Chapter 2

Review & General Considerations

Introduction

In the present times, research work is going on in context of knowledge-based systems and expert system development in the field of law. In the subsequent section general consideration of the research study such as knowledge-based systems, rule-based reasoning, case-based reasoning and the hybrid approach is discussed. Also, in this chapter the historical review of legal knowledge-based system is given and some of the major existing work in these areas has been reviewed.

Knowledge-based system development

John. S. Edwards in the book “Building Knowledge Based Systems towards a methodology” says “By knowledge-based systems we mean computer-based systems which support or perform automatically, cognitive tasks in a narrow problem domain which are usually only carried out by human experts” [3].

Hence, it can be inferred that knowledge-based systems (henceforth referred as KBS) are computer programs that are designed to emulate the work of experts in specific areas of knowledge. One of the important lessons learned in AI during the 1960s was that general purpose problem solvers that use a limited number of laws or axioms were too weak to be effective in solving problems of any complexity. This realization eventually led to the design of what is now known as knowledge-based systems, systems that depend on a rich base of knowledge to perform difficult tasks.

This new view of AI systems marked the turning point in the development of more powerful problem solvers. Since this realization, much of the work done in AI has been related to KBS, including work in vision-learning, general problem solving, and natural language understanding. This is in turn has led to more emphasis being placed on research related to knowledge representation, memory organization, and the use and manipulation of knowledge. A simple knowledge-based system is represented in figure 2.1.
The profounder of Expert system, Edward Feigenbaum summarized this new thinking in a paper at the International Joint Conference on Artificial Intelligence (IJCAI) in 1977. He emphasized the fact that “The real power of an expert system comes from the knowledge it possesses rather than the particular inference schemes and other formalisms it employs” [17].

Thus knowledge-based systems in principle replaces the human problem solver capable of performing the task by himself, either completely or more commonly by allowing less skilled workers to perform the same task assisted by the KBS. The introduction of a KBS is typically intended to take boring routine tasks out of the hands of scarce experts so that they can spend more time on the hard problems. The KBS for instance is capable of handling the great bulk of law applications without any human intervention, a stage that has already been reached in countries like United States of America, Italy, Sweden to name a few. As a result the experts in the legal administration will get to spend more time on complicated and suspect cases. Scarcity of expertise seems inescapable in the legal field in the foreseeable future as any increase in efficiency of the legal system will presumably be cancelled by increasing demand. The argument for this observation is simple, if the legal system is the expensive last resort solution for maintaining normative order in a society, as is often argued, any reduction in the costs of this solution generates increased demand. It is reasonable to expect that the use of KBS increases the quality of jobs in the legal field, while making the legal solutions more accessible. Expert systems in the domain of law have not only been used as prototypes, but they also act as an important venture in testing theories and in the assistance in legal decision-making [1]. J M. Bench-Capon et.al substantiating with a view discussed earlier states that “Legal Knowledge-Based Systems are, by definition grounded on law, because law is subject to amendment, significant problems of adaptation are posed for KBS in practical use” [18].

KBS get its input from the expert knowledge that has been coded into facts, rules, heuristics, and procedures. The knowledge is stored in a knowledge-base separate from the control and inferencing components. This makes it possible to add new knowledge or refine
existing knowledge without recompiling the control and inferencing programs. This greatly simplifies the construction and maintenance of KBS. The structure of the expert system is illustrated in figure 2.2 as below.

![Figure 2.2 Structure of Expert System [20]](image)

**The Need for Knowledge-based systems / Expert Systems**

Expert systems are necessitated by the limitations associated with conventional human decision-making processes, including:

1. Human expertise is very scarce.
2. Humans get tired from physical or mental workload.
3. Humans forget crucial details of a problem.
4. Humans are inconsistent in their day-to-day decisions.
5. Humans have limited working memory.
6. Humans are unable to comprehend large amounts of data quickly.
7. Humans are unable to retain large amounts of data in memory.
8. Humans are slow in recalling information stored in memory.
9. Humans are subject to deliberate or inadvertent bias in their actions.
10. Humans can deliberately avoid decision responsibilities.
11. Humans lie, hide, and die [19].
Coupled with these human limitations are the weaknesses inherent in conventional programming and traditional decision-support tools. Despite the mechanistic power of computers, they have certain limitations that impair their effectiveness in implementing human-like decision processes. Conventional programs:

1. Are algorithmic in nature and depend only on raw machine power
2. Depend on facts that may be difficult to obtain
3. Do not make use of the effective heuristic approaches used by human experts
4. Are not easily adaptable to changing problem environments
5. Seek explicit and factual solutions that may not be possible [19].

