# Language Technology Resources (LTR) for Sanskrit and other Indian Languages at Jawaharlal Nehru University, India

**Girish Nath Jha**
Associate Professor, Computational Linguistics
Special Center for Sanskrit Studies, J.N.U., New Delhi – 110067
&
Mukesh and Priti Chatter Distinguished Professor of History of Science,
University of Massachusetts Dartmouth

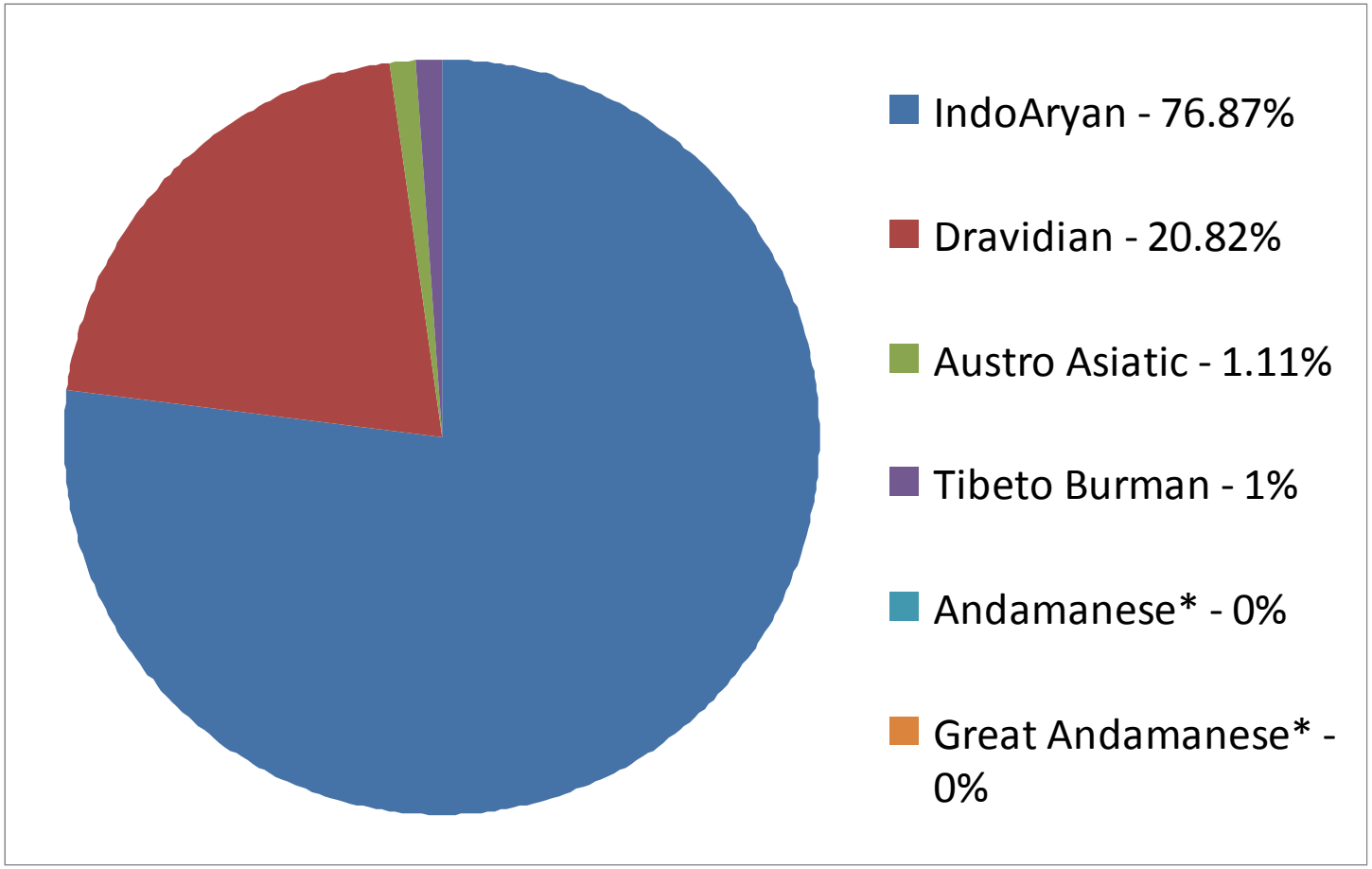
# In this presentation…

- India's diversity and LTR development by various government agencies, particularly the IT ministry
- Role of Sanskrit and its current status
- LTR for Sanskrit and other Indian languages at JNU
- Corpora development in India
- Issues & challenges
- Opportunities for collaboration and Business

