Modular Argumentation For Modelling Legal Doctrines in Common Law of Contract

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Abstract. To create a programming environment in which autonomous agents could be built to resolve contract disputes, we propose an extension of assumption-based argumentation (ABA) into modular assumption-based argumentation (MABA) in which different modules of argumentation representing different knowledge bases for reasoning about beliefs and facts and for representation and reasoning with the legal doctrines could be built and assembled together. A distinct novel feature of modular argumentation in compare with other modular logic-based systems like Prolog is that it allows references to different semantics in the same module at the same time, a feature critically important for application of argumentation in legal domains like contract dispute resolution where the outcomes of court cases often depend on whether credulous or skeptical modes of reasoning were applied by the contract parties. We apply the new framework to model the doctrines of contract breach and mutual mistake.

1. Introduction

Example 1.1 *Imagine that your organization had contracted a software company to integrate the computer systems of its head office and a newly acquired business following a design from your IT department. The integration failed. Your organization sued the software company. The company argues that both sides have made a mistake in believing that the design is workable. It hence asks for relief of performance. How should the court rule ? Would it be possible to arbitrate such disputes online ?*

Common law has a case-by-case basis. The main task in reasoning with cases is to construct a theory from past cases that produces the desired legal result and to persuade the judge of its validity [5,15]. As the vast and increasing number of cases lead to many conflicting decisions and an increased uncertainty in the law, Restatements (First and Second) of Contracts have been proposed to "restate" clearly and precisely the principles and rules of common law [3]. The restatements are especially helpful when there are not many precedent cases similar to the case at hand, a situation that is characterstic of e-commerce. The clear and precise presentation of the legal doctrines in Restatement Second (Rest 2d) makes it especially appropriate for formal modeling. Such model would make the intepretation of cases much easier and less arbitrary. Legal doctrines in

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Restatement Second could be viewed as representing the principles, guidline and rules for constructing theories in reasoning with cases.

Much work has been done in the literature to study computational models for different aspects of law and legal argument [1,5,10,12,11,13,14,17]. The application of formal argumentation developed in AI to legal reasoning has also received considerable attention [2,4,5,17]. Works done in [2,4,5] have extended the abstract argumentation framework in [8] with values and demonstrated that value-based argumentation frameworks provide a natural basis for modelling legal case-based reasoning. In [10], a rule-based system has been developed to assist decision makers on making decision in a dispute on offer and acceptance in contract law.

To resolve contract disputes the court often has to construct hypothetical contracts, also called intended contracts, to represent what the parties would have agreed on had they forseen the unexpected situations. Legal doctrines in contract laws provide rules and guidelines for determining risk allocation in intended contracts. The court's decision will then follow the terms of the risk allocation in the intended contracts.

To motivate the introduction of modular argumentation for contract dispute resolution, we first introduce the doctrine of mutual mistake. The mutual mistake doctrine allows one party to rescind a contract because both parties have acted on a mistaken belief about an existing fact. The party seeking relief must show that 1) the mistake concerns a basic assumption on which the contract was based, and 2) the mistake has a major impact on the fairness of the contract , and 3) the risk of this type of mistake is not allocated to the party seeking relief. For illustration of the doctrine, we recall several famous court cases below [9].

Example 1.2 *(Sherwood Case, Michigan, 1887) Walker, a cattle breeder, agreed to sell Sherwood, a banker, a cow (Rose 2d of Aberlone) which both parties believe to be barren. The price was 80 USD. Prior to the delivery, Walker discovered that Rose 2d is pregnant and refused to deliver her. The market price of a pregnant cow was around 800 USD. Sherwood sued, prevailed in trial court but lost in appeal. The appeal court based its decision on mutual mistake.*

Example 1.3 *(Wood Case, Wisconsin, 1885) Clarissa Wood found a colourful stone. She was told it could possibly be a topasz. She asked Boyton, a jewellry dealer. Boyton was not sure either and offered to buy it for one dollar. Wood declined. But later she needed money and returned to sell it to Boyton for one dollar. Later it turned out to be a rough diamont worth around 700 dollars. Wood brought a court action for the return of the stone citing mutual mistake. The court agreed that there was a mutual mistake but still ruled in favor of Boyton though not quite clear reasons had been given.*

Analyzing this case under the doctrine of mutual mistake, modern courts and scholars agree with the ruling for the reason of conscious ignorance meaning that Wood had known that there was a risk that the stone could be more valuable but still decided to sell it. Hence she should be allocated the risk of her decision.

