

Maharshi Panini's Aṣṭādhyāyī

A Computational Marvel

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ॐ श्री गणेशाय नमः (Mangala Slokam)

सरस्वति नमस्तुभ्यं वरदे कामरूपिणि ।
विद्यारम्भं करिष्यामि सिद्धिर्भवतु मे सदा ॥

At the beginning of study, we seek blessings from the goddess Sarasvati for grace. May accomplishment be there for me at all time.

येनाक्षरसमाम्नायमधिगम्य महेश्वरात् ।
कृत्स्नं व्याकरणं प्रोक्तं तस्मै पाणिनये नमः ॥

My Namaskarah to Panini, who taught the entire Vyakarana after understanding that Maheshvarasutras from Shiva

वाक्यकारं वररुचिं भाष्यकारं पतञ्जलिम् ।
पाणिनिं सूत्रकारं च प्रणतोऽस्मि मुनित्रयम् ॥

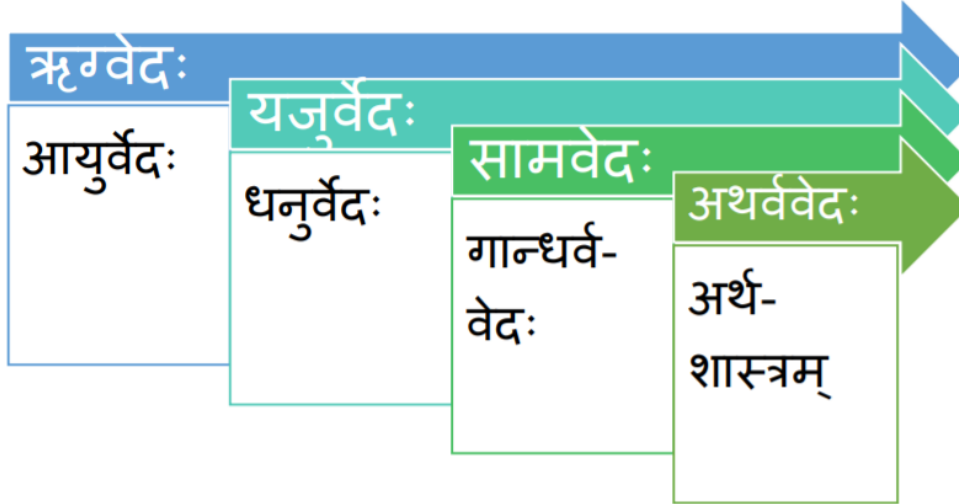
I do pranam to the three sages;
Panini who created the Sutras, Katyayana who wrote the Vaartika, and Patanjali who wrote the Mahabhashyam.



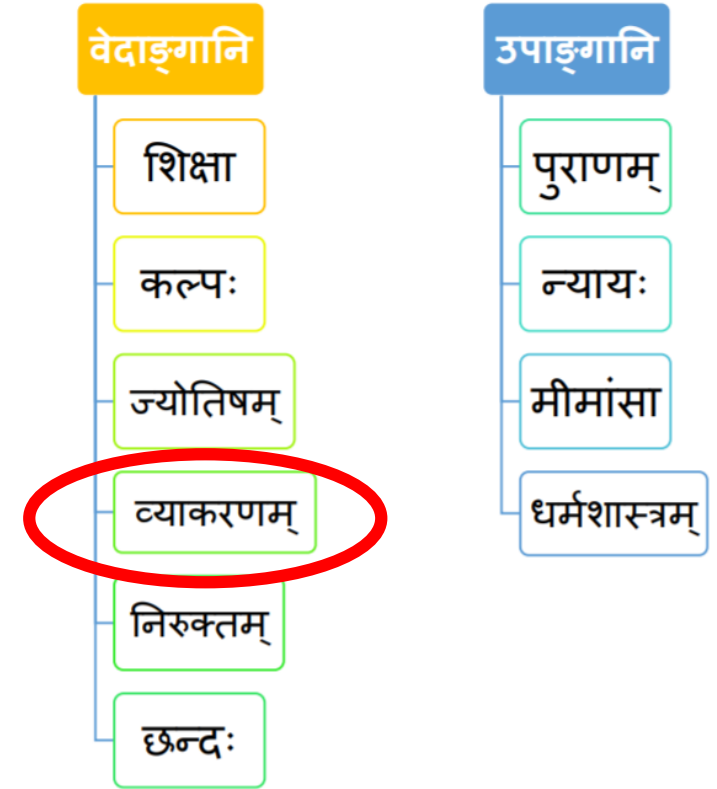
Vyakaranam Samskritam Panini Ashtadhyayi

