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A Decision Support System for Sex-Crime Sentencing

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Abstract

In this research the AJAX technique was used to develop an expert system for sex-crime sentencing. The goals were as follows: (1) to create an expert system which can be easily operated by judges and members of an observer jury; (2) to take a humanized perspective to designing a sentencing operating procedure which is streamlined and efficient; (3) to retain in the system the judge's prerogative to adjust the sentence according to the actual circumstances of the case; and (4) to design the system in such a way that it provides sentencing recommendations as well as information on past cases of a similar type. The system developed in this research consists of three parts: a database of past sentences; a user interface; and an operational rule base. The system makes sentencing recommendations based on the average length of past sentences, while also applying a weighting formula for taking into account the specific circumstances of the case, so as to make sentences more consistent and equitable.

Keywords: Sex Crime; Sentencing; Decision Support System; Expert System

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性犯罪量刑專家決策支援系統之建置

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摘要

本研究將應用 AJAX 技術開發性犯罪量刑專家系統，並有以下研究目的：其一、建構法官與觀審員個別操作介面之量刑系統。其二、以人性化的角度，設計選擇量刑條件的操作流程；同時避免量刑系統資料過於龐大，導致讀取緩慢之情形。其三、法官量刑系統之部分，保留法官根據案件實際情節增減刑期之空間。其四、除過去判決資料之呈現外，實際給予判決刑度的建議。本系統之架構分為三個部分：歷年判決資料庫、使用者介面以及運算規則庫。其量刑結果將依據歷年判決刑期之平均數值，藉由公式運算科刑條件的權重加減，最後得致量刑刑度之建議，提供法官與觀審員參考，以期降低判決之歧異，維持量刑之一致性與穩定性。

關鍵詞：性犯罪、量刑、專家系統

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1. Introduction

In a recent study on sentences for exhibitionism, Chen¹ and Lin (2010) conducted a search of the Judicial Yuan's online "Law and Regulation Retrieval System" and "Judgment Database" for all the entries between January 1, 2007 and November 10, 2010 which included "Criminal Code Article 234 + obscenity."² The results show that sentences for those convicted of public obscenity in Taiwan are rather light and inconsistent. For example, in one case the prosecutor had requested a severe sentence, but since it was not a repeat offence the judge gave a sentence of only seven months.³ In another case, a repeat offender was sentenced to only ten days detention.⁴ Another repeat offender was sentenced to only 40 days detention.⁵ In another case involving a repeat offender, since the current offense was less serious, he was sentenced to only five months detention.⁶ Such cases demonstrate that sentencing in such cases is inconsistent, a situation which makes it more difficult to prevent sex crimes and reform the perpetrators.

In 2010 there were two cases of child molestation which sparked a great deal of public debate concerning sentencing standards in Taiwan. In one case, a man surnamed Lin was convicted for sexually assaulting a six-year-old girl;⁷ the prosecutor was seeking a conviction for aggravated sexual assault and a sentence of seven years and ten months; however, the final sentence issued by the Kaohsiung District Court, citing Article 227 of the Criminal Code, was a mere three years and two months (Tsai 2013). In the other case, a person was accused of sexually molesting a three-year-old girl, and in the second instance was convicted of sexual assault by the Kaohsiung Branch of the Taiwan High Court and sentenced to seven years and two months in prison.⁸ However, on appeal to the conviction was overturned by the Supreme Court, which stated that the use of force had not been proven beyond a reasonable doubt.⁹ While both of these cases involved the application of important legal conditions, many observers were surprised

¹ All transliterations of Chinese terms, organizations, and place names are in Hanyu Pinyin. The only exceptions are "Taipei," "Kaohsiung," "Chiayi," and personal names used by the authors themselves.

² This study was limited to Article 234, Paragraph 1, of the statute on non-commercial public lewdness.

³ Judgment No. 99, yi, 1471.

⁴ Judgment No. 99, su, 1210.

⁵ Judgment No. 99, shen jian, 1574.

⁶ Judgment No. 99, zhong jian, 1595.

⁷ Judgment No. 99, su, 422.

⁸ Judgment No. 99, shang su, 1008.

⁹ Judgment No. 99, tai shang, 4894.

by the leniency of the sentences. In response, the Presidential Office, the Legislative Yuan, and the Judicial Yuan jointly held a public hearing, during which civic groups called for stiffer punishment for sex offenders. In response, in February 2011 the Judicial Yuan set up the Investigative Subcommittee on Sentencing for Offenses against Sexual Autonomy, tasked with establishing a sentencing information system (Judicial Yuan Investigative Subcommittee on Sentencing for Offenses against Sexual Autonomy 2010).

Although the Judicial Yuan already has a public system cataloging verdicts made by the court, because it's mainly meant for looking up legal documents, it's of limited use to those without a background in law. Moreover, the Judicial Yuan currently also has an information system for sex-crime sentencing, but this system is only available for use by judges and prosecutors, and not the general public. Its main features are as follows:

1. It includes only sentencing guidelines for sex crimes.
2. It is mainly based on sentencing criteria established in the UK, the USA, Australia, and Hong Kong for offenses against sexual autonomy.
3. It lacks detailed categorization of the different types of sex crimes. For example, it doesn't specify whether or not the offender has been diagnosed with pedophilia.

In 2012 the Judicial Yuan formulated the Provisional Regulations for Observer Juries. In addition to establishing the procedures to be used for selecting jury members, the Regulations invest the observer jury with an advisory function at trials for serious crimes; i.e., when making a verdict the judge is supposed to take the jury's recommendation into consideration (Judicial Yuan 2011). Having ordinary citizens participate in an observer jury will undoubtedly help to bring fresh ideas into the legal system. However, jury members will inevitably have widely divergent levels of familiarity with Taiwan's laws and legal system. For this reason it is desirable to have a user-friendly information system to help jurors easily access information on related cases.

The problems with the current sentencing information system can be summed up as follows:

1. It's intended for use by the judiciary.
2. It's highly detailed, but the interface is difficult and slow to use.
3. The user has to search for specific statutes, documents, or circumstances; otherwise it's likely that no information will be found.
4. It doesn't provide any sentencing suggestions, but only information on previous

sentences.

5. Because it is not very user friendly, it's not of much use to jurors who need additional information but are not very familiar with legal terminology and the legal system.

Thus the purpose of the present research was to create a user-friendly information system for accessing sentencing guidelines, so as to improve the current on-line system, and serve as an important resource for judicial verdicts and sentencing. The scope of this research is limited to two sections of Chapter 16 of the Criminal Code, known as "Offences Against Sexual Autonomy": Articles 221–229-1, and Article 234, Paragraph 1.

In this research the AJAX (Asynchronous JavaScript and XML) technique was used to develop a quick and efficient system which both judges and jurors can use to access relevant information on past sentences for sex crimes, and which also uses artificial intelligence to provide sentencing recommendations.

In sum, the sentencing system developed in this project is intended to amend and improve the existing system in the following ways:

1. By creating an expert system (ES) which can be easily operated by judges and members of an observer jury.
2. By taking a humanized perspective to design a sentencing operating procedure which is streamlined and efficient.
3. By retaining in the system the judge's prerogative to adjust the sentence according to the actual circumstances of the case.
4. By designing the system in such a way that it provides information on past sentencing and provides recommendations for sentencing in current cases.

