POORNIMA
COLLEGE OF ENGINEERING

TEACHING MANUAL

Name of faculty	**Amol Saxena**
Class- VI SEM	**B. Tech – VI SEM**
Branch	**Information Technology**
Course Code	**6IT4-05**
Course Name	**Artificial Intelligence**
Session	**(2021-2022)**

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POORNIMA COLLEGE OF ENGINEERING, JAIPUR

Vision

To create knowledge based society with scientific temper, team spirit and dignity of labour to face global competitive challenges.

Mission

To evolve and develop skill based systems for effective delivery of knowledge so as to equip young professionals with dedication and commitment to excellence in all spheres of life.

Quality Policy

We believe in providing quality education through faculty development, updating of facilities and continual improvement for meeting norms laid down by government, keeping the stakeholders satisfied.

DEPARTMENT OF INFORMATION TECHNOLOGY

VISION

To attain distinction in education to enable students for their establishment as globally competent professional and empowering them with proficiency, knowledge and research ability required to be successful in field of Information Technology.

MISSION

1. To provide state-of-the-art facilities with modern IT tools to students and faculty thereby enabling them to develop sustainable solutions for real world problems.
2. To create and propagate knowledge in field of Information Technology through research, teaching and learning for meeting societal challenges.
3. To inculcate analytical, leadership and team working skills with ethical behavior in students and provide an environment for continuous learning.

PROGRAM EDUCATIONAL OBJECTIVES (PEO'S)

1. Graduates will perform effectively as individuals and team members of multidisciplinary projects to create innovative and sustainable solutions for societal problems, meeting with global challenges and emerging trends.
2. Graduates will possess core competence in Information Technology and allied engineering fields thereby maintaining the leading positions in industry and/ or excel in higher studies.
3. Graduates will exhibit professionalism, ethical attitude, communication ability, spirit of entrepreneurship and adapt to current advancements through research ability and lifelong learning.

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Programme Specific outcomes (PSOs)

PSO-1

Analyze, design and develop efficient algorithms and software applications to deploy in secure network enabled environment meeting ever changing societal needs in economically acceptable terms.

PSO-2

Comprehend and apply knowledge of contemporary areas in Information Technology viz. Cloud based technologies, Machine Learning, Data Analytics, IOT and Network and Cyber Security to develop creative software solutions for automation of various industrial requirements.

PSO 3:

Exhibit familiarity and practical competence in modern programming languages and open source platforms so as to develop innovative projects related to business applications.

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POORNIMA COLLEGE OF ENGINEERING, JAIPUR
DEPARTMENT OF INFORMATION TECHNOLOGY
PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Mapping between Vision of the Institute and Vision of Department of IT

Vision of Institute	Vision of Department of IT
Knowledge based society	Distinction in education
global competitive challenges	Global competence

Mapping between Mission of the Institute and Mission of Department of IT

Mission of Institute	Mission of Department of IT
Develop skill based systems	state-of-the-art facilities, developing sustainable solutions
Effective delivery of knowledge	Teaching learning, research
Excellence in all spheres of life	Analytical, leadership and team working skills, ethical behaviour, continuous learning

Mapping between PEOs and the Mission of the Department

Mission/ PEO (keywords)	**PEO-1** Team working, Multidisciplinary project, sustainable solutions, global challenges	**PEO-2** Competence in IT field, Leading position in industry, higher education	**PEO-3** Professionalism, ethical attitude, communication skill, entrepreneurship, research & lifelong learning
Sustainable solutions for real world problems	√		
Create and propagate knowledge in IT filed		√	
Teaching learning and Research		√	√
Analytical, leadership and team working skills and Ethical behaviour	√	√	
Continuous learning		√	√

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Consistency between PEOs and the Mission of the Institute

Mission / PEO (Keywords)	PEO-1 Team working, Multidisciplinary project, sustainable solutions, global challenges	PEO-2 Leading position in industry, higher education	PEO-3 professionalism, ethical attitude, communication skill, entrepreneurship, research & lifelong learning
Skill based system	√		
Effective Delivery of Knowledge		√	√
Commitment to Excellence	√	√	√

Correlation between PEOs and Program Outcomes (POs)

POs / PEOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO-1 Team working, Multidisciplinary project, sustainable solutions, global challenges		S	S	S	M	M	M	M	S		M	
PEO-2 Competence in IT field, Leading position in industry, higher education	S	S	S		M				S			S
PEO-3 Professionalism, ethical attitude, communication skill, entrepreneurship, research & lifelong learning						M	S	S		S		S

Correlation: S- Strong, M- Medium W-Weak

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Correlation between PEOs and Program Specific Outcomes (PSOs)

PEOs Vs PSOs	PSO1 Development of software applications	PSO2 Emerging technologies	PSO3 Modern programming languages & open source tools
PEO-1 Team working, Multidisciplinary project, sustainable solutions, global challenges	S	M	
PEO-2 Competence in IT field, Leading position in industry, higher education	S	M	M
PEO-3 Professionalism, ethical attitude, communication skill, entrepreneurship, research & lifelong learning	S	M	M

Correlation: S- Strong, M- Medium W-Weak

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POORNIMA COLLEGE OF ENGINEERING, JAIPUR

Department of Information Technology

Campus: Poornima College of Engineering | **Class/Section: 3rd** | **Date: 08-01-2022**
Course: B. Tech. | **Year/ Section – III Year (VI Sem.)**
Name of Faculty: Amol Saxena | **Name of Subject: Artificial Intelligence** | **Code: 6IT04-05**

Course Outcomes

Upon successful completion of the course, the student will be able to -

1. **Explain** basic understanding and various applications of AI techniques in intelligent agents, expert systems, game playing, natural language processing, robotics etc.
2. **Apply** various principles and techniques like knowledge representation, reasoning, game playing, planning, learning, NLP etc to provide solutions for different task domains of AI.
3. **Analyze** different AI techniques with respect to their applicability to the solution of the real world problems.
4. **Create** AI based solutions for simple real life problems using appropriate AI techniques.

Mapping of CO with PO and PSO

CO Vs PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-		3	-	-	-	-	-	-	-	-	-	3	-	-

PO Strongly Mapped:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

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PSO Strongly Mapped:

PSO-1

Analyze, design and develop efficient algorithms and **software applications** to deploy in **secure network** enabled environment meeting ever changing societal needs in **economically acceptable** terms.

PSO-2

Comprehend and apply knowledge of contemporary areas in Information Technology viz. **Cloud based technologies, Machine Learning, Data Analytics, IOT** and **Network and Cyber Security** to develop creative software solutions for automation of various **industrial requirements**.

PSO 3:

Exhibit familiarity and practical competence in **modern programming languages** and **open source platforms** so as to develop innovative projects related to **business applications.**

RULES FOR CO/LO ATTAINMENT LEVELS: (TARGETS)

Course Category	Level 3	Level 2	Level 1
A	**60% of students getting >60% marks**	**50-60% of students getting >60% marks**	**40-50% of students getting >60% marks**

END TERM RTU COMPONENT: CO ATTAINMENT LEVELS

Course Category	Level 3	Level 2	Level 1
A	**50% of students getting >60% marks**	**40-50% of students getting >60% marks**	**30-40% of students getting >60% marks**

S. No.	Course Type	Attainment Level=1	Attainment Level=2	Attainment Level=3
1	Theory Courses Mid Semester Exams	60% of students getting > 60% marks	50-60% of students getting >60% marks	40-50% of students getting >60% marks
2	Theory Courses University Exam	50% of students getting > 60% marks	40-50% of students getting >60% marks	30-40% of students getting >60% marks
3	Assignments/Unit Test	60% of students getting > 60% marks	50-60% of students getting >60% marks	40-50% of students getting >60% marks
4	Any other	NA	NA	NA

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Department of Information Technology

Campus: Poornima College of Engineering
Course: B. Tech.
Name of Faculty: Amol Saxena

Class/Section: 3rd

Year/ Section – III Year (VI Sem.)
Name of Subject: Artificial Intelligence

Date: 08-01-2022

Code: 6IT04-05

CO wise assessment activities (as mentioned in session plan)

CO	Assignments	Class Test	Mid 1	Mid 2
CO1	Y	Y	Y	Y
CO2	Y	Y	Y	Y
CO3	Y	Y	Y	Y
CO4	Y	Y	Y	Y
CO5	Y	Y	Y	Y

CO-PO/PSO MAPPING AND TARGETS

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	Target CO for PO	PS O1	PSO 2	PSO 3	Target CO for PSO
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	3	3
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	3
CO 3	-	3	-	-	-	-	-	-	-	-	-	-	3	-	3	-	3
CO 4	-	-	3	-	-	-	-	-	-	-	-	-	3	3	-	-	3

ACTIVITY WISE ASSESSMENT TOOLS

Sr. No.	Activity	Assessment Method	Tools	Marks	Recommendation
1	Class Test	Direct	Marks	30	For CO1-CO4
2	Home Assignments	Direct	Marks	40	For CO1-CO4
4	MidTerm1	Direct	Marks	40	For CO1-CO3
5.	MidTerm2	Direct	Marks	40	For CO2-CO4

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

III Year- VI Semester: B.Tech. (Information Technology)

6IT4-05: Artificial Intelligence

Credit: 2
2L+0T+0P

Max. Marks: 100(IA:20, ETE:80)
End Term Exam: 2 Hours

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Introduction to AI and Intelligent agent:** Different Approach of AI, Problem Solving : Solving Problems by Searching, Uninformed search, BFS, DFS, Iterative deepening, Bi directional search, Hill climbing, Informed search techniques: heuristic, Greedy search, A* search, AO* search, constraint satisfaction problems.	01
3	**Game Playing:** Minimax, alpha-beta pruning, jug problem, chess problem, tiles problem	07
4	**Knowledge and Reasoning:** Building a Knowledge Base: Propositional logic, first order logic, situation calculus. Theorem Proving in First Order Logic. Planning, partial order planning. Uncertain Knowledge and Reasoning, Probabilities, Bayesian Networks.	07
5	**Learning:** Overview of different forms of learning, Supervised base learning: Learning Decision Trees, SVM, Unsupervised based learning, Market Basket Analysis, Neural Networks.	07
6	**Introduction to Natural Language Processing:** Different issue involved in NLP, Expert System, Robotics.	05
	Total	28

II mid term syllabus — As underlined above

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Rajasthan Technical University, Kota

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POORNIMA COLLEGE OF ENGINEERING

DEPARTMENT OF INFORMATION TECHNOLOGY

ABC Analysis

Course: B. Tech. **Class/Semester: III Yr/VI Sem** **Date: 10/01/2022**
Name of Faculty: Amol Saxena **Name of Subject: Artificial Intelligence** **Subject Code: 6IT4-05**

Unit No.	Category A	Category B	Category C
UNIT-I Introduction to AI and Intelligent agent	Hill climbing, Informed search techniques: heuristic, Greedy search, A* search, AO* search, constraint satisfaction problems.	Different Approach of AI, Problem Solving : Solving Problems by Searching, Uninformed search, BFS, DFS, Iterative deepening, Bi directional search,	
UNIT-II Game Playing		Minimax, alpha-beta pruning, jug problem, chess problem, tiles problem	
UNIT-III Knowledge and Reasoning	Situation calculus. Theorem Proving in First Order Logic. Planning, partial order planning. Uncertain Knowledge and Reasoning, Probabilities, Bayesian Networks.	Building a Knowledge Base: Propositional logic, first order logic	
UNIT-IV Learning	SVM, Unsupervised based learning, Market Basket Analysis, Neural Networks	Overview of different forms of learning, Supervised base learning: Learning Decision Trees	
UNIT-V Introduction to Natural Language Processing		Different issue involved in NLP, Expert System, Robotics.	

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POORNIMA COLLEGE OF ENGINEERING, JAIPUR
Department of Information Technology
Blown-up Syllabus

Campus: Poornima College of Engineering | **Class/Section: 3rd year** | **Date: 08-01-2022**

Course: B. Tech. | **Year/ Section – III Year (VI Sem.)**

Name of Faculty: Amol Saxena | **Name of Subject: Artificial Intelligence** | **Code: 6IT04-05**

S. NO.	TOPIC AS PER UNIVERSITY SYLLABUS	BLOWN UP TOPICS (1X10 TIMES UNIV. SYLLABUS)
Unit I: Introduction to Artificial Intelligence, Intelligent agent & Search Algorithms		
1	Meaning & Definition of AI	What is Artificial Intelligence? • Definition & Meaning • Acting humanly: the Turing test approach • Thinking humanly: the cognitive modeling approach • Thinking rationally: the laws of though approach • Acting rationally: the rational agent approach
2	Task domains of AI	Mundane tasks • Perception • Natural language • Commonsense reasoning • Robot control Formal tasks • Games • Mathematics Expert tasks • Engineering – design, fault finding, manuf. Planning • Scientific planning • Medical diagnosis • Financial analysis
3	Problems, problem spaces	Problem definition as a state space search • Water jug problem • Chess • 8 puzzle Problem characteristics • Decomposable problems • Can solution steps be undone? • Is the universe is predictable? • Is a good solution absolute or relative? • Is the solution state or a path? • Role of knowledge • Does the task require interaction with a person? • Problem classification
4	Uninformed Search	Definition Difference between informed and uninformed search

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		Search Control strategies
		• Breadth first search
		  ○ Examples
		• Depth first search
		  ○ Examples
		• comparison of BFS and DFS
		  ○ Adv of BFS
		  ○ Adv of DFS
		• Branch and bound technique
		• Iterative deepening search
		  ○ Examples
		• Bi directional search

5	Heuristic Search Techniques
	Hill climbing
		Heuristic search
		• Some simple heuristic functions
		  ○ Tower of Hanoi
		  ○ Traveling salesman problem
		  ○ 8-Puzzle
		Generate and test algorithm
		Hill climbing
		• Simple hill climbing
		• Steepest ascent hill climbing
		  ○ Local maximum
		  ○ Plateau
		  ○ Ridge

6	Best First Search	OR graphs Algorithm – best first search
7	A* Algorithm	The A* Algorithm Admissibility
8	Problem reduction AO* algorithm	AND-OR graphs Problem reduction – algorithm The AO * algorithm
9	Constraint satisfaction	Definition Algorithm - Constraint satisfaction • Example
Unit II: Game Playing		
1	Game playing	Introduction & Overview Game Playing and AI Game Playing as Search Game Tree Representation • Water-jug problem • Chess problem • Tile problem The minimax search procedure • algorithm Adding alpha beta cutoffs • Algorithm • examples Additional refinements • waiting for quiescence

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		• secondary search • using book moves
Unit-III Knowledge & Reasoning		
1	Knowledge Representation	Introduction Facts and its representation Mappings between facts and representations Approaches to Knowledge Representation • Simple relational knowledge • Inheritable knowledge • Inferential knowledge • Procedural knowledge
2	Knowledge representation using propositional logic	Syntax and semantics of propositional logic Representing simple facts in logic • Example Model, validity and satisfiability Entailment Logical inference problem • Truth-table approach • Inference rules • Resolution-refutation
3	Knowledge representation using predicate logic	Predicate logic – representing facts as WFFs Computable functions and predicates Question answering
4	Conversion to clausal form	Introduction Refutation Conversion to clause form • Algorithm – convert to clause form • Example
5	Resolution Theorem Proving, Refutation	The basis of resolution Resolution in propositional logic • Algorithm: Propositional resolution The Unification algorithm • Algorithm • Examples Resolution in predicate logic • Algorithm • Example The need to try several substitutions Question answering Example
6	Situation Calculus	Introduction Representation of actions, situations and events Components of a planning system • Choosing rules to apply • Applying rules • Detecting a solution • Detecting dead ends • Repairing an almost correct solution

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		Example, the blocks world Knowledge base • Effect axioms • Frame axioms STRIPS planning Sussman's Anomaly Partial order planning • Example
7	Uncertain Knowledge and Reasoning	Methods for handling uncertainty • Default (non-monotonic) logic • Rules with fudge factor • Probability • Fuzzy logic
8	Probabilities, Bayesian Networks	Introduction Probability and Bayes' theorem Bayesian probabilistic inference Bayesian networks
Unit IV: Learning		
1	Introduction to Learning & Techniques used in learning	What is learning? Different forms of learning Supervised, unsupervised & reinforcement learning
2	Supervised learning, decision trees	What is a Decision Tree Classification by decision tree induction 1. Decision tree induction 2. Attribute selection measures a. Information gain b. Example c. Gain ratio d. Gini index, example
3	Support Vector Machines	Basic concept Classification of linearly separable data
4	Unsupervised learning	Introduction to clustering
5	Market Basket Analysis	Basic concept with examples
6	Introduction to neural networks	Learning in neural networks • Perceptrons • Algorithm – fixed increment perceptron learning • Backpropagation networks
Unit V: Introduction to Natural Language Processing & expert systems		
1	Natural language processing	Introduction • Steps in the process ○ Morphological analysis ○ Syntactic analysis ○ Semantic analysis ○ Discourse integration ○ Pragmatic analysis • Syntactic processing ○ Grammars and parsers ▪ Top down versus bottom up parsing ▪ Finding one/ many interpretation

