Department of
Computer Science and Engineering
IIT Bombay
AI-ML group

Jan 2020

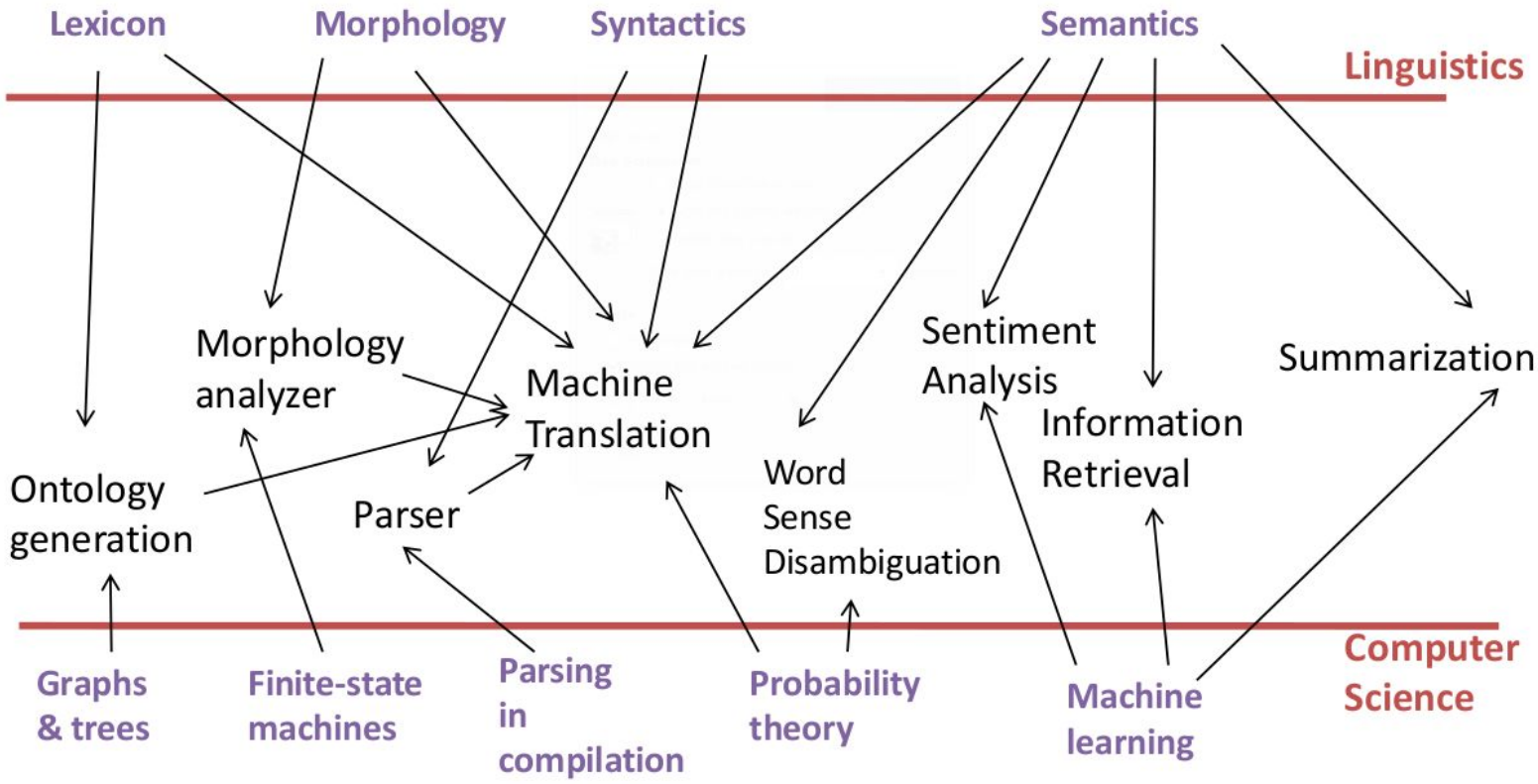
Faculty Members Working in ML, AI, NLP

- Pushpak Bhattacharya: Natural Language Processing, Machine Learning, AI
- Soumen Chakrabarti: Web Crawling, Search, and Mining
- Abir De: Learning on graphs, Trustworthiness and AI
- Preethi Jyothi. Machine Learning for Speech Recognition, Cross-lingual Audio Visual Learning,
- Shivaram Kalyankrishnan: Artificial Intelligence, Reinforcement Learning
- Ganesh Ramakrishnan: Deep Learning in NLP, Cross-lingual Audio Visual Learning, AI and Human-in-the-Loop, Subset Selection,
- Sunita Sarawagi. Graphical models, Deep learning, Extraction, AI and Human-in-the-Loop