अष्टादश विद्या-स्थानानि

वेद-उपवेद-सम्बन्धः



वेदाङ्ग-उपाङ्गे – वेद-तात्पर्य-ग्राहके



विदाङ्गानि (Vedangani)



Jyotishya (Eyes)
Siksha (Nose)
Nirukta (Ears)
Vyakarana (Mouth)

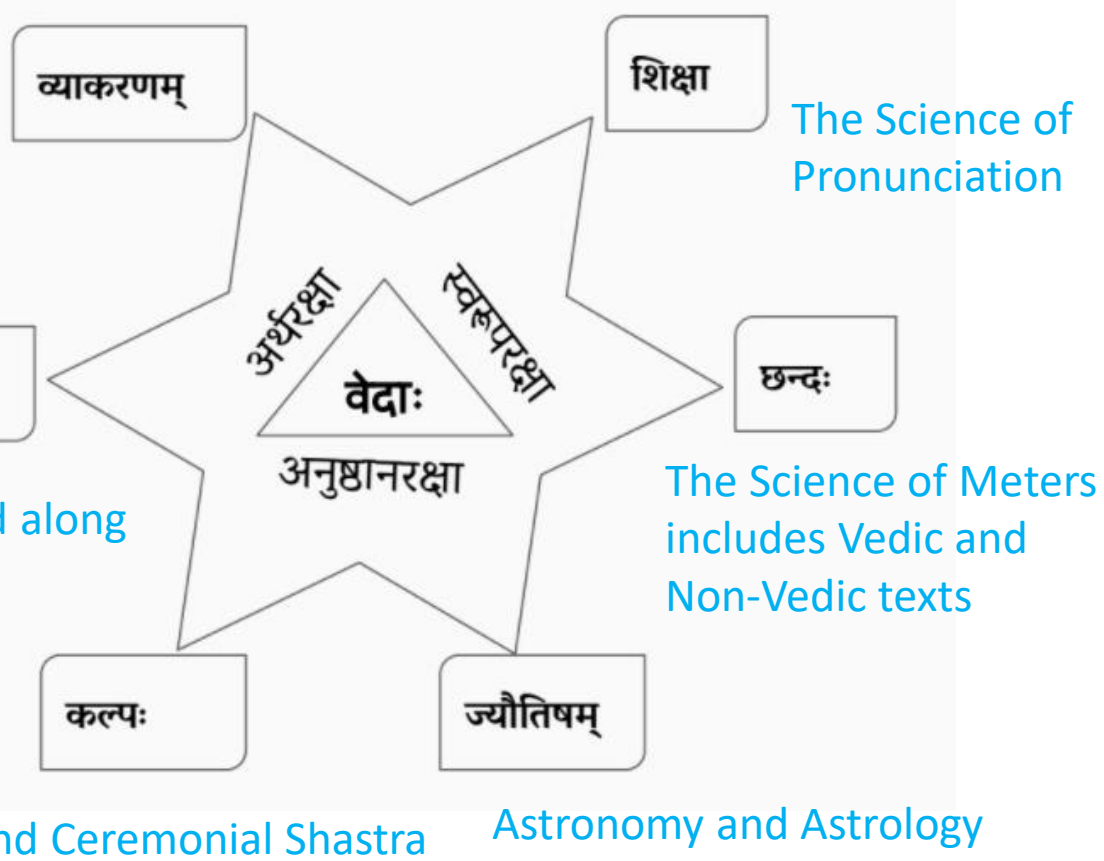
Kalpa (Hands)

Chandas (Feet)