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		▪ Parser summary • Semantic analysis o lexical processing o sentence level parsing o semantic grammars o case grammars o conceptual parsing
2	Expert systems	Introduction and definition Characteristics and features Applications Representing and using domain knowledge Expert system shells Explanation Knowledge acquisition
3	Examples of expert systems	DENDRAL MYCIN PROSPECTOR, R1
4	Robotics	Basic concepts

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Department of Information Technology

Campus: Poornima College of Engineering **Class/Section: 3rd** **Date: 10-01-2022**
Course: B. Tech. **Year/ Section – III Year (VI Sem.)**
Name of Faculty: Amol Saxena **Name of Subject: Artificial Intelligence** **Code: 6IT04-05**

S. No.	Topic As Per Blown-up Syllabus	Lect. No.	Planned Date	Actual Del. Date	Reason for Deviation	CO & Bloom's Level (BL)	Ref. / Text Book With Page No. & Website
1	Zero Lecture	L0	21-01-22	21.1.22			
Unit 1: Introduction to Artificial Intelligence, Intelligent agent & Search Algorithms							
2	Meaning & Definition of AI Task domains of AI • Mundane tasks • Formal tasks • Expert tasks	L1	24-01-22	24.1.22		CO1, BL1	T1, R1
3	Problems, problem spaces Problem definition as a state space search • Water jug problem • Chess • 8 puzzle Problem characteristics • Decomposable problems • Can solution steps be undone? • Is the universe is predictable? • Is a good solution absolute or relative? • Is the solution state or a path? • Role of knowledge • Does the task require interaction with a person? • Problem classification	L2	31-01-22	31.1.22		CO1, BL1	T1, R1, R2
4	Uninformed Search Definition Difference between informed and uninformed search Search Control strategies • Breadth first search o Examples • Depth first search o Examples	L3	02-02-22	2.2.22		CO2, BL2	T1, R1, R2
5	Uninformed Search	L4	04-02-22	4.2.22		CO2, BL2	T1, R1,

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	• comparison of BFS and DFS ○ Adv of BFS ○ Adv of DFS • Branch and bound technique						R2
6	Uninformed Search • Iterative deepening search ○ Examples • Bi directional search	L5	07-02-22	7.2.22		CO2, BL2	T1, R1, R2
7	Heuristic search • Some simple heuristic functions ○ Tower of Hanoi ○ Traveling salesman problem ○ 8-Puzzle • Generate and test algorithm	L6	10-02-22	10.2.22		CO2, BL2	T1, R1
8	Heuristic Search Techniques Hill climbing • Simple hill climbing • Steepest ascent hill climbing ○ Local maximum ○ Plateau ○ Ridge Best First Search • OR graphs • Algorithm – best first search	L7	11-02-22	11.2.22		CO3, BL3	T1, R1
9	A* Algorithm • Admissibility • Example problems	L8	24-03-22	24.3.22		CO4, BL4	T1, R1, R2
10	Problem reduction AO* algorithm	L9	25-03-22	25.3.22		CO3, BL3	T1, R1
11	Constraint satisfaction • Definition • Algorithm - Constraint satisfaction • Example	L10	28-03-22	29.3.22	Due to leave on 28.3.22	CO2, BL2	T1, R1
Unit-2: Game Playing							
1	Game Playing Introduction & Overview Game Playing and AI Game Playing as Search Game Tree Representation	L11	31-03-22	31.3.22		CO2, BL2	T1, R1, R2

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	• Water-jug problem						
2	Game Tree Representation • Chess problem • Tile problem	L12	01-04-22	31.3.22	Lecture Arrangement	CO2, BL2	T1, R1, R2
3	Game Playing The minimax search procedure • Algorithm • Examples	L13	04-04-22	6.4.22	Arrange-ment/ class	CO3, BL3	T1, R1, R2
4	Adding alpha beta cutoffs • Algorithm, Examples	L14	07-04-22	7.4.22	change in	CO3, BL3	T1, R1, R2
5	Adding alpha beta cutoffs Examples	L15	08-04-22	7.4.22	Time-table	CO3, BL3	T1, R1, R2
6	Additional refinements • waiting for quiescence • secondary search • using book moves	L16	11-04-22	8.4.22		CO3, BL3	T1, R1, R2
Unit-3: Knowledge & Reasoning							
1	Knowledge & Reasoning Introduction Facts and its representation Mappings between facts and representations Approaches to Knowledge Representation • Simple relational knowledge • Inheritable knowledge • Inferential knowledge • Procedural knowledge	L17	14-04-22	11.4.22	change in Time table	CO1, BL1	T1, R1, R2
2	Knowledge representation using propositional logic Syntax and semantics of propositional logic Representing simple facts in logic • Example Model, validity and satisfiability Entailment Logical inference problem • Truth-table approach • Inference rules Resolution-refutation	L18	15-04-22	13.4.22	change in time table	CO2, BL2	T1, R1
3	Knowledge representation using predicate logic Predicate logic – representing facts as WFFs Computable functions and predicates	L19	18-04-22	14.4.22		CO2, BL2	T1, R1

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	Question answering						
4	Conversion to clausal form Introduction Refutation Conversion to clause form • Algorithm – convert to clause form • Example	L20	21-04-22	14.4.22 15.4.22	Replacement class taken	CO3, BL3	T1, R1
5	Resolution Theorem Proving, Refutation Introduction Refutation Conversion to clause form • Algorithm – convert to clause form • Example	L21	22-04-22	15.4.22	due to change in time table	CO3, BL3	T1, R1, R2
6	The basis of resolution Resolution in propositional logic • Algorithm: Propositional resolution The Unification algorithm • Algorithm • Examples	L22	25-04-22	18.4.22	"	CO3, BL3	T1, R1, R2
7	Resolution in predicate logic • Algorithm • Example Question answering • Example	L23	28-04-22	21.4.22	"	CO4, BL4	T1, R1, R2
8	Uncertain Knowledge and Reasoning Introduction Probability and Bayes' theorem	L24	29-04-22	22.4.22		CO4, BL4	T1, R1, R2
9	Bayesian probabilistic inference Bayesian networks	L25	02-05-22	16.5.22	Boot Camp (Placement activity)	CO3, BL3	T1, R1
10	I midterm paper solving class	L26	12-05-22	16.5.22			
11	Situation Calculus Introduction Representation of actions, situations and events Components of a planning system • Choosing rules to apply • Applying rules • Detecting a solution • Detecting dead ends • Repairing an almost	L27	13-05-22	19.5.22	Duti to Boot Camp.	CO3, BL3	T1, R1, R2

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	correct solution						
12	Example, the blocks world Knowledge base • Effect axioms • Frame axioms STRIPS planning • Sussman's Anomaly Partial order planning • Example	L28	16-05-22	19.05.22	due to Boot camp placement activity	CO3, BL3	T1, R1, R2
Unit IV: Learning							
1	What is learning? Different forms of learning Supervised, unsupervised & reinforcement learning	L29	19-05-22	20.5.22	due to change in time table	CO2, BL2	T1, R1, R2
2	Supervised learning, decision trees What is a Decision Tree Classification by decision tree induction 1. Decision tree induction 2. Attribute selection measures a. Information gain b. Example	L30	20-05-22	20.5.22	20.5.22	CO2, BL2	T1, R1, R2
3	Attribute selection measures c. Gain ratio, Example	L31	23-05-22	23.5.22		CO3, BL3	T1, R1, R2
4	Support Vector Machines a. Basic concept b. Classification of linearly separable data	L32	26-05-22	26.5.22		CO3, BL3	T1, R1, R2
5	• Unsupervised learning ○ Introduction to clustering • Market Basket Analysis ○ Basic concept with examples	L33	27-05-22	26.5.22	class arranged due to RTU theory exams wef 3-06-2022	CO3, BL3	T1, R1, R2
6	Introduction to neural networks Learning in neural networks • Perceptrons • Algorithm – fixed increment perceptron learning	L34	30-05-22	27.5.22	class Pre-Poned/ arranged,	CO4, BL4	T1, R1, R2
7	Learning in neural networks • Backpropagation networks	L35	02-06-22	27.5.22	-do-	CO3, BL3	T1, R1, R2
Unit V: Introduction to Natural Language Processing & expert systems							
1	Natural language processing Introduction	L36	03-06-22	28.5.22		CO2, BL2	T1, R1, R2

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	• Steps in the process ○ Morphological analysis ○ Syntactic analysis ○ Semantic analysis ○ Discourse integration ○ Pragmatic analysis						
2	• Syntactic processing ○ Grammars and parsers ▪ Top down versus bottom up parsing ▪ Finding one/ many interpretation ▪ Parser summary	L37	06-06-22	28.5.22	class arranged due to RTU theory exams wef 1-6-22	CO3, BL3	T1, R1, R2
3	• Semantic analysis ○ lexical processing ○ sentence level parsing ○ semantic grammars ○ case grammars ○ conceptual parsing	L38	09-06-22	28.5.22	-do-	CO3, BL3	T1, R1, R2
4	Expert systems • Introduction and definition • Characteristics and features • Applications • Representing and using domain knowledge • Expert system shells • Knowledge acquisition	L39	10-06-22	Last teaching day announced 28-05-22 due to RTU theory exams. - from 3-6-2022		CO3, BL3	T1, R1, R2
5	Examples of expert systems • DENDRAL • MYCIN • PROSPECTOR, R1 Robotics Basic concepts	L40	13-06-22			CO3, BL3	T1, R1, R2

Text Book: Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-Graw Hill — T1
Ref. Book: Introduction to AI & Expert System, Dan W Patterson, PHI — R1
Ref Books: Artificial Intelligence: A Modern Approach, Russel & Norvig, Pearson — R3
Ref Book: Artificial Intelligence by Luger (Pearson Education) — R2

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Poornima Group of Colleges, Jaipur

Session: 2021-22 (Even Sem.)

Name of College : Poornima College of Engineering
Department of : Information Technology

Zero Lecture

Name of Faculty: **Amol Saxena** Department: Information Technology

1). Name of Subject with Code: Artificial Intelligence (6IT4-05)

2). Self-Introduction:

a). Name: Amol Saxena
b). Qualification: M. Tech., MCA, RPSC-SET
c). Designation: Asst. Prof.
d). Research Area: Data Mining, Software Reliability, Software Defect Analysis, Object Oriented Technology
e). E-mail Id: amolsaxena@poornima.org
f). Other details: Information about areas of proficiency/ expertise such as subject taught, laboratory taken, Member of Professional body, Academic Proficiency, Book Authored, Paper published in National and International Conference/Journals etc.

3). Introduction of Students:

a). *Identifying and keeping records* of students based on merit/ weak in academics, smart/ dull in extra & co-curricular activity, day scholar/ hosteller, Hindi or English medium, urban or rural family background, their learning style (seeing, hearing, doing) etc.

Sr. No.	Average result of 12th	Name of student scored highest marks	Marks 60% above (No. of students)	Marks between 40%-60% (No. of students)	English Medium Students (No.)	Hindi Medium Students (No.)	No. of Hostellers	No. of Day Scholar
1	73.12%	Mohini Garg, Naman Khamesra, Aditi Maheshwari	56	5	52	11	33	31

b). *Achievement of students in previous years*

Sr. No.	Year	Result At PCE (I MTE)	Univ. Result (In %)	Name of student scored highest marks with the scored marks.	Fail (no. of students)	Marks between 40%-60% (no. of students)	Marks 60% above (no. of students)
1	2020-21	100%	100%	Shreya Jain (A++), Triyanshi Gupta (A++)	0	0	33
2	2019-20	80.56%	100%	Lovely Jain (89), Amulya Jain (83), Kartik Agarwal(81), Nikhil Sharma (81)	0	9	28
3	Not Applicable as the course was introduced in session 2019-20						

4). Instructional Language: - 80% English; 20% Hindi (English not less than 60%)

5). Introduction to subject: - (Pl. separate out subject specific matter and general matter valid for all subjects and group/place them appropriately)

What is AI?

- Artificial Intelligence is concerned with the design of intelligence in an artificial device. The term was coined by McCarthy in 1956.
- AI is the study of how to make computers do things which at the moment people do better. [Rich & Knight]

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- AI is a field of study that encompasses computational techniques for performing tasks that apparently require intelligence when performed by humans.
- AI is the study of mental faculties through the use of computational models
- Textbooks define the field as "**the study and design of intelligent agents**" where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success.

AI is generally associated with *Computer Science*, but it has many important links with other fields such as *Maths*, *Psychology*, *Cognition*, *Biology* and *Philosophy*, among many others.
The central problems of AI include such traits as reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects. **General intelligence** (or "strong AI") is still a long-term goal of (some) research.

There are four approaches to AI -

	Human Like	**Rationally**
Think	Cognitive science approach	Laws of thought approach
Act	Turing test approach	Rational agent approach

1. One view is that artificial intelligence is about designing systems that are as intelligent as humans. This view involves trying to understand human thought and an effort to build machines that emulate the human thought process. This view is the cognitive science approach to AI.
2. The second approach is best embodied by the concept of the Turing Test. In Turing Test a human being and a computer would be interrogated under conditions where the interrogator would not know which was which, the communication being entirely by textual messages. If the interrogator could not distinguish them by questioning, then it would be unreasonable not to call the computer intelligent. Turing's 'imitation game' is now usually called the Turing test for intelligence.
3. Logic and laws of thought deals with studies of ideal or rational thought process and inference. The emphasis in this case is on the inference mechanism, and its properties. The focus was on the development of systems of representation to allow inferences to be like "X is a man. All men are mortal. Therefore X is mortal". But not all problems can be solved just by reasoning and inferences.
4. The fourth view of AI is that it is the study of rational agents. A system is rational if it does the right thing. This view deals with building machines that **act rationally**. Intelligent agents are software assistants that can take care of specific tasks for us. For example, if want to search WWW for specific information, we might use an intelligent agent to consult a selection of search engines and filter the appropriate web pages. In this way we will be presented with only two or three pages of information that precisely matches our needs. The focus is on how the system acts and performs, and not so much on the reasoning process. A rational agent is one that acts rationally, that is, is in the best possible manner. For example, recoiling or moving back from a hot stove is a reflex action that is usually more successful than a slower action taken after careful deliberation (thought).

Areas and Applications of Artificial Intelligence –

1. **Perception**
    a. **Machine Vision:** It is easy to interface a TV camera to a computer and get an image into memory; the problem is *understanding* what the image represents. Vision takes *lots* of computation; in humans, roughly 10% of all calories consumed are burned in vision computation.
    b. **Speech Understanding:** Speech understanding is available now. Some systems must be trained for the individual user and require pauses between words. Understanding continuous speech with a larger vocabulary is harder.
    c. **Touch (*tactile*) Sensation:** Important for robot assembly tasks.

2. **Robotics** - The limiting factor in application of robotics is not the cost of the robot hardware itself. What is needed is perception and intelligence to tell the robot what to do; ``blind'' robots are limited to very well-structured tasks (like spray painting car bodies).
3. **Planning** - Planning attempts to order actions to achieve goals. Planning applications include logistics, manufacturing scheduling, planning manufacturing steps to construct a desired product. There are huge amounts of money to be saved through better planning.
4. **Expert Systems** - Expert Systems attempt to capture the knowledge of a human expert and make it available through a computer program. There have been many successful and economically valuable applications of expert systems. Expert systems provide the following benefits
   a. Reducing skill level needed to operate complex devices.
   b. Diagnostic advice for device repair.
   c. Interpretation of complex data.
   d. ``Cloning'' of scarce expertise.
   e. Capturing knowledge of expert who is about to retire.
   f. Combining knowledge of multiple experts.
   g. Intelligent training.
5. **Theorem Proving** - Proving mathematical theorems might seem to be mainly of academic interest. However, many practical problems can be cast in terms of theorems. A general theorem prover can therefore be widely applicable.
   Examples:
   a. Automatic construction of compiler code generators from a description of a CPU's instruction set.
   b. J Moore and colleagues proved correctness of the floating-point division algorithm on AMD CPU chip.
6. **Symbolic Mathematics** - Symbolic mathematics refers to manipulation of *formulas*, rather than arithmetic on numeric values.
   a. Algebra
   b. Differential and Integral Calculus

   Symbolic manipulation is often used in conjunction with ordinary scientific computation as a generator of programs used to actually do the calculations. Symbolic manipulation programs are an important component of scientific and engineering workstations.
7. **Game Playing** - Games are good vehicles for research because they are well formalized, small, and self-contained. They are therefore easily programmed. Games can be good models of competitive situations, so principles discovered in game-playing programs may be applicable to practical problems.