Many modern courts and law schools advocate the allocation of risk based on efficiency as illustrated in the following case.

Example 1.4 *(Stees v Leonard, Minnesota, 1874) Leonard, the defendant, had a contract with Stees to build a house following a given specification commissioned by Stees.*

But due to unforeseen soil conditions, the construction collapsed twice when it reached certain height. Leonard then refused to continue. Stees sued for breaching of contract. Leonard defended himself by reason of mutual mistake in not foreseeing the soil conditions and faulty specification. The court ruled in favor of Stees for reasons that although there was a mutual mistake, as an expert in this building business, Leonard is expected to foresee such conditions and to take appropriate measures. The failure to do so should be at the risk of Leonard.

The decision could be completely different if Stees has the resource and means to detect more cheaply than Leonard the soil conditions and the mistakes in the specification (see Bentley v State, Wisconsin, 1889 [9])

How should the dispute in example 1.1 be resolved ? The decision depends on many factors. If your organization does not have much expertise in IT then the software company would be the more efficient cost bearer and the decision could be in the favor of your organization (witness Stees v Leonard). But if your organization has a reputed software engineering department or has been warned about possible problems in the design before signing the contract then the ruling could very well be in favor of the defendant (witness Bentley v State).

To represent and reason with the doctrine of mutual mistake, a number of distinct knowledge bases about the beliefs of the contract parties and their expertises as well as about common market, social and legal knowledge at the time of contract making need to be established. A module representing the mutual mistake doctrine should then combine these knowledge bases to determine the outcome of the case.

2. Modular Argumentation

An abstract argumentation framework [8] is a pair $(AR, attacks)$ where AR is a set of arguments and $attacks$ is a binary relation over AR representing the relation that an argument A attacks an argument B for $(A, B) \in attacks$. The semantics of abstract argumentation is determined by the acceptability of arguments and various associated notions of extensions. For the purpose of this paper, we introduce only one of them. A set S of arguments is said to be *admissible* if for each argument A that attacks some argument B in S there is an argument C in S that attacks A. A maximal admissble set of arguments is called a *preferred extension*.

Abstract argumentation provides a natural platform for understanding many legal procedures [2,4,5,11,12,17,18]. But it does not provide an programming environment in which the arguments for such procedures could be constructed automatically. To address this issue, an instance of abstract argumentation called assumption-based argumentation where the arguments are deductive proofs based on assumptions [6] could be used. An assumption-based argumentation (ABA) framework is a triple $(\mathcal{R}, \mathcal{A}, \overline{})$ where $\mathcal{R}$ is set of inference rules of the form $l_0 \leftarrow l_1, \ldots l_n$ (for $n \geq 0$), and $\mathcal{A} \subseteq \mathcal{L}$ is a set of assumptions, and $\overline{}$ is a (total) mapping from $\mathcal{A}$ into $\mathcal{L}$, where $\overline{x}$ is referred to as the *contrary* of x. If $\neg\lambda \in \mathcal{A}$ then $\overline{\lambda} = \lambda$. Assumptions in $\mathcal{A}$ do not appear in the heads of rules in $\mathcal{R}$. A *(backward) deduction* of a conclusion α based on (or supported by) a set of premises P is a sequence of sets $S_1, \ldots, S_m$, where $S_i \subseteq \mathcal{L}$, $S_1 = \{\alpha\}$, $S_m = P$, and for every i, where σ is the selected sentence in S_i: If σ is not in P then $S_{i+1} = S_i - \{\sigma\} \cup S$ for some inference rule of the form $\sigma \leftarrow S \in \mathcal{R}$. Otherwise $S_{i+1} = S_i$.

For a set of propositions X, and some sentence l, we write $X \models l$ if there exists a backward deduction for l from some $X' \subseteq X$'. An *argument* for $x \in \mathcal{L}$ supported by a set of assumptions X is a (backward) deduction from x to X and denoted by (x, X). An argument (x, X) attacks an argument (y, Y) if x is the contrary of some assumption in Y.

Given an ABA framework $\mathcal{F}$, a proposition $\pi \in \mathcal{L}$ is said to be a *credulous consequence* of $\mathcal{F}$, denoted by $\mathcal{F} \vdash_{cr} \pi$ if it is supported by an argument in some preferred extension E of $\mathcal{F}$. π is said to be a *skeptical consequence* of $\mathcal{F}$, denoted by $\mathcal{F} \vdash_{sk} \pi$ if it is supported by some argument in each preferred extension E of $\mathcal{F}$.