2. Literature Review

The system developed in this study uses AJAX to conduct an asynchronous data search. Most of the data is encapsulated and transported using JSON (JavaScript Object Notation), which enhances the way in which AJAX carries out data interchange. In addition, the JSON format can be used directly and doesn't require decoding, making it possible to apply the concept of an expert system to creating a system which provides ready access to sentencing guidelines. In this section we examine the related literature in three areas:

1. Sentencing information systems in Taiwan and abroad.

2. Examples of the application of AJAX to expert systems.
3. Various types of expert systems.

2.1 Sentencing information systems in Taiwan and abroad

As pointed out by Miller (2005), in 1953 Norval Morris had already come up with the concept of a sentencing information system in the US. However, his proposal was never carried out, mainly because of deficiencies in the Penal Code during the 1950s as well as the large amount of data required by such a system. It wasn't until the 1980s that other countries and cities began to conduct research and assessment on sentencing information systems. For example: in 1988 the Judicial Information Research System (JIRS) was established in New South Wales, Australia (Judicial Commission of New South Wales 2013); in 2002 the Scottish government began testing a sentencing information system for judges (The Scottish Government Riaghaltas na h-Alba 2006); in 2013 Ireland commenced an initiative called the Irish Sentencing Information System (Irish Sentencing Information System 2013); and in 2000 the basic database for a sentencing system had already been set up in Israel (Schild 2000).

These examples demonstrate that there is indeed work being conducted in this field. However, because the legal systems in these countries differ from the civil law system used in Taiwan, there are significant differences between the above-mentioned sentencing systems and one developed in this study, precluding the possibility of making a detailed comparison. However, Japan also uses a civil law system, for which reason the sentencing system developed in Japan has much in common with the one developed in this study, and will thus be examined below.

As mentioned above, Taiwan already has a system which provides judges with information on past cases of sexual assault. In an article which appeared in the *Judicial Weekly*, Judge Xu (2011a; 2011b) explains that this system uses transcoding to increase its efficiency. However, this creates difficulties due to the many changes in sentencing standards. Additional difficulties are posed by the need to balance the system's tabs and sentencing factor options, as well as those associated with processing such large amounts of data. After the judge specifies such factors as motivation, means, harm caused to victim, and attitude of the perpetrator, the system generates information on past cases of the same type, including minimum, maximum, and average sentences, as well as the reasons for the sentence and the full text of the verdict. The drawback with this is that if there are few or no past cases meeting the specified criteria, then the

system isn't able to generate any results. In such an instance, the only way to get the system to generate a sufficient number of results is to reduce the criteria selected, but by doing so the results are less relevant to the case at hand.

In recent years computerized databases have become an indispensable part of professional life in Japan, and court documents on past judicial decisions are mainly accessed from databases available through internet platforms. Research organizations in Japan are regularly commissioned to set up database platforms for accessing information on judicial decisions. Because the information in such databases can be updated at any time and is easy to download, these internet platforms are widely used in Japan. However, in the case of legal statutes and sentences, it is necessary to have the data checked by a legal professional so as to ensure its accuracy (Matsuura 2010). At the same time, research has also shown that such legal databases created by research institutes are highly accurate and conveniently used by organizations which require such information, and such cooperation between academia and government has already become an international trend (Matsuura 2010).

The system used in Japan to retrieve sentencing information is being developed by the Supreme Court and is intended for use by prosecutors, judges, defense attorneys, and lay judges. Its use is intended to make verdicts more transparent and sentences more equitable. However, this system is not available all the time; it only becomes available for use after a given case is entered into the system. However, even though this is the main sentencing information system in use in Japan at present, it was found that total of 85 records were missing from the database, showing that it is not entirely free of errors (Mainichi Daily News 2011). This is one of the most critical issues in such a data retrieval system. As a result, research on how to process such large amounts of legal data is an increasingly popular area of research in both Japan and Taiwan.

2.2 The application of AJAX to sentencing system

The expert system developed in this research uses AJAX to increase the speed of data retrieval and also to make it possible to carry out an asynchronous search when updating web pages, thereby saving much time (Figure 1). Further, AJAX makes it possible to use JavaScript to make modifications to HTML DOM objects when linking front-end pages, making it easier to communicate with back-page programs. Moreover, the use of client-side scripting and a Web server for exchanging data overcomes the problem of having to reload pages, thereby optimizing user-friendliness and feature-rich

GUI. Further, to retrieve the required data, AJAX applications only need to send to the server, whereas traditional web applications have to send a request to the server. This significantly reduces the exchange of data between the server and the browser (Liu & Wang 2008).

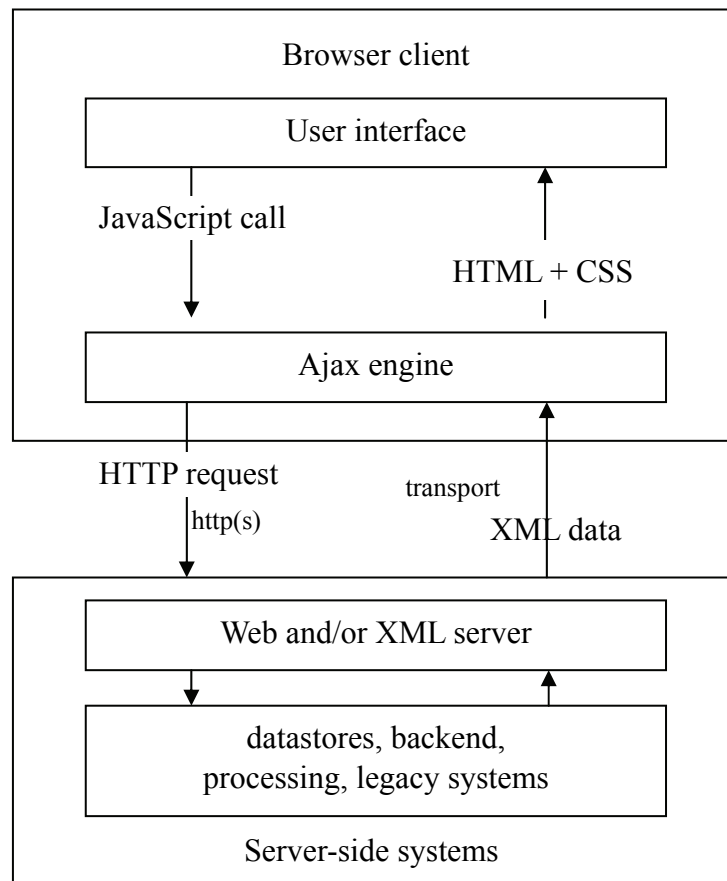


Figure 1 : Model of an AJAX Web application

Sources: Cai et al. (2008); Liu & Wang (2008); Kachhwaha & Rajvanshi (2010).

AJAX is used in various kinds of systems, such as those for selecting classes (Li 2008), and those used to conduct online examinations (Zhou & Lu 2010). Such systems are characterized by a large number of functions, a high rate of usage, and a large volume of data transmission. If such tasks were carried out using traditional Web technology, the back-end processing and response time would be very slow, frequent page updates would cause the screen to flicker, there would be a heavy burden on the server, and the user interface would not be very user-friendly (Guo & Xiao 2007).

