Proposal for a Gurmukhi Script Root Zone Label Generation Ruleset (LGR)

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# General Information/ Overview/ Abstract

This document lays down the Label Generation Ruleset for Gurmukhi script. Three main components of the Gurmukhi Script LGR i.e. Code point repertoire, Variants and Whole Label Evaluation Rules have been described in detail here. All these components have been incorporated in a machine-readable format in the accompanying XML file named "Proposed-LGR-Guru-20171011.xml".

# Script for which the LGR is proposed

ISO 15924 Code: Guru

ISO 15924 Key N°: 310

ISO 15924 English Name: Gurmukhi

Latin transliteration of native script name: gurmukhī

Native name of the script: ਗੁਰਮੁਖੀ

Maximal Starting Repertoire [MSR] version: 2

# Background on Script and Principal Languages Using It

It is commonly accepted that Gurmukhi is a member of the BRAHMI family. Brahmi is an Indic script that was developed in the Indian subcontinent and adapted to the local needs. According to an opinion, the Brahmi script was introduced between the 8th and the 6th century BC. It does not concern us here whether the script was foreign or local, but it has now been established, on the basis of its name, that the Indiana did have a system of writing which must have been borrowed freely from local script.

Alternatively, when the Indo-Bactrians established themselves in the Gandhara region of Western Indian subcontinent, the Kharoshti script contemporary to Brahmi was developed and used in the Punjab, Gandhar and Sindh between 300 BC and 3rd century AD. But even then Brahmi which in its development in the Punjab had undergone several changes, was commonly used along with Kharoshthi. There are coins of the Bactrian kings and inscriptions of the Kushan rulers having both scripts on them. Brahmi was, of course, more popular on account of its simple curves alternated with straight strokes. Hence, in due course, it replaced Kharoshthi and became the single script with composite features brought about by various local and neighborly influences. With the growth of literary and cultural activity during the Gupta period (4th-5th century AD) the Brahmi script improved further and became more expansive and common.

Immediately later, it developed, especially in northern India, fine curves and embellished flourishes with a small headline over each letter and became rather ornamental. This stage of Indian script was called Kutil (meaning curved) which had the widest use in Northern India. With the rise of regional languages taking the place of Sanskrit and Prakrit, regional scripts grew in number. Ardhanagari (west), Sharda (Kashmir) and Nagri (beyond Delhi) came into use and later both Sharda and Devanagari started their inroads into the land of the five rivers. This is evident from the coins of the Ghaznavids and Ghorids minted at Lahore and Delhi. It is also known that the common (non-Brahman and non-official) people used a number of scripts for their temporal and commercial requirements. Of these scripts, Landa and Takri characters were most prevalent.

## The Evolution of the Script

Like most of the North Indian writing systems, the Gurmukhi script is a descendant of the Brahmi script. The Proto-Gurmukhi letters evolved through the Gupta script from 4th to 8th century, followed by the Sharda script from 8th century onwards and finally adapted their archaic form in the Devasesha stage of the later Sharda script, dated between the 10th and 14th centuries.

The development of Gurmukhi script is indicated by the following diagram (where “-Kalin” means “in the time of”).

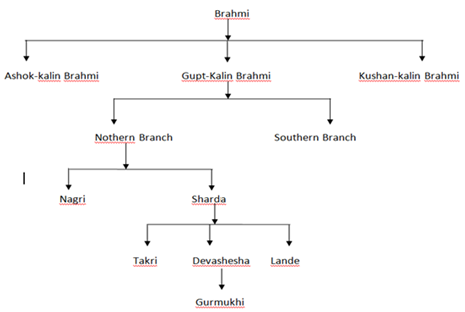


Figure 1: Evolution of Gurmukhi

The traditional accounts such as the references found in Janamsakhi literature say that the Gurmukhi script was invented by the second Sikh Guru, Guru Angad Dev. However it would be correct to say that the script was standardized rather than invented. Newton [12] writes that at least 21 Gurmukhi characters are found in ancient manuscripts: 6 from 10th century, 12 from 3rd century B.C. Apparently, the first Sikh Guru, Guru Nanak Dev also used the Gurmukhi script for his writings. Scholars have tried to establish relationship of Gurmukhi script with different scripts, such as Devanagari [13], Ardhanagari [14], Siddham/Siddhamatrika [15], Sharda [11] and Brahmi (generally). Some ascribe it to Landa [7] [8] and some others to Takri, a branch of Sharda used in the Chamba area. The fact is that it is derived from, or at least allied to, all these and others mentioned above in their historical perspective. Regionally and contemporarily compared, Gurmukhi characters have direct similarities with Gujarati, Landa, Nagri, Sharda, and Takri: they are either exactly the same or essentially alike. Internally, A (ਅ), HA (ਹ), CA (ਚ), DA (ਦ), NNA (ਣ), LA (ਲ) letters of Gurmukhi had undergone some minor orthographical changes before 1610 A.D. A major change occurred in NGA (ਙ) and NYA (ਞ) letters. BA (ਬ) letter was invented later. Further changes came in the forms of A (ਅ), HA (ਹ) and LA (ਲ) letters in the first half of the nineteenth century.



Figure 2: Pictorial depiction of Proto-Gurmukhi (13th century) with current glyphs displayed above each character

Another reform carried out is the separation of lexical units of the sentence which previously formed one jumbled unit; lately punctuation marks borrowed from English have been incorporated besides the full stop. In place of full stop, dandi has been used which existed traditionally.

There are two major theories on how the Proto-Gurmukhi script emerged in the fifteenth century. Singh [14] while quoting Al-Biruni’s Al-Hind [5], says that the script evolved from Ardhanagri. Al-Biruni writes that the Ardhanagri script was used in Bathinda (more exactly, Bhātiya), including Sindh and western parts of the Punjab in the tenth century. For some time Bathinda remained the capital of the kingdom of Bhatti Rajputs, who ruled North India before the Muslims occupied the country. Resulting from its connection with the Bhattis, the Ardhanagri script was also called Bhatachhari. According to Al-Biruni [5] Ardhanagri was a mixture of Nagri, used in Ujjain and Malwa, and Siddhamatrika is a variant of the Sharda script used in Kashmir. Singh [15] also traced the origins of Gurmukhi to the Siddhamatirka.

