

VL²: Visualization of Linguistic Layers in Vedic Literature

ヴェーダ文献における言語層の可視化

Hiroaki Natsukawa (Osaka Seikei University)

夏川浩明 (大阪成蹊大学)

Kyoko Amano (Kyoto University)

天野恭子 (京都大学)



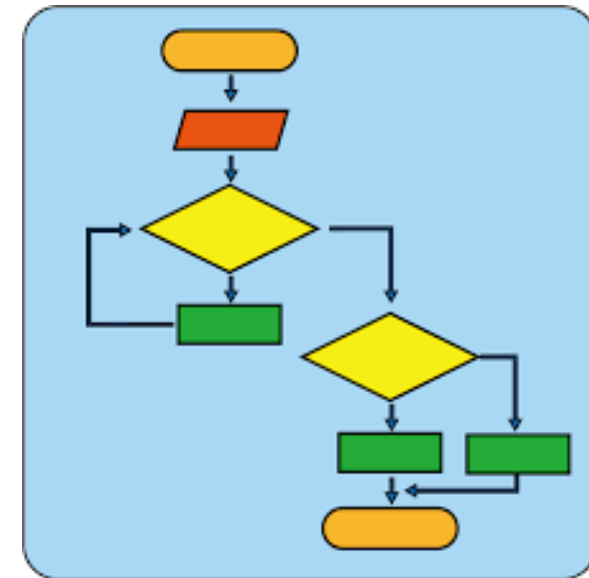
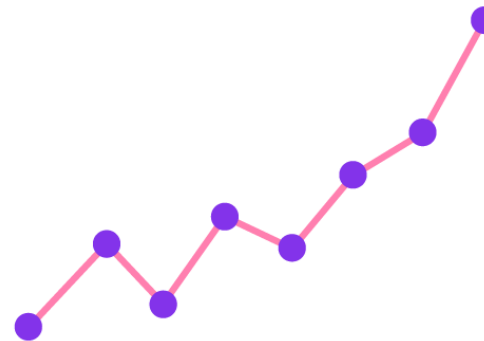
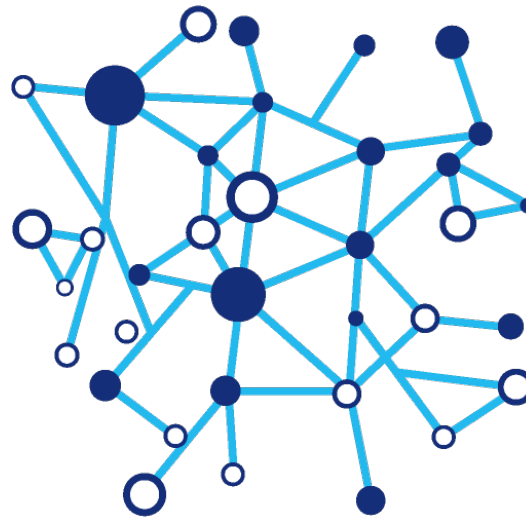
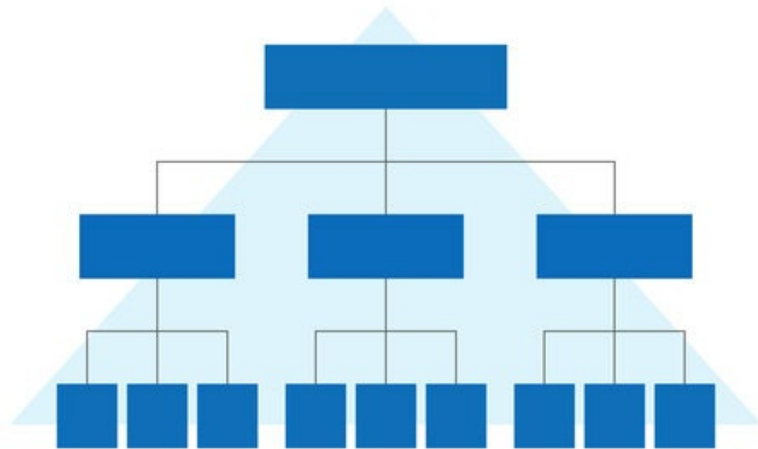
International Workshop

Exploring the Potential of Utilizing Data from Sanskrit Literature

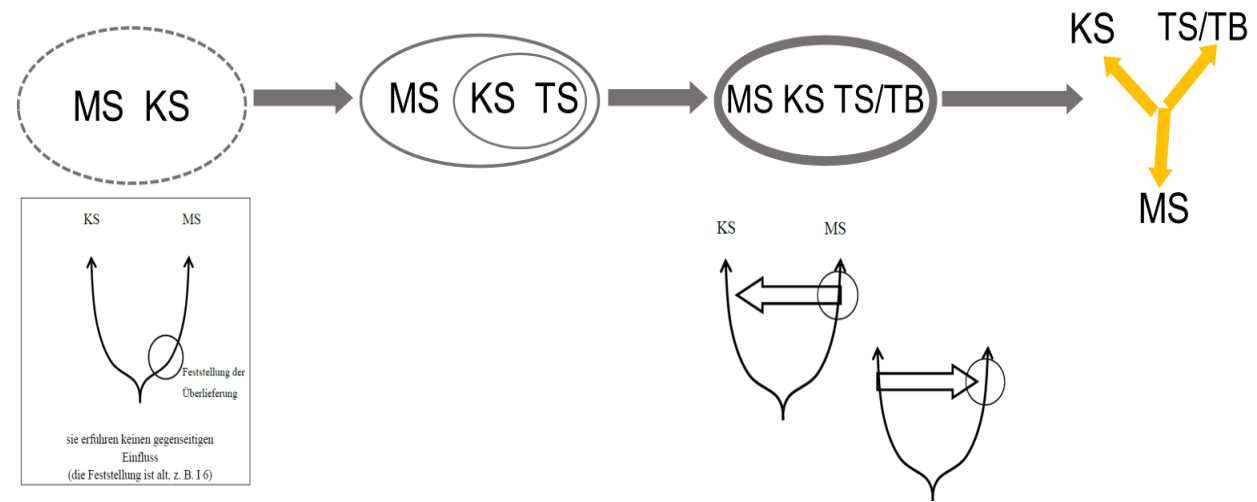
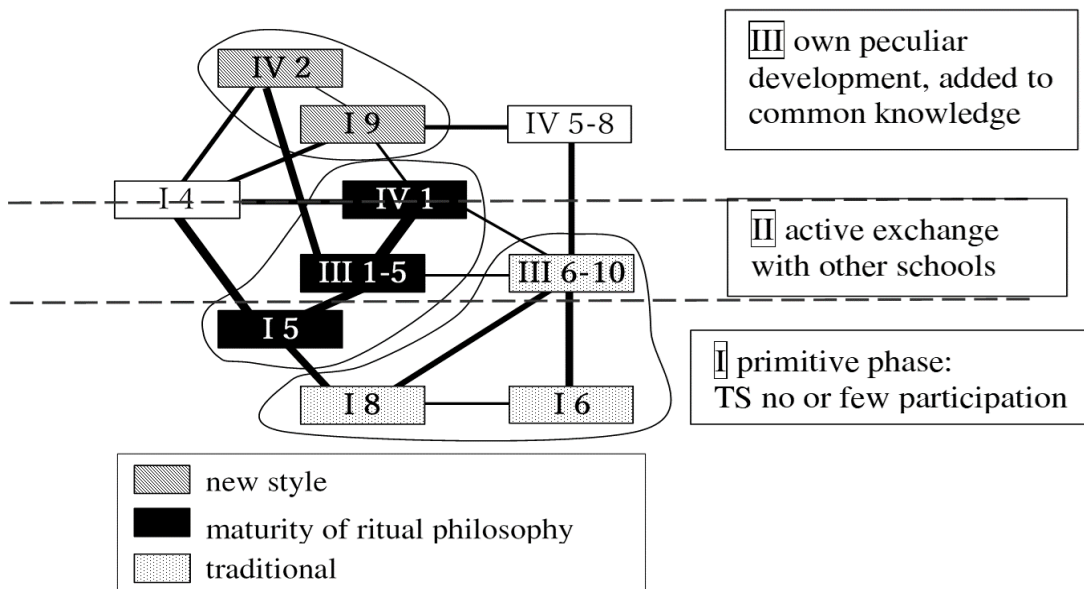
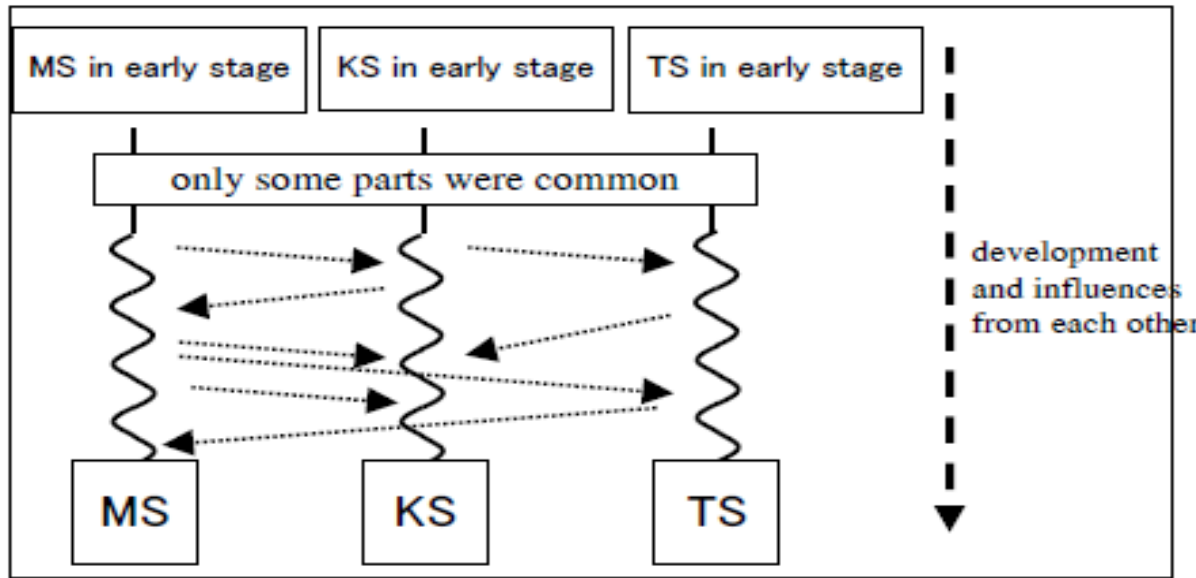
19-20 March 2024, Kyoto University

When you read literature, what mental images come to mind?