A *modular assumption-based argumentation (MABA) framework* is structured into distinct modules where exactly one of them is considered as the main module while the others are called submodules. A module is basically an ABA framework with the exceptions that the premises in its rules are either sentences in $\mathcal{L}$ or a *module call* of the form (l, M, t) where l is a non-assumption sentence in $\mathcal{L}$, M is a module in which l occurs, $t \in \{cr, sk\}$ is the type of semantics of M according to which l is defined (i.e. $M \vdash_t l$). Note that in this paper, we restrict ourself to two types of semantics, notably the credulous and skeptical preferred semantics defined shortly before.

Example 2.1 *Let $\mathcal{F}$ be a MABA framework consisting of two modules M_1, M_0 where*
M_1 consists of a single rule $h \leftarrow (p, M_0, cr), (q, M_0, cr)$ *and*
M_0 consists of two rules $p \leftarrow \neg q$ *and* $q \leftarrow \neg p$ *and* $\mathcal{A} = \{\neg p, \neg q\}$ *and* $\overline{\neg p} = p$ *and* $\overline{\neg q} = q$. *M_0 has two preferred extensions $\{\neg p\}$ and $\{\neg q\}$. Hence, $M_0 \vdash_{cr} p$ and $M_0 \vdash_{cr} q$. Hence both module calls $(p, M_0, cr), (q, M_0, cr)$ are accepted. As result, M_1 has an unique extension in which h is concluded.*

Note that $\mathcal{F}$ is distinct to the ABA framework consisting of three rules: $h \leftarrow p, q$ *and* $p \leftarrow \neg q$ *and* $q \leftarrow \neg p$ *in which h is not concluded wrt any semantics.*

In this paper, we restrict our consideration to stratified MABA frameworks where the modules names are ranked (by ordinals) such that all module calls in rules belonging to a module of rank k refer to modules of ranks lower than k. The rank of the main module is the highest rank. The MABA framework in example 2.1 is an example of stratified modular argumentation.

The semantics of stratified MABA framework is defined inductively by defining the semantics of the higher ranks modules based on the semantics of lower ranks modules. Suppose that the semantics (i.e. extensions) of all modules of ranks lower than the rank of a module M have been defined. A *(backward) deduction* of a conclusion α wrt module M based on (or supported by) a set of premises P is defined similarly as the backward deduction wrt ABA framework with the exception that when the selected element σ is a module call of the form (l, N, t) then $N \vdash_t l$ and $S_{i+1} = S_i - \{\sigma\}$.

The notions of arguments, extensions and consequences wrt a module M in MABA are defined similarly as in usual ABA frameworks. For a MABA framework $\mathcal{F}$, we write $\mathcal{F} \vdash_t p$ if $M \vdash_t p$ where M is the main module of $\mathcal{F}$ and $t \in \{cr, sk\}$.

3. Modeling Contracts and Contract Contexts

We assume a language $\mathcal{L}$ containing a finite set of integers and a partial order $p \succ q$ between the integers representing that p is greater than q by orders of magnitude. We further assume that $\mathcal{L}$ also contains fluents and actions.

Definition 3.1 *A contract between contractor CO (as seller or service provider) and contractee CE (as buyer or service requester) is modeled as a six-tuple* $\Gamma = \langle CO, CE, T, \kappa, \pi, RA \rangle$ *where*

1. T *identifies the transaction or service that contractor promises to perform.*
2. κ *specifies properties of T or of the environment of T*
3. π *describes the price of performing T*
4. *RA allocates risks among the contract parties and consists of rules of the form* $\sigma \rightarrow CX$ *stating that if condition* σ *holds at the time of making the contract then the risk is allocated to* $CX \in \{CO, CE\}$.

In cases where the identities of contractor and contractee are clear from the context, we often denote a contract as a quadruple $\langle T, \kappa, \pi, RA \rangle$ *or* $\langle T, \kappa, \pi \rangle$ *if RA is empty.*

Under the doctrine of mutual mistake, the semantics of a contract $\Gamma = \langle T, \kappa, \pi, RA \rangle$ states that under condition κ, the contractor CO is obliged to perform the transcation T for a price π paid by contractee CE. But the court could make exceptions by allowing either of the parties to rescind the contract if a mutual mistake has been made. But if a condition σ holds at the time of making the contract and the party asking to rescind the contract (denoted by CX) is the risk bearer under such condition (i.e. the rule $\sigma \rightarrow CX$ belongs to RA) then no such exception is granted.

