Knowledge Representation of Political Parties' Ideological Characteristics Using Formal Concept Analysis

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***Abstract*—We build a knowledge representation of ideological characteristics of political parties. In particular, we propose a knowledge representation regarding the ideological characteristics of Indonesia's political parties in the 2019 general election. Our proposed knowledge base is constructed using the rigorous approach of Formal Concept Analysis (FCA). We first define several formal contexts specifying the ideological characteristics satisfied by the associated political parties. These formal contexts are then used to construct the pictorial relationship among political parties' ideologies in the form of concept lattice. From this lattice, we also derived implications and association rules pertaining to the relationship between two or more ideological characteristics. These implications and association rules are useful for building the ontology of Indonesia's Political Parties ideological characteristics.**

Keywords*—ideological characteristics, formal concept analysis, knowledge representation, ontology

I. Introduction

Indonesia holds both presidential and legislative general elections quinquennially. The general election in 2019 is the first one in which presidential and legislative election are held concurrently. Indonesia's General Elections Commission (*Komisi Pemilihan Umum*) announced that the legislative elections are contested among 16 national political parties [1].

According to the previous research by S. Mujani and R. W. Liddle during 1999 and 2004 general elections—by ignoring sociological and cultural factors—there were two dominant influencing motivations in the election of each political party by voters, namely the leadership of presidential candidates and the identity of the party itself. Accordingly, the knowledge representation and hierarchical clustering regarding Indonesia's political parties becomes a valuable thing as a tool for the political scientist in Indonesia as well as for constructing the formal ontology concerning the ideological characteristics of political parties.

In computer science, an ontology is a formal representation which can be used to model a domain consisting of objects with existing concepts that occur and inter-object relationships. Several studies regarding the ontology design stated that Formal Concept Analysis is a promising method because it can assess similar concepts and spot new concepts in the domain [2]. The application of Formal Concept Analysis (FCA) in the field of ontology is for mapping, structure checking, constructing and even improving an ontology. In this paper, we focus on constructing ontology in the political domain with FCA. Nevertheless, the reader should be aware that we do not conduct any further correctness or consistency checking of the resulting ontology in this paper.

We use an FCA approach to represent the knowledge regarding Indonesia's political parties and their corresponding ideological characteristics. FCA can be used to identify the conceptual structures and exploring new concepts and relations in such representation [3], [4] since building a knowledge representation, e.g., ontology requires the structural concept in which political domain in Indonesia does not have it. Moreover, compared to common clustering methods, the concept lattice in FCA allows attaching political parties to more than one cluster, whereas other methods only attached one object to at most one cluster [5]. It means that FCA has a feature to model overlapping concepts among several objects. In other words, our proposed clustering method handles the overlapping attributes or ideological characteristics.

Our work is partly inspired by works of B. Kohler-Koch [6], [7] in which FCA has been successfully applied in the domain of political sciences. Here we use FCA to construct the ontology about the ideological characteristics of political parties in Indonesia. We firstly conduct knowledge acquisition via literature review. This will be beneficial in constructing the ontology since we require more information related to the parties, not merely their ideological characteristics. Subsequently, we construct the formal context and concept lattice using ConExp, where the objects are the political parties and the attributes are their characteristics. Afterward, we obtain the implication rules from the resulting concept lattice. Finally, we translate these implication rules into first-order logic (FOL) formulas to facilitate the future works regarding the reasoning and consistency checking about the resulting ontology.

II. Preliminaries: Formal Concept Analysis and Related Theories

In this section, we review the notion of formal concept analysis, its notations, and its terminologies used throughout this paper. Formal concept analysis (FCA) is a mathematical theory about concept and concept hierarchies [8]. FCA is valuable in defining the structural concepts among objects and attributes. It was firstly developed by R.Wille in early 1980s. FCA is frequently used in several research areas such as data mining, data analysis, information retrieval, error correction for source code, machine learning as well as for designing taxonomies and ontologies [9].

