None
Internet-Draft
Intended status: Informational
Expires: July 5, 2011

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January 1, 2011

Encoding the graphemes of the SignWriting Script with the x-ISWA-2010
draft-slevinski-iswa-2010-00

Abstract

For concreteness, because the universal character set is not yet universal, because an undocumented and unlabeled coded character set hampers information interchange, a 12-bit coded character set has been created that encodes the graphemes of the SignWriting script as described in the open standard of the International SignWriting Alphabet 2010. The x-ISWA-2010 coded character set is defined with hexadecimal characters and described with Unicode characters, either proposed characters on plane 1 or interchange characters on plane 15.

This memo defines a standard coded character set for the Internet community. It is published for reference, examination, implementation, and evaluation. Distribution of this memo is unlimited.

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1. Introduction

SignWriting is the universal script for writing any sign language. SignWriting is an unusual script because the graphemes of the script are used spatially before they are used sequentially. Other scripts either use a sequential list of individual graphemes or combination of graphemes that morph when used together. SignWriting is different because the writer decides the placement of static graphemes on a 2-dimensional canvas. The graphemes are static because they do not change size or shape. Some graphemes can be transformed into other graphemes through a change of variation, fill, or rotation.

When written by hand, the variety and style of graphemes is potentially unlimited.

When written with computers, the grapheme set must be limited and organized. This document defines the encode for a limited set of graphemes for written sign language. Encoding the graphemes is the first step to standardization. This memo defines a standard coded character set for the Internet community. It is published for reference, examination, implementation, and evaluation.

Beyond the standardization of the graphemes, the internal structures within the script must be encoded. A practical script encoding model called Binary SignWriting is defined in Section 5.2 and Appendix B.

1.1. Terminology

The terminology used for the SignWriting script will vary depending on the context.

This document contains 5 layers of contexts: a script for sign languages, a symbolset to organize a set of graphemes, a coded character set to encode the symbols, a proposal for integration with the universal character set, and a script encoding model as an appendix.

The first context is the SignWriting script in general. This context assumes that sign languages are human languages, with all of the uses and benefits of other voiced or written languages. This section explains the usage of graphemes in clusters and the structure of sign text. (Section 2)

The second context is the International SignWriting Alphabet 2010 as a symbolset that organizes and structures a set of graphemes for the SignWriting script. A symbol is a reference to a grapheme rather than the grapheme itself. (Section 3)

The third context is the symbol encoding with the x-ISWA-2010 coded character set. Each symbol is divided into 3 characters of base, fill, and rotation. Each base has a list of valid fills and rotations. (Section 4)

The fourth context is for Unicode as the universal character set. The first part lays out the proposal for adding the ISWA 2010 to plane 1, known as the Supplementary Multilingual Plane. The second part defines interchange data with an ABNF grammar that uses plane 15, known as the Private Use Area. (Section 5)

The fifth context is the script encoding model of Binary SignWriting. Sign text is defined and described with tokens based on the x-BSW3 coded character set. Regular expressions can parse and validate sign text strings. (Appendix B)

1.2. Background

The SignWriting script was invented by Valerie Sutton in 1974. The script was written exclusively by hand for 10 years. The script has evolved, spread around the world, and continues to be written on paper and chalkboard.

In 1984, the first SignWriting prototype was created for the Apple IIe and Apple IIc. The application supported only a small subset of the SignWriting script.

In 1986, SignWriter was conceived by Richard Gleaves. Development started on the Apple IIe and Apple IIc. The resulting symbolset was limited due to the 128KB memory limit.

SignWriter DOS continued the development and expanded the symbolset, resulting in the SSS-95.

The SSS-99 was created for SignWriter Java. The revamped symbolset was created without the limitations imposed upon the SSS-95.

The SSS-2002 reorganized the structure of the symbolset imposing a multi level hierarchy with the modern symbol ID. The SSS-2002 was the first symbolset used in the SignBank 2002 application by Todd Duell.

The SSS-2004 was created after reaching widespread international use. The SSS-2004 was the first symbolset used in the SignPuddle application by Steve Slevinski. This symbolset was expanded to include international MovementWriting concepts and became known as the International MovementWriting Alphabet.

The International SignWriting Alphabet 2008 was a major refactoring of the IMWA concept by eliminating the general MovementWriting symbols and focusing on the SignWriting script. The ISWA 2008 was the first symbolset released under the Open Font License.

The International SignWriting Alphabet 2010 was a further refinement of the symbolset to incorporate additional current best practices as deep in the standard as possible. The ISWA 2010 is the result of over 35 years of an inventor working with writers from around the world, and over 25 years of an inventor working with computers and programmers. The design (Section 3) balances complexity, efficiency, and usability. The ISWA 2010 defines 7 categories (Appendix A.1), 30 groups (Appendix A.2), and 652 bases (Appendix A.3). Understanding the basic concepts of the ISWA 2010 allows easy access to the graphemes without memorizing the minute details.

The graphemes of SignWriting are not sufficient for using the script. Additional structures are required to be able to process SignWriting as text. At the very least, the structures of cluster and punctuation must be defined. Additionally, the relationship between the graphemes in the cluster must be formally defined and parsable. These two prime considerations are required for using the script.

Binary SignWriting revision 3 (Appendix B) is the latest optimized script encoding model for SignWriting that uses the x-ISWA-2010 for symbol identity. With additional characters, BSW 3 is capable of rendering the graphemes of SignWriting as text, and includes formal searching and sorting.

1.3. Overview

This memo is the key reference to the Open Standard of SignWriting resulting from the Sutton-Slevinski collaboration that started in 2004 and continues to this day.

Section 1 includes a discussion of terminology, a historical background, and this overview of the document.

Section 2 includes a general discussion of the SignWriting script. Graphemes are written in cluster, divided by punctuation to form text.

Section 3 documents the ISWA 2010 symbolset. A symbol is a reference to a grapheme rather than the grapheme itself. The symbols are organized in a layered hierarchy.

Section 4 defines the x-ISWA-2010 coded character set. Each symbol can be identified with 3 characters.

Section 5 discusses Unicode integration with proposed characters on plane 1 or interchange characters on plane 15.

Appendix A documents the ISWA 2010 data for categories, groups, and bases.

Appendix B presents a script encoding model for SignWriting. Formal structures for text, layout, searching, and sorting are included.

2. Script

SignWriting is the universal script for writing any sign language. Started in 1974, the script was written exclusively by hand for 10 years. The script has spread around the world and continues to be written on paper and chalkboard.

2.1. Grapheme

The grapheme is the fundamental unit of writing for the SignWriting script. Many graphemes of SignWriting are visually iconic. Each grapheme is static with a defined shape and size. Some graphemes can be transformed into other graphemes through a change of variation, fill, or rotation

The main writing graphemes of SignWriting represent a visual conception: either hands, movement, dynamics, timing, head, face, trunk, or limb. The body concept is a combination of trunk and limb. The specific size and shape of each grapheme is designed to balance and complement other graphemes.

The writing graphemes are extensive and specifically organized for written sign language and sign gestures. The writing graphemes do not include the specific graphemes of DanceWriting or the general graphemes of MovementWriting.

The writing graphemes are used in clusters. A cluster is a spatial grouping of graphemes written as a single unit. The graphemes do not change size or shape when combined in a visual pattern. The graphemes can overlap and obscure graphemes underneath. A cluster can represents a sign of a sign language or a visual performance of a sign gesture.

Detailed location graphemes are separate from the main writing graphemes. Detailed location graphemes are used individually or sequentially. They represent isolated analysis that is written outside the cluster.

Punctuation graphemes are used when writing sentences. They are used individually, between clusters.

When written by hand, lines are drawn to form each grapheme. Different styles draw different types of lines: either for personal taste, speed, or quality. The main types of handwriting are formal, cursive, and shorthand. Formal handwriting, equivalent to block printing, includes defined lines for all graphemes, specific palm facings for hand shapes, and detailed arrow heads and tails. Cursive handwriting is more fluid and less detailed. Handwriting for personal use can omit palm facings, generalize arrows, and other liberties of personal consumption. Shorthand is a further reduction of detail, written for speed. Shorthand is a memory aid to a written record and should be rewritten soon after the notes were taken.

Understanding the ratios of size and shape for the graphemes improves hand writing. SignWriting was exclusively hand written script for 10 years.

When written with computers, the graphemes have two aspects. The first is the line that defines the shape of the grapheme. The second aspect is the fill that is sometimes used inside the lines. Not every grapheme has fill. Fill matters when graphemes overlap. The official standard size and shape for each grapheme is defined with a 2 dimensional pixel map of line, fill, and background. Automated vector based refinements have been completed using polygon tracing. Manual vector based refinements for the ISWA 2010 should be completed in 2011.

Each grapheme in SignWriting has two centers: absolute and artistic. The absolute center of the grapheme is based on the width and height of the grapheme. The artistic center of a grapheme is context dependent. For a hand shape grapheme, the artistic center is the center of the palm.

2.2. Cluster

The writing graphemes of the SignWriting script are arranged in spatial clusters on a variably sized 2 dimensional canvas. Many clusters of graphemes are visually iconic. Every cluster has two centers: absolute and artistic.

The absolute center of a cluster is defined as the center of a bounding box: the smallest possible rectangle that encloses a set of graphemes. Graphemes for the head and trunk are special for centering. If a cluster includes any head or trunk graphemes, the bounding box is only placed around those head and trunk graphemes. Otherwise, the bounding box is placed around all of the graphemes in

the cluster.

The artistic center of a cluster is the grapheme(s) that the other graphemes relate or revolve around. A point of contact or a hand grapheme will often represent the artistic center.

2.3. Text

The layout of the SignWriting script is based on clusters and punctuation. Each cluster represents a sign of a sign language or a visual performance of a sign gesture.

Punctuation divides the clusters into sentences. Most commonly, the clusters are arranged vertically, from top to bottom aligned on their absolute centers. Occasionally, the signs are arranged horizontally from left to right.

When written vertically, SignWriting can use 3 different lanes in a column of text to represent body weight shifts. Body weight shifts are important to the grammar of sign languages, used for two different aspects of sign language grammar: 1) role shifting during sign language storytelling, and 2) spatial comparisons of two items under discussion. One "role" or "item" is placed on the right side of the body (right lane), and the other on the left side of the body (left lane), and the weight shifts back and forth between the two, with the narrator in the middle (middle lane).

For body weight shifts to one side or the other, the center of the cluster is aligned with a fixed horizontal offset from the middle lane in either the left or right lane. Punctuation is always used in the middle lane.

2.4. Viewpoints, Planes, & Perspectives

Writing based on vision uses two viewpoints: receptive and expressive. The receptive viewpoint is based on the idea of receiving an image. For the receptive viewpoint, the right hand of a signer will be written on the left side of the canvas. When SignWriting is used for transcription, the receptive view is most often used. The related writing systems of DanceWriting and MovementWriting normally use the receptive viewpoint.

The expressive viewpoint is based on the idea of expressing a concept. For the expressive viewpoint, the right hand of a signer will be written on the right side of the canvas. When SignWriting is used for authorship, the expressive view is most often used.

The are two main writing planes: the front wall (Frontal Plane) and

the floor (Transverse Plane). The choice of writing plane can affect the shape of the graphemes, such as the fill pattern for the hand graphemes or the tail for the movement arrow graphemes.

There are two perspectives: front and top. The front perspective is a straight on view of the signer. The top perspective is a top-down view of the signer. Usually, a cluster will be written from a single perspective.

3. Symbolset

The ISWA 2010 is the abstract symbolset for the x-iswa-2010 coded character set. A symbol is a reference to a grapheme rather than the grapheme itself. Several symbols may reference the same grapheme. The "Circle" base hand shape is a prime example. The first palm facing of the "circle" base uses a single grapheme for all 16 symbols regardless of rotation. The relation between graphemes and symbols is a design feature.

3.1. Grapheme

The grapheme set for the ISWA 2010 is a practical set of unique 2 dimensional bitmaps of line, fill, and background points. This grapheme set is verbose. It includes rotations and mirrors as unique graphemes, particularly for hand shapes and movement arrows. There are 36,600 graphemes in this set.

The ISWA 2010 graphemes are a specific implementation of the SignWriting grapheme ideal. A SignWriting grapheme is a meaningful segment that represents: hands, movement, dynamics, timing, head, face, trunk, limb, detailed location, or punctuation.

3.2. Symbol

A symbol is a reference to a grapheme rather than the grapheme itself. For the ISWA 2010, there are more symbols than graphemes. Several symbols can be assigned to the same grapheme. This results in a relationship that is not bidirectional. It is not always possible to determine the symbol from a grapheme.

