPENDIX A

## SECTION 3:
## BRAILLE INDICATORS AND OTHER SYMBOLS

⠩  Start indicator

⠱  Stop indicator

⠰  Shape indicator

⠩⠱  Arrow

⠬⠜  First option arrow

⠩⠱⠱  Second option arrow

⠪⠺  Open author's comment

⠮⠾  Close author's comment

⠲⠢  Separation line for tables, extended to cover the width of the column by repeating dots 2-5 as necessary.

⠳⠣⠪⠺  Broken box indicator  (The dash stands for the shape of the box.)

# APPENDIX B

# EXAMPLES

Applicable braille codes for the transcription of the flow-charts are indicated at the top of the print examples.
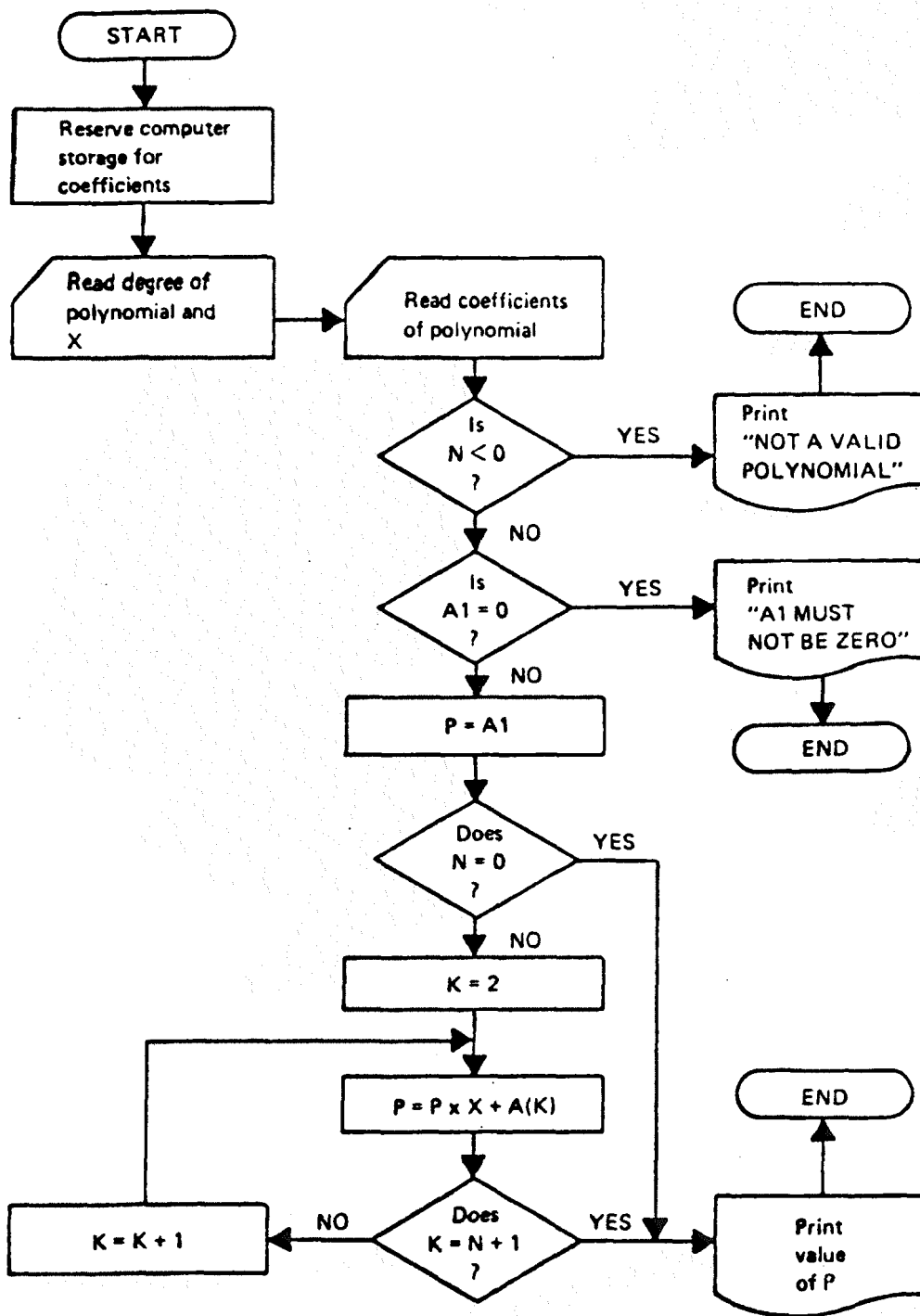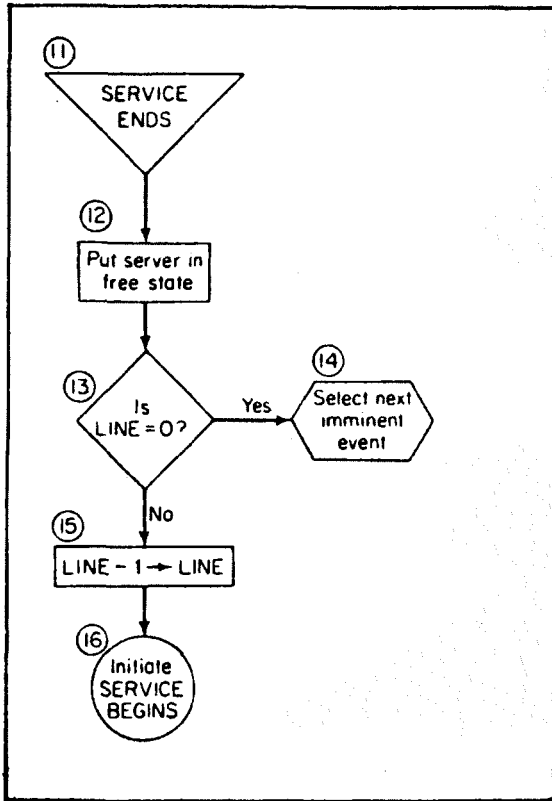
EXAMPLE 1