We consider structure, segmentation, connection etc...
Or we feel change in mood, tempo, intensity etc ...



new model

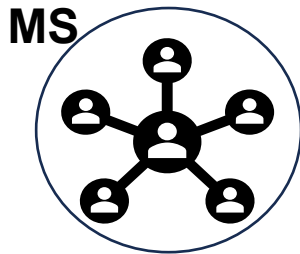


Merits of Visualization

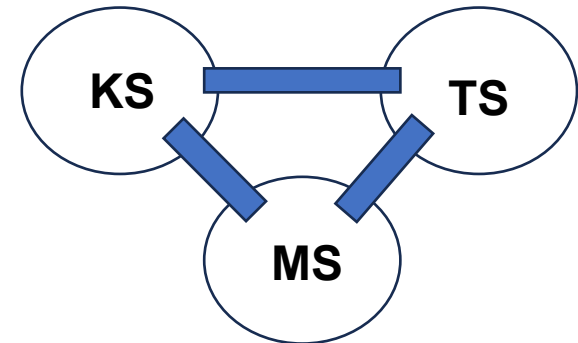
- Make it easy to share ideas and images
- Helpful for organizing, assembling and arranging one's own thoughts
- Uncovering uncertain facts that even one may not be sure
- Develop thoughts and facilitate discussion

Perspectives of the study of the Maitrāyaṇī Saṃhitā (MS): Two main focuses

Internal construction
(layer structure,
connection between the
chapters) of the MS, and
history (process) of its
composition

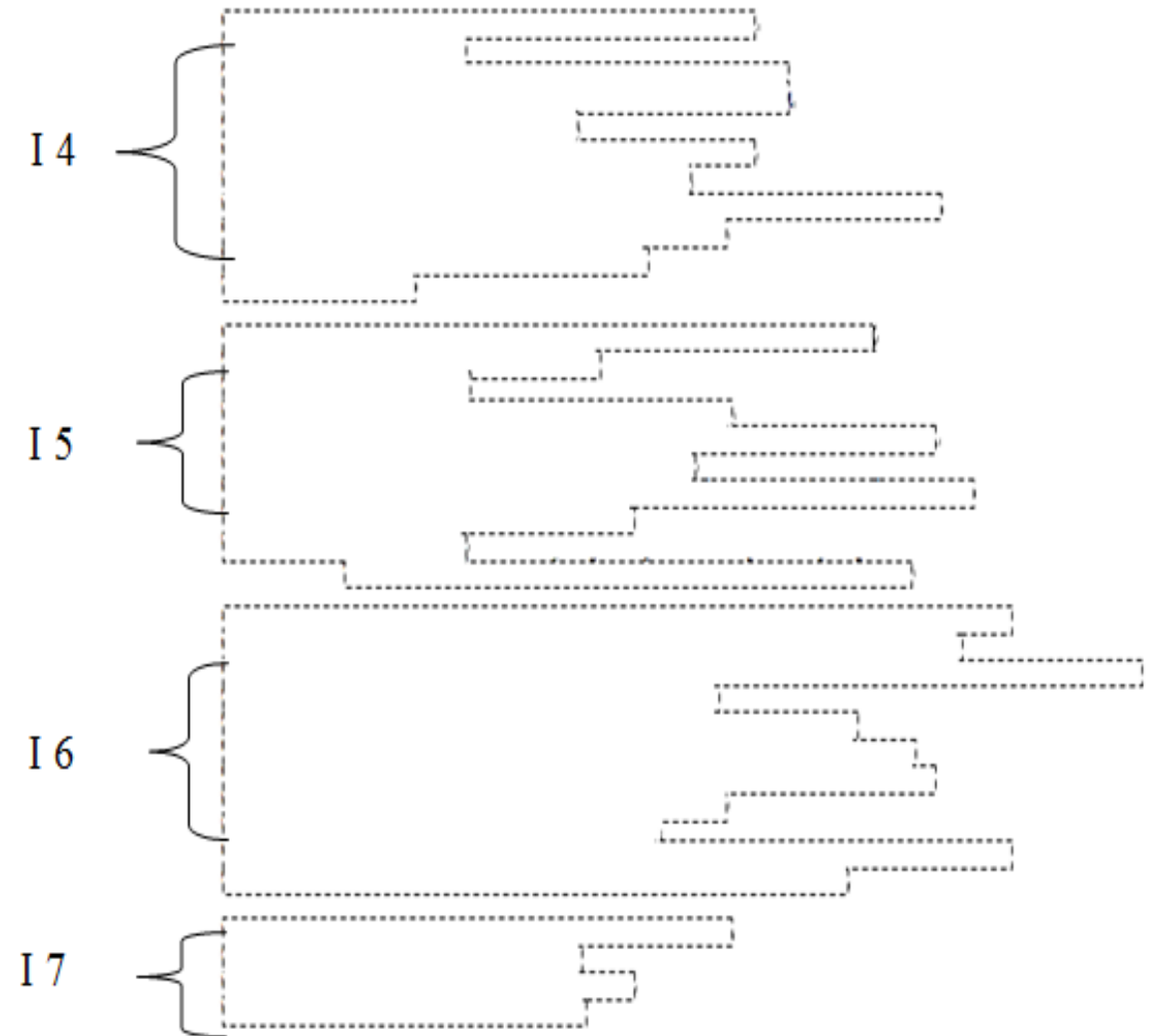


Relationship among MS,
KS and TS, and
the change of the
relationship of the texts




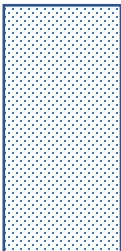
Visualization of Layers: making blank map and marking appearances

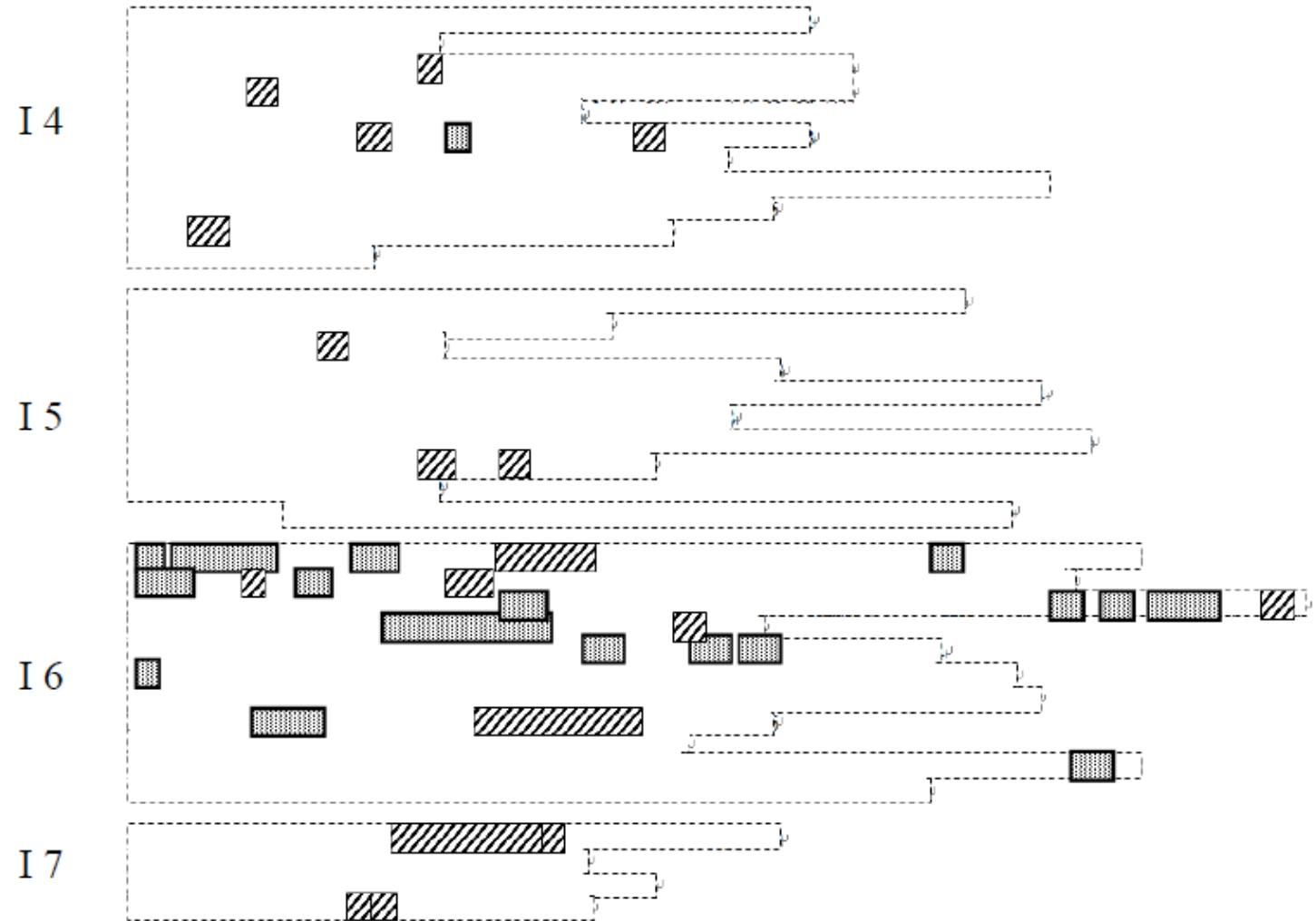
- Quantify the number of sentences or words and draw a map (one line corresponds to one chapter)
- Mark the places showing certain appearances.