Therefore, the application of AJAX to the present system solved the problem of a slow response time which would otherwise result from a rapidly growing number of verdicts to be included, the large amount of data on each verdict, and categorizing of the information.

2.3 Various types of expert systems

At present the only large-scale sentencing system in Taiwan is the aforementioned one created by the Judicial Yuan. As for other types of databases, it has been noted that “Databases are not only an important tool for social science research, but can also be used to conduct market surveys, performance evaluations, and organizational development. The development and application of data bases is becoming the focus of an increasing amount of academic research at home and abroad. . . . A notable example from abroad is the MIS Survey Instruments” (Hong 2010). It should be noted that in addition to the traditional print format, legal decisions in Taiwan are now also compiled using a digital format. Moreover, most of Taiwan's major research institutions now compile relevant data for use in their own database.

The sentencing system we developed in this project is also a database of the type described above, but it's also an “expert system” designed to use a formula and data on past sentences to provide sentencing guidelines and recommendations, while allowing judges a certain degree of discretion. In order to predict the possible outcomes of a given case, this system was also designed to serve as a specialist system which conforms to the civil law system of Taiwan.

2.3.1 *Definition and use of expert systems*

A survey of the literature on expert systems reveals that they are widely used in various fields, especially commercial finance, such as credit analysis, pension fund management, automated service desks, homeland security, market monitoring, and process reengineering systems. For example, Kao et al. (2012) used a fuzzy expert system to study the various management models used by different types of companies. Another example from Taiwan is the field of tunnel engineering, in which expert systems are used for on-site data processing during the various construction phases, engineering analysis, construction decision-making, safety assessment, and to track the progress of the project (Yu et al. 2012). Moreover, expert systems are now used to support decision making by many enterprises (Turban et al. 2011).

The term “expert system” is a shortened form of “knowledge-based expert

system,” which refers to the use of computers to capture information which can then be used to solve problems which would otherwise require the application of human reasoning and professional expertise. Herein the term “expert” refers to an individual with special knowledge, judgment, experience, and skills which can be used to provide sound advice and solve complex problems in a particular field. Therefore, an expert is someone who is significantly better at solving problems in a particular field than the average person (Turban et al. 2011). It has also been pointed out that an expert system is usually designed to be applied to a specific area or issue, and collects the experience of experts and then transforms it into a usable knowledge base which can be used to make inferences (Chi & Chen 2009).

Buchanan (1981) conducted a study of a number of early expert systems (MACSYMA, DENDRAL, MOLGEN, EMYCIN, etc.), as well as the future prospects of such systems. He found that the most effective expert systems include a number of the following factors: a causal model; propositional attitudes and modalities; multiple sources of expertise; temporal and spatial continuity; parallel processing; abstraction and hierarchies; learning from experience; analogies; and focus of attention on facts and relations. He also points out that the most basic model of an expert system includes a knowledge base, consultation driver, and domain knowledge base, as well as a debugging feedback process. He also notes that, in contrast to human intelligence, an expert system has utility, performance, and transparency (or understandability). Finally, Buchanan emphasizes that an expert system should have a suitable ergonomic interface.

More recently, Al Ahmar (2012) designed a prototype rule-based expert system for helping high school students select a university major. He asserts that expert systems are the most successful branch of artificial intelligence, and defines an expert system as a computer program which attempts to imitate the behavior of an expert and is designed for use in a particular field. For Al Ahmar, the three main components of an expert system are: 1) A knowledge base, which contains the relevant knowledge necessary for understanding, formulating, and solving problems; 2) An inference engine, which is the “brain” of the ES, and provides directions about how to use the system’s knowledge by developing an agenda for organizing and controlling the steps taken to solve problems whenever consultation takes place; and 3) The user interface, which consists of all the computer screens through which the user interacts with the ES.

Summing up the results of the above studies, we can say that a formal expert system normally consists of a user interface, a knowledge acquisition subsystem, a knowledge base, an inference engine, a working memory, and an explanation subsystem.

Although there is some variation in the names of these components, those most commonly used are shown in Figure 2.

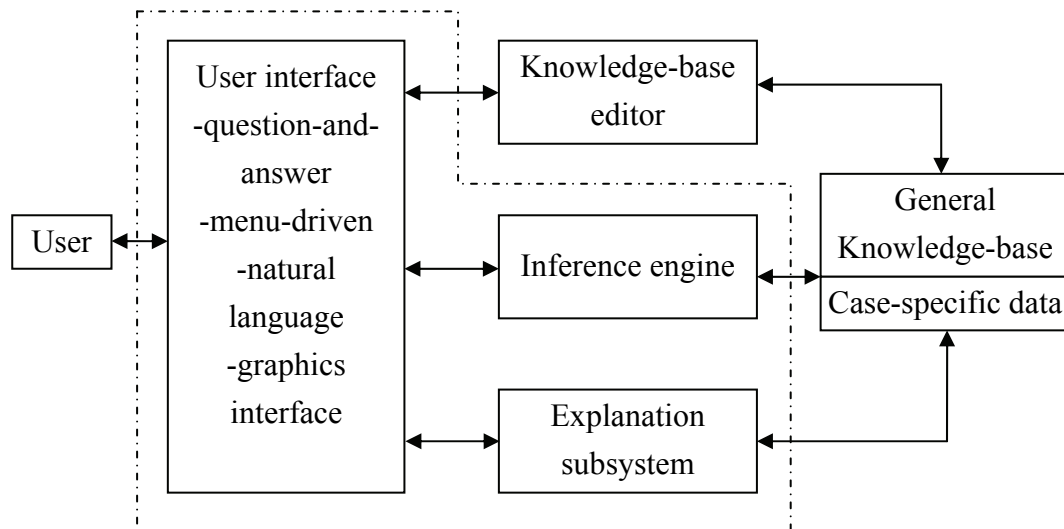


Figure 2 : Structure of a typical expert system

Source: Sadiq (2008).

The above discussion makes clear the feasibility of an expert system which collects past judgments by experts (judges), builds a knowledge base, and uses an algorithm to make sentencing recommendations. Thus the structure of the sentencing system developed in this research is basically that of an expert system. However, Taiwan has a civil legal system which sets sentencing parameters for all types of crimes, specifies mitigating circumstances to be considered, and gives a certain amount of discretion to the judge. Therefore, a sentencing system designed for use in Taiwan is not very comparable with those designed for use in countries which have a common law system. A system for use in Taiwan has to be compatible with a database of local sentences, have a user interface designed for use by judges and lay jurors, and use an operational rule base which complies with the sentencing logic of Taiwan's criminal code. The only difference between an expert system and the sentencing support system developed in this study is that the latter has to take into account Taiwan's legal statutes and the judge's discretionary rights; this is why the user can't completely rely on the suggestions generated by the sentencing engine. Thus the sentencing support system developed in this study can be seen as an extension of the expert system concept.

2.3.2 *Definition and application of a decision support system*

In the present process by which a judge makes a judgment and sets a sentence, the judge applies a formula to the actual circumstances of the case, but there is always room for a certain amount of personal discretion. This conforms to Turban et al.'s (2011) definition of a DSS as a computer-centered interactive system which helps a decision maker utilize data and models to solve unstructured problems. In other words, a DSS helps one quickly find an accurate solution to a complex problem.