There are 37,811 symbols, each with a unique ID. A symbol ID is a sequence of six formatted numbers of increasing detail. The first dashed number defines the category (11). The first two dashed numbers define the group (11-22). The first four dashed numbers define a base (11-22-333-44). The fifth number represents the fill (55). The sixth number represents the rotation (66). A symbol ID is a combination of base ID with a valid fill and a valid rotation. A

symbol ID has the format "nn-nn-nnn-nn-nn-nn", where each "n" is a digit from 0 to 9.

The fill modifier can best be understood through the palm facing of the hand graphemes. The palm facing is based on planes. The SignWriting script uses two planes: the Front Wall (Frontal Plane) and the Floor (Transverse Plane). There are 6 palm facings. The first three palm facings are parallel with the Front Wall. The second three palm facings are parallel with the Floor. The reader can view the signer from different viewpoints (expressive or receptive) and can view the hands from different perspectives (front or top), but no matter what the viewpoint or perspective, the first three Fills represent the palm facing parallel to the Front Wall and the second three Fills represent the palm facing parallel to the Floor.

Fill	Indicator	Meaning
01	grapheme with white palm	reader sees palm of hand parallel Front Wall
02	grapheme with half black palm	reader sees side of hand parallel Front Wall
03	grapheme with black palm	reader sees back of hand parallel Front Wall
04	grapheme with white palm and broken line	reader sees palm of hand parallel Floor
05	grapheme with half black palm and broken line	reader sees side of hand parallel Floor
06	grapheme with black palm and broken line	reader sees palm of hand parallel Floor

Table 1

The fill modifier is redefined for the movement arrows of category 2.

Fill	Indicator	Meaning
01	a grapheme with a black arrow head	movement of the right hand
02	a grapheme with a white arrow head	movement of the left hand
03	a grapheme with a thin, unconnected arrow head	spatial overlapping of movement arrows for the left and right hands when they move as a unit
04	Irregular arrow stems	building blocks for complex movement

Table 2

The rest of the other bases use a fill modifier for grouping and visual organization that is meaningful only for a particular base symbol or small set.

The rotation modifier can best be understood through the hand symbols. The first 8 rotations progress 45 degrees counter clockwise. The last 8 rotations are a mirror of the first 8 and progress 45 degrees clockwise. Zero (0) degrees is understood to point to the top of the grapheme.

Rotation	Direction	Degrees from top
01	Counter Clockwise	0
02	Counter Clockwise	45
03	Counter Clockwise	90
04	Counter Clockwise	135
05	Counter Clockwise	180
06	Counter Clockwise	225
07	Counter Clockwise	270
08	Counter Clockwise	315
09	Clockwise	0
10	Clockwise	45
11	Clockwise	90
12	Clockwise	135
13	Clockwise	180
14	Clockwise	225
15	Clockwise	270
16	Clockwise	315

Table 3

3.3. Hierarchy

The symbols of the ISWA 2010 are placed in a layered hierarchy for organization and access. There are 4 levels to the ISWA 2010 hierarchy: category, group, base, and symbol.

The categories mirror the concept of grapheme classification for the SignWriting script. (Section 2.1)

There are 7 categories. (Appendix A.1) The first number of the

symbol ID identifies the category. The first 5 categories contain writing symbols for use in clusters: 1) Hands, 2) Movement, 3) Dynamics & Timing, 4) Head & Face, and 5) Body. The Body category can be broken into 2 subcategories: 5.1) Trunk and 5.2) Limb.

The 6th category is Detailed Location that contains symbols used alone or in sequence, always outside the cluster. The 7th category is Punctuation that contains symbols used between clusters for text.

There are 30 groups. (Appendix A.2) The first 2 dashed numbers in the symbol ID identify the group. The 30 groups can be divided into 3 sets of 10. The first ten are hands, category 1. The second ten are movements, category 2. The third ten are categories 3 thru 7. In order, 1 group for the Dynamics & Timing category, 1 for Head, 4 for Face, 1 for Trunk, 1 for Limb, 1 for Detailed Location, and 1 for Punctuation.

The 30 groups with symbol ID segment.

First Set	Second Set	Third Set
01-01 Index	02-01 Contact	03-01 Dynamics & Timing
01-02 Index Middle	02-02 Finger Movement	04-01 Head
01-03 Index Middle Thumb	02-03 Straight Wall Plane	04-02 Brow Eyes Eyegaze
01-04 Four Fingers	02-04 Straight Diagonal Plane	04-03 Cheeks Ears Nose Breath
01-05 Five Fingers	02-05 Straight Floor Plane	04-04 Mouth Lips
01-06 Baby Finger	02-06 Curves Parallel Wall Plane	04-05 Tongue Teeth Chin Neck
01-07 Ring Finger	02-07 Curves Hit Wall Plane	05-01 Trunk
01-08 Middle Finger	02-08 Curves Hit Floor Plane	05-02 Limbs
01-09 Index Thumb	02-09 Curves Parallel Floor Plane	06-01 Detailed Location

01-10 Thumb	02-10 Circles	07-01 Punctuation

Table 4

There are 652 bases. (Appendix A.3) The first 4 dashed numbers of a symbol ID identify the base. The 652 bases are divided between the 30 groups. For each group, there are less than 60 bases. The bases are often displayed in columns of 10.

Each base can have up to 96 symbols. All 6 dashed numbers of the symbol ID are required to identify a symbol. Each symbol is a combination of a base, fill, and rotation. The fill is identified by the 5th number of the symbol ID with possible values from 01 to 06. The rotation is identified by the 6th number of the symbol ID with possible values from 01 to 16.

4. Symbol Encoding

The x-iswa-2010 coded character set does not directly encode the graphemes of the SignWriting script. The x-iswa-2010 encodes the symbols of the ISWA 2010. The x-iswa-2010 does not directly encode the symbols of the ISWA 2010, but divides each symbol into a combination of 3 characters. The first character represents the base of the symbol. The next represents the fill of the symbol. The last character represents the rotation of the symbol.

There are 674 characters defined for the x-iswa-2010 coded character set. The first 652 characters represent the symbol bases of the ISWA 2010. The next 6 characters represent the possible fills. The last 16 represent the possible rotations.

4.1. Characters

General Ranges of the x-ISWA-2010

Primary	Secondary	Tertiary	Code	Hex
Base			256 - 907	100 - 38b
Base	Writing		256 - 894	100 - 37e
Base	Writing	Hands	256 - 516	100 - 204
Base	Writing	Movement	517 - 758	205 - 2f6
Base	Writing	Dynamics	759 - 762	2f7 - 2fa
Base	Writing	Timing	763 - 766	2fb - 2fe
Base	Writing	Head	767 - 777	2ff - 309
Base	Writing	Face	778 - 876	30a - 36c
Base	Writing	Trunk	877 - 885	36d - 375
Base	Writing	Limb	886 - 894	376 - 37e
Base	Detailed Location		895 - 902	37f - 386
Base	Punctuation		903 - 907	387 - 38b
Modifiers			908 - 929	38c - 3a1
Modifiers	Fill		908 - 913	38c - 391
Modifiers	Rotation		914 - 929	392 - 3a1

Table 5

Tokenized Ranges for the x-ISWA-2010

Range	Token	Code	Hex	Notes
Writing	w	256 - 894	100 - 37e	A writing base from category 1 thru 5
Detailed Location	s	895 - 902	37f - 386	A detailed location symbol base from category 6 used for isolated or sequential analysis
Punctuation	P	903 - 907	387 - 38b	A punctuation symbol from category 7 used alone between clusters
Fill Modifiers	i	908 - 913	38c - 391	A fill modifier for a symbol base
Rotation Modifiers	o	914 - 929	392 - 3a1	A rotation modifier for a symbol base

Table 6

4.2. Combined Character Sequence

Each symbol of the ISWA 2010 can be expressed with a combination of 3 characters. The first character represents the base of the symbol. The next character represents the fill of the symbol. The last character represents the rotation of the symbol. Since each character can be represented with 3 hexadecimal digits, any symbol can be identified with a string of 9 hexadecimal digits, called the symbol string.

A shorter hexadecimal string, called a symbol key, can be used to identify a symbol with 5 digits. The first 3 represent the base code in hexadecimal. The 4th represents the fill key using 0-5 for fill values 1-6. The 5th represents the rotation key using 0-f for rotation values 1-16.

The symbol string (9 hex) and the symbol key (5 hex) are equivalent representations of the same symbol. They both contain the same base hex. The fill key is equivalent to the fill hex. The rotation key

is equivalent to the rotation hex. Computationally, (fill value = fill code - 907) and (rotation value = rotation code - 913).

Value	Key	Fill Code	Fill Hex	Rotation Code	Rotation Hex
1	0	908	38c	914	392
2	1	909	38d	915	393
3	2	910	38e	916	394
4	3	911	38f	917	395
5	4	912	390	918	396
6	5	913	391	919	397
7	6			91a	398
8	7			91a	399
9	8			91b	39a
10	9			91c	39b
11	a			91d	39c
12	b			91e	39d
13	c			91f	39e
14	d			920	39f
15	e			921	3a0
16	f			922	3a1

Table 7

Further, a 16 bit symbol code exists that is equivalent to the symbol string and the symbol key. This relationship can be stated as (symbol code = ((base code - 256) * 96) + ((fill value - 1) * 16) + rotation value). The first symbol code is 1 and the last valid symbol code is 62,504. The symbol code can be represented with 4 hexadecimal digits, from 0001 to f428.

4.3. Validity

Although there are 6 possible fills and 16 possible rotations, not every combination of base, fill, and rotation is valid. Each base has a set of valid fills and a set of valid rotation. These validity sets contain one or more values from the defined range.

For each value, the inclusion in the validity set can be expressed with a binary value of "0" or "1". For fill values, lining up the binary digit from left to right, will result in a binary string 6 digits long. The value of the 6 digit binary number is 2 ^ (value -1).

Fill Value	1	2	3	4	5	6	Binary	Power of 2
1	X						100000	1
2		X					010000	2
3			X				001000	4
4				X			000100	8
5					X		000010	16
6						X	000001	32

Table 8

The value of any fill validity set is equal to the sum of the power of 2 for each fill value in the set. The empty set is invalid and has a sum of zero (0). The full set of all possible fills has a sum of 63.

Fill Set	1	2	3	4	5	6	Binary	Power of 2
{}							000000	0
{1,2,3,4,5,6}	X	X	X	X	X	X	111111	63

Table 9

Each base has a defined validity set for fills. The "Binary Fills" column in the "Bases" section. (Appendix A.3)

The rotation validity sets have a larger range than the fills. The possible rotation values range from 1 to 16. The power of 2 numbers are 16-bit.

Value	Binary	Power of 2
1	2^0	1
2	2^1	2
3	2^2	4
4	2^3	8
5	2^4	16
6	2^5	32
7	2^6	64
8	2^7	128
9	2^8	256
10	2^9	512
11	2^10	1024
12	2^11	2048
13	2^12	4096
14	2^13	8192
15	2^14	16384
16	2^15	32768

Table 10

The value of a rotation validity set is the summation of the power of 2 numbers. The minimum summation is 1. The largest possible summation is 65,535 where all 16 rotations are valid.

Each base has a defined validity set for rotations. The "Binary Rotations" column in the "Bases" section. (Appendix A.3)

Interestingly enough, there are only 12 possible validity sets in the ISWA 2010.

Sum	Binary	Set
1	100000	{1}
2	010000	{2}
3	110000	{1, 2}
7	111000	{1, 2, 3}
15	111100	{1, 2, 3, 4}
31	111110	{1, 2, 3, 4, 5}
63	111111	{1, 2, 3, 4, 5, 6}
187	11011101	{1, 2, 4, 5, 6, 8}
255	11111111	{1, 2, 3, 4, 5, 6, 7, 8}
511	1111111110000000	{1, 2, 3, 4, 5, 6, 7, 8, 9}
48059	1101110111011101	{1, 2, 4, 5, 6, 8, 9, 10, 12, 13, 14, 16}
65535	1111111111111111	{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16}

Table 11

5. Unicode Integration

The Unicode standard can be used as the character encoding form. The codes for the set are shifted twice. First to shift the range and second to shift the plane.

The first shift moves the codes to a higher range. Each code is increased by 55,046 or d706 in hex. This shifts the 12 bit range of 0fa - 3a1 to the 16 bit range of d806 - daa7.