# India's cultural & linguistic diversity

- 1 billion plus people, 2000 castes, 43000 sub-castes
- Hinduism, Islam, Christianity, Sikhism, Jainism, Buddhism, Parsis etc
- 5 language families - Indo Aryan, Dravidian, Austro Asiatic, Tibeto-Burman, Andamanese
- 25 states in India, more than 1600 languages

# Indian Language Families and % Speakers



# Status of languages

- 22 **national languages** and 12 scripts
- Most of these are also **official languages** of the states they are spoken in
- 100 **mother-tongues** reported in census 2001
- About 1000 **documented languages** and dialects
- Hindi – (**NOL**) 42% speakers, the official language of Union with English (**AOL**) as its associate (4 %)

# National Languages & Scripts

| Sl. No. | Language | Script |
|---|---|---|
| 1. | Hindi | Devanagari |
| 2. | Sanskrit | Devanagari |
| 3. | Marathi | Devanagari |
| 4. | Konkani | Devanagari |
| 5. | Nepali | Devanagari |
| 6. | Maithili | Devanagari |
| 7. | Sindhi | Devanagari |
| 8. | Bodo | Devanagari |
| 9. | Dogri | Devanagari |
| 10. | Santhali | Devanagari, Ol Chiki |
| 11. | Bengali | Bengali |
| 12. | Assamese | Bengali |
| 13. | Manipuri | Bengali, Meithei |
| 14. | Gujarati | Gujarati |
| 15. | Kannada | Kannada |
| 16. | Malayalam | Malayalam |
| 17. | Oriya | Oriya |
| 18. | Punjabi | Gurmukhi |
| 19. | Tamil | Tamil |
| 20. | Telugu | Telugu |
| 21. | Urdu | Perso-Arabic |
| 22. | Kashmiri | Perso-Arabic |

# Indian constitution on languages

- 448 articles, 12 schedules, 107 amendments (so far)
- Article III – Fundamental rights
- Article IV A – Fundamental duties
- Article XVII – Official Language
- Article XVII – Regional Languages
- Article XVII – Language of Supreme Court and High Court
- Article XVII – Special Directives

# Role of government agencies

- **MHRD (Ministry of Human Resource Development)**
  - Central Institute of Indian Languages (CIIL), Mysore
  - University Grants Commission (UGC) and Indian universities
- **MCIT(Ministry of Communications & Information Technology)**
  - Department of Technology (DIT)
    - Technology Development for Indian Languages (TDIL)
- **MST(Ministry of Science & Technology)**
  - Department of Science & Technology (DST)
- **MC (Ministry of Culture)**
  - Anthropological Survey of India

# Ministry of HRD

- **Central Institute of Indian Languages (CIIL)**
  - New Linguistic Survey of India (NLSI)
  - National Translation Service
  - Linguistic Data Consortium for Indian Languages (LDC-IL)
  - Development and Promotion of Minor Indian Languages
  - National Testing Mission (NTM)

# Ministry of Communication & IT

- **TDIL - Technology Development for Indian Languages (TDIL) established in 1991**
- **TDIL objectives**
  - develop and promote the information processing tools
  - support R&D efforts in the area of information processing in Indian Languages and to support research on Knowledge Tools
  - consolidate technologies thus developed for Indian Languages
- **TDIL activities**
  - National Rollout plan
  - Funding Language and speech technology projects
  - Work on corpora and tool standards
  - Create and seed dedicated research groups in each region of India

# Activities by TDIL

- **National Rollout Plan**
  - Software tools and fonts for all 22 Indian languages have been released in the public domain
  - The CD-ROM typically contains the following software tools:
    - Fonts, Keyboard Drivers, converters, editors, typing tutors
    - Integrated Word Processor
    - Bharateeya Open Office
    - Bilingual Dictionaries
    - Spell checker
    - Transliteration tool
    - Browser
    - Email Client
    - Messenger
    - Text to Speech system
    - OCR