The Shastra for right words including the science of linguistics

Meaning of word along with Etymology

Procedural and Ceremonial Shastra

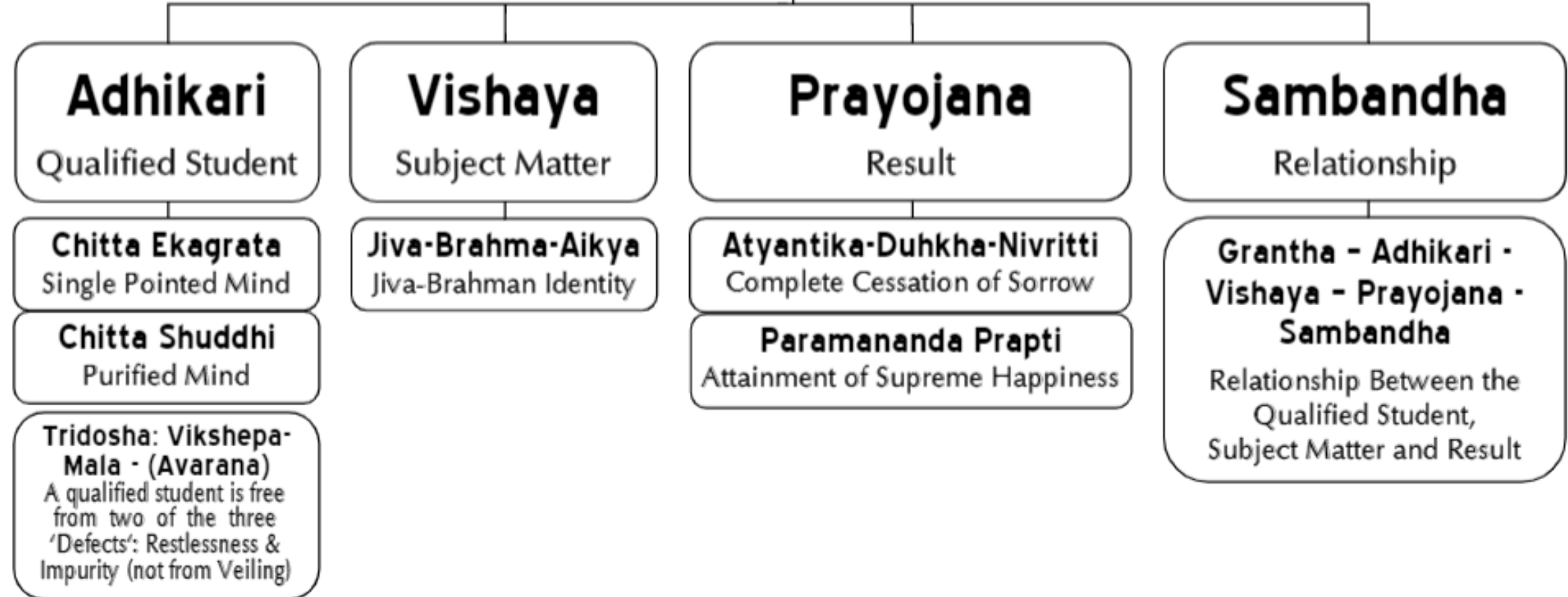


Vyakaranam - येन शास्त्रेण साधवः शब्दाः ज्ञाप्यन्ते ततः शास्त्रं व्याकरणम् ।

Four Connections Between Aspirant and Texts

ANUBANDHA-CHATUSHTAYA

Four Connections

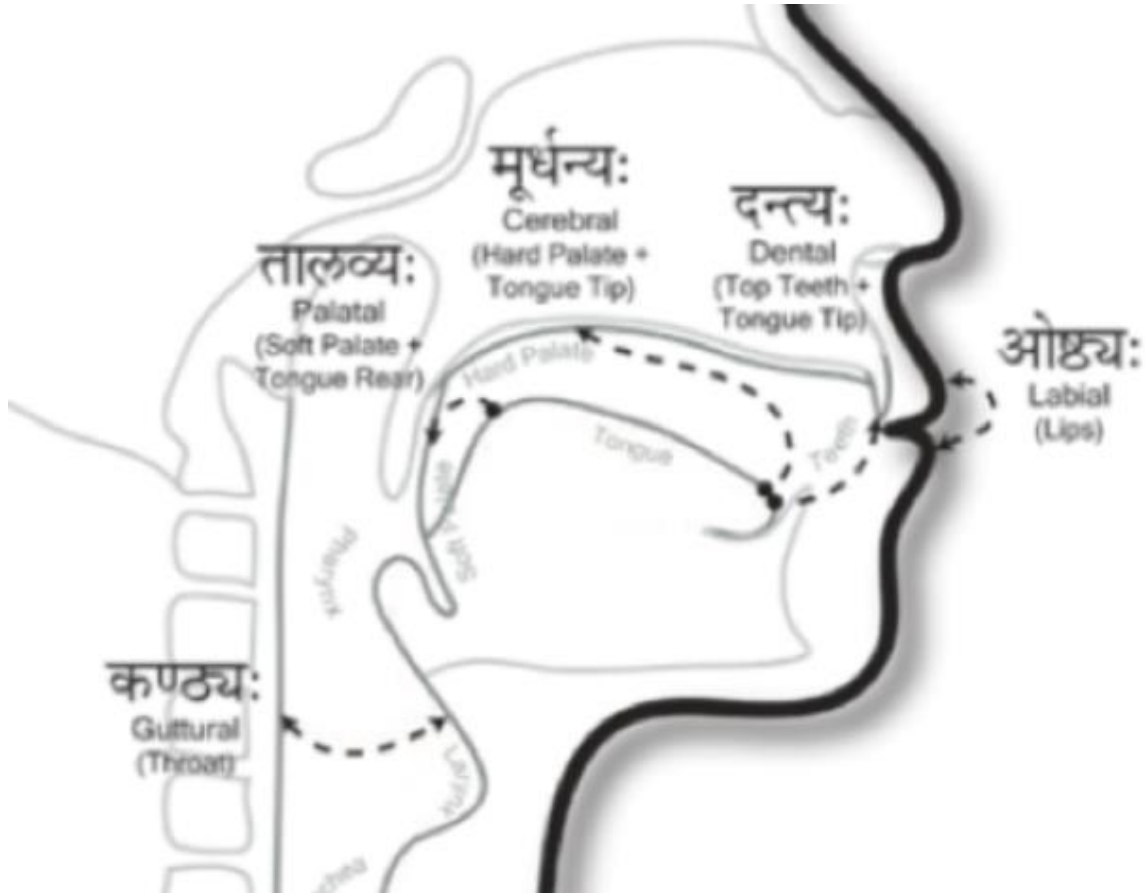


Language of Shastras – What is so special about Samskritam?

वर्णोत्पत्तिस्थानानि

आभ्यन्तरप्रयत्नाः

बाह्यप्रयत्नाः



संस्कृतवर्णमाला SAṆSKṚTA-VARṆA-MĀLĀ

vowels (svara)

simple – short & long:

अ A आ Ā इ I ई I उ U ऊ Ū ऋ R ॠ Ṛ
guttural palatal labial cerebral (retroflex)

diphthongs – long:

ए E ऐ AI ओ O औ AU अं AM अः AH लृ L ॠ Ṛ
anuvāra visarga dental

consonants (vyañjana)

mutes or stops (sparsha)

class – location	hard (non-voiced)		soft (voiced)		nasal
	simple	aspirate	simple	aspirate	
gutturals – throat	क KA	ख KHA	ग GA	घ GHA	ङ ṆA
palatals – middle of mouth	च CA	छ CHA	ज JA	झ JHA	ञ NA
cerebrals – roof of mouth	ट TA	ठ THA	ड DA	ढ DHA	ण ṆA
dentals – teeth	त TA	थ THA	द DA	ध DHA	न NA
