

# Ontology Modeling for Criminal Law

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**Abstract.** In the continental law system, more attention is paid to judicial interpretation to judge legal facts or actions than judicial precedents. Thus, the use of knowledge representation technologies such as ontologies and rule-based methods for legal interpretations and judgments are effective in building computer aided systems for the continental law. In order to construct the knowledge representation and rule-based methods, legal analysis on a target law should be preceded by collaboration with legal experts and knowledge engineers. This paper presents an ontology design methodology for legal knowledge representation by introducing a super-domain concept, which describes common domain knowledge depending upon law types. In particular, this paper describes the ontology and rule design of the criminal law based on the continental law, and presents an application example of the Korean anti-graft act.

**Key words:** Criminal law ontology, Ontological modeling of legal data, SWRL rules, Legal reasoning

## 1 Introduction

Artificial intelligence (AI) has been increasingly applied to researches and services in specialized areas such as law and medicine. The majority of recent AI applications utilize data-driven machine learning approaches. However, these approaches might not be appropriate for the specialized fields. The legal AI field commonly requires logically explainable implementations, which utilize white box approaches for solving a legal problem.

Therefore, it becomes important to use machine-readable knowledge representation and logic structures in legal AI applications. There were several approaches to build such AI systems: Generalization of legal information [1], semantic web technology [2], legal ontology and rule designs [3][17].

This paper presents ontology-based legal knowledge representation and logic based legal rule design methodology. Especially, this paper focuses on the Korean criminal law. The presented methodology is applied to and tested on the Korean anti-graft act, which is part of the criminal law.

Section 2 introduces related works on legal ontology. Section 3 explains the characteristics of the Korean legal system and criminal law. This section also describes differences between continental and common law, and between civil and criminal law.

The Korean anti-graft act is described as an example of criminal law. Section 4 introduces the methodology to construct a criminal law ontology. This section firstly reviews existing researches on legal and criminal ontologies, and on recent developments for legal analysis systems and legal ontology learning. Then, it presents the main idea of this paper, which is the design of an ontology for criminal law. Section 5 describes the application process of the proposed methodology for the Korean anti-graft act. Finally, this paper concludes with a discussion as the proposed methodology in Section 6.

## 2 Related Works

Various studies have been conducted on the design and construction of crime ontologies [3][4][5]. As part of the e-Court European project<sup>1</sup>, Breuker [3] introduced ontology construction and reusability for the *Leibniz Research Institute for law* (LRI) ontology and the domain ontology of the Dutch Criminal Act (OCL.NL). The LRI-Core ontology consists of two parts, which are concept and legal key element ontologies. The concept ontology describes physical, mental and abstract concepts, and the legal key element ontology describes legal case, legal action, legal person, etc. Bezzazi [4] developed an ontology to identify what article of criminal law is applied to a cybercrime. Each legal article is defined as description logic and crime cases are classified by the logic. Bak and Jedrzejek [5] suggested an ontology model of financial fraud. They constructed the concept-wise ontology with a modular ontology and invented an inference method with Web Ontology Language<sup>2</sup> (OWL) and Semantic Web Rule Language<sup>3</sup> (SWRL).

Many studies on rule-based legal argumentation have been conducted [6][7][8]. Gordon [6] showed the syntax of the *Legal Knowledge Interchange Format* (LKIF) rule language and argumentation-theoretic semantics which are developed in the European ESTRELLA project<sup>4</sup>. The rules for those legal arguments were roughly composed of the provisions of the German family law. Contissa [7] introduced the legal rule-based system based on the Italian Copyright law. This is a support system creating and deploying rule-based knowledge models. Ontology-based methods generally apply to legal knowledge modeling. Ontologies are suitable for modeling legal knowledge because these represent resource relationships with inferable expressions. Governatori [8] applied a rule-based approach to the business process field.

