

J-UNIMORPH: Japanese Morphological Annotation through the Universal Feature Schema

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 github.com/cl-tohoku/J-UniMorph

Abstract

We introduce a Japanese Morphology dataset, J-UNIMORPH, developed based on the UniMorph feature schema. This dataset addresses the unique and rich verb forms characteristic of the language’s agglutinative nature. J-UNIMORPH distinguishes itself from the existing Japanese subset of UniMorph, which is automatically extracted from Wiktionary. On average, the Wiktionary Edition features around 12 inflected forms for each word and is primarily dominated by denominal verbs (i.e., [noun]+*suru* (do-PRS)). Morphologically, this form is equivalent to the verb *suru* (do). In contrast, J-UNIMORPH explores a much broader and more frequently used range of verb forms, offering 118 inflected forms for each word on average. It includes honorifics, a range of politeness levels, and other linguistic nuances, emphasizing the distinctive characteristics of the Japanese language. This paper presents detailed statistics and characteristics of J-UNIMORPH, comparing it with the Wiktionary Edition. We release J-UNIMORPH and its interactive visualizer publicly available, aiming to support cross-linguistic research and various applications.

1 Introduction

Universal Morphology (UniMorph) is a collaborative project that delivers a wide-ranging collection of standardized morphological features for over 170 languages in the world (Sylak-Glassman, 2016; McCarthy et al., 2020). UniMorph feature schema comprises over 212 feature labels across 23 dimensions of meaning labels, such as tense, aspect, and mood. More concretely, UniMorph dataset consists of a lemma coupled with a set of morphological features that correspond to a specific inflected form, as illustrated by the following example:

走る/*hashi-ru* 走った/*hashi-tta* V;PST;IPFV

where the original form (lemma) “*hashi-ru*” (走る, run-PRS) is inflected to “*hashi-tta*” (走った,

run-PST) to indicate the past tense (PST) and imperfective aspect (IPFV) as morphological features.

The challenge of morphological (re)inflection, which started with the SIGMORPHON 2016 Shared Task (Cotterell et al., 2016), involves generating an inflected form from a given lemma and its corresponding morphological feature. This effort has continued over years, covering multiple shared tasks (Cotterell et al., 2017, 2018; McCarthy et al., 2019; Vylomova et al., 2020; Pimentel et al., 2021; Kodner et al., 2022; Goldman et al., 2023).

The SIGMORPHON–UniMorph 2023 Shared Task 0 (Goldman et al., 2023) released a Japanese Morphology dataset,¹ which was automatically extracted from Wiktionary. This Wiktionary Edition, on average, highlights 12 inflected forms for each word. It mainly consists of denominal verbs, which are formed by combining a noun with “*suru*” (do-PRS), and their inflection patterns are morphologically equivalent to those of the verb “*suru*.”

We introduce J-UNIMORPH, which emphasizes a wider variety of verb forms, with an average of 118 inflected forms per word. It includes honorifics, varying levels of politeness, and imperatives with fine-grained distinctions, showcasing the distinctive features of the Japanese language.

This paper begins with an overview of the UniMorph Schema, detailing the characteristics of each dimension and the criteria used for labeling J-UNIMORPH (§2). We then explain the data creation process for J-UNIMORPH (§3). As illustrated in Figure 1, this process includes three main steps: (1) generating inflected forms (Generation), (2) assigning UniMorph labels (Annotation), and (3) removing incorrect or infrequent forms based on frequency (Filtering). Finally, a comparative analysis (§4) between J-UNIMORPH and the Wiktionary Edition shows that J-UNIMORPH includes more commonly used verbs and a wider variety of in-