Machine Learning & AI At a glance

- Natural Language Processing and Cross-lingual learning
- Web Crawling, Search, Mining and Graphs
- Large Scale Information extraction
- Deep Learning in Text & Vision, Multi-modal learning
- Machine Learning for Speech Recognition
- Graphical models, Deep learning
- Reinforcement Learning
- Faculty: Pushpak Bhattacharyya, Soumen Chakrabarti, Abir De, Preethi Jyothi, Shivaram Kalyanakrishnan Ganesh Ramakrishnan, Sunita Sarawagi

NLP: At the confluence of linguistics & computer science



Linguistics is the eye and computation the body

Information Retrieval and Data Management

- Next generation Web search
  - Information Extraction
    - From unstructured to structured data, From text to entities
  - Entity and entity-relationship queries
- Fake News Detection (Kauwa Kaate)
- Database systems
  - Holistic optimization of database applications
  - Test and grading SQL queries
  - Querying Big Data and Data Streams
- Faculty: Soumen Chakrabarti, S. Sudarshan

Course: CS 635 - Information Retrieval & Mining for Hypertext & the Web

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Artificial Intelligence and ML

- AI
  - Robotics
  - Reinforcement Learning
  - Markov decision processes
  - Faculty: Shivaram Kalyanakrishnan
- Speech Recognition
  - Faculty: Preethi Jyothi
- Optical Character Recognition for Indian Languages
  - Faculty: Ganesh Ramakrishnan, Parag Chaudhuri

Deep Learning

- Deep Learning models for sequence prediction
- Model Adaptation
  - Labeled memory networks for online model adaptation
  - Training neural models that are robust to new domains
- Deep Learning models for question answering and text comparison
- Applications of Deep Learning in Text and Vision
  - Deep Learning for Analytics of Surveillance Videos
  - Complementing Symbolic Expert Input with “Deep” Embeddings

Papers at ICLR, ICML, WWW, EMNLP, IJCAI

- Faculty: Soumen Chakrabarti, Abir De, Preeti Jyothi, Ganesh Ramakrishnan, Sunita Sarawagi

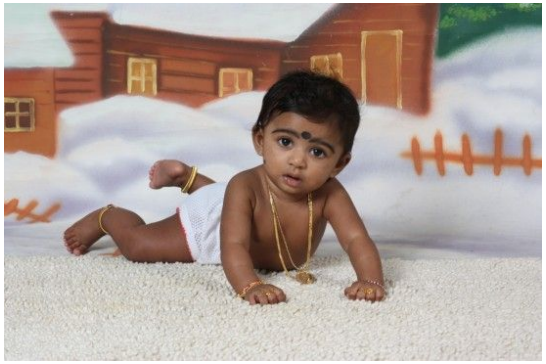
Spoken Language Processing
Faculty: Preethi Jyothi

- **Low-Resource Speech Recognition**
  - Accent Adaptation
  - Automatic Speech Recognition (ASR) for Indian Languages
  - Multilingual ASR Systems
- **Computational Models for Code-switching**
  - Generating code-switched text
  - ASR for code-switched speech
- **Cross-lingual Audio-visual Learning**
- **Spoken Machine Translation**

Recent publication venues: Interspeech, ACL, EMNLP, ICASSP.
Course: Automatic Speech Recognition (**CS 753**)

Shivaram Kalyanakrishnan's Research

How does an infant *learn* to walk?



- Initially moves joints at random.
- Sometimes gets positive feedback (moving in intended direction).
- Sometimes gets negative feedback (falling).
- Through trial and error, identifies sequences of actions for successful walking.