# TDIL – Mission mode projects

**In the consortium mode, 26 premier Institutes and R&D organizations are working on LTR projects**

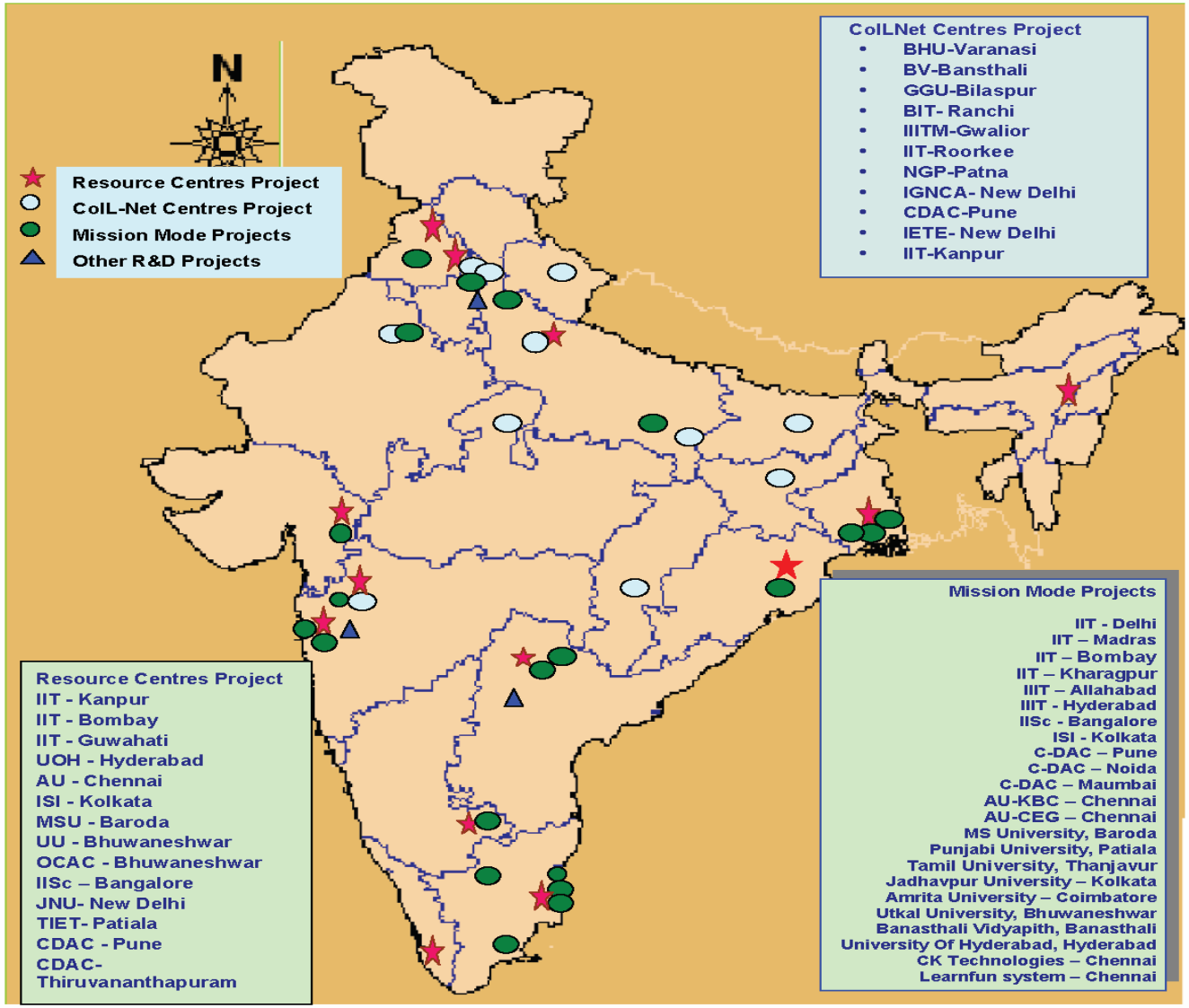
# Major ongoing TDIL projects

- English to Indian Languages Machine Translation (MT) System (E-ILMT) →**CDAC, Pune**
- English to Indian Languages Machine Translation (MT) System with Angla-Bharti Technology (E-ILMT-ABT) →**IIT Kanpur**
- Indian Language to Indian Language Machine Translation System: (ILMT) →**IIIT Hyderabad**
- **Sanskrit-Hindi Machine Translation (SHMT) → University of Hyderabad, JNU…**

# Major ongoing TDIL projects

- **Document Analysis & Recognition System for Indian Languages (DARSIL) →IIT Delhi**
- **On-Line Handwriting Recognition (OLHR) →I.I.Sc, Bangalore**
- **Cross Lingual Information Access (CLIA) → IIT, Bombay**
- **Speech Corpora & Technologies (SCT) → IIIT Chennai**
- **Indian Language Corpora Initiative (ILCI) → JNU, New Delhi**