labials – lips	प PA	फ PHA	ब BA	भ BHA	म MA

semi-vowels (antastha) – soft

य YA र RA ल LA व VA
palatal cerebral dental labio-dental

sibilants – hard & pure aspirate – soft (āṣhman)

श SA ष ṢA स SA ह HA
palatal cerebral dental guttural

special conjunct consonants

क्ष KṢA त्र TRA ज्ञ JṆA

Do we know our Alphabets?

अ

Is of 18 Types

अ (ह्रस्वः)

आ (दीर्घः)

अ३ (प्लुतः)

अ अ अ

आ आ आ

अ३ अ३ अ३

अ/अँ/अँ/अँ/अँ/अँ

आ/आँ/आँ/आँ/आँ/आँ

अ३/अँ३/अँ३/अँ३/अँ३/अँ३

Different meanings – Vocal Annotations

वेदशब्दस्य अर्थः =>

संस्कृतभाषायां प्रकृतिविकृतयोः योजनेन पदानि जायन्ते । धातवः (क्रियापदानां कृते) वा प्रातिपदिकानि (नामपदानां कृते) प्रकृतयः। प्रत्ययाः विकृतयः। प्रकृतिप्रत्ययात्मकं सर्वं पदम्।

चत्वारः धातवः वेदशब्दस्य निष्पादने उपयुज्यन्ते।

१) विद् अँ (इत्) ज्ञाने (द्वितीयगणः अदादिगणधातुः वेत्ति परस्मैपदी सकर्मक) ।
वेदशब्दः ज्ञानकरणं भवति। विदन्ति अनेन इति वेदः।

२) विद् (अनुदात्तः) अँ सत्तायाम् (चतुर्थगणः दिवादिगणधातुः विद्यते आत्मनेपदी अकर्मक) ।

यद् यद् सर्वदा अस्ति तत् सर्वम् अस्मिन् अस्ति इत्यर्थः। वेदस्य आनन्त्यं तस्मात् ज्ञाप्यते।