Code(s):   Literary and Computer

```
                    ┌─────────┐
                    │  START  │
                    └────┬────┘
                         │
              ┌──────────▼──────────┐
              │ Reserve computer    │
              │ storage for         │
              │ coefficients        │
              └──────────┬──────────┘
                         │
        ┌────────────────▼─────┐      ┌──────────────────┐
        │ Read degree of       │      │ Read coefficients│
        │ polynomial and       ├─────▶│ of polynomial    │
        │ X                    │      └────────┬─────────┘
        └──────────────────────┘               │
                                                │
                              ┌─────────────────▼─┐
                              │       Is           │     YES
                              │      N < 0         ├──────────▶  Print "NOT A VALID POLYNOMIAL"  ──▶ END
                              │        ?           │
                              └─────────┬──────────┘
                                      NO│
                              ┌─────────▼──────────┐
                              │       Is           │     YES
                              │     A1 = 0         ├──────────▶  Print "A1 MUST NOT BE ZERO"  ──▶ END
                              │        ?           │
                              └─────────┬──────────┘
                                      NO│
                              ┌─────────▼──────────┐
                              │      P = A1         │
                              └─────────┬──────────┘
                                        │
                              ┌─────────▼──────────┐
                              │       Does         │     YES
                              │      N = 0         ├──────────┐
                              │        ?           │          │
                              └─────────┬──────────┘          │
                                      NO│                     │
                              ┌─────────▼──────────┐          │
                              │       K = 2        │          │
                              └─────────┬──────────┘          │
                                        │                     │
                              ┌─────────▼──────────┐          │
                              │   P = P x X + A(K)  │          │
                              └─────────┬──────────┘          │
                                        │                     │
                              ┌─────────▼──────────┐          │
         K = K + 1   ◀── NO ──┤       Does         │── YES ──▶│──▶  Print value of P  ──▶ END
                              │     K = N + 1      │
                              │        ?           │
                              └────────────────────┘
```

**FIGURE 5.6**

EXAMPLE 1

| Decision Box Worksheet |
|:---:|
| 5 |
| 6 |
| 8 |
| 11 |

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EXAMPLE 2

Code(s):  Literary and Computer



## Correspondence Worksheet

| Author's Label | Transcriber's Number |
|:---:|:---:|
| 11 | 1 |
| 12 | 2 |
| 13 | 3 |
| 14 | 6 |
| 15 | 4 |
| 16 | 5 |

1

2

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# EXAMPLE 3

Code(s):   Nemeth
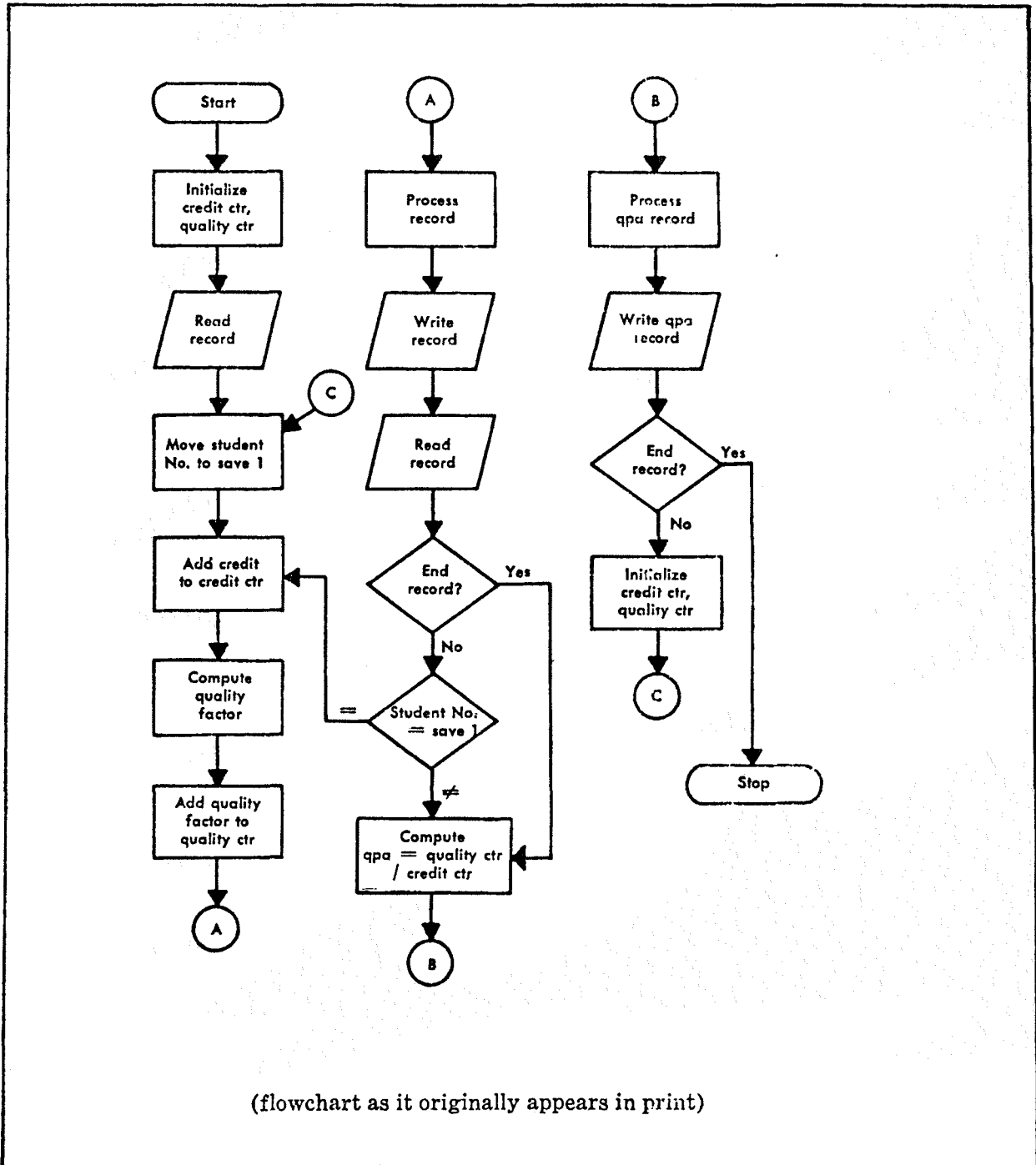


(flowchart as it originally appears in print)