¹<https://github.com/sigmorphon/2023InflectionST/>

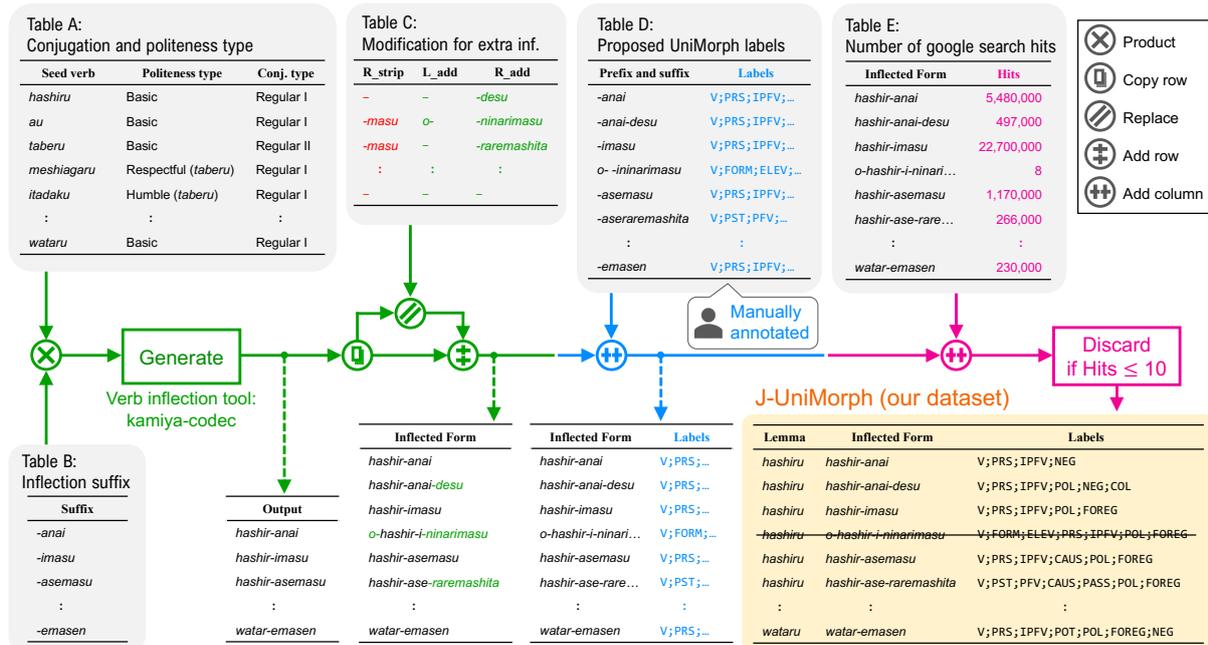


Figure 1: Overview of the J-UNIMORPH creation process: First, we **generate** inflected forms from seed verbs (Table A, detailed in §3.1) and inflection suffix (Table B, detailed in §3.2) using the verb inflection tool, *kamiya-codec*. This is followed by modifying and adding inflected forms that the tool does not cover (Table C, detailed in §3.2). Second, Japanese native speakers **annotate** UniMorph labels to each form (Table D, detailed in §2). Finally, we apply a frequency **filter** to discard infrequent inflected forms (Table E, detailed in §3.3).

flected forms than the Wiktionary Edition, with a slightly larger size (12,687 vs. 12,000).

We release J-UNIMORPH and its interactive visualizer publicly available, aiming to provide a useful resource for cross-linguistic studies and a range of applications.

2 Features Schema in J-UNIMORPH

Japanese, an agglutinative language, allows for the expression of various meanings through altering verb endings and adding affixes. Verbs in Japanese are broadly categorized into three conjugation types: Regular I verbs, Regular II verbs, and Irregular verbs (Kamiya, 2001). Among these, the Irregular verbs include only “*kuru*” (来る, come-PRS) and “*suru*” (する, do-PRS).² Table 1 provides examples of Regular I and II verbs.

The authors, who are all native Japanese speakers with Linguistics backgrounds, have carefully and thoroughly discussed to determine the alignment between the inflection patterns and their Uni-

²In Japanese, *denominal verbs* are formed by combining a noun with the light verb “*suru*.” For example, “*benkyo*” (勉強, study-N) becomes “*benkyo-suru*” (勉強する, study-V;PRS). These verbs share the same inflection pattern as “*suru*” (do-V;PRS). Given their identical inflection pattern, we have excluded denominal verbs from the J-UNIMORPH.

Regular I verbs (I型動詞, 五段活用動詞) <i>a-u</i> (会う, meet), <i>ik-u</i> (行く, go), <i>kak-u</i> (書く, write), <i>kik-u</i> (聞く, listen), <i>hashir-u</i> (走る, run)
Regular II verbs (II型動詞, 一段活用動詞) <i>ki-ru</i> (着る, wear/put on), <i>kotae-ru</i> (答える, answer), <i>tabe-ru</i> (食べる, eat), <i>mi-ru</i> (見る, see/watch)

Table 1: Examples of Regular I and II Verbs

Morph feature labels.³ In this section, we review the common Japanese inflections such as politeness (§2.1), mood including imperatives (§2.2), tense and aspect (§2.3), negation (§2.4), passive (§2.5), and causative (§2.6), and the criteria for labeling J-UNIMORPH. We note that some inflected forms share the same spelling but have ambiguous or multiple meanings, and we annotate these as distinct entries in J-UNIMORPH for clarity.

2.1 Politeness

Honorific speech (*Keigo*, 敬語), which conveys politeness in Japanese, is primarily classified into three types: polite form (*Teineigo*, 丁寧語), respectful form (*Sonkeigo*, 尊敬語), and humble form (*Kenjōgo*, 謙讓語). We explain the character-

³The “label” is also referred to as “tag” recently (McCarthy et al., 2020; Batsuren et al., 2022).

istics, forms of expression, usage, and applicable labels in the following.

Polite form (*Teineigo*, 丁寧語) Polite form is a form that conveys respect to the reader or listener, and it uses the “*-desu/masu*” (-です/ます) form. The level of politeness can be further heightened when used in inflection with respectful or humble form (Hirabayashi and Hama, 1988). The UniMorph Schema includes the label POL (Polite), so we attach this label to these form. Additionally, the UniMorph Schema provides the label FOREG (Formal register) for the Japanese “*mas(u)-style*” (Sylak-Glassman, 2016); therefore we have also assigned FOREG to the “*-masu*” form.

Respectful form (*Sonkeigo*, 尊敬語) The respectful form of expression elevates the person who should be respected, and is typically used for superiors and customers. This is not employed for individuals within the same group or for one’s own actions. Most verbs generally take the form of “*-reru/rare-ru*” (-れる/られる), and “*o—ninaru*” (お—になる), where the verb’s inflection occurs between the “*o*” and “*ninaru*.” Some verbs also take lexical honorifics, where the word itself changes to express respect, such as changing “*iku*” (行く, go-PRS⁴) to “*irassharu*” (いらっしゃる, go-PRS;ELEV).

Although these lexical honorifics go beyond the scope of standard “inflection,” we have chosen to include some of them for practical reasons, particularly because they are commonly used in place of basic verbs when expressing respect.

The “*o—ninaru*” (お—になる) form is commonly used for verbs that do not have any lexical honorific. Both the lexical honorific and the “*o—ninaru*” form are labeled with FORM+ELEV (Formal, Referent Elevating), following the UniMorph Schema (Sylak-Glassman, 2016). The “*-reru/rare-ru*” form is assigned only ELEV (Referent Elevating) without FORM (Formal). This choice is based on the consideration that this form conveys a lower level of respect compared to the “*o—ninaru*” (お—になる) and the lexical honorific, despite slightly deviating from the UniMorph Schema definition (Sylak-Glassman, 2016). The following examples illustrate the verb “*iku*” (行く, go-PRS) with a lexical honorific and “*au*” (会う, meet-PRS) without a lexical honorific.

⁴In the main text, only the relevant label set is presented for brevity.