The legal ontology is made up of ontology design based on accurate legal analysis. Especially, legal analysis needs to be reviewed by legal experts because it requires interpretation based on the meaning of the legal texts and the purpose of the law. Knowledge engineers have actively worked with legal experts to conduct researches on legal analysis, information extraction and ontology generation. Many researches are conducted to automatically analyze legal sentences and construct legal knowledge bases, which are tagging semantic annotation for legal sentences with NLP tools [9][10],

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<sup>1</sup> [http://cordis.europa.eu/project/rcn/56906\\_en.html](http://cordis.europa.eu/project/rcn/56906_en.html)

<sup>2</sup> <https://www.w3.org/TR/2012/REC-owl2-primer-20121211/>

<sup>3</sup> <https://www.w3.org/Submission/SWRL/>

<sup>4</sup> <http://www.estrellaproject.org/>

extracting rules from legal sentences with text structure lightweight ontologies or NLP parser [11][12], and generating ontology from legal documents using NLP and ontology learning tools [13][14][15][16].

### **3 Legal System and Criminal Law in Korea**

#### **3.1 The Differences between Continental Law and Common Law**

Legal systems around the world generally fall into one of two main categories: continental law (civil law) and common law systems. The main difference between the two systems is that the continental law systems are codified, whereas the common law is generally uncoded. The continental law system is based on the statutory law and the Pandekten-system<sup>5</sup>, and the deficiency of the law is supplemented by the precedents. The common law system is based on the customary law and the common law, and the precedents play a pivotal role. However, in the modern age, even common law countries adopt the form of the statutory law for a new law. In addition, the precedents are becoming more important in the continental law system, and the difference between the legal systems is getting smaller.

The Korean legal system follows the German legal system, which is based on the Roman law; the system has a hierarchical structure of constitution, law, enforcement ordinance and enforcement rules. The inside of each law follows the Pandekten-system.

#### **3.2 The Differences between Civil Law and Criminal Law**

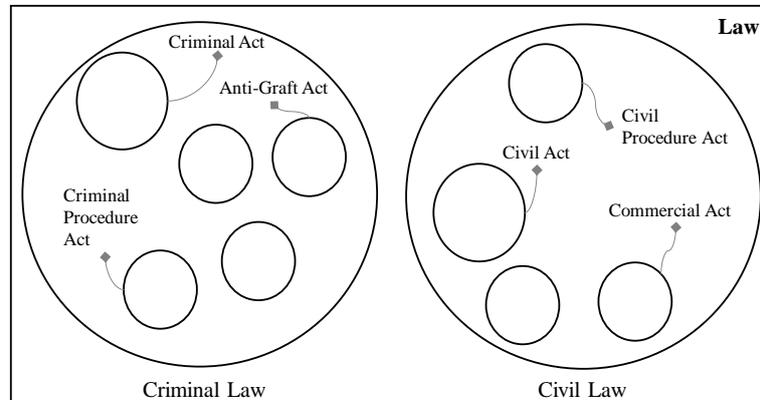
Laws are generally categorized into civil law and criminal law. Civil law is a general law of private law that regulates the rights and obligations arising from the relations between private law actors such as private persons and private juristic persons. Especially, civil law regulates the relationships between private persons' lives, ruled by the principle of private autonomy or legal relations. The legal relationship consists of individual rights or obligations.

Criminal law is a law that regulates crime and punishment. It specifies what acts are criminal and which punishments are legally imposed. Criminal law is the part of legal order, which defines what constitutes a crime (requirement) and what effect will be attributed (effect).

Fig. 1 shows the statutes in the criminal and civil law categories. It is noting that criminal law and civil law are not completely disjoint. For example, commercial law in the civil law category also has penalty clauses. Although all the laws have corpus-delicti (constitutional requirements) and effects, criminal law most obviously includes this feature.

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<sup>5</sup> Pandekten-system begins with the general principles, followed by separate provisions governing particular areas of law



**Fig. 1.** Detailed acts in criminal and civil law

### 3.3 Korean Anti-Graft Act

There is the Improper Solicitation and Graft Act<sup>6</sup> as an anti-corruption law in Korea, which is a part of criminal law. The sanctions for the prevention of corruption are traditionally governed mainly by bribery in criminal law. However, the effectiveness has been limited. Therefore, the Improper Solicitation and Graft Act was enacted in accordance with OECD Anti-Bribery Convention<sup>7</sup> and the precedents of anti-corruption legislation in some countries shown in Table 1.