A. Formal Context and Formal Concept

A formal context is an essential object of consideration in FCA. It specifies objects and their corresponding attributes which are satisfied by the objects. Formal context is usually visualized in a cross-table, where the rows represent the objects and the columns represent the attributes. In this paper, we use the notation *m* to represent an attribute, whilst an object is denoted by *g*. A cross in an intersection between a row and a column means that the object *g* satisfies an attribute *m* (or equivalently an attribute *m* is satisfied by an object *g*), thus it forms a relation between objects and attributes. Formally, we denote the formal context by $\mathbb{K}$ = (*G*, *M*, *I*) where the set of objects, the set of attributes, and the relation between objects and attributes consecutively denoted by *G* (in German: *Gegenstandsmenge*), *M* (in German: *Merkmalsmenge*), and *I* (in German: *Inzidenzrelation*) [10]. There is a pair of operators that are induced by formal context, i.e., concept-forming operators. Those operators are also used in the next formal concept and concept lattice notations. We formally define these operators in Definition 1.

Definition 1 Concept-forming operators for a formal context (G, M, I) where $X \subseteq G$ and $Y \subseteq M$ are defined by:

$$\begin{aligned} X^{\uparrow} &= \{m \in M \mid \forall g \in X : (g, m) \in I\}, \\ Y^{\downarrow} &= \{g \in G \mid \forall m \in Y : (g, m) \in I\}. \end{aligned} \tag{1}$$

In FCA, once a formal context has been constructed, we obtain the formal concepts of the context. These concepts cover the attributes shared by many objects and vice versa. We formally describe the formal concept definition in Definition 2

Definition 2 Formal concept is a pair of an object set X and attribute set Y that the objects in X satisfy. Formal concept can be denoted by (X, Y) where the object set X is called as the extent and the attribute set Y is called as the intent. For $X \subseteq G$ and $Y \subseteq M$, formal concept satisfies $X^{\uparrow} = Y$ and $Y^{\downarrow} = X$.

B. Concept Lattice

Concept lattice is a visualization of formal context. It is the main notion in FCA [11]. It also represents all information in the formal context so that it can be easily understood. Moreover, a concept lattice facilitates in creating the query of the knowledge representation from the formal context [10].

III. Indonesia's Political Parties: Ideologies and Pertinent Characteristics

In this section, we briefly explain the ideologies of Indonesia's political parties and their corresponding characteristics.

Ideology is a fundamental thing of the political party. In fact, a political party was initially formed by the same views, goals, and ideas which were put together to form a political policy. Ideology represents the basic notion or the character of a party. It is a valuable thing that are needed by the party and voters in the campaigns and to face the political issues [16]. Ideology often supports a political party in convincing the voters of its political capacity as well [16], [17].

Several kinds of research related to ideology clustering of political parties have been initiated by Lipset and Rokkan in [18]. They charted four clusters that pointed to the group and the possibility of the party's mobility, namely: periphery, state-church, land-industry, and owner-worker [17].

The ideological mapping of political parties in Indonesia has been initiated by H. Feith and L. Castle in their work in [19]. According to this work, the ideological mapping of political parties in Indonesia was divided into communism, nationalism, democratic socialism, Islam, and Javanese traditionalism [20]. In addition, there were other ideologies such as Catholicism and regional beliefs. However, this study did not provide a concrete concept of ideological characteristics.

In this paper, we summarize the mapping or clustering of all ideological characteristics from the previous studies into 11 atomic ideological characteristics as in Table I. The previous studies used the basic identity, i.e., Memorandum and Articles of Association (i.e., *Anggaran Dasar-Anggaran Rumah Tangga* or AD-ART) of each political party in constructing the mapping. The main references for the mapping in this paper are explained in [12]–[15].

IV. Formal Concepts Construction and Their Graphical Representations

We first explain the formal model construction using FCA that consists of formal context and concept lattice. For convenience, we present the formal context design of political parties' ideological characteristics in Indonesia using a tabular format.

Availability: The source of ConExp script and the documentations related to this paper is available at `https://github.com/slhanum/KRwithFCA`

We use the information in Table I to construct the formal context in Table II. There are 16 national political parties as the objects and 11 atomic ideological characteristics as the attributes. These characteristics are denoted by their corresponding abbreviations which are described as follows:

1) PS (Pancasila): parties that use Pancasila as their basic ideology.