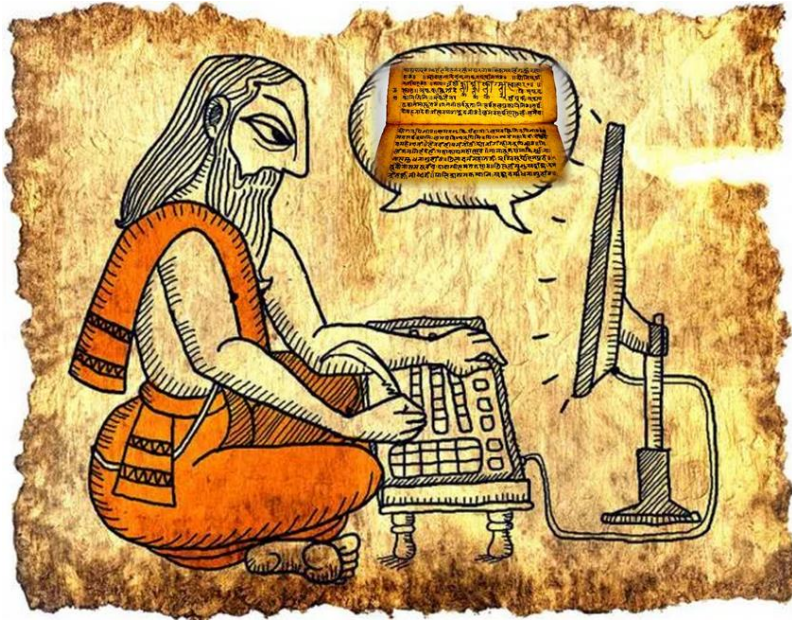
३) विद् लृ लाभे (षष्ठगणः तुदादिः विन्दति/ते उभयपदी सकर्मक) ।
वेदात् सर्वं प्रसिद्यति इति ऐकं वचनं विद्यते। यद् यद् अभीष्टम् अस्माकं ऐहिकं वा आमुष्मिकं वा निश्चेयसं सर्वं अस्मात् करणात् वेदोक्त-उपाय-अनुष्ठानात् लब्धुं शक्यते इत्यर्थे अस्मात् तुदादिगणधातोः वेदः इति शब्दः सञ्जायते।

४) विद् (अनुदात्तः) अँ विचारणे (सप्तमगणः रुधादिगणधातुः विन्ते आत्मनेपदी सकर्मक)
वेदशब्दः विचारार्थकः अपि भवति।

Key Samskritam Language Features

- Concept of Shabda-Artha
- Order of words does not matter
- No need to know the new word to derive the meaning

Pāṇini



Linguist

~ 600 B.C.E.

Vedic Age

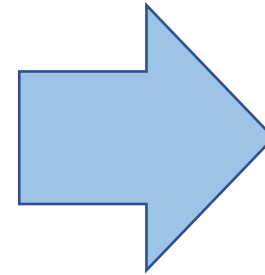
The Aṣṭādhyāyī

1000's of Ancient Indic Texts



**Vedic Language
Highly Complicated
Ambiguity**

**Science of Fine Arts
Science of Life and Health
Science of Archery and Warfare
Science of Economics, Politics, and Statecraft**



The Ashtādhyāyī ***What is it?***

**8 Chapters
4,000 Rules**

**Codified Language
Grammar
Scientific Theory
Succinct**



**Standardized
Classical Sanskrit**

**1000's of Ancient
Indic Texts**



Vedic Language
Highly Complicated
Ambiguity

Science of Fine Arts
Science of Life and Health
Science of Archery and Warfare
Science of Economics, Politics, and Statecraft

The Aṣṭādhyāyī

Created a pathway to decipher texts,
previously deemed complicated
and/or Abstruse

Facilitate
benefits of
ancient
knowledge



Holistic Health;
Immunity



Yoga;
Meditation



Philosophy;
Buddhism



Fine Arts;
Kamasutra

Structure of Ashtadhyayi

षड्विधसूत्राणि

अष्टाध्याय्याः संरचनक्रमः



संज्ञासूत्राणि

परिभाषासूत्राणि

विधिसूत्राणि

नियमसूत्राणि

अतिदेशसूत्राणि

अधिकारसूत्राणि

Object Oriented Programming concepts

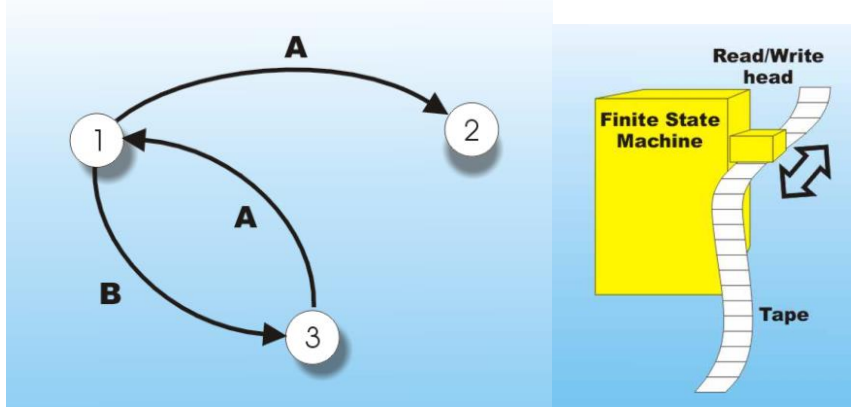
- Definition Statements or Sutras - Declaration Variables (Sanjna Sutras)
- Meta-Data Definitions (Paribhashika Sutras)
- Recursion (Anuvritti)
- Domain Definition (Adhikara Sutras)
- Functions (Vidhi Sutras)
- Polymorphism
- Hierarchy