The Improper Solicitation and Graft Act is divided into the action of improper solicitation and the action of graft. The sanctions against improper solicitation were intended to eradicate corrupt practices and to prohibit public officials from improper solicitation by enabling criminal sanctions beyond a simple code of ethics.

The penalty for graft was introduced to allow criminal punishment if a public official receives a certain amount of money or entertainment even unintentionally. A public official receives more than 1,000,000 KRW<sup>8</sup> in money or entertainment from a person who is not directly related to duties of the public official, he or she can be punished even though there is no intention for an immediate favor. If the person is directly related to duties of the public official, penalties are imposed even if the price is less than 1,000,000 KRW regardless of whether or not it is intending the return.

<sup>6</sup> [http://elaw.klri.re.kr/kor\\_service/lawView.do?hseq=39287&lang=ENG](http://elaw.klri.re.kr/kor_service/lawView.do?hseq=39287&lang=ENG)

<sup>7</sup> <http://www.oecd.org/corruption/oecdantibriberyconvention.htm>

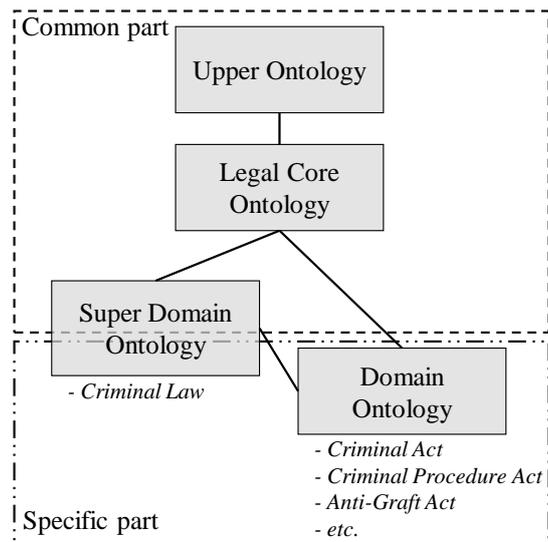
<sup>8</sup> KRW is the Korean currency

**Table 1.** An anti-graft act of other countries

Country or Organization	Act Title
OECD	Anti-Bribery Convention
USA	Foreign Corrupt Practices Act <sup>9</sup>
USA	Bribery, Graft and Conflict of Interest Act <sup>10</sup>
UK	Bribery Act <sup>11</sup>
Singapore	Prevention of Corrupt Act <sup>12</sup>
Singapore	Corruption Confiscation of Benefits Act <sup>13</sup>

## 4 Approach of Criminal Law Ontology

### 4.1 Criminal Law Ontology Construction



**Fig. 2.** A structure of legal ontology

The basic methodology of ontology design is to distinguish between a common part and a specific part of target design object. The LRI-core [3] and LKIF [17] ontologies are implemented in accordance with the basic design methodology. This paper extends

<sup>9</sup> <https://www.justice.gov/criminal-fraud/foreign-corrupt-practices-act>

<sup>10</sup> <http://law.justia.com/codes/us/2011/title-18/part-i/chapter-11>

<sup>11</sup> <http://www.legislation.gov.uk/ukpga/2010/23/contents>

<sup>12</sup> search “Prevention of Corrupt Act” at <http://statutes.agc.gov.sg/>

<sup>13</sup> search “CONFISCATION OF BENEFITS” at <http://statutes.agc.gov.sg/>

the design concepts of the LRI-core and LKIF ontologies by adding a super-domain ontology concept. As shown in Fig. 2, the proposed design has the common and specific parts. The upper ontology and legal core ontology are utilized as the common part, and the super-domain ontology and domain ontology used as the specific part.

The upper ontology includes abstract, physical, and mental concepts, and the legal core ontology consists of the basic elements of law such as legal action, legal case, etc. The super domain ontology is constructed based on law-types, such as criminal law or civil law. There are various acts in criminal law as shown in Fig. 1. They have punishment of crime in common. The super domain ontology abstracts these commonalities. The domain ontology describes the anti-graft act, which is a part of the criminal law.