Research of contents: lineage of mythology

 Myths in which the gods and the Asuras play the leading role

 Myths in which Prajāpati (the Creator God) plays the leading role



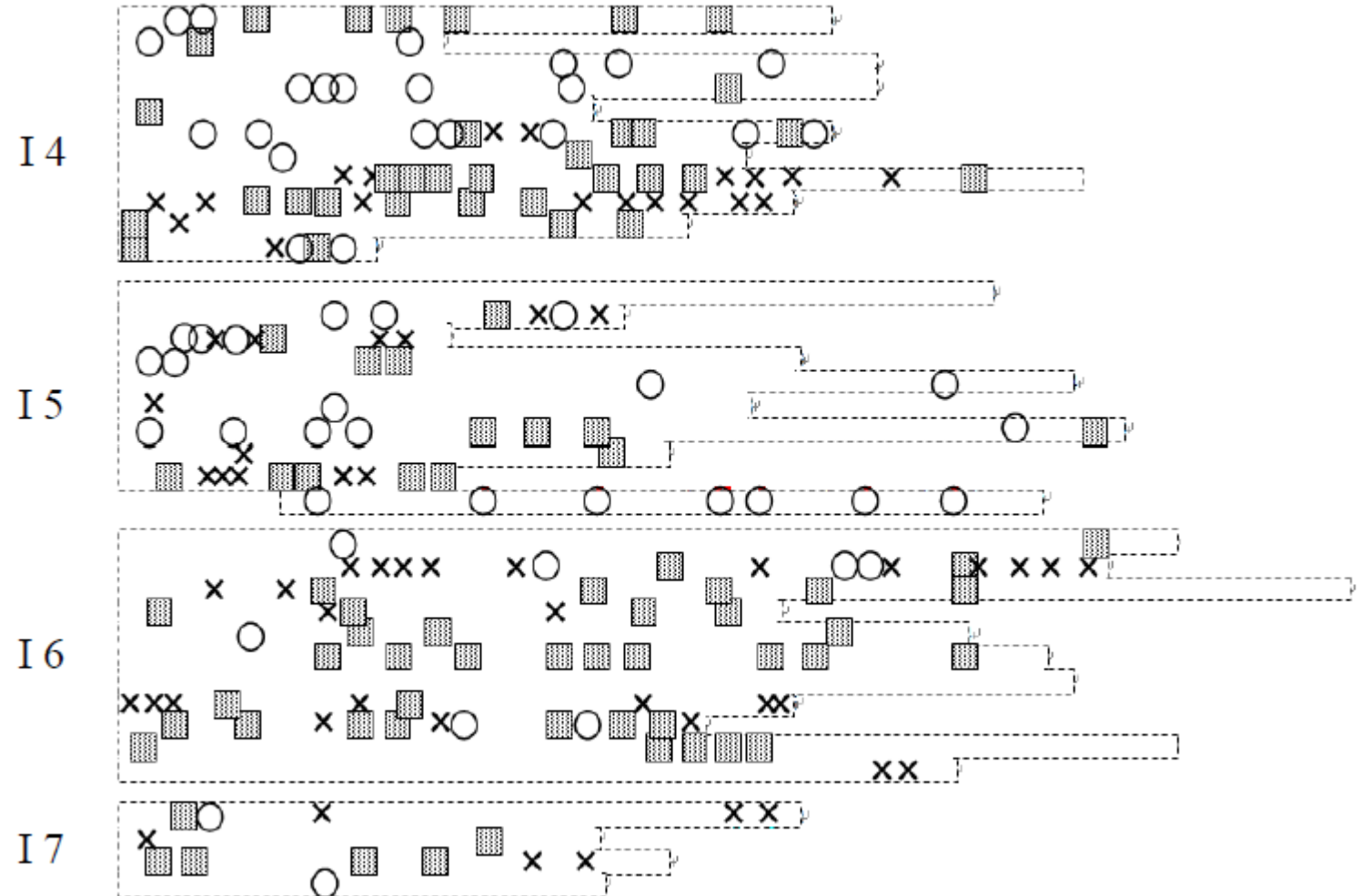
Research of linguistic phenomena and style of description

Different expressions of ritual prescription

- Present indicative ○
dadāti "he gives"

- Optative ▨
dadyāt "he should give"

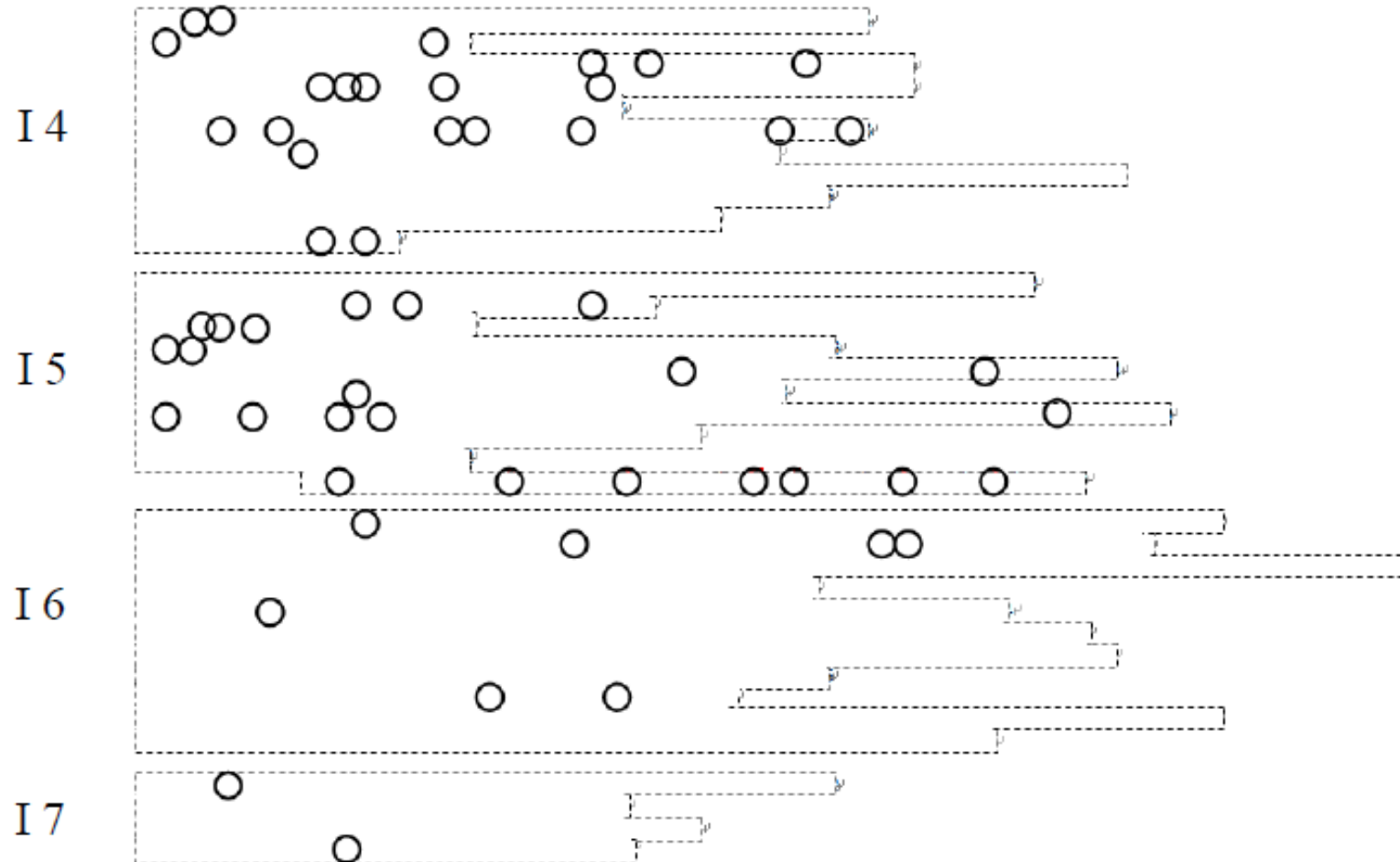
- Gerundive ×
deyam "should be given"



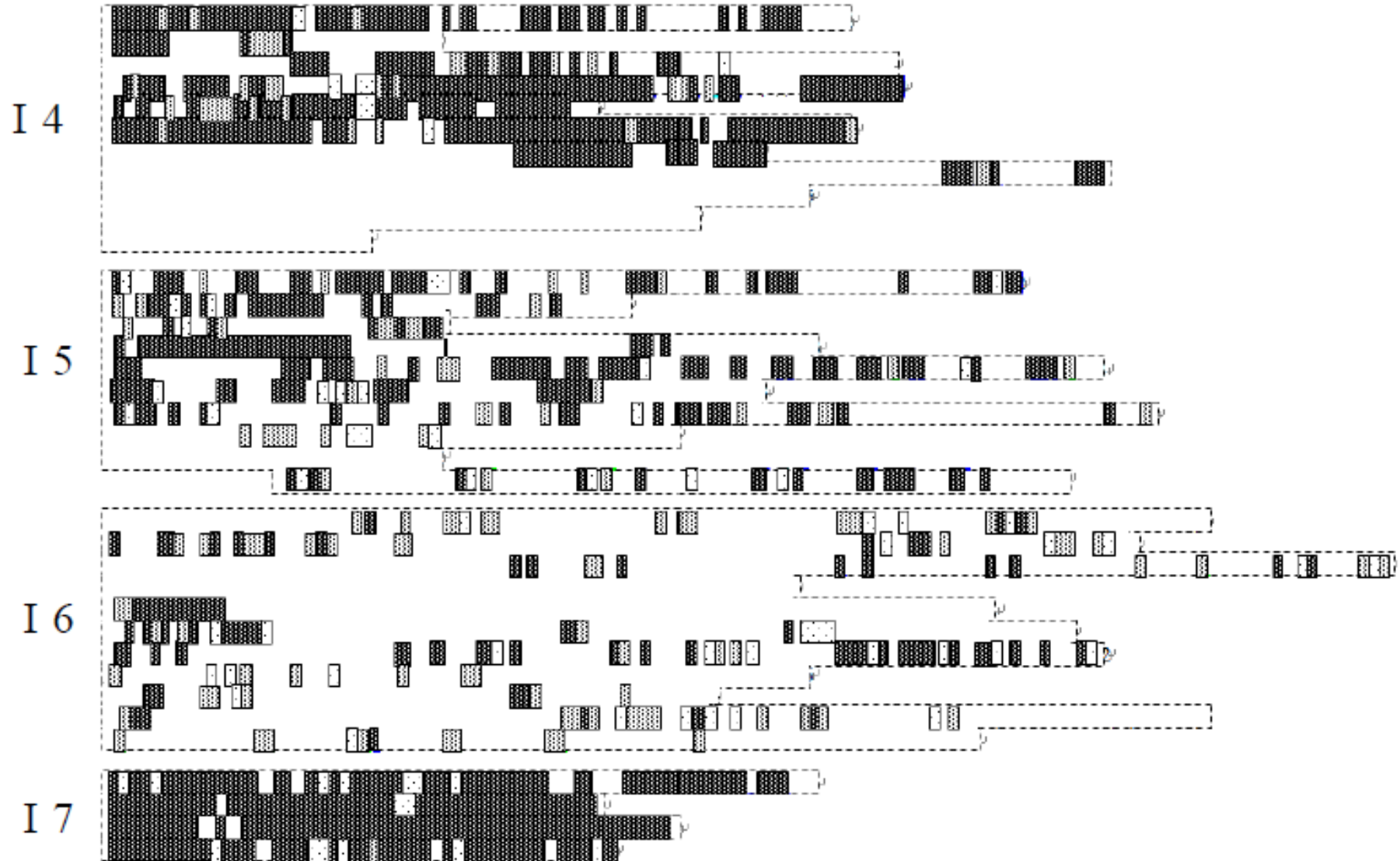
Research of linguistic phenomena and style of description present indicative in ritual prescription

○ present indicative

- describes established procedures;
- frequent use in I 4 and I 5 can indicate advanced stages of arrangement of ritual.



