

# 1 Introduction to Braille

Standard Braille is an approach to creating documents which can be read through touch. As English words are composed of letters, Braille words are composed of Braille cells. A cell consists of six dots arranged in the form of a rectangular grid of two dots horizontally and three dots vertically. With six dots arranged this way, one can obtain sixty three different patterns of dots. The sixty-fourth pattern, a blank cell, represents a space.

In addition to letters, the Braille alphabet includes combination of dots for punctuation, capitalization and numbers. In the Braille alphabet is depicted by a cell that contains six raised dots. The cell is divided into three rows of two columns. A letter is indicated by which dots are raised and which are smooth. Any letter can be capitalized by placing an indicator in front of the letter.

**Capitalization** is indicated by a cell with only the sixth dot, or the last dot of the cell in the lower right hand corner of the cell, raised while the rest are smooth. This cell appears in front of a letter cell to show capitalization. To capitalize an entire word, two cells with only the sixth dot raised in each cell is placed in front of the first letter of the word.

For example: 'ccc' =  $\begin{matrix} \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \end{matrix}$ ; 'Ccc' =  $\begin{matrix} \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \end{matrix}$ ; 'CCC' =  $\begin{matrix} \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \end{matrix}$

**Numbers** are represented using the first ten letters of the alphabet, "a" through "j", and a special number sign,  $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{matrix}$ . This number sign is placed in front of a word to convert the entire word into numbers. If one wishes to switch from numbers to letters within a word (i.e. 212a) the letter sign,  $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{matrix}$ , is used.

For example: 'cc' =  $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{matrix}$ ; '33' =  $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{matrix}$ ; '3c' =  $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{matrix}$

**Contractions** are special characters used to reduce the length of words. English includes contractions (for example, "don't" is a contraction of the two words "do" and "not"). In Braille there are 189 additional contractions. Some contractions stand for a whole word.

For example: 'for' =  $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{matrix}$ ; 'and' =  $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{matrix}$ ; 'the' =  $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{matrix}$ . Other contractions stand for a group of letters within a word.

In the example below, the contraction "ing" is used in the word "sing" and as an ending in the word "playing." Likewise, the contraction "ed" is used in the word "edge" and as an ending in the word "played."

{ing} =  $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{matrix}$ ; 's' + {ing} =  $\begin{matrix} \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet \end{matrix}$ ; 'play' + {ing} =  $\begin{matrix} \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet \end{matrix}$   
 {ed} =  $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{matrix}$ ; {ed} + 'ge' =  $\begin{matrix} \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet \end{matrix}$ ; 'play' + {ed} =  $\begin{matrix} \bullet & \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet & \bullet \end{matrix}$

**Short-form contractions** are abbreviated spellings of common longer words. For example: "tomorrow" is spelled "tm", "friend" is spelled "fr", and "little" is spelled "ll" in Braille.

Translating the phrase "you like him" into uncontracted (a.k.a Grade 1 Braille) and contracted (a.k.a Grade 2 Braille), the effect contractions have on sequence length is evident.

$\begin{matrix} \bullet & \bullet & \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet & \bullet & \bullet \end{matrix}$  (Uncontracted)  
 $\begin{matrix} \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet \\ \bullet & \bullet & \bullet & \bullet \end{matrix}$  (Contracted)

The reader is encouraged to see the appendices for further information on Grade 1 and 2 Braille translations.

## 1.1 Binary Braille

The Braille alphabet is depicted by a cell that contains six raised/flat dots, numbered one through six beginning with the dot in the upper left-hand corner with the number descending the columns (see figure below). In order to create a bitstring easily parsable by the computer, "0" = flat, "1" = raised. The 3x2 matrix (Braille cell) is represented as a 1x6 bitstring (Binary Braille).

1	4
2	5
3	6

 = 

1	2	3	4	5	6
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; Thus, "c" =  $\begin{matrix} \bullet & \bullet \\ \bullet & \bullet \\ \bullet & \bullet \end{matrix}$   $\equiv$ 

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 $\equiv$ 

1	1
0	0
0	0

 $\equiv$ 

1	0	0	1	0	0
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 $\equiv$  100100