Ranges of the First x-ISWA-2010 Shift

Primary	Secondary	Tertiary	Hex
Base			d806 - da91
Base	Writing		d806 - da84
Base	Writing	Hands	d806 - d90a
Base	Writing	Movement	d90b - d9fc
Base	Writing	Dynamics	d9fd - da00
Base	Writing	Timing	da01 - da04
Base	Writing	Head	da05 - da0f
Base	Writing	Face	da10 - da72
Base	Writing	Trunk	da73 - da7b
Base	Writing	Limb	da7c - da84
Base	Detailed Location		da85 - da8c
Base	Punctuation		da8d - da91
Modifiers			da92 - daa7
Modifiers	Fill		da92 - da97
Modifiers	Rotation		da98 - daa7

Table 12

5.1. Proposal

A second shift of the 16 bit range of d806 thru daa7 moves the characters to plane 1 with characters in the range of 1d806 thru 1daa7. This proposal will use 3 8-bits rows of Unicode Plane 1 known as the SMP: Supplementary Multilingual Plane. These rows occur inside an unassigned section of the Notational systems.

Ranges of the Unicode Proposal

Concept	Proposed Unicode Range
Writing	U+1D806 - U+1DA84
Detailed Location	U+1DA85 - U+1DA8C
Punctuation	U+1DA8D - U+1DA91
Modifiers	U+1DA92 - U+1DAA7

Table 13

5.2. Interchange

When using Unicode for interchange, plane 15 is used. This second shift results in a character range from U+FD800 to U+FE277. The range is larger due to the additional Binary SignWriting characters. (Appendix B).

Ranges of the Unicode Interchange

Concept	Interchange Unicode Range
Structural Markers	U+FD800 - U+FD003
Writing	U+FD806 - U+FDA84
Detailed Location	U+FDA85 - U+FDA8C
Punctuation	U+FDA8D - U+FDA91
Fill Modifiers	U+FDA92 - U+FDA97
Rotation Modifiers	U+FDA98 - U+FDAA7
Negative Numbers	U+FDAA8 - U+FDE8E
Zero	U+FDE8F
Positive Numbers	U+FDE90 - U+FE277

Table 14

ABNF for SignWriting Interchange

Rule	Formal Definition	Meaning
BASE	%xFD806-%xFDA91	A base symbol of the ISWA 2010, either writing, detailed location, or punctuation
FILL	%xFDA92-%xFDA97	A fill modifier of the ISWA 2010
ROTATION	%xFDA98-%xFDAA7	A rotation modifier of the ISWA 2010
SYMBOL	BASE FILL ROTATION	A potential symbol of the ISWA 2010. Not all possible symbol combinations are valid.
WRITING	%xFD806-%xFDA84 FILL ROTATION	A writing symbol of the ISWA 2010
LOCATION	%xFDA85-%xFDA8C FILL ROTATION	A detailed location symbol of the ISWA 2010
PUNC	%xFDA8D-%xFDA91 FILL ROTATION	A punctuation symbol of the ISWA 2010
ZERO	%xFDE8F	The numerical center of every canvas.
POS	%xFDE8F-%xFE277	Numbers used on the X and Y axis from 0 to 1000.
NEG	%xFDAA8-%xFDE8E	Numbers used on the X and Y axis from -999 to -1.
NUM	POS / NEG	Numbers used on the X and Y axis from -999 to 1000.
COORD	NUM NUM	Two numbers used as a pair of coordinates for the X and Y axis.
SPATIAL	WRITING COORD	A writing symbols of the ISWA 2010 with top-left X,Y coordinates.

CLUSTER	*SPATIAL	Zero or more writing symbols with top-left X,Y coordinates for each symbol
BOX	%xFD802	A structural marker starting a new coordinate space, in the middle lane by default.
LEFT	%xFD801	A structural marker starting a new coordinate space, in the left lane.
RIGHT	%xFD803	A structural marker starting a new coordinate space, in the right lane by default.
SIGN	(LEFT / BOX / RIGHT) CLUSTER	A cluster of spatial symbols in any lane
SEQ	%xFD800	A structural marker for a sequence that will precede a sign.
SEQUENCE	SEQ 1*(WRITING / LOCATION)	A sequence of writing symbols and detailed location symbols on the ISWA 2010
SIGNTEXT	1*(([SEQUENCE] SIGN) / PUNC)	A sign text as a series of signs preceded by optional sequences divided by punctuation.
SIZESIGN	(LEFT / BOX / RIGHT) POS POS CLUSTER	A cluster of spatial symbols in any lane with a defined maximum coordinate and assumed absolute center as 0,0.
PUNCTUATION	PUNC NEG NEG	A punctuation symbol with top-left coordinates and assumed absolute center of 0,0.
LAYOUT	1*(([SEQUENCE] SIZESIGN) / PUNCTUATION)	Sign text for layout adds sizing information. It contains all the required data for text layout.

DISPLAY	1*(BOX POS POS *((WRITING / LOCATION / PUNC) POS POS))	Sign text for display will combine multiple signs and punctuation onto a single canvas. The canvas will most often contain text written in columns or rows. The coordinates 0,0 are assumed as the top-left of the box. The bottom-right coordinates are explicitly stated as 2 positive numbers of width and height.

Table 15

6. IANA Considerations

See IANA: http://www.rfc-editor.org/rfc/rfc2978.txt

Conforms with RFC 2040.

The ISWA 2010 is a stable, well documented standard that is openly available under the Open Font License.

19th September 2008, Valerie Sutton and Steve Slevinski released the open standard of the ISWA 2008 under the open font license. Valerie organized and named 37,811 unique symbols. She hand crafted 36,600 graphemes. Steve analyzed and formatted the ISWA 2008, creating a 16-bit coded character set called the x-ISWA-2008. Steve also created the first iteration of Binary SignWriting as a script encoding model.

The ISWA 2008 was used in a production setting for a year and a half without issue. In 2010, the ISWA 2008 was updated. 576 unused symbols had a palm facing irregularity that needed to be fixed. General size and shape of the symbols did not change.

The small fix opened the idea to a more radical update. The ISWA 2010 was designed as a focused refactor of the ISWA 2008 concepts. The update included a restructured hierarchy, better movement symbols, variation defects were eliminated, new hand shapes were added, and hand shape variations were removed.

11th May 2010, Valerie and Steve released the ISWA 2010. Revision 2 of Binary SignWriting was released for the ISWA 2010. The symbolset and encoding have been stable since release with only a cosmetic fix

for symbol 01-06-017-01-03-10.

22nd June 2010, Steve refactored the coded character set as 12-bit rather than 16-bit to improve searching. The updated model was called Binary SignWriting revision 3.

The appendix in this document defines the final optimization called Binary SignWriting revision 3. This latest model simplifies layout, display, and sorting while dramatically improving processing speed.

No further changes are planned for the symbolset, coded character set, or script encoding model. This document is a statement of stability.

7. Security Considerations

None.

Appendix A. ISWA 2010 Data

A.1. Categories

The 7 Categories of the ISWA 2010

Cat	Purpose	Name	Description
1	Writing	Hands	Handshapes from over 40 Sign Languages are placed in 10 groups based on the numbers 1-10 in American Sign Language.
2	Writing	Movement	Contact symbols, small finger movements, straight arrows, curved arrows and circles are placed into 10 groups based on planes: The Front Wall Plane includes movement that is "parallel to the front wall" and the Floor Plane includes movement that is "parallel to the floor".

3	Writing	Dynamics & Timing	Dynamics Symbols are used to give the "feeling" or "tempo" to movement. They provide emphasis on a movement or expression, and combined with Punctuation Symbols become the equivalent to Exclamation Points. The Tension Symbol, combined with Contact Symbols, provides the feeling of "pressure", and combined with facial expressions can place emphasis or added feeling to an expression. Timing symbols are used to show alternating or simultaneous movement.
4	Writing	Head & Face	Starting with the head and then from the top of the face and moving down.
5	Writing	Body	Torso movement, shoulders, hips, and the limbs are used in Sign Languages as a part of grammar, especially when describing conversations between people, called Role Shifting, or making spatial comparisons between items on the left and items on the right.
6	Detailed Location	Detailed Location	Detailed Location symbols used are used alone or in sequence outside of the cluster. They may be useful for sorting large dictionaries, refining animation, simplifying translation between scripts and notation systems, and for detailed analysis of location sometimes needed in linguistic research.

7	Punctuation	Punctuation	Punctuation symbols are used when writing complete sentences or documents in SignWriting.

Table 16

A.2. Groups

The 30 Groups of the ISWA 2010

Code	Hex	Group	Symbol ID	Name	Token	Color
256	100	1	01-01	Index	w	0000CC
270	10e	2	01-02	Index Middle	w	0000CC
286	11e	3	01-03	Index Middle Thumb	w	0000CC
324	144	4	01-04	Four Fingers	w	0000CC
332	14c	5	01-05	Five Fingers	w	0000CC
390	186	6	01-06	Baby Finger	w	0000CC
420	1a4	7	01-07	Ring Finger	w	0000CC
442	1ba	8	01-08	Middle Finger	w	0000CC
461	1cd	9	01-09	Index Thumb	w	0000CC
501	1f5	10	01-10	Thumb	w	0000CC
517	205	11	02-01	Contact	w	CC0000
534	216	12	02-02	Finger Movement	w	CC0000
554	22a	13	02-03	Straight Wall Plane	w	CC0000
597	255	14	02-04	Straight Diagonal Plane	w	CC0000

613	265	15	02-05	Straight Floor Plane	w	CC0000
648	288	16	02-06	Curves Parallel Wall Plane	w	CC0000
678	2a6	17	02-07	Curves Hit Wall Plane	w	CC0000
695	2b7	18	02-08	Curves Hit Floor Plane	w	CC0000
725	2d5	19	02-09	Curves Parallel Floor Plane	w	CC0000
739	2e3	20	02-10	Circles	w	CC0000
759	2f7	21	03-01	Dynamics & Timing	w	FF0099
767	2ff	22	04-01	Head	w	006600
778	30a	23	04-02	Brow Eyes Eyegaze	w	006600
810	32a	24	04-03	Cheeks Ears Nose Breath	w	006600
827	33b	25	04-04	Mouth Lips	w	006600
857	359	26	04-05	Tongue Teeth Chin Neck	w	006600
877	36d	27	05-01	Trunk	w	000000
886	376	28	05-02	Limbs	w	000000
895	37f	29	06-01	Detailed Location	s	884411
903	387	30	07-01	Punctuation	P	FF9900

Table 17

A.3. Bases

The 652 Bases of the ISWA 2010

Code	Hex	Base Num	Symbol Base	Binary Fills	Binary Rotation	Binary Variations
256	100	1	01-01-001-01 Index	63	65535	1
257	101	2	01-01-002-01 Index on Circle	63	65535	1
258	102	3	01-01-003-01 Index on Cup	63	65535	1
259	103	4	01-01-004-01 Index on Oval	63	65535	1
260	104	5	01-01-005-01 Index on Hinge	63	65535	1
261	105	6	01-01-006-01 Index on Angle	63	65535	1
262	106	7	01-01-007-01 Index Bent	63	65535	1
263	107	8	01-01-008-01 Index Bent on Circle	63	65535	1
264	108	9	01-01-009-01 Index Bent on Fist Thumb Under	63	65535	1
265	109	10	01-01-010-01 Index Raised Knuckle	63	65535	1
266	10a	11	01-01-011-01 Index Cup	63	65535	1
267	10b	12	01-01-012-01 Index Hinge	63	65535	1

268	10c	13	01-01-013-01 Index Hinge Low	63	65535	1
269	10d	14	01-01-014-01 Index Hinge on Circle	63	65535	1
270	10e	15	01-02-001-01 Index Middle	63	65535	1
271	10f	16	01-02-002-01 Index Middle on Circle	63	65535	1
272	110	17	01-02-003-01 Index Middle Bent	63	65535	1
273	111	18	01-02-004-01 Index Middle Raised Knuckles	63	65535	1
274	112	19	01-02-005-01 Index Middle Hinge	63	65535	1
275	113	20	01-02-006-01 Index Up, Middle Hinge	63	65535	1
276	114	21	01-02-007-01 Index Hinge, Middle Up	63	65535	1
277	115	22	01-02-008-01 Index Middle Unit	63	65535	1
278	116	23	01-02-009-01 Index Middle Unit, Index Bent	63	65535	1

