ChandaŚāstra of Piṅgala

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introduction

Prayojanam vinā na mando'pi pravartate
Without any purpose, even a fool does not get initiated.

Every knowledge system developed in India was from 'Application point of view'.

Knowledge for Knowledge Sake
Versus
Knowledge for the Benefit of the Society

Chandaśāstra

Chanda = Pleasing, Alluring, Delightful
Chanda = Metrical part of Vedas or Poetry

Chandaśāstra

Piṅgala: Chandaśāstra (circa 500 BC)
Book is in the form of sūtras.
Eight chapters.

Piṅgala's Chandaśāstra

Basic Terminology

- Akṣara: Cluster of one vowel with zero or more consonants
- pāda (foot): A quarter of a stanza

Piṅgala's Chandaśāstra

Meters are of 3 types

- Syllabic Verse (akṣaravṛtta)
  Number of Syllables in a verse are fixed.
- Syllabo-quantitative verse (gaṇvṛtta)
  The syllable patterns is fixed.
- Quantitative verse (mātrāvṛtta)
  The number of syllables measured in terms of their duration is fixed.

Piṅgala's Chandaśāstra

Light and Heavy Syllables (Laghu and Guru akṣaras)

- If the vowel is short, and is followed by at most one consonant before another vowel, the syllable is laghu
- A syllable with an anusvāra or visarga is always guru.
- The last syllable is taken as a guru optionally

Laghu syllable counts as one unit and guru syllable counts as two units.

Example

या सृष्टिः स्रष्टुराद्या वहति विधिहुतं या हविर्या च होत्री
ये द्वे कालं विधत्तः श्रुतिविषयगुणा या स्थिता व्याप्य विश्वम्
यामाहुः सर्वबीजप्रकृतिरिति यया प्राणिनः प्राणवन्तः
प्रत्यक्षाभिः प्रसन्नस्तनुभिरवतु वस्ताभिरष्टाभिरीशः

G GG GLGG LLL LLLG G LGG L GG
(GGG GLG GLL LLL LGG LGG LGG)

Gaṇa: A Triplet of laghu-guru

gaṇa	pattern
ya	LGG
mā	GGG
tā	GGL
rā	GLG
ja	LGL
bhā	GLL
na	LLL
sa	LLG
la	L
gu	G

आदिमध्यावसानेषु यरता यान्ति लाघवम्
भजसा गौरवं यान्ति मनौ तु गुरुलाघवम्

ya LGG
ra GLG
ta GGL

bha GLL
ja LGL
sa LLG

ma GGG
na LLL

म्रभ्नैर्यानां त्रयेण त्रिमुनियतियुता स्रग्धरा कीर्तितेय्म
ma ra bha na ya ya ya

GGG GLG GLL LLL LGG LGG LGG

ya LGG
ra GLG
ta GGL

bha GLL
ja LGL
sa LLG

ma GGG
na LLL

Example

या सृष्टिः स्रष्टुराद्या वहति विधिहुतं या हविर्या च होत्री

GGG GLG GLL LLL LGG LGG LGG

ma ra bha na ya ya ya

ya LGG
ra GLG
ta GGL

bha GLL
ja LGL
sa LLG

ma GGG
na LLL

De Bruijn Sequence

Gaṇa: A Triplet of laghu-guru

gaṇa	pattern	mnemonic
ya	LGG	yamātā
mā	GGG	mātārā
tā	GGL	tārāja
rā	GLG	rājabhā
ja	LGL	jabhāna
bhā	GLL	bhānasa
na	LLL	nasala
sa	LLG	salagā
la	L	
gu	G	

yamātārājabhānasalaga
LGGGLGLLLGLG

De Bruijn Sequence

De Bruijn cyclic sequence of length 3
10001011 De Bruijn sequence of length 4

10000111110110010 Total such Binary sequences of length n:

$2^{2^{(n-1)}-n}$
For n=3; $2^{(2^2-3)} = 2^1 = 2$
For n=4; $2^{(2^3-4)} = 2^4 = 16$

Use of this code: Digital Door Locks

Piṅgala

In the eighth chapter of Chandaśāstra *Piṅgaḷa* describes algorithms for several operations called as pratyayas. All these algorithms are recursive in nature.
In the later work of *Kedār Bhaṭṭa*'s Vṛttaratnākara, all these algorithms were described in iterative manner.

Recursion Versus Iteration

Recursion

```
let rec fact n =
 if n = 1 then 1
 else n * fact (n-1)
;;
```

Iteration

```
let factorial n =
  let result = ref 1 in
  for i = 1 to n do
    result := !result * i
  done;
  !result
```