Some other applications of AI

1. **Web search engines**
   - Improve the quality of search
   - Rely on methods/algorithms developed in AI
   - Add inferences and knowledge to search queries
2. **Bioinformatics**
   - **Genomics and Proteomics**
     - Sequence analysis
     - Prediction of gene regions on DNA
     - Analysis of DNA micro-array and proteomic MS profiles: find genes, proteins (peptides) that characterize a specific disease
3. **Transportation**
   - **Autonomous vehicle control:**
     - ALVINN (CMU, Pomerleau 1993)
     - Series of DARPA challenges (http://www.darpa.mil/grandchallenge/)
   - **Pedestrian detection**
   - **Traffic monitoring**
   - **Navigation/route optimizations**

4. **Classification of images or its parts**
5. **Natural language processing**
   - **Document analysis:**
     - Automatic classification of articles
     - Content extraction/ inference
     - Email SPAM detection
6. **Human face detection**
7. **Medicines**
   - **Medical diagnosis:**
     - QMR system. Internal medicine.
   - **Patient Monitoring and Alerting:**
     - Cerner
   - **Medical imaging**
     - Classification of body structures and visualization
   - **Robotic surgeries**
8. **Software systems**
   - **Diagnosis of:** software, technical components
   - **Adaptive systems**
     - Adapt systems to user needs
     - Adapt systems to specific tasks
   - **Examples:**
     - Intelligent interfaces
     - Intelligent helper applications
     - Collaborative filtering
     - Target advertising

a). Relevance to Branch:

AI is a field of study that encompasses computational techniques for performing tasks that require intelligence when performed by humans. The objective of AI is to improve human understanding of reasoning, learning and perception in order to be able to build new development tools and achieve a more mature view of human intelligence than what currently exists.

The field of AI is mainly associated with computer science besides other linkages with fields such as mathematics, cognition, biology, philosophy among others.

To study AI students should have familiarity with basic concepts of computer science like programming, data structures including trees, graphs, recursions, and algorithmic complexity. Students should also have knowledge of discrete mathematics including predicate calculus, set theory, counting and graph theory.

Since the ultimate goal of AI is the construction of programs that solve complex problems, no study of AI is complete without some experience writing programs. Most AI programs are written in LISP, PROLOG or some specialized AI shell.

So, we can say that the study of AI is an integral part of the branch computer science.

b). Relevance to Society:

AI has grown from a small scale laboratory science into a **technological** and **industrial** success. We now possess a collection of techniques for creating computer programs that control manufacturing process, diagnose computer faults and human diseases, design computers, do insurance underwriting, play chess, and so on.

Banks use artificial intelligence systems to organize operations, invest in stocks, and manage properties. Financial institutions have long used artificial neural network systems to detect charges or claims outside of the norm, flagging these for human investigation.

Artificial neural networks are used as **clinical decision support systems** for medical diagnosis, such as in Concept Processing technology in **EMR** (Electronic Medical Record) software. Computer aided interpretation of medical images systems help scan digital images, e.g. from **computed tomography**, for typical appearances and to highlight noticeable sections, such as possible diseases. A typical application is the detection of a **tu**[illegible]

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Robots have become common in many industries. They are often given jobs that are considered dangerous to humans. Robots have proven effective in jobs that are very repetitive which may lead to mistakes or accidents due to a lapse in concentration and other jobs which humans may find degrading.

Artificial intelligence is implemented in **automated online assistants** that can be seen as **avatars** on web pages. Such avatars are used by organizations as a part of **automated customer services** in order to interact with consumers and users of services. This can avail for enterprises to reduce their operation and training cost. A major underlying technology to such systems is **natural language processing**.

Similar techniques may be used in answering machines of call centers, such as speech recognition software to allow computers to handle first level of customer support, text mining and natural language processing to allow better customer handling, agent training by automatic mining of best practices from past interactions, support automation and many other technologies to improve agent productivity and customer satisfaction.

Fuzzy logic controllers have been developed for automatic gearboxes in automobiles. Fuzzy logic is a form of many valued logic. It deals with reasoning that is approximate rather than fixed and exact. Fuzzy logic variables may have truth values that ranges between 0 and 1 whereas in binary logic – 1 (true) and 0 (false).

The evolution of **music** has always been affected by technology. With AI, scientists are trying to make the computer emulate the activities of the skillful musician. Composition, performance, music theory, sound processing are some of the major areas on which research in Music and Artificial Intelligence are focusing.

Airplane simulators are using artificial intelligence in order to process the data taken from simulated flights. Other than simulated flying, there is also simulated aircraft warfare. The computers can also create strategies based on the placement, size, speed, and strength of the forces and counter forces. Pilots may be given assistance in the air during combat by computers. The artificial intelligent programs can sort the information and provide the pilot with the best possible military exercises. Multiple aircraft are needed to get good approximations for some calculations so computer simulated pilots are used to gather data. These computer simulated pilots are also used to train future air traffic controllers.

Many **companies** are making **computer generated news** and reports commercially available, including summarizing team sporting events based on statistical data from the game. It also creates financial reports and real estate analyses

Similarly companies are using artificial intelligence to turn **structured data into intelligent comments** and recommendations in natural language. They are able to write financial reports, executive summaries, personalized sales or marketing documents and more at a speed of thousands of pages per second and in multiple languages including English, Spanish, French and German.

c). Relevance to Self:

I have good interest in almost all the prerequisite courses of Artificial Intelligence like programming, data structures, logics, databases, and data mining etc., so it motivated me to teach the challenging subject of AI. There are many potential applications of AI. These include military applications such as autonomous control and target identification, game playing, medical applications such as diagnosis banking and insurance applications such as predicting customer behavior and analyzing trends, manufacturing process control etc. These different applications of AI open a wide scope of research in the fields of AI.

d). Relation with laboratory:

The ultimate goal of AI is the construction of programs that solve hard problems. Most AI programs are written in LISP (List Processing) and PROLOG or some specialized AI shell.

PROLOG (Programming in Logic) uses the syntax of predicate logic to perform symbolic, logical computations. It has a number of built in features that limit its flexibility but simplify many aspects of programming. Programming in PROLOG is accomplished by creating a database of facts and rules about objects, their properties, and their relationships to other objects. Queries can then be posed about the objects and valid conclusions will be determined and

returned by the program. Responses to user queries are determined through a form of inference control known as resolution.

Indian (person) :- student (person)	Rule
Student (mr ram)	Fact
Indian (X)	query

We will get the conclusion

X= Mr. Ram

Both of these programming languages of AI (LISP and PROLOG) are not part of the syllabus of B Tech VI semester in terms of theory as well as lab. But students should have an introductory knowledge of these languages in order for completeness to learn AI.

e). Connection with previous year and next year:

To study AI, students should have some background in both computer science and mathematics. As computer science/ IT background, they should have experience of programming and they should feel comfortable with data structures. They should be familiar with the use of recursion as a program control structure. And they should be able to do simple analysis of time complexity of algorithms. As mathematical background, students should have familiarity with logic, with quantifiers and the basic notion of a decision procedure. As this course is included in VI semester, the students have fair understanding of mathematics, data structures and programming as these subjects have been covered in previous semesters of B Tech.

As far as next semester or year is concerned the field is AI is very vast and has lot of scope of further research and study. In final year, students can develop their projects based on intelligent systems, natural language processing and expert systems. The subject of data mining and warehousing in VII semester integrates various fields and one of them is AI. Machine learning in AI is the most relevant area to data mining, from the AI perspective. AI is a broader area than machine learning. AI systems are knowledge processing systems. Knowledge representation, knowledge acquisition, and inference including search and control, are three fundamental techniques in AI that are all relevant to Data Mining.

AI research is concerned with the principles and design of rational agents and data mining systems can be good examples of such rational agents. Most AI research areas (such as reasoning, planning, natural language processing, game playing and robotics) have concentrated on the development of symbolic and heuristic methods to solve complex problems efficiently. These methods have also found extensive use in data mining.

6). Syllabus of Rajasthan Technical University, Kota

a). Index Terms/ Key Words:

Intelligence, production systems, search techniques, hill climbing, A* search, AO* search, knowledge, predicate logic, resolution, fuzzy, games, robotics, learning, neural networks, expert systems, reasoning.

b). **RTU Syllabus with Name of Subject & Code**

Artificial Intelligence (6IT4-05)

Units Contents of the subject

S. N.	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course	01
2	**Introduction to AI and Intelligent agent:** Different Approach of AI, Problem Solving : Solving Problems by Searching, Uninformed search, BFS, DFS, Iterative deepening, Bi directional search, Hill climbing, Informed search techniques: heuristic, Greedy search, A* search, AO* search, constraint satisfaction problems.	07
3	**Game Playing:** Minimax, alpha-beta pruning, jug problem, chess problem, tiles problem	07
4	**Knowledge and Reasoning:** Building a Knowledge Base: Propositional logic, first order logic, situation calculus. Theorem Proving in First Order Logic. Planning, partial order planning. Uncertain Knowledge and Reasoning, Probabilities, Bayesian Networks.	07
5	**Learning:** Overview of different forms of learning, Supervised base learnin...	07

	Learning Decision Trees, SVM, Unsupervised based learning, Market Basket Analysis, Neural Networks	
6	**Introduction to Natural Language Processing:** Different issue involved in NLP, Expert System, Robotics.	**05**

c) Course Outcomes

Upon successful completion of the course, the student will be able to -

1. **Explain** basic understanding and various applications of AI techniques in intelligent agents, expert systems, game playing, understanding natural language, robotics etc.
2. **Describe** core concepts and algorithms of AI including searching, knowledge and reasoning, game playing, planning, various types of learning, natural language processing, expert system, and so on.
3. **Apply** various principles and techniques like knowledge representation, reasoning, game playing, planning, learning, NLP etc to provide solutions for different task domains of AI.
4. **Create** solutions for AI based tasks by formalizing the problem as a state space, designing heuristics and selecting appropriate search and control techniques to solve them.

d) Mapping of CO with PO and PSO

CO Vs PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3														2
CO2		3													
CO3		3												3	
CO4			3										3		

7). Books/ Website/Journals & Handbooks/ Association & Institution:

a). Recommended Text & Reference Books and Websites:

S. No.	Title of Book	Authors	Publisher	Cost (Rs.)	No. of books in Library
Text Books					
1	Artificial Intelligence	Elaine Rich, Kevin Knight	McGraw Hill	350	60
Reference Books					
1	Introduction to AI & Expert System	Dan W. Patterson	PHI	275	35
3	Artificial Intelligence: A Modern Approach	Russel & Norvig	Pearson	575	25
4	Artificial Intelligence	George F Luger	Pearson	550	
5	Artificial Intelligence	Patrick Henry Winston	Pearson	500	
Websites related to subject					
1	http://www.aaai.org/aitopics				
2	http://www.cse.iitb.ac.in/~cs344-2012, http://aima.cs.berkeley.edu/ai.html				
3	http://www.facweb.iitkgp.ernet.in/~pallab/ai.slides				
4	http://aass.oru.se/~fpa/teaching/AdvancedAI-lecture-4-HT10.pdf				
5	http://www.freebookcentre.net/ComputerScience-Books-Download/Artificial-Intelligence-Lecture-Notes-MIT.html				
6	http://textofvideo.nptel.iitm.ac.in/106105077/lec1.pdf, www.myreaders.info				

b). Journals & Handbooks: - To give information about different Journals & Handbooks available in library related to the subject and branch.

- IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI)
- Knowledge and Information Systems: An International Journal (KAIS)

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- IEEE Transactions on Knowledge and Data Engineering (TKDE) (www.computer.org/tkde)
- Data Mining and Knowledge Discovery: An International Journal (DMKD)
- ACM Transactions on Knowledge Discovery from Data (TKDD)
- KAIS - Knowledge and Information Systems
- International Journal of Business Intelligence and Data Mining, Inderscience Publishers
- Statistical Analysis and Data Mining, Wiley Publishers
- DM Review - Covering Business Intelligence, Integration & Analytics - http://www.dmreview.com/
- http://academic.research.microsoft.com

c). Associations and Institutions: - To give information about different Associations and Institutions related to the subject and branch.

ACM http://www.acm.org

IEEE computer society http://www.computer.org

8). Syllabus Deployment: -

a). Total weeks available for academics (excluding exams/ holidays) as per PGC calendar-

Semester	VI
No. of Working days available(Approx.)	72
No. of Weeks (Approx.)	12

- Total weeks available for covering RTU syllabus- 11 weeks (Approx.)
- Total weeks available for special activities (as mentioned below)- 01 week (Approx.)

Note: Individual faculty must calculate the exact no. of lectures available according to time table etc. after consultation with HOD.

b). Special Activities (To be approved by HOD, Dean & Campus Director & must be mentioned in deployment):

- Open Book Test- Once in a semester
- Quiz (50% Technical & 50% Aptitude)- Once in a semester
- Special Lectures (SPL)- 10% of total no. of lectures including following
  - i. One PPT by the faculty, who is teaching the subject
  - ii. SPL by expert faculty at PGC level
  - iii. SPL by expert from industry/academia (other institution)
- Revision classes:- 1 to 3 turn at the end of semester (Before II Mid Term Exam)
- Solving Important Question Bank- 1 Turn before I & II Mid Term Exam (each) - Total Two turn.

c). Lecture schedule per week

i). University scheme (L+T+P) = 3+0+N/A

ii). PGC scheme (L+T+P) = 3+0+N/A

Sr. No.	Name of Unit	No. of lectures	Broad Area	Degree of difficulty (High/Medium/ Low)	No. of Question in RTU Exam.	Text/ Reference books
1	Objective & Scope, Introduction to AI	11	Algorithms and search methods	Medium		Rich & knight
2	Game Playing	6	Adversarial search	Medium		Rich & knight, Patterson, Winston
3	Knowledge and Reasoning	12	Predicate logic, Probability, fuzzy logic	High		Rich & knight, Winston
4	Learning	7	Machine learning	High		Rich & knight
5	Introduction to natural language processing and expert systems	5	NLP, expert systems	High		Rich & knight, Russell & Norvig, Patterson

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d). Introduction & Conclusion: Each subject, unit and topic shall start with introduction & close with conclusion. In case of the subject, it is Zero lecture.

e). Time Distribution in lecture class: - Time allotted: 60 min.

i. First 5 min. should be utilized for paying attention towards students who were absent for last lecture or continuously absent for many days + taking attendance by calling the names of the students and also sharing any new/relevant information.
ii. Actual lecture delivery should be of 50 min.
iii. Last 5 min. should be utilized by recapping/ conclusion of the topic. Providing brief introduction of the coming up lecture and suggesting portion to read.
iv. After completion of any Unit/Chapter a short quiz should be organized.
v. During lecture student should be encouraged to ask the question.

Note: Pl. ensure that each student is having Lecture Note Book. Pl. Write on the black board day and date, name of the teacher, name of sub. with code, unit and lecture no. and topics to be covered at the beginning of each lecture and ensure that students write in lecture note book. Ask students to leave 4/5 pages blank for copying the note from fellow students in case of their absenteeism.

9). Tutorial: - N/A.

10). Examination Systems:

Sr. No.	Name of the Exam	Max. Marks	% of passing marks	Nature of paper Theory + Numerical	Syllabus coverage (in %)	Conducted by
1.	I Mid Term Exam	40	40	Th+N	60%	PCE
2.	II Mid Term Exam	40	40	Th+N	40%	PCE
3.	University (End) Term Exam	80	32	Th+N	100%	RTU

11).

Any other important point:

Unit-wise subject introduction

Unit-1 (Objective & Scope, Introduction to AI)

This unit introduces AI by examining the nature and of the difficult problems that AI seeks to solve. It then develops the theory and practice of heuristic search, providing detailed algorithms and for standard search methods, including best first search, hill climbing, means ends analysis and constraint satisfaction.

Unit-2 (Game Playing)

There are two reasons that games appeared to be a good domain in which to explore machine intelligence: (a) they provide a structured task in which it is easy to measure success or failure (b) they do not obviously require large amounts of knowledge if we talk about very simple games.

Developing programs that understand natural language is important in AI because a natural form of communication with systems is essential for user acceptance. But, developing programs that understand a natural language is a difficult problem. Natural languages contain infinity of different sentences. Many words have several meanings in different contexts. This makes the creation of programs that understand a natural language, one of the most challenging task in AI. This unit introduces various aspects of natural language processing.