Powera and Sharda (2007) assert that a model-driven decision support system differs from ordinary computer-assisted decision analysis in that it is intended for use by a non-technical expert, but provides the same or similar results. There are five main types of DDSs based on models and quantified data: 1) A model-driven DSS uses a computer system to run a quantified model, and uses a simple analytical tool based on an algebraic model to provide the basic required functions. The data and parameters provided by the system are used by the decision maker to analyze the problem at hand; 2) A communications-driven DSS uses communications and related informational tools to carry out an analysis; 3) A data-driven DSS centers on the storage, management, and retrieval of data; 4) A document-driven DSS uses various types of storage and management techniques to retrieve and analyze data; and 5) a knowledge-driven DSS uses artificial intelligence and statistical tools to provide suggestions. As shown in Figure 3, computerized DSSs can be divided into three main parts. The Automated Decision System uses a fixed channel to carry out an analysis of a structured decision situation. However, in a half-structured or a routine situation the DSS will assist the decision maker. By contrast, Computerized Analysis for Special Studies is mainly used to provide experts with the interface they require for a highly specialized research project. Thus the operational model is not geared towards routine use, for which reason neither of these two can be seen as a completely computerized DSS.

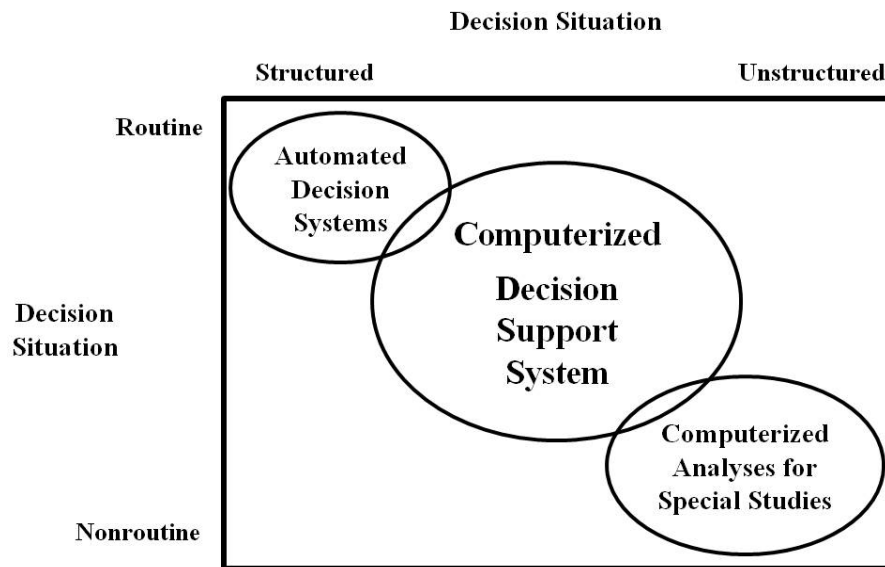


Figure 3 : Computerized decision support system for various situations

Source: Powera & Sharda (2007).

In addition, a model-driven DSS uses decision analysis to carry out a quantified assessment of various possible courses of action. Examples include the analytical hierarchy process; the decision matrix; the decision tree; optimization and mathematical programming models; simulation techniques; development and delivery mechanisms; Web-based DSSs developed from a spreadsheet-based DSS; and group DSSs. The interface of such systems is designed for use by non-technical experts. The way in which the user enters and manipulates the values and controls the way in which the results are displayed have a bearing on how he interprets them and therefore has an influence on his final decision.

As shown by the above discussion, the functions of the system developed in the present study are rather like those of a DSS, but it also includes a number of elements typical of an expert system. Therefore, similar to the way in which Powera and Sharda (2007) integrate different models and systems, this system uses AJAX technology to provide two different interfaces (one for judges, one for lay jurors), thereby combining the functions of a DSS and an expert system.

As for the structure of the decision analysis, Thammaboosadee, Watanapa and Charoenkitkarn (2012) used a two-stage classifier to set up the analytical structure of a DSS for applying the assault sections of the criminal code (Figure 4). First, they used

principal component analysis and a support vector machine to obtain the fact-level attributes of past decisions. In the first stage they used their Artificial Neural Network, which utilizes an algorithm with a modular structure, to carry out case diagnostic issues identification, thereby classifying 99 attributes according to level of force in the action, and then the severity of the result. The results were used to differentiate three sub-modules: important organs; severity of injury; and severity of weapon used. These are case-level attributes. In the second stage they used a C4.5 decision tree to determine the differences between each of the attributes. This process conforms with legal reasoning, and uses awareness class. For example, the decision analysis takes into account whether or not hatred was necessary for carrying out the criminal act. These law-level attributes are useful for determining the scope and duration of the punishment.

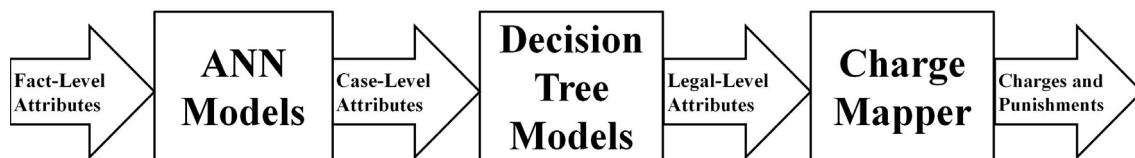


Figure 4 : Analytical structure of a criminal code DSS

Source: Thammaboosadee, Watanapa and Charoenkitkarn (2012).

In this system, selecting the sentencing conditions in accordance with the classifications of criminal responsibility and adjusting the sentence is done in a way which conforms to the reasoning process of the law. This makes it easier to interpret the final sentencing value and distribution, as well as the decision-making process.

2.3.3 *The application of computerized information to sentencing*

Next we present a number of studies exploring the application of computerized information to sentencing. Yang (2004) has proposed the following three-step procedure for increasing the standardization of sentencing: 1) Divide the length of the sentence into a certain number of levels by using a coefficient based on the internal logic of the relevant statutes; 2) Divide the degree of harm to society into a certain number of levels; and 3) Determine the sentence (Lin et al. 2012). Such a sentencing formula takes into account the degree of harm to society as well as the legally defined circumstances of the case. The inevitable difficulty that arises is how to quantify such fuzzy issues, since actual judicial practice is inevitably influenced by a judge's subjective views.

In addition, Lin et al. (2012) carried out research in Taiwan on the use of auto-tagging technology to improve categorization and sentencing standards in cases of larceny and extortion. After determining 21 kinds of legal labels, both global and local,¹⁰ from amongst a total of 2,113 cases of larceny and extortion, 140 were randomly selected and treated with manual marking; the auto-tagging technology was used for the remaining 1,973 cases. Because the results for the local labels were unsatisfactory, only “facts established by the judge” and “behavior” were used to make classifications and sentencing forecasts. The F1 score (a.k.a. F-score and F-measure),¹¹ the Pearson correlation coefficient (PCC), and the root-mean-square error (RMSE) were used to carry out four-fold cross validation. The results show that case categorization and sentencing predictions are enhanced when labeling takes into account reduplication and judge factors.

