

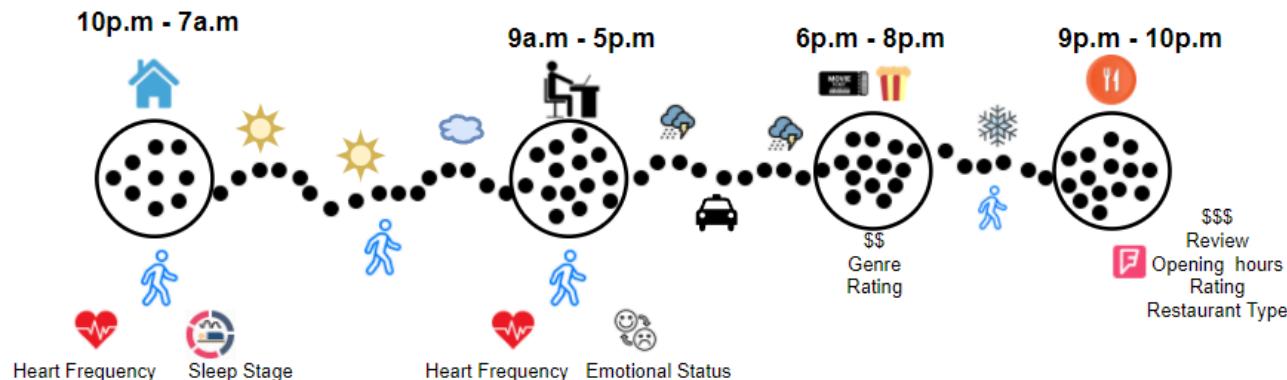
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**Title:** brief technical report

## 1. Context

Basômetro is a tool that monitors the support of the Federal Government in the Chamber of Deputies. Using this tool, it is possible to collect data from all votes that have taken place at a given period (from 2003 to the nowadays). For simplicity, the name of the dataset formed from this tool is *basometro*. The idea is to work with this dataset from the perspective of multiple aspect trajectories (MAT) to explore what types of patterns we can identify on it. The objective is to show the applicability of MAT clustering methods on different domains. In a simple way, a trajectory is a trace with two dimensions (time and space), for example, any object that provides its location through GPS in a time interval. Now suppose that each location provided by the GSP is enriched with information other than time and space (named *semantic*), which could be any type of data such as: name of a restaurant, price assessments, or weather information. Such a trajectory enriched with different data (aspects) implies a much more complex format, which is currently called multiple aspect trajectories as illustrated in Figure 1.

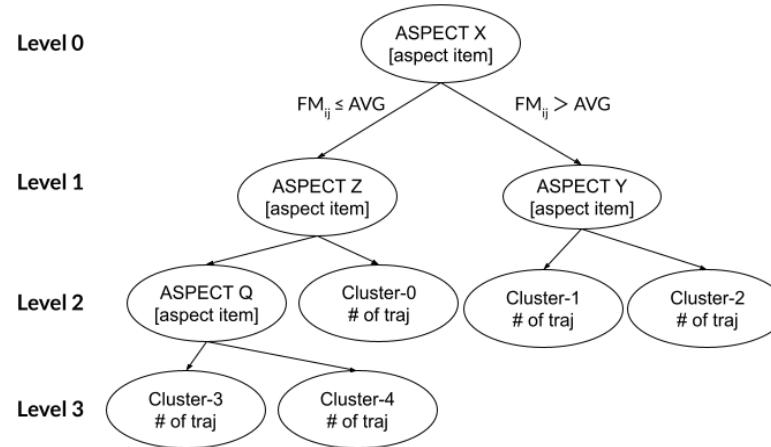


**Figure 1.** Example of a Multiple Aspect Trajectory.

We can model the basometro dataset from a MAT perspective. From that, a trajectory may represent how a given parliamentarian voted during a period such as 6 months, 1 year, 2 years, and so on. So, for each parliamentarian's vote, there are different aspects such as party name, parliamentarian name, proposition type, voting date, government during the vote, and others. In this report, we will show the results generated by the method called MAT-Tree used to identify clusters in the basometro dataset. MAT-Tree is a new hierarchical clustering algorithm for multiple aspect trajectories and we want to evaluate the applicability of this method in domains that are not native to trajectories. Section 2 presents the main points about the MAT-Tree, while Section 3 presents the main clustering results according to the methods available options.

## 2. MAT-Tree summary

The objective of this method is to separate similar trajectories in the same group based on the frequency of occurrence of aspects of the trajectories using the hierarchical strategy. We seek to provide a method that supports answering questions related to trajectory similarities regarding different aspects and at different levels of abstraction. Figure 2 illustrates the hierarchical clustering result generated by MAT-Tree with five 5 clusters (from id 0 to 4). Walking on the tree to reach a leaf node (cluster) shows the rules (path) that identify the cluster. For instance, Cluster-2 in Figure 2 has the path *ASPECT X* → High Frequency → *ASPECT Y* → High Frequency. Therefore, this path means that such aspects and frequencies are relevant to identify Cluster-2. Last but not least, the same logic is used to construct this path for other clusters.



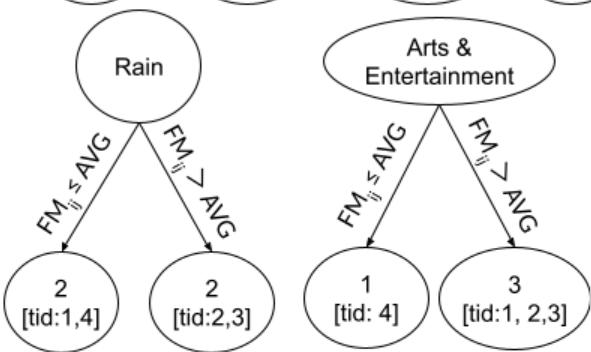
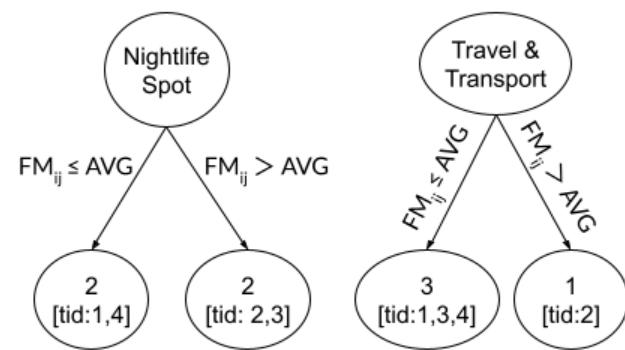
**Figure 2.** Example of hierarchical tree generated by MAT-Tree.

The choice of the most relevant aspect depends on the selection strategy that is used to separate the trajectories along the iterations. At this moment, we have four strategy options for selecting the relevant aspect: i) binary division (BD); ii) minimum variance (MV); iii) maximum variance reduction (MVR); and iv) largest reduction average (LRA). **Binary division** evaluates the absolute difference in the number of trajectories between the splitted subsets (left and right nodes) for each subtree. This method selects the aspect in the subtree that generates the smallest difference value among the subsets. **Minimum variance** evaluates the mean variance of an aspect in both trajectory subsets for each subtree. This method selects the aspect in the subtree that generates the smallest mean variance. **Maximum variance reduction** evaluates the mean variance reduction considering the previously selected aspect (parent node) in both trajectory subsets for each subtree. This method selects the aspect in the subtree that generates the maximum reduction value regarding the parent node. The last strategy, **largest reduction average**, is similar to MVR, but instead of considering the max reduction of the aspects individually, LRA considers all aspects to compute the average reduction. Thus, LRA selects the aspect that generates the largest reduction average of variance regarding the whole aspects set.

Each strategy uses a frequency matrix (FM), Figure 3A, which is generated from the number of occurrences of the aspects in the set of trajectories under evaluation to identify the most relevant aspect. The selection process starts with the idea of separating the trajectories into two subsets according to the frequency of a given aspect: i) less frequent trajectories (left side) and ii) more

frequent trajectories (right side). Regarding this initial separation, the chosen aspect selection strategy will evaluate each aspect in the sets of trajectories to select the most relevant one.

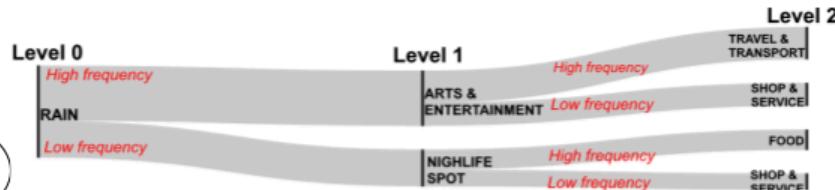
Figure 3B illustrates the trajectories subtree using the average for each aspect regarding the frequency matrix of four trajectories. At this point, the most relevant aspect depends on which selection aspect strategy is chosen to evaluate each aspect. So, the subtrees of each aspect, Figure 3B, are evaluated by the selection aspect strategy to identify the relevant aspect. Suppose that we choose the **Minimum Variance** strategy, looking at Figure 3A and Figure 3B we see that the aspect *Arts & Entertainment* generates the minimum variance among the subsets, i.e., it is selected as the relevant aspect. Figure 3C illustrates a Sankey visualization over the MAT-Tree result as another way to represent its output in comparison to Figure 2. Considering Figure 3C, the vertical bars indicate the clusters generated by the division through the chosen aspect, noting that the leftmost bar represents the complete dataset with all trajectories and the rightmost bars represent the leaf nodes. Then, we have that Figure 3C illustrates tree levels with aspect *RA/N* as the most relevant to start the splitting where other six aspects contributed to identify four clusters (leaf nodes).



(B)

Frequency matrix (FM)				
Traj. ID	Nightlife Spot	Travel & Transport	Rain	Arts & Entertainment
1	3	0	12	10
2	14	12	14	11
3	12	3	17	12
4	5	2	6	4
<b>AVG</b>	8.5	4.25	12.25	9.25
<b>VAR</b>	21.25	21.18	16.18	9.68

(A)



(C)

**Figure 3.** Minimal example to illustrate the basic idea of selecting an aspect and its visualization.

### 3. Basometro dataset: identified clusters using MAT-Tree

Basometro dataset was collected from a tool (API) that allows to collect data about the votes held in the Chamber of Deputies in Brazil. These data can be used to measure the governance of the deputies and parties in the Chamber according to the party's orientation regarding the votes. In other words, how deputies voted in relation to the orientation of the party leadership towards the government. The data collected on the votes comprise the year 2003 to 2022 containing 20 columns with different information and ids. Attribute summary as follows:

1. UF: Acronym of the name of the state that the congressman represents (27 options)).
2. voto: The position of the congressman in the vote on the proposal of the day. Six options: *Sim* (Yes), *Não* (No), *Abstenção* (Abstention), *Ausente* (Absent), *Liberado* (Free) e *Obstrução* (Obstruction).
3. orientacaoGoverno: Position of the party leadership on the proposition.
4. anoProposicao: Year in which the proposition was created.
5. anoVotacao: Year in which the proposal was voted on.
6. tipoProposicao: Proposition type on voting.
7. governo: Government executing the mandate in the period.
8. parlamentar: Congressmans name.
9. data: Date on which the vote took place.
10. idVotacao: Similar to date column, but in another format.
11. tid: Trajectory ID that the proposition is related to.
12. partido: Name of the party to which the parliamentarian was affiliated on the day of the voting.
13. horaVotacao: Voting time (1 to 24).
14. diaDaSemanaVotacao: Day of week in number (0 to 6; 0: Monday, 6: Sunday).
15. diaDaSemanaVotacaoNome: Day of the week with name (Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday).
16. diaDoAno: Number of days in relation to the voting year (1 to 365).
17. diaDoMesVotacao: Day of the month on which the voting took place (1 to 31).
18. mesVotacao: Month in which the vote took place (1 to 12).
19. delayVotacaoAnos: Difference in years between the year the proposal was created and the year it was voted on.
20. alinhamento: Label on how the congressman voted in relation to the partys orientation.
  - votou com o governo: *voted with the government* (tr.)
  - votou contra o governo: *voted against the government* (tr.)
  - indefinido: *undefined* (tr.)
  - não se aplica: *not applicable* (tr.)
21. governo\_alinhamento: Concatenation between the attributes governo and alinhamento.

22. `partido_voto_sim_%`: Percentage of YES votes that the candidate's party expressed related to the type of proposition being voted on.
23. `partido_voto_nao_%`: Percentage of NO votes that the candidate's party expressed related to the type of proposition being voted on.
24. `partido_voto_abstencao_%`: Percentage of ABSTENTION votes that the candidate's party expressed related to the type of proposition being voted on.
25. `partido_voto_obstrucao_%`: Percentage of OBSTRUCTION votes that the candidate's party expressed related to the type of proposition being voted on.
26. `partido_voto_ausente_%`: Percentage of ABSENT votes that the candidate's party expressed related to the type of proposition being voted on.
27. `orientacao_partido_voto`: Party guidance related to the type of vote (*Sim, Não, Abstenção, Obstrução, Ausente*) that the parliamentarian should follow when voting on a specific proposition.
28. `alinhamento_candidato`: Candidate's alignment on how he voted in relation to the party's orientation. Two options:
  - votou com o partido: *voted with the party*
  - Votou contra o partido: *voted against the party*
29. `esp_pol_partido`: espectro político do partido que o candidato está filiado.
  - extrema esquerda: far left
  - esquerda: left
  - centro-esquerda: centrist-left
  - centro: centrist
  - centro-direita: centrist-right
  - direita: right
  - extrema direita: far right

We present in sections 3.1 and 3.2 the experiment results considering the features independently and combined, respectively. We run MAT-Tree using the following hyperparameters: `max_depth=5`, `min_traj=50`. Besides, each section shows the results according to the split selection strategy (MVR and MV). Moreover, we summarize the characteristics in the following attributes: i)

Cluster (cluster level in the tree node); ii) Number of trajectories; iii) Entropy<sup>1,2,3</sup>; iv) Unique parties; v) Relevant aspects (aspects selected by the algorithm).

## 3.1 Independent features

We performed an EDA using the aspects to identify minimum tree patterns or highly unbalanced trees. After this previous test, we ended up with seven aspects that are used for this report: **partido**, **alinhamento**, **orientacaoGoverno**, **voto**, **tipoProposicao**, and **governo**. Regarding the clustering task, these aspects facilitated the analysis of the outputs, while including other aspects generated either an unbalanced tree or repeated aspect (the same aspect with different values). We show some details for MVR and MV in the following sections.

### 3.1.1 Maximum Variance Reduction (MVR)

**Maximum variance reduction** evaluates the mean-variance reduction considering the previously selected aspect (parent node) in both trajectory subsets for each subtree. This method chooses the aspect in the subtree that generates the maximum reduction value regarding the parent node.

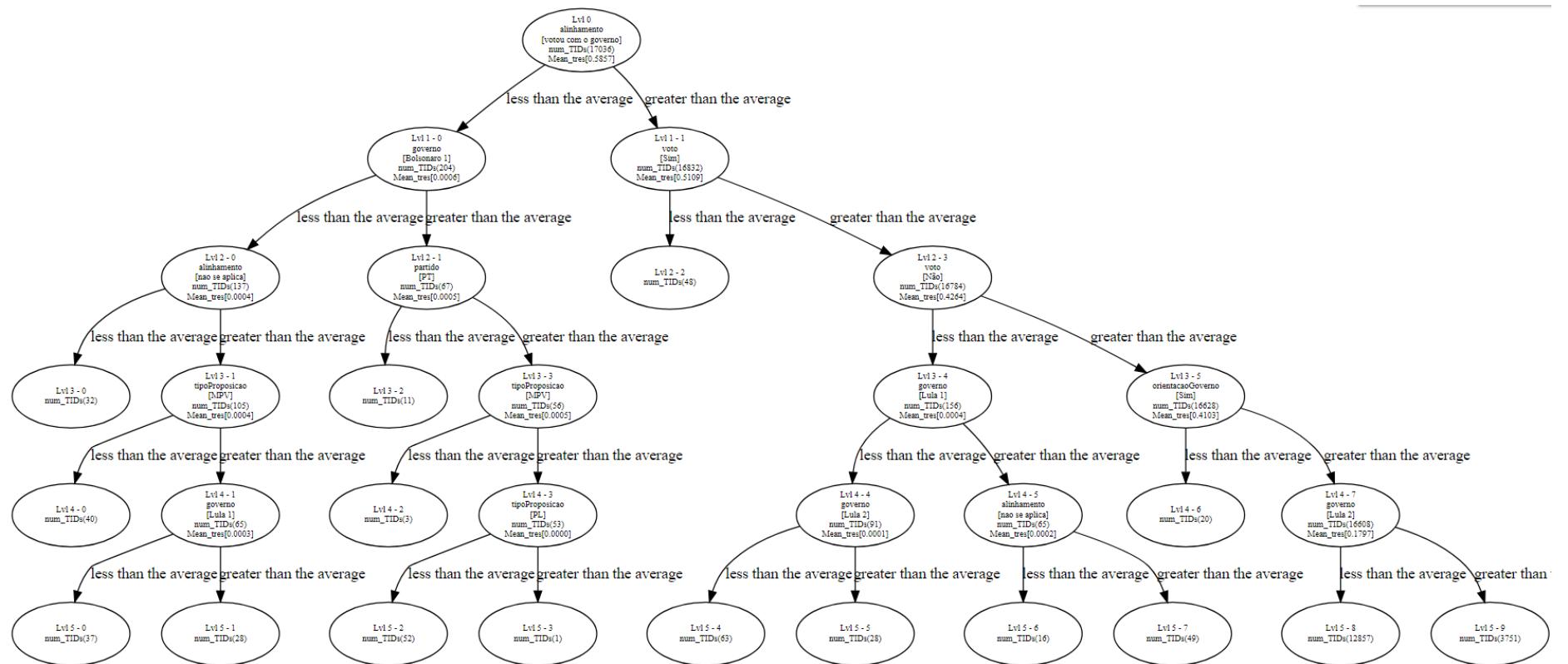
Regarding this selection aspect strategy, we can see in Figure 4 that MAT-Tree identified 16 clusters. Furthermore, we summarized the main characteristics of Figure 4 in Table 2 such as cluster (node), number of trajectories, cluster entropy, unique labels, and the relevant aspects.