# EXAMPLE 3



**1 A** Start

**2** Initialize credit ctr, quality ctr

**3** Read record

**4** Move student No. to save 1

**5** Add credit to credit ctr

**6** Compute quality factor

**7** Add quality factor to quality ctr

**8** A

**24 C**

**9 B** A

**10** Process record

**11** Write record

**12** Read record

**13** End record? — Yes

**14** Student No. = save 1

**15** Compute qpa = quality ctr / credit ctr

**16** B

**17 C** B

**18** Process qpa record

**19** Write qpa record

**20** End record? — Yes

**21** Initialize credit ctr, quality ctr

**22** C

**23** Stop

(flowchart after transcriber has numbered the boxes)

*B-10*

EXAMPLE 3

| *Connector Worksheet* | | |
|---|---|---|
| *Connector* | *Exit* | *Enter* |
| Ⓐ | 8 | 9 |
| Ⓑ | 16 | 17 |
| Ⓒ | 22 | 24 |

(transcriber's Connector Worksheet as it appears after all numbers have been assigned)

| *Decision Box Worksheet* |
|---|
| ~~18~~ |
| ~~14~~ |
| ~~20~~ |

(transcriber's Decision Box Worksheet as it appears after all numbers have been assigned)

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## EXAMPLE 4

Code(s):   Literary and Computer
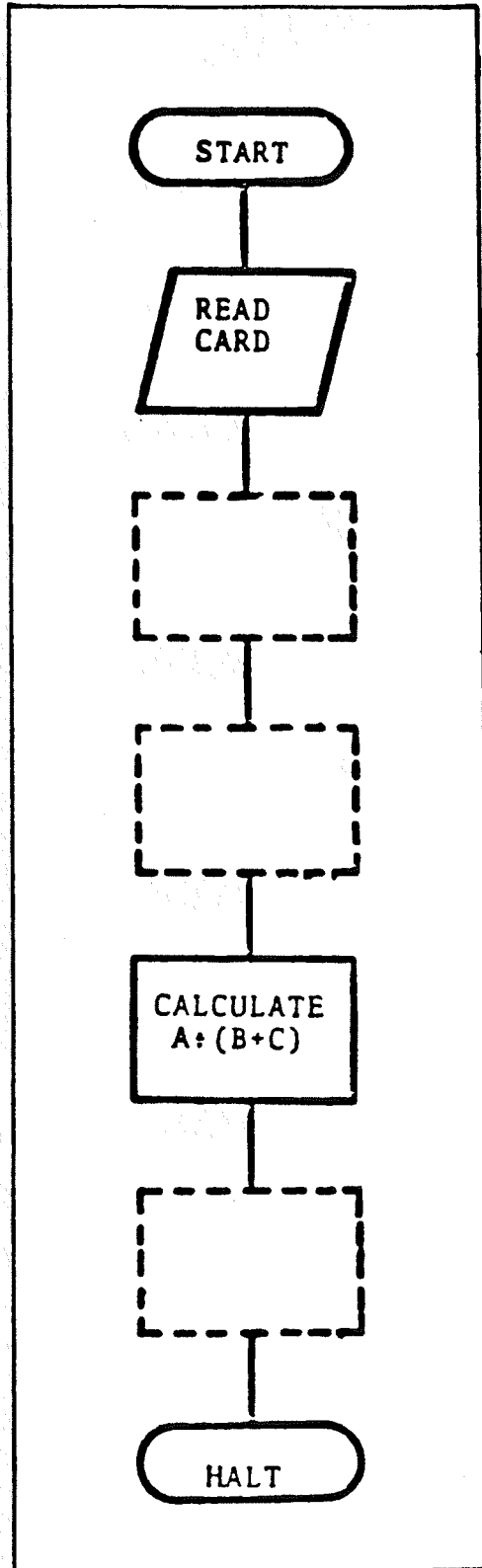
EXAMPLE 5

Code(s):   Literary

Is it relevant? → yes → Can you answer the question? → no → WHY NOT? → Need to choose between two rules Choose A.

Is it relevant? → no → Choose D.

Can you answer the question? → yes → Choose C.

Do certain words lead you to a rule?
Is there enough information in the facts?

Need to choose between two rules Choose A. → Need more information or another rule Choose B.

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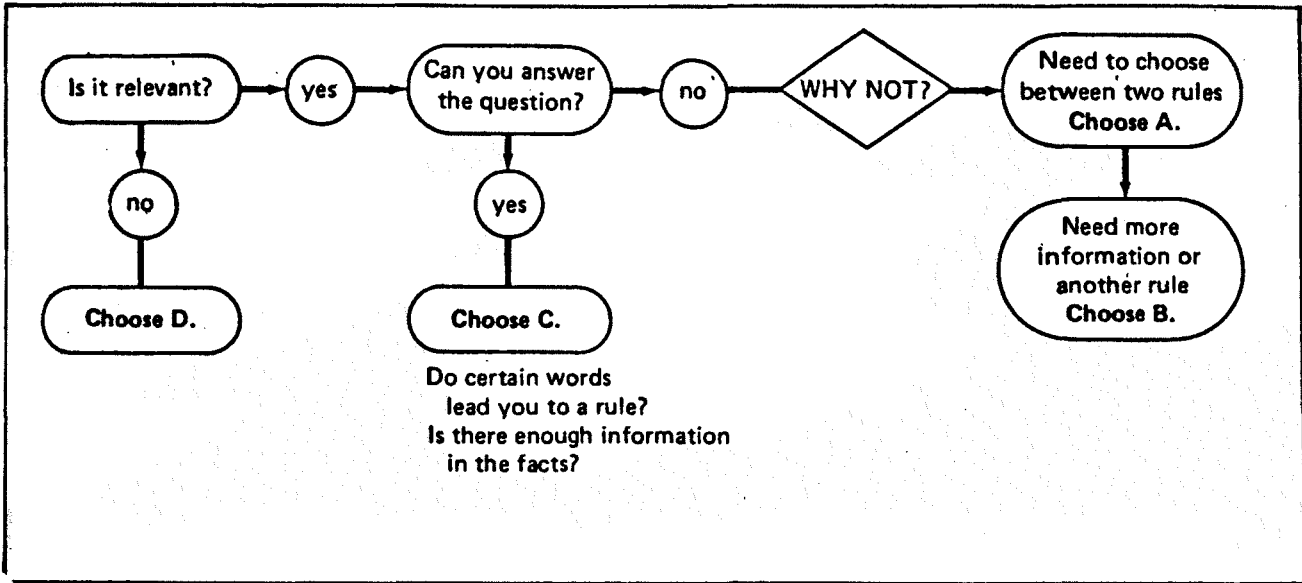
22