行く <i>iku</i>	行く <i>iku</i>
行かれる <i>ika-reru</i>	いらっしゃる <i>irassharu</i>
V;PRS;IPFV;ELEV	V;FORM;ELEV;PRS;IPFV

会う <i>au</i>	会う <i>au</i>
会われる <i>awa-reru</i>	お会いになる <i>o-ai-ninaru</i>
V;PRS;IPFV;ELEV	V;FORM;ELEV;PRS;IPFV

Humble form (*Kenjōgo*, 謙讓語) The humble form conveys respect by lowering oneself or one’s group in comparison to the person deserving respect. In business contexts, it is used even when referring to the actions of one’s own company’s superiors, especially when addressing customers. Most verbs mainly take the form of “*o—suru*” (お—する), where the verb’s inflection occurs between the “*o*” and “*suru*.” Some verbs also take lexical honorifics. These are labeled as FORM+HUMB (Formal, Speaker Humbling), following the UniMorph Schema (Sylak-Glassman, 2016). The examples below demonstrate the use of the verb “*iku*” (行く, go-PRS) with the lexical honorific and “*kaku*” (書く, write-PRS) without a lexical honorific.

行く <i>iku</i>
伺う <i>ukagau</i>
V;FORM;HUMB;PRS;IPFV

書く <i>kaku</i>
お書きする <i>o-kaki-suru</i>
V;FORM;HUMB;PRS;IPFV

The complexity of Japanese honorifics and their inflection patterns is further complicated by lexical honorifics corresponding to multiple basic forms, and vice versa. For instance, the humble verb “*ukagau*” (伺う) corresponds to three basic verbs: “*kuru*” (来る, come), “*iku*” (行く, go), and “*kiku*” (聞く, ask/listen). On the other hand, the basic verb “*iku*” (行く, go) is associated with three humble verbs: “*mairu*” (まいる), “*ukagau*” (伺う), and “*agaru*” (上がる). In Appendix A, we provide the correspondence between the basic forms and lexical honorifics adopted in J-UNIMORPH.

2.2 Mood

In terms of expressing mood, we deal with the following five categories: Imperatives, Intensive, Optative, Potential, and Permissive.

Imperatives Japanese has a variety of imperative expressions, as shown in Table 2. This table com-

Inflected form	Romanization	Labels
食べる	<i>tabe-ro</i>	V;IMP;OBLIG
食べな	<i>tabe-na</i>	V;IMP;OBLIG;COL
食べなさい	<i>tabe-nasai</i>	V;IMP;OBLIG;POL
食べて	<i>tabe-te</i>	V;IMP;COL
食べてください	<i>tabe-te-kudasai</i>	V;IMP;POL
お食べください	<i>o-tabе-kudasai</i>	V;FORM;IMP;POL
食べるな	<i>tabe-ru-na</i>	V;IMP;OBLIG;NEG
食べないで	<i>tabe-nai-de</i>	V;IMP;NEG;COL
食べないでください	<i>tabe-nai-de-kudasai</i>	V;IMP;POL;NEG
お食べにならないでください	<i>o-tabе-ni-naranai-de-kudasai</i>	V;FORM;IMP;POL;NEG
召し上がれ	<i>meshiaga-re</i>	V;FORM;ELEV;IMP;OBLIG
召し上がりな	<i>meshiaga-ri-na</i>	V;FORM;ELEV;IMP;OBLIG;COL
召し上がりなさい	<i>meshiaga-ri-nasai</i>	V;FORM;ELEV;IMP;OBLIG;POL
召し上がって	<i>meshiaga-tte</i>	V;FORM;ELEV;IMP;COL
召し上がってください	<i>meshiaga-tte-kudasai</i>	V;FORM;ELEV;IMP;POL
お召し上がりください	<i>o-meshiaga-ri-kudasai</i>	V;FORM;ELEV;IMP;POL;COL
召し上がるな	<i>meshiaga-ru-na</i>	V;FORM;ELEV;IMP;OBLIG;NEG
召し上がらないで	<i>meshiaga-ra-nai-de</i>	V;FORM;ELEV;IMP;NEG;COL
召し上がらないでください	<i>meshiaga-ra-nai-de-kudasai</i>	V;FORM;ELEV;IMP;POL;NEG
お召し上がりにならないでください	<i>o-meshiaga-ri-ni-naranai-de-kudasai</i>	V;FORM;ELEV;IMP;POL;NEG;COL

Table 2: Correspondence between the imperative form and labels, using the verb “*taberu*” (食べる, eat).

piles the inflection and label correspondence of the verb “*tabe-ru*” (食べる, eat-PRS) as an example, organizing them into four groups based on the similarity of their label sets. Each group’s inflected forms are roughly sorted by the strength of degree of command, from strong to weak. All forms in Table 2 are labeled IMP (Imperative).

In Table 2, the term “*tabe-ro*” (食べる, Do eat!), representing the most forceful command, is annotated with OBLIG (Obligative) due to its compelling nature. This expression is rarely used in everyday conversations as it comes across as overly authoritative. For colloquial forms like “*tabe-na*” (食べな, Eat.) in the second row, commonly used in informal speech, COL (Colloquial) is assigned. For forms that include polite expressions such as “*-nasai*” and “*-kudasai*,” POL (Polite) is assigned.

The bottom two groups of Table 2 show imperative inflection patterns and their corresponding labels for lexical honorifics “*meshiaga-ru*” (召し上がる, eat-PRS;ELEV), which is one of the respectful forms of the basic verb “*tabe-ru*” (食べる, eat-PRS). For these instances, we also assign FORM+ELEV labels (§2.1).

Intentive Japanese intentive forms such as “*-yō*” (-よう), “*-ō*” (-おう), and “*-mashō*” (-ましよう) are marked with INTEN (Intentive). Since “*-mashō*” is one of the inflections of the polite form “*-masu*” (-ます), it is additionally annotated with POL+FOREG (Polite, Formal register) (§2.1). Be-

low are examples of intentive expressions, where “*tabe-yō*” and “*tabe-mashō*” are inflected forms of the verb “*tabe-ru*” (食べる, eat-PRS).