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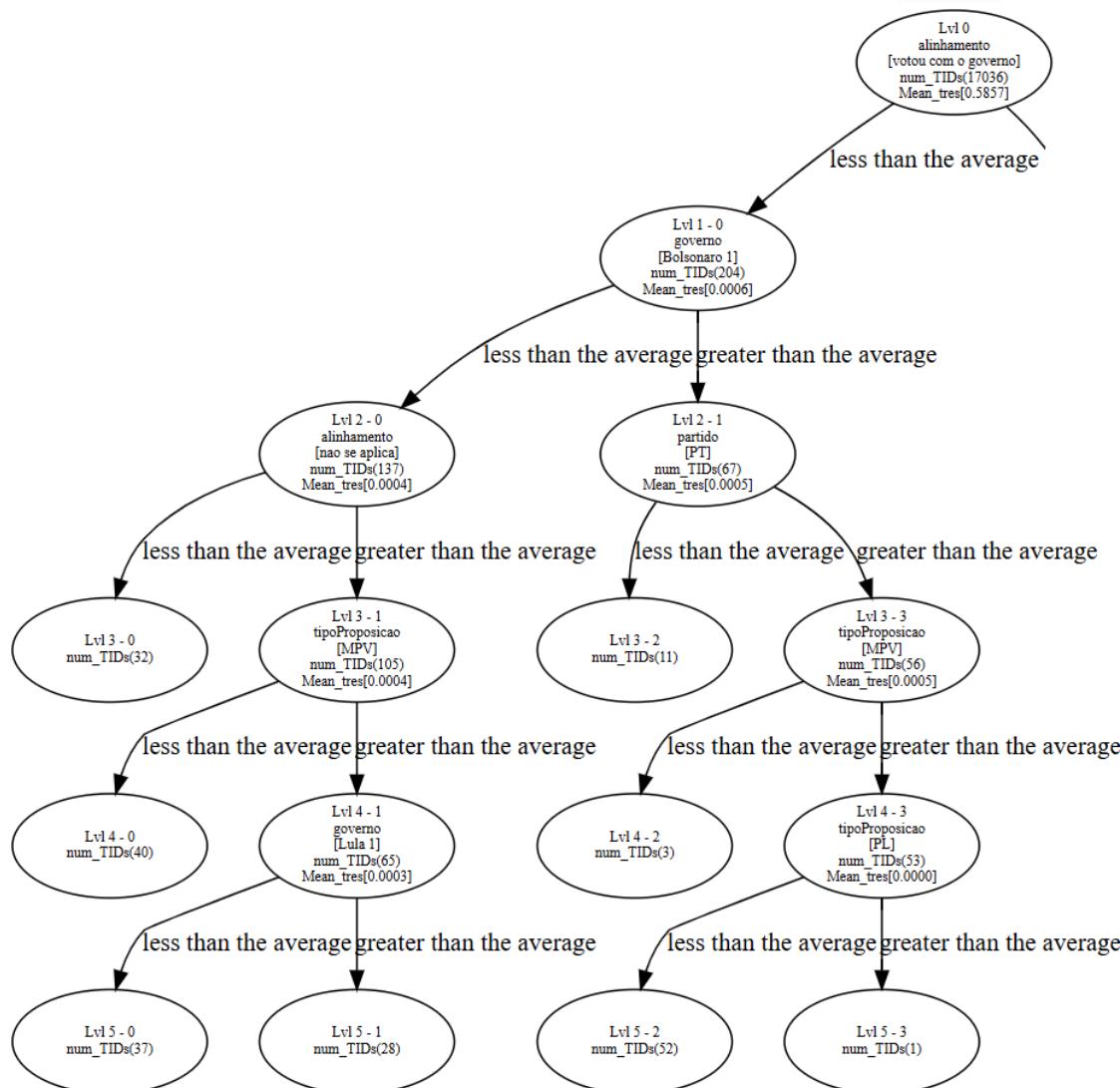
<sup>1</sup>Shannon, C. E. (1948) [A mathematical theory of communication](#). The Bell System Technical Journal, 27, 379–423 and 623–656.

<sup>2</sup>[https://en.wikipedia.org/wiki/Diversity\\_index](https://en.wikipedia.org/wiki/Diversity_index)

<sup>3</sup>Entropy and Information Theory: [Uses and Misuses](#)

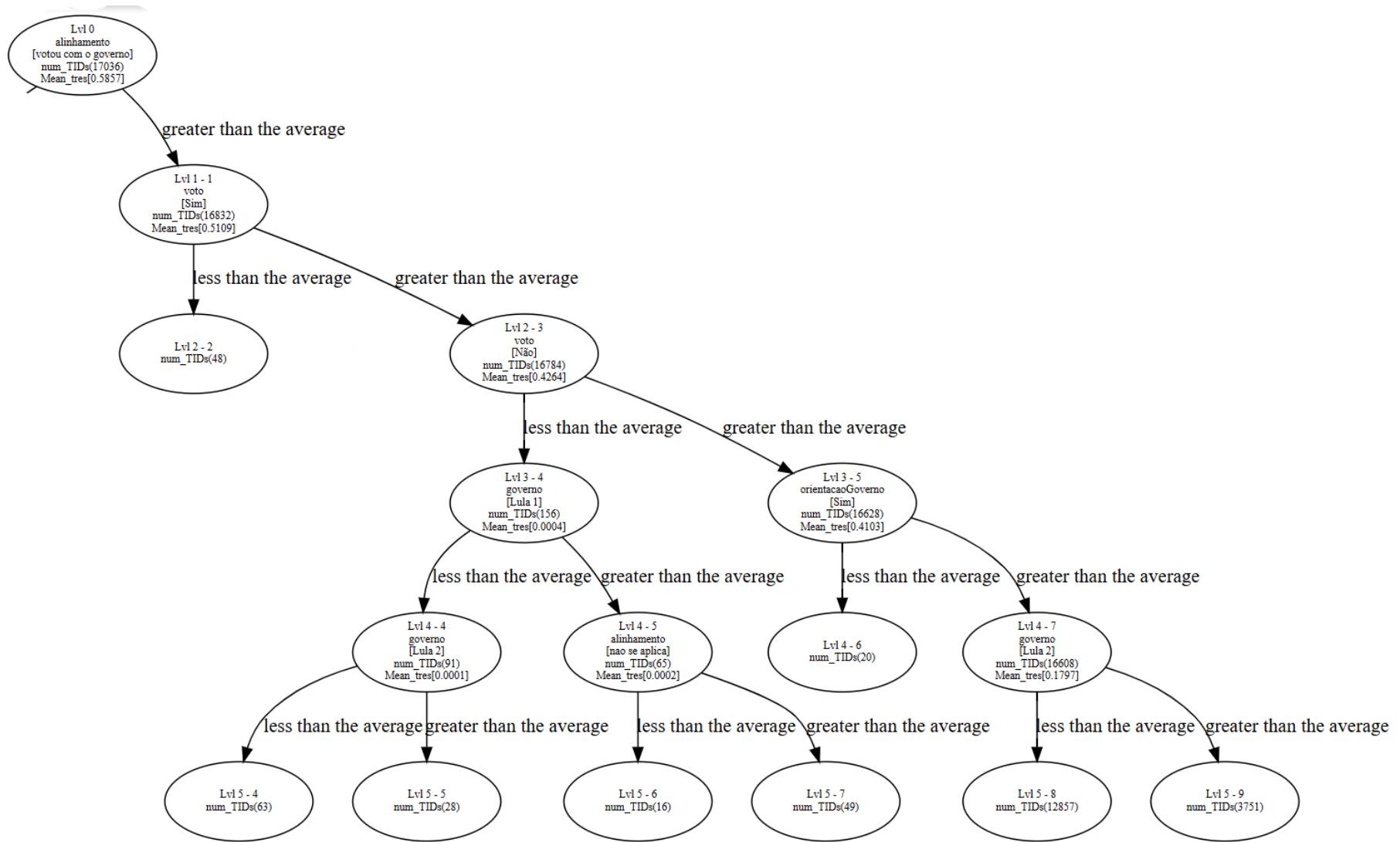


**Figure 4.** Clustering result with 16 clusters. Hyperparameters: selection strategy = MVR; max depth = 5; min trajs = 50.



**Figure 5.** The tree's left side has 8 clusters.

Hyperparameters: selection strategy = MVR; max depth = 5; min trajs = 50.



**Figure 6.** The tree's right side has 8 clusters starting from the root node.  
Hyperparameters: selection strategy = MVR; max depth = 5; min trajs = 50.

Table 1 shows the main characteristics of the identified clusters in Figure 4. The main characteristics are the number of trajectories, the entropy, parties in the node, and the selected aspects.

**Table 1.** Main characteristics of the clusters using MVR. (*LT*): *Less than*; (*GT*): *Greater than*.

Cluster (node)	Characteristics			
	Number of trajectories	Entropy	Unique parties	Relevant aspects (rules)
Lvl 2-2	48	0.8655	MDB, PL, PT, Progressistas, Cidadania, PDT, PTB, Sem Partido, PSB and DEM	Alinhamento [votou com o governo] → <sup>GT</sup> voto [Sim] → <sup>LT</sup> cluster
Lvl 3-0	32	0.8507	DEM, PL, PT, PSDB, PV, MDB, PDT, Progressistas, Cidadania and PTB	Alinhamento [votou com o governo] → <sup>LT</sup> governo [Bolsonaro 1] → <sup>LT</sup> alinhamento [não se aplica] → <sup>LT</sup> cluster
Lvl 3-2	11	0.5462	PCdoB, PTB and PSOL	Alinhamento [votou com o governo] → <sup>LT</sup> governo [Bolsonaro 1] → <sup>GT</sup> label [PT] → <sup>LT</sup> cluster
Lvl 4-0	40	0.899	DEM, MDB, PT, PSDB, PCdoB, PSB, PV, PSD, Solidariedade, PL, Cidadania, and PTB	Alinhamento [votou com o governo] → <sup>LT</sup> governo [Bolsonaro 1] → <sup>LT</sup> alinhamento [não se aplica] → <sup>GT</sup> tipoProposicao [MPV] → <sup>LT</sup> cluster
Lvl 4-2	3	0	PT	Alinhamento [votou com o governo] → <sup>LT</sup> governo [Bolsonaro 1] → <sup>GT</sup> label [PT] → <sup>GT</sup> tipoProposicao [MPV] → <sup>LT</sup> cluster

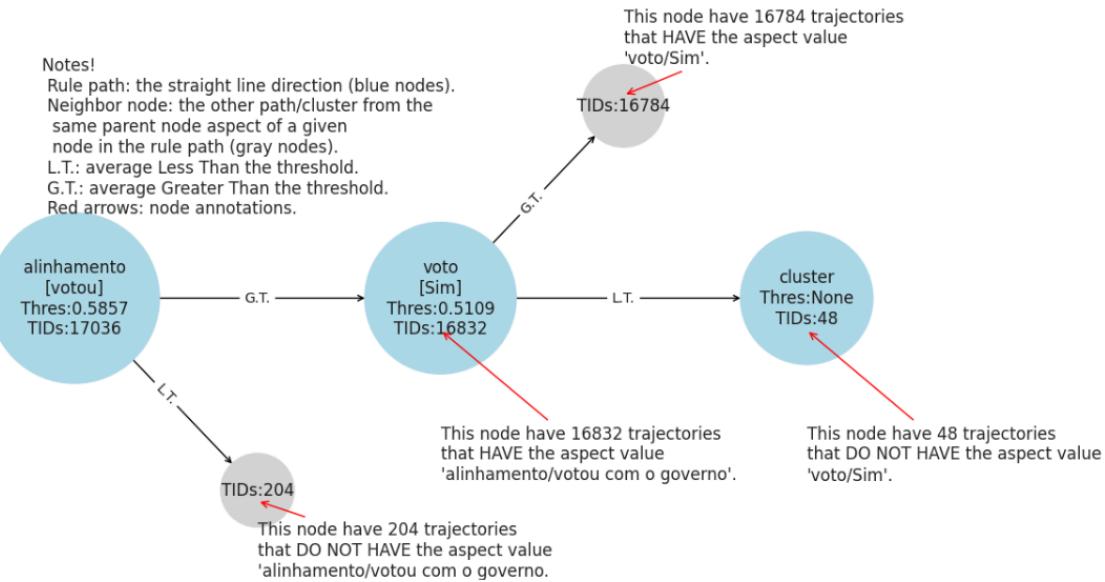
Lvl 4-6	20	0.9659	DEM, MDB, PL, PDT, PT, Progressistas, Cidadania, PSD, PSDB and PTB	Alinhamento [votou com o governo] → <sup>GT</sup> voto [Sim] → <sup>GT</sup> voto [Não] → <sup>GT</sup> orientacaoGoverno [Sim] → <sup>LT</sup> cluster
Lvl 5-0	37	0.7675	DEM, PT, PSDB, PCdoB, PSC, MDB, PL, PDT and Progressistas	Alinhamento [votou com o governo] → <sup>LT</sup> governo [Bolsonaro 1] → <sup>LT</sup> alinhamento [não se aplica] → <sup>GT</sup> tipoProposicao [MPV] → <sup>GT</sup> governo [Lula 1] → <sup>LT</sup> cluster
Lvl 5-1	28	0.6685	DEM, PSDB, PRONA, MDB and Cidadania	Alinhamento [votou com o governo] → <sup>LT</sup> governo [Bolsonaro 1] → <sup>LT</sup> alinhamento [não se aplica] → <sup>GT</sup> tipoProposicao [MPV] → <sup>GT</sup> governo [Lula 1] → <sup>GT</sup> cluster
Lvl 5-2	52	0	PT	Alinhamento [votou com o governo] → <sup>LT</sup> governo [Bolsonaro 1] → <sup>GT</sup> label [PT] → <sup>GT</sup> tipoProposicao [MPV] → <sup>GT</sup> tipoProposicao [PL] → <sup>LT</sup> cluster
Lvl 5-3	1	0	PT	Alinhamento [votou com o governo] → <sup>LT</sup> governo [Bolsonaro 1] → <sup>GT</sup> label [PT] → <sup>GT</sup> tipoProposicao [MPV] → <sup>GT</sup> tipoProposicao [PL] → <sup>GT</sup> cluster
Lvl 5-4	63	0.85	DEM, MDB, PL, PT, PSDB, Progressistas, PSB, PSD, PROS, Solidariedade, Podemos, PDT, Cidadania and PTB	Alinhamento [votou com o governo] → <sup>GT</sup> voto [Sim] → <sup>GT</sup> voto [Não] → <sup>LT</sup> governo [Lula 1] → <sup>LT</sup> governo [Lula 2] → <sup>LT</sup> cluster

Lvl 5-5	28	0.8771	DEM, PL, Cidadania, PSB, PHS, MDB, PT, PSDB, Progressistas and PTB	Alinhamento [votou com o governo] → <sup>GT</sup> voto [Sim] → <sup>GT</sup> voto [Não] → <sup>LT</sup> governo [Lula 1] → <sup>LT</sup> governo [Lula 2] → <sup>GT</sup> cluster
Lvl 5-6	16	0.9685	DEM, PDT, PT, Progressistas, MDB, PL, PSDB and PTB	Alinhamento [votou com o governo] → <sup>GT</sup> voto [Sim] → <sup>GT</sup> voto [Não] → <sup>LT</sup> governo [Lula 1] → <sup>GT</sup> alinhamento [nao se aplica] → <sup>LT</sup> cluster
Lvl 5-7	49	0.8186	DEM, PL, PDT, PSDB, Progressistas, Cidadania, PTB, PRONA, PSC, PTC and MDB	Alinhamento [votou com o governo] → <sup>GT</sup> voto [Sim] → <sup>GT</sup> voto [Não] → <sup>LT</sup> governo [Lula 1] → <sup>GT</sup> alinhamento [nao se aplica] → <sup>GT</sup> cluster
Lvl 5-8	12857	0.7213	DEM, Sem Partido, Progressistas, MDB, PL, PTB, Solidariedade, PSD, PRB, PSDB, União, Republican, PSB, PSC, Cidadania, PMB, PDT, PROS, Avante, Podemos, PHS, PSL, PRP, PT, PCdoB, PSOL, Patriota, PV, PRONA, REDE, PMN, PTC, PPL, PST, PRTB, DC, Rede and Novo	Alinhamento [votou com o governo] → <sup>GT</sup> voto [Sim] → <sup>GT</sup> voto [Não] → <sup>GT</sup> orientacaoGoverno [Sim] → <sup>GT</sup> governo [Lula 2] → <sup>LT</sup> cluster
Lvl 5-9	3751	0.7538	DEM, Progressistas, MDB, PSC, PL, Cidadania, PDT, PTC, PTB, PSDB, Sem Partido, PT, PSB, PRB, PCdoB, PAN, PSOL, PV, PMN, PHS, PRTB and Avante	Alinhamento [votou com o governo] → <sup>GT</sup> voto [Sim] → <sup>GT</sup> voto [Não] → <sup>GT</sup> orientacaoGoverno [Sim] → <sup>GT</sup> governo [Lula 2] → <sup>GT</sup> cluster

In addition, we present the meaning of the rules represented by the relevant aspects in Table 2 as follows.