Unit-3 (Knowledge and Reasoning)

This unit explores a variety of methods for encoding knowledge in computer systems. These methods include predicate logic, production rules semantic networks and frames. We will also study a problem solving technique, resolution that can be applied when knowledge is represented in this way (predicate logic). This unit also gives an introduction to reasoning under uncertainty. The probability theory and Bayesian statistics are provide a good basis for reasoning under various kinds of uncertainty.

The last part of the unit discusses the concept of planning. In planning a problem is decomposed into appropriate subparts and then interactions among the subparts are recorded and handled as

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they are detected during the problem solving process. Our aim is to accomplish the following two goals – avoiding plan failure and minimizing resource consumption.

Unit-4 (Learning)

This unit gives an introduction to various types of learning especially supervised learning methods like decision tree based learning, ANN, SVM etc.

Unit-5 (Introduction to natural language processing and expert systems)

This unit introduces various aspects of natural language processing. Developing programs that understand natural language is important in AI because a natural form of communication with systems is essential for user acceptance. But, developing programs that understand a natural language is a difficult problem. Natural languages contain infinity of different sentences. Many words have several meanings in different contexts. This makes the creation of programs that understand a natural language, one of the most challenging tasks in AI.

This unit concludes with some introduction of expert systems. Expert systems solve problems that are normally solved by human experts. Expert systems are complex AI programs. Expert systems need access to a substantial domain knowledge base. They also need to exploit one or more reasoning mechanisms to apply their knowledge to the problems they are given. Expert systems are used in diagnostic applications. They also play chess, make financial planning decision, configure computers, monitor real time systems, underwrite insurance policies etc.

Place & Date: Jaipur/08-01-2022

(Amol Saxena)

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III B.TECH. (VI Sem.)

Roll No. _____

FIRST MID TERM EXAMINATION 2021-22

Code: 6IT4-05 Category: PCC Subject Name– ARTIFICIAL INTELLIGENCE

(BRANCH – INFORMATION TECHNOLOGY)

Max. Time: 2 hrs. Course Credit: 02

Max. Marks: 40

NOTE:- Read the guidelines given with each part carefully.

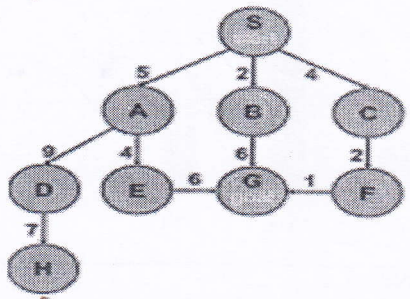
Course Outcomes (CO): At the end of the course the student should be able to:

CO1: Explain basic understanding and various applications of AI techniques in intelligent agents, expert systems, game playing, understanding natural language, robotics etc.

CO2: Describe core concepts and algorithms of AI including searching, knowledge and reasoning, game playing, planning, various types of learning, natural language processing, expert system, and so on.

CO3: Apply various principles and techniques like knowledge representation, reasoning, game playing, planning, learning, NLP etc. to provide solutions for different task domains of AI.

CO4: Create solutions for AI based tasks by formalizing the problem as a state space, designing heuristics and selecting appropriate search and control techniques to solve them.

		Marks	CO	BL	PO
	PART - A: (All questions are compulsory) Max. Marks (5)				
Q.1	What is the difference between monotonic and non-monotonic reasoning?	1	CO1	BL1	PO1
Q.2	Give names of any four uninformed search strategies.	1	CO1	BL1	PO1
Q.3	Give names of problems that occur in hill climbing search.	1	CO1	BL1	PO1
Q.4	Is the minimax procedure a depth-first or breadth-first search procedure?	1	CO1	BL1	PO1
Q.5	What do you mean by heuristic search?	1	CO1	BL1	PO1
	PART - B: (Attempt 4 questions out of 6) Max. Marks (20)				
Q.6	Explain the Steepest Ascent Hill Climbing algorithm. How it is different from the Best First Search procedure?	5	CO2	BL2	PO2
Q.7	What is the difference between propositional and predicate logics? Explain with suitable examples. Convert the following formulas to CNF (conjunctive normal form). (a) $((P \Rightarrow Q) \wedge \neg Q) \Rightarrow \neg P$ (b) $(\neg Q \Rightarrow \neg P) \Rightarrow (P \Rightarrow Q)$	5	CO3	BL3	PO2
Q.8	Explain how Depth First search works; is it complete and/ or optimal? What is the algorithm's time and space complexity?	5	CO2	BL2	PO2
Q.9	At a certain university, 4% of men are over 6 feet tall and 1% of women are over 6 feet tall. The total student population is divided in the ratio 4:3 in favour of women. If a student is selected at random from among all those over six feet tall, what is the probability that the student is a woman?	5	CO3	BL3	PO2
Q.10	Translate the following statements into well-formed formulas in predicate logic. 1. Every gardener likes the sun 2. All purple mushrooms are poisonous 3. No purple mushroom is poisonous 4. Tom is not tall 5. All professors are people	5	CO2	BL3	PO2
Q.11	Briefly explain how uniform cost search (UCS) algorithm works. Illustrate how the algorithm proceeds by writing down the order in which it visits the nodes of the following exploration trace (graph/tree). Assume the node S as start node and G as the goal node. 	5	CO3	BL3	PO2

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(M) 24-02-20

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III B.TECH. (VI Sem.) Roll No. (M) F 36

FIRST MID TERM EXAMINATION 2019-20

Code: 6IT04-05 Category: PCC Subject Name– ARTIFICIAL INTELLIGENCE

(BRANCH – INFORMATION TECHNOLOGY)

Max. Time: 2 hrs. Max. Marks: 40

NOTE:- Read the guidelines given with each part carefully.

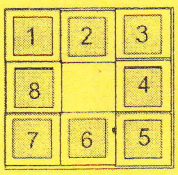
PART - A: (All questions are compulsory) Max. Marks (5)

Q.1	CO1	PO2	What do you mean by heuristic search? Why a greedy search uses a heuristic function?	(1)
Q.2	CO1	PO2	List some of the uninformed search techniques.	(1)
Q.3	CO1	PO2	Give names of problems that occur in hill climbing.	(1)
Q.4	CO1	PO2	Is the minimax procedure a depth-first or breadth-first search procedure?	(1)
Q.5	CO1	PO2	What do you mean by problem space?	(1)

PART - B: (Attempt 4 questions out of 6) Max. Marks (20)

Q.6	CO2	PO2	Explain the Steepest Ascent Hill Climbing algorithm. How it is different from the Best First Search procedure?	(5)
Q.7	CO2	PO2	Explain how Depth First search works; is it complete and/ or optimal? What is the algorithm's time and space complexity?	(5)
Q.8	CO3	PO3	Convert the following formulas to CNF (conjunctive normal form). (a) $((P \Rightarrow Q) \wedge \neg Q) \Rightarrow \neg P$ (b) $(\neg Q \Rightarrow \neg P) \Rightarrow (P \Rightarrow Q)$	(5)
Q.9	CO3	PO3	(i) Explain why predicate logic is better approach than propositional logic for knowledge representation. (ii) Translate the following sentences into formulas in predicate logic. a) John likes all kinds of food. b) Bill eats peanuts. c) Sue eats everything Bill eats.	(2+3)
Q.10	CO3	PO3	Trace the constraint satisfaction procedure by solving the following cryptarithmatic problem. Assume that no two letters have the same value. EAT +THAT APPLE	(5)
Q.11	CO2	PO2	A problem solving search can proceed either forward or backward. What factors determine the choice of direction for a particular problem?	(5)

PART - C: (Attempt 2 questions out of 3) Max. Marks (15)

Q.12	CO3	PO3	(i) A solved 8-puzzle game looks like this:  Given a puzzle state like the one below, where the num places, we want to search for a series of moves which ends in the	(2+2+1)

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B.TECH. (VI Sem.) Roll No. Cotton 64

SECOND MID TERM EXAMINATION 2021-22

Code: 6IT4-05 Category: PCC Subject Name– ARTIFICIAL INTELLIGENCE

(BRANCH – INFORMATION TECHNOLOGY)

(M) 22-06-22

Max. Time: 2 hrs. Course Credit: 02

Max. Marks: 40

NOTE:- Read the guidelines given with each part carefully.

Course Outcomes (CO):

At the end of the course the student should be able to:

CO1: Explain basic understanding and various applications of AI techniques in intelligent agents, expert systems, game playing, understanding natural language, robotics etc.

CO2: Describe core concepts and algorithms of AI including searching, knowledge and reasoning, game playing, planning, various types of learning, natural language processing, expert system, and so on.

CO3: Apply various principles and techniques like knowledge representation, reasoning, game playing, planning, learning, NLP etc. to provide solutions for different task domains of AI.

CO4: Create solutions for AI based tasks by formalizing the problem as a state space, designing heuristics and selecting appropriate search and control techniques to solve them.

	PART - A: (All questions are compulsory) Max. Marks (5)				
		Marks	CO	BL	PO
Q.1	What do you mean by the term logistic regression?	1	CO1	BL1	PO1
Q.2	Give any three applications of Natural Language Processing.	1	CO1	BL1	PO1
Q.3	What is goal stack planning?	1	CO1	BL1	PO1
Q.4	Give examples of any two applications of neural networks.	1	CO1	BL1	PO1
Q.5	What do you mean by linearly separable data?	1	CO1	BL1	PO1
	PART - B: (Attempt 4 questions out of 6) Max. Marks (20)				
Q.6	Explain in brief the different phases of natural language understanding process.	5	CO2	BL2	PO2
Q.7	Briefly outline the major steps of decision tree classification.	5	CO2	BL2	PO2
Q.8	Give definitions of the following STRIPS style operators that are used in planning systems to solve Blocks World problems. Describe the operators in terms of Precondition, Delete and Add list of predicates. Stack(x, y) Unstack (x, y) Pickup (x) Putdown (x)	5	CO3	BL3	PO2
Q.9	A patient goes to the doctor for a medical condition, the doctor suspects three diseases as the cause of the condition. The three diseases are D1, D2, D3, which are marginally independent from each other. There are four symptoms S1, S2, S3, S4 which the doctor wants to check for presence in order to find the most probable cause of the condition. The symptoms are conditionally dependent to the three diseases as follows: S1 depends only on D1, S2 depends on D1 and D2. S3 is depends on D1 and D3, whereas S4 depends only on D3. Assume all random variables are Boolean, they are either 'true' or 'false'. i. Draw the Bayesian network for this problem. ii. Write down the expression for the joint probability distribution as a product of conditional probabilities.	2.5+2.5	CO2	BL2	PO2
Q.10	Why does an SVM searches for the hyperplane with the largest margin, that is, the maximum marginal hyperplane (MMH). Explain your answer with the help of appropriate diagram.	5	CO3	BL3	PO2
Q.11	Contrast expert systems and neural networks in terms of knowledge representation, knowledge acquisition and explanation. Give one domain in which the expert system approach would be more promising and one domain in which the neural network approach would be more promising.	5	CO3	BL3	PO2

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III B.TECH. (VI Sem.)

28-04-14

Sec→ A

PGC

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SECOND MID TERM EXAMINATION 2013-14
6CS6.2 – ARTIFICIAL INTELLIGENCE
BRANCH – COMPUTER ENGINEERING

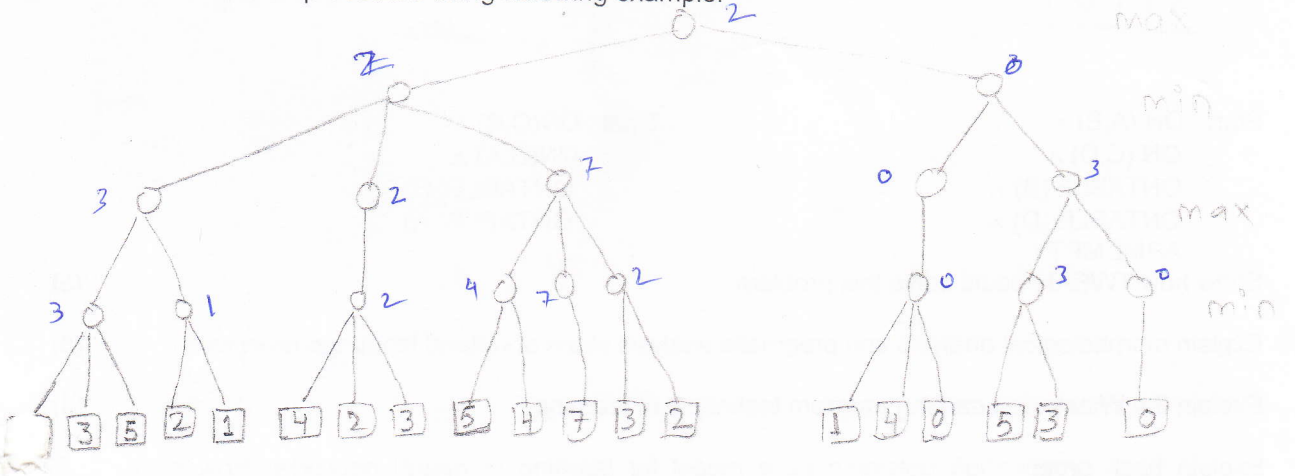
Copy → 69

Max. Time: 2 hrs.

Max. Marks: 40

NOTE:- **Attempt all four questions. There is internal choice in Q. 1 & 2, Q. 3 & 4, Q. 5 & 6, Q. 7 & 8.**

Q.1. (a) Write the Minimax search algorithm used in game playing programs. Explain the Minimax search procedure using following example.

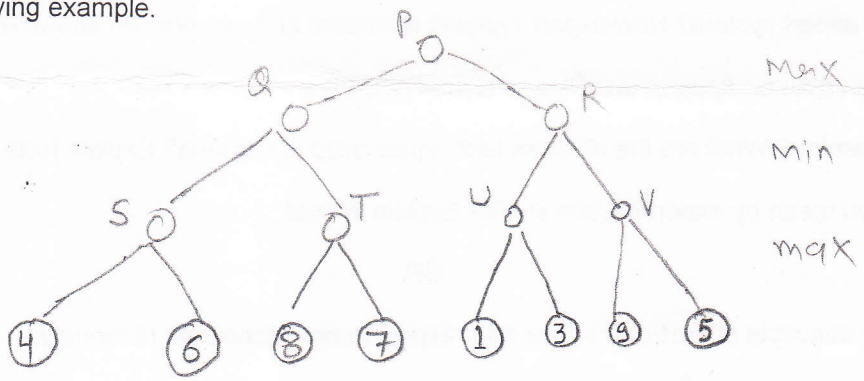


(8)

(b) Is the Minimax procedure a depth first or breadth first search procedure? Explain in short. **(2)**

OR

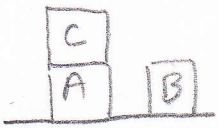
Q.2. (a) Explain Minimax search procedure with Alpha-Beta pruning strategy with the help of the following example.

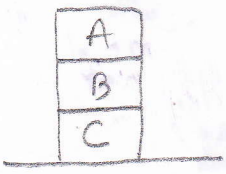


(7)

(b) What is waiting for quiescence? How does it improve the performance of Minimax search procedure? **(3)**

Q.3. (a) Consider the following blocks world problem:





Start : ON (C,A) ∧
ONTABLE (A) ∧
ONTABLE (B) ∧
ARMEMPTY

Goal : ON(A,B) ∧
ON(B,C)

Show how STRIPS would solve this problem. **(6)**

(b) What is understanding? What factors make understanding problems difficult in Artificial Intelligence? Explain in short the level of interaction among components in the context of understanding. **(4)**

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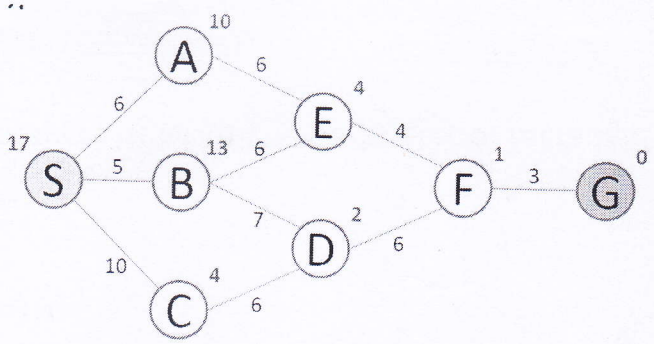
Department of Information Technology
Even Semester 2021-22
Subject: Artificial Intelligence (6IT04-05)
Assignment#1 (Unit-1)

Faculty: Amol Saxena

Due Date: 2nd April-2022

Q. 1	CO3	PO2	Give a complete problem formulation for each of the following. Choose a formulation that is precise enough to be implemented. Also **suggest** a **solution** for problem (c). **a.** Using only four colors, you have to color a planar map in such a way that no two adjacent regions have the same color. **b.** You have a program that outputs the message "illegal input record" when fed a certain file of input records. You know that processing of each record is independent of the other records. You want to discover what record is illegal. **c.** You have three jugs, measuring 12 gallons, 8 gallons, and 3 gallons, and a water faucet. You can fill the jugs up or empty them out from one to another or onto the ground. You need to measure out exactly one gallon.
Q.2	CO4	PO3	Consider the following graph that represents road connections between different cities. The weights on links represent driving distances between connected cities. Let S be the initial city and G the destination.  Show how the A* algorithm with the straight-line distance heuristic works. The straight line distances between G and other cities are given in red on top of each node. Is the path found optimal?