Example 3.1 *The contract between Sherwood and Walker in the Sherwood case is represented by* $\langle Walker, Sherwood, SaleOfCow, True, 80, \emptyset \rangle$ *stating that a cow is sold to Sherwood for the price of 80 USD. No conditions and risk allocation are given.*

Similarly, the contract between Wood and Boynton in the Wood case is represented by $\langle Wood, Boynton, SaleOfStone, True, 1, \emptyset \rangle$

The semantics of contracts depend on their contexts characterized by the beliefs, expertises of the contract parties. Contexts under different doctrines are different.

Definition 3.2 *A context under the doctrine of mutual mistake (or just context for short) of a contract* $\Gamma = \langle T, \kappa, \pi, RA \rangle$ *between contractor CO and contractee CE is defined as a 7-tuple* $\langle \delta, CK, KO, BO, KE, BE, Cost \rangle$ *where* CK, KO, BO, KE, BE *are ABAs and*

1. δ *is a fluent representing the unexpected condition causing the reconsideration of contract* Γ.
2. CK *describes a body of common market, social and legal knowledge about the contract domain at the time of making the contract established by the court, i.e. the contract parties may not be aware of much of it at the time of making their contract.*
3. KO, KE *describe respectively the general domain knowledge contractor CO and contractee CE are expected to know at the time of making the contract.*
4. BO, BE *contain the evidences and facts about the relevant beliefs of contractor CO and contractee CE respectively at the time of making the contract.*
5. *A cost function Cost specifies the cost of possible actions the contract parties could carry out to detect the unexpected condition* δ.

Example 3.2 *(Sherwood Case, continued) The context of the contract in the Sherwood case is represented by* $\langle Pregnant, CK, KO, BO, KE, BE\rangle$ *:*

$CK = (\mathcal{R}_0, \mathcal{A}, \overline{})$ *with* $\mathcal{A} = \{Barren\}$*, and* $\mathcal{R}_0$ *consists of the following rules:* $r_1 : Price(800) \leftarrow Pregnant$*, and* $r_2 : 800 \succ 80$*, and* $r_3 : \neg Barren \leftarrow Pregnant$*.*

The intuition of $\mathcal{A} = \{Barren\}$ *is that it is an accepted commonsense that cows are assumed to be barren unless there is explicit evidence to the contrary.*

$KO = KE = CK$*, and* $BO = BE = (\mathcal{R}_1, \mathcal{A}, \overline{})$ *with* $\mathcal{R}_1 = \mathcal{R}_0 \cup \{Price(80) \leftarrow Barren\}$ *representing a situation where both Sherwood and Walker fully believed (by commonsense) that the cow is barren with a price tag of 80.*

There are no actions that the parties could do to check the pregnancy of the cow (note that the case happened in 1887). Hence no Cost function.

Example 3.3 *(Wood Case, continued) The context of the contract in the Wood case is represented by* $\langle Diamond, CK, KO, BO, KE, BE\rangle$ *:*

$CK = (\mathcal{R}_0, \mathcal{A}, \overline{})$ *with* $\mathcal{A} = \emptyset$ *and* $\mathcal{R}_0$ *consists of the following rules:* $r_1 : Price(700) \leftarrow Diamond$*, and* $r_2 : 700 \succ 1$*, and* $r_3 : False \leftarrow Topasz, Diamond$*.*

The intuition of $\mathcal{A} = \emptyset$ *is that commonsense does not make any assumption about this type of stones.*

$KO = KE = (\mathcal{R}_0, \mathcal{A}_1, \overline{})$ *with* $\mathcal{A}_1 = \{Topasz, \neg Topasz\}$ *representing that both Wood and Boynton are not expected to know whether the stone is a topasz or not*[2] *.*

$BO = BE = (\mathcal{R}_1, \mathcal{A}_1, \overline{})$ *and* $\mathcal{R}_1 = \{Price(1) \leftarrow Topasz\}$*, representing that both Wood and Boynton were not sure whether the stone is topasz or not, but accepted to trade it for the price of one dollar.*

4. Intended Contracts

Contract parties often do not specify their contract completely. In a dispute, the court has to complete it with the terms that the parties would have agreed to had they negotiated over the unforeseen situation. In the following, we first define the notion of mutual mistake before giving the definition of the notion of complete intended contracts.