Bedi [9] has suggested that the Gurmukhi script was developed during the tenth-fourteenth centuries from the Devasesha stage of the Sharda script. His argument suggests that regional differences started to appear in the Sharda script used in Punjab, partly Himachal Pradesh and Kashmir from the tenth century. The regional form of Sharda, used in Punjab, started to appear in the form of Gurmukhi in the 14th century. Bedi [9] called this stage Pritham Gurmukhi or Proto-Gurmukhi.

The Sikh Gurus adopted the proto-Gurmukhi script to write the Guru Granth Sahib, the primary religious scripture of the Sikhs. Other contemporary scripts used in Punjab were Takri and the Landa alphabets. Takri was a script that developed through the Devasesha stage of the Sharda script and is found mainly in the Hill States such as Chamba, where it is called Chambyali and in Jammu, where it is called Dogri. The local Takri variants attained the status of official scripts in some of the Punjab, Hills States and were used for both administrative and literary purposes. When Himachal Pradesh was established, the local Takri was replaced by Devanagari.

Meanwhile, the mercantile scripts of Punjab known as Landa were normally not used for literary purposes. In Punjab, there were at least ten different variants of Landa. Landa alphabets were used for household and trade purposes.

The letters no doubt existed before the time of Guru’s period. But Sikh Gurus not only modified and re-arranged certain letters but also shaped them into a script. They gave new shape and new order to the alphabet and made it precise and accurate. They fixed one letter for each of Punjabi phonemes; use of vowel-symbols was made obligatory; the letters used to construct conjuncts were not adopted; and only those letters were retained which depicted sounds of the then spoken language. There was some re-arrangement of the letters also: e.g., SA ( ਸ ) and HA ( ਹ ) were shifted to the first line and URA ( ੳ ) was given the first place in the new alphabet.

**“Gurmukhi” Etymology**

The word Gurmukhi is the compound form of Guru and Mukh. It is commonly translated as from the mouth of Guru. However the term is used for the Punjabi script and has somewhat different connotations. The opinion given by traditional scholars is that as the Sikh holy writings, before they were scribed, were uttered by the Gurus, they came to be known as Gurmukhi (the Utterance of the Guru) and consequently, the script that was used for the scribing the utterance was also given the same name. However the prevalent view among Punjabi linguists is that as in the early stages, the Gurmukhi letters were primarily used by Gurmukhs (those living a life as instructed by the Guru) or the Sikhs devoted to the Guru, the script came to be associated with them. The script associated with Gurmukhs came to be known as Gurmukhi.

Now Gurmukhi is the name of the script used in writing primarily for the Punjabi language. It was secondarily used for the Sindhi language, but is not now.

## Languages considered

Punjabi (EGIDS 2) is the only language currently using the Gurmukhi script.

## The structure of written Gurmukhi

Punjabi is written using the Gurmukhi script. It is an alphasyllabary with the akshar as its core. All scripts derived from Brahmi are Abugidas, i.e. syllabary driven systems. The main features of Abugidas are:

* The consonant has an implicit /ə/ vowel which is also known as the schwa.
* The inherent vowel can be modified by the addition of other vowels or muted by a diacritic termed as a Virama.
* Vowels can be handled as full vowels with a vocalic value.
* When two or more consonants join together they form ligatures. In Gurmukhi script, ligatures are formed only with following /h, r and v/ consonants.

The writing system of Gurmukhi could be summed up as composed of the following:

### The Consonants

In Gurmukhi, all consonants have an implicit vowel sign schwa /ə/ within them [1]. In Punjabi, /ə/ vowel is called mukta vowel. The word mukta is derived from the word mukt that means free. So mukta means free from any vowel sign [3]. As an example the word ਕਰ is made up of three phonemes /k/, /ə/ and /r/, but /ə/ does not appear in the word ਕਰ as it is inherited in the letter ਕ. Hence mukta is free from any vowel sign. But Gurumukhi consonants are also used without any modification to represent consonant sounds without following /ə/ vowel. Actually Gurmukhi script is of semi-syllabic nature in that a Punjabi consonant letter by itself may stand for a consonant sound as well as for the consonant plus following /ə/ vowel.

Punjabi is a tone language; but each tone is not represented by its own distinct letter or symbols in the Gurmukhi script. Nevertheless, in Punjabi the same sequence of vowel and consonant segments can represent different words depending on the pitch of voice or tone used in pronouncing it.

In the traditional classification, consonants are categorized according to their phonetic properties; there are 7 groups (vargas) representing points of articulation, and one non-varga group, which comes last in display. Varga means category that contains consonants pronounced from the same point of articulation. The first group contains five letters: three vowel carriers and two consonants. In this group, both consonants represent fricatives, the first dental and the second glottal. The next five groups each set out the stops and nasal of the varga, each displaying five consonants classified as per their manner of articulation. The first four consonants are classified on the basis of Voicing and Aspiration and the last is the corresponding Nasal. The fourth consonant in these five vargas has been traditionally classified (following its historic use) as a voiced aspirated consonant; but it is in fact used to denote tone.

Punjabi does not now contain voiced aspirated consonants [2]. Instead, the pronunciation of these five, once voiced aspirated, consonants corresponds to tonally marked syllables. When any of these letters comes in initial position it is to be pronounced as a unvoiced unaspirated consonant of that varga with a low tone [4]; in middle position it is to be pronounced as a voiced unaspirated consonant of that varga with a high or low tone, depending on the length of the preceding or the following vowel; at the end of a word, it is to be pronounced as a voiced unaspirated consonant of that varga with high tone. So these letters can be pronounced only in two tones, either a high tone or a low tone.

