CS344: Introduction to Artificial Intelligence
(associated lab: CS386)

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Lecture–39: Recap

Persons involved

- Faculty instructor: Dr. Pushpak Bhattacharyya (www.cse.iitb.ac.in/~pb)

- TAs: *Prashanth, Debraj, Ashutosh, Nirdesh, Raunak, Gourab {pkamle, debraj, ashu, nirdesh, rpilani, roygourab}@cse*

- Course home page

  - www.cse.iitb.ac.in/~cs344-2010 (will be up)

- Venue: SIT Building: SIC301

- 1 hour lectures 3 times a week: Mon-11.30, Tue-8.30, Thu-9.30 (slot 4)

- Associated Lab: CS386- Monday 2-5 PM

Perspective

Disciplines which form the core of AI- inner circle
Fields which draw from these disciplines- outer circle.
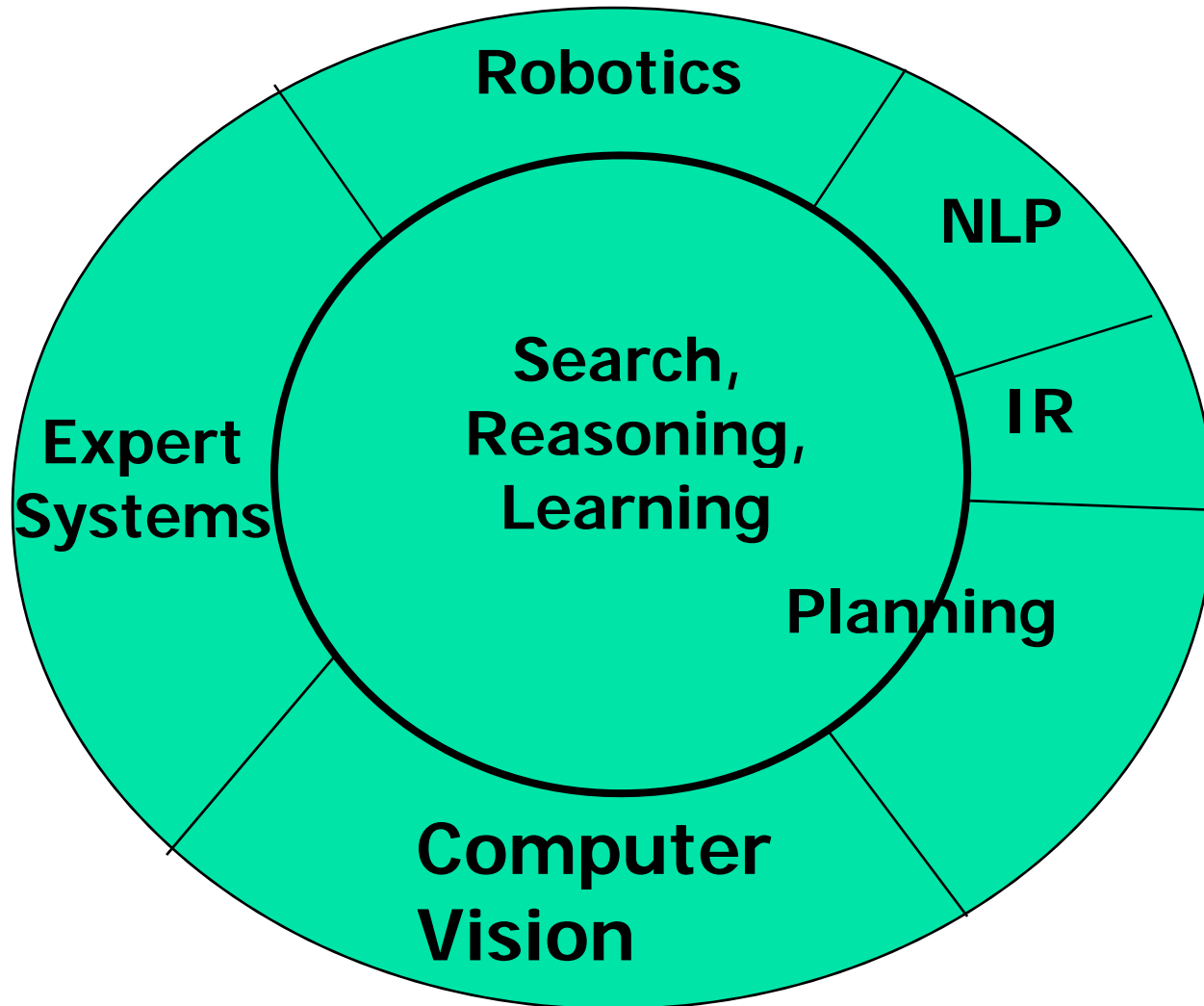
Topics planned to be covered & actually covered (1/2)