Definition 4.1 *Let* $\Gamma_0 = \langle T, \kappa, \pi, RA\rangle$ *be a contract between a contractor CO and a contractee CE and* $CNT = \langle \delta, CK, KO, BO, KE, BE, Cost\rangle$ *be a context of* Γ_0*.*

1. *We say that a* **mutual mistake** *has been made by both contract parties wrt CNT if there exists a condition* λ*, called the* **intended condition***, such that following conditions are satisfied:*
   (a) $BO \vdash_{cr} \lambda$ *and* $BE \vdash_{cr} \lambda$*, i.e. both parties believed that* λ *(possibly) holds at the time of making the contract.*
   (b) $\lambda \models \kappa$*, i.e.* λ *is a specific condition of* κ*.*
   (c) $\{\delta\} \cup CK \vdash_{sk} \neg\lambda$ *, i.e. the parties made a mistake in believing that* λ *holds at the time of contract making.*

[2]One can ask why not $\mathcal{A}_1 = \{\}$ or $\mathcal{A}_1 = \{Topasz, \neg Topasz, Diamond, \neg Diamond\}$. Wood was aware that the stone could possibly be a topasz but may be not. Therefore, it is not possible that $\mathcal{A}_1 = \{\}$. The idea that the stone could be a diamond does not come up at all at the time of making the deal. Hence no contract party could assume that it could be a Diamond. Therefore it is not possible that $\mathcal{A}_1 = \{Topasz, \neg Topasz, Diamond, \neg Diamond\}$.

(d) $BO \cup \{\lambda\} \vdash_{sk} Price(\pi)$ *and* $BE \cup \{\lambda\} \vdash_{sk} Price(\pi)$*, i.e. both parties accept price* π *under condition* λ.

2. *We say that the contact parties have made a* **mutual mistake violating a basic assumption** *wrt CNT if a mutual mistake has been made by the contract parties and one of the following conditions holds:*

   (a) $\{\delta\} \cup CK \vdash_{sk} \neg T$*, i.e T is not executable under* δ. [3]
   (b) *If* $CK \cup \{\delta\} \vdash_{sk} Price(p)$ *then either* $CK \vdash_{sk} p \succ \pi$ *or* $CK \vdash_{sk} \pi \succ p$.

Condition 2 determines that λ *is a "basic assumption" in the sense that its non-satisfaction would either invalidate the transaction or service T or the market value of T is qualitatively different to* π *(by orders of magnitude) and hence one of the parties would not accept* π *as the contract price as it will suffer a significant loss.*

Example 4.1 *Let* $\Gamma = \langle SaleOfCow, True, 80\rangle$ *be the original contract in the Sherwood case and CNT be the context defined in example 3.2. It is not diificult to check that a mutual mistake violating a basic assumption has been made where the intended condition is Barren.*

There are two principles for determining risk allocation for unexpected situations. The conscious ignorance principle states that if a party was aware that its knowledge is limited but still went ahead with the contract, this party should bear the risk of the contract [3]. The other principle is based on efficiency stating that risks should be allocated to the party that could bear it at the least cost [16].

Definition 4.2 *Let* $\Gamma_0 = \langle T, \kappa, \pi, RA\rangle$ *be a contract between CO and CE. The* **complete intended contract** *of* Γ_0 *in the context* $CNT = \langle \delta, CK, KO, BO, KE, BE, Cost\rangle$ *is defined as follows:*

1. *If a mutual mistake violating a basic assumption (with* λ *being the intended condition) has been made wrt CNT then* $\Gamma_1 = \langle T, \lambda, \pi, RB\rangle$ *where RB is obtained by adding risk allocation clauses to RA as follows:*

   (a) **Conscious Ignorance***: Adding* $\delta \rightarrow CO$ *to RA if* $BO \not\vdash_{sk} \lambda$ *(i.e. the contractor does not fully believe in* λ*), and*
   Adding $\delta \rightarrow CE$ *to RA if* $BE \not\vdash_{sk} \lambda$.
   (b) **Efficiency** *If a party could reasonably anticipate the unexpected situation* δ *more efficient than other party, this party should bear the risk. Formally, this doctrine is represented by adding*
   $\delta \rightarrow CO$ *to RA if there is some reasonable action* α *the contractor CO could do to detect* δ*, i.e.* $\{\alpha\} \cup KO \vdash_{sk} \delta$*, and for each reasonable action* β *that could be carried out by CE to detect* δ*,* $Cost(\beta) \succ Cost(\alpha)$ *holds.*
   An action α *is said to be reasonable if its cost is acceptable wrt price of the contract, i.e.* $\pi \succ Cost(\alpha)$.
   Similar conditions for assigning risk to CE

[3]For example, CO sells to CE an annuity (T) on some person P's life. Then P must be alive ($\lambda = alive$) (CK could contain a rule like $dead \rightarrow \neg annuity$).