279	117	24	01-02-010-01 Index Middle Unit, Middle Bent	63	65535	1
280	118	25	01-02-011-01 Index Middle Unit, Cup	63	65535	1
281	119	26	01-02-012-01 Index Middle Unit, Hinge	63	65535	1
282	11a	27	01-02-013-01 Index Middle Cross	63	65535	1
283	11b	28	01-02-014-01 Index Middle Cross on Circle	63	65535	1
284	11c	29	01-02-015-01 Middle Bent Over Index	63	65535	1
285	11d	30	01-02-016-01 Index Bent Over Middle	63	65535	1
286	11e	31	01-03-001-01 Index Middle Thumb	63	65535	1
287	11f	32	01-03-002-01 Index Middle Thumb on Circle	63	65535	1
288	120	33	01-03-003-01 Index Middle Straight, Thumb Bent	63	65535	1

289	121	34	01-03-004-01 Index Middle Bent, Thumb Straight	63	65535	1
290	122	35	01-03-005-01 Index Middle Thumb Bent	63	65535	1
291	123	36	01-03-006-01 Index Middle Hinge Spread, Thumb Side	63	65535	1
292	124	37	01-03-007-01 Index Up, Middle Hinge, Thumb Side	63	65535	1
293	125	38	01-03-008-01 Index Up, Middle Hinge, Thumb Unit	63	65535	1
294	126	39	01-03-009-01 Index Hinge, Middle Up, Thumb Side	63	65535	1
295	127	40	01-03-010-01 Index Middle Up Spread, Thumb Forward	63	65535	1
296	128	41	01-03-011-01 Index Middle Thumb Cup	63	65535	1
297	129	42	01-03-012-01 Index Middle Thumb Circle	63	65535	1

298	12a	43	01-03-013-01 Index Middle Thumb Hook	63	65535	1
299	12b	44	01-03-014-01 Index Middle Thumb Hinge	63	65535	1
300	12c	45	01-03-015-01 Thumb Between Index Middle Straight	63	65535	1
301	12d	46	01-03-016-01 Index Middle Unit, Thumb Side	63	65535	1
302	12e	47	01-03-017-01 Index Middle Unit, Thumb Side Unit	63	65535	1
303	12f	48	01-03-018-01 Index Middle Unit, Thumb Side Bent	63	65535	1
304	130	49	01-03-019-01 Middle Thumb Hook, Index Up	63	65535	1
305	131	50	01-03-020-01 Index Thumb Hook, Middle Up	63	65535	1
306	132	51	01-03-021-01 Index Middle Unit Hinge, Thumb Side	63	65535	1

307	133	52	01-03-022-01 Index Middle Cross, Thumb Side	63	65535	1
308	134	53	01-03-023-01 Index Middle Unit, Thumb Forward	63	65535	1
309	135	54	01-03-024-01 Index Middle Unit Cup, Thumb Forward	63	65535	1
310	136	55	01-03-025-01 Middle Thumb Cup, Index Up	63	65535	1
311	137	56	01-03-026-01 Index Thumb Cup, Middle Up	63	65535	1
312	138	57	01-03-027-01 Middle Thumb Circle, Index Up	63	65535	1
313	139	58	01-03-028-01 Middle Thumb Circle, Index Hinge	63	65535	1
314	13a	59	01-03-029-01 Index Thumb Angle Out, Middle Up	63	65535	1
315	13b	60	01-03-030-01 Index Thumb Angle In, Middle Up	63	65535	1

316	13c	61	01-03-031-01 Index Thumb Circle, Middle Up	63	65535	1
317	13d	62	01-03-032-01 Index Middle Thumb, Unit Hinge	63	65535	1
318	13e	63	01-03-033-01 Index Middle Thumb, Angle Out	63	65535	1
319	13f	64	01-03-034-01 Index Middle Thumb, Angle	63	65535	1
320	140	65	01-03-035-01 Middle Thumb Angle Out, Index Up	63	65535	1
321	141	66	01-03-036-01 Middle Thumb Angle Out, Index Crossed	63	65535	1
322	142	67	01-03-037-01 Middle Thumb Angle, Index Up	63	65535	1
323	143	68	01-03-038-01 Index Thumb Hook, Middle Hinge	63	65535	1
324	144	69	01-04-001-01 Four Fingers	63	65535	1
325	145	70	01-04-002-01 Four Fingers Bent	63	65535	1

326	146	71	01-04-003-01 Four Fingers Hinge	63	65535	1
327	147	72	01-04-004-01 Four Fingers Unit	63	65535	1
328	148	73	01-04-005-01 Four Fingers Unit Split	63	65535	1
329	149	74	01-04-006-01 Four Fingers Unit Claw	63	65535	1
330	14a	75	01-04-007-01 Four Fingers Unit Bent	63	65535	1
331	14b	76	01-04-008-01 Four Fingers Unit Hinge	63	65535	1
332	14c	77	01-05-001-01 Five Fingers Spread	63	65535	1
333	14d	78	01-05-002-01 Five Fingers Spread Heel	2	65535	1
334	14e	79	01-05-003-01 Five Fingers Spread, Four Bent	63	65535	1
335	14f	80	01-05-004-01 Five Fingers Spread, Four Bent Heel	2	65535	1
336	150	81	01-05-005-01 Five Fingers Spread Bent	63	65535	1

337	151	82	01-05-006-01 Five Fingers Spread Bent Heel	2	65535	1
338	152	83	01-05-007-01 Five Fingers Spread, Thumb Forward	63	65535	1
339	153	84	01-05-008-01 Five Fingers Spread Cup	63	65535	1
340	154	85	01-05-009-01 Five Fingers Spread Cup Open	63	65535	1
341	155	86	01-05-010-01 Five Fingers Spread Hinge Open	63	65535	1
342	156	87	01-05-011-01 Five Fingers Spread Oval	63	65535	1
343	157	88	01-05-012-01 Five Fingers Spread Hinge	63	65535	1
344	158	89	01-05-013-01 Five Fingers Spread Hinge, Thumb Side	63	65535	1
345	159	90	01-05-014-01 Five Fingers Spread Hinge, No Thumb	63	65535	1
346	15a	91	01-05-015-01 Flat	63	65535	1

347	15b	92	01-05-016-01 Flat, Between Palm Facings	15	65535	1
348	15c	93	01-05-017-01 Flat Heel	2	65535	1
349	15d	94	01-05-018-01 Flat, Thumb Side	63	65535	1
350	15e	95	01-05-019-01 Flat, Thumb Side Heel	2	65535	1
351	15f	96	01-05-020-01 Flat, Thumb Bent	63	65535	1
352	160	97	01-05-021-01 Flat, Thumb Forward	63	65535	1
353	161	98	01-05-022-01 Flat Split Index, Thumb Side	63	65535	1
354	162	99	01-05-023-01 Flat Split Center	63	65535	1
355	163	100	01-05-024-01 Flat Split Center, Thumb Side	63	65535	1
356	164	101	01-05-025-01 Flat Split Center, Thumb Side Bent	63	65535	1
357	165	102	01-05-026-01 Flat Split Baby	63	65535	1

358	166	103	01-05-027-01 Claw	63	65535	1
359	167	104	01-05-028-01 Claw, Thumb Side	63	65535	1
360	168	105	01-05-029-01 Claw, No Thumb	63	65535	1
361	169	106	01-05-030-01 Claw, Thumb Forward	63	65535	1
362	16a	107	01-05-031-01 Hook Curlicue	63	65535	1
363	16b	108	01-05-032-01 Hook	63	65535	1
364	16c	109	01-05-033-01 Cup Open	63	65535	1
365	16d	110	01-05-034-01 Cup	63	65535	1
366	16e	111	01-05-035-01 Cup Open, Thumb Side	63	65535	1
367	16f	112	01-05-036-01 Cup, Thumb Side	63	65535	1
368	170	113	01-05-037-01 Cup Open, No Thumb	63	65535	1
369	171	114	01-05-038-01 Cup, No Thumb	63	65535	1

370	172	115	01-05-039-01 Cup Open, Thumb Forward	63	65535	1
371	173	116	01-05-040-01 Cup, Thumb Forward	63	65535	1
372	174	117	01-05-041-01 Curlicue Open	63	65535	1
373	175	118	01-05-042-01 Curlicue	63	65535	1
374	176	119	01-05-043-01 Circle	63	65535	1
375	177	120	01-05-044-01 Oval	63	65535	1
376	178	121	01-05-045-01 Oval, Thumb Side	63	65535	1
377	179	122	01-05-046-01 Oval, No Thumb	63	65535	1
378	17a	123	01-05-047-01 Oval, Thumb Forward	63	65535	1
379	17b	124	01-05-048-01 Hinge Open	63	65535	1
380	17c	125	01-05-049-01 Hinge Open, Thumb Forward	63	65535	1
381	17d	126	01-05-050-01 Hinge	63	65535	1
382	17e	127	01-05-051-01 Hinge Small	63	65535	1

383	17f	128	01-05-052-01 Hinge Open, Thumb Side	63	65535	1
384	180	129	01-05-053-01 Hinge, Thumb Side	63	65535	1
385	181	130	01-05-054-01 Hinge Open, No Thumb	63	65535	1
386	182	131	01-05-055-01 Hinge, No Thumb	63	65535	1
387	183	132	01-05-056-01 Hinge, Thumb Side Touches Index	63	65535	1
388	184	133	01-05-057-01 Hinge, Thumb Between Middle Ring	63	65535	1
389	185	134	01-05-058-01 Angle	63	65535	1
390	186	135	01-06-001-01 Index Middle Ring	63	65535	1
391	187	136	01-06-002-01 Index Middle Ring on Circle	63	65535	1
392	188	137	01-06-003-01 Index Middle Ring on Hinge	63	65535	1
393	189	138	01-06-004-01 Index Middle Ring on Angle	63	65535	1

394	18a	139	01-06-005-01 Baby Hinge	63	65535	1
395	18b	140	01-06-006-01 Index Middle Ring, Bent	63	65535	1
396	18c	141	01-06-007-01 Index Middle Ring, Unit	63	65535	1
397	18d	142	01-06-008-01 Index Middle Ring, Unit Hinge	63	65535	1
398	18e	143	01-06-009-01 Baby Down	63	65535	1
399	18f	144	01-06-010-01 Baby Down, Ripple Straight	63	65535	1
400	190	145	01-06-011-01 Baby Down, Ripple Curved	63	65535	1
401	191	146	01-06-012-01 Baby Down, Others Circle	63	65535	1
402	192	147	01-06-013-01 Baby Up	63	65535	1
403	193	148	01-06-014-01 Baby Up on Fist Thumb Under	63	65535	1
404	194	149	01-06-015-01 Baby Up on Circle	63	65535	1

405	195	150	01-06-016-01 Baby Up on Oval	63	65535	1
406	196	151	01-06-017-01 Baby Up on Angle	63	65535	1
407	197	152	01-06-018-01 Baby Raised Knuckle	63	65535	1
408	198	153	01-06-019-01 Baby Bent	63	65535	1
409	199	154	01-06-020-01 Baby Touches Thumb	63	65535	1
410	19a	155	01-06-021-01 Baby Thumb	63	65535	1
411	19b	156	01-06-022-01 Baby Thumb on Hinge	63	65535	1
412	19c	157	01-06-023-01 Baby Index Thumb	63	65535	1
413	19d	158	01-06-024-01 Baby Index Thumb on Hinge	63	65535	1
414	19e	159	01-06-025-01 Baby Index Thumb, Index Thumb Angle Out	63	65535	1
415	19f	160	01-06-026-01 Baby Index Thumb, Index Thumb Angle	63	65535	1

416	1a0	161	01-06-027-01 Baby Index	63	65535	1
417	1a1	162	01-06-028-01 Baby Index on Circle	63	65535	1
418	1a2	163	01-06-029-01 Baby Index on Hinge	63	65535	1
419	1a3	164	01-06-030-01 Baby Index on Angle	63	65535	1
420	1a4	165	01-07-001-01 Index Middle Baby	63	65535	1
421	1a5	166	01-07-002-01 Index Middle Baby on Circle	63	65535	1
422	1a6	167	01-07-003-01 Index Middle Baby on Hinge	63	65535	1
423	1a7	168	01-07-004-01 Ring Hinge	63	65535	1
424	1a8	169	01-07-005-01 Index Middle Baby on Angle	63	65535	1
425	1a9	170	01-07-006-01 Index Middle Cross with Baby	63	65535	1
426	1aa	171	01-07-007-01 Index Middle Cross with Baby on Circle	63	65535	1