**Benefits of Knowledge-based systems / Expert Systems**

Expert systems offer an environment where the good capabilities of humans and the power of computers can be incorporated to overcome many of the limitations discussed in the previous section. Expert systems:

1. Increase the probability, frequency, and consistency of making good decisions
2. Help distribute human expertise
3. Facilitate real-time, low-cost expert-level decisions by the non-expert
4. Enhance the utilization of most of the available data
5. Permit objectivity by weighing evidence without bias and without regard for the users personal and emotional reactions
6. Permit dynamism through modularity of structure
7. Free up the mind and time of the human expert to enable him or her to concentrate on more creative activities
8. Encourage investigations into the subtle areas of a problem [19].

**Limitations of Knowledge based systems / Expert Systems**

Although the expert system technology has progressed substantially, it would be a mistake to overestimate the abilities of the technology. Deficiencies of the current expert systems include:

- **The lack of causal (or deep) knowledge.** The expert systems do not have a real understanding of the causes and effects in a system, mainly because it is much easier to program expert systems with shallow knowledge, based on empirical and
heuristic knowledge. Designing an expert system based on basic structures, functions and behaviours of objects takes a lot more effort and the resulting system is a lot more complex (and more difficult to maintain / upgrade)

- **Dealing with uncertainty.** Human experts recognise the limits of their knowledge and can qualify their expertise when the problem reaches their so-called limit of ignorance, an expert system, unless this problem is explicitly catered for, will make confident recommendations even in the presence of incomplete and/or inaccurate data. In conclusion the expert system's solution must degrade gracefully, just like in the case of a human expert.

- **The current expert systems cannot make analogies** i.e. cannot generalise their knowledge in order to reason about new situations in the way that people can. Rule induction may help the system achieve only some types of new knowledge. Expert systems, even limited in the present form, have still been able to solve problems that conventional programming methodologies were unable to scope with. By fully understanding the capabilities and limitations of the expert system technology, we can make appropriate use of it [19].

**Historical Review of legal knowledge based system.**

The scope of computer applications in the law is wide. It extends from general applications of use to lawyers, to applications designed specifically for the law. This thesis is concerned with the development of legal knowledge-based system with specific reference to the Transfer of Property Act, a subset of Indian Legal Domain. A legal knowledge-based system / expert system, as the term is used in this thesis, are the systems capable of performing on par with a lawyer.

Artificial Intelligence (AI) focuses on capturing the idea of intelligent reasoning in computers and on making “intelligent” computer programs. In the early days of Artificial intelligence research, it was recognised that intelligent performance of both humans and computers requires a great deal of factual knowledge. This means that the development of systems which demonstrates a general artificial intelligence is practically impossible, because it presupposes the development of enormous knowledge bases [20]. It is thus recognised that AI research should aim at developing more specific systems, confined to knowledge domains with limited zones. The limitation of a domain reduces the amount of knowledge to be incorporated in the system and makes it possible to aim for systems which
can make expert-like decisions in that domain. [20]. It was observed during the literature survey that during the ‘90s, there was a special trend of using the term ‘Knowledge-Based systems’ not only for computer applications implementing Artificial Intelligence concepts, but also organisational systems that paid a special attention to knowledge acquisition, storage and retrieval [21].

In order to know about the previous research done in this direction, several studies dedicated to the topic or to broader topics including references to KBSs were examined. Expert Systems developed can be categorized into following types. [22].

- The ‘expert systems’, and the main models of computerized inferencing (drawing inferences) that have emerged.
- The relationship between legal theory (jurisprudence) and computerization of legal tasks.
- Rule-based reasoning and its applications to statute-based law.
- Case-based reasoning and the problems of applying it (or neural networks or anything else) to case law.
- The relationships between inferencing and the other technologies of hypertext and text retrieval.
- The special issues in web-based legal inferencing, and the opportunities for greater integration with hypertext and text retrieval.
- Automated legal document generation systems
- Evaluation of Legal Knowledge Based systems

In order to explore about the research work done in the area of AI and law many research studies were collected and analysed. In the subsequent part a review of some of works is given.

**James Popple [23]** in his PhD thesis SHYSTER demonstrates that a useful, working legal expert system could be based upon a pragmatic approach to the law. SHYSTER is of a general design, so that it can operate in different legal domains. It was designed to provide advice in areas of case law that have been specified by a legal expert using a specially developed specification language. SHYSTER is also a case-based legal expert system. Its knowledge of the law is acquired, and represented, as information about cases. It produces its advice by examining, and arguing about, the similarities and differences between cases. By contrast, a rule-based expert system represents the law using rules. A hybrid system uses both rule-based and case-based techniques. SHYSTER has been designed so that it
can be linked with a rule-based system to form a hybrid legal expert system. Although SHYSTER attempts to model the way in which lawyers argue with cases, it does not attempt to model the way in which lawyers decide which cases to use in those arguments. It uses statistical techniques to quantify the similarity between cases, and chooses cases on the basis of that similarity measure. SHYSTER’s representation structure was designed so as to be as simple as possible while complex enough to allow SHYSTER to produce good advice. This simple structure greatly simplifies the process of knowledge acquisition.