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EXAMPLE 6

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EXAMPLE 7

1. What will the computer print when programs are based on the following flow charts?

a.

START

ENTER
A=2
B=A$^2$
C=A$^3$

C>B?

YES

NØ

PRINT
B

PRINT
C

STØP

EXAMPLE 8

START

INPUT:
  READ the number of numbers to be sorted N
  DIMension an array A to hold the numbers to be sorted
  FOR I=1 TO N
        READ A(I)
  NEXT I

SELECTION SORT:
  FOR I=1 TO N-1
        LET X equal the first number in the list (A(I)) which
            is a candidate for the smallest in the list
        LET K be the subscript of the first number in the
            list (I)
        FOR J=I+1 TO N
          IF A(J)<X
            THEN
                    Set X equal to the smaller number A(J) and
                        set K equal to its subscript J
            ELSE
        NEXT J
        Exchange smallest number in list (subscript K) with the
            first number in the list (subscript I)
  NEXT I

OUTPUT:
  PRINT the ordered array

END

**Figure 7.8** A modular flowchart for the selection sort.

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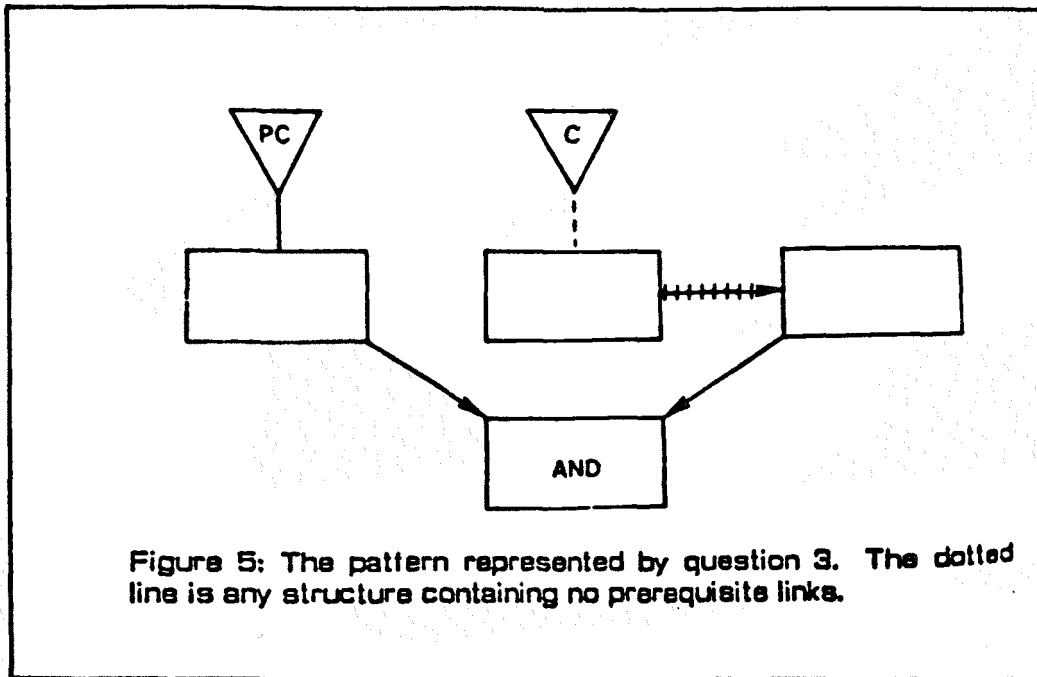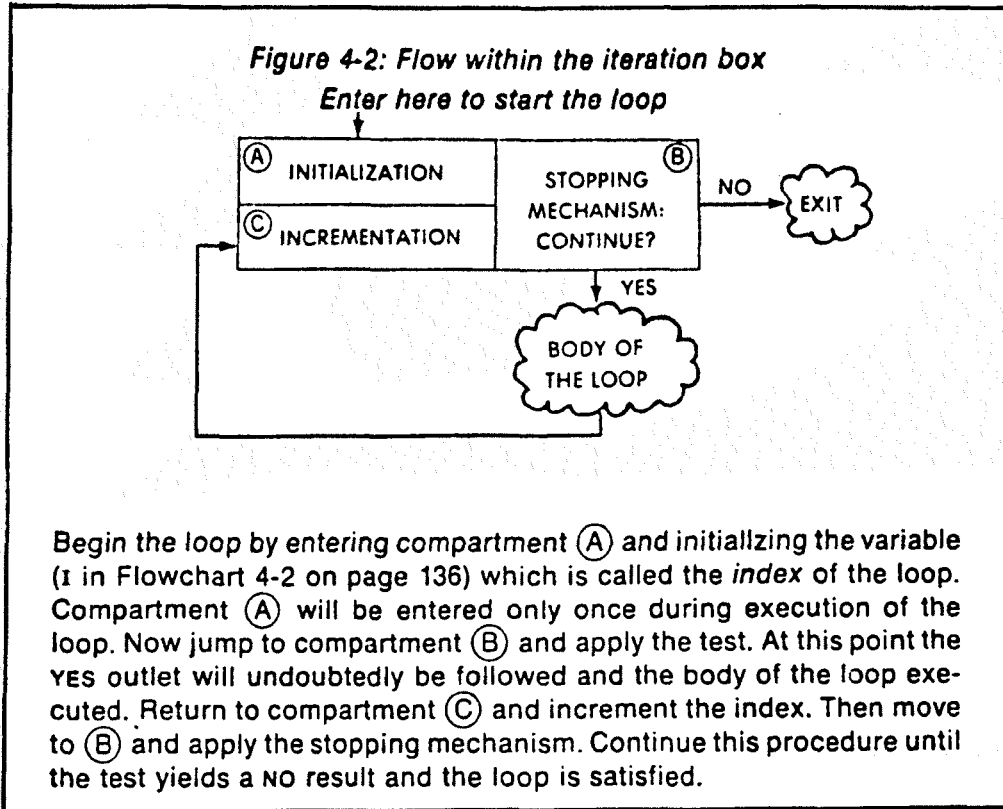
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EXAMPLE 9