After the varga groups, the next five consonants do not have a single point and manner of articulation. So they do not correspond to a single varga. They are categorized as a non-varga group. The last group has six letters. All the letters in this group have a bindi (dot) placed in their foot. So they are categorized as *pairin bindi* letters, meaning “having dot in the foot”.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Varga** | **Vowel carriers** | | | **Fricatives** | |
|  | For back vowels:  u, ū, o | For low vowels:  a, ā | For front vowels:  i, ī, e | Dental: [s] | Glottal: [h] | |
| **Mul Varga** | ੳ  U+0A73 | ਅ  U+0A05 | ੲ  U+0A72 | ਸ  U+0A38 | ਹ  U+0A39 | |

Table 1: Mul varga

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Varga** | **Unvoiced** | | **Voiced** | | **Nasal** |
|  | -Asp | +Asp | -Asp | +Asp\* |  |
| **Velar** | ਕ  U+0A15  k | ਖ  U+0A16  kh | ਗ  U+0A17  g | ਘ  U+0A18  (gh) | ਙ  U+0A19  ŋ |
| **Palatal** | ਚ  U+0A1A  c | ਛ  U+0A1B  ch | ਜ  U+0A1C  j | ਝ  U+0A1D  (jh) | ਞ  U+0A1E  ñ |
| **Retroflex** | ਟ  U+0A1F  ṭ | ਠ  U+0A20  ṭh | ਡ  U+0A21  ḍ | ਢ  U+0A22  (ḍh) | ਣ  U+0A23  ṇ |
| **Dental** | ਤ  U+0A24  t | ਥ  U+0A25  d | ਦ  U+0A26  th | ਧ  U+0A27  (dh) | ਨ  U+0A28  n |
| **Bi-labial** | ਪ  U+0A2A  p | ਫ  U+0A2B  ph | ਬ  U+0A2C  b | ਭ  U+0A2D  (bh) | ਮ  U+0A2E  m |

Table 2: Varga classification of consonants

\*Traditionally these letters indicate voiced aspirates but in Punjabi they are used to represent low + high tones on adjacent syllables.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Non Varga** | ਯ  U+0A2F  y | ਰ  U+0A30  r | ਲ  U+0A32  l | ਵ  U+0A35  v | ੜ  U+0A5C  rr |

Table 3: Non-Varga consonants

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Pairin Bindi Varga** | ਸ਼  U+0A36  š | ਖ਼  U+0A59  x | ਗ਼  U+0A5A  γ | ਜ਼  U+0A5B  z | ਫ਼  U+0A5E  f | ਲ਼  U+0A33  ḷ |

Table 4: Pairin bindi consonants

### The Implicit Vowel Killer: Virama

In Gurmukhi and Devanagari, consonants have an implicit schwa /ə/ included in them. In Hindi, a special sign called halant "੍" (U+094D) is needed to indicate that this implicit vowel is stripped off, so to create conjuncts, halant is used with the consonants in Devanagari. Unlike Devanagari, Gurmukhi consonants are also used to represent consonant sounds where / ə / is not included in them.

In Gurmukhi, virama “੍” (U+ 0A4D) is used in place of halant "੍" (U+094D). In Gurmukhi, virama is not used with any consonant that represents only the consonant sound instead of consonant plus vowel sound. Therefore in Punjabi virama is only used to create a conjunct where the letters HA ਹ (U+0A39), RA ਰ (U+0A30) or VA ਵ (U+0A35) are the second element in a conjunct. When /h, r and v/ phonemes occur as the second member of a consonant cluster, the virama joins these consonants in the foot of their preceding consonants and creates a conjunct. In these consonant clusters, HA (ਹ), RA (ਰ) and VA (ਵ) letters change their shape to pairin haha (), pairin rara () and pairin vava (). In practice, the three letters assume a smaller shape which is subjoined to the preceding consonant. For example in the word ਸ੍ਰੀ, ਸ and ਰ occurs as consonant conjuncts, wherein ਸ is followed by ੍, ਰ and ੀ i.e. ਸ + ੍ + ਰ + ੀ => ਸ੍ਰੀ (srī). Similar pattern is followed when RA (ਰ) and VA (ਵ) occur as consonant clusters. Whereas in the word ਸਰੀ (sarī), ਸ and ਰ do not occur as consonant conjuncts as ਸ is followed by ə, which prohibit the formation of consonant conjunct, hence ਰ does not appear in the foot of ਸ like in the word ਸ੍ਰੀ. Therefore the word ਸਰੀ consists of ਸ + ə + ਰ + ੀ.

The example words corresponding to pairin haha () and pairin vava () are as follows:

In the word ਮਨ੍ਹਾ (manhā), ਮ is followed by ਨ, ੍, ਹ and ਾ i.e. ਮ + ਨ + ੍ + ਹ +ਾ. Here ਨ and ਹ occur as consonant conjunct. Whereas in the word ਸ੍ਵਰ (svar), ਸ is followed by ੍, ਵ and ਰ i.e. ਸ + ੍ + ਵ + ਰ. So in this word ਸ and ਵ occur as consonant conjunct.

### Vowels

Punjabi has ten vowels /ਅ(ə), ਆ(a), ਇ(I), ਈ(i), ਉ(U), ਊ(u), ਏ(e), ਐ(ɛ), ਓ(o) and ਔ(ͻ)/. The vowels are represented by nine matras (vowel signs) + three matra vahaks (vowel carriers). Of these vowels, three /ਅ(ə), ਇ(I), ਉ(U)/ are short vowels and seven (ਆ(a), ਈ(i), ਊ(u), ਏ(e), ਐ(ɛ), ਓ(o) and ਔ(ͻ)/ are long vowels. Separate symbols exist for all vowels, when they occur at the initial position of syllables. To indicate a vowel sound after a consonant other than the implicit / ə /, a vowel sign (Matra) is attached to the consonant. Since the consonant has a built-in schwa, there are equivalent matras for all vowels except the ਅ [6]. Punjabi has ten vowels but it has signs for only nine of them.