Ajith Abraham, [24] presents the study conducted by many researchers who have given the view points on the aspect of rule-based expert systems. Conventional problem-solving computer programs make use of well-structured algorithms, data structures, and crisp reasoning strategies to find solutions. The author observes that for the difficult problems with which expert systems are concerned, it may be more useful to employ heuristic strategies that often lead to the correct solution, but that also sometimes fail. Conventional rule-based expert systems use human expert knowledge to solve real-world problems that normally would require human intelligence. Expert knowledge is often represented in the form of rules or as data within the computer. The author also discusses inference engine and development of expert system.

Chorley Alison and Trevor Bench-Capon. et al [25] have proposed that reasoning with legal cases be seen as a process of theory construction, evaluation and application. They have proposed a set of theory constructors to specify the process of theory construction. In their research work the authors describe an implementation of these constructors as part of a system intended to support the development of a Legal Knowledge-Based System (LKBS) from a set of cases. The constructors provide a means of building a theory from a background analysis. Once a theory has been constructed, the system generates Prolog code conforming to the theory, including the priorities demanded by the theory. This code can then be incorporated into a shell to provide a simple LKBS, which can be used for testing and evaluation, or upgraded into a usable application. The process is illustrated by showing how the tool could be used to develop a LKBS for US Trade Secret Law, drawing on the analysis used in Aleven’s CATO system.

Donald A. Waterman. et al [26] in a work opine that AI technology is being used to develop expert systems that solve complex problems in the legal area. Most of these systems employ rules to describe the strategies and procedures used by litigators to analyze legal issues. The tasks performed by these systems include interpreting the law, anticipating the legal consequences of proposed actions, predicting the effects of changes
in legislation, as well as analyzing and managing cases. The special characteristics of the legal domain cause certain problems for expert system builders. The authors discuss some of these problems and describe LDS and SAL, two expert systems. The authors have developed for case evaluation and settlement in the product liability area. SAL (System for Asbestos Litigation) evolved from the earlier and more general expert system, LDS (Legal Decision making System). The authors also describe XPL, an explanation facility developed for use by SAL and other expert system applications.

**Gabriela Avram, [27]** in a research work “Empirical Study on Knowledge-Based systems” state that knowledge-based systems (KBSs) implement the heuristic human reasoning through specific techniques, procedures and mechanisms, in order to solve problems that do not have a traditional algorithmic solution. The author opines that research on this topic is being done in numerous organisations all over the world, from higher education laboratories to research institutes and software development organisations. The author discuss their two research project, the first aimed at gathering information about the State-of-the-Practice in building Knowledge-Based systems with practical applications, needed a preliminary study to ascertain if KBSs still exist today as a research topic, or the interest in them actually faded. The study was also required for finding organisations currently building KBSs for different domains. The project's aim was to catalogue the software and/or knowledge engineering methods employed by the listed organisations, in order to draw a comprehensive image (State-of-the Practice) of the field. The author’s second research project re-used the results of the preliminary study, focusing on the study of KBS successful implementations as a basis for building a method that would allow practitioners to choose the most appropriate KM tools for each organisation's specific problems and situations. A trigger for this second project was the interest in studying the causes of KBS rejection by the end-users. An attempt to map the identified applications of KBS to different phases of knowledge management lifecycle is also presented.

**Hussein H. Owaied., et al [28]** in a research work presents a framework for developing shell expert system as new environment development for expert systems. The framework is based on the integration of two different knowledge representation formats. The integration consists of the Rule-base and the Case-based formats using the Blackboard. This scheme uses both procedural and declarative knowledge representation formalisms through the application of relational data base. So the rule-base and case-base formats have been converted into tables. The authors in their work present all the algorithms, for creating,
indexing, and checking the availability of a rule and a case. The scheme facilitates combination of forward and backward chaining reasoning, using many problem solving methodologies, and different searching techniques. The scheme makes the proposed rule-case-based shell expert system more flexible, efficient, and more powerful for the development of the expert systems in future.

Ioannis Hatzilygeroudis, et al [29] in their research work, presents an approach that integrates symbolic rules, neural networks and cases. This is achieved by integrating hybrid rules, called neurules, with cases. Neurules integrate symbolic rules with the Adaline neural unit. In the integration, neurules are used to index cases representing their exceptions. In this way, the accuracy of the neurules is improved. On the other hand, due to neurule based efficient inference mechanism, conclusions can be reached more efficiently. In addition, neurule based inferences can be performed even if some of the inputs are unknown, in contrast to symbolic rule-based inferences. Furthermore, an existing symbolic rule-base with indexed exception cases can be converted into a neurule base with corresponding indexed exception cases. Finally, empirical data can be used as a knowledge source, which facilitates knowledge acquisition. These authors also present a new high-level categorization of the approaches integrating rule-based and case-based reasoning.