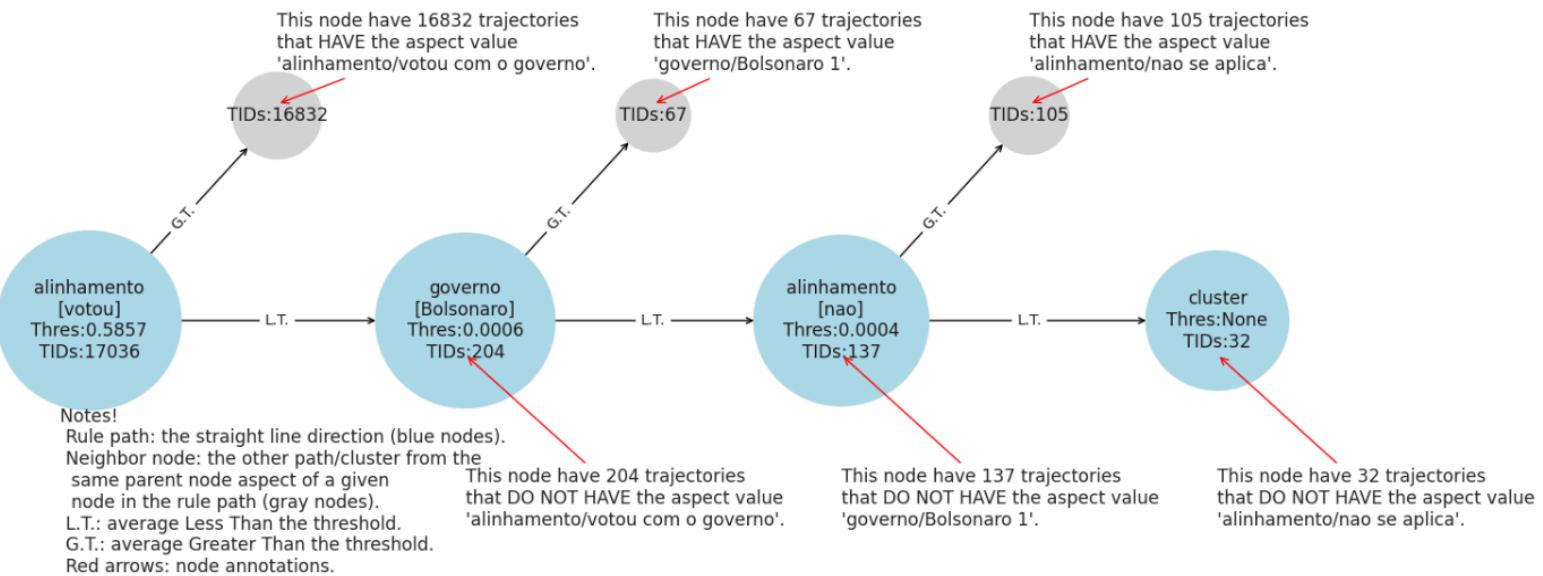
- Rules meaning

- **Cluster Lvl 2-2:** 48 trajectories that voted aligned with the government and then did not vote YES on others propositions.



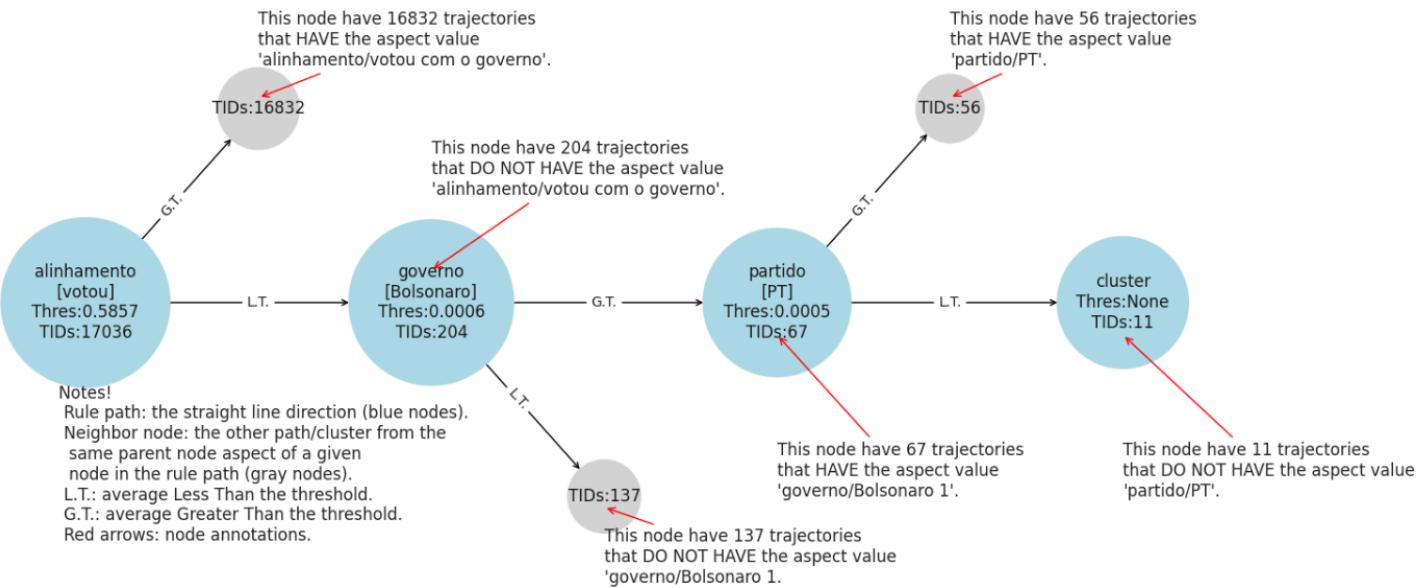
**Figure 7.** The cluster rule path for node 2-2.

- **Cluster Lvl 3-0:** 32 trajectories that do not voted with the government, then this set does have occurrences during the Bolsonaro government, and it had the Alignment different than Not Applicable.



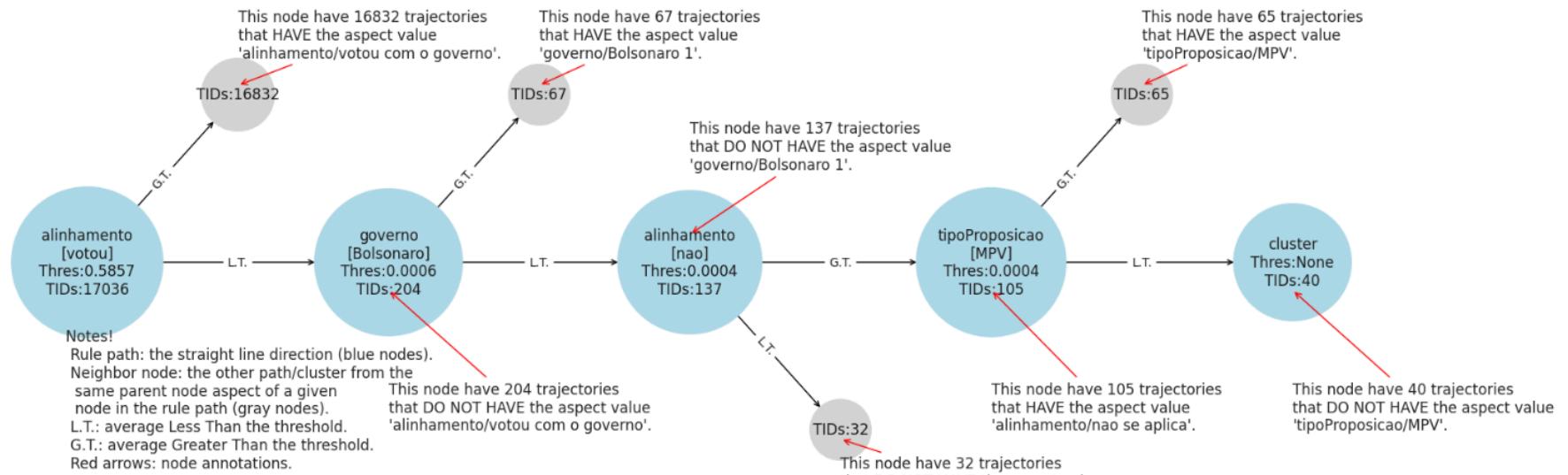
**Figure 8.** The cluster rule path for node 3-0.

- **Cluster Lvl 3-2:** 11 trajectories that do not voted with the government, it does not have occurrences during the Bolsonaro government, and that are from parties different from PT.



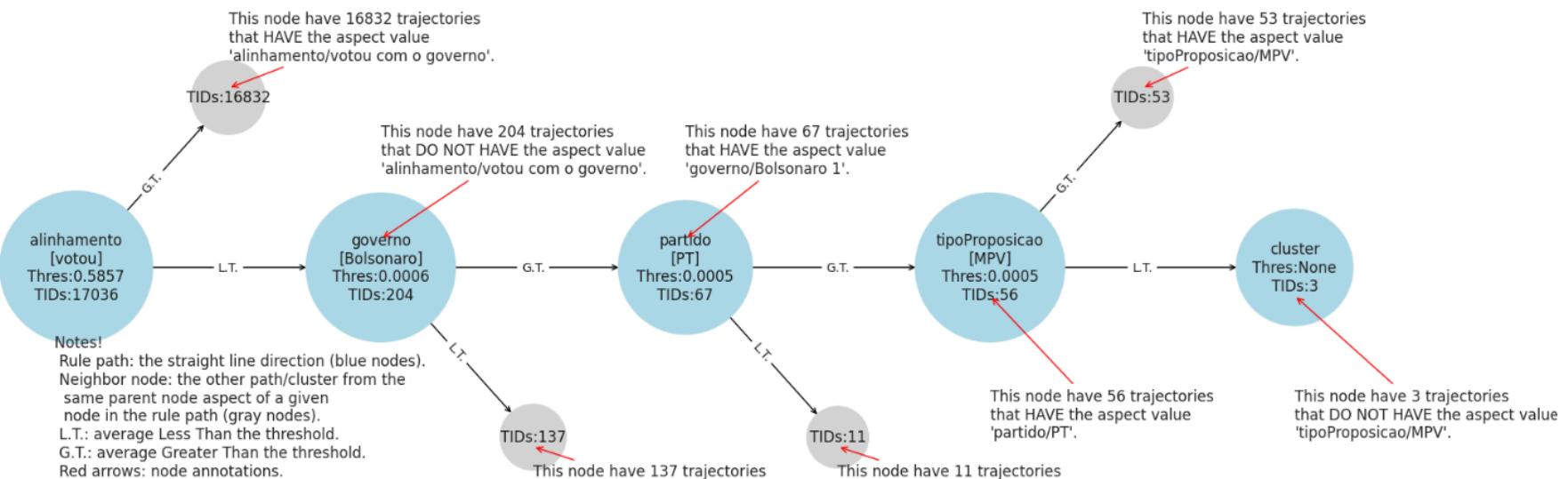
**Figure 9.** The cluster rule path for node 3-2.

- **Cluster Lvl 4-0:** 40 Trajectories that do not voted with the government, it does not have occurrences during the Bolsonaro government with Alignment different than Not Applicable for propositions that were different of MPV.



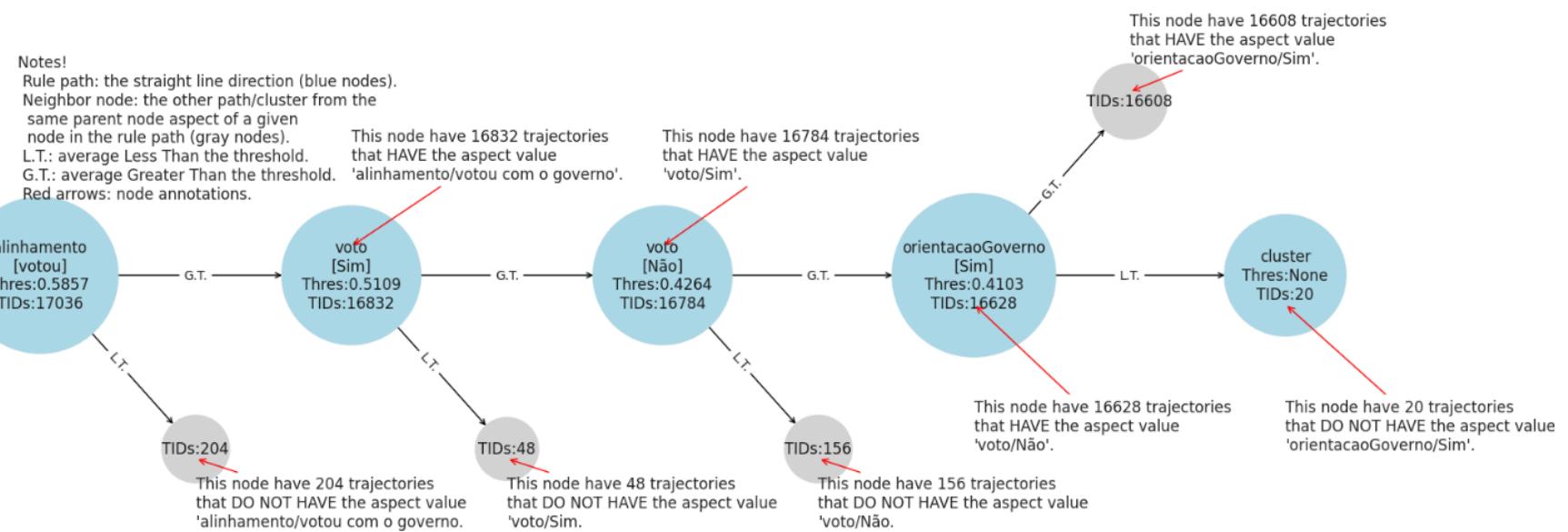
**Figure 10.** The cluster rule path for node 4-0.

- **Cluster Lvl 4-2:** 3 trajectories that do not voted with the government with occurrences during the Bolsonaro government that were from PT party and it has occurrences on propositions different of MPV.