Visualization of Similarity (similarity to the KS)



Amano (2019) in Living Tradition of Vedas



nírvapet and *yājayet* in the
**Kāmyā-Iṣṭi Chapter of the
Maitrāyaṇī Saṃhitā**

**Tradition and Practice
in the Old Vedic Ritual Literature**

Kyoko AMANO

(Research Fellow of Japan Society for the Promotion of Science)
Kyoto University, JAPAN

MS II 1-4 *kāmyā-iṣṭi* (vegetarian
sacrifice according to wish)

MS II 5 *kāmya-paśu* (animal
sacrifice according to wish)

II 1-2 are different from II 3-4.

II 5 is quite new (imitating II 1-4).

ha

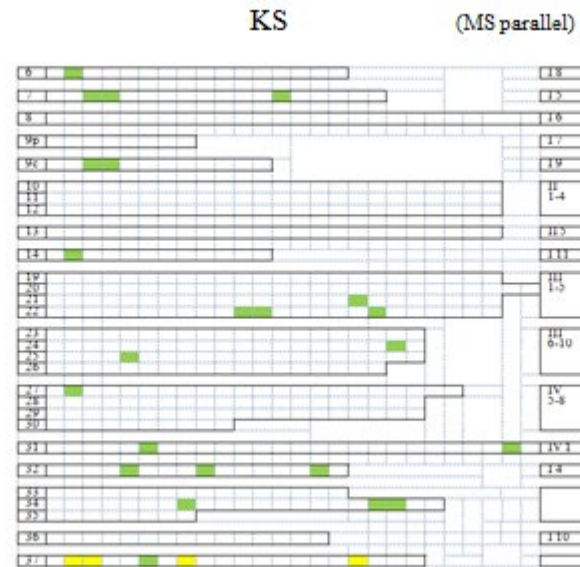
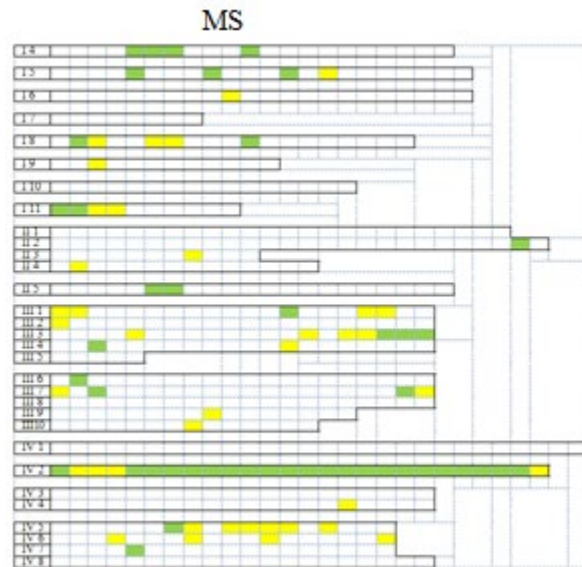
::

ha vai

MS

KS

TS



VL²

Visualization of Linguistic Layers in Vedic Literature

Creating distribution maps automatically using XML/TEI data.

Simple idea: making blank map and marking appearances

Simple yet highly adaptable!

to any issue: contents, vocabulary, grammatical form, syntactic construction, description style etc...

to any text corpus constructed as XML/TEI data (regardless of quantity, genre, language)

Case study:

- prose chapters of the Maitrayani Samhita I – II (data for III –IV is not complete)
prose parts were selected (mantra parts inserted in prose parts were excluded):

1.4.5-15 Sacrificer

1.5.5-15 Daily worship

1.6.3-13 Establishment of fires

1.7.2-5 Re-establishment of fires

1.8.1-9 Daily offering

1.9.3-8 Caturhotar (Sattra)

1.10.5-20 Seasonal sacrifices

1.11.5-9 Chariot race

2.1.1-12 Sacrifice

2.2.1-13 according to wish

2.3.1-3 + 2.3.5-7 + 2.3.9

2.4.1-6 + 2.4.8

2.5.1-11 Animal sacrifice

according to wish

Case study 1: Myth narrated in imperfect tense

- Chapters have preference of mythological explanation or philosophical/cosmological explanation, this possibly reflects the lineage and the chronology (the development stage of ritual philosophy). Amano (2014-15) and (2020).

Mythological explanation:

“Three offerings are offered, because the gods offered three offerings.”

Cosmological explanation:

“Three offerings are offered, because these worlds are three (heaven, atmosphere, earth).”

Purpose of examination of imperfect: to recognize chapters preferring mythological explanation and chapters not preferring mythological explanation.

Case Study 2: sentence describing the result of ritual action, with *eva* + aorist and with *vai* + *etad* + aorist

Sentences describing the result / effect / benefit of ritual actions

eva (indecl.) + present indicative

eva (indecl.) + aorist

vai (indecl.) + *etad* (pronoun n.sg.acc. „in this way“) + present indicative

vai (indecl.) + *etad* (pronoun n.sg.acc. „in this way“) + aorist

tad (pron.n.sg.acc. „therefore“; in the 1st position) + present

tad (n.sg.acc.; in the 2nd position) + present

tena/tayā (inst. of *tad* „with that“; in the 1st position) + present

tena/tayā (inst. of *tad*; in the 2nd position)

ha + present

ha vai + present etc...

These are almost equivalent.

Choice from these types can indicate linguistic feature of the chapter.

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Case Study 2: sentence describing the result of ritual action, with *eva* + aorist and with *vai* + *etad* + aorist

eva + aorist

(1.6.6:95.15) *rucam evainam ajīgamat* (3. sg. aor ind. *gam* “go”)

He has made him go to shine.

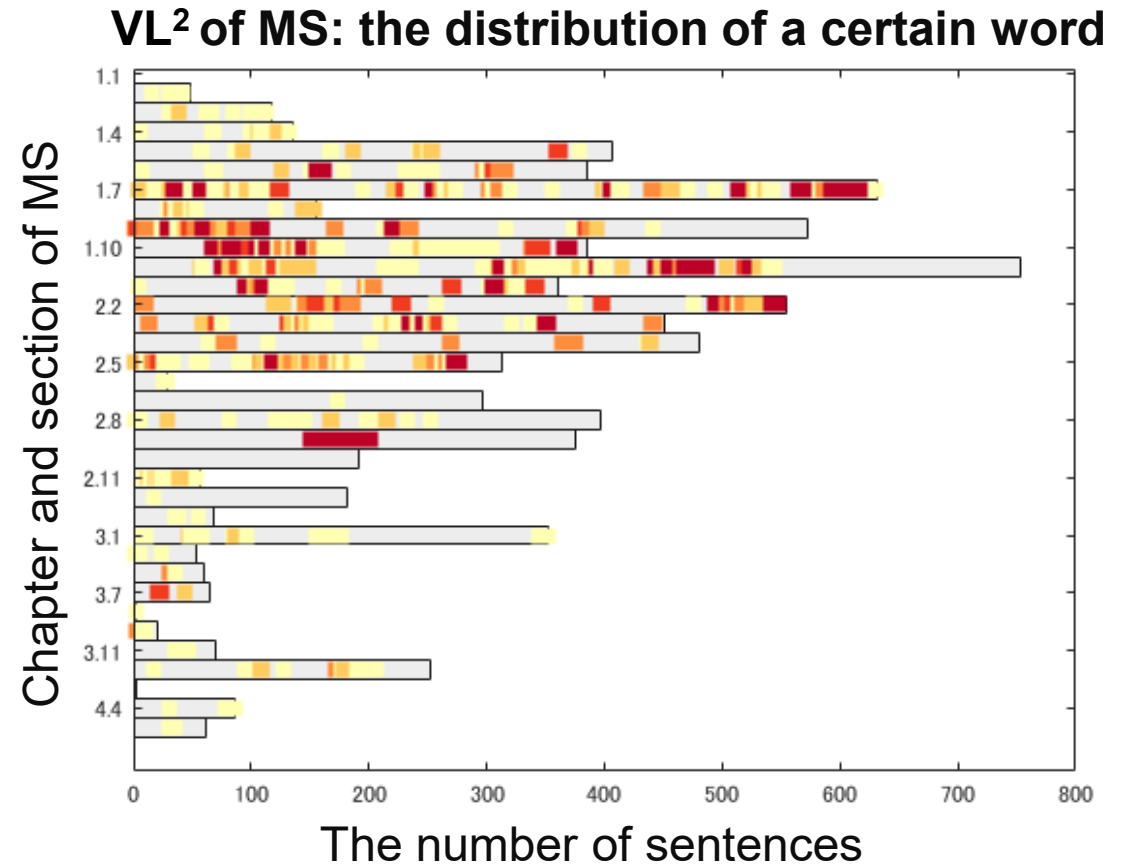
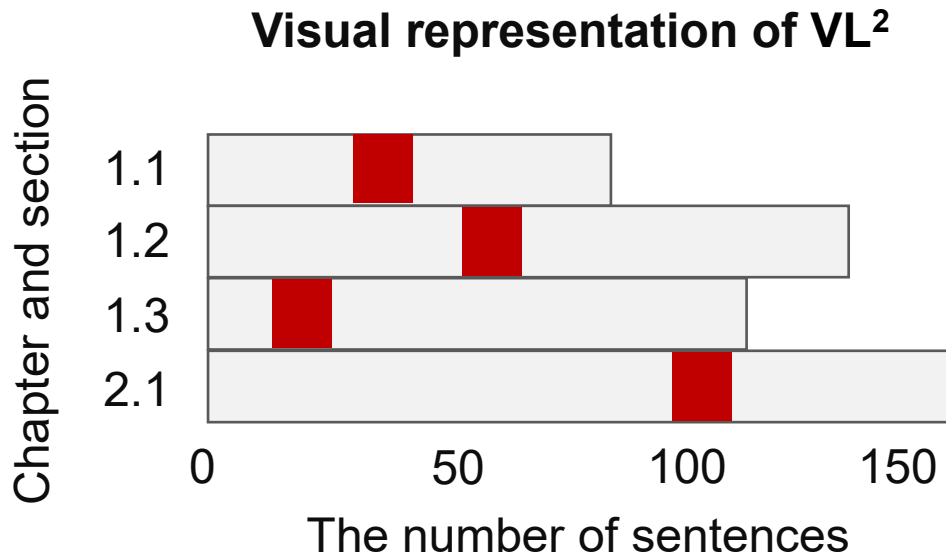
vā etad + aorist

(1.4.5:52.12) *devatā vā etat pūrvedyur agrahīt* (3. sg. aor. ind. *grah* „grasp“)

He has grasped the deities the previous day in this way.