The Juvenile Delinquent Disposition Advisor (JDDA) is a sentencing system developed in the United States which has a rule-base structure, and uses a Present Offense Evaluation, a Probation Investigation Evaluation, and a Diagnostic Assessment Evaluation to determine the level of supervision and control appropriate in a particular case (Ferns 1996), thereby taking into account such factors as the criminal act, family background, support system, intelligence level, and mental state.

When a judge makes a judgment and sets a sentence, he applies a formula to the actual circumstances of the case, but there is always room for a certain amount of personal discretion. This conforms to Turban et al.’s (2011) definition of a DSS as a computer-centered interactive system which helps a decision maker utilize data and models to solve unstructured problems. In other words, a DSS helps one quickly find an accurate solution to a complex problem.

The above studies make it clear that it’s not possible to use an algorithm to completely quantify the particular nature of each individual case, and that the judge’s discretion will inevitably influence the outcome of each case. These are the two main challenges to be addressed in designing and developing a sentencing system. In

¹⁰ Global labels consist of facts established by the judge, sentencing, charges filed by the prosecutor, arguments made by the defense, and statements. Local labels consist of the perpetrator, criminal behavior, the victim, the victim’s reaction, the removal of property, the perpetrator’s subjective factors, the time when the crime was committed, the tools used to commit the crime, the place of the crime, the characteristics of the perpetrator, victim characteristics, attitude of the perpetrator, motivation, the relationship between the perpetrator and the victim, type of property involved, and accomplices (Lin et al. 2012).

¹¹ A way of simultaneously measuring the precision and volume of recall of information retrieval systems, useful for comparing the efficiency of different techniques or systems. National Academy for Educational Research. Retrieved July 6, 2013 at <http://terms.naer.edu.tw/detail/1679003/>.

addressing these issues we referred to a report published in Washington DC by the Constitution Project (2012) titled *Principles for the Design and Reform of Sentencing Systems*. In the section titled “General Principles, Sentencing Structures, and Federal Sentencing Guidelines” this report describes three principles to be applied to the structure of a sentencing system:

1. Effective sentencing guidelines with meaningful appellate review are a critical component of a successful sentencing system.
 - A. Sentencing guidelines are best capable of controlling unwarranted disparities while retaining appropriate flexibility.
 - B. Sentencing guidelines enhance public confidence in the sentencing system by being open about the factors upon which sentences are being based.
2. Essential to the successful operation of a sentencing guidelines system is a sentencing commission or similar entity with the expertise and stature to study sentencing issues, gather data, and formulate proposed sentencing rules and amendments. The commission should continually assess the performance of sentencing rules and should periodically recommend modifications, which may include either upward or downward adjustments of sentences, based on its assessment. Commission processes should include transparency and fair administrative rulemaking procedures.
3. Experience has shown that mandatory minimum penalties are at odds with a sentencing guidelines structure (The Constitution Project 2012).

The sentencing system developed in this study was designed with the above principles in mind, so as to increase sentencing consistency and also be of use to members of the observer jury. Information on past sex-crime cases was collected and analyzed; highly anomalous sentences were excluded before calculating the averages. In accordance with Article 57 of the Criminal Code, the judge can enter the weighted conditions based on the actual circumstances of the case, thereby increasing or decreasing the sentence, so as to provide more stable and equitable sentencing recommendations. A more detailed description of the design of the system will be provided below.

3. Research Methodology and System Design

According to the aforementioned objectives, we developed a sentencing system interface which is streamlined, efficient and not slowed down by an overabundance of

extraneous data. Moreover, the sentencing algorithm was designed so as to retain the judge's prerogative to adjust the sentence according to the actual circumstances of the case. The system provides both information on past sentencing and recommendations for sentencing in the current case.

3.1 Structure of the System

In order to improve system interactivity and user experience, the front-end page of this system uses HTML5 and CSS3. Scalable vector graphics (SVG) and results charts (Quint 2003) are used to present the data and related information. The JSON package with a back-end server program (Servlet) is used to convey the necessary information, and AJAX is used to integrate the data with the back-end program when searching the database.

The structure of the system consists of three parts: the database on past verdicts; the user interface; and an operational rule base. The database consists of documents on sex-crime cases from the past ten years. An algorithm is used to make sentencing recommendations. The interface is designed to optimize user-friendliness when looking up different types of sex crimes. Below is a detailed description of these three parts.

3.1.1 *The database of past sentences*

In preparing the sample used in this study we collected such documents as the indictments and sentencing transcripts for more than 1,000 cases of domestic sexual assault filed at courts at all levels between 2000 and 2011. These documents were analyzed to determine the characteristics and relevant factors in cases of domestic sexual assault, and then classified accordingly. In Figure 5 can be seen a sample of the data in the management interface of the system.

判決文管理—詳細列表如下：

新增

修改	刪除	流水號	裁判字號	裁判日期	裁判案由
		1	101侵上更(一)22	101/11/21	妨害性自主
		2	101侵上訴283	101/11/22	妨害性自主
		3	101侵上訴332	101/11/21	妨害性自主
		4	101侵訴9	101/8/22	妨害性自主
		5	92,上訴,2889	93/1/30	妨害性自主
		6	93,上更(一),296	93/8/26	妨害性自主
		7	95,上更(一),781	96/1/26	妨害性自主
		8	95,上訴,3486	95/10/31	妨害性自主
		9	95,上訴,866	95/6/30	妨害性自主
		10	96,上更(一),372	97/4/3	妨害性自主
		11	97,上訴,29	97/6/3	妨害性自主
		12	97,上訴,1042	97/8/14	妨害性自主
		13	101,侵上訴,353	101/11/21	妨害性自主
		14	101,侵上訴,303	101/10/16	妨害性自主

Figure 5 : Management interface of the verdict database

3.1.2 User interface

The system interface is divided into five main parts: offenses against sexual autonomy—sexual assault (B1); offenses against sexual autonomy—forcible obscenity (B2); offenses against public morals—non-commercial public obscenity (B3); system interface and operating instructions (B4); and sentence weighting conditions (B5). Although B1 and B2 both come under the Offenses against Sexual Autonomy chapter of the Criminal Code, in this system they are treated separately so that they can be readily distinguished from one another.