ピザを食べよう。

Piza-o tabe-yō.

Let’s eat pizza.

ピザを食べましょう。

Piza-o tabe-mashō.

Let’s eat pizza. (Polite)

Optative In Japanese, expressions of wishes include “*-tai*” (たい) to express subjective desires and “*-tagaru*” (たがる) for objective observations. We distinguish these two optative expressions with the label OPT (Optative-Desiderative), associated with person specification (1: first person, 3: third person). Below are examples with the verb “*hashiru*” (走る, run).

走る/*hashir-u*

走りたい/*hashir-i-tai*

V;PRS;IPFV;OPT;1

e.g., I want to run. (*Watashi-wa hashir-i-tai*)

走る/*hashir-u*

走りたいがる/*hashir-i-tagaru*

V;PRS;IPFV;OPT;3

e.g., He wants to run. (*Kare-wa hashir-i-tagaru*)

Potential We assign the label POT (Potential) to expressions that indicate possibility. For Regular I verbs, the suffix “-eru” is attached, while Regular II verbs take “-reru/rareru,” which is identical to the respectful form (§2.1). In J-UNIMORPH, we include these forms as separate entries. Below are examples, with “kaku” (書く, write-PRS) being a Regular I verb and “miru” (見る, look-PRS) a Regular II verb.

書く /kak-u	見る /mi-ru
書ける /kak-eru	見られる /mi-rareru
V;PRS;IPFV;POT	V;PRS;IPFV;POT

Permissive The expression “-(sa)se-te-itadaku” (-させていただく) is used to politely request permission, demonstrating humility.⁵ We assigned this form with FORM+HUMB (Formal, Speaker Humbling) and PERM (Permissive). The following examples demonstrate annotated suffixes for “-(sa)se-te-itadaki-masu” with V;FORM;HUMB;PRS;IPFV;POL;FOREG;PERM.

- (a) 私から答えさせていただきます。
Watashi-kara kotae-sase-te-itadaki-masu.
 (If I am allowed,) I will answer (the question).⁶
- (b) [店先の貼り紙で] 本日は休ませていただきます。
Honjitsu-wa yasuma-se-te-itadaki-masu.
 [Notice at the store front] (Our store) will be closed today. (No specific permission is required)

2.3 Tense and Aspect

There are two forms to express tense or aspect: *ta*-form and *ru*-form in Japanese. The “*ta*” and “*ru*” respectively represent verb endings such as “*tabe-ta*” (食べた, eat-PST) or “*tabe-ru*” (食べる, eat-PRS). From a tense perspective, these forms represent the contrast between “past” and “non-past,” while from an aspect perspective, they represent the contrast between “perfective” and “imperfective” (Kato and Fukuchi, 1989).

Japanese does not have a distinct form to explicitly distinguish between present and future. Future

⁵While originally meant for contexts where a specific approver for a particular action could be anticipated, it has now changed to express humility even when the approver may not be evident (Nihongo Kijutsu Bunpo Kenkyukai, 2009b).

⁶Brackets indicate implied meaning not explicitly stated in Japanese.

tense is expressed by adverbial elements such as “next week” or “tomorrow,” so we do not assign the label FUT (Future) to the *ru*-form.

Based on the above considerations, the *ta*-form is assigned the label PST+PFV (Past, Perfective), while the *ru*-form is assigned the label PRS+IPFV (Present, Imperfective). The following are examples of the verb “*hashi-ru*” (走る, run-PRS).⁷

走る /hashi-ru	走る /hashi-ru
走る /hashi-ru	走った /hashi-tta
V;PRS;IPFV	V;PST;PFV

Note that the *ru*- and *ta*-form have various meanings by being accompanied by peripheral words such as adverbs and interjections. The examples about special usage of the *ru*-form are property: 日本人は米を食べる。(Japanese people eat rice.), and command: さっさと歩く! (Walk quickly!). The examples about special usage of the *ta*-form are discovery: [鍵を探していて] あっ、ここにあった。(Oh, here’s the key.), and recall: あっ、今日は会議だった。(Oh, I have a meeting today.) (Nihongo Kijutsu Bunpo Kenkyukai, 2007). Since the meaning of these cases relies on peripheral words, not on the inflected form itself, we exclude these instances from the J-UNIMORPH.

Prospective forms such as “-*darō*” (-だろ う) and “-*deshō*” (-でしょう) are marked with PROSP (Prospective). As “-*deshō*” is one of the inflections of the polite form “-*desu*,” it is also annotated with POL (Polite). An example of the usage of “-*deshō*” is presented below.

明日は晴れるでしょう。
Ashita-wa hare-ru-deshō.
 It will be sunny tomorrow.

2.4 Negation

Negation in Japanese is primarily expressed through the suffixes “-*nai*” (-ない) or “-*masen*” (-ません), and in J-UNIMORPH, the label NEG (Negative) is assigned to indicate negation. Since “-*masen*” is an inflection of the polite form “-*masu*,” we assign the label POL+FOREG+NEG (Polite, Formal register, Negative) to it. Another polite negation form, “-*nai-desu*,” is commonly used in colloquial speech, and thus, the label POL+NEG+COL (Negative, Colloquial) is applied to it.

⁷As in this example, the *ta*-form does not necessarily involve simply replacing “*ru*” with “*ta*” from the base form.

Importantly, neither “*-nai*” (NEG) nor “*-desu*” (POL) alone conveys a colloquial tone; however, COL becomes apparent when they are combined, highlighting the non-monotonic compositional nature of verb inflection in Japanese. Below are examples of “*mi-ru*” (見る, look-PRS).