TABLE I: Ideological characteristics of political parties in Indonesia based on [12]–[15].

Political Parties	Ideologies/Characteristics
PKB	Pancasila, Right-Wing, Islamism, Pluralism, Economic Equality
Gerindra	Pancasila, Right-Wing, Secularism, Anti-Communism, Economic Growth
PDI-P	Pancasila, Left-Wing, Secularism, Economic Equality
Golkar	Pancasila, Right-Wing, Secularism, Anti-Communism, Economic Growth
Nasdem	Pancasila, Secularism, Economic Growth
Garuda	Pancasila
Berkarya	Pancasila, Anti-Communism, New Order Revivalism
PKS	Right-Wing, Islamism, Anti-Communism, Economic Growth
Perindo	Pancasila
PPP	Pancasila, Islamism, Economic Equality
PSI	Pancasila, Left-Wing, Pluralism
PAN	Pancasila, Islamism, Anti-Communism, Economic Equality
Hanura	Pancasila, Secularism, Economic Growth
Demokrat	Pancasila, Center-Wing, Secularism, Economic Growth
PBB	Islamism
PKPI	Pancasila, Secularism

TABLE II: Formal context of political parties in Indonesia.

Political Parties	PS	RW	CW	LW	ISL	PL	SC	AC	NOR	EQ	EG
PKB	×	×			×	×				×	
Gerindra	×	×					×	×			×
PDI-P	×			×			×			×	
Golkar	×	×					×	×			×
Nasdem	×						×				×
Garuda	×										
Berkarya	×							×	×		
PKS		×			×			×			×
Perindo	×										
PPP	×				×					×	
PSI	×			×		×					
PAN	×				×			×		×	
Hanura	×						×				×
Demokrat	×		×				×				×
PBB					×						
PKPI	×						×				

2) RW (Right-Wing): parties that maintain conservative values in the political life.
3) CW (Center-Wing): parties that hold moderate views in political life which lie between right-wing and left-wing.
4) LW (Left-Wing): parties that maintain liberal values in the political life.
5) ISL (Islamism): parties that hold Islamic values in the political life.
6) PL (Pluralism): parties that tolerate and admit diversity in the political life.
7) SC (Secularism): parties that separate religion from political affairs.
8) AC (Anti-Communism): parties that oppose the communism ideology.
9) NOR (New Order Revivalism): parties that adopt the *new order regime* point of views.
10) EQ (Economic Equality): parties that focus on economic-equality affairs.
11) EG (Economic Growth): parties that focus on economic-growth affairs.

We use ConExp to construct the concept lattice in Fig.

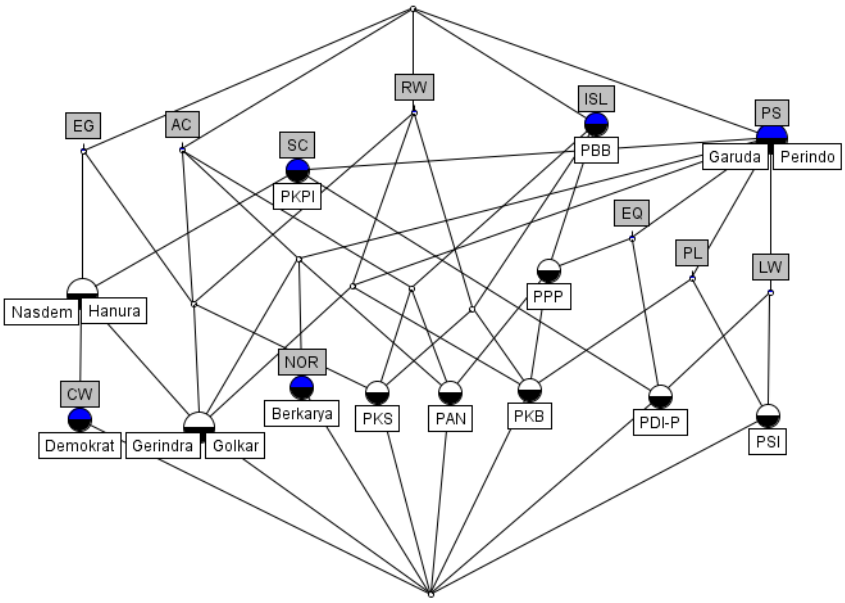

Fig. 1: The overall concept lattice for formal context of political parties in Indonesia based on Table II.

