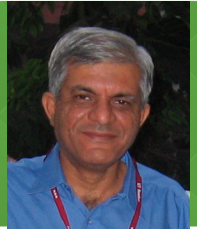

# ARTIFICIAL INTELLIGENCE : SEARCH METHODS FOR PROBLEM SOLVING

**PROF. DEEPAK KHEMANI**
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**INTENDED AUDIENCE :** This is a first course on Artificial Intelligence. While the intended audience is both UG and PG students studying Computer Science, in fact anyone comfortable with talking about algorithms should be able to do the course.

**INDUSTRY SUPPORT :** Any industry that is involved in development of AI applications. This not only includes software companies (like Microsoft, Google, and Facebook) but also manufacturing companies like Ford and General Electric, and retail companies like Amazon and Flipkart.

**COURSE OUTLINE :**

For an autonomous agent to behave in an intelligent manner it must be able to solve problems. This means it should be able to arrive at decisions that transform a given situation into a desired or goal situation. The agent should be able to imagine the consequence of its decisions to be able to identify the ones that work. In this first course on AI we study a wide variety of search methods that agents can employ for problem solving. In a follow up course – AI: Knowledge Representation and Reasoning – we will go into the details of how an agent can represent its world and reason with what it knows. These two courses should lay a strong foundation for artificial intelligence, which the student can build upon. A third short course – AI: Constraint Satisfaction Problems – presents a slightly different formalism for problem solving, one in which the search and reasoning processes mentioned above can operate together.

**ABOUT INSTRUCTOR :**

Prof. Deepak Khemani is Professor at Department of Computer Science and Engineering, IIT Madras. He completed his B.Tech. (1980) in Mechanical Engineering, and M.Tech. (1983) and PhD. (1989) in Computer Science from IIT Bombay, and has been with IIT Madras since then. In between he spent a year at Tata Research Development and Design Centre, Pune and another at the youngest IIT at Mandi. He has had shorter stays at several Computing departments in Europe. Prof Khemani's long-term goals are to build articulate problem solving systems using AI that can interact with human beings. His research interests include Memory Based Reasoning, Knowledge Representation and Reasoning, Planning and Constraint Satisfaction, Qualitative Reasoning and Natural Language Processing.

**COURSE PLAN :**

**Week 0 :** Introduction: History, Can Machines think?, Turing Test, Winograd Schema Challenge, Language and Thought, Wheels & Gears
**Week 1 :** Introduction: Philosophy, Mind, Reasoning, Computation, Dartmouth Conference, The Chess Saga, Epiphenomena
**Week 2 :** State Space Search: Depth First Search, Breadth First Search, Depth First Iterative Deepening
**Week 3 :** Heuristic Search: Best First Search, Hill Climbing, Solution Space, TSP, Escaping Local Optima, Stochastic Local Search
**Week 4 :** Population Based Methods: Genetic Algorithms, SAT, TSP, emergent Systems, Ant Colony Optimization
**Week 5 :** Finding Optimal Paths: Branch & Bound, A*, Admissibility of A*, Informed Heuristic Functions
**Week 6 :** Space Saving Versions of A*: Weighted A*, IDA*, RBFS, Monotone Condition, Sequence Alignment, DCFS, SMGS, Beam Stack Search
**Week 7 :** Game Playing: Game Theory, Board Games and Game Trees, Algorithm Minimax, AlphaBeta and SSS*
**Week 8 :** Automated Planning: Domain Independent Planning, Blocks World, Forward &Backward Search, Goal Stack Planning, Plan Space Planning
**Week 9 :** Problem Decomposition: Means Ends Analysis, Algorithm Graphplan, Algorithm AO*
**Week 10 :** Rule Based Expert Systems: Production Systems, Inference Engine, Match-Resolve-Execute, Rete Net
**Week 11 :** Deduction as Search: Logic, Soundness, Completeness, First Order Logic, Forward Chaining, Backward Chaining
**Week 12 :** Constraint Processing: CSPs, Consistency Based Diagnosis, Algorithm Backtracking, Arc Consistency, Algorithm Forward Checking