Figure 5: The pattern represented by question 3. The dotted line is any structure containing no prerequisite links.
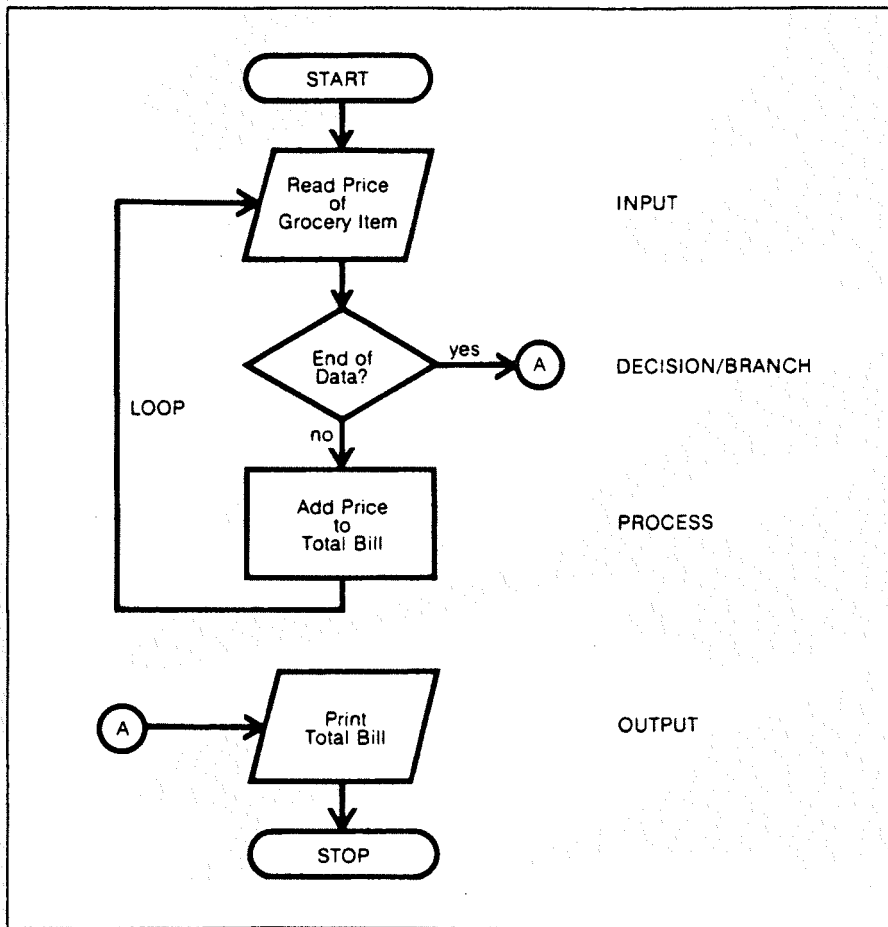
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EXAMPLE 10

## Figure 4-2: Flow within the iteration box
### Enter here to start the loop



Begin the loop by entering compartment Ⓐ and initializing the variable (I in Flowchart 4-2 on page 136) which is called the *index* of the loop. Compartment Ⓐ will be entered only once during execution of the loop. Now jump to compartment Ⓑ and apply the test. At this point the YES outlet will undoubtedly be followed and the body of the loop executed. Return to compartment Ⓒ and increment the index. Then move to Ⓑ and apply the stopping mechanism. Continue this procedure until the test yields a NO result and the loop is satisfied.