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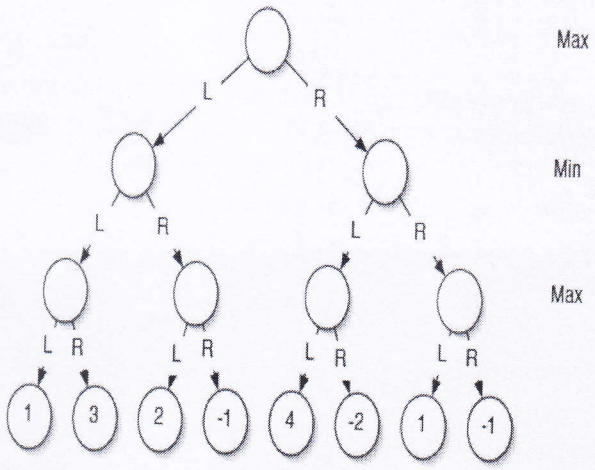
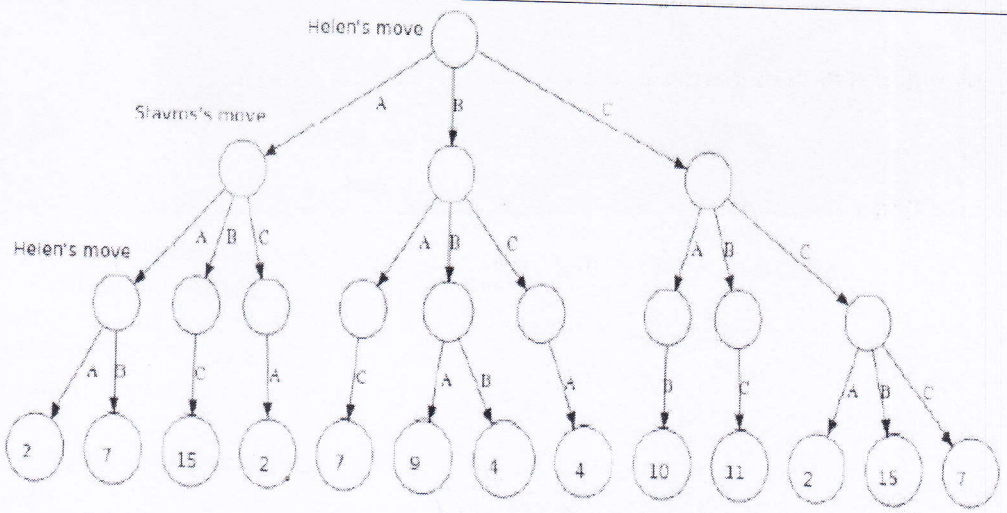
Department of Information Technology
Even Semester 2021-22
Subject: Artificial Intelligence (6IT04-05)
Assignment#2 (Unit-2)

Faculty: Amol Saxena

Due Date: 8th April-2022

Q.1	CO3	PO2	Consider the game tree shown below. Assume the top node is a max node. The labels on the arcs are the moves. The numbers in the bottom layer are the values of the different outcomes of the game to the max player.  1. What is the value of the game to the max player? 2. What first move should the max player make? 3. Assuming the max player makes that move, what is the best next move for the min player, assuming that this is the entire game tree?
Q.2	CO3	PO2	 Assume the first player is the max player and the values at leaves of the tree reflect his/her utility. The opponent wants the same utility to be minimized. a) Compute the minimax values for each node in the tree? What move should the first player choose? What is the solution path the rational players would play? b) Assume we use alpha-beta pruning algorithm to explore the game tree and we do this in left-to-right order and determine the player's strategies. List all nodes that are cut off from the tree and are never examined by the alpha beta procedure.

Department of Information Technology
Even Semester 2021-22
Subject: Artificial Intelligence (6IT4-05)
Assignment#3 (Unit-3)

Faculty: Amol Saxena

Due Date: 20th April-2022

1.	CO2	PO2	Convert the following propositional expression into CNF (Conjunctive Normal Form). $(B \vee (A \wedge C)) \Longrightarrow (B \vee \neg A)$
2.	CO3	PO2	Prove the following using **resolution**. (Hint: Negate the conclusion, convert all formulas to CNF and then try to prove a contradiction.) $\{P \vee Q, Q \text{ -> } (R \wedge S), (P \vee R) \text{ -> } U\} \vdash U$ Note: KB $\vdash$ U, Derives a sentence U from the KB (knowledge base)
3.	CO3	PO2	Translate the following statements into First Order Logic or Predicate Logic. 1. Every gardener likes the sun 2. All purple mushrooms are poisonous 3. No purple mushroom is poisonous 4. Tom is not tall 5. All professors are people 6. Everyone is a friend of someone 7. People only criticize people that are not their friends
4.	CO3	PO2	Given the joint probability distribution table sunny rainy cloudy snowing cold 0.01 0.10 0.04 0.20 hot 0.50 0.05 0.10 0.00 what are the probabilities a) P(cold v rainy) b) P(cold|rainy)
5.	CO3	PO2	Given the following axioms KB (Knowledge Base) and the goal sentence Q, show that KB |= Q using resolution by refutation (proof by contradiction) method. KB: – allergies(X) → sneeze(X) – cat(Y) ∧ allergicToCats(X) → allergies(X) – cat(felix) – allergicToCats(mary) Goal: – sneeze(mary)
6.	CO3	PO2	A doctor performs a test that has 99% reliability, i.e. 99% of people who are sick test positive, and 99% people who are healthy test negative. The doctor estimates that 1% of the population is sick. If a patient tests positive then what is the chance that the patient is sick?

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Department of Information Technology
Even Semester 2021-22
Subject: Artificial Intelligence (6IT04-05)
Assignment#4 (Unit-4)

Faculty: Amol Saxena
Date: 23-05-2022

<table>
<tr><td>1</td><td>CO3</td><td>PO2</td><td>Consider the following training dataset with three attributes color, shape and size. The fourth attribute ‘class’ is the class label attribute.

<table><tr><th>Color</th><th>Shape</th><th>Size</th><th>Class</th></tr><tr><td>Red</td><td>Square</td><td>Big</td><td>+</td></tr><tr><td>Blue</td><td>Square</td><td>Big</td><td>+</td></tr><tr><td>Red</td><td>Circle</td><td>Big</td><td>+</td></tr><tr><td>Red</td><td>Circle</td><td>Small</td><td>–</td></tr><tr><td>Green</td><td>Square</td><td>Small</td><td>–</td></tr><tr><td>Green</td><td>Square</td><td>Big</td><td>–</td></tr></table>
Use the information gain method of decision tree induction algorithm to find out the best attribute at the root.</td><td>10</td></tr>
<tr><td>2</td><td>CO3</td><td>PO2</td><td>Why the Boolean function XOR cannot be computed using single layer perceptron? Explain.</td><td>10</td></tr>
<tr><td>3</td><td>CO4</td><td>PO3</td><td>Give a solution to ‘XOR’ problem by designing a two layer feed forward neural network.</td><td>10</td></tr>
</table>

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Department of Information Technology
Even Semester 2021-22
Subject: Artificial Intelligence (6IT04-05)
Assignment#5 (Unit-5)

Faculty: Amol Saxena
Date: 23-05-2022

1	CO2	PO2	Explain the architecture of Expert System with the help of a block diagram.
2	CO3	PO2	Briefly explain the different phases of natural language understanding process. Show the parse tree for the following sentences. 1. "The cat sat on the mat" 2. "Does this flight include a meal?"
3	CO3	PO2	Give definitions of the following STRIPS style operators that are used in planning systems to solve Blocks World problems. Describe the operators in terms of Precondition, Delete and Add list of predicates. Stack(x, y) Unstack (x, y) Pickup (x) Putdown (x)

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FIRST MID TERM EXAMINATION 2021-22 (Exam Date: 09-05-2022)
Code: 6IT4-05 Category: PCC Subject Name– ARTIFICIAL INTELLIGENCE
(BRANCH – INFORMATION TECHNOLOGY)
Hints/ Solutions

Q.1	What is the difference between monotonic and non-monotonic reasoning?
Hint	The definite clause logic is monotonic in the sense that anything that could be concluded before a clause is added can still be concluded after it is added; adding knowledge does not reduce the set of propositions that can be derived. A logic is non-monotonic if some conclusions can be invalidated by adding more knowledge. The logic of definite clauses with negation as failure is non-monotonic. Non-monotonic reasoning is useful for representing defaults. A default is a rule that can be used unless it overridden by an exception. For example, to say that b is normally true if c is true, a knowledge base designer can write a rule of the form $b \leftarrow c \wedge \sim ab_a$. where aba is an atom that means abnormal with respect to some aspect a. Given c, the agent can infer b unless it is told ab_a. Adding ab_a to the knowledge base can prevent the conclusion of b. Rules that imply ab_a can be used to prevent the default under the conditions of the body of the rule
Q.2	Give names of any four uninformed search strategies.
Ans	BFS DFS Uniform Cost Search Iterative Deepening Search
Q.3	Give names of problems that occur in hill climbing search.
Ans	Local Maximum Plateua/ float local maximum Ridge
Q.4	Is the minimax procedure a depth-first or breadth-first search procedure?
Ans	The minimax procedure a depth-first procedure
Q.5	What do you mean by heuristic search?
Ans	Heuristics — A heuristic is a way of trying to discover something or an idea embedded in a program. The term is used extensively in AI. Heuristic functions are used in some approaches to search or to measure how far a node in a search tree seems to be from a goal. Heuristic search is class of method which is used in order to search a solution space for an optimal solution for a problem. The heuristic here uses some method to search the solution space while assessing where in the space the solution is most likely to be and focusing the search on that area.
Q.6	Explain the Steepest Ascent Hill Climbing algorithm. How it is different from the Best First Search procedure?
Hint	Algorithm for Steepest-Ascent hill climbing: **Step 1:** Evaluate the initial state, if it is goal state then return success and stop, else make current state as initial state. **Step 2:** Loop until a solution is found or the current state does not change.

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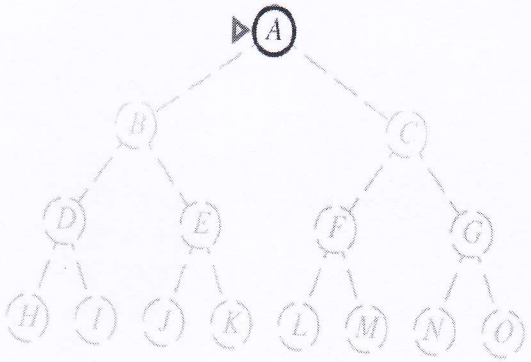
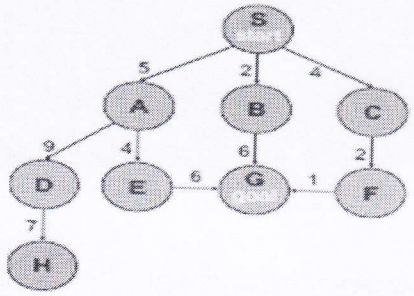
	a. Let SUCC be a state such that any successor of the current state will be better than it. b. For each operator that applies to the current state: a. Apply the new operator and generate a new state. b. Evaluate the new state. c. If it is goal state, then return it and quit, else compare it to the SUCC. d. If it is better than SUCC, then set new state as SUCC. e. If the SUCC is better than the current state, then set current state to SUCC. **Step 5:** Exit. Best First Search is similar to steepest-ascent, but do not throw away states that are not chosen.
Q.7	What is the difference between propositional and predicate logics? Explain with suitable examples. Convert the following formulas to CNF (conjunctive normal form). (a) $((P \Rightarrow Q) \wedge \neg Q) \Rightarrow \neg P$ (b) $(\neg Q \Rightarrow \neg P) \Rightarrow (P \Rightarrow Q)$
Sol.	$((P \Rightarrow Q) \wedge \neg Q) \Rightarrow \neg P$ $\equiv \neg((\neg P \vee Q) \wedge \neg Q) \vee \neg P$ *eliminate* $\Rightarrow$ $\equiv (\neg(\neg P \vee Q) \vee \neg \neg Q) \vee \neg P$ *move* $\neg$ *in (De Morgan)* $\equiv ((\neg \neg P \wedge \neg Q) \vee \neg \neg Q) \vee \neg P$ *move* $\neg$ *in (De Morgan)* $\equiv (P \wedge \neg Q) \vee (Q \vee \neg P)$ *eliminate double negation and regroup* $\equiv (P \vee Q \vee \neg P) \wedge (\neg Q \vee Q \vee \neg P)$ *distributivity law* $(\neg Q \Rightarrow \neg P) \Rightarrow (P \Rightarrow Q)$ $\equiv \neg (\neg \neg Q \vee \neg P) \vee (\neg P \vee Q)$ *eliminate* $\Rightarrow$ $\equiv (\neg \neg \neg Q \wedge \neg \neg P) \vee (\neg P \vee Q)$ *move* $\neg$ *in (De Morgan)* $\equiv (\neg Q \wedge P) \vee (\neg P \vee Q)$ *eliminate double negations* $\equiv (\neg Q \vee \neg P \vee Q) \wedge (P \vee \neg P \vee Q)$ *distributivity law*
Q.8	Explain how Depth First search works; is it complete and/ or optimal? What is the algorithm's time and space complexity?

Hint	 $O(b^m)$ m = max depth b = branching factor *DFS expands the deepest unexpanded node. This equates to implementing a LIFO queue in the node expansion procedure. DFS is complete only in finite state spaces, provided that it is modified to avoid repeated states. Its time complexity is $O(b^m)$ where b is the branching factor and m is the maximum depth of the state space. However, the space complexity of DFS is only $O(bm)$ (linear), which is what makes it appealing. As for optimality, DFS is not optimal (not even in the unit cost case), since it will stop at the first solution it finds along a branch.* *In the tree above, the order in which nodes are visited is A,B,D,H,I,E,J,K,C,F,L,M,G,N,O.*
Q.9	At a certain university, 4% of men are over 6 feet tall and 1% of women are over 6 feet tall. The total student population is divided in the ratio 4:3 in favour of women. If a student is selected at random from among all those over six feet tall, what is the probability that the student is a woman?
Sol	Solution Let M={Student is male}, F={Student is female}, T={student is over 6 feet tall} We know that P(M) = 4/7, P(F)= 3/7 P(T|M)= 4/100 P(T|F)=1/100 We require P(F|T)? Using Bayes's theorem we have – $P(F\|T) = \frac{P(T\|F)\,P(F)}{P(T\|F)\,P(F)+(T\|M)\,P(M)}$ $P(F\|T) = \frac{1/100 \times 3/7}{1/100 \times 3/7+4/100 \times 4/7}$ Ans is 0.157
Q.10	Translate the following statements into well-formed formulas in predicate logic. 1. Every gardener likes the sun 2. All purple mushrooms are poisonous

	3. No purple mushroom is poisonous 4. Tom is not tall All professors are people
Sol	1. Every gardener likes the sun (∀x) gardener(x) => likes(x,Sun) 2. All purple mushrooms are poisonous ∀x (∃x) (mushroom(x) ^ purple(x)) => poisonous(x) 3. No purple mushroom is poisonous ~(∃x) ~(Ex) purple(x) ^ mushroom(x) ^ poisonous(x) or, equivalently, ∀x (∀x) (mushroom(x) ^ purple(x)) => ~poisonous(x) 4. Tom is not tall □□□all (Tom) ~ Tall (Tom) 5. All professors are people ∀ □□x (is-prof(x) → is-person(x))
Q.11	Briefly explain how uniform cost search (UCS) algorithm works. Illustrate how the algorithm proceeds by writing down the order in which it visits the nodes of the following exploration trace (graph/tree). Assume the node S as start node and G as the goal node. 
Hint	**Uniform-Cost Search (UCS)** • Use a **Priority Queue** to order nodes in *Frontier* sorted by path cost • Let $g(n)$ = cost of path from start node s to current node n • Sort nodes by increasing value of g

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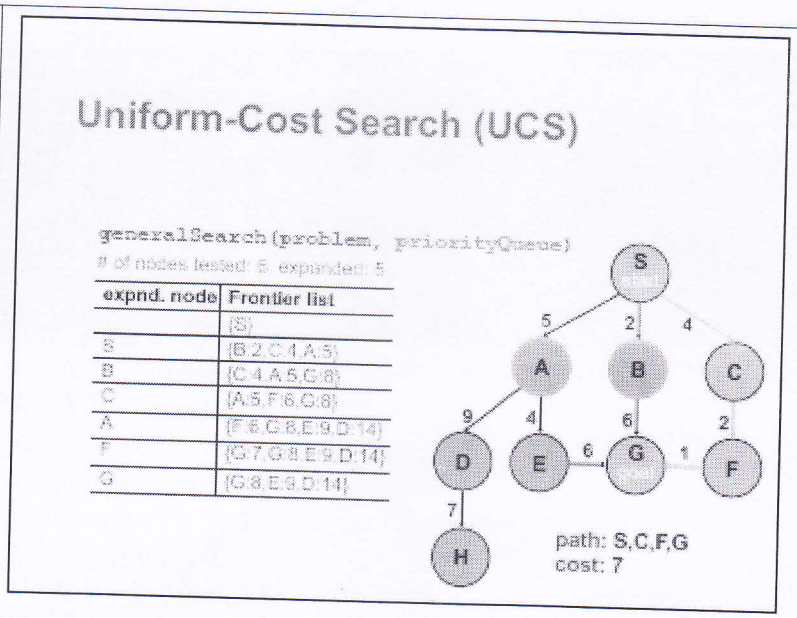


Q.12

(i) Write down a heuristic function, *h*, for 8-puzzle game where start state and goal state are given below. What is the value of *h* for the below given start state?