विधिनिमन्त्रणामन्त्रणाधीष्टसंप्रश्नप्रार्थनेषु लिङ्

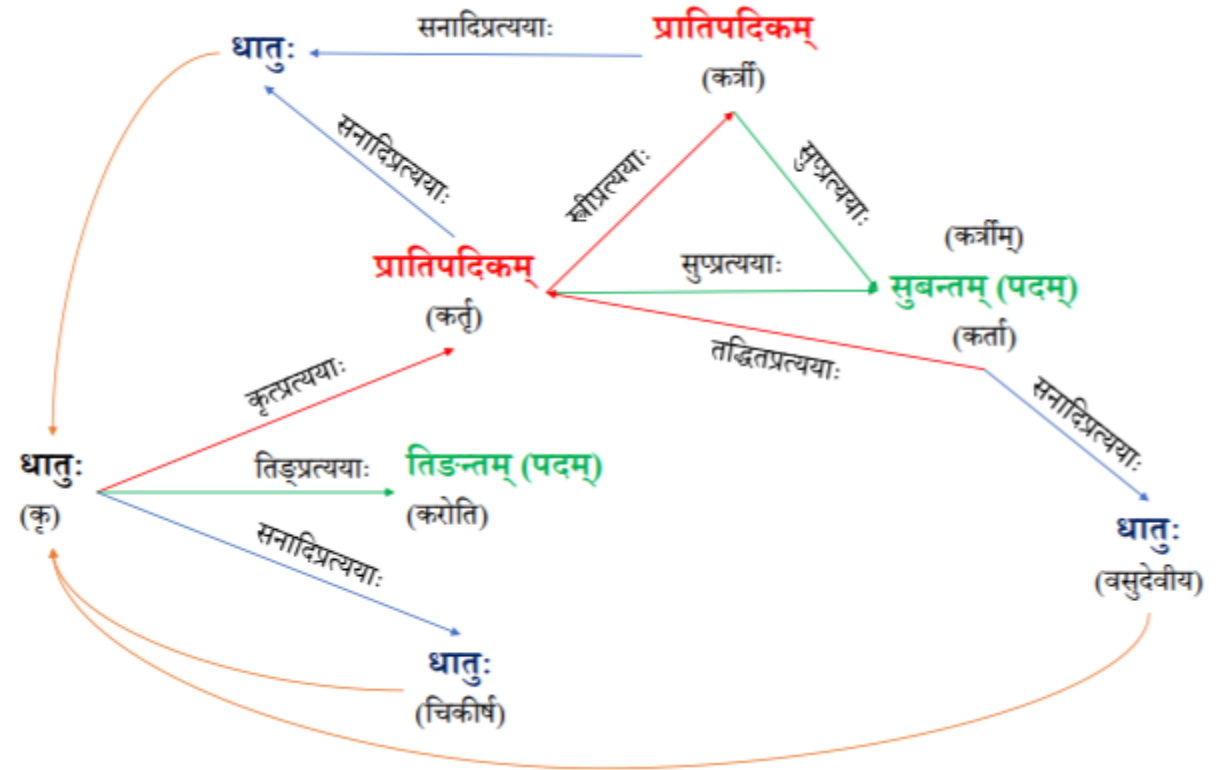
लिङ्‌लकार can be used to indicate विधि (= order) , निमन्त्रण (= an invitation that cannot be rejected), आमन्त्रण (= an invitation that can be rejected), अधीष्ट (= Ask something with respect, often in exchange of money or something else), सम्प्रश्न (= A question about doing or not doing something) and प्रार्थना (= request)

- Injunction – You should eat
- Invitation – Please eat here
- Permission – You may eat here
- Respectful Command – Please eat now
- Deliberation – Should I eat now?
- Request – May I eat?