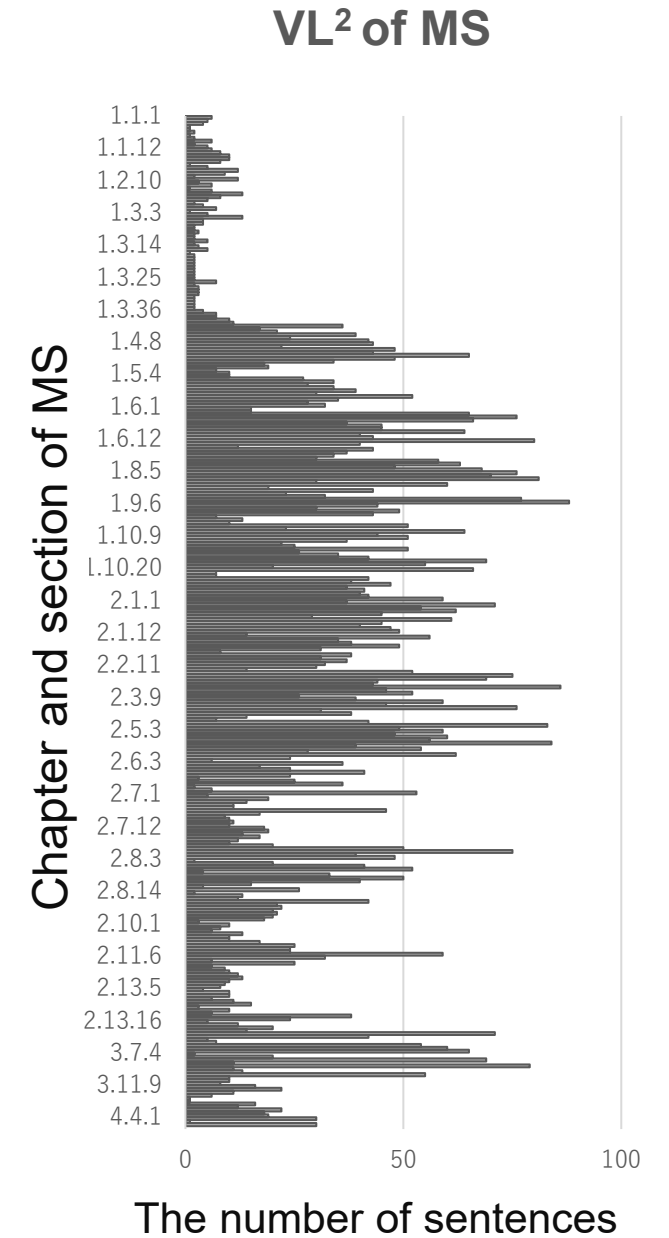
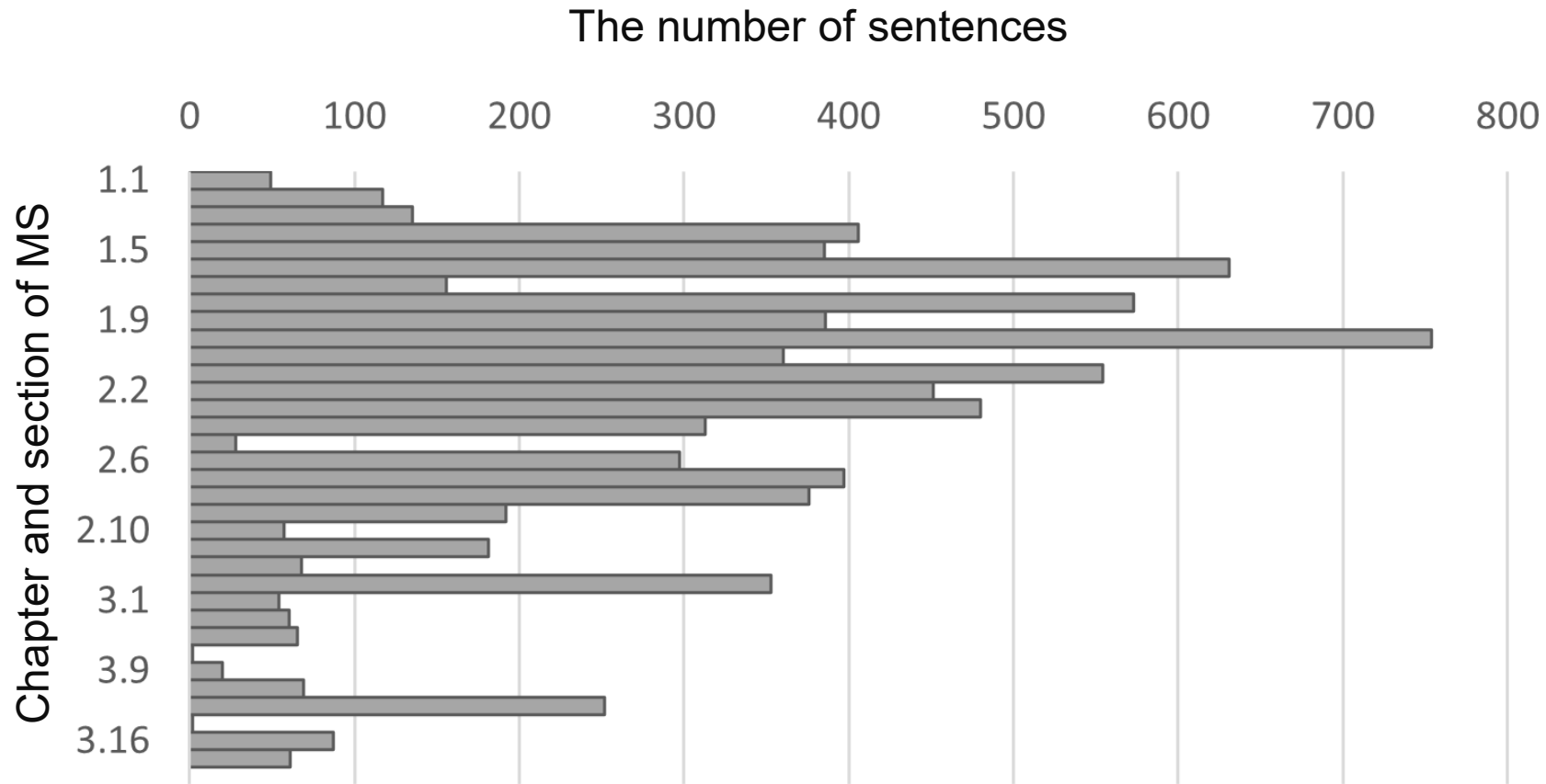
VL² : Visualization of Linguistic Layers in Vedic Literature

Database of Maitrāyaṇī Saṃhitā (MS)

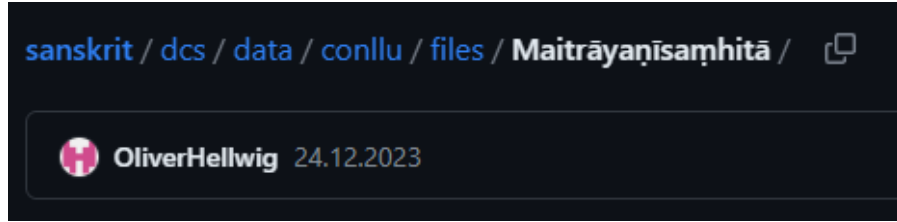


① The number of words and sentences from each subsection of the MS

VL² template using the number of sentences per chapter and section



VL² : Visualization of Linguistic Layers in Vedic Literature



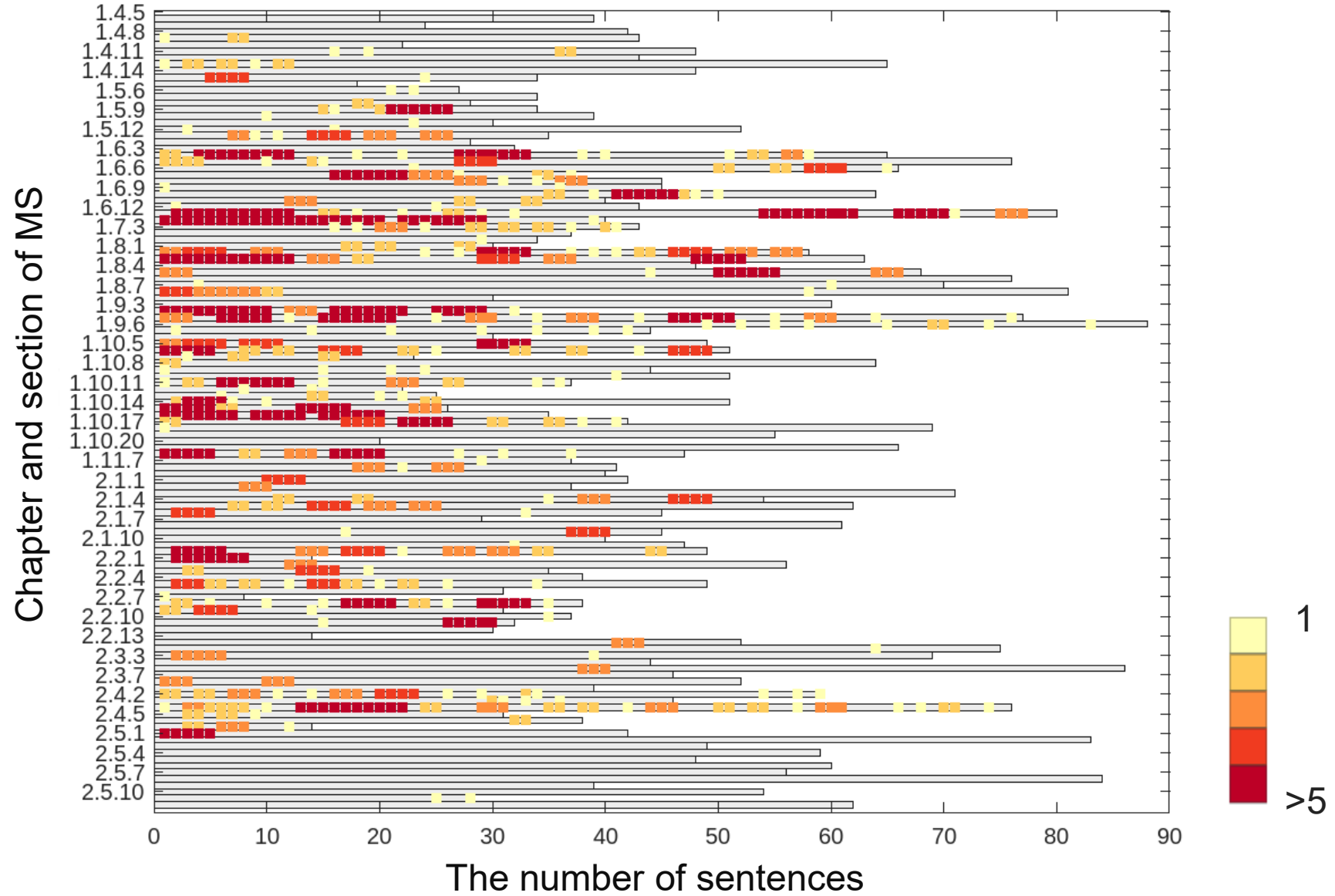
Search Oliver's Digital Corpus of Sanskrit (DCS) database and extract data on whether the following three conditions appear in the sentences or words