Start State

1	2	3
8	6	
7	5	4

Goal State

1	2	3
8		4
7	6	5

In a greedy search, what move would be chosen next?

(ii) Consider the implications given below –

¬ A -> B, B ->A, A->(C ^ D)

Prove the proposition A ^ C ^ D using resolution by refutation method.

Hint

(i) The heuristic function must be designed to estimate the cost to the solution from the current state. One simple possibility is to calculate the number of pieces which are not in their final state (i.e., the position they will occupy in the solution state).

In the case above, the numbers 4, 5 and 6 are out of place. Hence, this heuristic function would score 3 for the above board state.

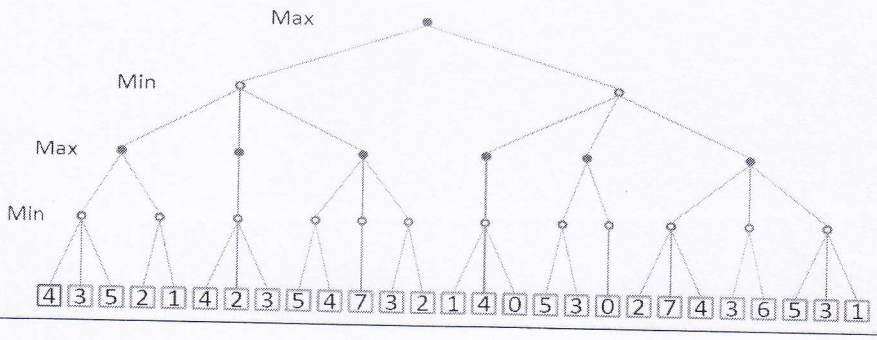
Moving the 6 into the gap would produce a value of *h* the same (namely three), because the 6 has not been moved into its final position. Moving the 3 would be disastrous, as the heuristic would now score four, as the 3 gets moved *out of*, rather than into its final position. Moving the four up would reduce the value of *h* to just two (the 5 and 6 are still out of place). Therefore, a greedy searching agent would move the four up.

(ii)

Resolution Refutation

- To prove that a sentence p can be derived from a set of sentences KB:
- Convert ¬p and the sentences in KB to CNF.

	• Repeat until the empty clause results (a contradiction) or no clauses can be resolved
	  ○ Find two clauses to which the resolution rule applies, but has not previously been applied.
	  ○ Apply the resolution rule to create a new clause.
	• If terminate with empty clause, p is proved. Otherwise, p cannot be proved.
	
	Proof by refutation:
	1. A V B premise
	2. ~B V A premise
	3. ~A V C premise
	4. ~A V D premise
	5. ~A V ~C V ~D negated thesis
	6. A resolution 1, 2
	7. C resolution 3, 6
	8. D resolution 4, 6
	9. ~C V ~D resolution 5, 6
	10. ~D resolution 7, 9
	11. [Nil] resolution 8, 10

Q.13	(i) How alpha-beta cutoffs are added in minimax search procedure of game playing? Write the key points of alpha-beta pruning algorithm. (ii) Consider the game search tree in the figure below. Perform minimax search with alpha-beta pruning. Circle all the nodes that are cutoff from the tree and are never examined by the alpha beta procedure. 

If α - value at any max node $\geq$ β value of any min ancestor - Beta cut off.

If β - value at any min node $\leq$ α - value of any max node ancester - Alpha cut off

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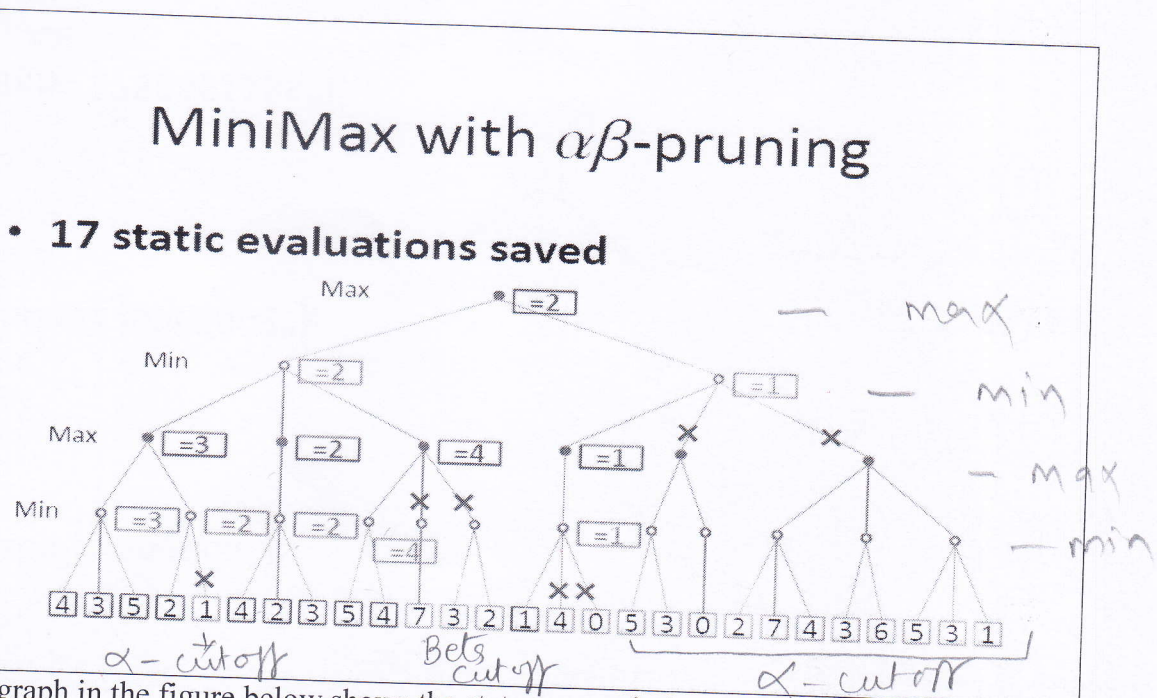
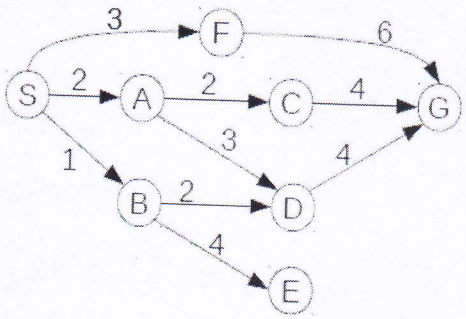
Hint



Q.14 The graph in the figure below shows the state space of a hypothetical search problem. States are denoted by letters, and the cost of each action is indicated on the corresponding edge. The table next to the state space shows the value of some admissible heuristic function, considering G as the goal state.

state space



heuristic function (goal state: G)

S	A	B	C	D	E	F	G
6	4	5	2	2	8	4	0

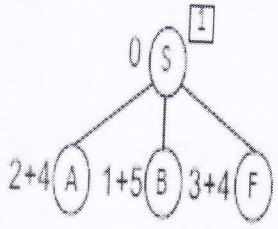
Considering S as the initial state, solve the above search problem using A* search with the heuristic above. When drawing the search tree you should clearly indicate: the order of expansion of each node (e.g., by numbering the expanded nodes according to the order of their expansion); the action corresponding to each edge of the tree; the state, the path cost and the value of the heuristic of each node. Is the path found optimal?

Ans The search tree built by A*-search is shown below. Next to each node the corresponding path cost g and heuristic h are shown as g + h.
At each step the leaf node with the minimum value of g +h is chosen for expansion (ties are broken randomly, as in all search strategies). The solution found at step 8 is guaranteed to be the minimum-cost one, according to the fact that A* is optimal when an admissible heuristic is used.

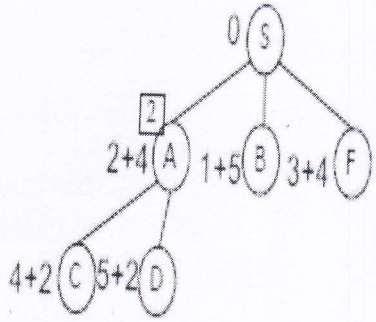
open -S

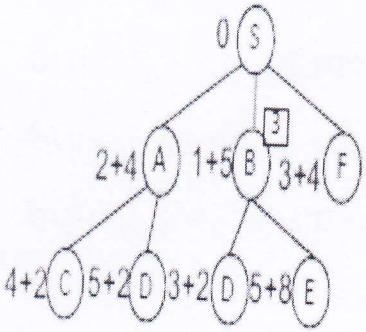
Open - A:6, B:6, F:7
closed - S

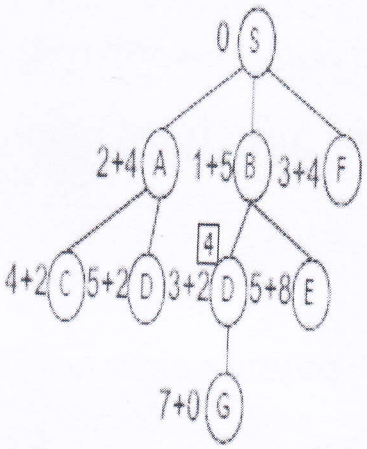
C-6,
Open= B-6, F-7, D-7
closed = S, A:6

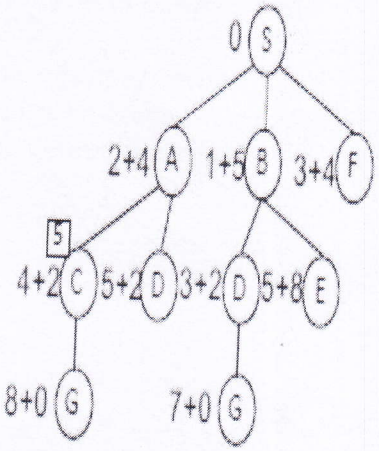


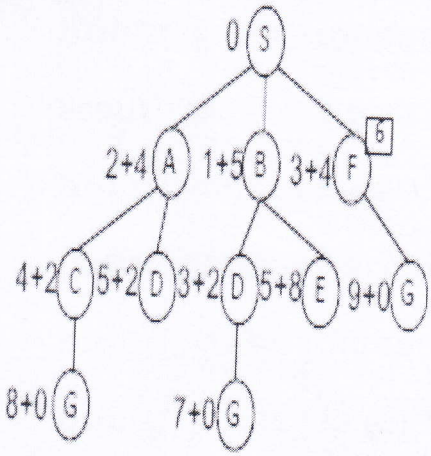
D-5
Open= C-6, F-7, D-7, E-13
closed = S, A-6, B-6

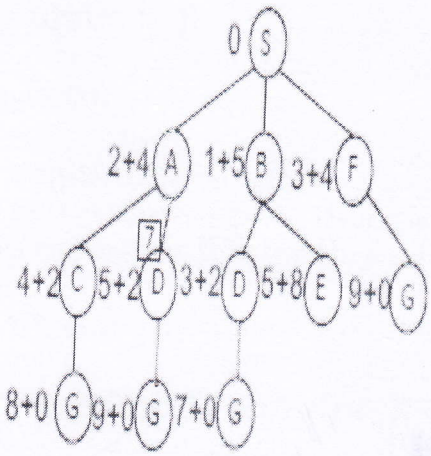


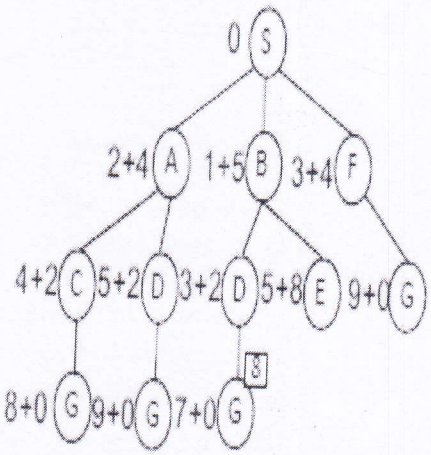












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Review Questions

Q.1 What is Genetic Algorithm? Write its parameters.

Q.2 What are the genetic parameters? How they play their role in genetic algorithm?

Q.3 What are the terminations parameters or termination conditions for agenetic algorithm?

Q.4 Write short note on:

(a) Niching & specification in genetic algorithms.

(b) Evolving neural network.

(c) ANT algorithm.

8E4023

B.Tech VIIIth Semester (Main) Examination, May/June-2010

Information Technology

ARTIFICIAL INTELLIGENCE [8IT4.1]

Time: 3 Hr. **[Maximum Marks: 80**

Min. Passing Marks: 24]

Use of following supporting material is permitted during examination. (Mentioned in form No. 205

1. _____*Nil*_____ *2.* _____*Nil*_____

Q.1 Define the heurestics search techniques. Also explain the Algo of steepest Ascent Hill climbing and Best first search. [4+6+6=16]

Or

Q.1 (a) What is various types of production system? Discuss the characteristics of a production system [4+4=8]

(b) Write an algorithm to describe "depth first search" procedure along with advantages and disadvantages. How is it different from Breadth first search? [6+2=8]

Q.2 (a) What is knowledge representation and also differentiate knowledge and knowledge base? [4+4=8]

(b) What is knowledge and knowledge engineering? Explain briefly the difference between procedural and declarative knowledge. [4+4=8]

Or

Q.2 (a) Determine whether following sentence is satisfiable, contradictory or valid:

$((A \rightarrow \neg B) \wedge (\neg C \rightarrow A) \wedge B) \rightarrow C$ [8]

(b) What are the various issues and approaches in knowledge representation? [8]

Q.3 (a) What is meant by conditional probability? Explain Baye's theorem. [8]

(b) What is reasoning? Differentiate forward and backward reasoning. [8]

(a) Refer Chapter 3, Section 3.3.5 on page no. 3.60.

(b) Refer Chapter 3, Section 3.3.3.2 on page no. 3.49.

(c) Refer Chapter 3, Setion 3.3.4 on page on. 3.54.

.2 (a) Explain the various requirements of an appropriate knowledge representation scheme. [5]

(b) Explain the Resolution principle by taking suitable example. Write the steps followed in the resolution. [6]

L. (a) Refer Chapter 4, Section 4.5 on page no. 4.10.

(b) Refer Chater 5, Section 5.8.2 on page no. 5.47.

OR

2 (a) Explain why predicate logic is better approach than propositional logic for knowledge representation. Given some examples also. [6]

(b) Explain why Close World Assumption (CWA) to deal with incomplete knowledge with suitable examples. [5]

(c) Write the steps to convert a predicate calculus expression into clausal form. Applying these steps convert the following into clausal form:

$(\neg P \wedge Q) \wedge (P \wedge \neg Q) \wedge S$ [6]

L. (a) Refer Chapter 5, Section 5.3 on page no. 5.10.

(b) Refer Chapter 6, Section 6.4.2 on page no. 6.13.