見る/*mi-ru* 見る/*mi-ru*
 見ない/*mi-nai* 見ないです/*mi-nai-desu*
 V;PRS;IPFV;NEG V;PRS;IPFV;POL;NEG;COL

見る/*mi-ru*
 見ません/*mi-masen*
 V;PRS;IPFV;POL;FOREG;NEG

2.5 Passive

The passive voice (PASS) in Japanese employs the suffix “*-re-ru/rare-ru*” (～れる/～られる), which shares the same form as the respectful form (§2.1 and also potential form (§2.2). In J-UNIMORPH, we categorize these forms as distinct entries for clarity. The past expression is created by replacing the last “*ru*” with “*ta*” (§2.3), resulting in “*-re-ta/rare-ta*” (～れた/～られた). An example of the use of past and passive expression is provided below.

私のテスト用紙を彼に見られた。
Watashi-no tesuto yōshi-o kare-ni mi-rare-ta.
 My test paper was seen by him.

2.6 Causative

In English, causatives are typically expressed using verbs like “have” or “make.” However, in Japanese, this can be achieved using suffixes, specifically the “*-se-ru/sase-ru*” (～せる/～させる) form, which is annotated with CAUS (Causative).⁸ The past expression is created by replacing the suffix “*ru*” with “*ta*” (§2.3), resulting in “*-se-ta/sase-ta*” (～せた/～させた). Below is an example of the past expression.

私はその映画を彼に見させた。
Watashi-wa sono eiga-o kare-ni mi-sase-ta.
 I made him watch the movie.

We also deal with the following forms: causative involving passive, and contraction of causative.

Causative and Passive It is possible to introduce passivity into the causative construction. In such cases, the “*-se-rare-ru/sase-rare-ru*” (～せられる/～させられる) form is employed, and the labels are annotated with CAUS+PASS (Causative,

Conj. type	Base	Ordinary	Contraction
Reg. I	書く <i>kak-u</i>	書かせる <i>kak-ase-ru</i>	書かす <i>kak-as-u</i>
Reg. II	見る <i>mi-ru</i>	見させる <i>mi-sase-ru</i>	見さす <i>mi-sas-u</i>
Irreg.	来る <i>ku-ru</i>	来させる <i>ko-sase-ru</i>	来さす <i>ko-sas-u</i>
Irreg.	する <i>su-ru</i>	させる <i>s-ase-ru</i>	さす <i>sas-u</i>

Table 3: Examples of Causative contraction forms. We also handle these contraction forms.

Conj. type	Base	Ordinary	Contraction
Reg. I	書く <i>kak-u</i>	書かせられる <i>kak-ase-rare-ru</i>	書かされる <i>kak-as-are-ru</i>
Reg. II	見る <i>mi-ru</i>	見させられる <i>mi-sase-rare-ru</i>	*見さされる <i>*mi-sas-are-ru</i>
Irreg.	来る <i>ku-ru</i>	来させられる <i>ko-sase-rare-ru</i>	*来さされる <i>*ko-sas-are-ru</i>
Irreg.	する <i>su-ru</i>	させられる <i>s-ase-rare-ru</i>	*さされる <i>*sas-are-ru</i>

Table 4: Examples of Passive-Causative contraction forms. We do not handle incorrect usages, which have the asterisk (*).

Passive). The past expression is created by replacing the last “*ru*” with “*ta*” (§2.3), resulting in “*-se-rare-ta/sase-rare-ta*” (～せられた/～させられた). Below is an example of the past expression.

私はその映画を彼に見させられた。
Watashi-wa sono eiga-o kare-ni mi-sase-rare-ta.
 I was made to watch the movie by him.
 ≈ He made me watch the movie.

Contraction of Causative The contracted form “*-su/sasu*” (～す/～さす) is frequently used for causative verbs. In Regular I Verbs, similarly, the contracted form “*-sare-ru*” (～される) is commonly employed for passive-causative expression (Nihongo Kijutsu Bunpo Kenkyukai, 2009a). Examples of each are presented in Table 3 and Table 4.

These shortening forms like “*-su/sasu*” or “*-sare-ru*” are assigned the same labels as “*-se-ru/sase-ru*” (CAUS) or “*-se-rare-ru/sase-rare-ru*” (CAUS+PASS), because they do not lead to any change in meaning, such as a decrease in respect. Below are examples of causative of “*tabe-ru*” (食べる, eat-PRS).

食べる/*tabe-ru* 食べる/*tabe-ru*
 食べさせる/*tabe-sase-ru* 食べさす/*tabe-sasu*
 V;PRS;IPFV;CAUS V;PRS;IPFV;CAUS

⁸We explain *lexical* causative verbs in §4.3.

3 How to Generate Inflected Forms

The previous section outlined how we matched inflected forms with their UniMorph labels. In this section, we will walk through our process for generating all the inflected forms and how we filter out the less common forms, yielding a total of 12,687 in J-UNIMORPH.

3.1 Seed Verb Selection Process

The selection of seed verbs (Table A in Figure 1) comprised two categories: (a) 107 basic verbs frequently encountered at the N5 (most basic) level of the Japanese Language Proficiency Test (JLPT), and (b) 40 lexical honorifics,⁹ divided into 19 respectful and 21 humble forms, as cited in Hirabayashi and Hama (1988). The conjugation types of each verb and their detailed statistics are provided in Appendix B.

3.2 Generate Inflected Forms

First, we made a list of inflected forms to be registered in J-UNIMORPH (Table B in Figure 1).¹⁰ Inflected forms were carefully selected by four native speakers of Japanese (the authors), who referred to several books on Japanese grammar (Nihongo Kijutsu Bunpo Kenkyukai, 2007, 2009a,b; Hirabayashi and Hama, 1988; Takami, 2011) and a book designed for Japanese language learners (Kamiya, 2001).

Next, we used `kamiya-codec`,¹¹ a verb inflection tool, to generate each inflected form based on patterns derived from Kamiya (2001). This tool produces inflected forms by taking the seed verb (lemma) and the arguments for its inflections.¹² In certain cases, we modified parts of the inflected forms for additional inflection beyond what this tool provides (see Table C). Irregular verbs were generated manually to ensure accuracy.