Mathematical framework: Reinforcement Learning
Applications: Game-playing, Robotics, Financial trading, Scheduling, ….

Shivaram Kalyanakrishnan's Research

- **Reinforcement Learning** (RL)
- **Markov Decision Problems** (MDPs)
  - (Theory of RL and sequential decision making)
- **Multi-armed Bandits** and **On-line Learning**
  - (Theory of "trial and error" or "explore/exploit")
- **Evolutionary algorithms**
- **Humanoid robotics and Robot Soccer**
- **AI and Society**

Recent publications venues: AAAI, IJCAI, AIES, UAI, ICML.
Course: Foundations of Intelligent and Learning Agents (**CS 747**)

Ganesh Ramakrishnan's Research

https://www.cse.iitb.ac.in/~ganesh/Publications.html

1. **Explainable and Human-in-the-loop approaches**
   a. Subset selection problems in machine learning (convex relaxations for feature induction and submodular mixtures for data/label subset selection)
   b. Use of logically encoded knowledge, labelling functions, hierarchy
   c. Publications at AAAI, IJCAI
2. **Data integration, Entity and Relation extraction, in Multimodal settings**
   a. Human Object Interaction, Visual Relationship Detection
   b. Optical Character Recognition (and post-editing) from images and Scenes
   c. (Query Driven) Video Summarization, Cross-Lingual Audio Visual Learning
   d. Video Analytics in the Surveillance domain
   e. Publications at AAAI, ACMM, Interspeech, ICDAR, WACV
3. **Deep learning in structured (sequence) settings**
   a. Question generation and answering in complex domains
   b. Machine Translation & ASR For Indian Languages with focus on post-editing
   c. Publications at ACL, EMNLP, NAACL, CoNLL

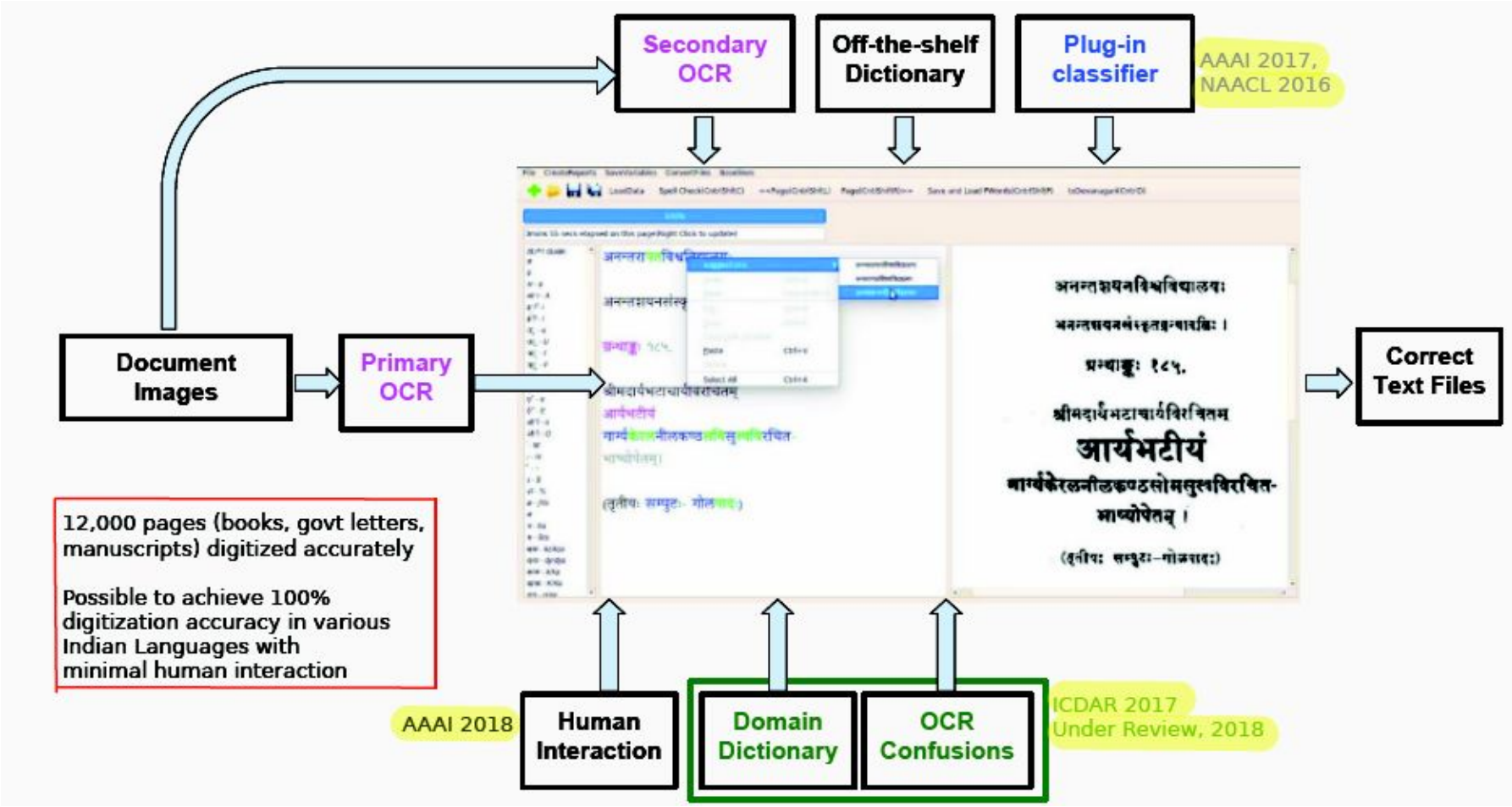
Courses: CS 337 AI & ML , **CS 769: Optimization in Machine Learning**