But if if it turns out that P was already dead at the time of making the contract ($\delta = dead$) then CE can rescind the contract.

2. *If no mutual mistake violating a basic assumption has been made wrt CNT then* Γ_1, Γ_0 *coincide*

Example 4.2 *(Sherwood, continuation of example 4.1) From* $BO \vdash_{sk} Barren$ *and* $BE \vdash_{sk} Barren$*, it follows that the principle of conscious ignorance does not allocate any risk to the contract parties. As there are no actions the parties could have carried out to check the pregnancy of the cow at the time of making the contract, no risk is allocated to the parties by the principle of efficiency. Therefore, no party should carry the risk of the cow being pregnant. The complete intended contract is* $\Gamma_2 = \langle SaleOfCow, Barren, 80, \emptyset \rangle$.

The complete contract would have been different if this case happens in our time when cheap pregnancy tests are available. The knowledge base KO of Walker would contain a clause $pregnant \leftarrow test$ *stating that a test will reveal that the cow is pregnant and the cost function satisfies* $80 \succ Cost(test)$*. According to the efficiency principle, Walker would have to bear the risk of the cow being pregnant, i.e.* $\Gamma_2 = \langle SaleOfCow, Barren, 80, \{pregnant \rightarrow Walker\}$.

Example 4.3 *(Wood, continued) From* $BO \vdash_{cr} \neg Topasz$ *and* $BE \vdash_{cr} \neg Topasz$*, it follows that the principle of conscious ignorance allocates risk to both parties. Therefore, the complete intended contract is* $\Gamma_2 = \langle SaleOfStone, Topasz, 1, \{diamont \rightarrow Wood,\ diamont \rightarrow Boynton\}$*. Hence none of the parties could rescind the contract.*

The semantics of a contract Γ_0 under the doctrine of mutual mistake could be stated as follows: *If no mutual mistake violating a basic assumption has been made then the contractor has to perform the contract transaction and the contractee has to pay the contract price* π*. If a mutual mistake violating a basic assumption has been made and CX does not have to bear the risk in the* complete intended contract *then CX could rescind the contract. Otherwise CX is not allowed to rescind the contract.*

5. Modular Argumentation for Contract Dispute Resolution

We present a modular ABA framework consisting of submodules representing the contexts of a contract dispute together with a main module representing the contract breach and mutual mistake doctrines.

Given a contract $\Gamma = (T, \kappa, \pi, RA)$ between CO and CE, a theory Th_Γ representing Γ consists of the self-explaining sentences $Contract(CO, CE, \Gamma),\ Transaction(T, \Gamma),$ $Price(\pi, \Gamma),\ Conditions(\kappa, \Gamma)$ together with a material implication $Happen(E) \rightarrow RiskAllocatedTo(CX, \Gamma)$ for each rule of the form $E \rightarrow CX$ is in RA, and a sentence $Hold(\delta, \Gamma)$ stating that condition δ actually held at the time of making the contract and further rules defined in the following.

The doctrine that a failure to perform a considered promise constitutes a breach of contract states that if CX is a party in a contract Γ then CX must perform his part of the bargain in the contract unless there are exceptions for him to rescind it. This doctrine is represented by two rules:

$$Pay(CE, \pi) \leftarrow Contract(CO, CE, \Gamma),\ Transaction(T, \Gamma),\ Perform(CO, T)$$
$$Price(\pi, \Gamma),\ \neg Rescind(CE, \Gamma)$$
$$Perform(CO, T) \leftarrow Contract(CO, CE, \Gamma), Transaction(T, \Gamma), \neg Rescind(CO, \Gamma)$$

where $\neg Rescind(CO,\Gamma),\ \neg Rescind(CE,\Gamma)$ are assumptions.