427	1ab	172	01-07-008-01 Ring Down	63	65535	1
428	1ac	173	01-07-009-01 Ring Down, Index Thumb Hook, Middle Hinge	63	65535	1
429	1ad	174	01-07-010-01 Ring Down, Middle Thumb Angle, Index Cross	63	65535	1
430	1ae	175	01-07-011-01 Ring Up	63	65535	1
431	1af	176	01-07-012-01 Ring Raised Knuckle	63	65535	1
432	1b0	177	01-07-013-01 Ring Baby	63	65535	1
433	1b1	178	01-07-014-01 Ring Baby on Circle	63	65535	1
434	1b2	179	01-07-015-01 Ring Baby on Oval	63	65535	1
435	1b3	180	01-07-016-01 Ring Baby on Angle	63	65535	1
436	1b4	181	01-07-017-01 Ring Middle	63	65535	1
437	1b5	182	01-07-018-01 Ring Middle Unit	63	65535	1
438	1b6	183	01-07-019-01 Ring Middle Raised Knuckles	63	65535	1

439	1b7	184	01-07-020-01 Ring Index	63	65535	1
440	1b8	185	01-07-021-01 Ring Thumb	63	65535	1
441	1b9	186	01-07-022-01 Ring Thumb Hook	63	65535	1
442	1ba	187	01-08-001-01 Index Ring Baby	63	65535	1
443	1bb	188	01-08-002-01 Index Ring Baby on Circle	63	65535	1
444	1bc	189	01-08-003-01 Index Ring Baby on Curlicue	63	65535	1
445	1bd	190	01-08-004-01 Index Ring Baby on Hook Out	63	65535	1
446	1be	191	01-08-005-01 Index Ring Baby on Hook In	63	65535	1
447	1bf	192	01-08-006-01 Index Ring Baby on Hook Under	63	65535	1
448	1c0	193	01-08-007-01 Index Ring Baby on Cup	63	65535	1
449	1c1	194	01-08-008-01 Index Ring Baby on Hinge	63	65535	1

450	1c2	195	01-08-009-01 Index Ring Baby on Angle Out	63	65535	1
451	1c3	196	01-08-010-01 Index Ring Baby on Angle	63	65535	1
452	1c4	197	01-08-011-01 Middle Down	63	65535	1
453	1c5	198	01-08-012-01 Middle Hinge	63	65535	1
454	1c6	199	01-08-013-01 Middle Up	63	65535	1
455	1c7	200	01-08-014-01 Middle Up on Circle	63	65535	1
456	1c8	201	01-08-015-01 Middle Raised Knuckle	63	65535	1
457	1c9	202	01-08-016-01 Middle Up, Thumb Side	63	65535	1
458	1ca	203	01-08-017-01 Middle Thumb Hook	63	65535	1
459	1cb	204	01-08-018-01 Middle Thumb Baby	63	65535	1
460	1cc	205	01-08-019-01 Middle Baby	63	65535	1
461	1cd	206	01-09-001-01 Middle Ring Baby	63	65535	1

462	1ce	207	01-09-002-01 Middle Ring Baby on Circle	63	65535	1
463	1cf	208	01-09-003-01 Middle Ring Baby on Curlicue	63	65535	1
464	1d0	209	01-09-004-01 Middle Ring Baby on Cup	63	65535	1
465	1d1	210	01-09-005-01 Middle Ring Baby on Hinge	63	65535	1
466	1d2	211	01-09-006-01 Middle Ring Baby on Angle Out	63	65535	1
467	1d3	212	01-09-007-01 Middle Ring Baby on Angle In	63	65535	1
468	1d4	213	01-09-008-01 Middle Ring Baby on Angle	63	65535	1
469	1d5	214	01-09-009-01 Middle Ring Baby Bent	63	65535	1
470	1d6	215	01-09-010-01 Middle Ring Baby Unit on Claw	63	65535	1
471	1d7	216	01-09-011-01 Middle Ring Baby Unit on Claw Side	63	65535	1

472	1d8	217	01-09-012-01 Middle Ring Baby Unit on Hook Out	63	65535	1
473	1d9	218	01-09-013-01 Middle Ring Baby Unit on Hook In	63	65535	1
474	1da	219	01-09-014-01 Middle Ring Baby Unit on Hook	63	65535	1
475	1db	220	01-09-015-01 Index Hinge	63	65535	1
476	1dc	221	01-09-016-01 Index Thumb Side	63	65535	1
477	1dd	222	01-09-017-01 Index Thumb Side on Hinge	63	65535	1
478	1de	223	01-09-018-01 Index Thumb Side, Thumb Diagonal	63	65535	1
479	1df	224	01-09-019-01 Index Thumb Side, Thumb Unit	63	65535	1
480	1e0	225	01-09-020-01 Index Thumb Side, Thumb Bent	63	65535	1
481	1e1	226	01-09-021-01 Index Thumb Side, Index Bent	63	65535	1

482	1e2	227	01-09-022-01 Index Thumb Side, Both Bent	63	65535	1
483	1e3	228	01-09-023-01 Index Thumb Side, Index Hinge	63	65535	1
484	1e4	229	01-09-024-01 Index Thumb Forward, Index Straight	63	65535	1
485	1e5	230	01-09-025-01 Index Thumb Forward, Index Bent	63	65535	1
486	1e6	231	01-09-026-01 Index Thumb Hook	63	65535	1
487	1e7	232	01-09-027-01 Index Thumb Curlicue	63	65535	1
488	1e8	233	01-09-028-01 Index Thumb Curve, Thumb Inside	63	65535	1
489	1e9	234	01-09-029-01 Index Thumb Curve, Thumb Inside on Claw	63	65535	1
490	1ea	235	01-09-030-01 Index Thumb Curve, Thumb Under	63	65535	1

491	1eb	236	01-09-031-01 Index Thumb Circle	63	65535	1
492	1ec	237	01-09-032-01 Index Thumb Cup	63	65535	1
493	1ed	238	01-09-033-01 Index Thumb Cup Open	63	65535	1
494	1ee	239	01-09-034-01 Index Thumb Hinge Open	63	65535	1
495	1ef	240	01-09-035-01 Index Thumb Hinge Large	63	65535	1
496	1f0	241	01-09-036-01 Index Thumb Hinge	63	65535	1
497	1f1	242	01-09-037-01 Index Thumb Hinge Small	63	65535	1
498	1f2	243	01-09-038-01 Index Thumb Angle Out	63	65535	1
499	1f3	244	01-09-039-01 Index Thumb Angle In	63	65535	1
500	1f4	245	01-09-040-01 Index Thumb Angle	63	65535	1
501	1f5	246	01-10-001-01 Thumb	63	65535	1
502	1f6	247	01-10-002-01 Thumb Heel	2	65535	1

503	1f7	248	01-10-003-01 Thumb Side Diagonal	63	65535	1
504	1f8	249	01-10-004-01 Thumb Side Unit	63	65535	1
505	1f9	250	01-10-005-01 Thumb Side Bent	63	65535	1
506	1fa	251	01-10-006-01 Thumb Forward	63	65535	1
507	1fb	252	01-10-007-01 Thumb Between Index Middle	63	65535	1
508	1fc	253	01-10-008-01 Thumb Between Middle Ring	63	65535	1
509	1fd	254	01-10-009-01 Thumb Between Ring Baby	63	65535	1
510	1fe	255	01-10-010-01 Thumb Under Two Fingers	63	65535	1
511	1ff	256	01-10-011-01 Thumb Over Two Fingers	63	65535	1
512	200	257	01-10-012-01 Thumb Under Three Fingers	63	65535	1
513	201	258	01-10-013-01 Thumb Under Four Fingers	63	65535	1

514	202	259	01-10-014-01 Thumb Over Four Raised Knuckles	63	65535	1
515	203	260	01-10-015-01 Fist	63	65535	1
516	204	261	01-10-016-01 Fist Heel	2	65535	1
517	205	262	02-11-001-01 Touch Single	1	1	1
518	206	263	02-11-002-01 Touch Multiple	3	15	1
519	207	264	02-11-003-01 Touch Between	3	15	1
520	208	265	02-11-004-01 Grasp Single	1	1	1
521	209	266	02-11-005-01 Grasp Multiple	3	15	1
522	20a	267	02-11-006-01 Grasp Between	3	15	1
523	20b	268	02-11-007-01 Strike Single	1	1	1
524	20c	269	02-11-008-01 Strike Multiple	3	15	1
525	20d	270	02-11-009-01 Strike Between	3	15	1
526	20e	271	02-11-010-01 Brush Single	1	1	1

527	20f	272	02-11-011-01 Brush Multiple	3	15	1
528	210	273	02-11-012-01 Brush Between	3	15	1
529	211	274	02-11-013-01 Rub Single	1	1	1
530	212	275	02-11-014-01 Rub Multiple	3	15	1
531	213	276	02-11-015-01 Rub Between	3	15	1
532	214	277	02-11-016-01 Surface Symbols	3	255	1
533	215	278	02-11-017-01 Surface Between	3	15	1
534	216	279	02-12-001-01 Squeeze Large Single	1	1	3
535	217	280	02-12-001-02 Squeeze Small Single	1	1	3
536	218	281	02-12-002-01 Squeeze Large Multiple	3	15	3
537	219	282	02-12-002-02 Squeeze Small Multiple	3	15	3
538	21a	283	02-12-003-01 Squeeze Sequential	63	65535	1

539	21b	284	02-12-004-01 Flick Large Single	1	1	3
540	21c	285	02-12-004-02 Flick Small Single	1	1	3
541	21d	286	02-12-005-01 Flick Large Multiple	3	15	3
542	21e	287	02-12-005-02 Flick Small Multiple	3	15	3
543	21f	288	02-12-006-01 Flick Sequential	63	65535	1
544	220	289	02-12-007-01 Squeeze Flick Alternating	3	255	1
545	221	290	02-12-008-01 Hinge Movement, Up Down Large	31	255	3
546	222	291	02-12-008-02 Hinge Movement, Up Down Small	31	255	3
547	223	292	02-12-009-01 Hinge Movement, Up Sequential	63	65535	3
548	224	293	02-12-009-02 Hinge Movement, Down Sequential	63	65535	3

549	225	294	02-12-010-01 Hinge Movement, Up Down Alternating Large	15	255	3
550	226	295	02-12-010-02 Hinge Movement, Up Down Alternating Small	15	255	3
551	227	296	02-12-011-01 Hinge Movement, Side to Side Scissors	15	255	1
552	228	297	02-12-012-01 Finger Contact Movement, Wall Plane	31	255	1
553	229	298	02-12-013-01 Finger Contact Movement, Floor Plane	31	255	1
554	22a	299	02-13-001-01 Single Straight Movement, Wall Plane Small	15	255	31
555	22b	300	02-13-001-02 Single Straight Movement, Wall Plane Medium	15	255	31

556	22c	301	02-13-001-03 Single Straight Movement, Wall Plane Large	15	255	31
557	22d	302	02-13-001-04 Single Straight Movement, Wall Plane Largest	15	255	31
558	22e	303	02-13-001-05 Single Wrist Flex, Wall Plane	15	255	31
559	22f	304	02-13-002-01 Double Straight Movement, Wall Plane	7	255	3
560	230	305	02-13-002-02 Double Wrist Flex, Wall Plane	7	255	3
561	231	306	02-13-003-01 Double Alternating Movement, Wall Plane	7	65535	3
562	232	307	02-13-003-02 Double Alternating Wrist Flex, Wall Plane	7	65535	3
563	233	308	02-13-004-01 Cross Movement, Wall Plane	7	65535	1

564	234	309	02-13-005-01 Triple Straight Movement, Wall Plane	7	255	3
565	235	310	02-13-005-02 Triple Wrist Flex, Wall Plane	7	255	3
566	236	311	02-13-006-01 Triple Alternating Movement, Wall Plane	7	65535	3
567	237	312	02-13-006-02 Triple Alternating Wrist Flex, Wall Plane	7	65535	3
568	238	313	02-13-007-01 Bend, Wall Plane Small	15	65535	7
569	239	314	02-13-007-02 Bend, Wall Plane Medium	15	65535	7
570	23a	315	02-13-007-03 Bend, Wall Plane Large	15	65535	7
571	23b	316	02-13-008-01 Corner, Wall Plane Small	15	65535	15
572	23c	317	02-13-008-02 Corner, Wall Plane Medium	15	65535	15
573	23d	318	02-13-008-03 Corner, Wall Plane Large	15	65535	15