	A	B	C	D	E	F	G	H	I	J
	type	chapter_id	chapter	sent_counter	sent_subcounter	word_counter	word_order	sentence_id	word_id	full_sentence
2	impf	12437	1.1.4	1		22	22	653389	130	veśāya vām karmaṇe vām sukr̥tāya vām devir āpo 'greguvo 'greniyo 'gre 'sya yajñ
3	impf	12437	1.1.4	1		26	26	653389	130	veśāya vām karmaṇe vām sukr̥tāya vām devir āpo 'greguvo 'greniyo 'gre 'sya yajñ
4	impf	12456	1.1.10	2	2	159	2	653510	312	tām airayaṃś candramasi svadhābhis tām dhirāsaḥ kavayo 'nudiśyāyajanta
5	impf	12456	1.1.10	2	2	166	9	653510	234	tām airayaṃś candramasi svadhābhis tām dhirāsaḥ kavayo 'nudiśyāyajanta
6	impf	12464	1.1.13	1	7	32	4	653564	37	indras tiṣṭhan vīryam akṛnod devatābhiḥ samārabhya
7	impf	12491	1.2.5	1	1	3	3	653704	624	sūryasya cakṣur āruham agner akṣaḥ kaninikām
8	impf	12491	1.2.5	4	2	56	9	653711	645	ūrdhvā yasyāmatir bhā adidyutat savīmāni hiranyaṇīr amimita sukratuh kṛpā s
9	impf	12498	1.2.6	4	1	49	1	653733	674	astabhnād dyām ṛṣabho antarikṣam amimita varimāṇam pṛthivyāḥ
10	impf	12498	1.2.6	4	1	53	5	653733	645	astabhnād dyām ṛṣabho antarikṣam amimita varimāṇam pṛthivyāḥ
11	impf	12498	1.2.6	4	2	56	1	653734	673	āsidad viśvā bhuvanāni samrād viśvet tāni varuṇasya vratāni
12	impf	12498	1.2.6	5	2	80	8	653736	268	hṛtsu kratum varuṇam dikṣv agniṃ divi sūryam adadhāt somam adrau
13	impf	12514	1.2.9	5	2	53	1	653856	822	vyaṣkabhnā rodasi viṣṇa ete dādhartha pṛthivim abhito mayūkhaiḥ
14	impf	12514	1.2.9	10	2	121	2	653864	841	yo askabhāyad uttarām sadhastham vicakramāṇas tredhorugāyah
15	impf	12526	1.2.13	6	8	114	6	653968	963	nir varuṇasya pāsād amuṣi svar abhivyakṣam jyotir vaiśvānaram
16	impf	12542	1.2.15	2	1	95	5	654021	1008	ye badhyamānam anu badhyamānā anvaiṣṭanta manasā cakṣuṣā ca
17	impf	12550	1.2.17	1	5	15	3	654084	1044	āpas tvā samariṇvan
18	impf	12556	1.3.1	5	6	108	3	654132	1088	samudraṃ gandharveṣṭhām anvātiṣṭhata
19	impf	12946	1.3.19	1	1	8	8	654256	544	indra marutva iha pāhi somam yathā śāryāte apibah sutasya
20	impf	12950	1.3.20	1	2	9	1	654260	138	avardhann indraṃ marutaś cid atra mātā yad vīraṃ jajanaḥ janiṣṭham
21	impf	13616	1.3.32	1	1	7	7	654328	1325	ojas tad asya titviṣa ubhe yat samavartayat
22	impf	13619	1.3.35	1	18	55	4	654363	541	yena prajā achidrah ajāyanta tasmai tvā prajāpataye viśvakarmaṇe viśvavyacase
23	impf	13619	1.3.35	2	1	74	6	654364	37	tisro jihvasya samidhah pariṃmano 'gner akr̥vann uśijo amṛtyave

- **Tense=Impf**
- **eva(PART)&Tense=Past**
- **(vai (PART) or vāva (PART)) & etad & Tense=Past**

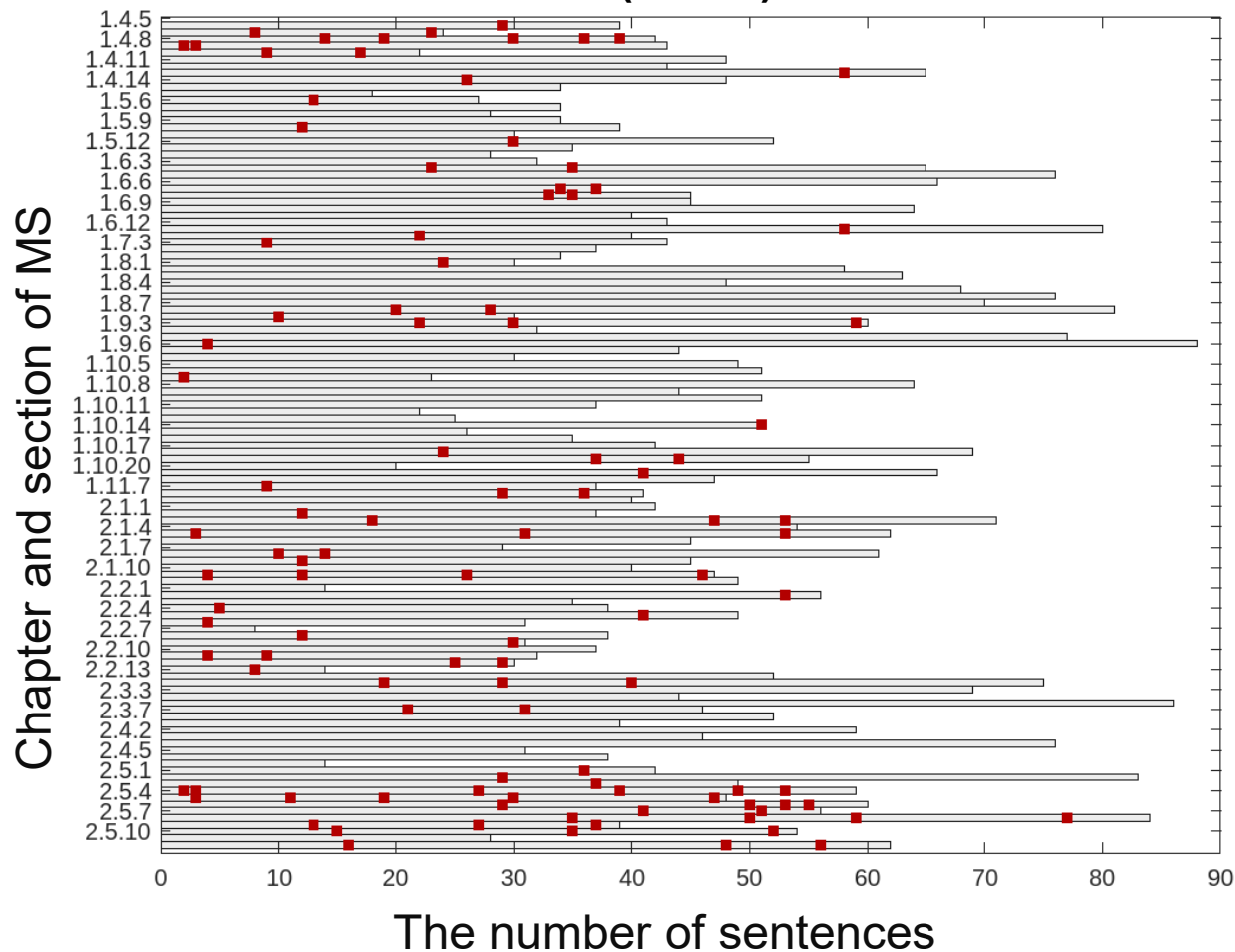
VL² of MS (Tense=Impf)

VL² of MS: the distribution of Tense = Impf

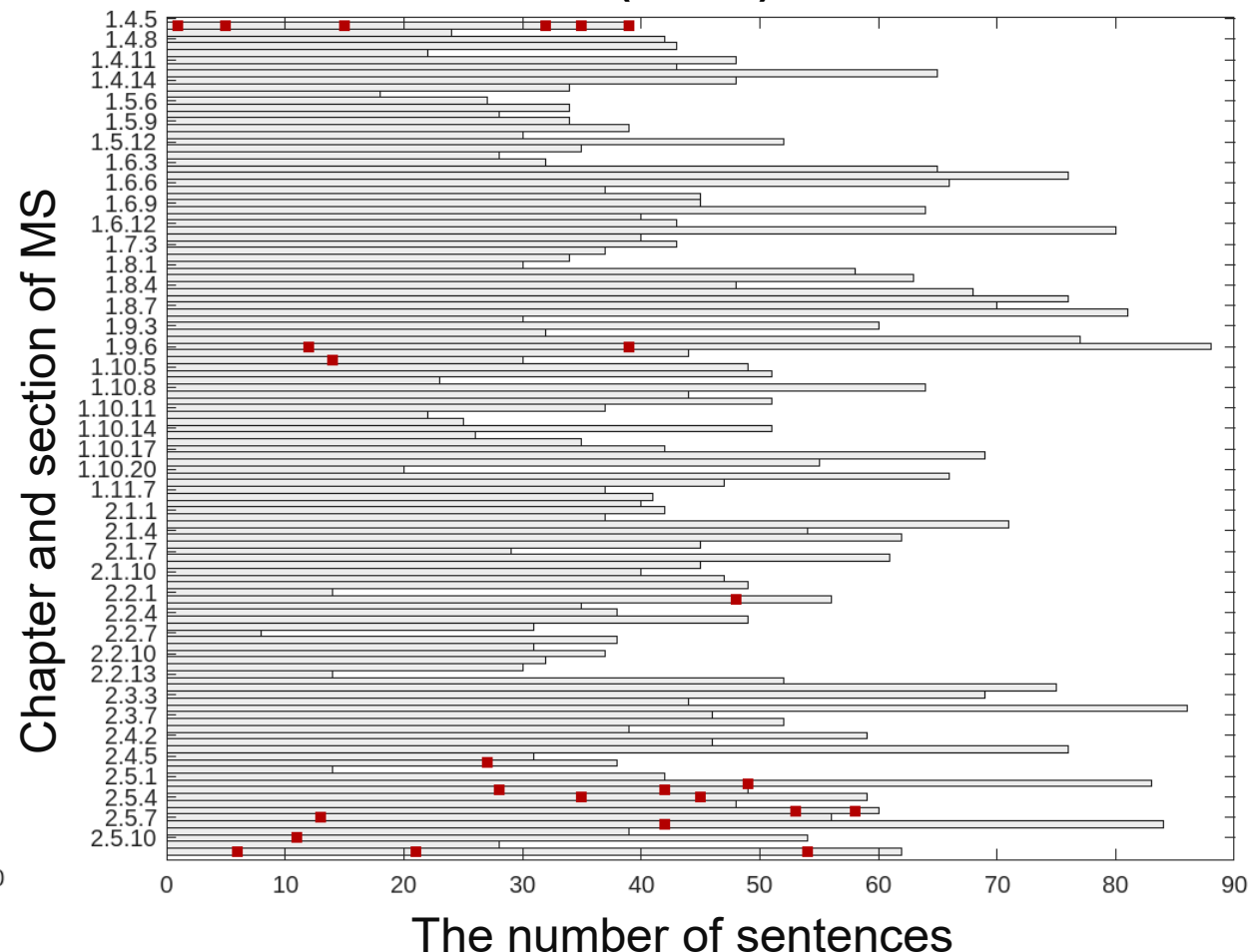


VL² of MS (Comparison between eva(PART) and vai(PART))

VL² of MS: eva(PART)&Tense=Past



VL² of MS: vai(PART)&Tense=Past



Enhance XML/TEI data to detect even finer distinctions

Present indicating result of ritual should be differentiated from present in other functions (prescription, general)

(2.5.1:46.12) *soma evāsmāi reto dadhāti* (3. sg. pre. ind. dhā "put")

Some puts semen for him. (result of ritual act)

BUT

(1.4.7:55.11) *sa vai mānuṣam evābhy upāvartate* (3. sg. pre. ind. *abhi + upa-vart* "turn to")

He turns **only** to the human's (thread). (general statement)

(1.5.11:80.10) *prāṇān vā etad iṭṭe* (pre. ind.)