The correlation is shown as below:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ਅ | ਆ | ਇ | ਈ | ਉ | ਊ | ਏ | ਐ | ਓ | ਔ |
| Mukta  [i.e. zero] (without any vowel sign)  ə | ਾ  a | ਿ  I | ੀ  i | ੁ  U | ੂ  u | ੇ  e | ੈ  ɛ | ੋ  o | ੌ  ͻ |

Table 5: Vowels with corresponding Matras

### Supra-Segmental signs; bindi, tippi and addak

Gurmukhi script has three supra-segmental signs; bindi, tippi and addak, which are used with Gurmukhi vowel signs to represent the supra-segmental phonemes’ nasality, gemination and stress. These supra-segmental signs are called lagakhars in Punjabi [10]. Every vowel in Punjabi has a nasalized version. Bindi and Tippi are allographic variants of the nasal meaning that in Gurmukhi, both bindi and tippi signs are used to nasalize vowels. Addak is used to represent gemination and stress. The following subsections describe the usage of these signs.

#### The Bindi (ਂ-U+0A02)

The bindi (ਂ) represents a homorganic nasal. Bindi is used with all long vowels/ਆ, ਈ, ਊ, ਏ, ਐ, ਓ, ਔ/ and the short vowel ਉ as in words – ਆਂਚਲ (āñchal), ਜਾਈਂ (jāīṃ), ਏਂਜਲ (ēñjal), ਐਂਗਲ (aiṅgal), ਓਂਕਾਰ (ōṅkār) ,ਔਂਕੜ (auṅkaṛ), ਉਂਗਲ(uṅgal), ਊਂਘ (ūṅgh) and with the matras of long vowels/ ਾ, ੀ, ੇ, ੈ, ੋ, ੌ / except the matra ( ੂ) as in the words – ਹਾਂ(hāṃ), ਟੀਂ (ṭīṃ), ਪੇਂਟ (paint), ਦੈਂਤ (daint), ਤੋਂ (tōṃ), ਜੌਂ (jauṃ).

#### The Tippi (ੰ -U+0A70)

Tippi (**ੰ**)is used to nasalize short vowels /ə/ and /I/ at all places and /U and u*/* after a consonant. So tippi comes with the matras of /ə/ and /I/ i.e. mukta (without any vowel sign) and ਿ with vowel carriers as ਅੰ and ਇੰ as in words ਅੰਗ (aṅg) and ਇੰਡੀਆ (india) and with consonants as ਸੰ and ਸਿੰ as in words ਸੰਦ (sand) and ਸਿੰਘ (siṅgh). Matras of /U and u/i.e. (ੁ, ੂ) after a consonant can be followed by tippi as in words- ਖੁੰਬ (khumb), ਗੂੰਦ (gūnd). In addition to this, tippi is also used in gemination for nasal consonants ਙ, ਞ, ਨ and ਮ. The rules for placement of bindi and tippi are:

1. The initial forms of *u, uu* vowels i.e. ਉ and ਊ can be followed by bindi as ਉਂ, ਊਂ. In addition to this the forms of *u, uu* vowels after any other vowel i.e. ਉ and ਊ can be followed by bindi as in words ਆਉਂਦਾ (āundā) and ਜਾਊਂ (jāūṃ).
2. Matras of *U, u* (ੁ, ੂ) after a consonant can be followed by tippi – ਖੁੰਬ (khumb), ਗੂੰਦ (gūnd).
3. All other short vowels / matras (mukta, ਿ) can be followed by tippi as in words – ਅੰਗ (aṅg), ਇੰਡੀਆ (india), ਸੰਦ (sand), ਚਿੰਤਾ (chintā).
4. All other long vowels/mātrās (ਆ, ਈ, ਏ, ਐ, ਓ, ਔ/ ਾ , ੀ, ੇ, ੈ, ੋ, ੌ ) can be followed by bindi as in words – ਆਂਦਰ (āndar), ਸਾਈਂ (sāīṃ), ਜਾਏਂ (jāēṃ), ਐਂਠ (aiṇṭh), ਸਿਓਂਕ (siōṅk), ਔਂਤਰਾ (auntrā)/ਹਾਂ (hāṃ), ਟੀਂ (ṭīṃ), ਪੇਂਟ (paint), ਦੈਂਤ (daint), ਤੋਂ (tōṃ), ਜੌਂ (jauṃ).
   * + 1. The Addak (ੱ -U+0A71)

Addak is used to mark the gemination of the following consonant. In Punjabi, addak usually comes with mukta, aunkar (ੁ) and sihari (ਿ), the vowel signs of /ə, u and i/ short vowels and geminates the consonant which follows it. Actually gemination of consonants occurs only when their preceding vowels are short vowels. For example in ਟੱਪਾ(ṭappā), ਗਿੱਲਾ(gillā) and ਮੁੱਕਾ(mukkā), the geminated /ਪ/, /ਲ/ and /ਕ/ consonants have /ə, I and U/ short vowels as their preceding vowels which are represented by mukta(zero vowel sign), sihari (ਿ) and aunkar (ੁ)vowel signs. In addition to this, addak is also used to write English source words having English vowel /ε/. For example, set, jet and web are written in Gurmukhi as ਸੈੱਟ (set), ਜੈੱਟ (jet) and ਵੈੱਬ (web).

**We now look at some of the exceptions.**

Addak does not precede HA (ਹ), NGA (ਙ), NYA (ਞ), NNA (ਣ), RRA (ੜ), KHHA (ਖ਼), GHHA (ਗ਼) and LLA (ਲ਼) letters. In these letters, NGA (ਙ) and NYA (ਞ) are nasal consonants so these are stressed or doubled by the nasal sign tippi. The rest of these letters cannot be pronounced with stress or elongation. So, addak is not used before any of the above mentioned letters. Addak is also not used with the last letter of the word, as there is no letter after it which has to be geminated. Addak is used with geminated consonants and the sign is placed on the preceding syllable. Addak cannot be used at the beginning of a word.