The design of a legal ontology is a representation of a relationship among the elements (such as legal object, legal actions, legal effects, etc.) required for legal argument, the hierarchical structure between concepts, and concept description. Furthermore, the ontologies distinguish between common and specific parts to facilitate reuse and expansion of the knowledge base.

#### 4.2 Judgment Rules of Criminal Law

This section explains the procedure of the judgment rule design by legal experts and ontologists. In particular, criminal law has clear characteristics of condition and effects such as corpus-delicti and a fine or imprisonment, respectively. Therefore, it is easier to design judgment rules than other laws.

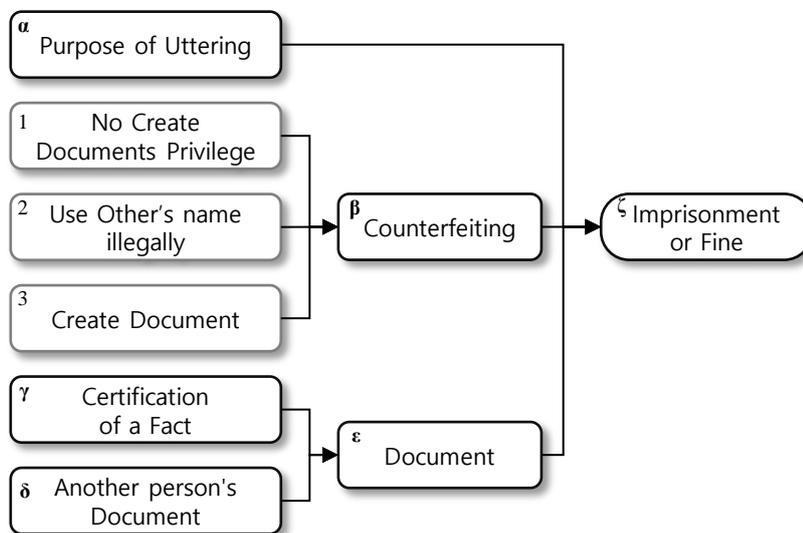


Fig. 3. A counterfeit argument diagram.

**Table 2.** Article on counterfeiting in Korea

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Original version

**제 231 조**(사 문서 등의 위조·변조) α 행사할 목적으로 권리·의무 또는 γ 사실 증명에 관한 δ 타인의 ε 문서 또는 도화를 β 위조 또는 변조한 자는 ζ 5년 이하의 징역 또는 1천만원 이하의 벌금에 처한다.

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English version

**Article 231** (Counterfeit or Alteration of Private Document, etc.)

A person who, α for the purpose of uttering, β counterfeits or alters δ another person's ε document or drawing which pertains to right, duty, or a γ certification of a fact by assuming the capacity of another person, shall be punished by ζ imprisonment for not more than five years, or a fine not exceeding ten million won.

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**Table 3** Articles on counterfeiting in some countries

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Japanese' counterfeiting article

**第百五十九条** α 行使の目的で、δ 他人の印章若しくは署名を使用して権利、義務若しくはγ 事実証明に関するε 文書若しくは図画をβ 偽造し、又は偽造した他人の印章若しくは署名を使用して権利、義務若しくは事実証明に関する文書若しくは図画を偽造した者は、ζ 三月以上五年以下の懲役に処する。

2 他人が押し又は署名した権利、義務又は事実証明に関する文書又は図画を変造した者も、前項と同様とする。

3 前二項に規定するもののほか、権利、義務又は事実証明に関する文書又は図画を偽造し、又は変造した者は、一年以下の懲役又は十万円以下の罰金に処する。

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French's counterfeiting article

**Article 441-1**  
Modifié par Ordonnance n°2000-916 du 19 septembre 2000 - art. 3 (V) JORF 22 Septembre 2000 en vigueur le 1er janvier 2002

β Constitue un faux toute altération frauduleuse de la vérité, de nature à causer un préjudice et accomplie par quelque moyen que ce soit, ε dans un écrit ou tout autre support d'expression de la pensée qui a α pour objet ou qui peut avoir pour effet d'établir la preuve d'un droit ou d'un fait ayant des conséquences juridiques.