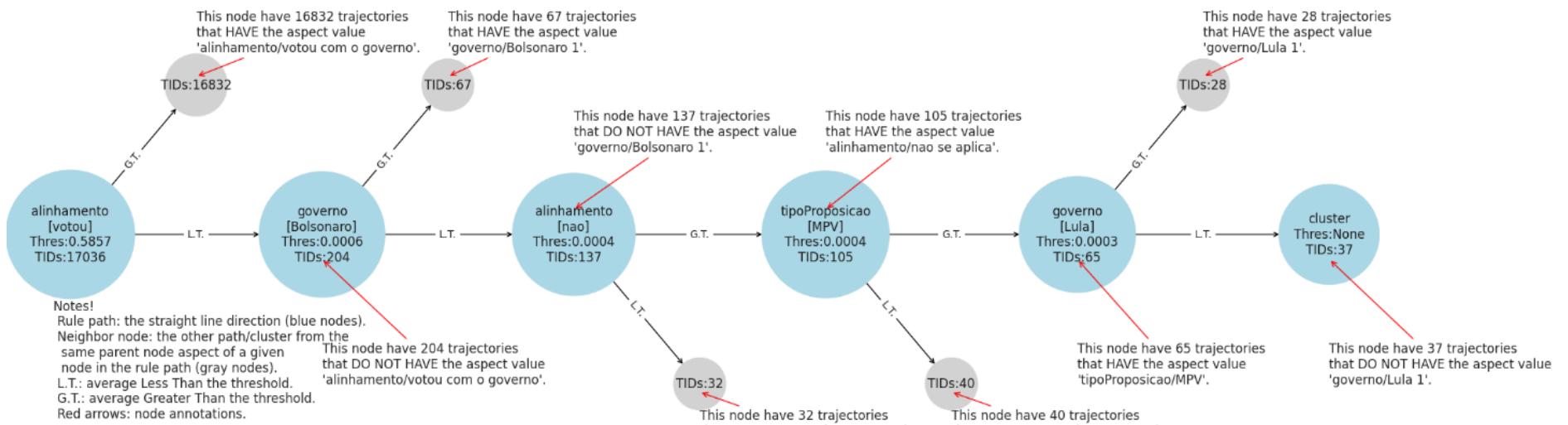
**Figure 11.** The cluster rule path for node 4-2.

- **Cluster Lvl 4-6:** 20 trajectories that voted with the government, voted Yes and No on different propositions, and concluded voting No which was different from the government orientation at that time.



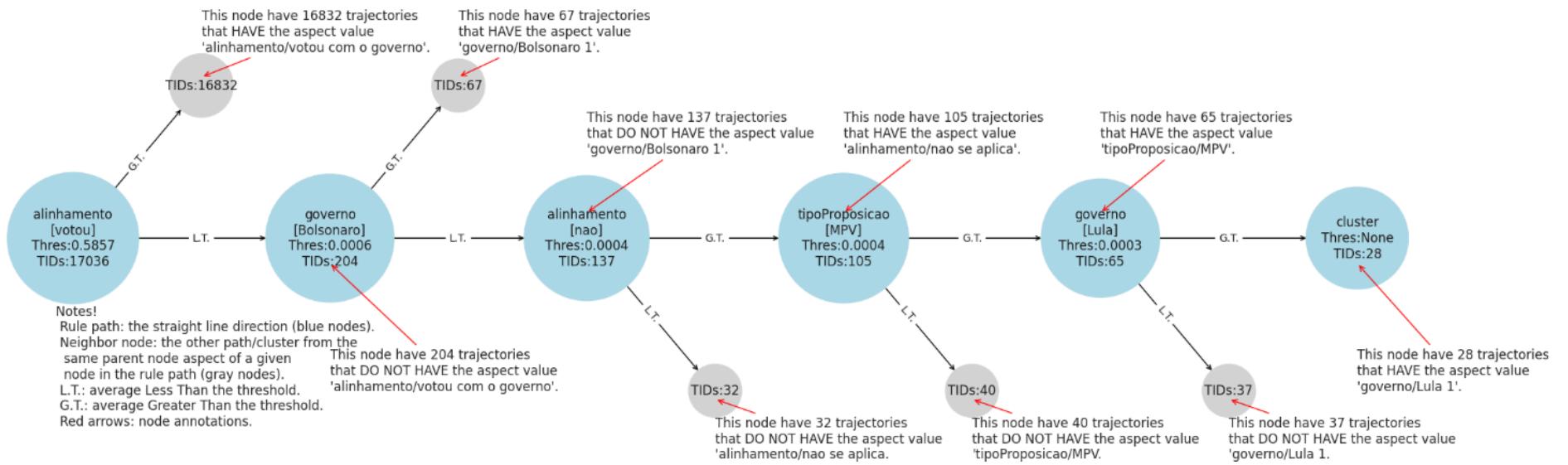
**Figure 12.** The cluster rule path for node 4-6.

- **Cluster Lvl 5-0:** 37 trajectories that do not voted with the government, it does not have occurrences during the Bolsonaro government where the Alignment is different than Not Applicable for propositions that are MPV and also do not occurred during Lula-1 government.



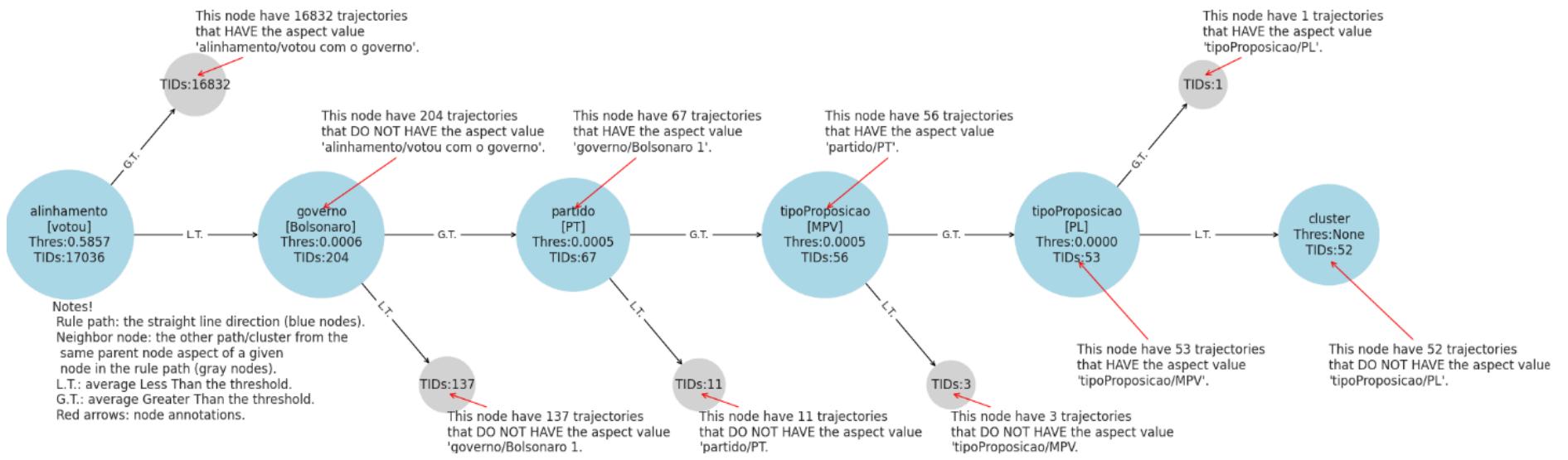
**Figure 13.** The cluster rule path for node 5-0.

- **Cluster Lvl 5-1:** 28 trajectories that do not voted with the government, it did not have occurrences during the Bolsonaro government where the Alignment is different than Not Applicable for propositions that are MPV and also occurred during Lula-1 government.



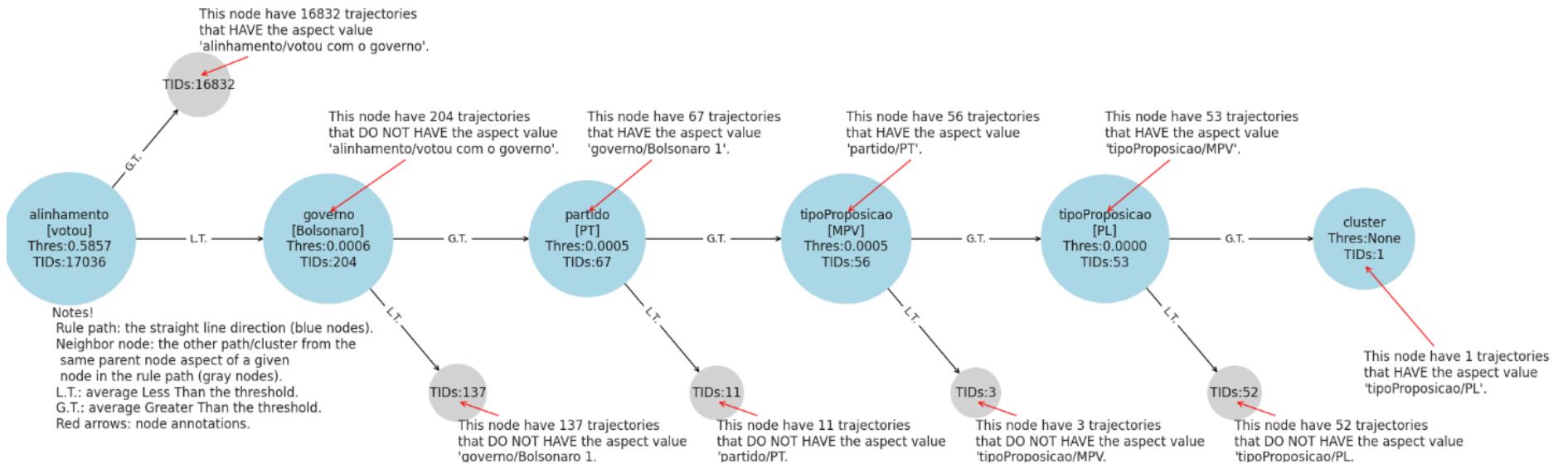
**Figure 14.** The cluster rule path for node 5-1.

- **Cluster Lvl 5-2:** 52 trajectories that do not noted with the government at all, then it occurred during Bolsonaro government which are from PT party that voted on MPV propositions and then do not voted on PL propositions.



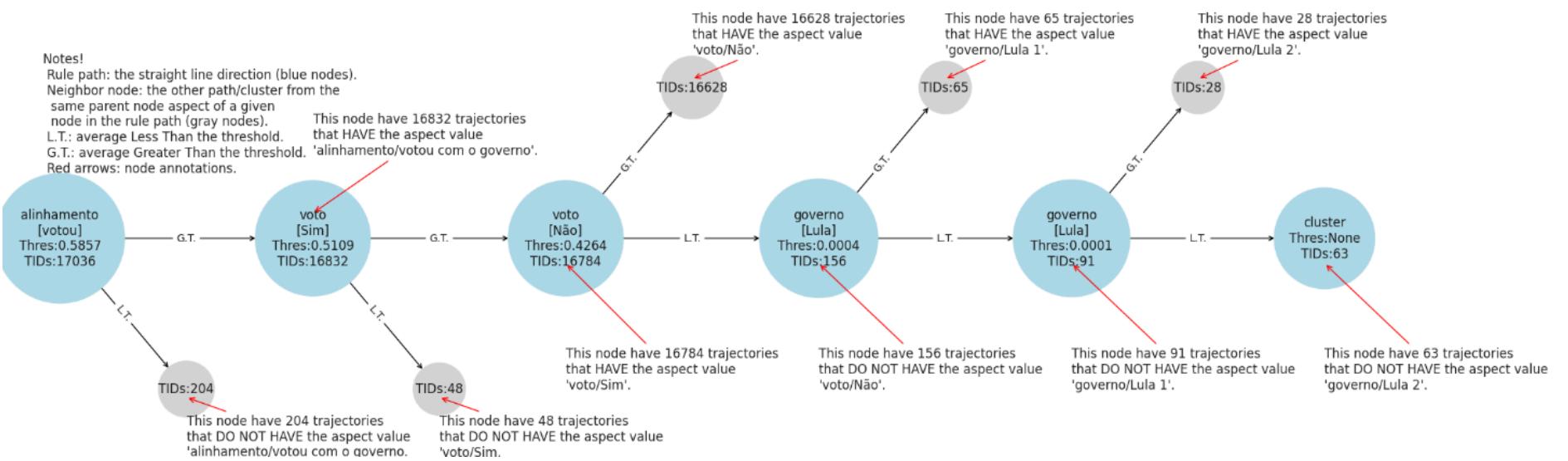
**Figure 15.** The cluster rule path for node 5-2.

- **Cluster Lvl 5-3:** 1 trajectory that do not noted with the government at all, then it occurred during Bolsonaro government which are from PT party that voted on MPV and PL propositions.



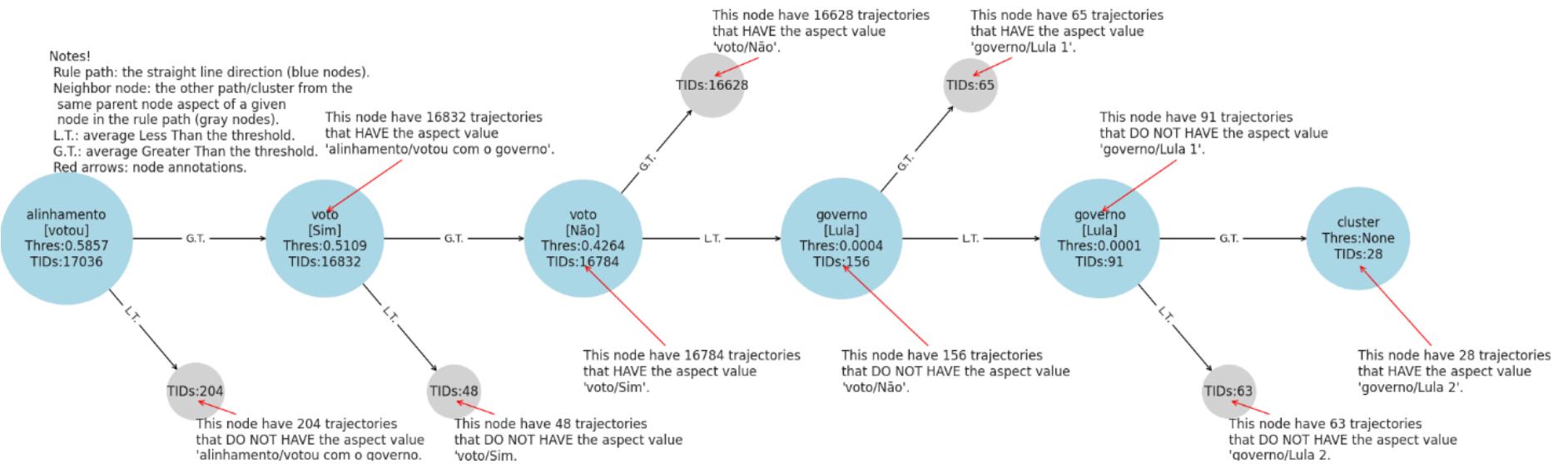
**Figure 16.** The cluster rule path for node 5-3.

- **Cluster Lvl 5-4:** 63 trajectories that voted with the government at first, then voted Yes, in posterior moment voted different of No and these trajectories do not occurred during Lula-1 and Lula-2 governments.



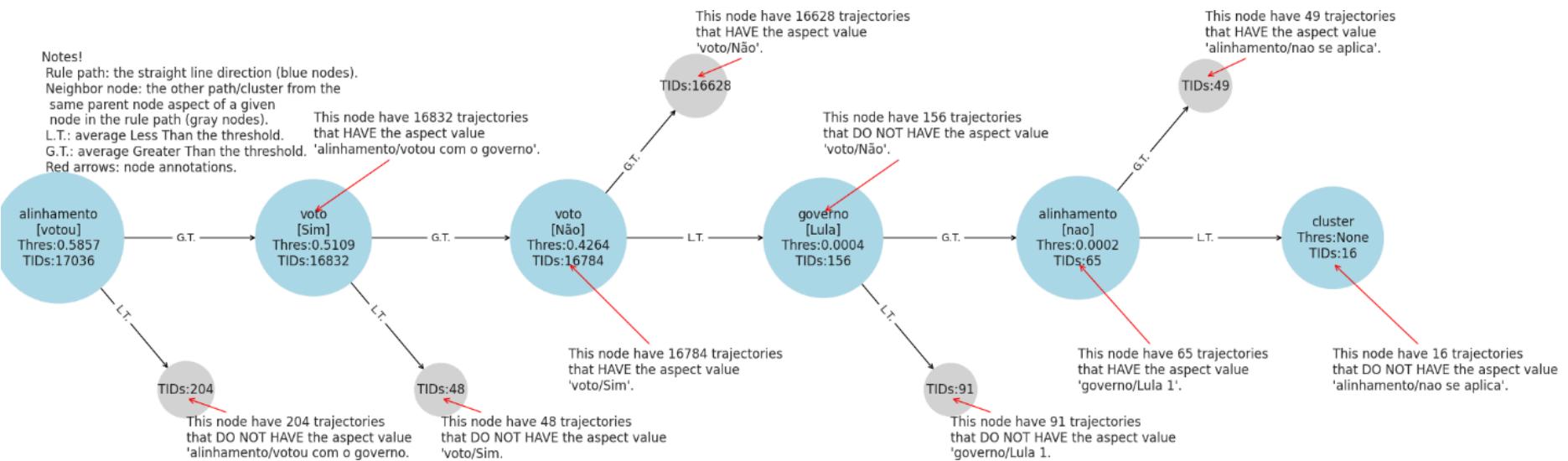
**Figure 17.** The cluster rule path for node 5-4.