Jinmu Choi, [30] in a work, “A Rule-Based Expert System Using an Interactive Question-and-Answer Sequence”, presents a rule-based expert system that uses an interactive question-and-answer sequence. In this system, the knowledge (prologue, questions and answers, and rules) can be constructed easily by an expert using English. Using this system, users can determine a solution to a specific problem easily from the constructed rules through the interactive question and answer sequence. The questions and solutions will be generated by a rule-based engine using existing rules. This rule-based expert system consists largely of a main window system (expert part, user part, and map part), rule-based engine, and a database. This system is applied to the interactive interpretation of aerial photographs for neophytes.

Karan Sharma. [31] in his work proposes that knowledge-based systems must be designed as complex adaptive systems and any other approach is not primary, even if sometimes it yields good results. Complex systems are characterized as having global behaviour not always explainable from local behaviour. He also proposes that the way to perceive knowledge in AI needs to change to Complex Adaptive; hence the need for a paradigm shift is stressed. Almost all historical KBS were not complex systems in an authentic sense. But it is not a good idea to criticize them because with the available
resources and theories, they did their best. Author state “Sooner or later, the author will have to design our KBS as complex adaptive systems, so why not sooner”. There are three mechanisms that must be part of any knowledge-based system, viz., Interdependency and fluidity, mechanisms for attribution of emergent properties and self-organization.

Mariana Maceiras., et al [32] present the results of the research carried out on the development of a medical diagnostic system applied to the Acute Bacterial Meningitis, using the case-based reasoning methodology. The research was focused on the implementation of the adaptation stage, from the integration of case-based reasoning and rule-based expert systems. In this adaptation stage the authors use a higher level RBC that stores and allows reutilizing change experiences, combined with a classic rule-based inference engine. In order to take into account the most evident clinical situation, a pre-diagnosis stage is implemented using a rule engine that, given an evident situation, emits the corresponding diagnosis and avoids the complete process.

Sascha Mertens., et al [33] in their research work describe a concept for creating free configurable, intelligent behaving web dialogues for rule-based expert systems. Free configurable is meant to indicate that, the dialogue module developed with this concept is domain independent and being configurable without requiring means of programming. Intelligent means that in spite of this independency, it can behave in accordance with the expert system’s knowledge and the received user inputs.

Thomas A. O'Callaghan et al [34] in a work titled “SHYSTER-MYCIN a Hybrid Legal Expert System” combines a case-based legal expert system (SHYSTER) with a rule-based expert system (MYCIN) to form a hybrid legal expert system. MYCIN’s reporting has been improved for use with SHYSTER-MYCIN to provide more useful information about the system’s conclusions. SHYSTER-MYCIN’s output was tested against a group of lawyers, not expert in the test domain (Australian copyright law). This allowed the system’s reasoning, rather than its depth of knowledge, to be tested. Testing indicates that SHYSTER-MYCIN’s approach to the law using a rule-based system to reason with legislation and a case-based system to reason with cases is appropriate.

Aida Batarekh., et al [35] opines that the success of numerous expert systems in practical applications warrants a more formal approach to their development and evaluation. Reliability assurance of expert systems requires a methodology for the specification and evaluation of these systems. Expert systems are a new class of software system, but some traditional techniques of software development may be adapted to their construction. However, the specification of an expert system differs from that of more traditional
software program in that parts of the specification are permitted to be only partially described when development starts.

Andrew R. Golding., et al [36] in this research the authors propose a novel architecture for combining rule-based and case-based reasoning. The central idea is to apply the rules to a target problem to get a first approximation to the answer but if the problem is judged to be comparing similar to a known exception of the rules in any aspect of its behaviour, then that aspect is modelled after the exception rather than the rules. The architecture is implemented for the full-scale task of pronouncing surnames. Preliminary results suggested that the system performs almost as well as the best commercial systems. However, of more interest than the absolute performance of the system is the result that this performance was better than what could have been achieved with the rules alone. This illustrates the capacity of the architecture to improve on the rule-based system it starts with. The results also demonstrate that a beneficial interaction in the system, in that improving the rules speeds up the case-based component.