Le faux et l'usage de faux sont ζ punis de trois ans d'emprisonnement et de 45000 euros d'amende.

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German counterfeiting article

**§ 267 Urkundenfälschung**

(1) Wer zur α Täuschung im Rechtsverkehr β, ε eine unechte Urkunde herstellt, eine echte Urkunde verfälscht oder eine unechte oder verfälschte Urkunde gebraucht, wird mit ζ Freiheitsstrafe bis zu fünf Jahren oder mit Geldstrafe bestraft.

(2) Der Versuch ist strafbar.

etc.

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Table 2 and 3 show the legal codes for private document counterfeit in some countries. The underlined passages in the articles indicate corpus-delicti and effects. The counterfeiting laws in each country are similar.

Fig. 3 shows a diagram for corpus-delicti (constitutional requirements) of the Article 231 of Korean Criminal Act<sup>14</sup> on counterfeiting. The Greek alphabets in Fig.3 indicate the related terms of the articles in Table 2 and 3, and the numbers 1, 2, 3 are for the additional elements of ‘counterfeiting’, which are derived by legal theories and precedents.

The counterfeiting action in Fig. 3 can be described using SWRL expression as follows:

$$\begin{aligned} & hasSubject(? action, ? x) \wedge Person(? x) \wedge hasPrivilege (? x, false) \\ & \wedge isIllegalUseOtherName(? x, true) \\ & \wedge createDocument(? x, true) \rightarrow Counterfeiting(? action) \end{aligned}$$

The subject of the document forgery, that is, the person who forged the document, becomes a principal offender of this crime. The SWRL of the logic is expressed as follows:

$$\begin{aligned} & Counterfeiting(? action) \wedge Person(? x) \wedge hasSubject(? action, ? x) \\ & \wedge hasObject(? action, ? document) \\ & \wedge hasPurpose(? action, ? purpose) \\ & \rightarrow isPrincipalOffender(? action, ? x) \end{aligned}$$

For example, in the case that nurse B wrote a false diagnosis in the name of doctor C for friend A, nurse B did not qualify to write the diagnosis and he or she made a false diagnosis by stealing the doctor’s name. Nurse B becomes a principal offender of this crime. As shown in the case of document counterfeiting, legal arguments consist of corpus-delicti. These forms of argument are identical in all laws, especially the criminal law.

## 5 Application to Anti-Graft Act

### 5.1 Legal Domain Ontology Construction

In this paper, an anti-graft act ontology was designed and constructed as a domain ontology. It is based on the criminal law ontology, which is a super-domain ontology. The anti-graft act ontology at the bottom layer in Fig. 4 is constituted by using a fundamental legal ontology and a super-domain ontology. The fundamental legal ontology consists of an upper ontology and a legal core ontology. The super-domain ontology is created to apply the criminal law as a common concept of the anti-graft act ontology.

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<sup>14</sup> [http://elaw.klri.re.kr/kor\\_service/lawView.do?hseq=38891&lang=ENG](http://elaw.klri.re.kr/kor_service/lawView.do?hseq=38891&lang=ENG)

*Crime* or *Penalty Action* concept (same as class) in the super-domain (criminal law) ontology is an upper concept of *Improper Solicitation Action* and *Graft Action* in the anti-graft act. *Public Official* indicates a subject of *Legal Action* in anti-graft act and is a lower concept of *Legal Person*. In addition, *Case Artifact* is applied to express an object for requisites of *Legal Action* such as in the form of food and drink, congratulatory or condolence money, gift, etc. *Case Artifact* such as a gift can have a value that used in numerical condition. *Legal Case(situation)* represents a set of various actions, for example, a combination action that a public official receives gifts and is treated to a meal simultaneously. In the anti-graft act ontology, principal entities are an action, a subject, an object, and a value of object. And a variety of rules can be expressed by the combination of these entities.