- **Cluster Lvl 5-5:** 28 trajectories that voted with the government at first, then voted YES, in posterior moment voted different of NOT, and then these trajectories do not occurred during Lula-1 government but occurred on Lula-2 government.



**Figure 18.** The cluster rule path for node 5-5.

- **Cluster Lvl 5-6:** 16 trajectories that voted with government at first, then voted Yes, in posterior moment voted different of No, and then these trajectories occurred during Lula-1 government and concluded with alignment different of Not Applicable.



**Figure 19.** The cluster rule path for node 5-6.

- **Cluster Lvl 5-7:** 49 trajectories that voted with government at first, then voted Yes, in posterior moment voted different of No, and then these trajectories occurred during Lula-1 government and concluded with alignment different of Not Applicable.

Notes!

Rule path: the straight line direction (blue nodes).

Neighbor node: the other path/cluster from the same parent node aspect of a given node in the rule path (gray nodes).

L.T.: average Less Than the threshold. This node have 16832 trajectories that HAVE the aspect value 'alinhamento/votou com o governo'.

G.T.: average Greater Than the threshold. 'voto/Sim'. Red arrows: node annotations.

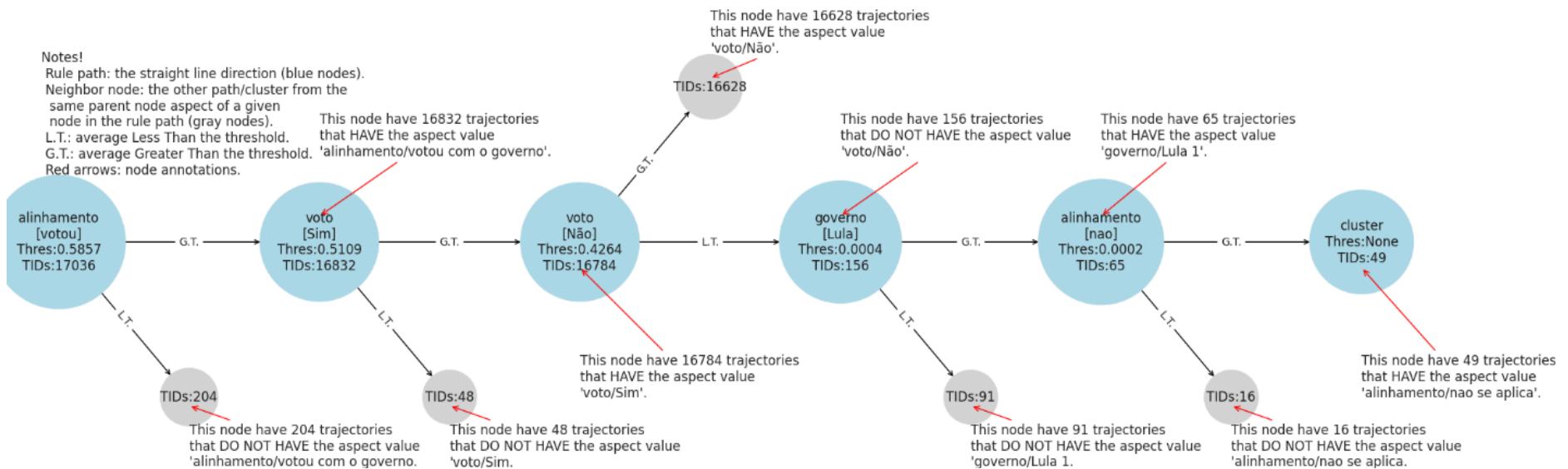
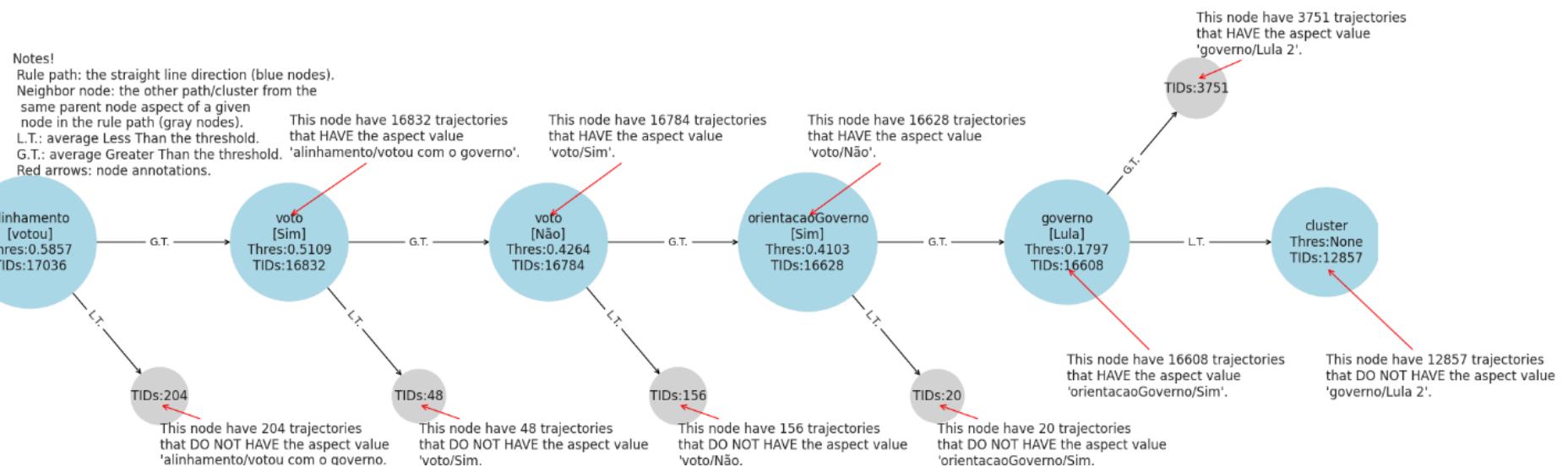


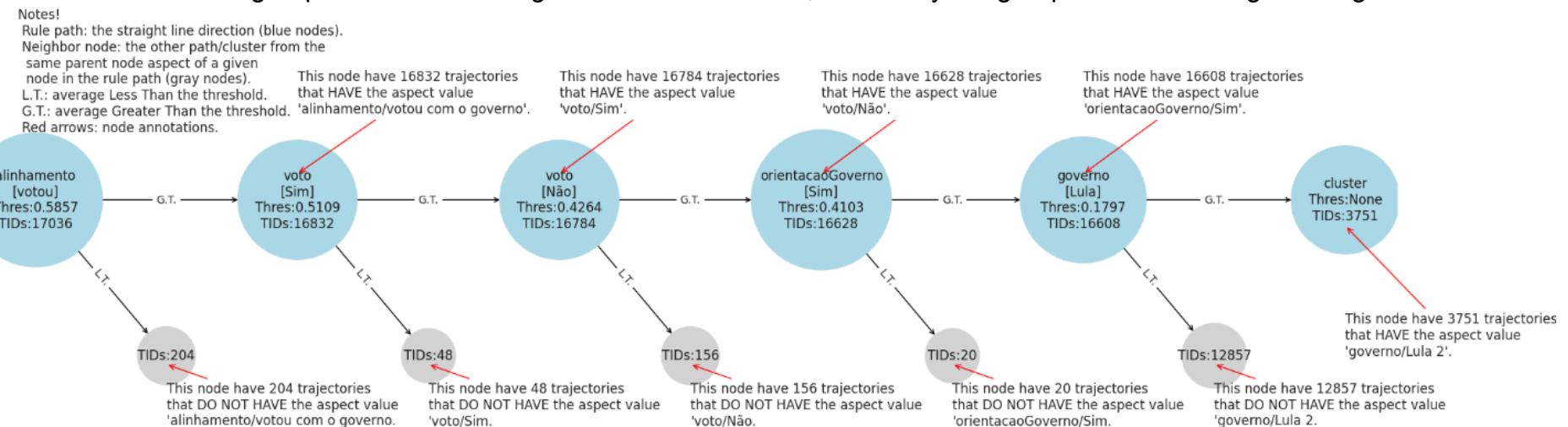
Figure 20. The cluster rule path for node 5-7.

- **Cluster Lvl 5-8:** A group of 12857 trajectories that voted with government at first, then voted Yes, in posterior moment voted No, where this group followed the Yes government orientation, and the group occurred in the government different of Lula-2.



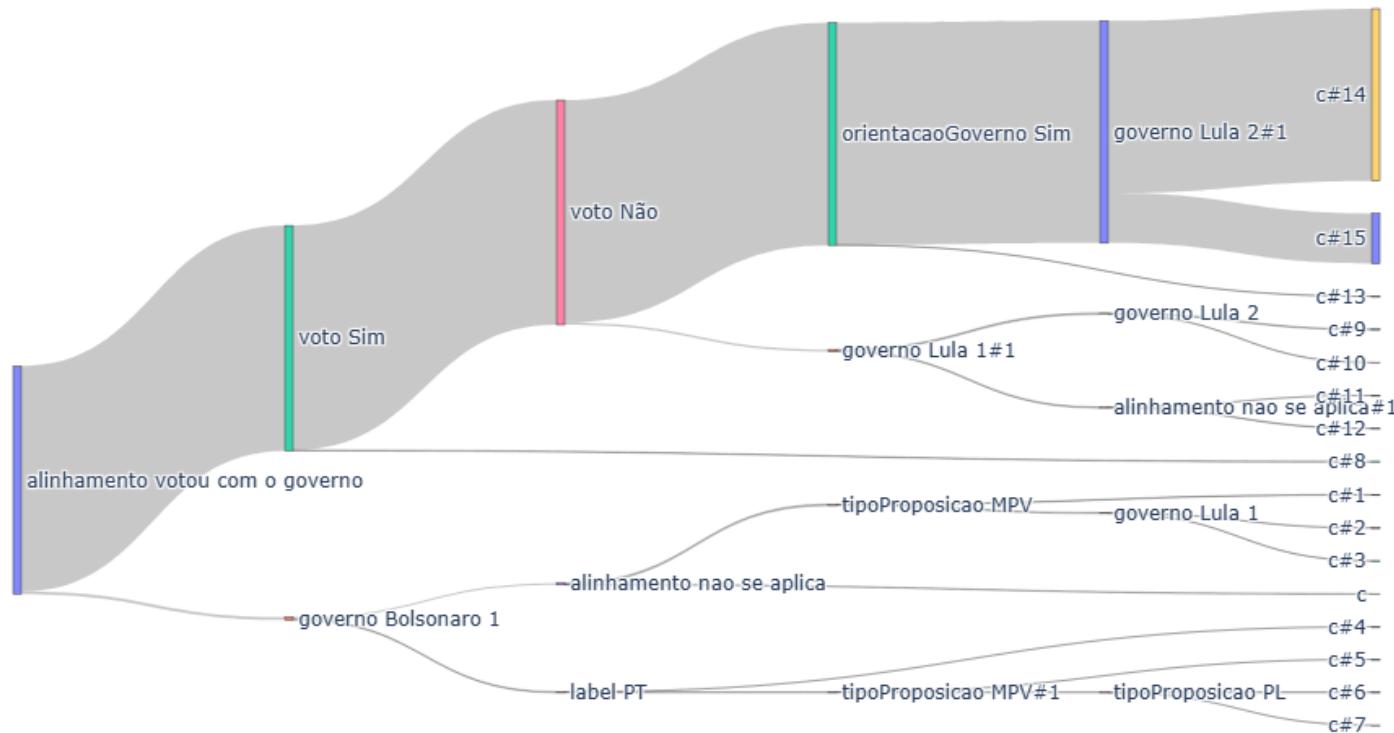
**Figure 21.** The cluster rule path for node 5-8.

- **Cluster Lvl 5-9:** 3751 trajectories that voted with government at first, then voted Yes, in posterior moment voted No, then this group followed the Yes government orientation, and finally the group occurred during Lula-2 government.



**Figure 22.** The cluster rule path for node 5-9.

The Sankey diagram, Figure 23, shows another way to visualize the tree. It helps to visualize the concentration of the number of trajectories for the clustering result.

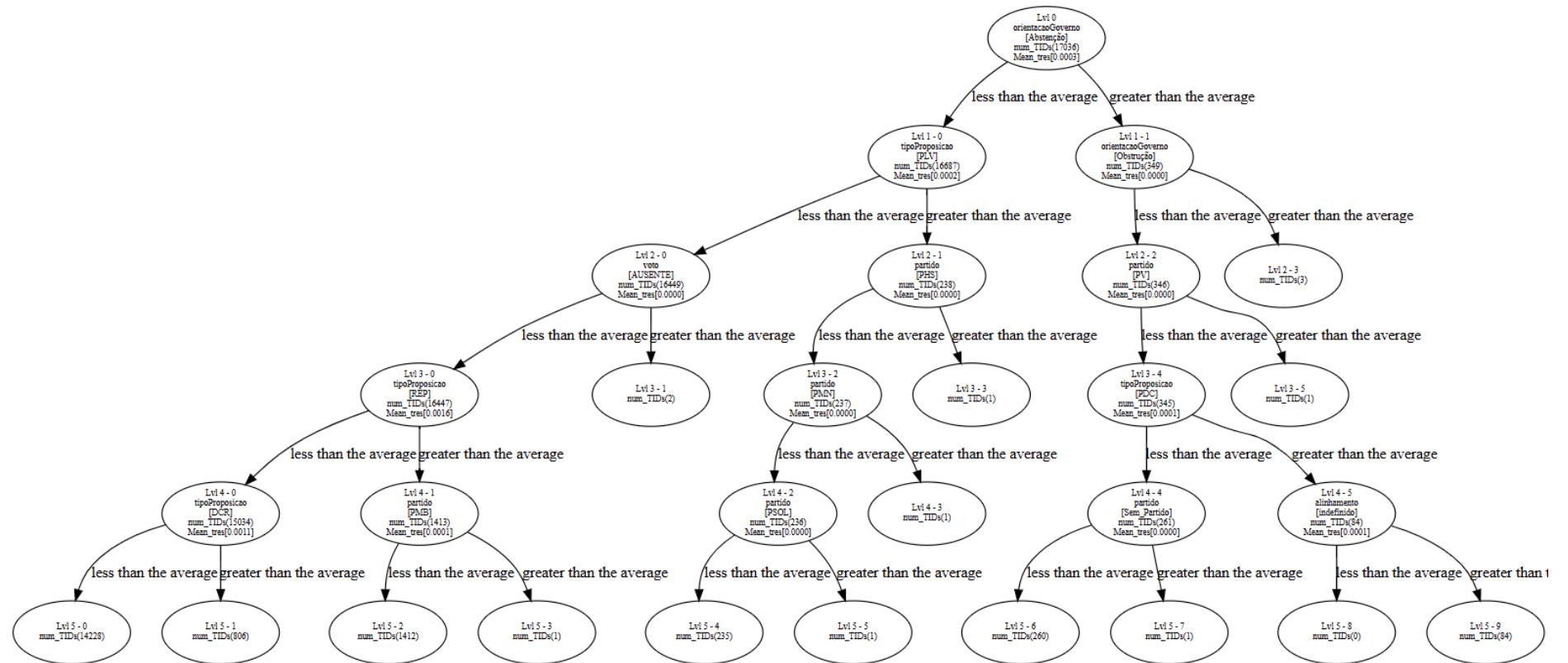


**Figure 23.** Sankey diagram with 16 clusters (*leaf nodes*).

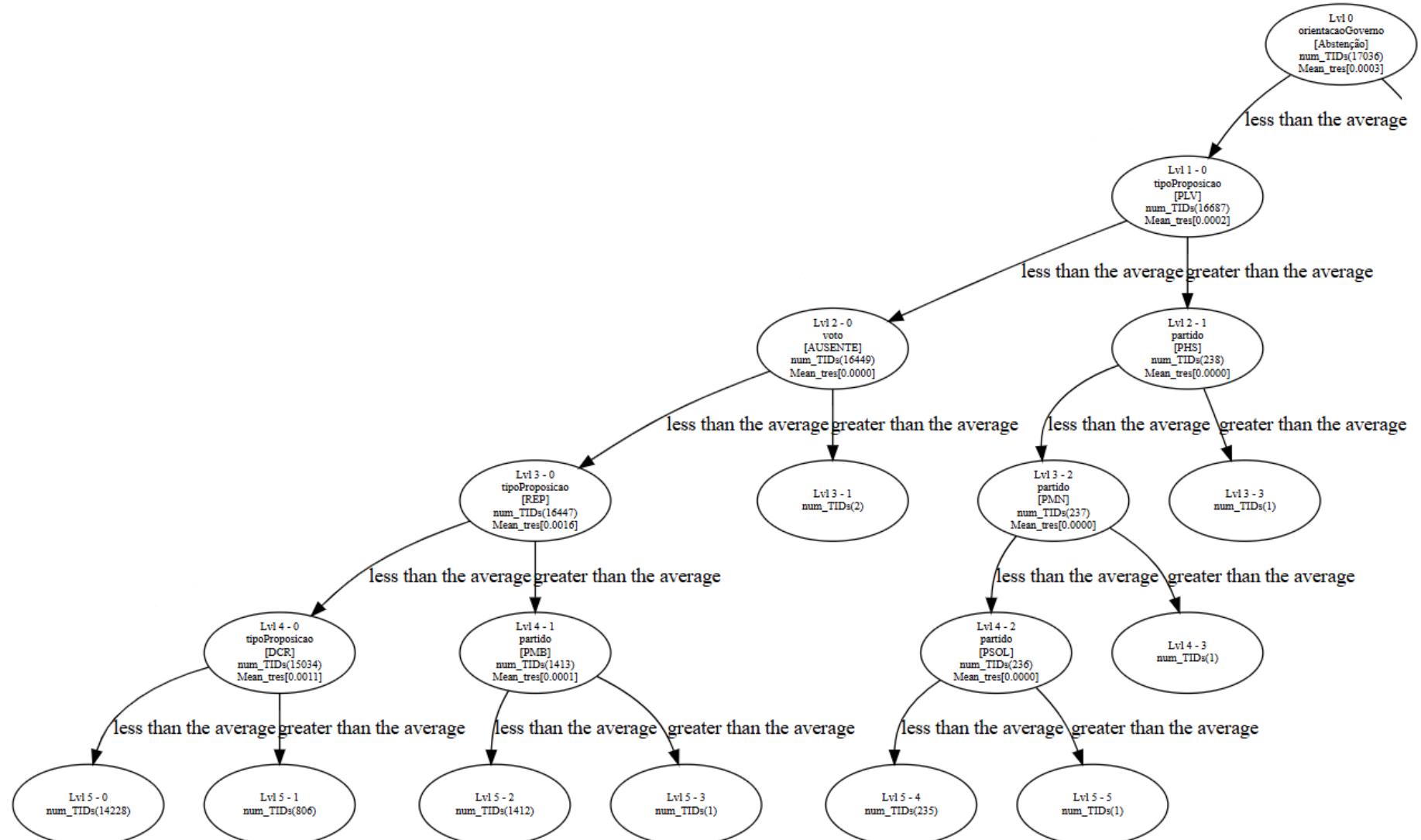
### 3.1.2 Minimum Variance (MV)