Andrew Stranieri., et al [37] the authors opine that the evaluation strategies to assess the effectiveness of legal Knowledge-Based systems enable strengths and limitations of systems to be accurately articulated. This facilitates efforts in the research community to develop systems and also promotes the adoption of research prototypes in the commercial world. However, evaluation strategies for systems that operate in a domain as complex as law are difficult to specify. The authors present evaluation frameworks put forward in earlier research work and describe how this motivated the evaluation of systems in Australian family law. Strategies surveyed include a comparison of linear regression with neural networks, user acceptance surveys, a comparison of system predictions with those from past cases, and a comparison of system outputs with those proposed by a panel of lawyers. Specific criteria for the evaluation of explanation facilities are also described.

Bench-Capon., et al. [38] Discusses in the research work the potential for providing Knowledge-Based support for the task of formulating policy, and determining what legislation is required to implement the policy. The authors also discuss of previous work in this area, certain major obstacles are identified, chief among these is the need to match what the KBS can do with the way in which policy makers conceptualize and perform their task. Effective support can only be provided by a system which can be fully integrated into the working practice of its users. Some examples of an alternative approach, based on hypertext, are discussed, and authors also come out with some proposals for overcoming the obstacles with a combination of the hypertext and Knowledge-Based approaches.
Cindy Marling, et al [39] in their research work the authors succinctly summarize work in integrating case-based reasoning (CBR) with other reasoning modalities. Including CBR in mixed mode approaches promotes synergies and benefits beyond those achievable using CBR or other individual reasoning approaches alone. Numerous examples of hybrid systems, with pointers to significant references, are provided.

Edwina L. Rissland, et al [40] discusses a heuristically controlled approach to combining reasoning with cases and reasoning with rules. The task presented is interpretation of under-defined terms that occur in legal statutes (like the Internal Revenue Code) where certain terms must be applied to particular cases even though their meanings are not defined by the statute and the statutory rules are unclear as to scope and meaning. The authors describe this problem, known as statutory interpretation, and provide examples of it; they also describe the need for melding case-based and rule-based reasoning, and discuss heuristics used in guiding reasoning on such problems.

Thomas Gordon’s presentation at ICAIL conference gives the detail account of the development of domain of AI & Law. These chronological developments can broadly categorise into five periods of time [41]. The first period from 1950s – 1960s was the initial period in which good knowledge representation model were not available. Hence emphasis of work was mainly on Legal Applications using the Classical Logic. The second period starting from 1970s – 1980s is considered as the period of Birth of AI and Law domain. The work of emphasis was on AI and legal reasoning. Thorne McCarty’s “Reflections on TAXMAN: An experiment in artificial Intelligence and legal reasoning. Harvard Law Review 90”, in the year 1977 is considered as landmark research work during this period. Also the work of Edwina Rissland’s on “Examples in the legal domain: Hypothetical in contract law” is an important contribution during this period. The third period starting from 1980-1990 contributed to the research work the development of expert systems in field of law like HYPO by Edwina Rissland and Kevin Ashley, Richard Susskind’s Expert Systems in Law. Case-based reasoning and development of composite expert systems was the focus of research and the contributors were “CABARET: Combining Case-Based and Rule- Based Reasoning” by Edwina Rissland & David Skalak & Kevin Ashley’s “Modeling Legal Argument: Reasoning with Cases and Hypothetical’s”. During the fourth period from 1991-2000 many new techniques were proposed such as isomorphism, conceptual retrievals of legal texts, LKS for Public Administration, Legal Ontologies, Dialectical Models in AI and Law and Legal Meta-Inference. The final period from 2001-2011 the important focus shifted to information extraction methods from cases,
role of context in case-based legal reasoning. Stefanie Brüninghaus, Kevin D. Ashley work on predicting outcomes of case-based legal arguments, Henry Prakken work on “AI & Law, Logic and Argument Schemes”, Giovanni Sartor research work on “Legal Reasoning: A Cognitive Approach” are some of important works.

**Rule based and case based reasoning.**

The development of the expert system demands use of reasoning methodologies. The development and implementation of rule-based systems in carried in different domain such banking, medicine, law [42]. Hence, two of the most popular choices are introduced for building knowledge-based systems; they are the rule-based and case-based methodologies. The details of the two methodologies are as discussed in subsequent sections.

**Rule-based Expert Systems**

Knowledge representation in expert systems may be rule-based or encapsulated in objects. The rule-based approach uses IF-THEN type rules and it is the method currently used in constructing expert systems. IF-THEN rules take the following form:

\[ IF \text{ there is a flame} \quad \text{THEN there is a fire} \]

The modern rule-based expert systems are based on the Newel and Simon model of human problem solving in terms of long-term memory (rules), short-term memory (working memory) and cognitive processor (inference engine). Some of the expert systems may be based on rules in thousands (e.g. XCON/R1 system from Digital Equipment Corporation, used for configuring computers) and surpass a human expert in a particular field. However, even smaller sized expert systems may be based on several hundred rules which may be extremely efficient in much specialized areas. While a knowledge-based system may be dependent on the knowledge commonly available, a true ‘expert’ system will be based on unwritten expertise, acquired from a human expert. In the conditions where no algorithm is available to solve a particular problem, a reasonable solution is the best we can expect from an expert (system or human). The expert system will infer a solution from the facts provided by the user and the rules in the knowledge base. Therefore, it should be able to explain the reasoning employed to achieve the solution. The explanation facility is an important feature of the rule-based expert systems, since it provides a mechanism for a human to follow and check the correctness of the solution achieved by the expert system. A
further enhancement to this facility is the availability of what-if scenarios (employing hypothetical reasoning questions), where the user may examine the outcomes of several possible situations [43].