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# EXAMPLE 11

## Code(s):  Literary

**FIGURE 3-12** Example of a Flowchart

START

Read Price
of
Grocery Item

INPUT

End of
Data?    yes    A

DECISION/BRANCH

LOOP

no

Add Price
to
Total Bill

PROCESS

A    Print
Total Bill

OUTPUT

STOP

1

2

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EXAMPLE 12

Code(s):  Literary and Computer

might need explanation or when, for emphasis, an additional statement on an operation is desired, a comment may easily be supplied by use of the symbol:
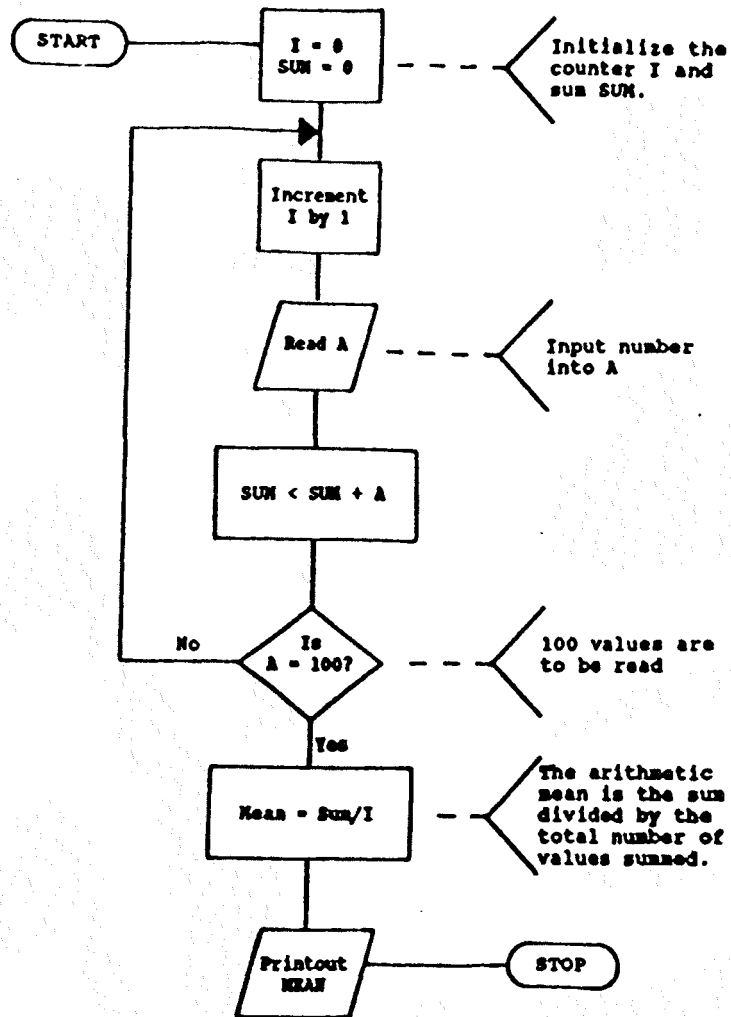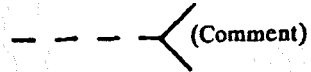


Figure 3.9.  Flowchart in Figure 3.8 redrawn with comments.

## EXAMPLE 13

4. **Branch or link pattern**
Control is transferred from
the simple sequence flow
to another portion of the
program. For instance, If
G is false, GO TO J. The
flow of the program
continues with execution
of J (rather than H) when-
ever G is false.

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EXAMPLE 14

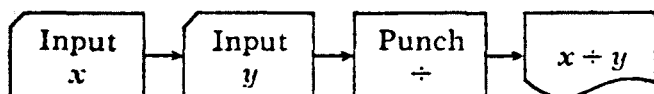Code(s):   Nemeth

B | It often makes a difference which number you insert first in a computer. For example, compare these inputs.

Study Mini-Review 19 (Commutative Axiom)

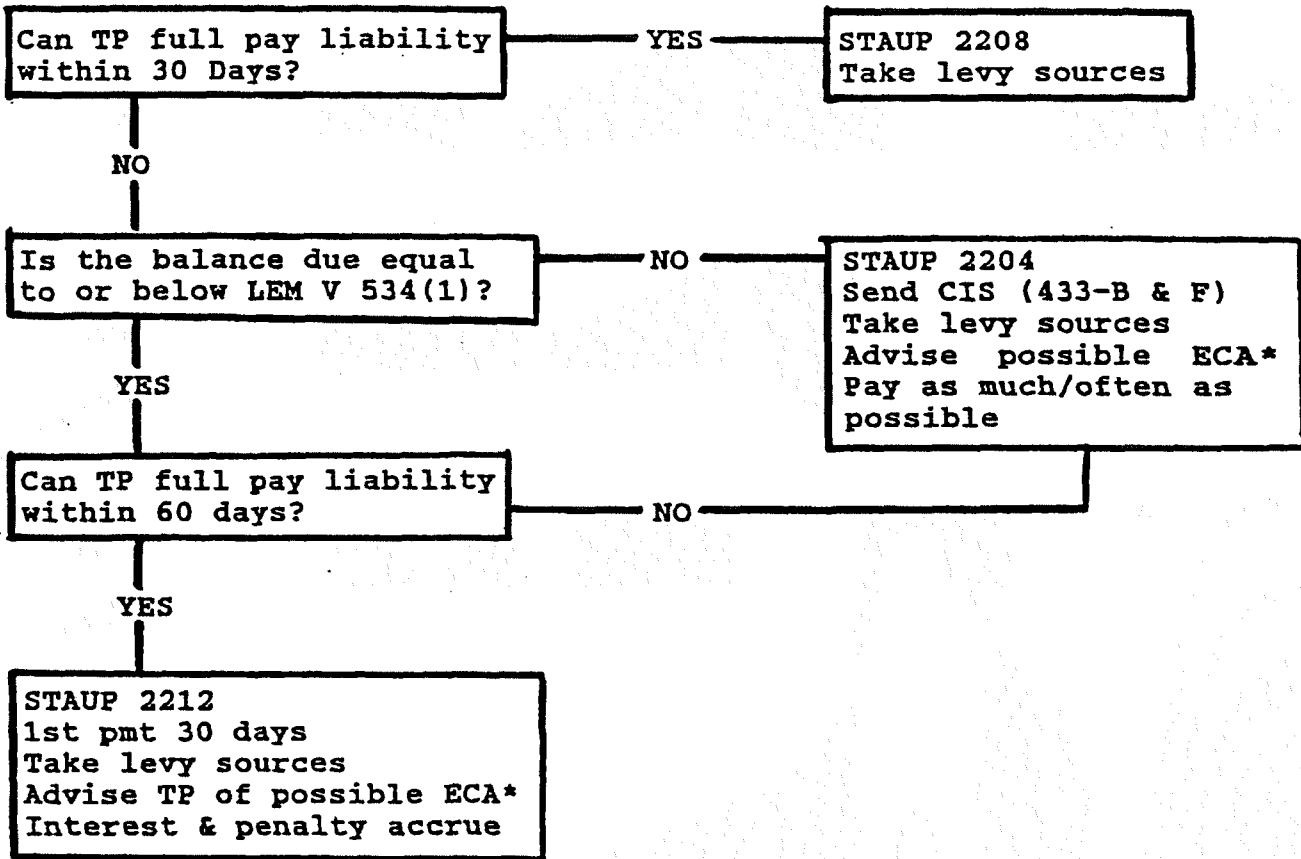| Input $x$ | Input $y$ | Punch $\div$ | $x \div y$ |
|-----------|-----------|--------------|------------|
| 6 | 3 | $6 \div 3$ | = | 2 |
| 3 | 6 | $3 \div 6$ | = | .5 |

A different order of input gives a *different* answer.