Finite State Machines – Turing Machine (Pre-cursor of the CPU)



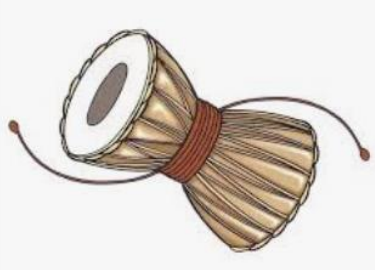
- start with <null> and apply rule 1 to get B<S1>
- use rule 2 to get BA<S2>
- use rule 3 to get BAB<S1>



Tagging and Use of Meta-Data in Ashtadhyayi

माहेश्वरसूत्राणि

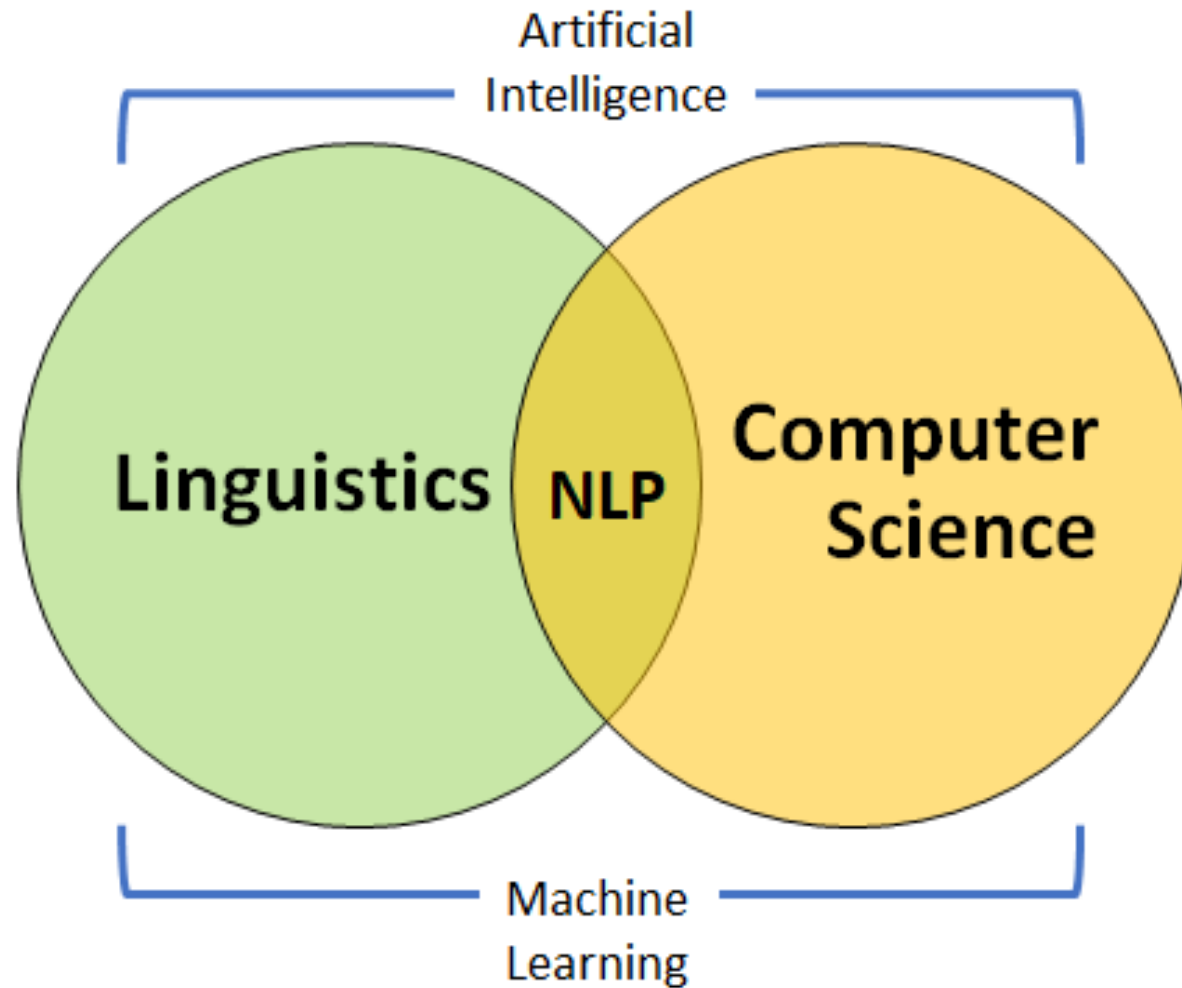
वर्णाः व्याकरणशास्त्रस्य उपयोगाय सूत्ररूपेण उक्ताः वर्तन्ते।
तानि सूत्राणि माहेश्वराणि सूत्राणि (१४)