The structure of a rule-based expert system is shown in figure 2.3.

![Figure 2.3: Structure of a Rule based expert system](image)

**Components of a rule-based expert system**

The domain knowledge needed to solve problems is contained in the knowledge-base in the form of rules. Components of the rule-based expert system:

- *user interface*: it is the user means of communication with the expert system;
- *explanation facility*: explains the expert system reasoning to the user;
- *working memory*: a global database of facts used by the rules;
- *inference engine*: decides which rule is satisfied by the supplied facts, prioritise the rules and execute the highest priority rule;
- *agenda*: the prioritised list of rules whose patterns are satisfied by facts (or objects) in the working memory;
- *(optional) knowledge acquisition facility*: a way for the user to directly enter knowledge in the system, without the need for explicit knowledge coding.

The rule whose patterns are satisfied by the facts are said to be activated. Given many rules are instantiated at the same time, the inference engine must select one rule for firing (termed by analogy with a nerve cell - neuron). Like a neuron, once the rule has fired, it
may not fire again for a certain period of time. This behaviour is aimed at preventing trivial loops and is called refraction.

**Case-based reasoning**

Case-based reasoning (CBR) is a problem solving paradigm that in many respects is fundamentally different from other major AI approaches. Instead of relying solely on general knowledge of a problem domain, or making associations generalized relationships between problem descriptors and conclusions, CBR is able to utilize the specific knowledge of previously experienced, concrete problem situations (cases). A new problem is solved by finding a similar past case, and reusing it in the new problem situation. A second important difference is that CBR also is an approach to incremental, sustained learning, since a new experience is retained each time a problem has been solved, making it immediately available for future problems. The case-based reasoning is basically to solve a new problem by remembering a previous similar situation and by reusing information and knowledge of that situation. [44].

Expertise comprises experience. In solving a new problem, one relies on past episodes. It is needed to remember what plans succeed and what plans fail. The need to know how to modify an old plan to fit a new situation should also be considered earlier. Case-based reasoning is a general paradigm for reasoning from experience. It assumes a memory model for representing, indexing, and organizing past cases and a process model for retrieving and modifying old cases and assimilating new ones. Case-based reasoning provides a scientific cognitive model. The research issues for case-based reasoning include the representation of episodic knowledge, memory organization, indexing, case modification, and learning. In addition, computer implementations of case-based reasoning address many of the technological shortcomings of standard rule-based expert systems. These engineering concerns include knowledge acquisition and robustness [45].

**Case-Based Reasoning (Method to create a Knowledge Base)**

The Case-based Reasoning Process is about the use of past experiences, based on the premise that human beings use analogical reasoning or experiential reasoning to learn and solve complex problems, particularly evident in precedence-based reasoning, useful when
little evidence is available or information is incomplete. The CBR CYCLE is shown in figure 2.4.

![Figure 2.4: CBR Cycle](image)

**Integrating rule-based reasoning and case-based reasoning**

The first reasoning modality to be successfully integrated with CBR was rule-case based reasoning. The earliest CBR/RBR systems were built for statutory legal domains, where statutes naturally correspond to rules and legal precedents naturally correspond to cases. CABARET used a rule-based agenda mechanism to integrate past cases with legal regulations in the domain of United States tax law. CABARET pioneered a domain-independent architecture in which there are independent CBR and RBR co-reasoners, each of which monitors and communicates its own processing and results, and an agenda-based controller that proposes and prioritizes tasks for the two co-reasoners. The early legal system, GREBE, integrated CBR and RBR to determine and justify legal conclusions for cases in the area of Texas employment law, IKBALS operated in the domains of Australian worker disability law and lending by financial institutions. This system also integrated information retrieval techniques to give users access to legal treatises. CBR/RBR hybrids
have since proliferated, in diverse domains and applications, ranging from planning nutritional menus to harmonizing melodies. ANAPRON integrated CBR and RBR for speech synthesis in pronouncing American surnames. This system used CBR to increase the accuracy of a primarily RBR system by handling exceptions to pronunciation rules. SaxEx integrated background musical knowledge into a primarily CBR system for generating expressive musical performances. In SaxEx, cases are musical scores with their associated expressive parameters, and rules are used to retrieve and adapt cases [46].