For B1, B2, and B3, the user can directly select the ordinances according to the type of case. For B5, only after the user chooses the applicable ordinance do the weightings appear. The information contained in each interface is shown in Tables 1–5:

Table 1 : Data included in B1

【B1】Offenses against sexual autonomy—sexual assault	
Statute	Content
Article 221, Paragraph 1 (sexual assault)	A person who by threats, violence, intimidation, inducing hypnosis, or other means against the will of a male or female and who has sexual intercourse with such person shall be sentenced to imprisonment for not less than three

	years but not more than ten years.
Article 221, Paragraph 2 (sexual assault)	An attempt to commit an offense specified in the preceding paragraphs is punishable.
Article 222, Paragraph 1 (aggravated sexual assault)	A person who commits an offense specified in the preceding article under one of the following circumstances shall be sentenced to imprisonment for not less than seven years: 1. Offense committed by two or more persons 2. Offense against a male or a female under the age of fourteen 3. Offense against a mentally, physically or otherwise handicapped person 4. Offense with the use of a drug in the offense 5. Abuse against the victim 6. Offense committed by taking the opportunity of operating a means of transportation used for the public or unspecified people 7. Commission of an offense by intruding into a residence or a structure used for residence or a vessel or by hiding inside of it for commission of the offense 8. Carrying a weapon while the offense is committed
Article 222, Paragraph 2 (aggravated sexual assault)	An attempt to commit an offense prescribed in the preceding paragraph is punishable.
Article 225, Paragraph 1 (opportunistic sexual assault)	A person who takes advantage of the mental or physical handicap, mental or intellectual defect, or a similar condition which makes resistance impossible for intercourse with a male or a female shall be sentenced to imprisonment for not less than three years but not more than ten years.
Article 222, Paragraph 3 (opportunistic sexual assault)	An attempt to commit an offense prescribed in paragraph is punishable.
Article 226, Paragraph 1 (aggravated offenses against sexual autonomy)	If the commission of an offense specified in Article 221, 222, 224, 224-1 or 225 results in the death of the victim, the offender shall be sentenced to life imprisonment or imprisonment for not less than ten years; if aggravated injury results, the offender shall be sentenced to imprisonment for not less than ten years.
Article 226, Paragraph 2	If the offense causes suicide of the victim because of

(aggravated offenses against sexual autonomy)	shame or humiliation or causes aggravated injury in an attempt to commit suicide, the offender shall be sentenced to imprisonment for not less than ten years. ¹²
Article 226-1 (sexual assault combined with another crime)	A person who commits the offense specified in Article 221, 222, 224, 24-1 or 225 and intentionally kills the victim, shall be sentenced to death or life imprisonment; if the offender causes aggravated injury to the victim, he shall be sentenced to life imprisonment, or imprisonment for not less than ten years.
Article 227, Paragraph 1 (sex with a minor)	A person who has sexual intercourse with a male or female under the age of fourteen shall be sentenced to imprisonment for not less than three years but not more than ten years.
Article 227, Paragraph 3 (sex with a minor)	A person who has sexual intercourse with a male or female who is over the age of fourteen but under the age of sixteen shall be sentenced to imprisonment for not more than seven years.
Article 227, Paragraph 5 (sex with a minor)	An attempt to commit an offense specified in paragraphs 1 and 3 is punishable.
Article 227-1 (perpetrator under 18 years old)	The punishment specified in the preceding paragraph shall be reduced or remitted for an offender under the age of eighteen.
Article 228, Paragraph 1 (abuse of authority)	A person who takes advantage of his authority over another who is subject to his supervision, assistance, caring because of family, guardian, tutor, educational, training, benefactor, official, or occupational relationship or a relationship of similar nature to have sexual intercourse with such other shall be sentenced to imprisonment for not less than six months but not more than five years.
Article 228, Paragraph 3 (abuse of authority)	An attempt to commit an offense specified in paragraph 1 is punishable.
Article 229, Paragraph 1 (deceitful means)	A person who by fraudulent means induces a male or female to mistake him or her as his or her spouse and has sexual intercourse shall be sentenced to imprisonment for

¹² This is the elliptical form of the original text. In the system this is expanded into “If the commission of an offense specified in Article 221, 222, 224, 224-1 or 225 results in the suicide of the victim because of shame or humiliation or causes aggravated injury in an attempt to commit suicide, the offender shall be sentenced to imprisonment for not less than ten years.”

	not less than three years but not more than ten years.
Article 229, Paragraph 2 (deceitful means)	An attempt to commit an offense specified in the preceding paragraph is punishable.
Article 222-1 (complaint necessary)	Prosecution for an offense of Articles 221 and 224 against spouse or an offense of Article 227 by a person under the age of eighteen may be instituted only upon the complaint.

Table 2 : Data included in B2

【B2】 offenses against sexual autonomy—forcible obscenity	
Statute	Content
Article 224 (forcible obscenity)	A person who commits an obscene act against a male or female against their will through the use of violence, threats, intimidation, or hypnosis shall be sentenced to imprisonment of not less than six months but not more than five years.
Article 224-1 (aggravated forcible obscenity)	A person who commits an offense specified in the preceding article under one of the circumstances specified in paragraph 1 of Article 222 shall be sentenced to imprisonment for not less than three years but not more than ten years. ¹³
Article 225, Paragraph 2 (opportunistic obscenity)	A person who takes advantage of the mental or physical handicap, mental or intellectual defect, or a similar condition which makes resistance impossible for obscene behavior with a male or a female shall be sentenced to imprisonment for not less than six months but not more than five years.
Article 226, Paragraph 1 (aggravated offenses against	If the commission of an offense specified in Article 221, 222, 224, 224-1 or 225 results in the death of the victim,

¹³ The circumstances specified in Article 222, Paragraph 1 are as follows:

1. Offense committed by two or more persons
2. Offense against a male or a female under the age of fourteen
3. Offense against a mentally, physically or otherwise handicapped person
4. Offense with the use of a drug in the offense
5. Abuse against the victim
6. Offense committed by taking the opportunity of operating a means of transportation used for the public or unspecified people
7. Commission of an offense by intruding into a residence or a structure used for residence or a vessel or by hiding inside of it for commission of the offense
8. Carrying a weapon while the offense is committed

sexual autonomy)	the offender shall be sentenced to life imprisonment or imprisonment for not less than ten years; if aggravated injury results, the offender shall be sentenced to imprisonment for not less than ten years.
Article 226, Paragraph 2 (aggravated offenses against sexual autonomy)	If the offense causes suicide of the victim because of shame or humiliation or causes aggravated injury in an attempt to commit suicide, the offender shall be sentenced to imprisonment for not less than ten years. ¹⁴
Article 226-1 (sexual assault combined with another crime)	A person who commits the offense specified in Article 221, 222, 224, 24-1 or 225 and intentionally kills the victim, shall be sentenced to death or life imprisonment; if the offender causes aggravated injury to the victim, he shall be sentenced to life imprisonment, or imprisonment for not less than ten years.
Article 227, Paragraph 2 (obscenity against a minor)	A person who commits an obscene act against a male or female who is under the age of fourteen shall be sentenced to imprisonment for not less than six months but not more than five years.
Article 227, Paragraph 4 (obscenity against a minor)	A person who commits an obscene act against a male or female who is over the age of fourteen years but under the age of sixteen shall be sentenced to imprisonment for not more than three years.
Article 227-1 (perpetrator under 18 years old)	The punishment specified in the preceding paragraph shall be reduced or remitted for an offender under the age of eighteen.
Article 228, Paragraph 2 (abuse of authority)	A person with relationship specified in the preceding paragraph who commits obscene act against such shall be sentenced to imprisonment for not more than three years. ¹⁵
Article 229-1 (complaint necessary)	Prosecution for an offense of Articles 221 and 224 against spouse or an offense of Article 227 by a person under the age of eighteen may be instituted only upon the complaint.

¹⁴ This is the elliptical form of the original text. In the system this is expanded into “If the commission of an offense specified in Article 221, 222, 224, 224-1 or 225 results in the suicide of the victim because of shame or humiliation or causes aggravated injury in an attempt to commit suicide, the offender shall be sentenced to imprisonment for not less than ten years.”