⁹Lexical honorifics are matched with the corresponding 107 basic verbs.

¹⁰In most cases, the inflected forms correspond to the “*bunsetsu*,” Japanese grammatical unit which is roughly equivalent to a (verb) phrase in English. However, they can sometimes extend beyond a single “*bunsetsu*,” especially when multiple suffixes are combined (cf. Goldman and Tsarfaty (2022)).

¹¹<https://github.com/fasiha/kamiya-codec>

¹²One exception is the negation of “*ar-u*” (ある, be), which is expressed as “*nai*” (ない) instead of “*ar-anai*.” This is implemented by `kamiya-codec`.

¹³To ensure visibility for forms with zero hits, we apply a smoothing technique by adding 0.5 for such cases.

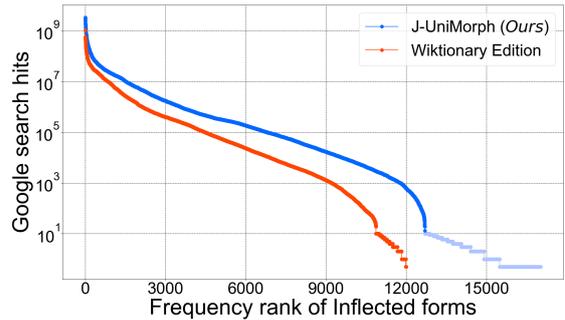


Figure 2: The relationship between the frequency rank of inflected forms and their corresponding number of Google search hits, highlighting a long-tail distribution pattern, regarding J-UNIMORPH and Wiktionary Edition, respectively. Both graphs exhibit a clear trend shift when the number of hits falls to 10^1 or fewer.¹³ Upon manual review by authors, for J-UNIMORPH, we concluded that these forms sound unnatural and should be discarded (indicated by the light-blue-colored plots), leaving a total of 12,687 inflected forms in J-UNIMORPH. Additionally, we found that inflected forms in Wiktionary Edition have fewer hits compared to those in J-UNIMORPH (detailed in §4.1).

3.3 Filtering

To ensure the correctness and actual usage of the generated inflected forms, we used SerpAPI¹⁴ to obtain the number of exact match hits from Google search results (Table E in Figure 1). Figure 2 shows the relationship between the frequency rank of inflected forms and their corresponding number of Google search hits, highlighting a long-tail distribution pattern. We see that the trend distinctly shifts when the number of hits reaches 10. After manually reviewing inflected forms with less than or equal to 10 hits, we concluded that most of these forms sound unnatural and should be discarded.¹⁵

We also manually excluded 16 specific forms that sound inappropriate with respect to honorifics. These are respectful forms of “*shinu*” (死ぬ, die) such as “**o-shini-ni-naru*” (*お死にならぬ) and “**shina-reru*” (*死なれる), which sounds inappropriate and rather unnatural. A more considerate expression is “*nakunar-u*” (亡くなる, pass away), which is not registered in the current version. While there are other expressions that may not be commonly used in practice, the expressions related to “die” were singled out for special attention and deletion, given the need for extra caution.

¹⁴<https://serpapi.com/>

¹⁵We release all the generated forms with their number of Google search hits for reference.

4 Analysis of J-UNIMORPH

4.1 Comparison with Wiktionary Edition

The SIGMORPHON–UniMorph 2023 Shared Task 0 (Goldman et al., 2023) introduced a dataset focusing on Japanese Morphology, automatically extracted from Wiktionary. Table 5 presents a list of inflection/derivation forms for the noun, “使用” (use-N), as registered in Wiktionary Edition.

Table 6 shows a comparison between the Wiktionary Edition and J-UNIMORPH in terms of the total number of inflected forms and the number of seed words. J-UNIMORPH has 12,687 inflected forms in total, which slightly exceeds the number found in the Wiktionary Edition (12,000). Notably, all seed words in J-UNIMORPH are verbs, in contrast to Wiktionary Edition, where denominal verbs dominate approximately 70%. As explained in §2, inflection patterns of denominal verbs are morphologically equivalent to those of the verb “*suru*.” It also indicates that J-UNIMORPH includes a wider variety of inflection patterns and combinations, with an average of 118.6 patterns per verb, compared to the Wiktionary Edition, which averages 12.0.

Figure 2 presents the comparison of the number of Google search hits for all inflected forms listed in J-UNIMORPH and Wiktionary Edition. The graph demonstrates that J-UNIMORPH contains inflected forms that are more commonly used, as indicated by higher search hits than those in Wiktionary Edition. The average hits by J-UNIMORPH and Wiktionary Edition are shown in Table 6.

Lemma	Inflected form	Labels
使用	使用せず <i>/-se-zu</i>	V.CVB;NEG
使用	使用すれ <i>/-su-re</i>	V.PTCP;IRR
使用	使用し <i>/-shi</i>	V.PTCP;LGSPEC01
使用	使用し <i>/-shi</i>	V.PTCP;LGSPEC02
使用	使用する <i>/-suru</i>	V.PTCP;REAL
使用	使用すれば <i>/-sure-ba</i>	*V;COND
使用	しよう <i>/-shi-yō</i>	V;IMP;NOM(1;PL)
使用	使用する <i>/-suru</i>	V;IND
使用	使用します <i>/-shi-masu</i>	V;IND;FORM
使用	使用しない <i>/-shi-nai</i>	V;IND;NEG
使用	使用される <i>/-sa-reru</i>	V;IND;PASS
使用	使用した <i>/-shi-ta</i>	V;IND;PST
使用	使用できる <i>/-deki-ru</i>	V;POT

Table 5: An example of the inflection/derivation pattern for “*shiyō*” (使用, use-N), sourced from Wiktionary Edition. *使用すれば */-sure-ba* is adverb.