**Minimum variance** evaluates the mean variance of an aspect in both trajectory subsets for each subtree. This strategy selects the aspect that generates the smallest mean variance among the subtree (children nodes).

Regarding this selection aspect strategy, we can see in Figure 24 that MAT-Tree identified 14 clusters. Furthermore, we summarized the main characteristics of Figure 24 in Table 3 as the cluster (node), number of trajectories, cluster entropy, unique labels, and the relevant aspects.

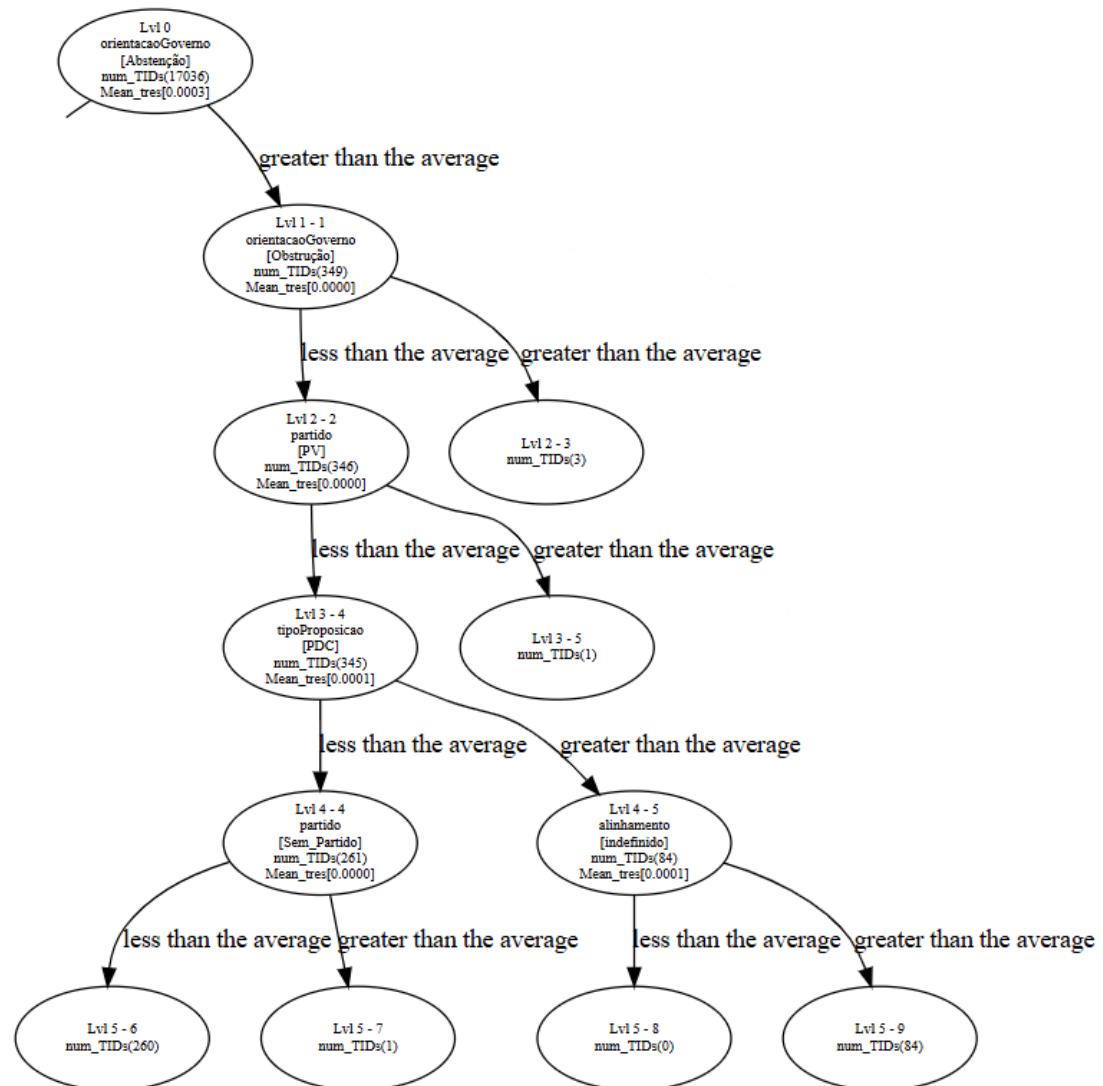


**Figure 24.** Clustering result with 14 clusters. Hyperparameters: selection strategy = MV; max depth = 5; min trajs = 50.



**Figure 25.** Left side of the tree starting from the root which has 9 clusters.

Hyperparameters: selection strategy = MV; max depth = 5; min trajs = 50.



**Figure 26.** Right side of the tree starting from the root which has 5 clusters.  
Hyperparameters: selection strategy = MV; max depth = 5; min trajjs = 50.

Table 3 shows the main characteristics of the clusters in Figure 24. Such characteristics are the number of trajectories, the entropy, parties in the node, and the selected aspects.

**Table 3.** Main characteristics of the clusters using MV strategy. (*LT*): *Less than*; (*GT*): *Greater than*.

Cluster (node)	Characteristics			
	Number of trajectories	Entropy	Unique parties	Relevant aspects
Lvl 2-3	3	1	DEM, PTB, and PSDB	orientacaoGoverno [Abstenção] → <sup>GT</sup> orientacaoGoverno [Obstrução] → <sup>GT</sup> cluster
Lvl 3-1	2	1	MDB and PL	orientacaoGoverno [Abstenção] → <sup>LT</sup> tipoProposicao [PLV] → <sup>LT</sup> voto [Ausente] → <sup>GT</sup> cluster
Lvl 3-3	1	0	PHS	orientacaoGoverno [Abstenção] → <sup>LT</sup> tipoProposicao [PLV] → <sup>GT</sup> partido [PHS] → <sup>GT</sup> cluster
Lvl 3-5	1	0	PV	orientacaoGoverno [Abstenção] → <sup>GT</sup> orientacaoGoverno [Obstrução] → <sup>LT</sup> partido [PV] → <sup>GT</sup> cluster
Lvl 4-3	1	0	PMN	orientacaoGoverno [Abstenção] → <sup>LT</sup> tipoProposicao [PLV] → <sup>GT</sup> partido [PHS] → <sup>LT</sup> partido [PMN] → <sup>GT</sup> cluster

Lvl 5-0	14228	0.7133	DEM, Sem_Partido, MDB, PL, PTB, Progressistas, Solidariedade, PSD, PSDB, União, Republican, PSB, PSC, Cidadania, PDT, PTC, PROS, Avante, Podemos, PHS, PSL, PRP, PT, PCdoB, PSOL, Patriota, PV, PRONA, PRB, REDE, PMN, PAN, PMB, PPL, PRTB, DC, Rede, and Novo	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{LT}$ voto [Ausente] $\rightarrow^{LT}$ tipoProposicao [REP] $\rightarrow^{LT}$ tipoProposicao [DCR] $\rightarrow^{LT}$ cluster
Lvl 5-1	806	0.8097	PRB, DEM, PL, MDB, PSD, PSDB, Cidadania, PMB, PTB, PDT, PHS, PT, Podemos, PSC, Patriota, Progressistas, PSL, Solidariedade, PCdoB, Sem_Partido, Avante, PSB, PSOL, PV, PTC, PROS, PMN, and REDE	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{LT}$ voto [Ausente] $\rightarrow^{LT}$ tipoProposicao [REP] $\rightarrow^{LT}$ tipoProposicao [DCR] $\rightarrow^{GT}$ cluster
Lvl 5-2	1412	0.7516	DEM, MDB, PL, PRB, PDT, PT, PSDB, Progressistas, Cidadania, PCdoB, PTB, PSB, PSOL, PSC, PV, PMN, PSL, PRP, PHS, Avante, PSD, PROS, Solidariedade, Podemos, REDE, and Sem_Partido	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{LT}$ voto [Ausente] $\rightarrow^{LT}$ tipoProposicao [REP] $\rightarrow^{GT}$ partido [PMB] $\rightarrow^{LT}$ cluster
Lvl 5-3	1	0	PMB	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{LT}$ voto [Ausente] $\rightarrow^{LT}$ tipoProposicao [REP] $\rightarrow^{GT}$ partido [PMB] $\rightarrow^{LT}$ cluster
Lvl 5-4	235	0.8473	DEM, MDB, PL, PDT, PT, PSDB, Progressistas, Cidadania, PCdoB, PTB, PSB, PSC, and PV	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{GT}$ partido [PHS] $\rightarrow^{LT}$ partido [PMN] $\rightarrow^{LT}$ partido [PSOL] $\rightarrow^{LT}$ cluster

Lvl 5-5	1	0	PSOL	orientacaoGoverno [Abstenção] $\xrightarrow{LT}$ tipoProposicao [PLV] $\xrightarrow{GT}$ partido [PHS] $\xrightarrow{LT}$ partido [PMN] $\xrightarrow{LT}$ partido [PSOL] $\xrightarrow{GT} cluster$
Lvl 5-6	260	0.8704	DEM, Progressistas, MDB, PL, PDT, PT, PSDB, Cidadania, PCdoB, PTB, and PSB	orientacaoGoverno [Abstenção] $\xrightarrow{GT}$ orientacaoGoverno [Obstrução] $\xrightarrow{LT}$ partido [PV] $\xrightarrow{LT}$ tipoProposicao [PDC] $\xrightarrow{LT}$ partido [Sem_partido] $\xrightarrow{LT} cluster$
Lvl 5-7	1	1*	PDT, Sem_Partido, and Cidadania	orientacaoGoverno [Abstenção] $\xrightarrow{GT}$ orientacaoGoverno [Obstrução] $\xrightarrow{LT}$ partido [PV] $\xrightarrow{LT}$ tipoProposicao [PDC] $\xrightarrow{LT}$ partido [Sem_partido] $\xrightarrow{GT} cluster$
Lvl 5-9	84	0.8436	DEM, MDB, PDT, PT, PSDB, Progressistas, Cidadania, PTB, Sem_Partido, and PCdoB	orientacaoGoverno [Abstenção] $\xrightarrow{GT}$ orientacaoGoverno [Obstrução] $\xrightarrow{LT}$ partido [PV] $\xrightarrow{LT}$ tipoProposicao [PDC] $\xrightarrow{GT}$ alinhamento [Indefinido] $\xrightarrow{GT} cluster$

In addition, we present the meaning of the rules represented by the relevant aspects in Table 3 as follows.

- Rules meaning
  - **Cluster Lvl 2-3:** A group of 3 trajectories with the occurrences of Abstenção and Obstrução for aspect orientacaoGoverno selected as the best aspect split.

Notes!

Rule path: the straight line direction (blue nodes).

Neighbor node: the other path/cluster from the

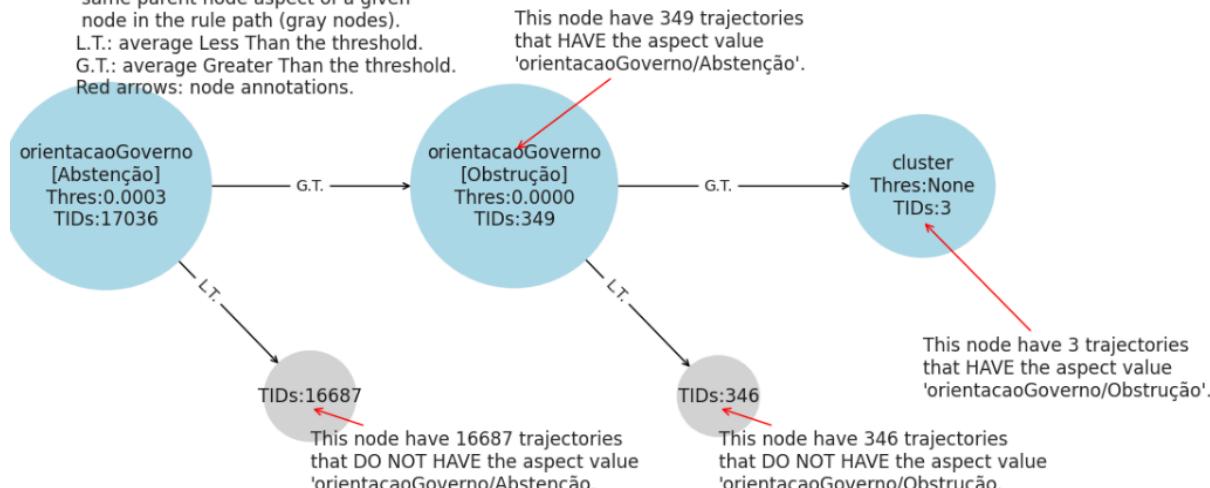
same parent node aspect of a given

node in the rule path (gray nodes).

L.T.: average Less Than the threshold.

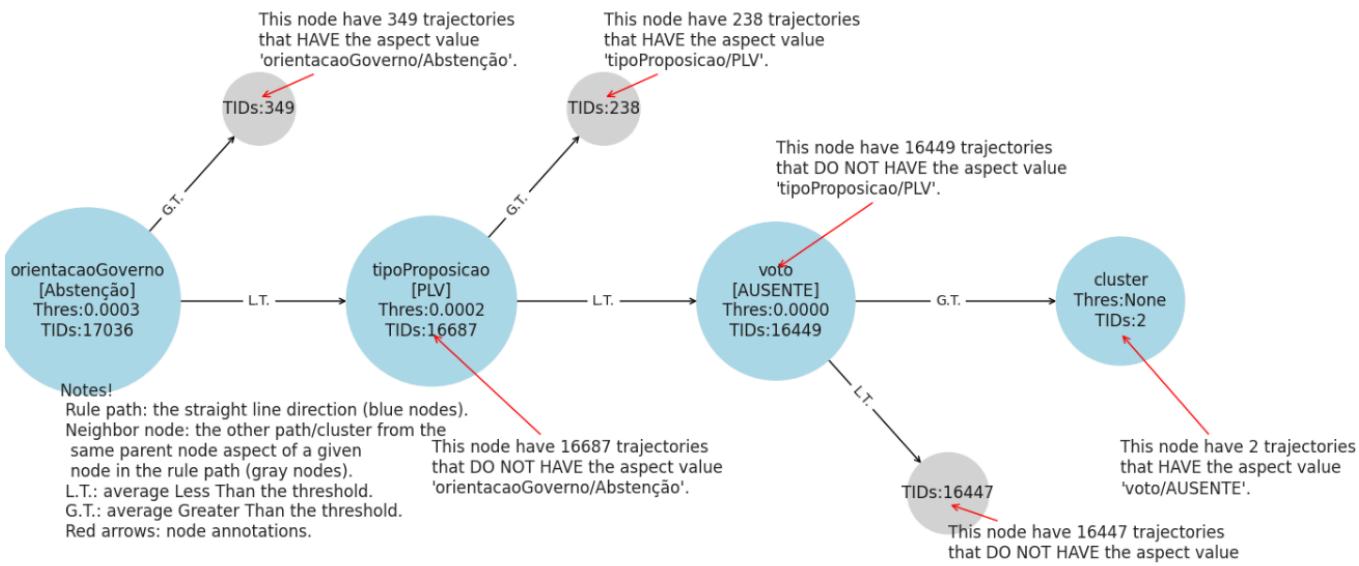
G.T.: average Greater Than the threshold.