## Institutions involved in Language Technology Development in India




The above figure is an indicative diagram of geographical spread of the projects supported by TDIL Programme

# e-governance

- National e-Governance Plan (NeGP) vision
  - Make all Government services accessible to **the common man in his locality**, through common service delivery outlets and ensure efficiency, transparency & reliability of such services at affordable costs to realize the basic needs of the **common man**
- NeGP started in 2006. comprises of 27 Mission Mode Projects (MMPs) and 8 components
- **Language Technology is a big component**
- 42K crores INR (approx 10,000 million USD) spread across 3 five-year plans

# Budget….

Lot of money available with different ministries

- TDIL (MCIT) → Approx 2 million USD per year
- E-gov (MCIT and other ministries) in 22 Indian languages → approx 9000 m USD total for 15 yrs
- E-learning and content creation in Indian languages (MHRD) → approx 217 m USD total for 5 yrs

# Sanskrit

# India…

- An ocean of diversity
- Has had weak governance
- Has had invasions, destructions, colonization, partitions….
- Still going on (for last 5000 years)
- and has maintained un-interrupted tradition without having to use any violence

# Role of Sanskrit

- Language with negligible speakers
- No state (Uttaranchal has recently accepted it as official language of the state)
- Yet spoken in all the states
- Mother of most of Indo Aryan languages (77% speakers of India)
- Source of India's intellectual, religious, spiritual power
- Common source for vocabulary for Indian as well many European languages
- Source of much of Indian languages literature, art, culture
- Language of Hinduism, Buddhism, Jainism
- Source of Indian language grammars

# Jawaharlal Nehru University (JNU), New Delhi

India's best research university

- One of the best language programs in Asia for Indian and foreign languages
- Known for post graduate research
- Students selected based on South Asia wide test, 10:1 student:teacher ratio
- Fully residential
- Semester system with grading scheme

# Special Center for Sanskrit Studies at JNU

- A center for traditional as well as modernized Sanskrit studies
- Wide variety of courses including linguistics, computational linguistics, grammar, logic, philosophy, literature etc
- Research students from Sanskrit, linguistics
- Large number of undergraduate students of foreign languages
- Heavily funded by Ministry of IT
- Consultancies
- Collaborations with foreign universities
- Rated 8+ (out of 10) by University Grants Commission

# Our Funded Activities

# Sanskrit-Hindi MT (SHMT) project – TDIL funded

- Members
  - University of Hyderabad
  - JNU
  - IIIT Hyderabad
  - Tirupati Vidyapeeth
  - Sanskrit Academy Hyderabad
  - Poornaprajna Vidyapeth Bangalore
  - Rajasthan Sanskrit University, Jaipur
- Budget → 3.16 crores
- Duration → 3 yrs (2008 – 2011)

# Goals of SHMT project

- Develop necessary tools and data leading to Sanskrit-Hindi machine translation in the domain of children stories
- Multimedia and e-learning tools for children
- Deliverable → online/standalone system, data

# Developments at JNU

- Rule based POS engine.
- annotated data for POS, Sandhi, samaasa
- Bilingual Dictionary
- Lexical Disambiguation Rules
- Standards for POS annotation
- Multimedia/e-learning  standalone as well as web version

# Our technology

- Online system
- Front end → Java, JSP, HTML, JS
- Backend → RDBMS, data files
  - Stored procedures, security features
- Standards → w3C, Unicode, TEI, EAGLES
- Connectivity → MS-JDBC driver
- Hosting → Tomcat/Apache webserver

# Indian Languages Corpora Initiative (ILCI)

- **Funded by TDIL program of Ministry of C & IT**
- **Approx 3 crores**
- **2 years**

# Languages & Consortia partners

1. Hindi (and English) – Special Center for Sanskrit Studies, JNU (consortium leader)
2. Punjabi – Punjabi University, Patiala
3. Urdu – Center for Indian languages, JNU
4. Tamil – Tamil University
5. Telugu – Dravidian University
6. Malayalam – IIITM-K, Trivandrum
7. Gujrati – Gujrat University
8. Konkani – Goa University
9. Oriya – Utkal University
10. Bangla – ISI Kolkata
11. Marathi – IIT Mumbai

# ILCI user-groups

- Various Indian language technology projects in the country, in particular Machine Translation projects in the tourism and health domain