#### Nukta (਼ - U+0A3C)

Termed as *pairin bindi* in Punjabi, nukta is used with the following consonants: ਸ /s/, ਖ /kh/, ਗ /g/, ਜ /j/, ਫ /ph/ and ਲ /l/ to represent the phonemes of words of Sanskrit and Perso-Arabic sources. ਸ਼ /š/ is used to represent the phoneme of Sanskrit source words. ਲ਼ /ḷ/ is used to represent Punjabi’s retroflexal /ḷ/ phoneme and ਖ਼ /x/, ਗ਼ /γ/, ਜ਼ /z/, ਫ਼ /f/ are used to represent Perso-Arabic sources words.

When pairin bindi is adjoined to SA (ਸ), KHA (ਖ), GA (ਗ), JA (ਜ), PHA (ਫ) and LA (ਲ) letters, these are written as:

ਸ਼(U+0A38+U+0A3C**)**, ਖ਼(U+0A16+U+0A3C), ਗ਼(U+0A17+U+0A3C), ਜ਼(U+0A1C+U+0A3C), ਫ਼ (U+0A2B+ U+0A3C), ਲ਼ (U+0A32+ U+0A3C)

These letters are called pairin bindi letters. All the letters are combinations of Consonant+Nukta. But in Gurmukhi, these letters can also be written as a single unit as ਸ਼ (U+0A36), ਖ਼ (U+0A59), ਗ਼ (U+0A5A), ਜ਼ (U+0A5B), ਫ਼ (U+0A5E) and ਲ਼ (U+0A33). Thus

ਸ਼ (U+0A36)= ਸ਼(U+0A38+U+0A3C**)**

ਖ਼ (U+0A59)= ਖ਼(U+0A16+U+0A3C)

ਗ਼ (U+0A5A)= ਗ਼(U+0A17+U+0A3C)

ਜ਼ (U+0A5B)= ਜ਼(U+0A1C+U+0A3C)

ਫ਼ (U+0A5E)= ਫ਼(U+0A2B+ U+0A3C)

ਲ਼ (U+0A33)= ਲ਼(U+0A32+ U+0A3C)

#### Visarga (ਃ U+0A03)

The visarga is used in Sanskrit. It is rarely found in old Punjabi writings as “Sri Guru Granth Sahib” or “Mahan Kosh” where it acts like a Sanskrit visarga where a voiceless 'h' sound is pronounced after the vowel. But its use is not common now, and seems to be used in Punjabi only to mark abbreviations.

# Overall Development Process and Methodology

Under the Neo-Brahmi Generation Panel, there are many different scripts belonging to separate Unicode blocks. Each of these scripts will be assigned a separate LGR; however Neo-Brahmi GP will ensure that the fundamental philosophy behind building those LGRs are all in sync with all other Brahmi derived scripts. This is the Gurmukhi LGR, which caters to Punjabi language written using Gurmukhi script.

## Guiding Principles

### External Limits on Scope:

The code point repertoire for root zone being a very special case, up the ladder in the protocol hierarchies, the canvas of available characters for selection as a part of the Root Zone code point repertoire is already constrained by various protocol layers beneath it. Following three main protocols/standards act as successive filters:

*i. The Unicode Chart:*

Out of all the characters that are needed by the given script, if the character in question is not encoded in Unicode, it cannot be incorporated in the code point repertoire. Such cases are quite rare, given the elaborate and exhaustive character inclusion efforts made by Unicode consortium.

*ii. IDNA Protocol:*

Unicode being the character encoding standard for providing the maximum possible representation of a given script/language, it has encoded as far as possible all the possible characters needed by the script. However the domain name being a specialized case, it is governed by an additional protocol known as IDNA (Internationalized Domain Names in Applications). The IDNA protocol excludes some characters out of Unicode repertoire from being part of the domain names.

Example: Gurmukhi letters ਸ਼ (U+0A36), ਖ਼ (U+0A59), ਗ਼ (U+0A5A), ਜ਼ (U+0A5B), ਫ਼ (U+0A5E), ਲ਼ (U+0A33) are not allowed to be a part of domain name. Their decomposed forms, i.e. Gurmukhi letters ਸ (U+0A38), ਖ (U+0A16), ਗ (U+0A17), ਜ (U+0A1C), ਫ (U+0A2B), ਲ (U+0A32) followed by Gurmukhi Sign Nukta (pairin bindi) “਼” (U+0A3C) can be used instead.

*iii. Maximal Starting Repertoire:*

The Root-zone LGR being a repertoire of the characters which are going to be used for creation of the root zone TLDs, which in turn are even more specialized case of domain names, the ROOT LGR procedure introduces additional exclusions on IDNA allowed set of characters.

To sum up, the restrictions start off with admitting only such characters as are part of the code-block of the given script/language. This is further narrowed down by the IDNA Protocol and finally an additional filter in the form of Maximal Starting Repertoire restricts the character set associated with the given language even more.

### No Punctuation Marks:

The TLDs being identifiers, punctuation marks present in Brahmi based languages such as Dandi “।” and double Dandi "॥" will not be included.

### No Symbols and Abbreviations:

Gurmukhi sign Addak Bindi ਁ (U+ 0A01) will not be included as it is not used in modern Punjabi.

### No Rare and Obsolete Characters:

There are characters which have been added to Unicode to accommodate the forms used in Medieval writings such as of “Sri Guru Granth Sahib”, e.g. like Gurmukhi sign Yakash “ ੵ” (U+ 0A75), and Visarga ਃ (U+ 0A03). Such characters will not be included. This is in compliance with the letter principle as laid down in the Root Zone LGR procedure.

### No Stress Markers of Medieval Punjabi:

Medieval Punjabi stress markers or tone marker sign e.g. Gurmukhi sign Uddat “ ੑ”, (U+ 0A51)will not be included. This is also in compliance with the Letter principle as laid down in the Root Zone LGR procedure.