574	23e	319	02-13-008-04 Corner, Wall Plane with Rotation	15	65535	15
575	23f	320	02-13-009-01 Check, Wall Plane Small	15	65535	7
576	240	321	02-13-009-02 Check, Wall Plane Medium	15	65535	7
577	241	322	02-13-009-03 Check, Wall Plane Large	15	65535	7
578	242	323	02-13-010-01 Box, Wall Plane Small	15	65535	7
579	243	324	02-13-010-02 Box, Wall Plane Medium	15	65535	7
580	244	325	02-13-010-03 Box, Wall Plane Large	15	65535	7
581	245	326	02-13-011-01 Zigzag, Wall Plane Small	15	65535	7
582	246	327	02-13-011-02 Zigzag, Wall Plane Medium	15	65535	7
583	247	328	02-13-011-03 Zigzag, Wall Plane Large	15	65535	7
584	248	329	02-13-012-01 Peaks, Wall Plane Small	15	65535	7

585	249	330	02-13-012-02 Peaks, Wall Plane Medium	15	65535	7
586	24a	331	02-13-012-03 Peaks, Wall Plane Large	15	65535	7
587	24b	332	02-13-013-01 Travel Rotation, Single Wall Plane	63	65535	1
588	24c	333	02-13-014-01 Travel Rotation, Double Wall Plane	63	65535	1
589	24d	334	02-13-015-01 Travel Rotation, Alternating Wall Plane	63	65535	1
590	24e	335	02-13-016-01 Travel Rotation, Single Floor Plane	63	48059	1
591	24f	336	02-13-017-01 Travel Rotation, Double Floor Plane	63	48059	1
592	250	337	02-13-018-01 Travel Rotation, Alternating Floor Plane	63	48059	1

593	251	338	02-13-019-01 Travel Shaking, Wall Plane	7	255	1
594	252	339	02-13-020-01 Travel Arm Spiral, Wall Plane Single	7	65535	7
595	253	340	02-13-020-02 Travel Arm Spiral, Wall Plane Double	7	65535	7
596	254	341	02-13-020-03 Travel Arm Spiral, Wall Plane Triple	7	65535	7
597	255	342	02-14-001-01 Diagonal Away Movement Small	31	187	15
598	256	343	02-14-001-02 Diagonal Away Movement Medium	31	187	15
599	257	344	02-14-001-03 Diagonal Away Movement Large	31	187	15
600	258	345	02-14-001-04 Diagonal Away Movement Largest	31	187	15

601	259	346	02-14-002-01 Diagonal Towards Movement Small	31	187	15
602	25a	347	02-14-002-02 Diagonal Towards Movement Medium	31	187	15
603	25b	348	02-14-002-03 Diagonal Towards Movement Large	31	187	15
604	25c	349	02-14-002-04 Diagonal Towards Movement Largest	31	187	15
605	25d	350	02-14-003-01 Diagonal Between Away Small	15	187	15
606	25e	351	02-14-003-02 Diagonal Between Away Medium	15	187	15
607	25f	352	02-14-003-03 Diagonal Between Away Large	15	187	15
608	260	353	02-14-003-04 Diagonal Between Away Largest	15	187	15

609	261	354	02-14-004-01 Diagonal Between Towards Small	15	187	15
610	262	355	02-14-004-02 Diagonal Between Towards Medium	15	187	15
611	263	356	02-14-004-03 Diagonal Between Towards Large	15	187	15
612	264	357	02-14-004-04 Diagonal Between Towards Largest	15	187	15
613	265	358	02-15-001-01 Single Straight Movement, Floor Plane Small	15	255	31
614	266	359	02-15-001-02 Single Straight Movement, Floor Plane Medium	15	255	31
615	267	360	02-15-001-03 Single Straight Movement, Floor Plane Large	15	255	31

616	268	361	02-15-001-04 Single Straight Movement, Floor Plane Largest	15	255	31
617	269	362	02-15-001-05 Single Wrist Flex, Floor Plane	15	255	31
618	26a	363	02-15-002-01 Double Straight Movement, Floor Plane	7	255	3
619	26b	364	02-15-002-02 Double Wrist Flex, Floor Plane	7	255	3
620	26c	365	02-15-003-01 Double Alternating Movement, Floor Plane	7	65535	3
621	26d	366	02-15-003-02 Double Alternating Wrist Flex, Floor Plane	7	65535	3
622	26e	367	02-15-004-01 Cross Movement, Floor Plane	7	65535	1
623	26f	368	02-15-005-01 Triple Straight Movement, Floor Plane	7	255	3

624	270	369	02-15-005-02 Triple Wrist Flex, Floor Plane	7	255	3
625	271	370	02-15-006-01 Triple Alternating Movement, Floor Plane	7	65535	3
626	272	371	02-15-006-02 Triple Alternating Wrist Flex, Floor Plane	7	65535	3
627	273	372	02-15-007-01 Bend, Floor Plane	15	65535	1
628	274	373	02-15-008-01 Corner, Floor Plane Small	15	65535	7
629	275	374	02-15-008-02 Corner, Floor Plane Medium	15	65535	7
630	276	375	02-15-008-03 Corner, Floor Plane Large	15	65535	7
631	277	376	02-15-009-01 Check, Floor Plane	15	65535	1
632	278	377	02-15-010-01 Box, Floor Plane Small	15	65535	7
633	279	378	02-15-010-02 Box, Floor Plane Medium	15	65535	7

634	27a	379	02-15-010-03 Box, Floor Plane Large	15	65535	7
635	27b	380	02-15-011-01 Zigzag, Floor Plane Small	15	65535	7
636	27c	381	02-15-011-02 Zigzag, Floor Plane Medium	15	65535	7
637	27d	382	02-15-011-03 Zigzag, Floor Plane Large	15	65535	7
638	27e	383	02-15-012-01 Peaks, Floor Plane Small	15	65535	7
639	27f	384	02-15-012-02 Peaks, Floor Plane Medium	15	65535	7
640	280	385	02-15-012-03 Peaks, Floor Plane Large	15	65535	7
641	281	386	02-15-013-01 Travel Rotation Single Floor Plane	63	65535	1
642	282	387	02-15-014-01 Travel Rotation Double Floor Plane	63	65535	1
643	283	388	02-15-015-01 Travel Rotation Alternating Floor Plane	63	65535	1

644	284	389	02-15-016-01 Travel Rotation Single Wall Plane	63	65535	1
645	285	390	02-15-017-01 Travel Rotation Double Wall Plane	63	65535	1
646	286	391	02-15-018-01 Travel Rotation Alternating Wall Plane	63	65535	1
647	287	392	02-15-019-01 Travel Shaking Floor Plane	7	255	1
648	288	393	02-16-001-01 Curve Wall Plane, Quarter Small	15	65535	15
649	289	394	02-16-001-02 Curve Wall Plane, Quarter Medium	15	65535	15
650	28a	395	02-16-001-03 Curve Wall Plane, Quarter Large	15	65535	15
651	28b	396	02-16-001-04 Curve Wall Plane, Quarter Largest	15	65535	15

652	28c	397	02-16-002-01 Curve Wall Plane, Half Circle Small	15	65535	15
653	28d	398	02-16-002-02 Curve Wall Plane, Half Circle Medium	15	65535	15
654	28e	399	02-16-002-03 Curve Wall Plane, Half Circle Large	15	65535	15
655	28f	400	02-16-002-04 Curve Wall Plane, Half Circle Largest	15	65535	15
656	290	401	02-16-003-01 Curve Wall Plane, 3 Quarter Circle Small	15	65535	3
657	291	402	02-16-003-02 Curve Wall Plane, 3 Quarter Circle Medium	15	65535	3
658	292	403	02-16-004-01 Hump Wall Plane Small	15	65535	7
659	293	404	02-16-004-02 Hump Wall Plane Medium	15	65535	7
660	294	405	02-16-004-03 Hump Wall Plane Large	15	65535	7

661	295	406	02-16-005-01 Loop Wall Plane Small	15	65535	15
662	296	407	02-16-005-02 Loop Wall Plane Medium	15	65535	15
663	297	408	02-16-005-03 Loop Wall Plane Large	15	65535	15
664	298	409	02-16-005-04 Loop Wall Plane Small Double	15	65535	15
665	299	410	02-16-006-01 Wave Wall Plane 2 Curves Small	15	65535	31
666	29a	411	02-16-006-02 Wave Wall Plane 2 Curves Medium	15	65535	31
667	29b	412	02-16-006-03 Wave Wall Plane 2 Curves Large	15	65535	31
668	29c	413	02-16-006-04 Wave Wall Plane 3 Curves Small	15	65535	31
669	29d	414	02-16-006-05 Wave Wall Plane 3 Curves Medium	15	65535	31

670	29e	415	02-16-006-06 Wave Wall Plane 3 Curves Large	15	65535	31
671	29f	416	02-16-007-01 Curve Then Straight Movement Wall Plane	15	65535	7
672	2a0	417	02-16-007-02 Curved Cross Movement Wall Small	15	65535	7
673	2a1	418	02-16-007-03 Curved Cross Movement Wall Medium	15	65535	7
674	2a2	419	02-16-008-01 Rotation Single Wall Plane	63	65535	1
675	2a3	420	02-16-009-01 Rotation Double Wall Plane	63	65535	1
676	2a4	421	02-16-010-01 Rotation Alternate Wall Plane	63	65535	1
677	2a5	422	02-16-011-01 Shaking Wall Plane	31	65535	1
678	2a6	423	02-17-001-01 Curve Hits Front Wall	7	15	1
679	2a7	424	02-17-002-01 Hump Hits Front Wall	7	15	1

680	2a8	425	02-17-003-01 Loop Hits Front Wall	7	15	1
681	2a9	426	02-17-004-01 Wave Hits Front Wall	7	15	1
682	2aa	427	02-17-005-01 Rotation Single Hits Front Wall	7	15	1
683	2ab	428	02-17-006-01 Rotation Double Hits Front Wall	7	15	1
684	2ac	429	02-17-007-01 Rotation Alternating Hits Front Wall	7	15	1
685	2ad	430	02-17-009-01 Curve Hits Chest	7	15	1
686	2ae	431	02-17-010-01 Hump Hits Chest	7	15	1
687	2af	432	02-17-011-01 Loop Hits Chest	7	15	1
688	2b0	433	02-17-012-01 Wave Hits Chest	7	15	1
689	2b1	434	02-17-013-01 Rotation Single Hits Chest	7	15	1

690	2b2	435	02-17-014-01 Rotation Double Hits Chest	7	15	1
691	2b3	436	02-17-015-01 Rotation Alternating Hits Chest	7	15	1
692	2b4	437	02-17-016-01 Wave Diagonal Path Small	7	48059	7
693	2b5	438	02-17-016-02 Wave Diagonal Path Medium	7	48059	7
694	2b6	439	02-17-016-03 Wave Diagonal Path Large	7	48059	7
695	2b7	440	02-18-001-01 Curve Hits Ceiling Small	63	255	3
696	2b8	441	02-18-001-02 Curve Hits Ceiling Large	63	255	3
697	2b9	442	02-18-002-01 Hump Hits Ceiling 2 Humps Small	15	255	15
698	2ba	443	02-18-002-02 Hump Hits Ceiling 2 Humps Large	15	255	15

699	2bb	444	02-18-002-03 Hump Hits Ceiling 3 Humps Small	15	255	15
700	2bc	445	02-18-002-04 Hump Hits Ceiling 3 Humps Large	15	255	15
701	2bd	446	02-18-003-01 Loop Hits Ceiling Small Single	15	255	15
702	2be	447	02-18-003-02 Loop Hits Ceiling Large Single	15	255	15
703	2bf	448	02-18-003-03 Loop Hits Ceiling Small Double	15	255	15
704	2c0	449	02-18-003-04 Loop Hits Ceiling Large Double	15	255	15
705	2c1	450	02-18-004-01 Wave Hits Ceiling Small	15	255	3
706	2c2	451	02-18-004-02 Wave Hits Ceiling Large	15	255	3
707	2c3	452	02-18-005-01 Rotation Single Hits Ceiling	63	255	1

708	2c4	453	02-18-006-01 Rotation Double Hits Ceiling	63	255	1
709	2c5	454	02-18-007-01 Rotation Alternating Hits Ceiling	63	255	1
710	2c6	455	02-18-008-01 Curve Hits Floor Small	63	255	3
711	2c7	456	02-18-008-02 Curve Hits Floor Large	63	255	3
712	2c8	457	02-18-009-01 Hump Hits Floor 2 Humps Small	15	255	15
713	2c9	458	02-18-009-02 Hump Hits Floor 2 Humps Large	15	255	15
714	2ca	459	02-18-009-03 Hump Hits Floor 3 Humps Small	15	255	15
715	2cb	460	02-18-009-04 Hump Hits Floor 3 Humps Large	15	255	15
716	2cc	461	02-18-010-01 Loop Hits Floor Small Single	15	255	15
717	2cd	462	02-18-010-02 Loop Hits Floor Large Single	15	255	15