V O W E L S	Simple vowels	अ इ उ ण ऋ ॠ लृ कृ
	Diphthongs	ए ओ ङ ऐ औ च
C O N S O N A N T S	हृ + Semivowels	ह य व र ढ्र लृ ण
	Class 5 (= Nasals)	ज म ङ ण न म
	Class 4	झ भ ञ घ ढ ध ष
	Class 3	ज ब ग ङ द श
	Class 2	ख फ छ ठ थ
	Class 1	च ट त वृ क प य
H A R D	Sibilants + हृ	श ष स र ह लृ

इति माहेश्वराणि सूत्राणि ।

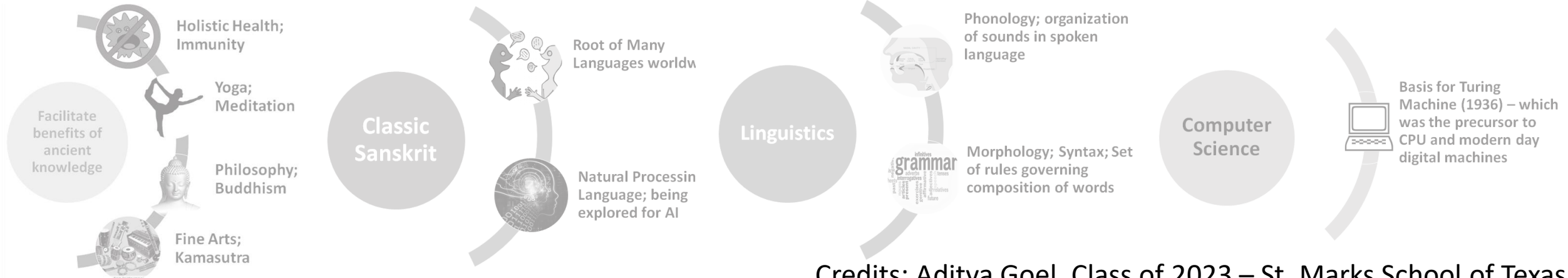
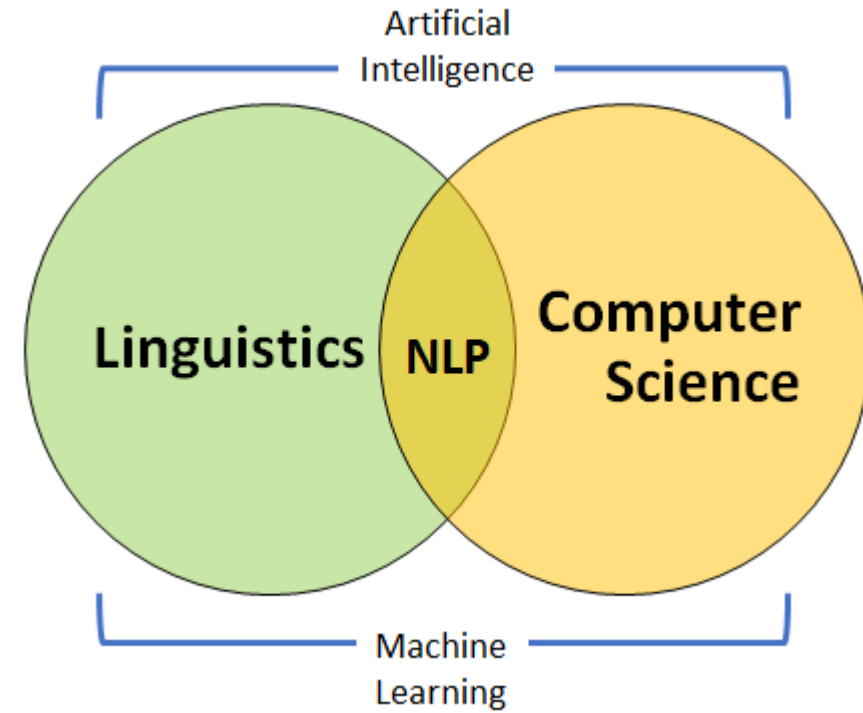
Maharshi Panini's contribution to all three areas



The Aṣṭādhyāyī

FUTURE: Artificial Intelligence and Machine Learning

Natural Language Processing



Credits: Aditya Goel, Class of 2023 – St. Marks School of Texas



ॐ सह नाववतु।
सह नौ भुनक्तु।
सह वीर्यं करवावहै।
तेजस्वि नावधीतमस्तु
मा विद्विषावहै।
ॐ शान्तिः शान्तिः शान्तिः ॥

Meaning:

Om. May It protect us both (Guru and Shishya) together. May It nourish us both together. May we both work with strength together. May our study have brilliance. May we not be antagonistic towards one another. Om peace, peace, peace.