- **Search**
  - **General Graph Search, A*:** *(yes)*
  - **Iterative Deepening, α-β pruning** *(yes in seminar)*, **probabilistic methods**
- **Logic:**
  - **Formal System**
  - **Propositional Calculus, Predicate Calculus, Fuzzy Logic:** *(yes)*
- **Knowledge Representation**
  - **Predicate calculus:** *(yes)*, **Semantic Net, Frame**
  - **Script, Conceptual Dependency, Uncertainty**

Topics planned to be covered & actually covered (1/2)

- **Neural Networks: Perceptrons, Back Propagation, Self Organization**
- **Statistical Methods**
  - **Markov Processes and Random Fields**
    - **Computer Vision, NLP *(yes)*, Machine Learning *(yes)***
- **Planning: Robotic Systems**

==================================(if possible)

- **Anthropomorphic Computing: Computational Humour *(yes in seminar)*, Computational Music**
- **IR and AI: *(yes)***
- **Semantic Web and Agents**

Resources

- **Main Text:**
  - Artificial Intelligence: A Modern Approach by Russell & Norvik, Pearson, 2003.
- **Other Main References:**
  - Principles of AI - Nilsson
  - AI - Rich & Knight
  - Knowledge Based Systems – Mark Stefik
- **Journals**
  - AI, AI Magazine, IEEE Expert,
  - Area Specific Journals e.g, Computational Linguistics
- **Conferences**
  - IJCAI, AAAI

Foundational Points

- **Church Turing Hypothesis**
  - Anything that is computable is computable by a Turing Machine
  - Conversely, the set of functions computed by a Turing Machine is the set of ALL and ONLY computable functions

Turing Machine

Finite State Head (CPU)

Infinite Tape (Memory)
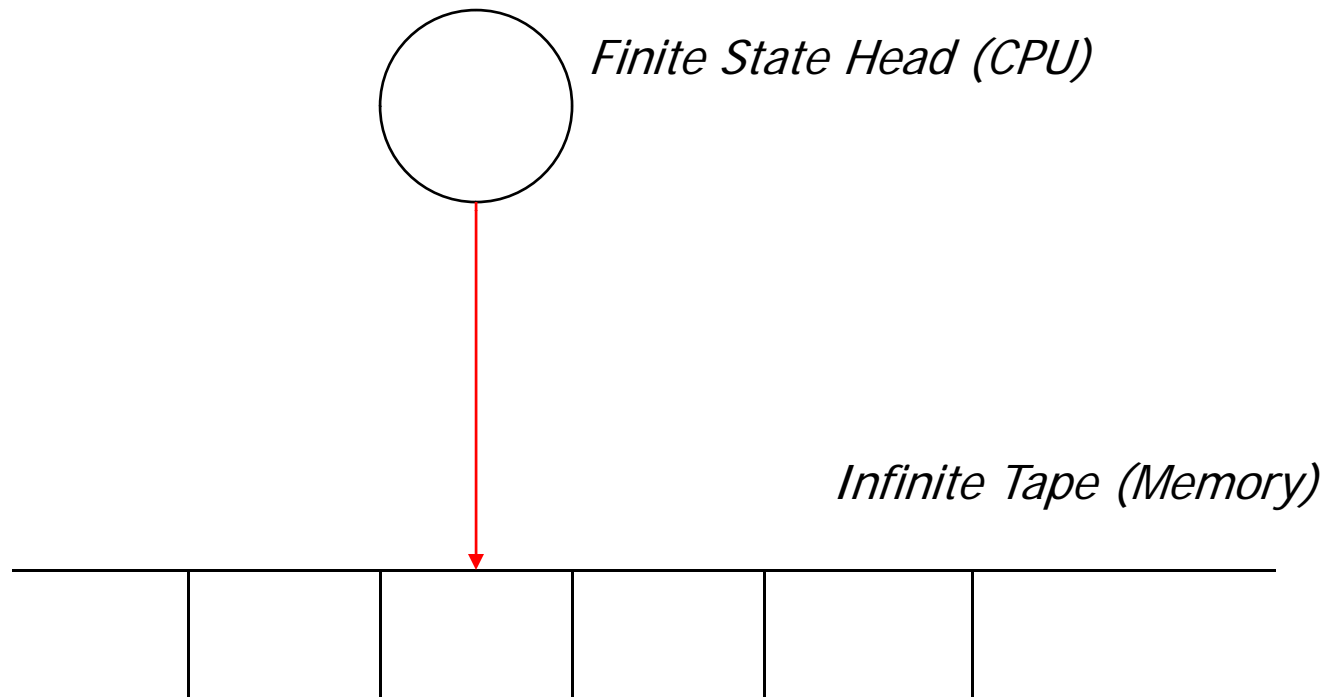
Foundational Points *(contd)*