EXAMPLE 15

Code(s):    Literary

## BMF ABOVE DEFERRAL

```
┌─────────────────────────┐                    ┌──────────────────────────┐
│ Can TP full pay liability│────── YES ─────────│ STAUP 2208               │
│ within 30 Days?          │                    │ Take levy sources        │
└─────────────────────────┘                    └──────────────────────────┘
            │
            NO
            │
┌─────────────────────────┐                    ┌──────────────────────────┐
│ Is the balance due equal │────── NO ──────────│ STAUP 2204               │
│ to or below LEM V 534(1)?│                    │ Send CIS (433-B & F)     │
└─────────────────────────┘                    │ Take levy sources        │
            │                                   │ Advise   possible   ECA* │
            YES                                 │ Pay as much/often as     │
            │                                   │ possible                 │
┌─────────────────────────┐                    └──────────────────────────┘
│ Can TP full pay liability│
│ within 60 days?          │────── NO ──────────
└─────────────────────────┘
            │
            YES
            │
┌─────────────────────────┐
│ STAUP 2212              │
│ 1st pmt 30 days          │
│ Take levy sources        │
│ Advise TP of possible ECA*│
│ Interest & penalty accrue│
└─────────────────────────┘
```

Note:    BMF includes in-business corporations, partnerships, and
         sole proprietors with trust fund liabilities.


*ECA (Enforced Collection Action)
 1.   Wage levy
 2.   Levy on bank accounts
 3.   Notice of Federal Tax Lien which encumbers real property
      and is a matter of public record for at least 6 years

EXAMPLE 16

Code(s):  Literary

---

# *Choking (Airway Obstruction) Action Guides*

## *Conscious Victim*

Survey the scene

Begin a primary survey

Ask, "Are you choking?"

Can the victim respond by coughing
forcefully, speaking, or breathing?

**Yes**

Identify yourself

If the victim is coughing forcefully,
encourage victim to continue coughing
and watch him or her until
obstruction is relieved

If coughing becomes weak
or ineffective, get consent

Phone EMS

Begin abdominal thrusts

Repeat until object comes out
or victim becomes unconscious

**No**

Shout, "Help!"

Say, "I can help you."

Phone EMS

Begin abdominal thrusts

Repeat until object comes out or
victim becomes unconscious

If victim becomes unconscious,
position victim on back

Begin first aid for an unconscious victim
with airway obstruction

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EXAMPLE 17

Code: Nemeth

# Finding Out About Computers
■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■

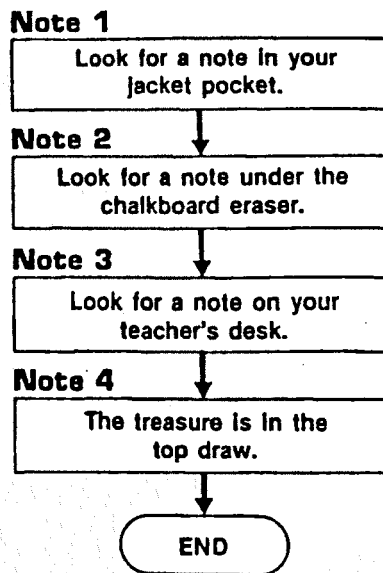## Computer Treasure Hunts

On a treasure hunt, you look for notes. Each note tells you where to look for the next note. The last note tells you where the treasure is.

The notes at the right show a treasure hunt. They are numbered in order from 1 to 4.

A computer goes on a "treasure hunt" each time it gets a program. The "notes" are the numbered instructions in the program. The order of the numbers tells the computer where to start, where to look for the next instruction, and where to stop.

**Note 1**
| Look for a note in your jacket pocket. |

**Note 2**
| Look for a note under the chalkboard eraser. |

**Note 3**
| Look for a note on your teacher's desk. |

**Note 4**
| The treasure is in the top draw. |

( END )

### On Your Own

**1.** You are on the treasure hunt above. Add 2 more notes to the hunt. Write your notes in the boxes below. Cut out and paste them some place between the other boxes. Are the boxes in order? Will the treasure hunt still work? _____

| | |

**2.** Now, make up your own treasure hunt. Cut out 6 boxes. Write a note in each box and paste them in order on a piece of paper. Draw arrows to connect the boxes.
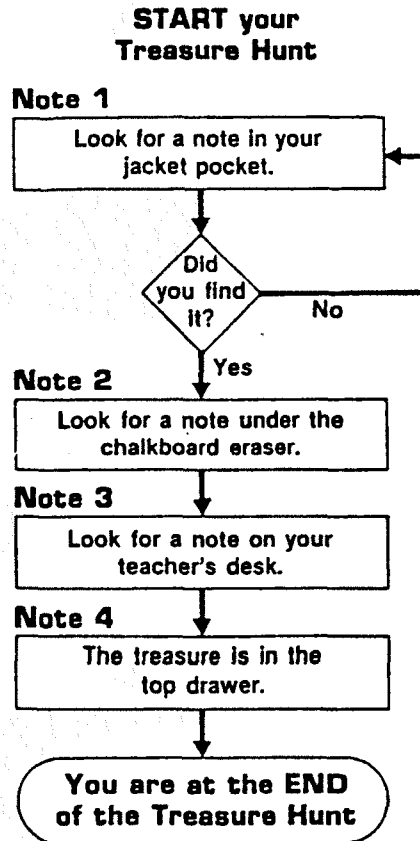
B-47

EXAMPLE 18

Code:   Nemeth

# Finding Out About Computers

■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■

## More Computer Treasure Hunts

Suppose you went on the treasure hunt at the right but you couldn't find your jacket. Let's see what might happen.

If you answered "no" to the question, you would have to follow the loop back to Note 1. When you find the note (after you have looked some more), you continue on your hunt following the arrows.