(c) Refer Chapter 5, Section 5.3 on page no. 5.10

Unit-III

(a) Explain the theory of Conceptual Dependency. Using diagram, show a conceptual dependency representation of the following sentence:

"While going home, I saw a frog" [6]

(b) Is it possible to compute P(A/~B) when you are only given P(A). P(B/A) and P(B)? Explain your answer. [5]

(c) How fuzzy logic is different from conventional binary logic. Explain it with suitable example. [5]

(a) Refer Chapter 1, Section 1.5. on page no. 1.12.

(b) Self Solved

(c) Refer Chapter 12, Section 12.1 and 12.3 on page no. 12.2 and 12.4.

OR

Q.3 (a) Explain the concept of Script as a structure describing the sequences of events. Construct a script of any suitable examples.

(b) Prove that if A and B are independent $P(B/A) = P(A)$. (Note that A and B are independent if and only if $P(A \& B) = P(A).P(B)$.

(c) Explain the concept of Semantic Net in knowledge representation. Using diagram, show a Semantic Net representation of the following sentence:

"John gave the book to Mary" [5]

Sol. (a) Refer Chapter 1, Section 1.5. on page no. 1.13.

(b) Self Solved

(c) Refer Chapter 1, Section 1.5 on page no. 1.10.

Unit-IV

Q.4 (a) Explain the Minimax search procedure used in game playing programs with suitable example. [6]

(b) Explain the Morphological analysis in Natural Language processing with suitable example. [6]

(c) Explain the goal stack planning approach for solving the compound goals. [5]

Sol. (a) Refer Chapter 7, Section 7.2. on page no. 7.4.

(b) Refer Chapter 9, Section 9.5 on page no. 9.9.

(c) Refer Chapter 8, Section 8.5 on page no. 8.10.

OR

Q.4 (a) What is Alpha-Beta pruning strategy? Explain its need with suitable example. [6]

(b) Explain the pragmatic analysis in natural Language processing with suitable example. [5]

(c) Explain the block world problem by taking suitable examples. [5]

Sol. (a) Refer Chapter 7, Section 7.3. on page no. 7.13.

(b) Refer Chapter 9, Section 9.9 on page no. 9.33.

(c) Refer Chapter 8, Section 8.2 on page no. 8.2.

(a) Refer chapter 1, section 1.8, page no. 1.21.

(b) (i) Refer chapter 3, section 3.3.3.2, page no. 3.49 and section 3.3.4.1, page no. 3.58.

(c) Refer chapter 2, section 2.9, page no. 2.18.

Unit–II

Q.2 (a) Explain briefly the difference between procedural & declarative knowledge. [5]

(b) Differentiate between domain dependent knowledge & domain independent knowledge. [5]

(c) What are KBS independent technologies? Explain in brief. Also write the business benefits of KBS. [6]

Sol. (a) Refer chapter 4, section 4.2, page no. 4.5.

OR

Q.2 (a) What are the various approaches & issues in knowledge representation? [8]

(b) Define the following terms:

(i) Mapping

(ii) Homomorphic

(iii) Horn clause

(iv) Reasoning [8]

Sol. (a) Refer chapter 4, section 4.4 and 4.5, page no. 4.8 and 4.10.

(b) (i) Refer chapter 4, section 4.3, page no. 4.7.

(ii) Refer chapter 4, section 4.5, page no. 4.13.

(iii) Refer chapter 4, section 4.6.1, page no. 4.14.

(iv) (i) Refer chapter 4, section 4.1, page no. 4.3.

Unit–III

Q.3 (a) Convert the following statement into predicate logic:

(i) Horses, cows and pigs are mammals.

(ii) An offspring of a horse is a horse.

(iii) Bluchog is a hog.

(iv) Bluchog is a Charlie parent.

(v) Offspring & parent are inverse relation.

(vi) Every mammal has a parent. [8]

(b) Write short note on:

(i) Default logic

(ii) Minimalist reasoning [8]

Sol. (b) (i) Refer chapter 6, section 6.4.1, page no. 6.9

(ii) Refer chapter 6, section 6.4.2, page no. 6.12

OR

Q.3 (a) Explain the algorithm of predicate logic resolution.

(b) explain the difference between forward & backward reasoning (chaining & u... what condition each would be best to use for.

Sol. (a) Refer chapter 5, section 5.3, page no. 5.11

(b) Refer chapter 6, section 6.2, page no. 6.3.

Unit–IV

Q.4 (a) Explain the algorithm of MINMAX search procedure and discuss any two from following:

(i) Alpha Beta cutoff

(ii) Secondary search

(iii) Waiting for quiescences [8]

(b) What are stips in NLP? List & explain them briefly. [8]

Sol. (a) (i) Refer chapter 7, section 7.2, page no. 7.4.

(ii) Refer chapter 7, section 7.2.2, page no. 7.18.

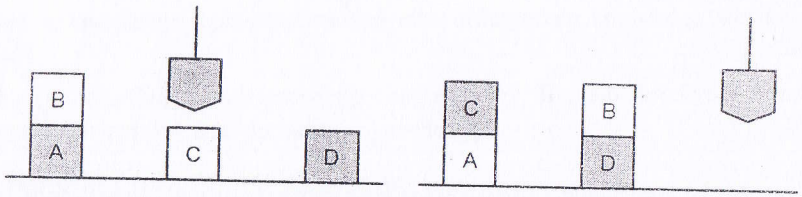
(iii) Refer chapter 7, section 7.3, page no. 7.17.

(b) Refer chapter 9, section 9.4, page no. 9.8.

OR

Q.4 (a) Write note on "hierarchical Planning". [8]

(b) Consider the following block world problem



Figure

Initial: On (B, A)n
On table (A)n
On table (C)n
On table (D)n

Goal: On table (A)n
On table (D)n
On (C, A)n
On (B, D)

POORNIMA FOUNDATION

LECTURE NOTES

Campus: P.C.E. Course: B.Tech Class/Section: III YR, VI Sem Date: 4.1.2022

Name of Faculty: Amol Sawant Name of Subject: Artificial Intelligence Code: 6EI4-05

Date (Prep.): Date (Del.): Unit No.: I Lect. No: I

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

Meaning and definition of AI,
Acting humanly, Thinking humanly, Thinking rationally
Acting rationally
Task domains of AI - Mundane, Formal, Expert tasks

IMPORTANT & RELEVANT QUESTIONS:

1. Discuss the rationalist approach of AI.
2. What are the various task domains of AI?

FEED BACK QUESTIONS (AFTER 20 MINUTES):

1. What is the difference between an agent and a Program?
2. What is turing test?

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Students can define AI, what are the different approaches to AI,
what are the various task domains of AI?

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

Rich & knight
Russel & Norvig

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PGC | DETAILED LECTURE NOTES | DATE:.....

Name of Faculty: Amol Sakeri College: Dept:

Name of Subject with Code: AI 6CS6.2 Branch.: CSE Class: III

What is Artificial Intelligence ?

Definitions to human performance. (Systems that think & act like humans)

1. The study of how to make computers do things at which, at the moment, people are better. (Rich & knight) 1991

2. The automation of activities that we associate with human thinking, activities such as decision making, Problem solving, learning ---- (Bellman, 1978)

Definitions of intelligence - 'Rationality'. measure success against an ideal concept

A system is rational if it does the 'right thing', given what it knows (Systems that think & act rationally)

3. The study of the computations that make it possible to perceive, reason and act. (Winston, 1992)

4. Computational intelligence is the study of the design of intelligent agents. (Poole, 1998)

Human centered approach — Empirical science, involving hypothesis and experimental confirmation. (experimental)

Rationalist Approach - Involves a combination of mathematics and engineering

Russell, Norvig - 1.

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IIT Kharagpur

1.1

PAGE NO:

PGC DETAILED LECTURE NOTES DATE:

Name of Faculty:..... College:..... Dept:.....

Name of Subject with Code:..... Branch.:..... Class:.....

What is AI ?

AI is concerned with the design of intelligence in an artificial device. [Mccarthy 1956]

Intelligence ?

- A system with intelligence is expected to behave as intelligently as human
- " " " to behave in the best possible manner.

what type of behavior we are talking about ?

1. Thought process or reasoning ability of the system
2. Final manifestations (demonstration) of the sys in terms of its actions.

→ Cognitive Science approach to AI -
Emulating human thought process

→ Turing test - computers can be programmed to acquire abilities rivaling human intelligence.

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PGC | DETAILED LECTURE NOTES | DATE:.....

Name of Faculty:.....College:.....Dept:.....

Name of Subject with Code:.....Branch.:.....Class:.....

Thinking Humanly : The cognitive modeling Approach

Cognitive ~~model~~ science brings together computer models from AI and experimental techniques from psychology to try to construct precise and testable theories of the workings of the human mind.

Common sense reasoning - Reasoning about physical objects and their relationship to each other (e.g. an obj can be in only one place at a time) as well as reasoning about actions and their consequences (e.g. if we let go of something, it will fall to the floor and may be break.)

To investigate this sort of reasoning, Newell built the General Problem Solver (GPS).

Thinking Rationally - The 'laws of thought' approach.

logic - X is a man; all men are mortal; therefore X is mortal.

Problems

- Not easy to take ~~information~~ informal knowledge and state it in the formal terms required by logical notation, when the ~~info~~ knowledge is < 100% certain.
- There is a big difference between being able to solve a problem in principle and doing so in practice.

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PGC DETAILED LECTURE NOTES DATE:

Name of Faculty:..... College:..... Dept:.....

Name of Subject with Code:..... Branch:..... Class:.....

Task Domains of AI

1. Mundane (ordinary) Tasks

Perception
- Vision
- Speech

Natural Lang.
- understanding
- Generation
- Translation

Commonsense reasoning

Robot control

2. Formal Tasks

Games
- chess
- checkers

Mathematics
- Geometry
- Logic
- Integral Calculus
- Proving properties of programs

3. Expert Tasks

Engineering
- Design
- fault finding
- Manufacturing planning

Scientific analysis

Medical diagnosis

Financial analysis

PGC | DETAILED LECTURE NOTES | DATE:.....

Name of Faculty: | College: | Dept:

Name of Subject with Code: | Branch.: | Class:

The Foundations of AI

- Philosophy
  - Can formal rules be used to draw valid conclusions?
  - How does mental mind arise from a physical brain?
  - Where does knowledge come from?
  - How does knowledge lead to action?

Philosophers made AI conceivable by considering the ideas that the mind is in some ways like a machine, that it operates on knowledge encoded in some internal language, and that thought can be used to choose what actions to take.

- Mathematician provided the tools to manipulate statements of logical certainty as well as uncertain, probabilistic statements.
  - Also. set the groundwork for understanding computation
  - Reasoning about algos.

- Economists formalized the problem of making decision that maximize the expected outcome to the decision maker.

How should we make decisions when the payoff may be far in the future?

- Neuroscience

How do brains process info?

- Psychology - How do humans and animals think and act?

Info processing machines - humans / animals.

Linguist & showed that language use fits into this model.

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PGC

LECTURE NOTES (COVER PAGE)

Name of Faculty: Anuj Saxena College: PCE Dept.: IT

Name of Subject with Code: AI Branch: IT Class: VI sem / III yr

Date (Prep.): Date (Del.): Unit No.: 3 Lect. No: 19

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

Predicate logic

Representing facts as WFFs.

Representing instance & Isa relationship.

IMPORTANT & RELEVANT QUESTION:

1. How instance attribute can be used in predicate logic?
2. What do you mean by computable predicates? explain.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

1. Define WFF.
2. Translate the sentence - 'Marcus was born in 40AD' into predicate logic formula.

OUTCOME OF THE DELEVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about student's feedback on this lecture, level of understanding of this lecture by students etc.)

Students learned that how facts can be represented as WFFs in first order predicate logic

REFERENCE: TEXT/REF. BOOK WITH PAGE NOS AND RELEVANT INTERNET WEBSITES:

Rich & knight - 137.

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PGC DETAILED LECTURE NOTES DATE:

Name of Faculty: College: Dept:

Name of Subject with Code: Branch.: Class:

Use of predicate logic as a way of representing knowledge (by example) –

1. Marcus was a man.

   man (marcus)

This representation captures the fact of marcus being a man. It fails to capture the notion of past tense.

2. Marcus was a Pompeian.

   Pompeian (Marcus)

3. All Pompeians were Romans

   $\forall x$: pompeian (x) → Roman (x)

4. Caesar was a ruler.

   ruler (caesar)

5. All romans were either loyal to caesar or hated him.

   $\forall x$: Roman (x) → loyalto (x, caesar) V hate (x, caesar)

OR - logical inclusive or. – means either left part is true or right part or both are true.

Here we have used inclusive interpretation

exclusive -OR (XOR) representation

$\forall x$: Roman (x) → [(loyalto (x, caesar) V hate (x, caesar))

∧ ¬ (loyalto (x, caesar) ∧ hate (x, caesar))

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Prooving the goal by reasoning backward from the desired goal. -

$\neg$ loyal to (Marcus, Caesar)

↑ ($\forall$, Substitution)

person (Marcus) $\wedge$
ruler (Caesar) $\wedge$
try assassinate (Marcus, Caesar)

↑ 4

person (Marcus)
try assassinate (Marcus, Caesar)

↑ 8

Person (Marcus)

we fail to prove it, since there is no way to satisfy the goal person (Marcus) with the stmts we have available.

~~We~~ We need to add another fact -

$\forall x$: man (x) $\longrightarrow$ person (x)

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1. instance (marcus, man)
2. instance (marcus, Pompeian)
3. isa (Pompeian, Roman)
4. instance (caesar, ruler)
5. $\forall x$: instance (x, Roman) $\rightarrow$ loyalto (x, caesar) $\vee$ hate (x, caesar)
6. $\forall x : \forall y : \forall z$: instance (x, y) $\wedge$ isa (y, z) $\rightarrow$ instance (x, z)

NOTE! Class and superclass membership are important facts that need to be represented, but these memberships need not be represented with predicates labeled instance and isa. Instead, unary predicates corresponding to the classes are often used.

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Name of Subject with Code: | Branch.: | Class:

Computable Functions and predicates

Representing facts, such as > and < relationship –

gt (1, 0)
gt (2, 1)
gt (3, 2)
⋮

lt (0, 1)
lt (1, 2)
lt (2, 3)
⋮

gt (2+3, 1) T.

1. Marcus was a man
   man (Marcus)
2. Pompeian (Marcus)
3. Marcus was born in 40 AD
   born (Marcus, 40)

   B.C. can be represented by negative numbers.

4. All men are mortal
   ∀x: man (x) → mortal (x)
5. All Pompeians died when the volcano erupted in 79 AD.
   erupted (volcano, 79) ∧ ∀x: [Pompeian (x) → died (x, 79)]

This sentence asserts the fact that the eruption of the volcano caused the death of the pompeians. People often assume causality b/w concurrent events if such causality seems believable.

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A set of facts about marcus.

1 man (marcus)

2 Pompeian (marcus)

3 born (marcus , 40)

4 $\forall x$: man (x) $\rightarrow$ mortal (x)

5 $\forall x$: Pompeian (x) $\rightarrow$ died (x, 79)

6 erupted (volcano, 79)

7 $\forall x : \forall t1 : \forall t2 :$ mortal (x) $\wedge$ born (x, t1) $\wedge$ gt (t2 - t1, 150) $\rightarrow$ dead (x, t2)

8 now = 1991

9 $\forall x : \forall t :$ [alive (x, t) $\rightarrow$ $\neg$ dead (x, t)] $\wedge$ [$\neg$ dead (x, t) $\rightarrow$ alive (x, t)]

10 $\forall x : \forall t1 : \forall t2 :$ died (x, t1) $\wedge$ gt (t2, t1) $\rightarrow$ dead (x, t2)

Note - the term nil at the end of each proof indicates that the list of conditions remaining to be proved is empty and so the proof has succeeded.

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LECTURE NOTES

Campus: ....P.C.E..... Course: ....B..Tech Class/Section: ....IV YR / VI Sem Date: .....

Name of Faculty: ....Amol Sakeng.... Name of Subject: ....AI..... Code: 6ET4-05

Date (Prep.): ..... Date (Del.): .....Unit No.:....2.....Lect. No: .....

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

Unit-2

Game playing - why games are studied in AI?
minimax search procedure,

IMPORTANT & RELEVANT QUESTIONS:

1. Define static evaluation function,
2. Explain the minimax search procedure.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

1. Why games are a good domain to explore machine intelligence.?
2. what are the two supportive procedures on which minimax algorithm relies?