- Physical Symbol System Hypothesis (Newel and Simon)

  - *For Intelligence to emerge it is enough to manipulate symbols*

Foundational Points *(contd)*

- Society of Mind (Marvin Minsky)
  - *Intelligence emerges from the interaction of very simple information processing units*
  - *Whole is larger than the sum of parts!*

Foundational Points *(contd)*

- Limits to computability
  - *Halting problem: It is impossible to construct a Universal Turing Machine that given any given pair <M, I> of Turing Machine M and input I, will decide if M halts on I*
  - What this has to do with intelligent computation? *Think!*

Foundational Points *(contd)*

- ## Limits to Automation

  - *Godel Theorem: A "sufficiently powerful" formal system cannot be BOTH complete and consistent*

  - "Sufficiently powerful": at least as powerful as to be able to capture Peano's Arithmetic

  - Sets limits to automation of reasoning

Foundational Points *(contd)*

- Limits in terms of time and Space
  - *NP-complete and NP-hard problems:* Time for computation becomes extremely large as the length of input increases
  - *PSPACE complete*: Space requirement becomes extremely large
  - Sets limits in terms of resources

Two broad divisions of Theoretical CS

- **Theory A**
  - Algorithms and Complexity
- **Theory B**
  - Formal Systems and Logic

AI as the forcing function

- Time sharing system in OS
  - Machine giving the illusion of attending simultaneously with several people