Red arrows: node annotations.



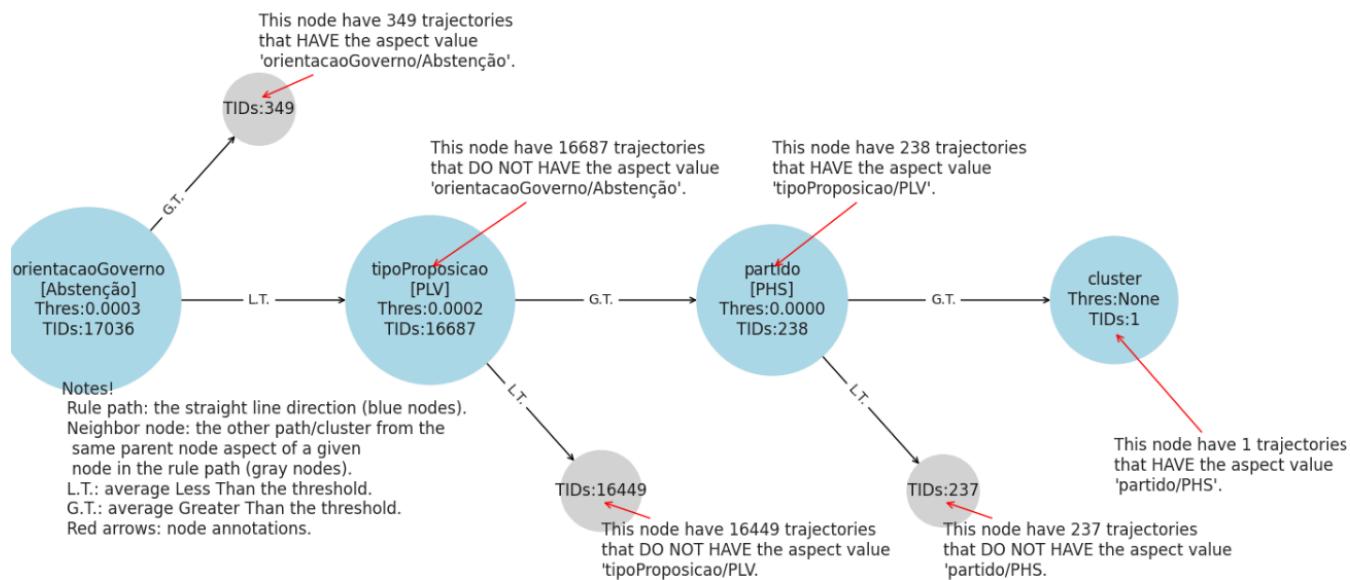
**Figure 27.** The cluster rule path for node 2-3.

- **Cluster Lvl 3-1:** A group of 2 trajectories that do not have the occurrence for aspects orientacaoGoverno/Abstenção and tipoProposicao/PLV but have the occurrence of aspect voto/Ausente.



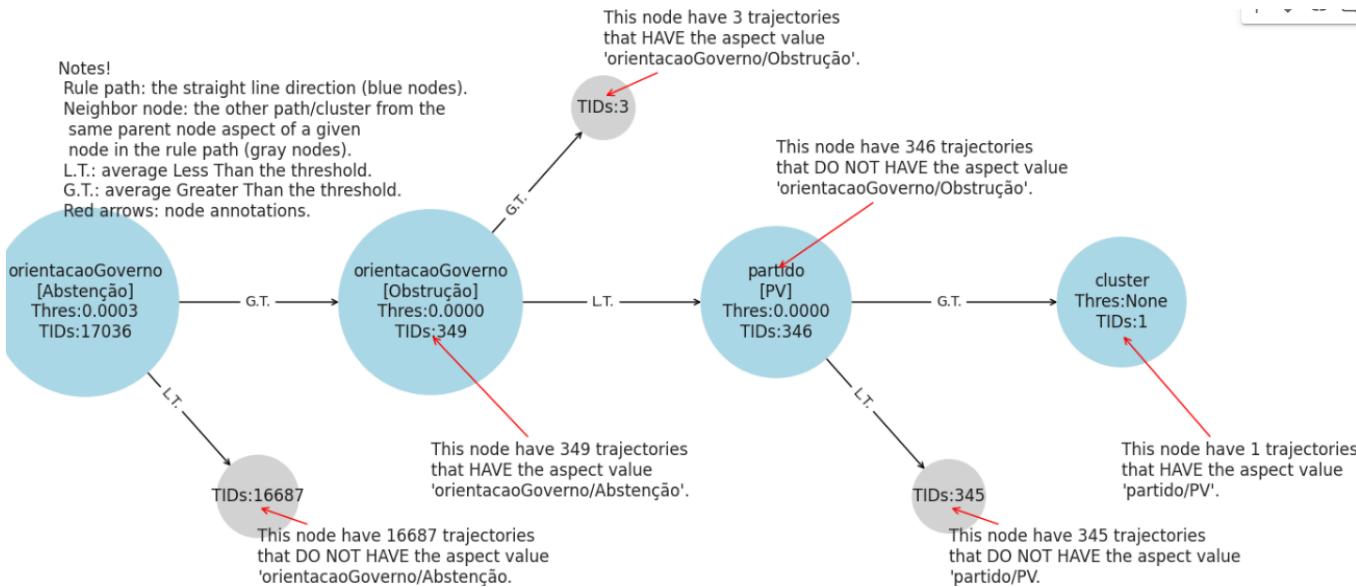
**Figure 28.** The cluster rule path for node 3-1.

- **Cluster Lvl 3-3:** A group of 1 trajectory that is from partido/PHS without the occurrence of orientacaoGoverno/Abstenção and voted on tipoProposicao/PLV.



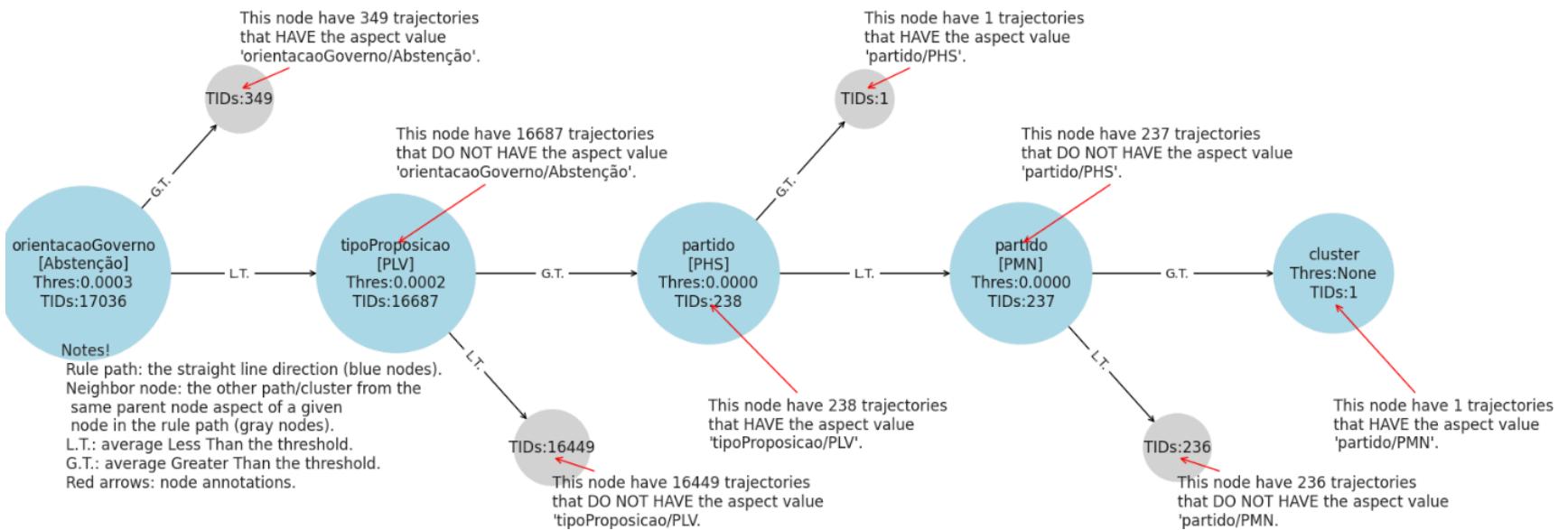
**Figure 29.** The cluster rule path for node 3-3.

- **Cluster Lvl 3-5:** A group of 1 trajectory from the party PV (partido/PV) with the occurrence of government orientation as Abstention (orientacaoGoverno/Abstenção) and does not have the government orientation Obstruction (orientacaoGoverno/Obstrução).



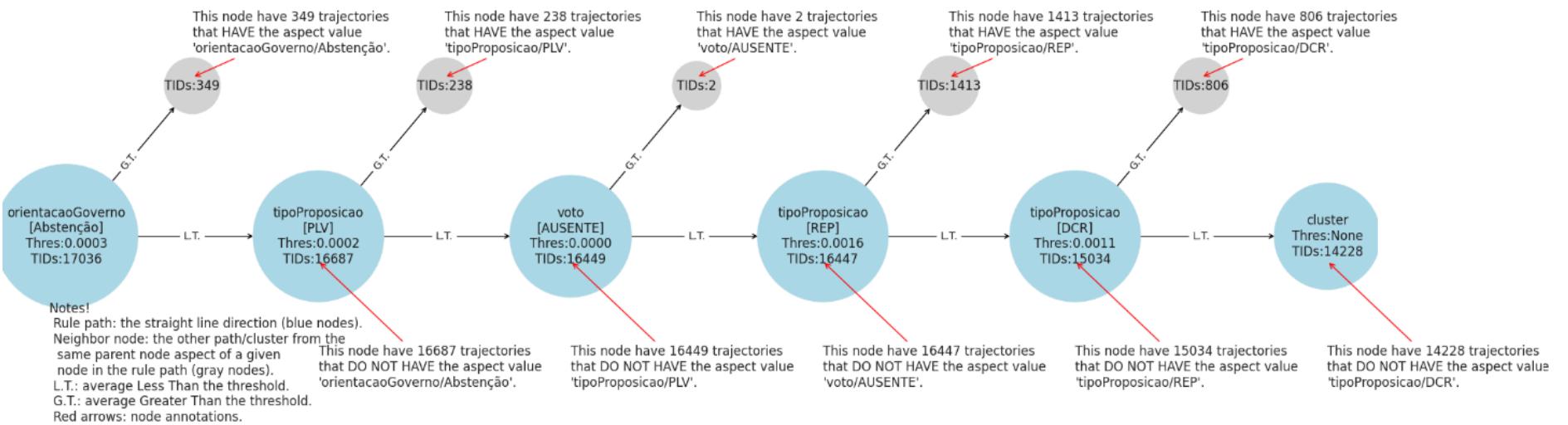
**Figure 30.** The cluster rule path for node 3-5.

- **Cluster Lvl 4-3:** A group of 1 trajectory from the party PMN (partido [PMN]) that does not have the occurrence of government orientation Abstention (orientacaoGoverno/Abstenção) and the no occurrence of party PHS (partido/PHS) aspect was also relevant to identify this pattern.



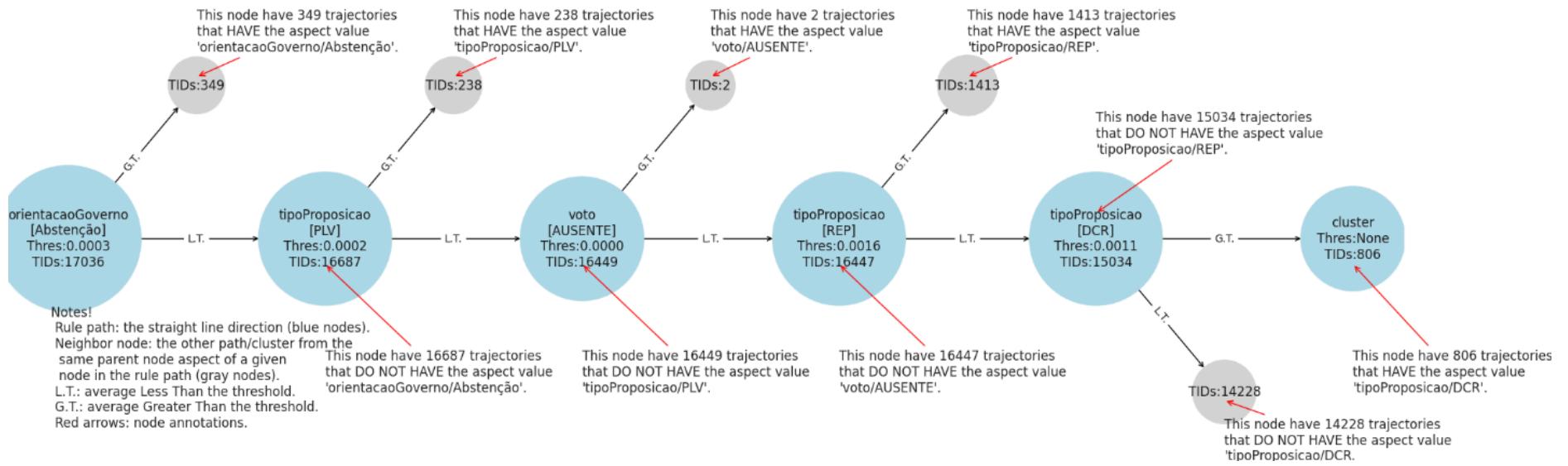
**Figure 31.** The cluster rule path for node 4-3.

- **Cluster Lvl 5-0:** A group of 14228 trajectories that do not have voted Propositions like PLV, REP, and DCR (tipoProposicao PLV/REP/DCR) beside it does not have the occurrence of government orientation Abstention (orientacaoGoverno/Absteção) and vote Absent (voto/Ausent).



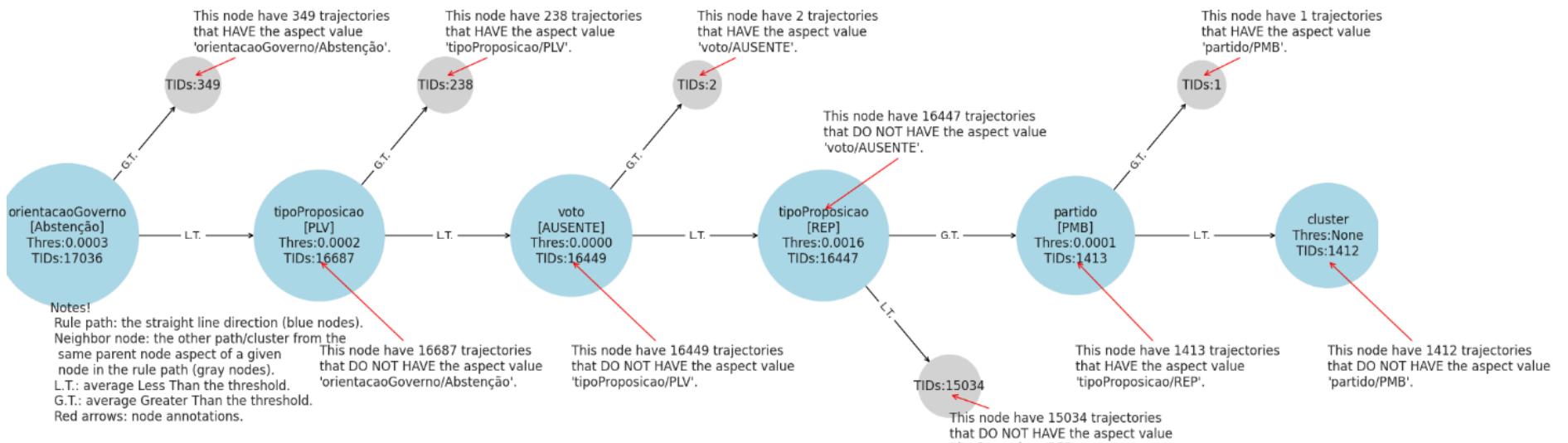
**Figure 32.** The cluster rule path for node 5-0.