¹⁵ A person who takes advantage of his authority over another who is subject to his supervision, assistance, caring because of family, guardian, tutor, educational, training, benefactor, official, or occupational relationship or a relationship of similar nature to commit an obscene act against such other.

Table 3 : Data included in B3

Offenses against public morals—non-commercial public obscenity	
Statute	Content
Article 234, Paragraph 1 (public obscenity)	A person who for purpose of exhibition publicly commits an obscene act shall be sentenced to imprisonment for less than one year, short-term imprisonment; and, in addition thereto, a fine of not more than three thousand <i>yuan</i> may be imposed.

Table 4 : Data included in B4

【B4】 System interface and operating instructions			
Introduction to the system	Operating instructions	General explanation for members of observer jury	Questions and answers (Q&A)

Table 5 : Weighting factors in B5 (one level equals six months)

Reduce weighting (-)										Perpetrator factors to be considered	Increase weighting (+)									
5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5	Motive	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
										Provocation										
										Means										
										Background										
										Character										
										Intelligence level										
										Relationship with victim										
										Breach of trust or duty										
										Degree of harm inflicted										
										Attitude										

3.1.3 Operational rule base

The operational rules of the system are based on the database of past sentences and the statutes in B1, B2, B3, and B5. When the user selects a statute from B1 to B3 to

query the database, the system carries out and presents a statistical analysis of all the applicable cases, calculates the average of all the sentences, and presents a distribution chart. In B5 the user adds weightings for each of the sentencing factors in Table 5, in accordance with Article 57 of the Criminal Code. Each weighting level has a value of 0.5, representing an increase or decrease of six months to the sentence. The formula used in this system is shown in Figure 6.

$$\left\{ \begin{array}{l}
 \textcircled{1} \quad \textit{Penalty}_{upper} := \textit{decided by selected article} \\
 \textcircled{2} \quad \textit{Penalty}_{lower} := \textit{decided by selected article} \\
 \textcircled{3} \quad S = \{S_i : S_i \in N, S_i > 0, S_i \leq \textit{Penalty}_{upper}\} \\
 \textcircled{4} \quad W = \{W_j : W_j \in Q\} \\
 \textcircled{5} \quad \textit{Penalty}_{Lower} \leq \textit{Penalty} = \frac{1}{n} \sum_{i=1}^n s_i + 12 * \sum_{j=1}^m w_j \leq \textit{Penalty}_{Upper}
 \end{array} \right.$$

Figure 6 : The formula used in this system

Both the minimum sentence ($\textit{Penalty}_{lower}$) and maximum sentence ($\textit{Penalty}_{upper}$) are determined by the statutes selected by the user. “S” represents the mean of the past sentences as determined by the legal statutes selected by the user and the related sentencing parameters. “W” represents the weighting in accordance with Article 57 of the Criminal Code. Step 5 of the formula shows how the sentencing recommendation is obtained by combining the mean of the past sentences and the weightings set by the sentencing parameters; “n” stands for the number of sentencing data items; “m” stands for the number of circumstances of the crime selected by the user. The resulting sentencing recommendation provides judges and lay jurors with a starting point for setting their own sentence. Figure 7 displays the structural logic of the system.

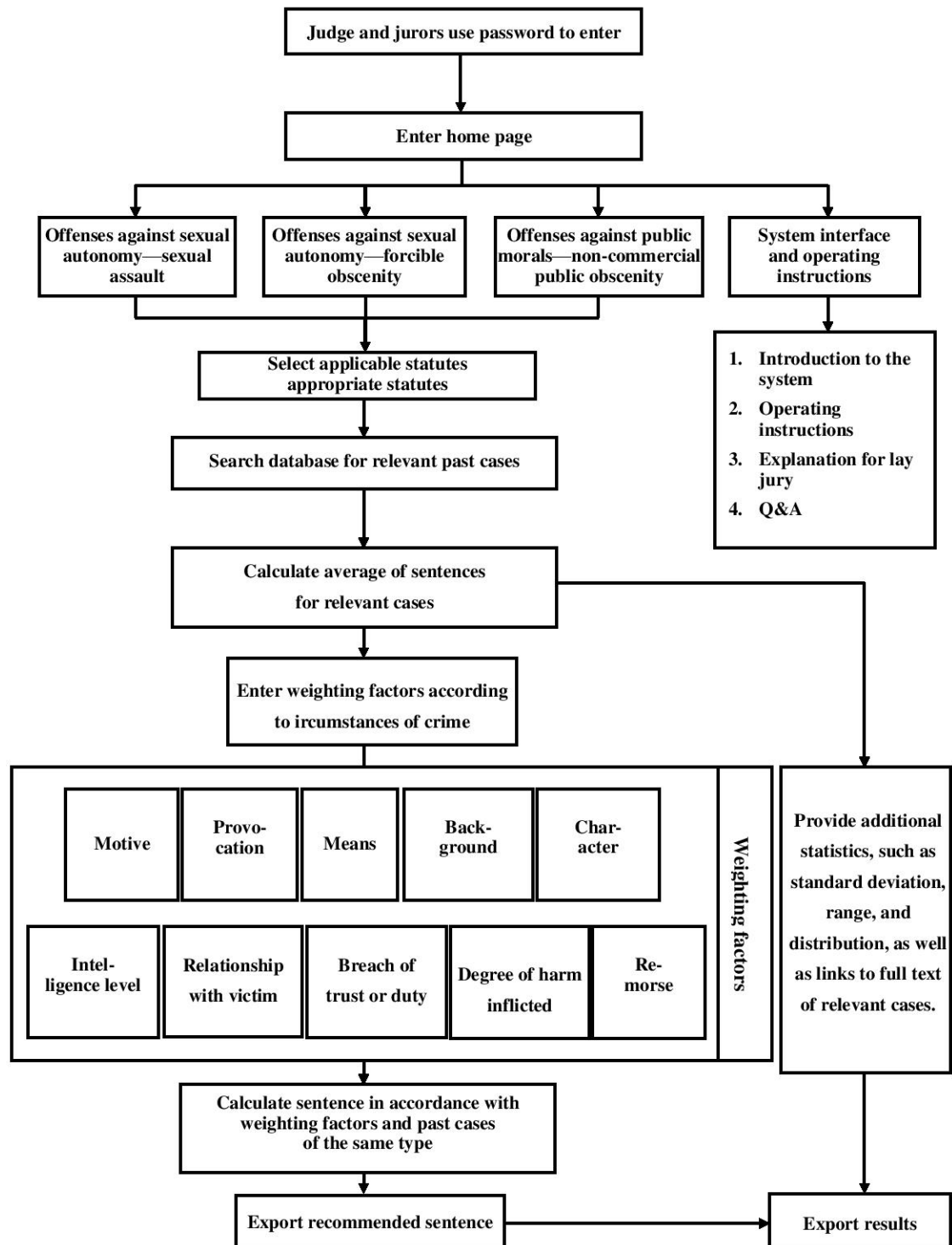


Figure 7 : System structure

3.2 How to operate the system

This section takes a violation of Article 221 of the Criminal Code (sexual assault) as an example. Figures 8–12 show the system’s interface, which is explained below.