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

Rich & Knight
Russel & Norvig

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PGC | DETAILED LECTURE NOTES | DATE:.....

Name of Faculty: Amol Saxena | College: PCE | Dept: IT

Name of Subject with Code: AI / 6IT4-05 | Branch.: | Class: III yr VI Sem

UNIT-II 2

Game Playing

Games are a good domain to explore machine intelligence.

- They provide a structured task in which it is easy to measure success or failure
- Do not require large amounts of Knowledge. (Earlier it was thought) Solvable by simple search methods.

The second reason is only true for only simplest games. For ex: consider the game of chess

- The avg branching factor is around 35
- In an avg game, each player might make 50 moves.
- In order to examine the complete game tree, we would have to check 35^{100} positions.

To improve the effectiveness of a search based Problem solving Program two things can be done —

- Improve the generate procedure so that only good moves (or paths) are generated.
- Improve the test procedure so that the best moves explored first.

Plausible move generator — only some small number of promising moves are generated, Heuristic is applied for this.

Note — In game playing, search is not the only available technique. For ex. in chess both openings and endgames are often highly stylized, so they are best played by table lookup into a ~~database~~ database of stored patterns.

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Name of Subject with Code: | Branch.: | Class:

So the two components (knowledge based) of a good game playing program are –

- Good Plausible move generator
- Good static eval. Function.

} Both incorporate a great deal of knowledge.

Imp' Unless these functions are perfect, we also need a search procedure that makes it possible to look ahead as many moves as possible to see what may occur.

What search strategy should be used? –

For a single simple one person game or puzzle, the A* algo can be used.

The heuristic func. h' can be applied at terminal nodes and used to propagate values back up the search graph so that the best next move can be chosen.

This procedure is inadequate for two person games like 'chess' because of their adversarial nature.

Note' – competitive environments in which goals of multiple agents are in conflict.

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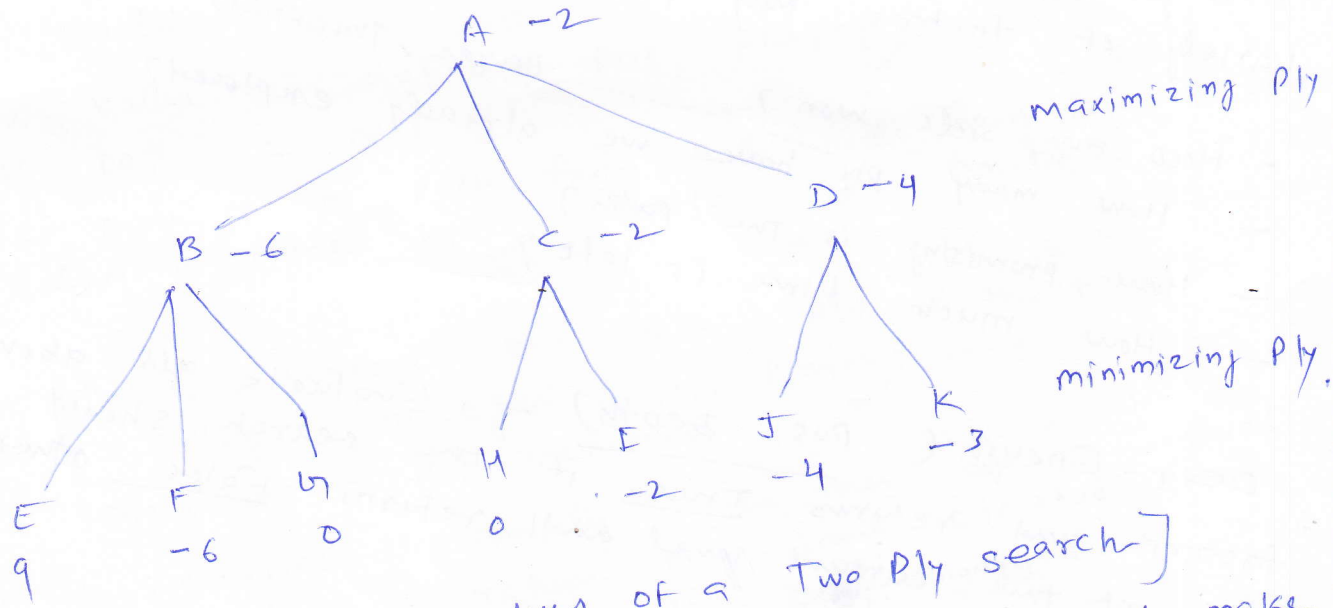
Name of Subject with Code: | Branch.: | Class:

But now we must take into account that the opponent gets to choose which successor moves to make and thus which terminal value should be backed up to the next level.

Suppose we made move B.
Then the opponent must choose among moves - E, F and G.
The opponent's goal is to minimize the value of the evaluation function, so he can be expected to choose move F.

This means that if we make move B, the actual position in which we will end up one move later is very bad for us.



[Backing up the values of a Two Ply search]

So, it becomes clear that the correct move for us to make at the first level, is C.

This process can be repeated for as many ply as time allows.

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Three params. → A board position, the current depth of the search, Player to move

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Initial call to compute the best move from the position current should be.

minimax (current , 0 , Player-one) → If player one is to move

minimax (current , 0 , Player-two) → If player-two is to move

Algorithm - Minimax (Position, Depth, player)

1. If Deep-Enough (pos, Depth), then return the structure.

value = static (pos, player)

path = Nil

ie. there is no path from this node and that its value is that determined by the static eval. function.

2. otherwise, generate one more ply of the tree by calling movegen (pos, player) and

successors = list returned.

3. If successors is empty, then there are no moves to be made, so return the same structure that would have been returned if Deep-Enough had returned false.

4. otherwise, examine each element in turn and keep track of the best one.

R & K 312 - 313

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LECTURE NOTES

Campus: ...PCE..... Course: ...B.Tech.. Class/Section: ...VI sem | III yr Date: .....

Name of Faculty: ...Amol Saxena.. Name of Subject: ...AI..... Code: 6IT4-05

Date (Prep.): ..... Date (Del.): .....Unit No.:...4.....Lect. No: ...30.....

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

Supervised learning - Decision trees.
classification by decision tree induction
Attribute selection measures - Information
Gain n method.

IMPORTANT & RELEVANT QUESTIONS:

1. Write the steps of ID3 decision tree induction algorithm.
2. How attributes are selected in ID3 method?

FEED BACK QUESTIONS (AFTER 20 MINUTES):

1. What are the different applications of decision tree based learning?
2. What do you mean by information Gain?

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

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DETAILED LECTURE NOTES

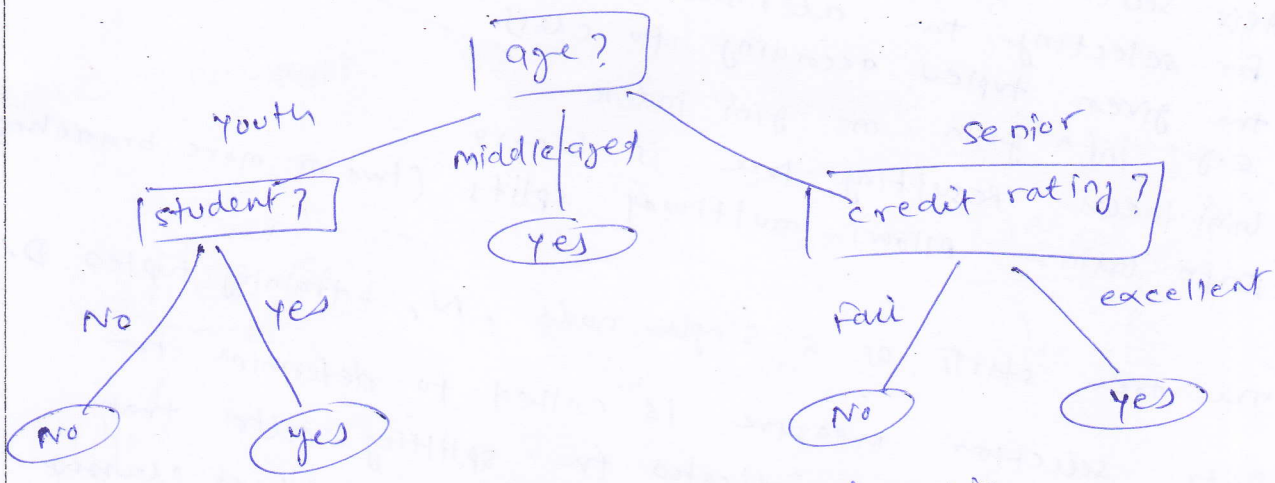
Unit - 5 Learning

Decision Trees

A decision tree is a flow chart like tree structure, where each internal node denotes a test on an attribute, each branch represents an outcome of the test, and each leaf node holds a class label.

Decision tree induction is the learning of decision trees from class labeled training data.

The following decision tree represents the concept buys-computer



Decision trees are used for classification (supervised learning)

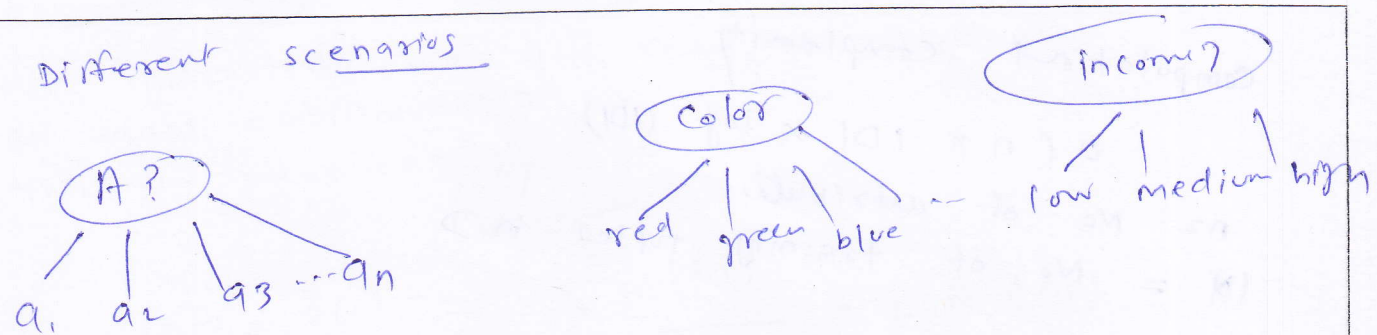
Application areas - medicine, manufacturing, production, financial analysis, molecular biology, commercial rule induction systems.

DETAILED LECTURE NOTES

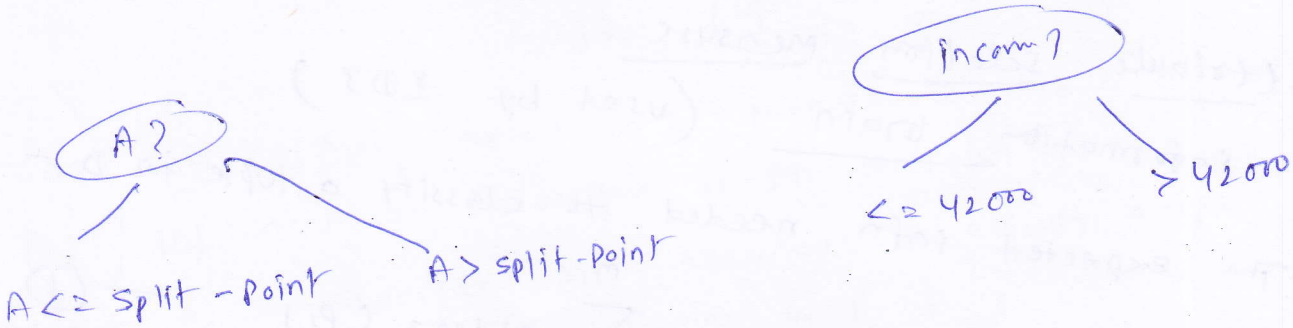
PAGE NO. .....

Different scenarios

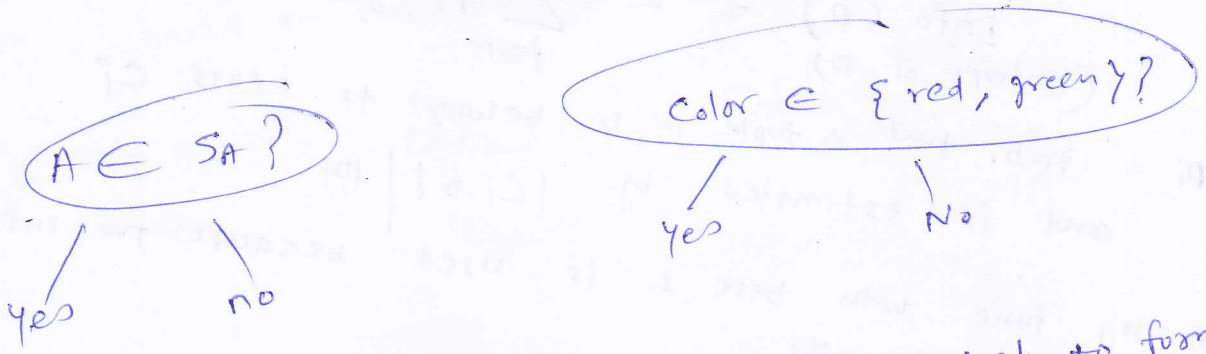
(a)



(b)



(c)



4. The algorithm uses the same process recursively to form a decision tree for the tuples at each resulting partition, Dj of D.

5. The recursive process stops when (any one is true)

(i) All the tuples in partition D belong to the same class

(ii) There are no remaining attributes on which the tuples may be further partitioned.

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More information we still need to arrive at an exact classification ?
This is measured by

$$Info_A(D) = \sum_{j=1}^{v} \frac{|D_j|}{|D|} \times Info(D_j) \quad -2$$

D_j contains those tuples in D that have outcome a_j of A

$\frac{|D_j|}{|D|}$ acts as a weight of j^{th} partition

$Info_A(D)$ - Expected info required to classify a tuple from D based on the partitioning by A

$$Gain(A) = Info(D) - Info_A(D) \quad -3$$

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LECTURE NOTES

Campus: PCE Course: B.Tech Class/Section: III yr / VI Sem Date:

Name of Faculty: Amol Saxena Name of Subject: AF Code: 6ET4-05

Date (Prep.): Date (Del.): Unit No.: 5 Lect. No: 39

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture) Unit - 5

Expert systems - Introduction & Definition characteristics and features, Applications Expert system shells, Representing and using domain knowledge, knowledge acquisition

IMPORTANT & RELEVANT QUESTIONS:

1. How knowledge is represented in expert systems, and how it is used by expert systems?
2. Write a short note on Expert system shells.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

1. Define expert systems.
2. What is EMYCIN

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

students will be able to explain how expert systems are built.

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

Rich & Knight

Dan W Patterson, Russel & Norvig

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Unit -5 (AI)

DETAILED LECTURE NOTES

Expert Systems

Expert systems are complex AI programs that solve problems that are normally solved by humans experts. For this, expert systems need access to a substantial domain knowledge base. ESs also need to exploit one or more reasoning mechanism to apply their knowledge to the problems they are given. They also need a mechanism for explaining what they have done to the users who rely on them

Representing and using Domain Knowledge

most widely used way of representing domain knowledge is a set of production rules, which are coupled with a frame system that defines the objects that occur in the rules.

English versions of the actual rules

PROSPECTOR is a program that provides advice on mineral exploration,

If: magnetite or pyrite in disseminated or veinlet form is present

Then: [2,-4] There is favorable mineralization and texture for the propylitic stage

Each rule contains two confidence estimates. The first indicates the extent to which the presence of the evidence described in the condition part of the rule suggests the validity of the rule's conclusion.

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TEIRESIAS was the first program to support explanation and knowledge acquisition. TEIRESIAS served as a front end for the MYCIN expert system

Knowledge Acquisition

We have to understand how are expert systems built, The domain experts are interviewed to elucidate expert knowledge, which is then translated into rules. After this, it must be regularly refined until it approximates expert level performance.
There are many programs that interact with domain experts to extract expert knowledge efficiently. These programs provide support for -

- Entering knowledge
- maintaining knowledge base consistency
- Ensuring KB completeness

The knowledge acquisition programs are based on a problem solving paradigm
For example - If the ~~program~~ paradigm is diagnosis, then the program can structure its knowledge base around symptoms, hypotheses, and causes.

MOLE is a knowledge acquisition system for heuristic classification problems, such as diagnosing diseases. An expert system produced by MOLE accepts input data, comes up with a set of candidate explanations or classifications that cover or explain the data, and then uses differentiating knowledge to determine which one is best.

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