Figure 3: Screenshot of J-UNIMORPH Visualizer, a tool for helping Japanese learners. Users input an inflected form and click the “Search” button to highlight corresponding UniMorph labels. If the inflected form has multiple meanings, they are displayed under the “Search Results” section, with the option to toggle between meanings. Additionally, “Related Words” section displays other inflected forms with the same label (including itself). Confidence values, ranging from 0 to 100 and based on Google search hits, assist users in determining which inflected form should be used. Higher values indicate more hits. Users also can switch between labels to investigate inflected forms with different meanings.

4.2 J-UNIMORPH Visualizer

We developed the J-UNIMORPH Visualizer,¹⁶ which takes an inflected form as the input and provides the UniMorph labels of its form (Figure 3). This makes manual analysis of J-UNIMORPH easier. Our visualizer is different from the *kamiya-codec* by accepting input with UniMorph labels such as Past, Negative, and Polite, instead of surface forms (*-ta*, *-nai*, *-masu*), making it more accessible to non-native users who may not be knowledgeable about surface forms and their meanings. We hope that this visualizer can also offer a user-friendly interface for Japanese learners, enabling them to easily understand complex Japanese verb inflection patterns.

¹⁶<https://github.com/cl-tohoku/J-UniMorph>

	Wiktionary Edition			J-UNIMORPH
	<i>Train</i>	<i>Dev</i>	<i>Test</i>	(<i>Ours</i>)
Number of inflected forms	10,000	1,000	1,000	12,687
Number of inflected forms per word	12.5	10.0	10.0	118.6
The average of number of hits (in millions)	3.4	4.6	5.5	12
Number of seed words	800	100	100	107
Verbs	25%	27%	30%	100%
Denominal verbs (noun + “ <i>suru</i> ”)	72%	69%	67%	0%
Accompanied by particles	3%	2%	3%	0%
Deadverbal verbs (adverb + “ <i>suru</i> ”)	1%	2%	0%	0%

Table 6: Comparison of lemma types between Wiktionary Edition and J-UNIMORPH.

4.3 Labels and Forms Excluded from the Current Version

While J-UNIMORPH contains a total of 12,687 inflected forms, covering a variety of labels and forms as described in §2, we have excluded several forms, such as subsidiary verbs, question expressions, lexical causative verbs, and informal expressions. The primary reason for their exclusion is their simple morphological pattern or morphological equivalence to other verbs already included in J-UNIMORPH. We provide several details on the excluded forms in this section, with the detailed list available in Appendix C.

Subsidiary Verbs In Japanese, a small group of verbs, referred to as subsidiary verbs (*hojo-dōshi*), are characterized by their grammaticalized functions after the *te*-form. Subsidiary verbs contribute additional meanings to the verbs they attach to. For example, the verb “*iru*” (いる), conveying “be” independently, transforms into “be running” or “have run” in the context of “*hashi-tte-iru*” (走っている). Similarly, the verb “*miru*” (見る), meaning “look” or “watch” on its own, takes on a different meaning, such as “try running,” when attached to the verb “*hashi-ru*” (走る, run) like “*hashi-tte-miru*” (走ってみる). We generally excluded subsidiary verbs from J-UNIMORPH due to their morphological equivalence to the subsidiary verbs that are already incorporated into J-UNIMORPH as seed verbs. Furthermore, one subsidiary verb can precede another subsidiary verb, to express a wide range of possible combinations, such as “*hashi-tte-mi-te-iru*” (走ってみている). We set aside these patterns for future research.

Question Expressions The interrogative (INT) suffix “*ka*” (か) forms questions,¹⁷ easily added

¹⁷In conversational contexts, raising the intonation at a sentence’s end can indicate a question without a specific marker.

to create inflected forms. However, its use with other suffixes can alter meanings. For example, “*tabe-masen*” (食べません, eat-PRS;POL;NEG), meaning “(I) don’t eat,” becomes “Shall (we) eat?” when “*ka*” is added, as in “*tabe-masen-ka?*” (eat-INT;INTEN;POL), dropping the negation. Matching these combined forms with their meanings is complex, and we reserve this for future research.

Lexical causative verbs In addition to verbs that marked CAUS (Causative) by attaching “*-se-ru/sase-ru*” (§2.6), some verbs have the corresponding transitive forms that inherently carry both the causation process and the resulting event (Takami, 2011). Below, example (a) shows the base form “*ne-ru*” (寝る, sleep) with the causative inflection suffix, whereas example (b) uses lexical causative verb “*nekas-u/nekas-e-ru*” (寝かす/寝かせる) to express causative feature. We did not include lexical causative verbs in J-UNIMORPH because they are not expressed through inflection.

- (a) お母さんは子供を寝させた。
Okāsan-wa, kodomo-o ne-sase-ta. (“*-sase-ru*” form)
 The mother put the child to sleep.
- (b) お母さんは子供を寝かした/寝かせた。
Okāsan-wa, kodomo-o nekas-i-ta/nekas-e-ta. (lexical causative verb)
 The mother put the child to sleep.

Controversial Informal Language Form Several colloquial expressions are controversial and seen as incorrect in Japanese.¹⁸ Table 7 shows examples of omitting “*ra*,” omitting “*i*,” and inserting “*sa*.” Although these expressions are widely used in spoken language, they are not currently used in

¹⁸https://www.bunka.go.jp/kokugo_nihongo/sisaku/joho/joho/kakuki/20/tosin03/09.html

Category	Formal Form	Informal Form	Rough translation
Omitting <i>ra</i>	<i>tabe-rareru</i> /食べられる	<i>tabe-reru</i> /食べれる	can eat
Omitting <i>i</i>	<i>tabe-te-iru</i> /食べている	<i>tabe-te-ru</i> /食べてる	be eating, have eaten
Inserting <i>sa</i>	<i>kawa-sete-itadaku</i> /買わせていただく	<i>kawa-sa-sete-itadaku</i> /買わせていただく	have the honor of buying

Table 7: Examples of Informal Forms

newspapers and formal writings, and are still considered incorrect in standard language. Therefore, we have excluded them from the current version of J-UNIMORPH.

