

Some special number systems in Sanskrit

- All the systems described here find innovative ways to represent number by the sequence of digits. This reinforces the fact that the decimal system of numbers with zero was the norm in India.
- There are several different traditional ways of representing a number. The first is a word system which uses a word which typically is associated with a number. Larger numbers are then formed by combining these words in a sequence and treating it like a compound (samāsa).

Thus eyes are generally two in number, so any word meaning eye is used for two. The word for three is loka (world) which are typically three, the hell, the heaven and our own. The word for zero is any word for sky or space like ākāśa, kha etc. Thus the current year can be written as bāṇākhākāśalocana(arrow-space-sky-eye). Note that this sequence goes 5002, which is the traditional way of stating numbers by the dictum "aṅkānām vāmato gatiḥ" (the numbers go towards left). Some systems use the straight version also. Note that I used two different words, both meaning space, to avoid simple repetition.

But thru the multiplicity of meanings in the Sanskrit language, the first word "kha" can be interpreted by an alternate meaning of a "hole" and the whole word can be describing a person with his eye on the space in a hole caused by an arrow! Needless to say, some clever poets can make interesting word with twisted meanings, but in a routine use, the word is meaningless as an independent word.

A more comprehensive list is on the handout. A lot of culture and history is often hidden in the choice of words.

- Another system is to use syllables to represent digits. This is called the kaṭapayādi system. Check the quick introduction to the Sanskrit (devnagari) alphabet on a separate handout. Thus the ten syllables from ku and cu (the ka-varga and ca-varga) represent the ten digits 1,2,...,9,0. Similarly the ṭu and tu. The pu gives 5 digits from 1 to 5, the syllables ya, ra, la, va, śa, ṣa, sa, ha give 1 thru 8. The vowels don't count unless by themselves and then they are zero. There are variations including special syllables like kṣa being counted (as zero), or by allowing forward order. In a compound syllable, usually the last syllable is the one to be counted; however, there are systems which use the first or some which use all.

A striking example is an encoding of the well known pi:

गोपीभाग्यमधुव्रात शृङ्गिशोदधिसन्धिग। खलजीवितखाताव गलहारसंधर॥

gopībhāgyamadhuvrāta śṛṅgiśodadhisandhig|khalajīvitakhātāva galahārasandhara||

- This verse is supposed to give the encoding of pi in forward sequence to 32 digits in addition to being a verse in praise of Krishna as well as Shiva (depending on

interpretation). It also is claimed to have a "master-key" for the continuing digits of pi. These matters will be discussed in class.

- There are variants of this system, some to accommodate related scripts or languages like Pali.
- There are more complicated systems, one notably introduced by Āryabhaṭa (5th cent. AD). It is extremely complicated and the resulting words are almost impossible to pronounce but it can represent large astronomical numbers in a compact space. It will be discussed separately.
- Many times, the numbers are also given just by their digits, except they are invariably listed from right to left.
- Negative numbers are indicated with a dot over the number symbols. The variables are called *varṇa*, literally meaning "color"; they were often names of colors or connective words like as much, as many etc. or any other words that the author liked. There was no equality symbols, but the sides of the equations were written next to each other. Symbols like addition were not used, but understood.