- Compilers
  - Raising the level of the machine for better man machine interface
  - Arose from Natural Language Processing (NLP)
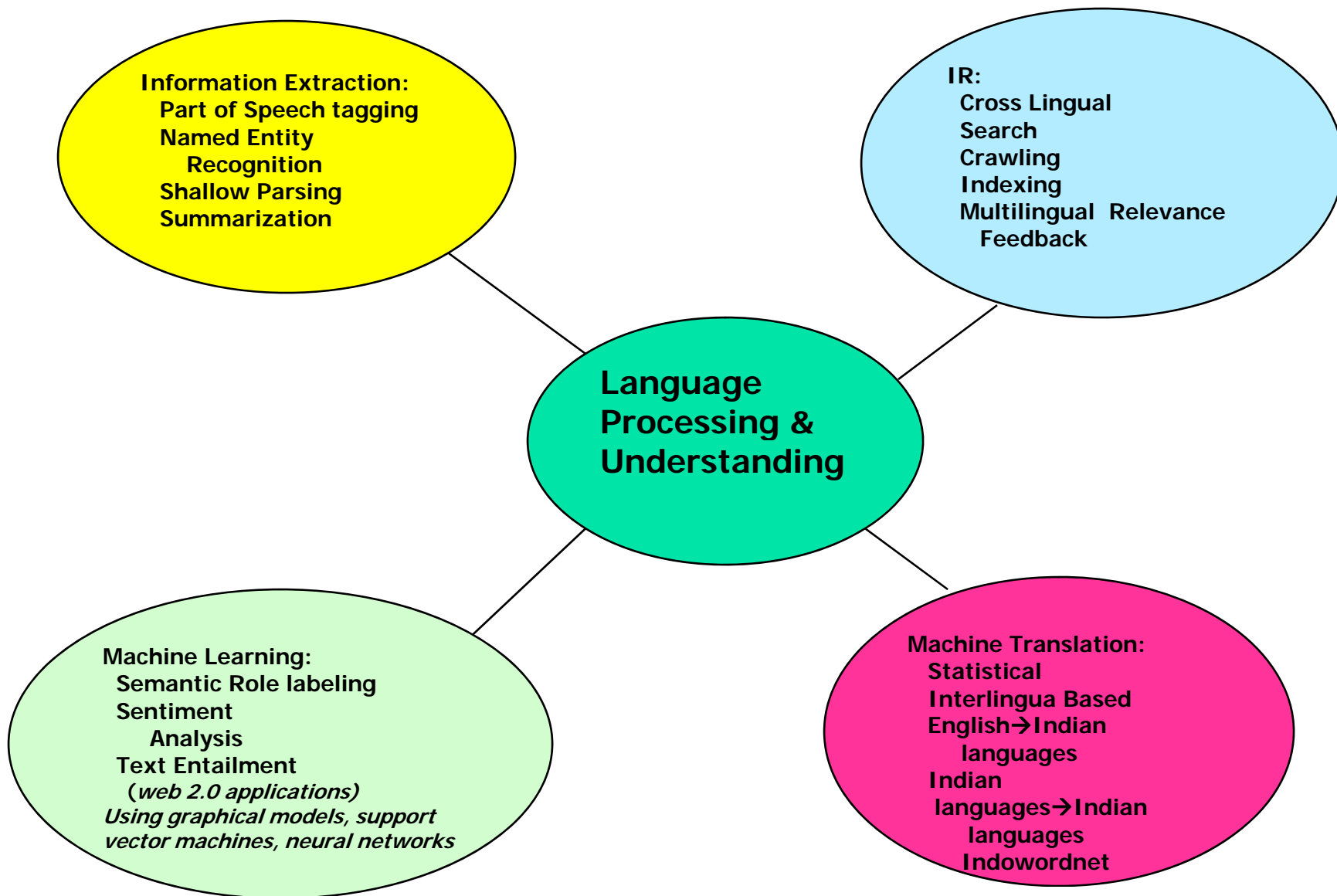   - NLP in turn called the forcing function for AI

Allied Disciplines

Philosophy	Knowledge Rep., Logic, Foundation of AI (is AI possible?)
Maths	Search, Analysis of search algos, logic
Economics	Expert Systems, Decision Theory, Principles of Rational Behavior
Psychology	Behavioristic insights into AI programs
Brain Science	Learning, Neural Nets
Physics	Learning, Information Theory & AI, Entropy, Robotics
Computer Sc. & Engg.	Systems for AI

Grading

- (i) Exams
  - Midsem
  - Endsem
  - Class test
- (ii) Study
  - Seminar (in group)
- (iii) Work
  - Lab Assignments (cs386; in group)

Our work at IIT Bombay

Information Extraction:
  Part of Speech tagging
  Named Entity
    Recognition
  Shallow Parsing
  Summarization

IR:
  Cross Lingual
  Search
  Crawling
  Indexing
  Multilingual Relevance
    Feedback

Language Processing & Understanding

Machine Learning:
  Semantic Role labeling
  Sentiment
    Analysis
  Text Entailment
    (*web 2.0 applications*)
  Using graphical models, support
  vector machines, neural networks

Machine Translation:
  Statistical
  Interlingua Based
  English→Indian
    languages
  Indian
    languages→Indian
    languages
  Indowordnet

Resources: *http://www.cfilt.iitb.ac.in*
Publications: *http://www.cse.iitb.ac.in/~pb*