1 from the formal context described in Table II. A concept lattice is actually a Hasse diagram visualization representing the concepts. The concept is depicted with the circle and attribute. A node contains black filled lower semicircle means that there is an object attached to this concept. Meanwhile, a node contains blue filled upper semicircle means that there is an attribute attached to this concept.

Pictorially, the concept *A* is called as a sub-concept of another concept *B* if and only if there is a path of descending node from *B* to *A*. An attribute *m* that attached to concept *B* is shared by an object *g* that attached to concept *A*, if and only if there is a strictly upward path from the node *A* to the node *B*.

As a consequence, two parties P_1 and P_2 share common ideological characteristics I if there is a path upward from node P_1 to node I and another path upward from node P_2 to node I. For example, despite their political discords, both PAN and PDIP have economic equality and Pancasila as their ideological characteristics.

From Table II, we have several result relating to concept-forming operators, such as $\{Gerindra\}^{\uparrow} = \{$*PS, RW, SC, AC, EG*$\}$ and $\{PDIP\}^{\uparrow} = \{$*PS, LW, SC, EQ*$\}$. It means that, Gerindra party is an object extent and its intent are: Pancasila, right-wing, secularism, anti-communism and economic growth. Meanwhile, PDIP has Pancasila, left-wing, secularism and economic equality as its intent. We can also derive all intents that satisfy a particular extent. For instance, from the attribute Islamism, we get $\{Islamism\}^{\downarrow} = \{PKB, PKS, PPP, PAN, PBB\}$. This means there are five political parties that admit Islamism as their ideology, namely: PKB, PKS, PPP, PAN, and PBB.

For clarity, we derived some sub-concept lattices from the main concept lattice in Fig. 1. In deriving the concept lattice, we consider the party's position—opposition or governing coalition—during 2014 and 2019, because both of them represent overlapping attributes that cannot be represented by ordinary clustering. In addition, we also add sub-concept lattice for the parties that admit Pancasila as their ideology. Hence, we focus on the three following sub-concept lattices:

1) Sub-concept lattice for the parties that admit Pancasila as their ideology (Fig. 2).
2) Sub-concept lattice concerning the ideological characteristics of opposition parties during 2014-2019 (Fig. 3).
3) Sub-concept lattice concerning the ideological characteristics of governing coalition parties during 2014-2019 (Fig. 4).

We can derive from Fig. 2 that all the 16 national political parties but PKS and PBB have Pancasila as their ideological characteristic. Afterward, we figure out the ideological characteristics of opposition parties in Fig. 3 and governing coalition parties in Fig. 4. As a result of these sub-concept lattices, all opposition parties share all attributes except new order revivalism, pluralism, left-wing, or center-wing as its characteristics. In contrast, for the governing coalition parties, all of them share all attributes as their common characteristic except new order revivalism or center-wing.

V. Implications, Association Rules, and Related First-Order Logic Formulas

Our research utilize ConExp (The Concept Explorer) version 1.3 over Windows 10 operating system. ConExp is used since it provides a friendly user interface and it can also derive the canonical basis of implications and the association rules of the associated concept lattice.

By using the aforementioned tool, we obtained the Duquenne-Guigues implication rules. The implication rules

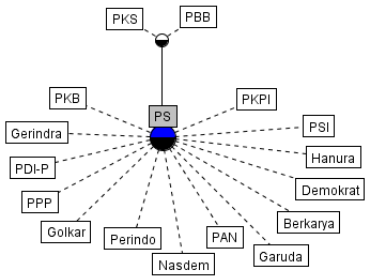

Fig. 2: Sub-concept lattice for the parties that admit Pancasila as one of its ideologies.

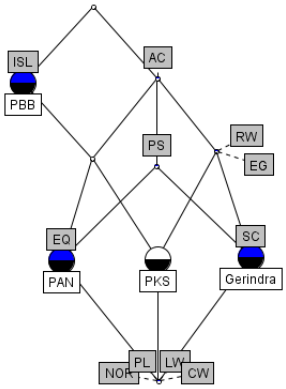

Fig. 3: Sub-concept lattice concerning the ideological characteristics of opposition parties during 2014-2019 period.