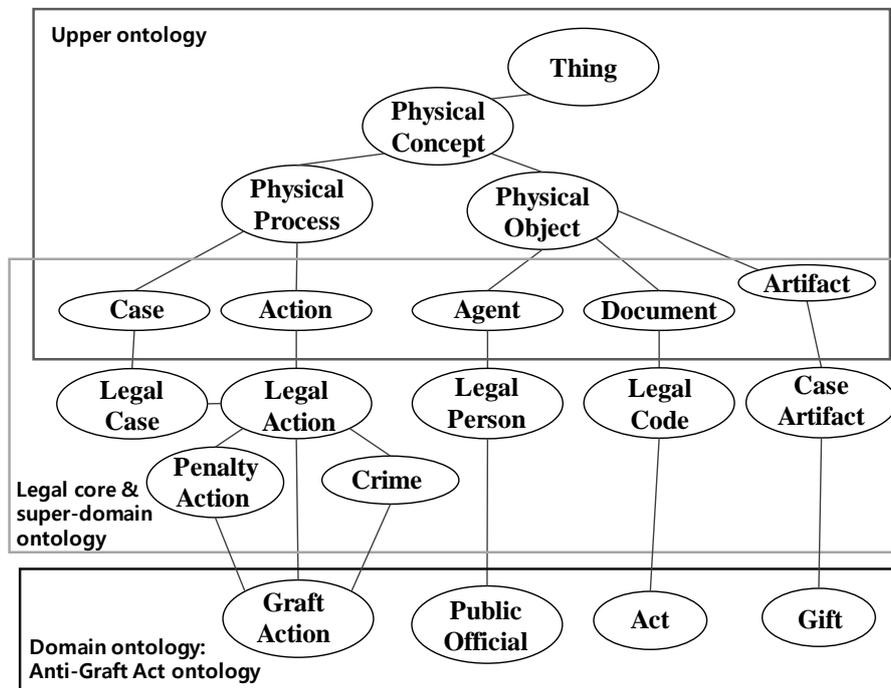


Fig. 4. Layers of ontologies illustrated by relations between some typical concepts

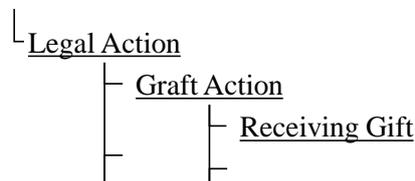


Fig. 5. A brief hierarchy of Graft Action Class

Fig. 5 briefly expresses a hierarchical structure of Action Classes. *Graft Action* has *Receiving Gift* class at the bottom. It can be defined as description logic as follows:

$$ReceivingGift \equiv Action \wedge \exists receive.Gift$$

## 5.2 Rules on Anti-Graft Act Domain Ontology

The Korean anti-graft act has two main parts, which are the improper solicitation and graft parts. And the anti-graft act has an additional section, which regulates external lectures of public officials. Furthermore, the anti-graft act describes various computational cases with numerical limitation. Numerical calculation based decision rules are necessary to judge the computational cases in the anti-graft act. The numerical rules are built on values of case artifacts related crime. Other laws that require numerical judgment can be applied in a similar way. The numbers of rules in the anti-graft act ontology are given in Table 4.

**Table 4.** Number of SWRL rule per category

Category	# of SWRL Rule
Graft	174
Improper solicitation	7
External lecture	9
Graft-numerical calculation	38
Total	228

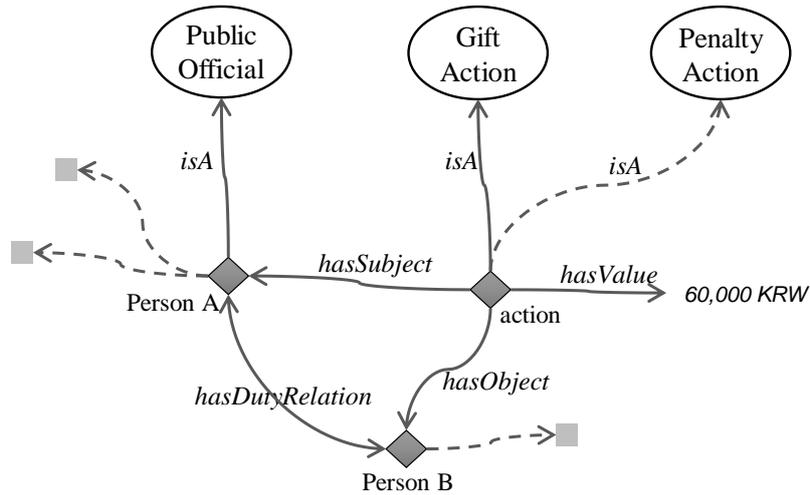
Some of the designed rules for the improper solicitation action and the graft action are shown in Table 5. The first rule in Table 5 describes the case that a stakeholder improperly solicits a public official through a third party; it is against the anti-graft act without an exception. In this situation, the stakeholder is charged a fine (up to 10,000,000 KRW) for negligence, and disciplinary and criminal punishments (not more than two years or an administrative fine not exceeding 20,000,000 KRW) are imposed on the public official.