He calls the breaths in this way. (result of ritual act)

BUT

(2.5.1:48.7) *prāṇam vā etat paśavaḥ pratidhāvanti yad varṣeṣu vātaṃ pratijighrati*

Animals go against the breath in this way that they catch the scent of wind in the rain.

(general statement)

Enhance XML/TEI data to detect even finer distinctions

How can we detect “*eva* + present meaning result of ritual” and “*vai* + *etad* + present meaning result of ritual”?

Differentiate functions/usages of present indicative (Amano 2009, 10-13):

- prescription *naktam agniṃ ḡṛhṇāti* "He (the sacrificer) takes fire at night."
- general statement *asurā vā naktam prerate* "The Asuras have action at night."
- result of a ritual act *jyotiṣaiva tamas tarati* "He overcomes the darkness (the Asuras, night) with the light (fire)."

Type of sentence is important!

Sanskrit ***vidhi*** "prescription" and ***arthavāda*** "explanation of the purpose / meaning"

Enhance XML/TEI data to detect even finer distinctions

We can add information to `<w />` word or `<s />` sentence:

```
<w lemma="gr̥h" type="VERB" tense="PRE"
```

```
function="prescription">gr̥hṇāti</w>
```

or

```
<s type="prescription">naktam agniṃ gr̥hṇāti</s>
```

Can we utilize {FN}
information in Fushimi's text?

(2.5.8:58.6) indrāyābhimāti ghnā ^穆 abham ā abheta bhrāt ^穆 yavān

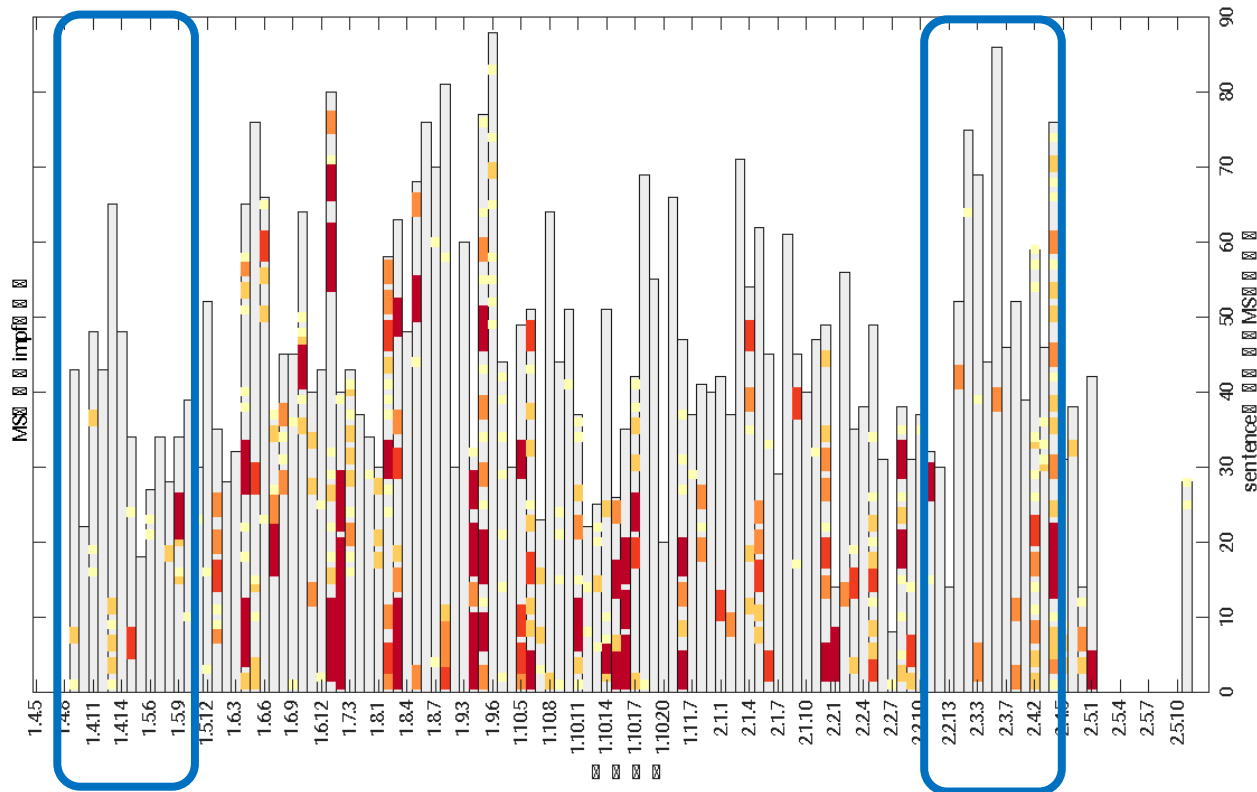
(2.5.8:58.6) abhimā(OP.2.5.8:58.7) tir vai pāpmā bhrāt ^穆 yas |

(2.5.8:58.7) indriyeṇaivābhimātiṃ pāpmānaṃ bhrāt ^穆 yam apahate

{FN vaPattern (P) optative, (I) vai, (R) eva}

Distribution map can be utilized as **finger print of linguistic layer.**

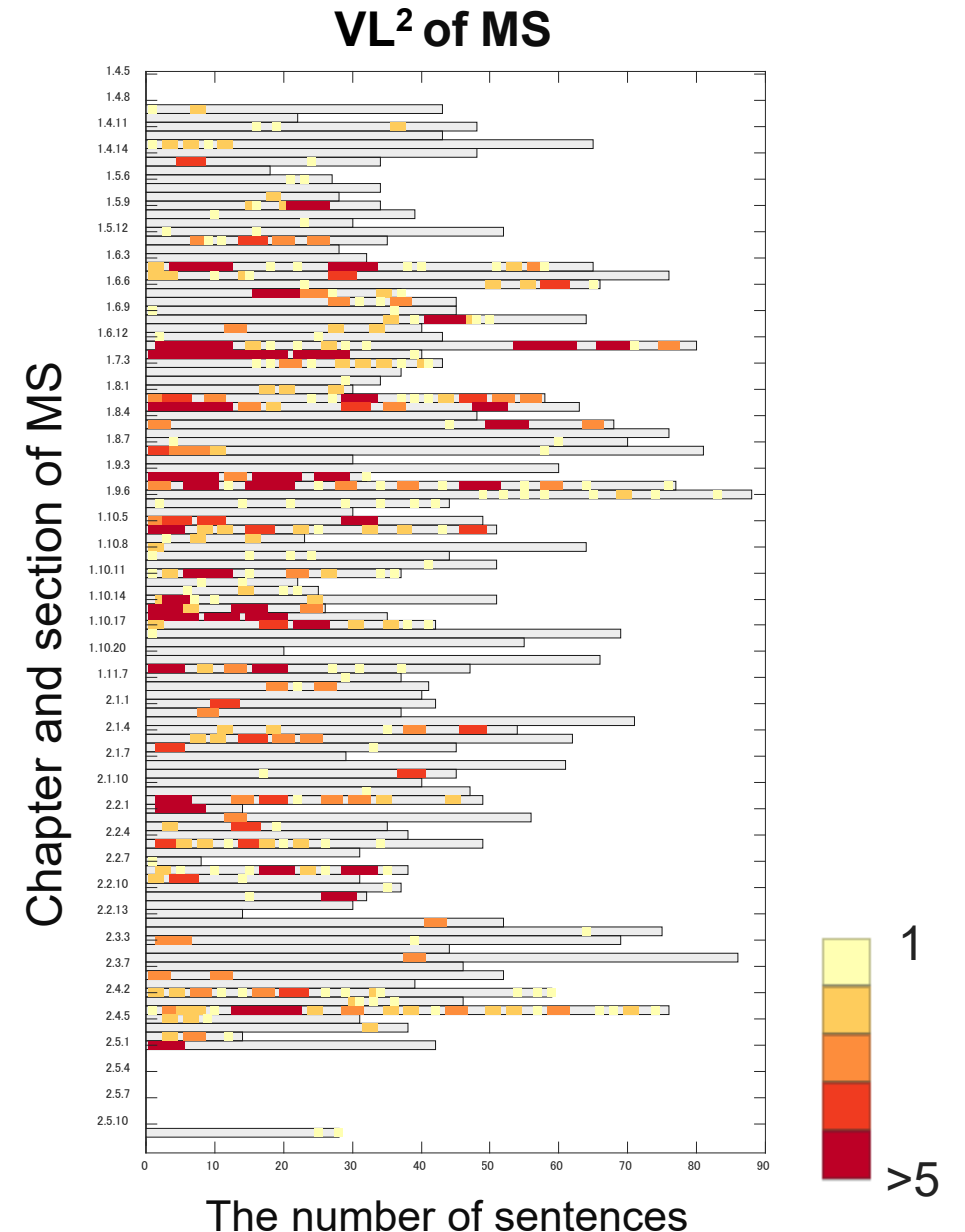
AI can recognize images and make similarity judgments?