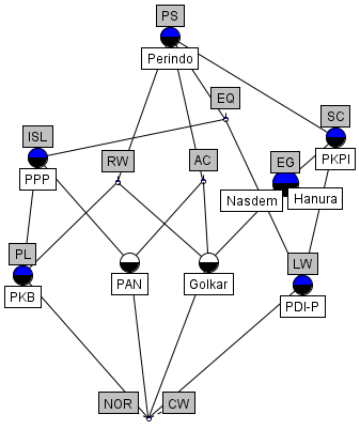

Fig. 4: Subconcept lattice concerning the ideological characteristics of governing coalition parties during 2014-2019 period.

represent the relations among the attributes over the objects. We firstly describe the definition of canonical basis of implications in Definition 3.

Definition 3 A set $P \subseteq M$ is called pseudo-closed (with respect to a closure operator $(\cdot)^{\uparrow\downarrow}$) if $P \neq P^{\uparrow\downarrow}$ and $Q^{\uparrow\downarrow} \subset P$ for every pseudo-closed $Q \subset P$. The Duquenne–Guigues or canonical basis of implications (with respect to a closure operator $(\cdot)^{\uparrow\downarrow}$) is the set of all implications of the form $P \rightarrow P^{\uparrow\downarrow}$, where P is pseudo-closed.

For each of these canonical implications, we construct the corresponding FOL (first-order logic) formulas. We assume the readers are familiar with the syntax of FOL formulas because we use the standard notation in translating the relations. For example, the first formula, $\forall x(\textit{LeftWing}(x) \rightarrow \textit{Pancasila}(x))$, means that all political parties that admit left-wing as its ideology also accept Pancasila as their ideological characteristic.

Another example, if x satisfies $\textit{Pancasila}(x)$ and $\textit{Islamism}(x)$, then it also satisfies $\textit{EconomicEquality}(x)$. Some instances of x are PKB, PPP, PAN. Hence, we have $\forall x(\textit{Pancasila}(x) \wedge \textit{Islamism}(x) \rightarrow \textit{EconomicEquality}(x))$. Our implications also overcome the representation of overlapping ideological characteristics. We present the implication rules obtained from ConExp and translate them into their corresponding FOL formulas as follows:

1) $\forall x(\textit{LeftWing}(x) \rightarrow \textit{Pancasila}(x))$
2) $\forall x(\textit{Pancasila}(x) \wedge \textit{Islamism}(x) \rightarrow \textit{EconomicEquality}(x))$
3) $\forall x(\textit{Pluralism}(x) \rightarrow \textit{Pancasila}(x))$
4) $\forall x(\textit{Pancasila}(x) \wedge \textit{RightWing}(x) \wedge \textit{Pluralism}(x) \rightarrow \textit{Islamism}(x) \wedge \textit{EconomicEquality}(x))$
5) $\forall x(\textit{Secularism}(x) \rightarrow \textit{Pancasila}(x))$
6) $\forall x(\textit{Pancasila}(x) \wedge \textit{LeftWing}(x) \wedge \textit{Secularism}(x) \rightarrow \textit{EconomicEquality}(x))$
7) $\forall x(\textit{NewOrderRevivalism}(x) \rightarrow \textit{Pancasila}(x) \wedge \textit{AntiCommunism}(x))$
8) $\forall x(\textit{EconomicEquality}(x) \rightarrow \textit{Pancasila}(x))$
9) $\forall x(\textit{Pancasila}(x) \wedge \textit{RightWing}(x) \wedge \textit{EconomicEquality}(x) \rightarrow \textit{Islamism}(x) \wedge \textit{Pluralism}(x))$
10) $\forall x(\textit{Pancasila}(x) \wedge \textit{LeftWing}(x) \wedge \textit{EconomicEquality}(x) \rightarrow \textit{Secularism}(x))$
11) $\forall x(\textit{Pancasila}(x) \wedge \textit{Pluralism}(x) \wedge \textit{EconomicEquality}(x) \rightarrow \textit{RightWing}(x) \wedge \textit{Islamism}(x))$
12) $\forall x(\textit{Pancasila}(x) \wedge \textit{Secularism}(x) \wedge \textit{EconomicEquality}(x) \rightarrow \textit{LeftWing}(x))$
13) $\forall x(\textit{Pancasila}(x) \wedge \textit{AntiCommunism}(x) \wedge \textit{EconomicEquality}(x) \rightarrow \textit{Islamism}(x))$
14) $\forall x(\textit{Pancasila}(x) \wedge \textit{EconomicGrowth}(x) \rightarrow \textit{Secularism}(x))$
15) $\forall x(\textit{RightWing}(x) \wedge \textit{EconomicGrowth}(x) \rightarrow \textit{AntiCommunism}(x))$
16) $\forall x(\textit{Islamism}(x) \wedge \textit{EconomicGrowth}(x) \rightarrow \textit{RightWing}(x) \wedge \textit{AntiCommunism}(x))$
17) $\forall x(\textit{AntiCommunism}(x) \wedge \textit{EconomicGrowth}(x) \rightarrow \textit{RightWing}(x))$