### No Vowel Carriers which cannot come without a matra:

The vowel carriers URA, ੳ (U+0A73) and IRI, ੲ (U+0A72), cannot occur without a matra in a word. They are used as vowel carriers and thus always need to be followed by some matra. In case they occur separately with a matra then they will create conflict with one of the vowel and this is not allowed in Unicode too. Thus ੳ (U+0A73) + ੁ (U+0A41), which looks same as ਉ (U+ 0A09), will create confusion and hence will not allowed. These characters can occur as single character words, but in TLD, single character labels are not allowed, so these letters will not be added.

# Repertoire

## Code Points

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sr. No.** | **Unicode Code Point** | **Glyph** | **Character Name** | **Unicode General Category (gc)** | **Indic Syllabic Category** | **Reference** |
| 1. | 0A02 | ਂ | GURMUKHI SIGN BINDI | Mn | Bindi | [UNICODE], [4], [7] |
| 2. | 0A05 | ਅ | GURMUKHI LETTER A = aira | Lo | Vowel/Vowel Carrier | [UNICODE], [4], [7] |
| 3. | 0A06 | ਆ | GURMUKHI LETTER AA | Lo | Vowel | [UNICODE], [4], [7] |
| 4. | 0A07 | ਇ | GURMUKHI LETTER I | Lo | Vowel | [UNICODE], [4], [7] |
| 5. | 0A08 | ਈ | GURMUKHI LETTER II | Lo | Vowel | [UNICODE], [4], [7] |
| 6. | 0A09 | ਉ | GURMUKHI LETTER U | Lo | Vowel | [UNICODE], [4], [7] |
| 7. | 0A0A | ਊ | GURMUKHI LETTER UU | Lo | Vowel | [UNICODE], [4], [7] |
| 8. | 0A0F | ਏ | GURMUKHI LETTER EE | Lo | Vowel | [UNICODE], [4], [7] |
| 9. | 0A10 | ਐ | GURMUKHI LETTER AI | Lo | Vowel | [UNICODE], [4], [7] |
| 10. | 0A13 | ਓ | GURMUKHI LETTER OO | Lo | Vowel | [UNICODE], [4], [7] |
| 11. | 0A14 | ਔ | GURMUKHI LETTER AU | Lo | Vowel | [UNICODE], [4], [7] |
| 12. | 0A15 | ਕ | GURMUKHI LETTER KA | Lo | Consonant | [UNICODE], [4], [7] |
| 13. | 0A16 | ਖ | GURMUKHI LETTER KHA | Lo | Consonant | [UNICODE], [4], [7] |
| 14. | 0A17 | ਗ | GURMUKHI LETTER GA | Lo | Consonant | [UNICODE], [4], [7] |
| 15. | 0A18 | ਘ | GURMUKHI LETTER GHA | Lo | Consonant | [UNICODE], [4], [7] |
| 16. | 0A19 | ਙ | GURMUKHI LETTER NGA | Lo | Consonant | [UNICODE], [4], [7] |
| 17. | 0A1A | ਚ | GURMUKHI LETTER CA | Lo | Consonant | [UNICODE], [4], [7] |
| 18. | 0A1B | ਛ | GURMUKHI LETTER CHA | Lo | Consonant | [UNICODE], [4], [7] |
| 19. | 0A1C | ਜ | GURMUKHI LETTER JA | Lo | Consonant | [UNICODE], [4], [7] |
| 20. | 0A1D | ਝ | GURMUKHI LETTER JHA | Lo | Consonant | [UNICODE], [4], [7] |
| 21. | 0A1E | ਞ | GURMUKHI LETTER NYA | Lo | Consonant | [UNICODE], [4], [7] |
| 22. | 0A1F | ਟ | GURMUKHI LETTER TTA | Lo | Consonant | [UNICODE], [4], [7] |
| 23. | 0A20 | ਠ | GURMUKHI LETTER TTHA | Lo | Consonant | [UNICODE], [4], [7] |
| 24. | 0A21 | ਡ | GURMUKHI LETTER DDA | Lo | Consonant | [UNICODE], [4], [7] |
| 25. | 0A22 | ਢ | GURMUKHI LETTER DDHA | Lo | Consonant | [UNICODE], [4], [7] |
| 26. | 0A23 | ਣ | GURMUKHI LETTER NNA | Lo | Consonant | [UNICODE], [4], [7] |
| 27. | 0A24 | ਤ | GURMUKHI LETTER TA | Lo | Consonant | [UNICODE], [4], [7] |
| 28. | 0A25 | ਥ | GURMUKHI LETTER THA | Lo | Consonant | [UNICODE], [4], [7] |
| 29. | 0A26 | ਦ | GURMUKHI LETTER DA | Lo | Consonant | [UNICODE], [4], [7] |
| 30. | 0A27 | ਧ | GURMUKHI LETTER DHA | Lo | Consonant | [UNICODE], [4], [7] |
| 31. | 0A28 | ਨ | GURMUKHI LETTER NA | Lo | Consonant | [UNICODE], [4], [7] |
| 32. | 0A2A | ਪ | GURMUKHI LETTER PA | Lo | Consonant | [UNICODE], [4], [7] |
| 33. | 0A2B | ਫ | GURMUKHI LETTER PHA | Lo | Consonant | [UNICODE], [4], [7] |
| 34. | 0A2C | ਬ | GURMUKHI LETTER BA | Lo | Consonant | [UNICODE], [4], [7] |
| 35. | 0A2D | ਭ | GURMUKHI LETTER BHA | Lo | Consonant | [UNICODE], [4], [7] |
| 36. | 0A2E | ਮ | GURMUKHI LETTER MA | Lo | Consonant | [UNICODE], [4], [7] |
| 37. | 0A2F | ਯ | GURMUKHI LETTER YA | Lo | Consonant | [UNICODE], [4], [7] |
| 38. | 0A30 | ਰ | GURMUKHI LETTER RA | Lo | Consonant | [UNICODE], [4], [7] |
| 39. | 0A32 | ਲ | GURMUKHI LETTER LA | Lo | Consonant | [UNICODE], [4], [7] |
| 40. | 0A35 | ਵ | GURMUKHI LETTER VA | Lo | Consonant | [UNICODE], [4], [7] |
| 41. | 0A38 | ਸ | GURMUKHI LETTER SA | Lo | Consonant | [UNICODE], [4], [7] |
| 42. | 0A39 | ਹ | GURMUKHI LETTER HA | Lo | Consonant | [UNICODE], [4], [7] |
| 43. | 0A3C | ਼ | GURMUKHI SIGN NUKTA  = pairin bindi | Mn | Nukta | [UNICODE], [4], [7] |
| 44. | 0A3E | ਾ | GURMUKHI VOWEL SIGN AA = kanna | Mc | Matra | [UNICODE], [4], [7], [3] |
| 45. | 0A3F | ਿ | GURMUKHI VOWEL SIGN I = sihari | Mc | Matra | [UNICODE], [4], [7] |
| 46. | 0A40 | ੀ | GURMUKHI VOWEL SIGN II = bihari | Mc | Matra | [UNICODE], [4], [7] |
| 47. | 0A41 | ੁ | GURMUKHI VOWEL SIGN U = aunkar | Mn | Matra | [UNICODE], [4], [7] |
| 48. | 0A42 | ੂ | GURMUKHI VOWEL SIGN UU = dulainkar | Mn | Matra | [UNICODE], [4], [7] |
| 49. | 0A47 | ੇ | GURMUKHI VOWEL SIGN EE = lavan | Mn | Matra | [UNICODE], [4], [7] |
| 50. | 0A48 | ੈ | GURMUKHI VOWEL SIGN AI = dulanvan | Mn | Matra | [UNICODE], [4], [7] |
| 51. | 0A4B | ੋ | GURMUKHI VOWEL SIGN OO = hora | Mn | Matra | [UNICODE], [4], [7] |
| 52. | 0A4C | ੌ | GURMUKHI VOWEL SIGN AU = kanaura | Mn | Matra | [UNICODE], [4], [7] |
| 53. | 0A4D | ੍ | GURMUKHI SIGN VIRAMA | Mc | Virama | [UNICODE], [4], [7] |
| 54. | 0A5C | ੜ | GURMUKHI LETTER RRA | Lo | Consonant | [UNICODE], [4], [7] |
| 55. | 0A70 | ੰ | GURMUKHI TIPPI | Mn | Tippi | [UNICODE], [4], [7] |
| 56. | 0A71 | ੱ | GURMUKHI ADDAK | Mn | Addak | [UNICODE], [4], [7] |