**CBR System versus Rule-Based System**

The approach of case-based reasoning can be contrasted with that used in other knowledge-based systems, such as rule-based or combined frame-rule-based systems. In rule-based systems, one has a rule base consisting of a set of production rules of the form: IF A, THEN B, where A is a condition and B is an action. If the condition A holds true, the action B is carried out. Condition A can be a composite condition consisting of, say, a conjunction of premises A1; A2; . . . ; An. In addition, a rule-based system has an inference engine that compares the data it holds in working memory with the condition parts of rules to determine which rules to fire. Combined frame-rule-based systems also utilize frames, in addition to rules, to capture stereotypical knowledge. Frames consist of slots that can have default values, actual values, or attached daemons. Frames use a procedure or a rule set to determine the values required when they are triggered. Rule-based and combined frame-rule-based systems require, acquiring the symbolic knowledge that is represented in these rules or frames using manual knowledge engineering or automated knowledge acquisition tools. Sometimes, one utilizes a model of the problem as a basis for reasoning about a situation, where the model can be qualitative or quantitative. These systems are referred to as model-based systems. Case-based reasoning systems are an alternative, in many situations, to rule based systems. In many domains and processes, referring to cases as a means of reasoning can be an advantage due to the nature of this type of problem solving. One of the most time-consuming aspects when developing a rule-based system is the knowledge acquisition task. Acquiring domain-specific information and converting it into some formal representation can be a huge task and in some situations, especially those with less well understood domains, formalization of the knowledge cannot be done at all. Case-based systems usually require significantly less knowledge acquisition, since it involves collecting a set of past experiences without the added necessity of extracting a formal
domain model from these cases. In many domains there are insufficient cases to extract a domain model, and this is another benefit of CBR: A system can be created with a small or limited amount of experience and then developed incrementally, adding more cases to the case base as they become available [46].

**Research Gaps Identified**

Although in the field of AI & law application like ESM, an expert system for Environmental Permit Law (in Dutch), e-Laws Advisors Online legal expert systems of the US Department of Labour, family law courts have implemented in Australia to name a few and in Indian context though the introduction of Information Computer Technology (ICT) some of the implementations like “e-courts”, an expert system called AGREX to help the Agricultural field personnel in kerala, have been explored in past but the expert system development in Indian legal domain with specific reference to transfer of property act has not been investigated so far.

Hence there is need to

i) Develop expert system on different facets of India legal domain with specific reference to transfer of property act.

ii) Develop a prototype to validate the key features with specific reference to transfer of property act.

iii) To develop an expert system where knowledge (rules and cases) can be upgraded / delete easily.

iv) To develop Tutoring model for the common man’s needs.

v) There is need for performing the case study for proper validation

**Transfer of property Act**

By its very existence, society mandates interaction, exchange or transfer. A property, movable or immovable, is transferred from one person to another under various different situations and circumstances and for different values. The transfer may be a gift, an inheritance or an asset acquired by paying full value. The research work concentrates on immovable property.

In India, the transfer of property act is assisted by orders of Courts under Civil Procedure Code before the Transfer of Property Act, 1882 came into existence. Transfer of movable goods was regulated to an extent by the Indian Contract Act, 1872. For transfer of
immovable property, the Anglo-Indian courts often turned to principles of Justice, Equity and Good Conscience as it prevailed in England at the time. This rarely did any good due to the vast differences in customs and society of the two countries. Of course the rapidly growing commerce and infrastructure in the late nineteenth century lead to more conflicts even in business. Thus, an immediate need was felt for a clear and pragmatic law regarding property and transfers suited to India and its peculiar problems as well as to take care of the potential economic problems. The task of drafting such legislation fell upon the first law commission and was later referred to the second law commission [47].

The Act

A Bill, finally presented to the Legislative Council, became a law on the 17th of February 1882 and came into force from 1st July of the same year. The Transfer of Property Act, 1882 mainly deals with transfer of immovable property. It does not apply to transfers by the operation of law such as transfer of immovable property necessitated by Order of Court for insolvency or forfeiture among others. The 137 sections contained within have been divided into 8 chapters. Interestingly, nowhere does the Act define ‘What is a transfer of property’. But it does define ‘transfer’ as a standalone in Section 5 [48].

Legal aspects and related terminologies

In law ‘property’ is defined as “any entity which can be owned”. Thus, right of ownership may be exercised by a person against a property. A ‘person’ is ‘any entity which has rights and duties under law’. A person may be a natural person (a human being) or an artificial person (such as a company, a corporation, etc.). ‘Ownership’ is a right by which the property belongs to the owner to the exclusion of all others. In fact, it is a collection of rights which the owner has against the property owned by him. Right of possession and enjoyment, right of alienation, right of destruction, etc. are some of the rights which an owner can exercise against his property, subject to the laws of the land and rights of others. ‘Title’ is the evidence of ownership, and a ‘title deed’ is a document that shows how and when a person became the owner of a property.