718	2ce	463	02-18-010-03 Loop Hits Floor Small Double	15	255	15
719	2cf	464	02-18-010-04 Loop Hits Floor Large Double	15	255	15
720	2d0	465	02-18-011-01 Wave Hits Floor Small	15	255	3
721	2d1	466	02-18-011-02 Wave Hits Floor Large	15	255	3
722	2d2	467	02-18-012-01 Rotation Single Hits Floor	63	255	1
723	2d3	468	02-18-013-01 Rotation Double Hits Floor	63	255	1
724	2d4	469	02-18-014-01 Rotation Alternating Hits Floor	63	255	1
725	2d5	470	02-19-001-01 Curve Floor Plane Small	15	65535	31
726	2d6	471	02-19-001-02 Curve Floor Plane Medium 1	15	65535	31
727	2d7	472	02-19-001-03 Curve Floor Plane Medium 2	15	65535	31

728	2d8	473	02-19-001-04 Curve Floor Plane Large	15	65535	31
729	2d9	474	02-19-001-05 Curve Floor Plane Combined	15	65535	31
730	2da	475	02-19-002-01 Hump Floor Plane Small	15	65535	1
731	2db	476	02-19-003-01 Loop Floor Plane Small	15	65535	1
732	2dc	477	02-19-004-01 Wave Floor Plane Snake	15	65535	7
733	2dd	478	02-19-004-02 Wave Floor Plane Small	15	65535	7
734	2de	479	02-19-004-03 Wave Floor Plane Large	15	65535	7
735	2df	480	02-19-005-01 Rotation Single Floor Plane	63	65535	1
736	2e0	481	02-19-006-01 Rotation Double Floor Plane	63	65535	1
737	2e1	482	02-19-007-01 Rotation Alternating Floor Plane	63	65535	1

738	2e2	483	02-19-008-01 Shaking Parallel Floor	31	65535	1
739	2e3	484	02-20-001-01 Arm Circle Wall Small Single	7	65535	3
740	2e4	485	02-20-001-02 Arm Circle Wall Medium Single	7	65535	3
741	2e5	486	02-20-002-01 Arm Circle Wall Small Double	7	65535	3
742	2e6	487	02-20-002-02 Arm Circle Wall Medium Double	7	65535	3
743	2e7	488	02-20-003-01 Arm Circle Hits Wall Small Single	63	65535	7
744	2e8	489	02-20-003-02 Arm Circle Hits Wall Medium Single	63	65535	7
745	2e9	490	02-20-003-03 Arm Circle Hits Wall Large Single	63	65535	7
746	2ea	491	02-20-004-01 Arm Circle Hits Wall Small Double	63	65535	7

747	2eb	492	02-20-004-02 Arm Circle Hits Wall Medium Double	63	65535	7
748	2ec	493	02-20-004-03 Arm Circle Hits Wall Large Double	63	65535	7
749	2ed	494	02-20-005-01 Wrist Circle Front Wall Single	7	65535	3
750	2ee	495	02-20-005-02 Wrist Circle Front Wall Double	7	65535	3
751	2ef	496	02-20-006-01 Wrist Circle Hits Wall Single	7	63	3
752	2f0	497	02-20-006-02 Wrist Circle Hits Wall Double	7	63	3
753	2f1	498	02-20-007-01 Finger Circles Wall Single	3	255	15
754	2f2	499	02-20-007-02 Finger Circles Wall Double	3	255	15
755	2f3	500	02-20-007-03 Finger Circles Hits Wall Single	3	255	15

756	2f4	501	02-20-007-04 Finger Circles Hits Wall Double	3	255	15
757	2f5	502	02-20-008-01 Arrowheads Small	63	255	3
758	2f6	503	02-20-008-02 Arrowheads Large	63	255	3
759	2f7	504	03-21-001-01 Fast	15	1	1
760	2f8	505	03-21-002-01 Slow	1	255	1
761	2f9	506	03-21-003-01 Tense	15	1	3
762	2fa	507	03-21-003-02 Relaxed	15	1	3
763	2fb	508	03-21-004-01 Same Time	1	255	15
764	2fc	509	03-21-004-02 Same Time Alternating	1	255	15
765	2fd	510	03-21-004-03 Every Other Time	1	255	15
766	2fe	511	03-21-004-04 Gradual	1	255	15
767	2ff	512	04-22-001-01 Head	15	15	1
768	300	513	04-22-002-01 Head Rims	1	255	1

769	301	514	04-22-003-01 Head Movement Straight Wall Plane	63	255	1
770	302	515	04-22-004-01 Head Movement Tilts Wall Plane	63	3	1
771	303	516	04-22-005-01 Head Movement Straight Floor Plane	63	255	1
772	304	517	04-22-006-01 Head Movement Curves Wall Plane	3	15	1
773	305	518	04-22-007-01 Head Movement Curves Floor Plane	3	15	1
774	306	519	04-22-008-01 Head Movement Circles	3	15	1
775	307	520	04-22-009-01 Face Direction Positions, Nose Forward Tilting	63	3	1

776	308	521	04-22-010-01 Face Direction Positions, Nose Up or Down	7	65535	3
777	309	522	04-22-010-02 Face Direction Positions, Nose Up or Down Tilting	7	65535	3
778	30a	523	04-23-001-01 Eyebrows Straight Up	63	1	7
779	30b	524	04-23-001-02 Eyebrows Straight Neutral	63	1	7
780	30c	525	04-23-001-03 Eyebrows Straight Down	63	1	7
781	30d	526	04-23-002-01 Dreamy Eyebrows Neutral Down	63	1	15
782	30e	527	04-23-002-02 Dreamy Eyebrows Down Neutral	63	1	15
783	30f	528	04-23-002-03 Dreamy Eyebrows Up Neutral	63	1	15
784	310	529	04-23-002-04 Dreamy Eyebrows Neutral-Up	63	1	15

785	311	530	04-23-003-01 Forehead Neutral	3	1	7
786	312	531	04-23-003-02 Forehead Contact	3	1	7
787	313	532	04-23-003-03 Forehead Wrinkled	3	1	7
788	314	533	04-23-004-01 Eyes Open	31	1	31
789	315	534	04-23-004-02 Eyes Squeezed	31	1	31
790	316	535	04-23-004-03 Eyes Closed	31	1	31
791	317	536	04-23-004-04 Eye Blink Single	31	1	31
792	318	537	04-23-004-05 Eye Blinks Multiple	31	1	31
793	319	538	04-23-005-01 Eyes Half Open	31	1	31
794	31a	539	04-23-005-02 Eyes Wide Open	31	1	31
795	31b	540	04-23-005-03 Eyes Half Closed	31	1	31
796	31c	541	04-23-005-04 Eyes Widening Movement	31	1	31

797	31d	542	04-23-005-05 Eye Wink (Squeezed Eye Blink)	31	1	31
798	31e	543	04-23-006-01 Eyelashes Up	31	1	7
799	31f	544	04-23-006-02 Eyelashes Down	31	1	7
800	320	545	04-23-006-03 Eyelashes Fluttering	31	1	7
801	321	546	04-23-007-01 Eyegaze Straight Wall Plane	15	255	7
802	322	547	04-23-007-02 Eyegaze Straight Wall Double	15	255	7
803	323	548	04-23-007-03 Eyegaze Straight Wall Alternate	15	255	7
804	324	549	04-23-008-01 Eyegaze Straight Floor Plane	15	255	7
805	325	550	04-23-008-02 Eyegaze Straight Floor Double	15	255	7
806	326	551	04-23-008-03 Eyegaze Straight Floor Alternate	15	255	7

807	327	552	04-23-009-01 Eyegaze Curved Wall Plane	7	65535	1
808	328	553	04-23-010-01 Eyegaze Curved Floor Plane	7	255	1
809	329	554	04-23-011-01 Eyegaze Circles Wall Plane	7	255	1
810	32a	555	04-24-001-01 Cheeks Puffed	31	1	7
811	32b	556	04-24-001-02 Cheeks Neutral	31	1	7
812	32c	557	04-24-001-03 Cheeks Sucked	31	1	7
813	32d	558	04-24-002-01 Tense Cheeks High	15	1	7
814	32e	559	04-24-002-02 Tense Cheeks Middle	15	1	7
815	32f	560	04-24-002-03 Tense Cheeks Low	15	1	7
816	330	561	04-24-003-01 Ears	31	1	1
817	331	562	04-24-004-01 Nose Neutral	3	1	15
818	332	563	04-24-004-02 Nose Contact	3	1	15

819	333	564	04-24-004-03 Nose Wrinkles	3	1	15
820	334	565	04-24-004-04 Nose Wiggles	3	1	15
821	335	566	04-24-005-01 Air Blowing Out	63	1	3
822	336	567	04-24-005-02 Air Sucking In	63	1	3
823	337	568	04-24-006-01 Air Blow Small Rotations	3	255	3
824	338	569	04-24-006-02 Air Suck Small Rotations	3	255	3
825	339	570	04-24-007-01 Breath Exhale	63	1	3
826	33a	571	04-24-007-02 Breath Inhale	63	1	3
827	33b	572	04-25-001-01 Mouth Closed Neutral	3	1	7
828	33c	573	04-25-001-02 Mouth Closed Forward	3	1	7
829	33d	574	04-25-001-03 Mouth Closed Contact	3	1	7
830	33e	575	04-25-002-01 Mouth Smile	3	1	7

831	33f	576	04-25-002-02 Mouth Smile Wrinkled	3	1	7
832	340	577	04-25-002-03 Mouth Smile Open	3	1	7
833	341	578	04-25-003-01 Mouth Frown	3	1	7
834	342	579	04-25-003-02 Mouth Frown Wrinkled	3	1	7
835	343	580	04-25-003-03 Mouth Frown Open	3	1	7
836	344	581	04-25-004-01 Mouth Open Circle	3	1	7
837	345	582	04-25-004-02 Mouth Open Forward	3	1	7
838	346	583	04-25-004-03 Mouth Open Wrinkled	3	1	7
839	347	584	04-25-005-01 Mouth Open Oval	3	1	7
840	348	585	04-25-005-02 Mouth Open Oval Wrinkled	3	1	7
841	349	586	04-25-005-03 Mouth Open Oval Yawn	3	1	7
842	34a	587	04-25-006-01 Mouth Open Rectangle	3	1	7

843	34b	588	04-25-006-02 Mouth Open Rectangle Wrinkled	3	1	7
844	34c	589	04-25-006-03 Mouth Open Rectangle Yawn	3	1	7
845	34d	590	04-25-007-01 Mouth Kiss	3	1	7
846	34e	591	04-25-007-02 Mouth Kiss Forward	3	1	7
847	34f	592	04-25-007-03 Mouth Kiss Wrinkled	3	1	7
848	350	593	04-25-008-01 Mouth Tense	3	1	7
849	351	594	04-25-008-02 Mouth Tense Forward	3	1	7
850	352	595	04-25-008-03 Mouth Tense Sucked	3	1	7
851	353	596	04-25-009-01 Lips Pressed Together	3	1	7
852	354	597	04-25-009-02 Lip Lower Over Upper	3	1	7
853	355	598	04-25-009-03 Lip Upper Over Lower	3	1	7
854	356	599	04-25-010-01 Mouth Corners	63	1	1

855	357	600	04-25-011-01 Mouth Wrinkles Single	63	1	3
856	358	601	04-25-011-02 Mouth Wrinkles Double	63	1	3
857	359	602	04-26-001-01 Tongue Sticks Out Far	3	255	31
858	35a	603	04-26-001-02 Tongue Licks Lips	3	255	31
859	35b	604	04-26-001-03 Tongue Tip Between Lips	3	255	31
860	35c	605	04-26-001-04 Tongue Tip Touches Inside Mouth	3	255	31
861	35d	606	04-26-001-05 Tongue Inside Mouth Relaxed	3	255	31
862	35e	607	04-26-002-01 Tongue Moves Against Cheek	15	255	1
863	35f	608	04-26-003-01 Tongue Center Sticks Out	63	1	1
864	360	609	04-26-004-01 Tongue Center Inside Mouth	15	1	1

865	361	610	04-26-005-01 Teeth	63	1	3
866	362	611	04-26-005-02 Teeth Movement	63	1	3
867	363	612	04-26-006-01 Teeth on Tongue	63	1	3
868	364	613	04-26-006-02 Teeth on Tongue Movement	63	1	3
869	365	614	04-26-007-01 Teeth on Lips	63	1	3
870	366	615	04-26-007-02 Teeth on Lips Movement	63	1	3
871	367	616	04-26-008-01 Teeth Bite Lips	63	1	1
872	368	617	04-26-009-01 Jaw Movement Wall Plane	7	255	1
873	369	618	04-26-010-01 Jaw Movement Floor Plane	7	255	1
874	36a	619	04-26-011-01 Neck	63	1	1
875	36b	620	04-26-012-01 Hair	15	1	1
876	36c	621	04-26-013-01 Excitement	15	1	1