A computer does "looping" when it follows one path in the instructions if the answer to a question is "yes", or a different path if the answer is "no."

**START your Treasure Hunt**

**Note 1**

| Look for a note in your jacket pocket. |

Did you find it? — No

Yes

**Note 2**

| Look for a note under the chalkboard eraser. |

**Note 3**

| Look for a note on your teacher's desk. |

**Note 4**

| The treasure is in the top drawer. |

You are at the END of the Treasure Hunt

## On Your Own

**1.** Draw this symbol in the treasure hunt above. Print a question in the symbol. The answer to the question must be either "yes" or "no." Draw a loop.

**2.** Write 2 questions for your treasure hunt. Use the symbol at the right. Cut and paste your questions on the paper. Draw the loops.

1

2

3

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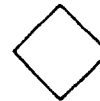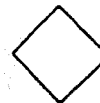
6 Boxes and arrows must be embossed.

7 "Soft-roll" on a manual braillewriter
to place arrow labels close to the
8 arrow lines.

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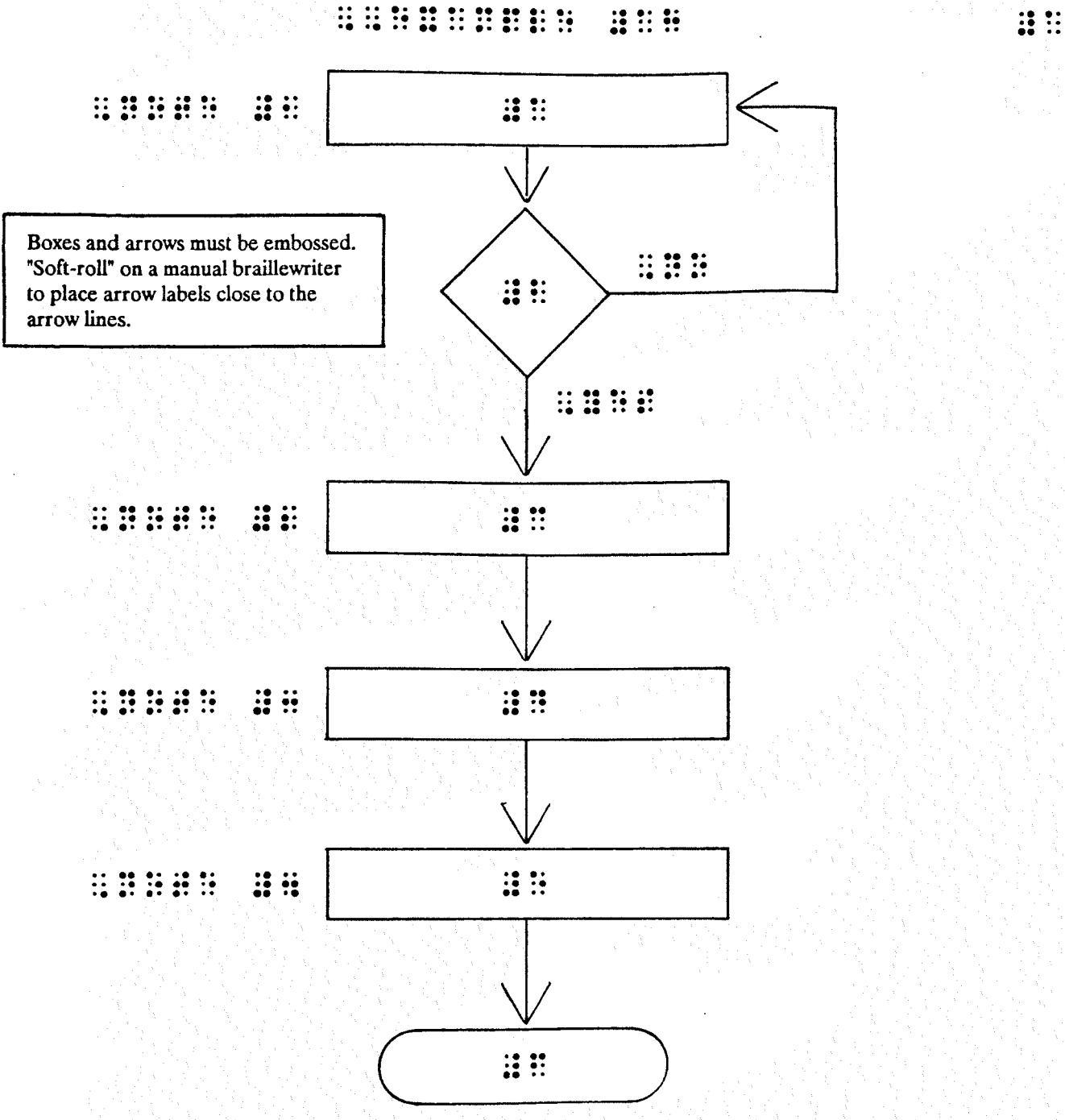
## SOURCES OF FLOWCHART EXAMPLES

The sources for many of the print flowchart examples are not known. Examples have been sent in to specialists and workshop leaders over the years for help in transcribing. If any reader can identify a source for an example, we would be glad to have the information to include in subsequent printings of this Supplement.

All known sources are listed below.


Example 3   *Provisional Braille Code for Computer Notation, 1972*

Example 4   IBM training course

Example 5   *Barron's How to Prepare for the LSAT - Law School Admission Test, 4th Edition.* ©1987, Barron's Educational Series, Inc.

Example 8   *Basic Programming Using Structural Modules,* by Jonathon C. Barron, CBS College Publishing ©1983

Examples 11 and 13   *Principles of Data Processing, Third Edition,* by Steven Mandell, West Publishing Co. ©1984

Example 14   *Algebra: The Language of Mathematics 1*

Example 16   *American Red Cross Standard First Aid Workbook,* ©1987

Examples 17 and 18   *Houghton-Mifflin Mathematics Teacher's Resource Book Level 3,* by Duncan, Houghton-Mifflin ©1987