18) $\forall x(\textit{CenterWing}(x) \rightarrow \textit{Pancasila}(x) \wedge \textit{Secularism}(x) \wedge \textit{EconomicGrowth}(x))$
19) $\forall x(\textit{Pancasila}(x) \wedge \textit{RightWing}(x) \wedge \textit{Secularism}(x) \rightarrow \textit{AntiCommunism}(x) \wedge \textit{EconomicGrowth}(x))$
20) $\forall x(\textit{RightWing}(x) \wedge \textit{AntiCommunism}(x) \rightarrow \textit{EconomicGrowth}(x))$
21) $\forall x(\textit{Pancasila}(x) \wedge \textit{Secularism}(x) \wedge \textit{AntiCommunism}(x) \rightarrow \textit{RightWing}(x) \wedge \textit{EconomicGrowth}(x))$

All of these FOL formulas are useful for the future work on reasoning the properties shared by many objects. FOL is widely used for knowledge representation because it can represent the fact in the real world clearly rather than propositional logic—which only declares the simple propositions. In addition, FOL provides quantifications and predicate which is compatible with knowledge representation [21]. Aside from those implication rules, we augment the resulting exact implication rules with association rules because they can describe the relationships among objects with some degree of certainty. The association rules formally defined in Definition 4 as follows.

Definition 4 Association rules define the frequency of patterns based on data using *support* and *confidence* measurements in order to obtain the frequent patterns, correlations, associations, or causal structure among the set of items.

Using ConExp, we obtain three association rules of the formal context in Table I, namely:

1) From sixteen political parties, 88% or fourteen of them admit Pancasila as their ideological characteristics.
2) From six political parties that focus on economic growth, 83% or five of them accept Pancasila and secularism as their ideological characteristics.
3) From five political parties that admit anti-communism as ideological characteristic, 80% or four of them admit Pancasila as their ideological characteristics.

VI. Conclusion and Future Works

In this paper, we successfully applied Formal Concept Analysis for representing the political situation pertaining to the ideological characteristics of political parties. Our resulting concept lattice yields graphical representations explaining the relationships among political parties based on their ideological characteristics. This can be used as a foundation to construct the ontology [9], [22]. In addition, we successfully overcome the overlapping ideologies because the concept lattice allows us to attach each political party to more than one ideological characteristics. Nevertheless, the reasoning process and consistency checking on the ontology still needs to be conducted. We recommend the utilization of description logic (DL) to reason the resulting ontology due to its expressiveness and decidability. These DL formulas can be derived from the aforementioned FOL formulas in Section V. These DL formulas can be used to verify the consistency and reliability of the resulting ontology.