Transfer of property means transfer of some or all of the rights of owner in respect of a property to some other person. If the transfer is of all the rights of the owner, the transfer is a complete transfer of property; else it is a partial transfer of property. ‘Sale’, ‘exchange’ and ‘gift’ are complete transfers of property, while ‘lease’ and ‘mortgage’ are examples of
partial transfers of property. Once the owner transfers his property by way of a complete transfer, he ceases to be the owner and the transferee becomes the owner. The ‘transferor’ loses his right of transfer and the ‘transferee’ gets the right of transfer. In case of partial transfer of property, the transferor continues to be the owner and hence, retains the right to transfer the property, subject to the rights of the transferee. For example, if the landlord sells the property leased by him to a tenant, the purchaser will purchase the property subject to that lease. Also in case of mortgage the purchaser will purchase the property subject to the mortgage. In other words, the transferee always gets the same rights and obligations of the transferor in respect of the property transferred to him. Such obligations subject to which the property is transferable are called the ‘encumbrance’ over the property. A transferee has to see that the transferor has the authority to transfer the property, and that there are no encumbrances attached to the property.

Under sec. 17 of the Indian Registration Act, a deed witnessing transfer of an immovable property must be compulsorily registered; otherwise it cannot be admitted in evidence. Therefore, if the transferor has received a property under an unregistered transfer deed, it will be impossible to prove that he had title to the property. Therefore, the transferee will not be able to prove that he has received a good title from the transferor whose title itself cannot be proved. Hence, registration of the deed under which the transferor has received the property is one of the most important aspects to be verified.

Sale, exchange, gift, lease, mortgage are transfers ‘inter vivos’, i.e., transfers by one or more living persons to one or more other living persons. If the owner of a property does not transfer his property to any other person during his life time, the property devolves upon his successors after his death, by way of succession. Succession may be ‘testamentary succession’ or ‘intestate succession’. If the deceased owner of the property leaves behind him a valid will and expresses his desire to give that property to some person after his death, the property devolves upon that other person, called the ‘legatee’, by way of testamentary succession. If the deceased does not leave behind him a valid will the property devolves upon his heirs by way of intestate succession. So also even if the deceased has left behind him a valid will, but has not provided for devolution of a particular property in that will, the property not covered by the will devolve upon his legal heirs. This is called ‘partial intestacy’. In case of a will a ‘probate’ is to be obtained to prove the genuineness of the will. Once a probate is granted by a competent Court, it is conclusive proof of the fact that the will is genuine. Therefore, one can purchase the property from the legatee to whom it is gifted by the deceased. In case of intestate
succession, one of the heirs may obtain ‘letters of administration’ from a competent Court. He is called the ‘administrator’ of the estate of the deceased and is competent to transfer the properties of the deceased. However, now obtaining probate or letter of administration is not compulsory. In lieu of them one may obtain a succession certificate from a competent court.

Once it is proved that the transferee has the title to the property, it is also necessary to verify whether the person from whom he has obtained the property had a clear and marketable title to the property. If he did not have one, then the transferor cannot have one, as already seen above. In such a case the true owner may file a suit for setting aside the transfer and the transferee will be deprived of the property. Though he may file a suit for recovery of the money he has paid to the transferor, it will be an unnecessary trouble which may be avoided by taking a little care. It is to be noted here that though the original owner can file a suit for setting aside the transfer, he can do so within twelve years from the date of transfer of his property by a third party. Therefore, if the transferor has purchased the property more than thirteen years ago, suit against him will be time barred, and no special precaution is necessary. Otherwise, the suit will be well within limitation prescribed by the Limitation Act, and the flow of title of the property will have to be traced for the last thirteen years by looking into the ‘Record of Rights’ maintained by the Revenue Authorities.

The transferee in case of a transfer inter vivos, and a legatee or legal heir in case of succession is holding the title to the property. Now once the title to the property is established, it is necessary to examine whether the property is free of encumbrances. For that purpose one has to obtain a ‘Nil Encumbrance Certificate’ from the Sub-Registrar’s office within whose jurisdiction the property or any part of it is situated. If there is encumbrance on the property, such a certificate will not be issued.

Further, if the transferor has not paid the taxes in respect of the property to the respective public authorities, the Government will have a charge over the property, and the money may be recovered by forfeiture or by attachment and sale of the property even in the hands of the transferee. Therefore, it is imperative to verify that the transferor does not have any tax dues, by looking into the up-to-date tax paid receipts.