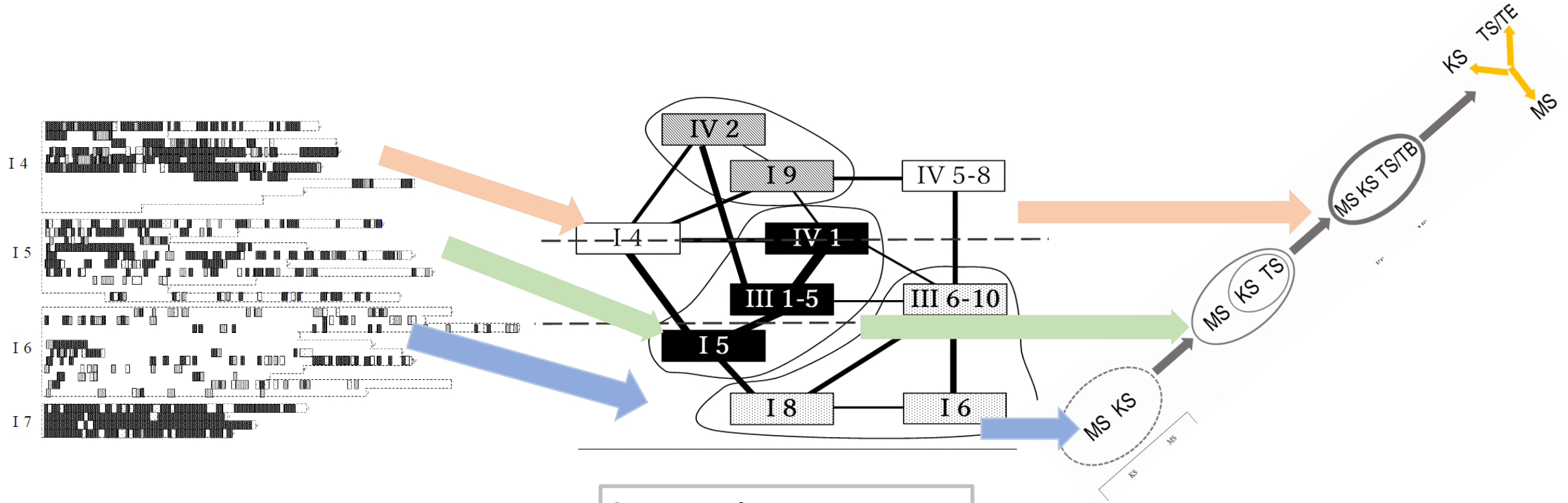
Similar?

Further progress of VL²

- What kind of findings can be summarized?
→ Are there aspects that can be abstracted?
- The potential for integration with other information such as mantra co-occurrences
- VL²'s representation of documents, not limited to Vedic literature



Future: Integrating multiple visualization systems into one



internal construction within a text (layers)

internal construction within a text (connection and development)

change of relationship between the texts

Enhance XML/TEI data to detect even finer distinctions

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He turns **only** to the human's (thread). (general statement)

Differentiate *eva* in the sentence for result of a ritual act from *eva* in other function

eva in the sentence `<s type="result_of_ritual_act">`

`<w type="PART" function="advmod">eva</w>`

advmod: adverbial modifier 

eva in other type of sentence, to emphasize the foregoing word

`<w type="PART" function="advmod:emph">eva</w>`

→ useful to make Universal Dependencies;
see Biagetti / Hellwig / Scarlata / Ackermann / Widmer (2021):
"Evaluating Syntactic Annotation of Ancient Languages. Lessons from the Vedic Treebank"

Enhance XML/TEI data to detect even finer distinctions

devatā vā etat agrahīt. `<s type="result_of_ritual_act">`

“He has grasped the deities in this way.”

`<w lemma="etad" type="PRON" case="Acc" case_function="advmod" reference_function="anaphoric" reference="previous_s">`

BUT

prāṇam vā etat paśavaḥ pratidhāvanti yad varṣeṣu vātaṃ pratijighrati.

`<s type="general_statement">`

“Animals go against the breath in this way that they catch the scent of wind in the rain.”

`<w lemma="etad" type="PRON" case_function="advmod" reference_function="cataphoric" reference="yad">`

Distinguish three functions of *etad*: anaphoric, cataphoric, recognitional

ha sma + present

::

ha + perfect

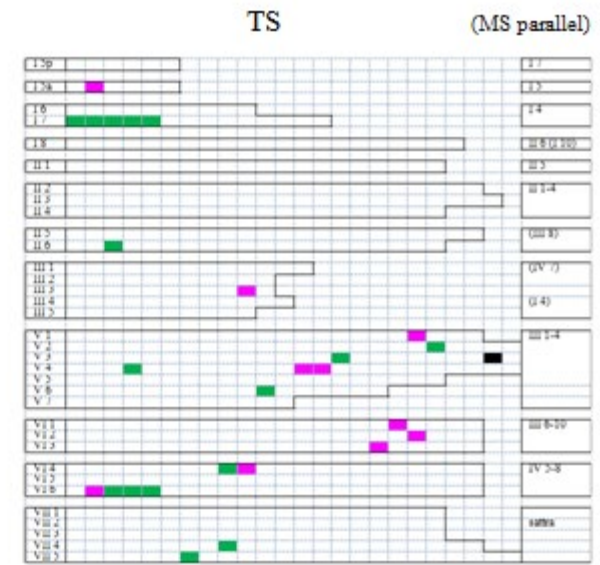
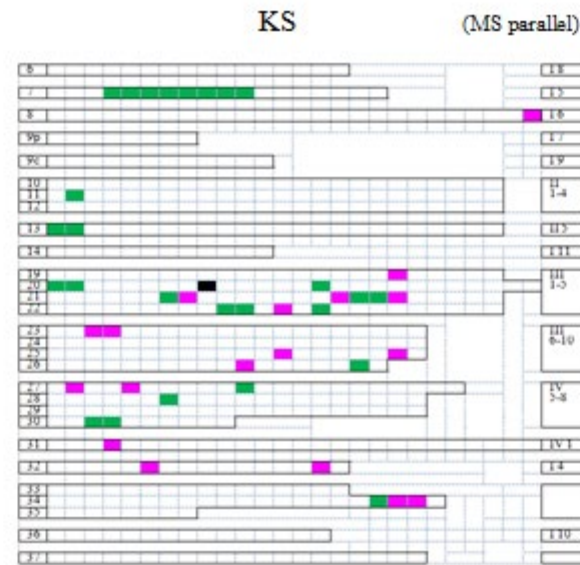
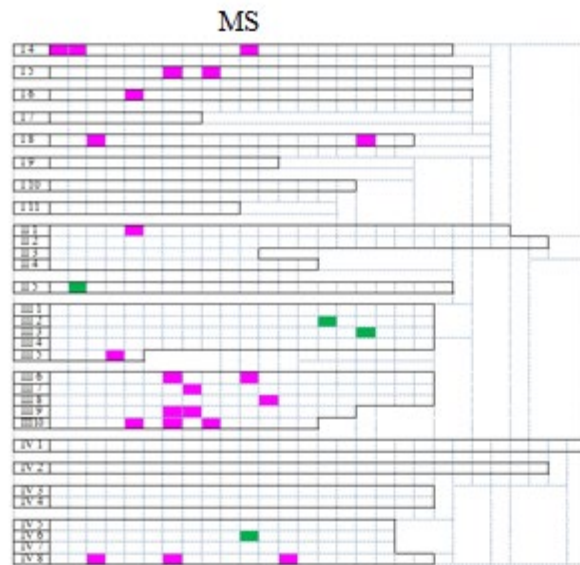
“He used to do”

“He did”

MS

KS

TS



predecessors

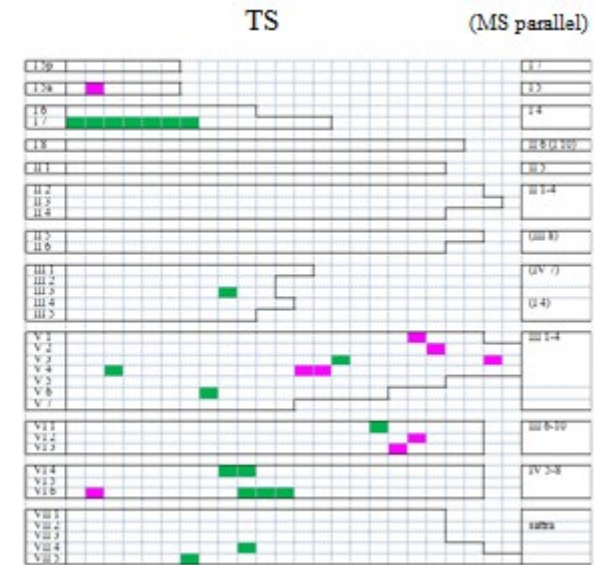
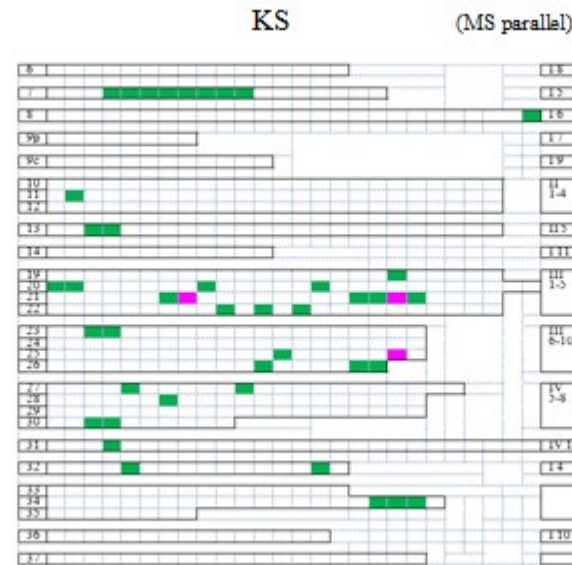
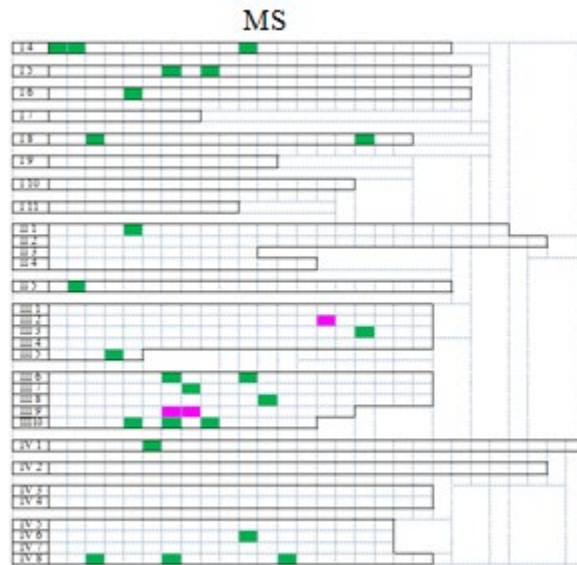
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gods

MS

KS

TS



Effective for comparing the MS, KS and TS.

But too much time-consuming and manpower-demanding!

What was happening in Vedic period society?

The movement of people, political changes, shifts in lifestyle, and the development of religious thought.

These movements can be extracted within a text as well as among several texts.