References

[1] "*Komisi Pemilihan Umum Republik Indonesia*," https://kpu.go.id/.
[2] A. Formica, "Ontology-based concept similarity in formal concept analysis," *Information Sciences*, vol. 176, no. 18, pp. 2624–2641, sep 2006.
[3] V. S. Marek Obitko and J. Smid, "Ontology design with formal concept analysis," 2004. [Online]. Available: https://pdfs.semanticscholar.org/2e55/9c6b75a5a49ab60831950c19acbc3c7d7d06.pdf
[4] L. Ning, L. Guanyu, and S. Li, "Using formal concept analysis for maritime ontology building," in *2010 International Forum on Information Technology and Applications*. IEEE, jul 2010.
[5] Y. Chen, "Document overlapping clustering using formal concept analysis," 2015.
[6] B. Kohler-Koch, "Zur Empirie und Theorie internationaler Regime," *Formen der Konfliktregelung: Eine Einführung mit Quellen*, vol. 3, p. 74, 1997.
[7] B. Kohler-Koch and F. Vogt, "Normen-und regelgeleitete internationale Kooperationen—Formale Begriffsanalyse in der Politikwissenschaft," in *Begriffliche Wissensverarbeitung*. Springer, 2000, pp. 325–340.
[8] S. Staab and R. Studer, Eds., *Handbook on Ontologies*. Springer Berlin Heidelberg, 2009.
[9] F. Škopljanac-Mačina and B. Blašković, "Formal concept analysis – overview and applications," *Procedia Engineering*, vol. 69, pp. 1258–1267, 2014.
[10] B. Sertkaya, "Formal concept analysis methods for description logics," Ph.D. dissertation, TU Dresden, 2007. [Online]. Available: https://pdfs.semanticscholar.org/0d2e/fbc14afee52ef29469c845d3b39610830701.pdf
[11] S. Yahia, E. Nguifo, and R. Belohlavek, *Concept Lattices and Their Applications: Fourth International Conference, CLA 2006 Tunis, Tunisia, October 30-November 1, 2006 Selected Papers*, ser. LNCS sublibrary: Artificial intelligence. Springer, 2008. [Online]. Available: https://books.google.co.id/books?id=htWL-wqPSXwC
[12] 2013. [Online]. Available: https://carnegieendowment.org/2013/10/24/indonesia-s-political-parties-pub-53414
[13] E. W. Diego Fossati, "Indonesia's political parties and minorities," Jul. 2018. [Online]. Available: https://www.iseas.edu.sg/images/pdf/ISEAS_Perspective_2018_37@50.pdf
[14] B. M. E. W. Edward Aspinall, Diego Fossati, "Mapping the indonesian political spectrum," Apr. 2018. [Online]. Available: http://www.newmandala.org/mapping-indonesian-political-spectrum/
[15] Quora, "How do you classify Indonesia political parties into right-wing, left-wing, liberal, etc.?" https://www.quora.com/How-do-you-classify-Indonesian-political-parties-into-right-wing-left-wing-liberal-etc.
[16] I. Budge, "A new spatial theory of party competition: Uncertainty, ideology and policy equilibria viewed comparatively and temporally," *British Journal of Political Science*, vol. 24, no. 4, pp. 443–467, 1994. [Online]. Available: http://www.jstor.org/stable/194029
[17] F. Vassallo and C. Wilcox, "Party as a carrier of ideas," in *Handbook of Party Politics*. SAGE Publications Ltd, pp. 413–421.
[18] S. M. Lipset and S. Rokkan, Eds., *Party systems and voter alignments: cross-national perspectives.* New York, Free Press, 1967.
[19] H. Feith and L. Castles, "Indonesian political thinking 1945-1965. 500 pp., 13.50, l.c. 69-18357," *American Behavioral Scientist, Ithaca: Cornell*, vol. 14, no. 1, pp. 139–139, sep 1970.
[20] D. Bourchier and V. R. Hadiz, *Pemikiran sosial dan politik Indonesia : periode 1965-1999*. Jakarta: Pustaka Utama Graffiti, 2006.
[21] I. Ayorinde and B. Akinkunmi, "Application of first-order logic in knowledge based systems," *Afr J. of Comp & ICTs*, vol. Vol 6, pp. 45 – 52, 01 2013.
[22] J. Xu and B. C. Han, "An ontology construction method based on formal concept analysis," *DEStech Transactions on Social Science, Education and Human Science*, no. meit, aug 2017.