The doctrine of mutual mistake provides a class of exceptions to the doctrine of contract breach when both parties make mistake and is reprsented by
$Rescind(CX,\Gamma) \leftarrow MutualMistake(\lambda,\Gamma),\ ViolateBA(\Gamma), \neg RiskAllocatedTo(CX,\Gamma)$
where $\neg RiskAllocatedTo(CX,\Gamma)$ is an assumption.

In the following BX stands for BE or BO and CX for CE or CO respectively.
The following rule represents that the contract is based on a mutual mistake. Its intuition is exlained in definition 4.1.
$MutualMistake(\lambda,\Gamma) \leftarrow Hold(\delta,\Gamma),\ (\neg\lambda, CK\cup\{\delta\}, sk),\ Condition(\kappa,\Gamma),\ (\kappa,\lambda,sk),$
$(\lambda, BO, cr),\ (\lambda, BE, cr),\ (Price(\pi), BO\cup\{\lambda\}, sk),\ (Price(\pi), BE\cup\{\lambda\}, sk)$

The following three rules establish that a basic assumption has been violated in the contract Γ. Its intuition is exlained in definition 4.1, step 2.
$ViolateBA(\Gamma) \leftarrow Hold(\delta,\Gamma),\ (\neg T, CK\cup\{\delta\}, sk)$
$ViolateBA(\Gamma) \leftarrow Price(\pi,\Gamma),\ Hold(\delta,\Gamma),\ (Price(p), CK\cup\{\delta\}, sk),\ \ p \succ \pi$
$ViolateBA(\Gamma) \leftarrow Price(\pi,\Gamma),\ Hold(\delta,\Gamma),\ (Price(p), CK\cup\{\delta\}, sk),\ \ \pi \succ p$

The following rule represents the principle of conscious ignorance.
$RiskAllocatedTo(CX,\Gamma) \leftarrow MutualMistake(\lambda,\Gamma),\ (\neg\lambda, BX, cr)$

The following rule captures a special case albeit probably a most frequent case, of the efficiency principle in allocating risk.
$RiskAllocatedTo(CX,\Gamma) \leftarrow Detectable(CX,\delta),\ \neg Detectable(\overline{CX},\delta)$ [4]
$Detectable(CX,\delta) \leftarrow (\delta, KX\cup\{\alpha\}, sk), ReasonableAction(CX,\alpha)$
$ReasonableAction(CX,\alpha) \leftarrow Action(CX,\alpha), Price(\pi,\Gamma), \pi \succ Cost(\alpha)$
where $Action(CX,\alpha)$ states that CX is capable to carry out action α at a cost $Cost(\alpha)$.

The MABA framework consisting of Th_Γ as the main module and the ABA frameworks CK,KO,BO,KE,BE as submodules is called the legal theory of Γ wrt the mutual mistake doctrine and denoted by $\mathcal{F}_\Gamma$. It is not difficult to see

Theorem 5.1 *Let $\Gamma = (T,\kappa,\pi,RA)$ be a contract between CO and CE and $CNT = \langle\delta, CK, KO, BO, KE, BE, Cost\rangle$ be a context of Γ. Assuming that the price for T is uniquely determined from the knowledge base CK, following assertions hold:*

1. *Th_Γ has an unique extension that is grounded, preferred and stable.*
2. *If $\mathcal{F}_\Gamma \vdash_{sk} Rescind(CX,\Gamma)$ then CX could rescind the contract Γ following the semantics defined in section 4.*

In general, the presented proof system is not complete due to the fact that to prove conscious ignorance, one should prove that $BO \not\vdash_{sk} \lambda$. Though $BO \vdash_{cr} \neg\lambda$ implies $BO \not\vdash_{sk} \lambda$, the reverse is not true.

[4] $\overline{CX}$ is the opposite party of CX

6. Conclusion and Future Work and Acknowledgements

In legal proceedings, the knowledge and belief bases forming the contexts of legal doctrines are constructed incrementally by the parties during their exchanges of arguments. Such exchanges also consitute a proof of the facts and evidences that the dispute parties need to prove [4,11,12,17,18]. To create a practical system for dispute resolution, it is necessary to construct procedures for contract dispute resolution along these lines.

We proposed modular argumentation to allow reference to different semantics of a argumentaton module at the same time. The new approach is applied to model the mutual mistake doctrine. Other doctrines for relief of performance like the doctrine of impossibities, impracticality and frustration of purpose could also easily be modelled within our framework [7].

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