877	36d	622	05-27-001-01 Shoulder Hip Spine	7	15	1
878	36e	623	05-27-002-01 Shoulder Hip Positions	31	63	1
879	36f	624	05-27-003-01 Shoulder Hip Move Wall Plane	63	65535	1
880	370	625	05-27-004-01 Shoulder Hip Move Floor Plane	63	65535	1
881	371	626	05-27-005-01 Shoulder Tilts (from Waist)	63	65535	1
882	372	627	05-27-006-01 Torso Straight Stretch Wall	15	15	1
883	373	628	05-27-007-01 Torso Curved Bend Wall	15	15	1
884	374	629	05-27-008-01 Torso Twist Floor Plane	15	15	1
885	375	630	05-27-009-01 Upper Body Tilts (from Hip Joints)	63	255	1
886	376	631	05-28-001-01 Limb Combinations	1	65535	1

887	377	632	05-28-002-01 Limb Length 1	3	65535	15
888	378	633	05-28-002-02 Limb Length 2	3	65535	15
889	379	634	05-28-002-03 Limb Length 3	3	65535	15
890	37a	635	05-28-002-04 Limb Length 4	3	65535	15
891	37b	636	05-28-003-01 Limb Length 5	3	65535	7
892	37c	637	05-28-003-02 Limb Length 6	3	65535	7
893	37d	638	05-28-003-03 Limb Length 7	3	65535	7
894	37e	639	05-28-004-01 Fingers	63	65535	1
895	37f	640	06-29-001-01 Location Space Wall Plane	15	255	3
896	380	641	06-29-001-02 Location Space Floor Plane	15	255	3
897	381	642	06-29-002-01 Location Height	3	255	1

898	382	643	06-29-003-01 Location Width	1	511	1
899	383	644	06-29-004-01 Location Depth	1	255	1
900	384	645	06-29-005-01 Location Head Neck	63	255	1
901	385	646	06-29-006-01 Location Torso	31	255	1
902	386	647	06-29-007-01 Location Limbs Digits	63	65535	1
903	387	648	07-30-001-01 Comma	15	255	3
904	388	649	07-30-001-02 Period	15	255	3
905	389	650	07-30-002-01 Semi Colon	1	255	3
906	38a	651	07-30-002-02 Colon	1	255	3
907	38b	652	07-30-003-01 Parentheses	1	255	1

Table 18

Appendix B. Script Encoding

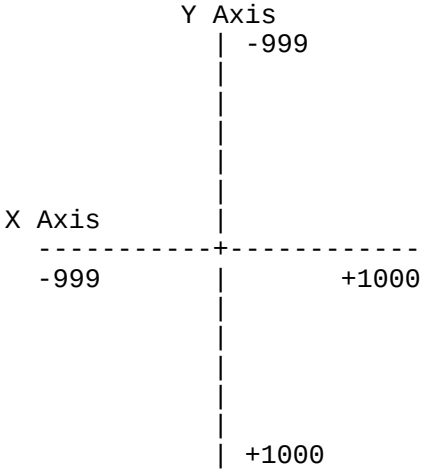
Binary SignWriting is the name of the heuristic script encoding model for SignWriting. The first draft of BSW was created in 2008. Through trial and error, the model was successively refactored to reduce the complexity and the computation cost of the implementations. This final implementation, Binary SignWriting revision 3, is optimized for common usage and processing. The x-BSW3 coded character set is a superset of the x-ISWA-2010.

B.1. Design

Binary SignWriting is a Cartesian coordinate based system. The data for BSW 3 uses a series of canvases, each with a unique coordinate space. General sign text (Appendix B.2.1) can use any section of the coordinate space. Sign text for layout (Appendix B.2.2) requires that each sign uses the coordinates 0,0 as the absolute center (Section 2.2). Sign text for display (Appendix B.2.3) defines the top left of every canvas as 0,0 and does not use negative numbers.

B.1.1. Canvas

Binary SignWriting limits the size of canvases by the range of possible numbers from -999 to 1,000. Most canvases will only use a small section of the coordinate space. A cluster is a spatial grouping of symbols. Each cluster is oriented on a separate canvas. Each canvas has an X and Y axis from -999 to 1,000. Symbols are placed on the canvas with coordinates that represent the top-left of the symbol glyph.



B.1.2. Sequence

A sequence is a list of writing symbols and/or detailed location symbols. A valid sequence must contain at least one symbol and can not contain punctuation. A sequence is an optional sign prefix. For a set of signs, the sequence is used for searching and sorting.

There are several theories on the best way to structure a sequence. The most productive is based on the SignSpelling Sequence theory of Valerie Sutton. A sequence is structured as a series of starting handshapes followed by optional movements, transitional handshapes, movement, and end handshapes. Only symbols from category 1 (hands) and category 2 (movement) should be used in this first section. The last section of the sequence should contain symbols of dynamics & timing, head & face, or body: categories 3, 4, and 5.

Detailed location symbols from category 6 can be used in a sequence, but are rarely (if ever) needed for a sequence in general writing.

B.1.3. Characters

The Binary SignWriting revision 3 character set includes all of the x-ISWA-2010 plus structural markers and number characters.

Character Ranges of the x-bsw3

Section	Name	Token	Code	Hex
Structural Marker	Sequence	Q	250	0fa
Structural Marker	Left Lane Sign Box	L	251	0fb
Structural Marker	Middle Lane Sign Box	B	252	0fc
Structural Marker	Right Lane Sign Box	R	253	0fd
ISWA 2010 Base	Writing	w	256 - 894	100 - 37e
ISWA 2010 Base	Detailed Location	s	895 - 902	37f - 386

ISWA 2010 Base	Punctuation	P	903 - 907	387 - 38b
ISWA 2010 Modifiers	Fill	i	908 - 913	38c - 391
ISWA 2010 Modifiers	Rotation	o	914 - 929	392 - 3a1
Number Character		n	930 - 2929	3a2 - b71

Table 19

A string of x-bsw3 characters must be well formed to be valid. Validity can be determined with regular expressions. Validity can be verified with a left to right parser, one character at a time. Validity can be defined with ABNF.

B.1.4. Tokens

There are 10 tokens used with Binary SignWriting revision 3. They can be grouped in 4 layers: the 4 structural makers, the 3 ranges of base symbols, the 2 modifiers, and the numbers.

```
 Q L B R
  w s P
   i o
    n
```

A string of x-BSW3 characters can be visualized as tokens rather than characters. A tokenized view replaces each character with 1 of the 10 token values. The use of tokens clarifies structures and simplifies regular expressions.

wio - a writing symbol as 3 characters of writing base, fill modifier and rotation modifier.

nn - coordinates with X and Y values as 2 numbers.

wionn - a spatial symbol as 5 characters with 3 characters of a writing symbol and 2 characters for coordinates for top left placement.

(wionn)* - zero or more spatial symbols.

[ws] - a writing base symbol or a detailed location base symbol.

[ws]io - a writing symbol or a detailed location symbol.

([ws]io)+ - one or more writing symbols and/or detailed location symbols.

Pio - a punctuation symbol as a punctuation base symbol with a fill modifier and a rotation modifier.

B.2. Text as Data

There are 3 flavors of Binary SignWriting 3: text, layout, and display.

B.2.1. Minimal

A minimal sign text string contains the minimal amount of data required to represent text. It defines signs and punctuations. A sign is defined with a lane and zero or more spatial writing symbol. A sign can be preceded by an optional sequence. Punctuation is always used alone. A sign canvas can use any section of the coordinate space.

[LBR](wionn)* - a cluster of writing symbols in a lane

(Q([ws]io)+)? - an optional sequence of writing and/or detailed location symbols

Pio - a punctuation symbol

((Q([ws]io)+)?[LBR](wionn)*)|(Pio) - a sign text

B.2.2. Layout

A layout sign text string defines maximum coordinates for signs and top-left coordinates for punctuation. Defining sizes in the data stream makes layout possible without needing to access symbol size. Sign text for layout requires that each sign uses the coordinates 0,0 as the absolute center (Section 2.2).

[LBR]nn(wionn)* - a cluster of writing symbols in a lane with defined maximum coordinates

(Q([ws]io)+)? - an optional sequence of writing and/or detailed location symbols

Pionn - a punctuation symbol with top-left coordinates

((Q([ws]io)+)?[LBR]nn(wionn)*)|(Pionn) - a sign text for layout

B.2.3. Display

A display sign text string combines multiple signs and punctuations onto a series of defined height canvases using transformation parameters to determine the placement of the various signs and punctuation. When written vertically in columns, the height represents the vertical length that all canvases share in common. For rows, the height represents the horizontal length in common with all canvases. Sign text for display defines the top left of every canvas as 0,0 and does not use negative numbers.

Bnn([wsP]ionn)* - a cluster of symbols with defined maximum coordinates

Transformational Parameters

Name	Value	Description
length	number of pixels	The chunk size of columns or rows
width	number of pixels	The width of the column or row
breadth	number of pixels	The breadth of all columns or rows
margin	number of pixels	Distance from closest symbol to width edge.
form	col,cols,row, or rows	Form of display. The form can be a single strip as a column or a row. The form can be a panel of multiple columns or rows.

style	fix or flex	The style of the width is either fixed by the width or flexible. For a flexible style, the margin is used as the distance from the edge of the column or row and the edge of the closest symbol. If a width is given, a flexible style will use the width as the minimum column or row width.
spacing	number of pixels: 20, 16, 12, 10	The spacing between signs and punctuation. There are 2 spaces between signs. There is one space from a sign to a punctuation. There are 2 spaces after a punctuation.
offset	number of pixels	The horizontal offset from the center of the middle lane to either the left or the right.
top	number of pixels.	The distance from the start of the column or row and the edge of the first symbol.
justify	option number: 1, 2, 3	Justify 1 pulls punctuation to the end of a column or row by moving signs closer together. Justify 2 pushes sign apart to evenly cover a column or row. Justify 3 will both pull punctuation and push signs.
punc	1 number or 2 comma separated numbers	The number of spaces before and after a punctuation. A single number will use the same number of spaces before a punctuation and after. For 2 numbers, the first represents the number of spaces from a sign to a punctuation, and the second represents the number of spaces after a punctuation. The default value is 1,2.

Table 20

B.3. Process

B.3.1. Format

When writing BSW 3 with hexadecimal, spaces and underscores should be used and ignored. Every 3 hex character gets an underscore prefix to eliminate false matching. Spaces are used to separate signs and punctuation. A space should not be used between a sequence and a sign, because the sequence is part of the sign and should not be separated.

For Unicode Interchange, UTF-8 should be used. Optional spaces can be used to separate signs and punctuation. A space should not separate a sequence and a sign. Alternately, a space or line break can be used every 72 characters to chunk Binary SignWriting into fixed width character strings.

B.3.2. Index

For a set of signs, each sign can be indexed by the base characters of the symbols in the sign cluster. This index can be used to create a symbol frequency. This index can be used to quickly generate a list of potential signs to search.

B.3.3. Sort

With the use of the sequence, sorting is natural when using the ISWA 2010 order. The sequence prefix will naturally enable comparison and sorting of signs without any special functions or configuration.

Symbol orders other than the ISWA 2010 order are not directly supported. This may be an issue if a language group chooses an alternative order for their specific hand shape subset. It is advised to maintain the same hand shape order as the ISWA 2010 for all subsets. Otherwise, sorting will require construction of a custom Unicode sorting table.

B.3.4. Search

Many types of searches are possible. The most productive pattern is filter and compare. It can be computationally expensive to analyze an entire set of signs. If a set has been indexed, then searching for a sign with a single base is trivial.

When searching for more than one base character without regard to placement, the index for each base character can be used to create a set of signs. The search result is the intersection of signs for the base character result sets.

When searching by base characters and placement, a two step process can be used. The first creates the intersection for the base character result sets. The second compares the relative position of the symbols in each sign.

An alternative search can be used on the sequence. It is possible to search for symbols in a sequence or for the start of the sequence. A decision tree can be used that slowly builds a longer sequence. The longer the sequence, the fewer the results. For any size sequence, a list of potential next symbols can be determined. Selection of a potential symbol will increase the sequence length and decrease the search results.

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