Ganesh Ramakrishnan's Research Interests

Practical development of AI-enabled software products (focused on the Indian eco-system): https://www.cse.iitb.ac.in/~ganesh/#software

1. Software for Video Surveliance Analytics (Real time as well as offline) Technology Licensed to SrivisifAI
2. Software for OCR and Scene text Recognition for Indian languages and Indian contex
3. Lokacart for helping MSME's, Farmer groups: as One of the projects initiated by IIT Bombay for COVID-19 mitigation (see pages 17 and 65-69) in collaboration with industrial partners. Technology Licensed to Strategic ERP
4. Lokavidya: Knowledge sharing platform for educational institutions: as One of the projects initiated by IIT Bombay for COVID-19 mitigation
5. Real time contact tracing through Corontine application : Geofenced Tracking, Tracing and Alerting

Real world system building: A Framework Indic OCR, Error Detection & Correction



Smart Search in Videos

Vehicle Counting

Suspect Identification

Gender Specific Counting

Face Search in Videos

Customized Real-Time Alerts

Subset selection, Active Learning, Ranking

Real world system building: Video Surveillance Analytics

https://www.cse.iitb.ac.in/~ganesh/videosurvellianceanalytics/

Machine Learning on graphs
Faculty: Abir De

- **Discriminative modeling and learning on graphs**
  - Designing rich embeddings for link prediction
  - Generative modeling with applications to new molcule design
  - Searching on graphs
- **Trustworthy algorithms on graphs**
  - Privacy preserving algorithm, design on graphs
  - Consequential learning with graphs

Recent publication venues: SIGIR, AAAI, WSDM, UAI, NIPS
Course: Learning with graphs (**CS 768)**)

Natural Language Processing

- Machine Translation
  - Statistical, interlingua based (English ⟷ Indian lang.), Indo wordnet, speech to speech MT
- Machine Learning
  - Semantic role learning, sentiment analysis
  - Using graphical models, Deep Neural networks
- Information Extraction
  - Named entity recognition, shallow parsing, summarization, Adverse Drug Reaction Prediction, Radiologist Productivity Improvement (Abdul Kalam Fellowship)
- Information Retrieval
  - Cross lingual search, Crawling, indexing, multilingual relevance,

Faculty: Pushpak Bhattacharyya, Preethi Jyothi,
Ganesh Ramakrishnan ((http://www.cfilt.iitb.ac.in/))

Publications at: ACL, AAAI, NAACL, EMNLP, IJCAI

Course: CS 626 - Speech, Natural Language Processing and the Web

Thank you!