4.4 UniMorph Limitations for Japanese

While the UniMorph schema includes a variety of morpho-semantic features, we have identified certain Japanese expressions that are not covered by the current UniMorph labels and format. In particular, due to its agglutinative nature, Japanese language includes compound suffixes consisting of multiple suffixes merging to express a new meaning beyond a simple combination of their individual semantic features (Morita and Matsuki, 1989). For example, “*-kamo-shire-nai*” (-かもしれない, \approx maybe) consists of “*kamo*” + “*shire*” + “*nai*.” The full meaning emerges when these suffixes are combined, with the meaning of “*nai*” (NEG) disappearing in the process.

Importantly, the order of these suffixes matters. Below, two examples showcase the same labels (PST, PFV, and LKLY) but in a different sequence.

- (a) 彼はリンゴを食べたかもしれない。
Kare-wa ringo-o tabe-ta-kamo-shire-nai.
 \approx He might have eaten an apple.
- (b) 彼はリンゴを食べるかもしれなかった。
Kare-wa ringo-o tabe-ru-kamo-shire-naka-tta.
 \approx He could have been able to eat an apple.

In the example (a), the suffix “*-(t)ta*” indicates PST;PFV and “*-kamo-shire-[nai|naka]*” represents likelihood (LKLY). Although both examples contain the same set of suffixes, the meaning of each sentence differs due to the varying order of the suffixes. That is, in example (a), LKLY dominates the overall meaning more than PST+PFV, whereas in example (b), PST+PFV governs the overall meaning more than LKLY.

One approach to address this morphological complexity is to adopt a hierarchical structure for annotations, as proposed by Gurriel et al. (2022),

who explored complex argument marking in the Georgian language.

5 Conclusion

We introduced J-UNIMORPH, a Japanese Morphology dataset based on the UniMorph schema. J-UNIMORPH covers a wide range of verb inflection forms, including honorifics, politeness levels, and other linguistic nuances, reflecting the language’s agglutinative nature. Unlike the Wiktionary Edition, which is automatically extracted from Wiktionary, J-UNIMORPH has been carefully designed by native speakers, featuring an average of 118 inflected forms per word (with a total of 12,687 instances), compared to Wiktionary Edition’s 12 inflected forms per word (12,000 instances in total). J-UNIMORPH, along with its interactive visualizer, has been released to facilitate cross-linguistic research and applications, offering a more comprehensive resource than previously available.

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C Inflection/derivation affixes not included in J-UNIMORPH

Reason	Affixes or example Inflected forms	Romanized and Rough translation
Subsidiary verbs (補助動詞)	～ている ～てみる ～ておく ～ておこう ～てあげる ～てもらう ～てくれる ～てある ～てしまう ～ていく ～つつある ～てほしい	- <i>te-iru</i> (be doing, have done) - <i>te-miru</i> (try doing) - <i>te-oku</i> (do in advance) - <i>te-okō</i> (let's do in advance) - <i>te-ageru</i> (do something for the benefit of someone) - <i>te-morau</i> (get someone to do something) - <i>te-kureru</i> (someone do something for me/us) - <i>te-aru</i> (has been done) - <i>te-shimau</i> (end up doing) - <i>te-iku</i> (keep on doing) - <i>tsutsu-aru</i> (be about to do) - <i>te-hoshii</i> (want someone to do)
Compound suffixes (複合辞)	～かもしれない ～てはいけない ～てはならない ～たがっている ～なければならない ～に違いない	- <i>kamo-shire-nai</i> (may) - <i>tewa-ike-nai</i> (must not do) - <i>tewa-nara-nai</i> (must not do) - <i>tagatte-iru</i> (wants to do) - <i>nakereba-naranai</i> (have to do) - <i>ni-chigai-nai</i> (must be doing)
Non verbs	～てもいい ～たら ～たり ～ば ～べきだ ～つもりだ ～はずだ ～らしい ～べし ～べからず 「笑い」「話」など ～に～（「買いに行く」など） ～ながら ～そうだ ～物，～方 ～始める，～終わる	- <i>te-mo-ii</i> (permissive) - <i>tara</i> (if) - <i>tari</i> (do and ...) - <i>ba</i> (if) - <i>beki-da</i> (should) - <i>tsumori-da</i> (intend to do) - <i>hazu-da</i> (be supposed to do) - <i>rashii</i> (It seems like ...) - <i>beshi</i> (should do) - <i>bekara-zu</i> (should not do) Treat as nouns, such as <i>warai</i> (laughter), <i>hanashi</i> (talk/conversation) - <i>ni-</i> (adverbial usage) - <i>nagara</i> (while doing) - <i>sōda</i> (It seems like ...) - <i>mono</i> , - <i>kata</i> (Nominative usage) - <i>hajimeru</i> , - <i>owaru</i> (begin -ing, finish -ing)
Noun/Adverb + light verb	～する	- <i>suru</i> (light verb)
Lexical causative verbs	寝かせる，立てる	<i>nekaseru</i> , <i>tateru</i>
Omitting <i>ra</i> (ら抜き言葉)	～れる	- <i>reru</i>
Omitting <i>i</i> (い抜き言葉)	～てる	- <i>teru</i>
Inserting <i>sa</i> (さ入れ言葉)	～させて～	- <i>sase-te-</i>
Interrogative suffix	～か？ ～でしょうか？，～ませんか？	- <i>ka?</i> - <i>mashōka?</i> , <i>masen-ka?</i>
Another respectful expressions	お～くださる	<i>o—kudasaru</i>
Another humble expressions	お～なさる お～いたす お～いたします	<i>o—nasaru</i> <i>o—itasu</i> <i>o—itashi-masu</i>
Others	～れる/られる ～よう	- <i>reru/rareru</i> (spontaneous) - <i>yō</i> (speculation)

Table 9: List of inflection/derivation affixes not included in the current version of J-UNIMORPH.