Figure 8 show the system’s login page. The user begins by clicking on either “Judge” or “Jury member,” and then enters a user name and a password, whereupon the system displays all the case numbers being presided over by a particular judge. The user then clicks on one of these cases, whereupon the system displays the homepage (Figure. 9).

Figure 8 : Login page

After entering the homepage the user selects the type of crime, “sexual assault” in this example. After the user selects “Offenses against sexual autonomy—sexual assault” on the upper left he is presented with the relevant statutes (Figure. 9).



Figure 9 : System homepage

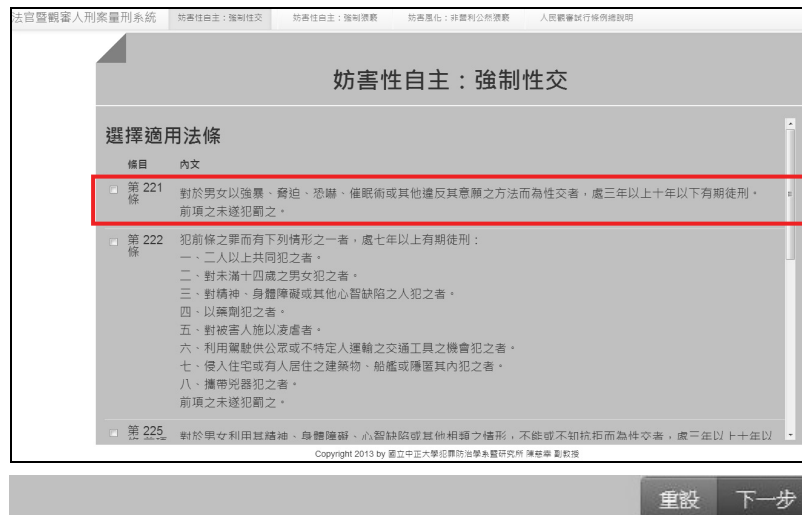


Figure 10 : Relevant statutes

When the user selects a statute (Article 221 in this example) he is presented with the sentence weighting interface (Figure. 10), and given the opportunity to provide information on the circumstances of the crime. Next, the user uses the drop-down menus to select a factor which has a bearing on the case at hand; he then selects the description which best fits the perpetrator and the circumstances of the crime, and then assigns an appropriate weighting, thereby increasing or decreasing the sentence. In this example (Figure. 11) the perpetrator was overcome by lust and used deceit to carry out the sexual assault. However, the perpetrator later expressed deep remorse and became

reconciled with the victim. Therefore, the two weighting selections in the present example are as follows: 1) Attitude > Remorse and reconciliation > -1; and 2) Means > Deceit due to lust > +2.5. As a result, the sentence receives a combined positive weighting of 1.5 units. After entering the information for all the relevant factors the user clicks on “next.”

妨害性自主：強制性交

犯罪情狀描述

犯罪行為人之智識程度

條件類型	條件內容	權重(6個月/1)	移除條件
犯罪後之態度	深感悔悟並與被害人達成和解	▲ -1 ▼	×
犯罪之手段	設局誘騙以逞性欲	▲ 2.5 ▼	×

Figure 11 : Sentence weighting

In the final step the system calculates a sentencing recommendation according to the information provided, which is displayed along with related data, including a distribution chart of past sentences (Figure. 12). Here it should be noted that regardless of the weighting, the recommended sentence is always within the range specified by the statute in question.

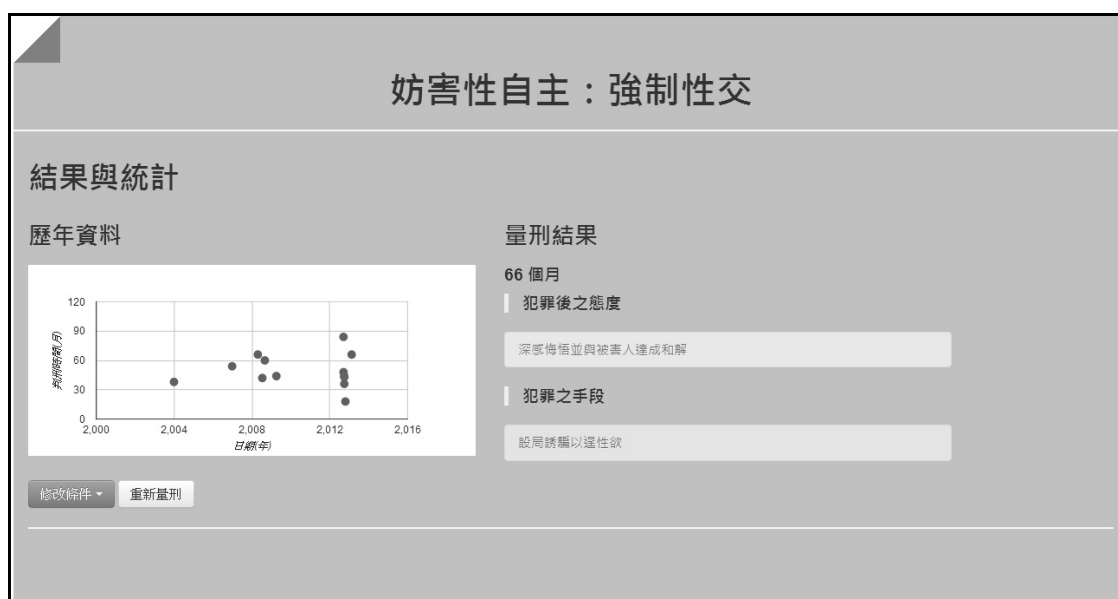


Figure 12 : Sentencing recommendation

4. Conclusion

The Criminal Code is intended to be a model of justice, and verdicts made by judges are widely regarded as sacrosanct. In recent years, however, there has been an increasing amount of discussion on sentencing discrepancies. For example, a judge may have a certain bias when presiding over a particular type of case, giving rise to inconsistency and lack of proportionality in verdicts and sentences. In order to address this issue, in this study we developed an expert system which uses information technology to create a database, analyze past sentences, and make sentencing recommendations.

In accordance with the four goals mentioned above, the results of this study are as follows: First, we developed a sentencing information system with an interface which can be used by both judges and lay jurors. Second, we applied the concept of the expert system to creating a system which provides users with precise sentencing recommendations and uses streamlined and efficient operational processes which allow the user to select various conditions which affect the sentence. Third, we designed the system so as to utilize the average length of past sentences to generate recommendations for the present case, while also taking into account the particular circumstances of the case and retaining the judge's prerogative to adjust the sentence accordingly. Fourth, we

designed the system in such a way that it provides information on past sentencing and provides recommendations for sentencing in current cases.

The sentencing system currently used by the Judicial Yuan is designed to be used by judges, and is not open to the public. Because the system developed in this study is also intended for use by the observer jury, the members of which come from a wide variety of backgrounds, it uses a streamlined, user-friendly interface which makes it quick and easy to enter the required information and obtain the results. Most importantly, the system's algorithm was designed in such a way that its sentencing recommendations accord with the sentencing guidelines of the Criminal Code, while retaining room for the judge to exercise discretion and make adjustments as required by the particular circumstances of the case. Therefore, the application of this system in the court system of Taiwan would help to increase sentencing equity and reduce the occurrence of widely discrepant sentences; it would also represent a major milestone in both the development of information technology and judicial reform.

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