Table 6: Code point repertoire

## Repertoire Excluded

Code Points in MSR-2 but excluded because they are either not in common use or used for special purpose only (Used as vowel carrier).

| **Sr. No.** | **Unicode Code Point** | **Glyph** | **Character Name** | **Note** |
| --- | --- | --- | --- | --- |
| 1. | 0A03 | ਃ | GURMUKHI SIGN VISARGA | Limited or declining use |
| 2. | 0A51 | $ੑ | GURMUKHI SIGN UDAAT | Limited or declining use |
| 3. | 0A72 | ੲ | GURMUKHI IRI | Does not occur alone |
| 4. | 0A73 | ੳ | GURMUKHI URA | Does not occur alone |
| 5. | 0A75 | $ੵ | GURMUKHI SIGN YAKASH | Limited or declining use |

Table 7: List of excluded characters

## Syllable formation rules for Gurmukhi:

The syllable is a basic unit of speech studied on both the phonetic and phonological levels of analysis. It is very easy for a native language speaker to count the number of syllables in a sequence however orthographic syllable required for text processing need not correspond exactly with a phonological syllable. This section details the syllable formation rules as applicable to Gurmukhi. The definition represents a vowel, consonant, or a conjunct.

**Variables involved:**

C → Consonant, which may or may not include a single nukta

M → Matra

V → Vowel

B → Bindi

D → Tippi

H → Halant / Virama

A → Addak

### **Operators used:**

|  |  |
| --- | --- |
| Symbol | Function |
| | | Alternative |
| [ ] | Optional |
| {} | Zero or One occurrence |
| ( ) | Sequence Group |

The definition is a combination of 2 rules:

Rule 1: V[A|B|D]

Rule 2: {CH}C[M][A|B|D]

Rule 1: V[A|B|D]

|  |  |  |
| --- | --- | --- |
| Sl. No. | Examples | Definition |
| 1 | ਅ, ਆ, ਇ | V (Vowel) is a syllable |
| 2 | ਇੰ, ਉਂ, ਇੱ | V+ (A/B/D) is a syllable |

Rule 2: {C(H|A)}C[M][B|D]

|  |  |  |
| --- | --- | --- |
| Sl. No. | Examples | Definition |
| 1 | ਕ, ਙ, ਧ | Consonant is a syllable where it has inherent ‘ə’ vowel |
| 2 | ਸ੍ਵ, ਲੱਗ | Zero or one Consonant + Virama/Addak sequence followed by consonant is a syllable |
| 3 | ਸ੍ਵੈ | Zero or one Consonant+ Virama sequence followed by a consonant followed by a matra or vowel sign is a syllable |
| 4 | ਸ੍ਵੰ | Zero or one Consonant+ Virama sequence followed by a consonant followed by bindi/tippi is a syllable |
| 5 | ਗ੍ਰਾਂ | Zero or one Consonant+ Virama sequence followed by a consonant followed by a matra and bindi/tippi is a syllable |

Examples of combination of the rules:

1. *ਕਰੰਸੀ (karasī)*- C + CD + CM has following syllables:

|  |  |
| --- | --- |
| *ਕ* | C |
| *ਰੰ* | CD |
| *ਸੀ* | CM |

2. *ਪਰਿੰਦਾ (parindā)* - CV + CMD + CM has following syllables:

|  |  |
| --- | --- |
| *ਪ* | CV |
| *ਰਿੰ* | CMD |
| *ਦਾ* | CV |

3. *ਅੰਦਰ* *(andar)* - VD + CV+ C

|  |  |
| --- | --- |
| ਅੰ | Vm |
| ਦਰ | CvC |

# Variants

There are no characters/character sequences in Gurmukhi that can be created by using the characters permitted in the [MSR] and that look exactly alike. However, Gurmukhi has ample cases of confusingly similar variants in both Gurmukhi and Devanagari scripts. We have categorized these confusingly similar variants in three groups.