- Language research groups in the country

# ILCI deliverables

- **Help evolve national Standards**
- **Parallel aligned corpora**
  - 11+1 languages (Hindi as source)
  - Tourism & health domain
  - 50 k sentences in 12 languages
- **Annotated corpora**
- **Tools**

# National standard for POS

- National Standard for POS annotation has been evolved recently by Bureau of Indian Standards (BIS)
- It is a generic hierarchical scheme considered adaptable for diverse Indian languages

# Corpora collection

- Collect 50 k sentences in tourism & health domain in Hindi
- Create parallel aligned corpora in 11 Indian languages
- An annotated corpora of approx 6 million words

# Other funded activities - Consultancies

- Microsoft Corp consultancy for Handwriting Recognition for Devanagari
- Microsoft Research Consultancy for Indic languages tagset and annotation
- CDAC consultancy for localization for software

# Collaborations

- With University of Massachusetts, Dartmouth (Center of Indic Studies) for the project STAIT (Science and Technology in Ancient Indic Texts)
- MoU with University of Wurzburg, Germany for Sanskrit, Hindi, Linguistics, Computational Linguistics

# Unfunded activities

# J-TESS :

# JNU Text Encoding & Search for Sanskrit

- An unfunded initiative by the Computational Linguistics group at Sanskrit Center

- Goals -
  - Creating a searchable database of Sanskrit texts
  - Search through Indian language scripts, IAST, ITRANS, Wx and other schemes
  - Linking searches with scanned images, with metadata, introduction and other useful links
  - Reading help like sandhi viccheda, morph analysis, lexical look up, translation
  - Multimedia texts, e-learning tools for younger generation
  - Tools

# What has been done

- Texts
  - Vedas
  - Ramayana
  - Mahabharata
  - Dictionaries (Nighantu-Nirukta, Amara, Medini, Mankha, Halayudha)
  - Dictionary (Apte)
  - Many other lexical resources (as part of student projects)
- Tagging schemes, tagged corpora

# Tools

- Sandhi splitter (vowel), consonant (shortly)
- Subanta (noun inflections) analyzer
- Tinanta (verb inflections) analyzer
- Kridanta (primary derived nouns)
- POS tagger
- Generators (sandhi, subanta, tinanta)
- SHMT (in progress)
- MM animation
- Lexical resources and search

# R&D by research students

- As part of M.Phil and Ph.D research by my students, a large number of tools have been developed mainly for Sanskrit
- Their tools and dissertations are online on our sever http://sanskrit.jnu.ac.in

# Corpora development at other places

- **Kolhapur Corpus of Indian English (KCIE)**
  - 1 million words of English
- **TDIL (1991-94)**
  - Approx 3 million words in major Indian languages (done by individual institutes)

## LDC-IL project → CIIL Mysore

- General purpose corpora of approx 3 million words for many Indian languages
- Annotation work is continuing

## Gyan Nidhi → CDAC Noida

- parallel aligned corpus of 13 Indian languages including English.

- **MSRI**
  - Multilingual Systems initiated IL-POST discussions by leading experts in the country (I was one of them)
  - The IL-POST scheme is a hierarchical scheme based on EAGLES guidelines
  - 200 K words tagged in Hindi, Bangla, Tamil
  - 50 K tagged in Sanskrit

- **IIIT Hyderabad**
  - annotated corpora in 9 languages including Hindi
  - Simple flat tagging scheme with 26 tags

- **TDIL MT projects**
  - Many of the consortium projects have developed corpora for specific tasks, may or may not be tagged

# Issues and Challenges

- Lack of uniform standards, now they are coming up
- Earlier projects suffered from transparency
- Too many languages, not enough trained manpower for all languages
- Manpower training projects are being planned

# Scope for collaboration

# India's advantages

- Low cost
- Good pool of trained linguists and computer scientists
- Un-paralleled linguistic diversity in **one** country
- Hindi is now a global language (inherits from Sanskrit – the oldest documented Indo-European language

# Collaborate to develop/examine standards

- Examine suitability/extensibility of existing standards
- New standards
- Progressive involvement of global standard bodies

# Collaborate in corpora development & data sharing

## Corpora development

- Low cost corpora development for English and Indian languages in specific domains (e.g. business, tourism, sports, culture)
- Spoken language corpora

## Sharing

- Bilateral/multilateral agreements on linguistic data sharing

# Collaborate in Localization of software

- There is a huge market for it in India
- Localized versions of major software applications has huge market in India Evolve standards for localization

# Demo

Sanskrit.jnu.ac.in

localhost

# Dhanyavaada

# Thank you

girishjha@gmail.com