The second rule in Table 5 explains the graft-numerical calculator rule. When a public official receives a present exceeding 50,000 KRW from a private person, a disciplinary punishment and a fine (2 to 5 times the price of the present) are imposed on the public official and the private person receives a criminal punishment (not more than three years or an administrative fine not exceeding 30,000,000 KRW).

**Table 5.** The SWRL rule examples in the anti-graft act ontology

An example of the improper solicitation action rule
$  \begin{aligned}  & Action(? a) \wedge IllegalSolicitation(? is) \wedge hasIllegalSolicitation(? a, ? is) \\  & \quad \wedge hasSubject(? a, ? p2) \wedge hasObject(? a, ? p1) \wedge through(? a, ? p3) \\  & \quad \wedge Person(? p3) \wedge PublicOfficial(? p1) \\  & \quad \wedge NonPublicOfficial(? p2) \wedge connected(? p1, ? p3) \\  & \quad \wedge connected(? p2, ? p3) \\  & \rightarrow PenaltyAction(? a) \\  & \quad \wedge hasDisciplinary(? p1, public\ official\ disciplinary) \\  & \quad \wedge hasPenalty(? p1, article_{22,2}\ penalty) \\  & \quad \wedge hasMaxFine(? p2, 10,000,000)  \end{aligned}  $
An example of the graft action rule
$  \begin{aligned}  & GiftAction(? a) \wedge hasSubject(? a, ? p) \wedge hasObject(? a, ? r) \wedge PublicOfficial(? r) \\  & \quad \wedge hasDutyRelation(? p, ? r) \wedge hasValue(? a, ? v) \\  & \quad \wedge greaterThan(? v, 50,000) \\  & \rightarrow PenaltyAction(? a) \\  & \quad \wedge hasDisciplinary(? r, public\ official\ disciplinary) \\  & \quad \wedge hasPenalty(? p, article_{22,1}\ penalty) \wedge hasMinFine(? r, ? v \times 2) \\  & \quad \wedge hasMaxFine(? r, ? v \times 5)  \end{aligned}  $

Fig. 6 describes a fictive example to demonstrate the graft-numerical calculation. A public official “Person A” is instantiated as a subject for a gift action. This gift action has an object “Person B”, and has a value of more than 60,000 KRW. The subject “Person A” has a relation to the object “Person B” regarding his or her duties. In this example, it is inferred that the gift action is a penalty action when the rule for the graft-numerical calculation in Table 5 is applied.



**Fig. 6.** Reasoning on the anti-graft act ontology

## 6 Conclusion and Future Work

This paper has presented the methodology for the design of ontologies and decision rules for the Korean criminal law. These ontologies and rules were created for the purpose of the legal argument, which should be demonstrated on a clear logical basis. The presented methodology extended the existing European ontology methodology by adding one layer, which is a super-domain ontology. This additional layer corresponds to law categories such as criminal law and civil law. In particular, criminal law was made into the super-domain ontology. Due to this declaration, acts belonging to criminal law can reuse the characteristics of the super-domain. This paper applied the presented methodology to construct the Korean anti-graft act ontology.

As future works, the super-domain ontology will be extended by adding other law including civil law to represent common characteristics of general legal areas. Furthermore, it will be conducted to construct automated design aid methods for legal ontology and judgment rules, especially for Korean legal ontology. Also, it will be studied to establish verification systems by legal experts and knowledge engineers.

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