**Group 1:** Visually similar Gurmukhi characters

**Group 2:** Visually similar Gurmukhi character combinations, due to the presence of dots and other characters

**Group 3:** Visually similar characters in other scripts such as Devanagari. Gurmukhi and Devanagari scripts are closely related to each other and there are many characters in both scripts, which can be confused with characters in the other script.

**Group 1:**

|  |  |
| --- | --- |
| ਟ (0A1F) | ਦ (0A26) |
| ਬ (0A2C) | ਥ (0A25) |
| ਚ (0A1A) | ਰ (0A30) |
| ਢ (0A22) | ਦ (0A26) |
| ਢ (0A22) | ਫ (0A2B) |
| ਤ (0A24) | ਭ (0A2D) |
| ੇ (0A47) | ੋ (0A4B) |

No cases belonging to Group 1 are proposed as variants, as there is another panel (String similarity assessment panel) entrusted to deal with such cases.

**Group 2:**

|  |  |
| --- | --- |
| Code Point Sequence | Code Point |
| ਖ਼ (0A16 + 0A3C) | ਖ (0A16) |
| ਗ਼ (0A17 + 0A3C) | ਗ (0A17) |
| ਫ਼ (0A2B + 0A3C) | ਫ (0A2B) |
| ਓਂ (0A13 + 0A02) | ਓ (0A13) |
| ਈਂ (0A08 + 0A02) | ਈ (0A08) |
| ਐਂ (0A10 + 0A02) | ਐ (0A10) |
| ਔਂ (0A14 + 0A02) | ਔ (0A14) |
| ਗੰ (0A17 + 0A70) | ਰੀ (0A30 + 0A40) |
| ਨੁ (0A28 + 0A41) | ਠ (0A20) |

No cases belonging to Group 2 are proposed as variants, as there is another panel (String similarity assessment panel) entrusted to deal with such cases.

**Group 3**

| # | Gurmukhi Code Points | Devanagari Code Points |
| --- | --- | --- |
| 1 | ਂ (0A02) | ं (0902) |
| 2 | ਙ (0A19) | इ (0907) |
| 3 | ਤ (0A24) | उ (0909) |
| 4 | ਗ (0A17) | ग (0917) |
| 5 | ਬ (0A2C) | घ (0918) |
| 6 | ਟ (0A1F) | ट (091F) |
| 7 | ਠ (0A20) | ठ (0920) |
| 8 | ਫ (0A2B) | ढ (0922) |
| 9 | ਧ (0A27) | प (092A) |
| 10 | ਮ (0A2E) | भ (092D) |
| 11 | ਸ (0A38) | म (092E) |
| 12 | ਕ (0A15) | व (0935) |
| 13 | ਵ (0A35) | ह (0939) |
| 14 | ੂ (OA42) | ॗ (0957) |
| 15 | ੁ(OA41) | ॖ(0956) |
| 16 | ਿ (0A3F) | ि (093F) |
| 17 | ੀ (0A40) | ी (0940) |
| 18 | ੇ (0A47) | े (0947) |
| 19 | ੈ (0A48) | ै (0948) |
| 20 | ਇ (0A07) | प्टि (092A 094D 091F 093F) |
| 21 | ਈ (0A08) | प्टी (092A 094D 091F 0940) |
| 22 | ਏ (0A0F) | प्टे (092A 094D 091F 0947) |
| 23 | ਜ (0A1C) | त्त (0924 094D 0924) |
| 24 | ੱ (0A71) | ॅ(0945) |
| 25 | ੇ (0A47) | ॆ (0946) |

# Whole Label Evaluation Rules (WLE)

This section provides the Whole Label Evaluation rules for text written in the Gurmukhi script. The rules have been drafted in such a way that they can be easily translated into the LGR specification.

Below are the symbols used in the WLE rules, for each of the "Indic Syllabic Category" as mentioned in the Table 6: Code point repertoire. In addition, we have created a few more symbols related to matras and vowels for the explanation of the rules.

C → Consonant

M → Matra

V → Vowel

B → Bindi

D → Tippi

H → Virama

N → Nukta

M1 → { ਿ(U+0A3F), ੁ(U+0A41) } (Short matras)

M2 → M - M1 (Long matras)

V1 → { ਅ (U+0A05), ਇ (U+0A0F), ਉ (U+0A09)} (Short Vowels)

V2 → V - V1 (Long Vowel)

C1 → {ਖ (U+0A16), ਗ (U+0A17), ਸ (U+0A38), ਜ (U+0A1C), ਫ (U+0A2B), ਲ (U+0A32)}

C2 → {ਰ (U+0A30), ਵ (U+0A35), ਹ (U+0A39)}

C3 → C – {ਹ(U+0A39), ਙ(U+0A19), ਞ(U+0A1E), ਣ(U+0A23), ੜ(U+0A5C),

ਖ਼(U+0A16+U+0A3C), ਗ਼(U+0A17+U+0A3C), ਲ਼(U+0A32+ U+0A3C)}

## N: must be preceded only by C1

## H: must be preceded by C or N and followed by C2 only

## M: must be preceded by C or N

## B: must be preceded by specific V or M

The specific Vs are:

1. V2
2. ਉ (U+0A09)

The specific Ms are:

1. M2 – { ੂ (U+0A42)}

## D: must be preceded by, C, N or a specified set of V or M

The specific Vs are:

1. V1– { ਉ (U+0A09)}

The specific Ms are:

1. M1
2. { ੂ (U+0A42)}

## A: must be preceded by C, N or specific V or M and followed by C3

The specific Vs are:

1. V1
2. ਐ (U+0A10)

The specific Ms are:

1. M1
2. ੈ (U+0A48)

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