- **Cluster Lvl 5-1:** A group of 806 trajectories that do not have occurrences of PLV and REP propositions (tipoProposicao PLV/REP) as well as no occurrence of government orientation Abstention (orientacaoGoverno/Abstenção), but that voted on DRC propositions (tipoProposicao/DCR).



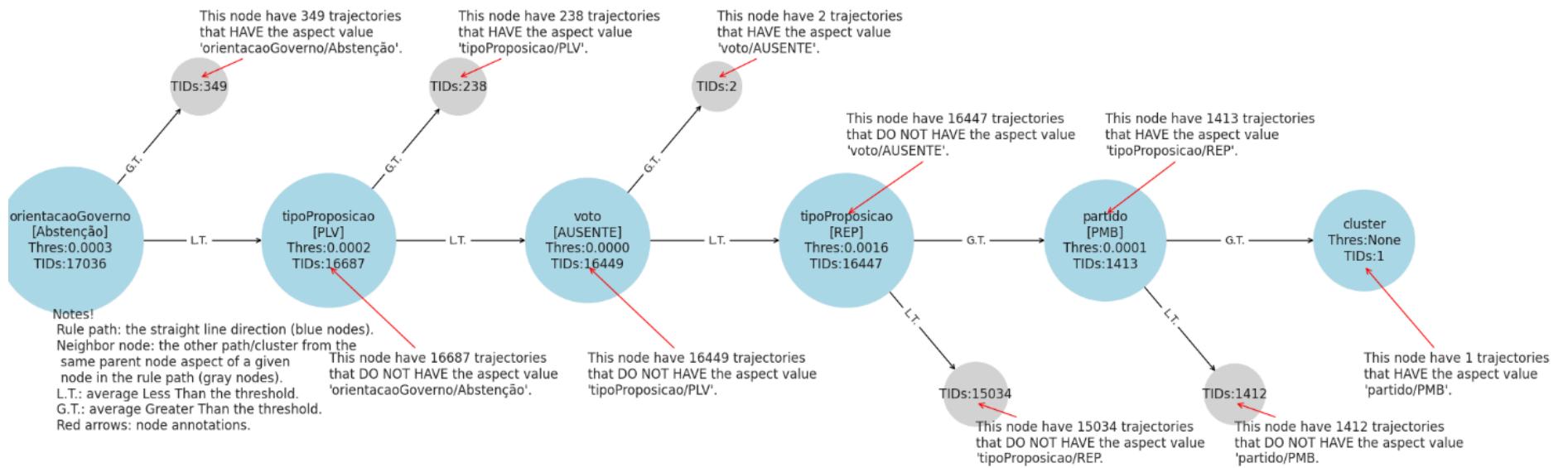
**Figure 33.** The cluster rule path for node 5-1.

- **Cluster Lvl 5-2:** A group of 1412 trajectories that do not have occurrences of government orientation as Abstention (*orientacaoGoverno/Abstenção*), PLV proposition (*tipoProposicao/PLV*), Absent vote (*voto/Ausente*) with PMB party (*partido/PMB*) out of this group, but all trajectories have occurrence of REP proposition (*tipoProposicao/REP*).



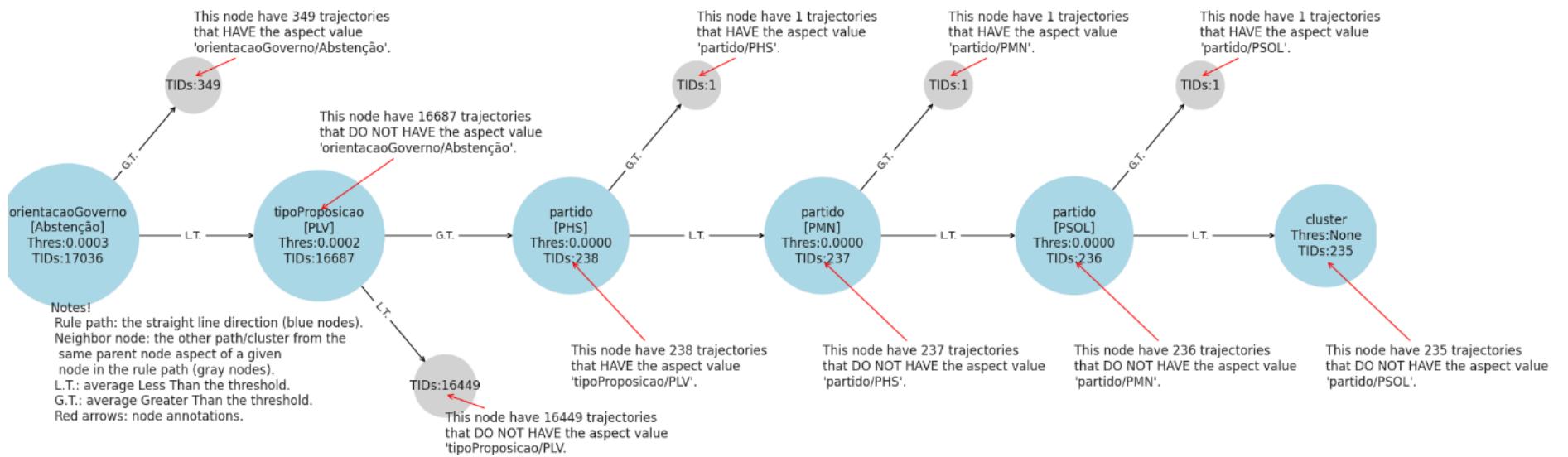
**Figura 34.** The cluster rule path for node 5-2.

- **Cluster Lvl 5-3:** A group of 1 trajectory that do not belongs to PMB party (partido/PMB), without occurrences of government orientation as Abstention (orientacaoGoverno/Abstenção), PLV proposition (tipoProposicao/PLV), Absent vote (voto/Ausente), besides it voted on REP proposition (tipoProposicao/REP).



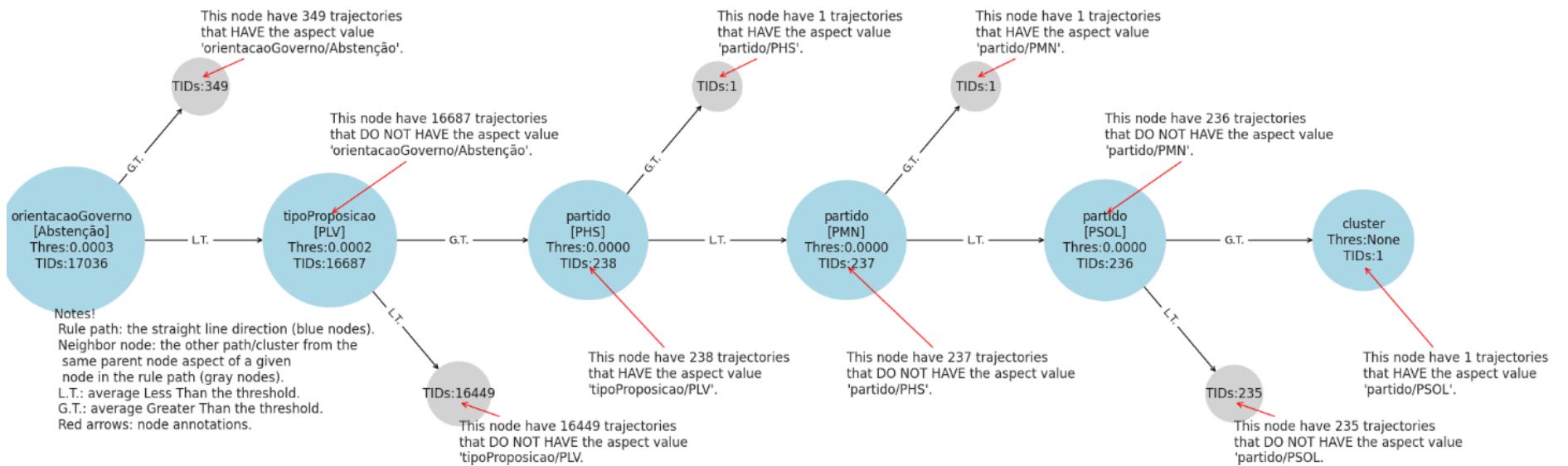
**Figura 35.** The cluster rule path for node 5-3.

- **Cluster Lvl 5-4:** A group of 235 trajectories that voted on PLV proposition (tipoProposicao/PLV), besides all of them do not have occurrences of government orientation as Abstention (orientacaoGoverno/Abstenção) and the PHS, PMN, and PSOL parties (partido PHS/PMN/PSOL).



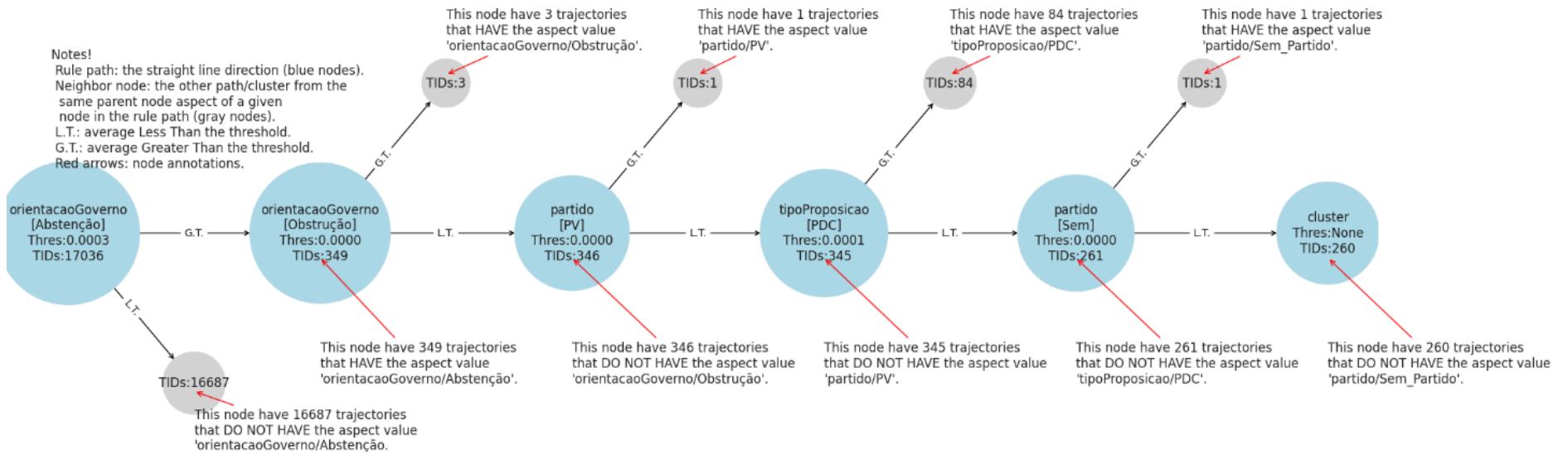
**Figure 36.** The cluster rule path for node 5-4.

- **Cluster Lvl 5-5:** A group of 1 trajectory that voted on PLV proposition (tipoProposicao/PLV) which is from PSOL party (partido/PSOL), and does not have occurrences of government orientation as Abstention (orientacaoGoverno/Abstenção) where the parties PHS and PMN (partido PHS/PMN) were relevant to this trajectory from PSOL party.



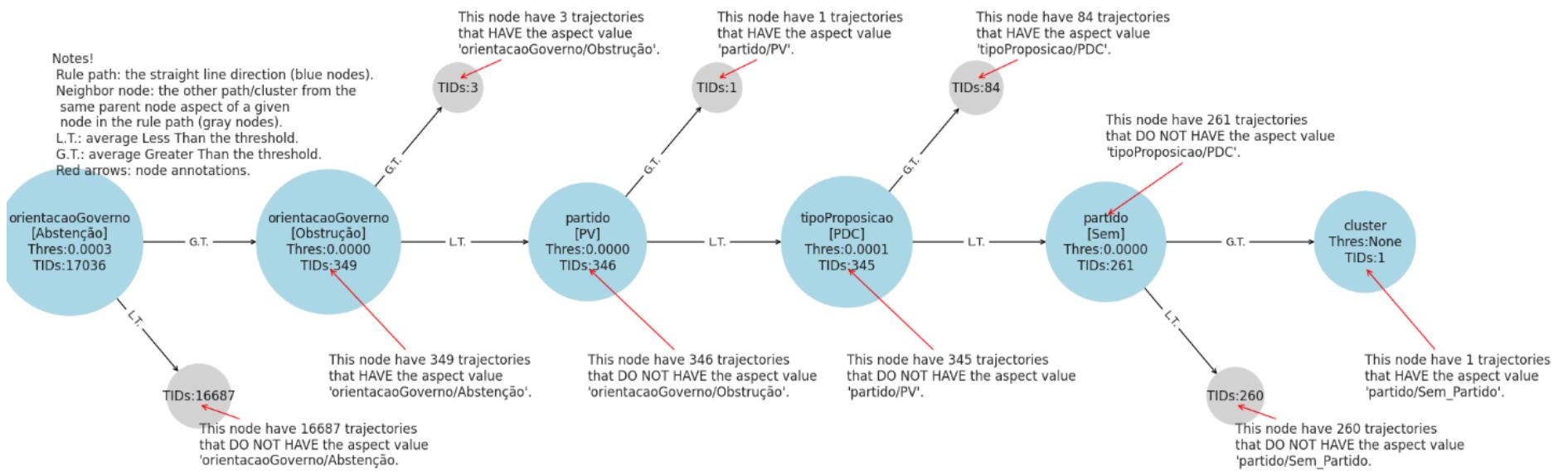
**Figure 37.** The cluster rule path for node 5-5.

- **Cluster Lvl 5-6:** A group of 260 trajectories that have the government orientation as Abstention (*orientacaoGoverno/Abstenção*) and do not have occurrences of PV and Sem\_partido parties (*partido PV/Sem\_partido*) as well as the government orientation Obstruction (*orientacaoGoverno/Obstrução*).



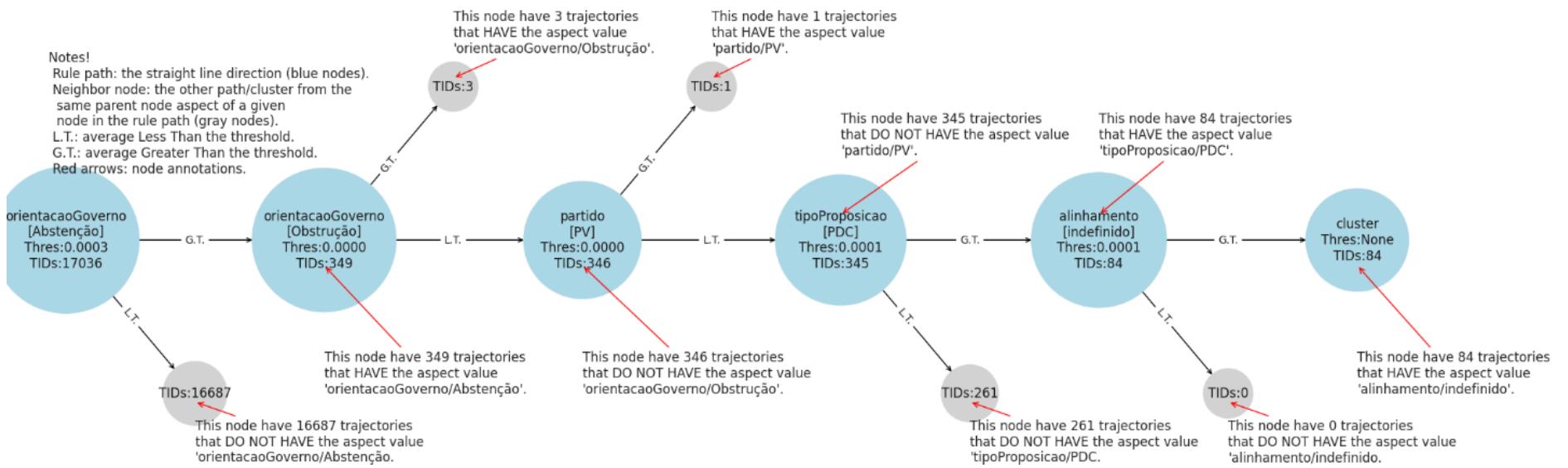
**Figure 38.**The cluster rule path for node 5-6.

- **Cluster Lvl 5-7:** A group of 1 trajectory that is from Sem\_partido party (partido/Sem\_partido) with the government orientation as Abstention (orientacaoGoverno/Abstenção) besides it does not have the occurrences of government orientation as Obstruction (orientacaoGoverno/Obstrução), PV party (partido/PV), and PDC proposition (tipoProposicao/PDC).



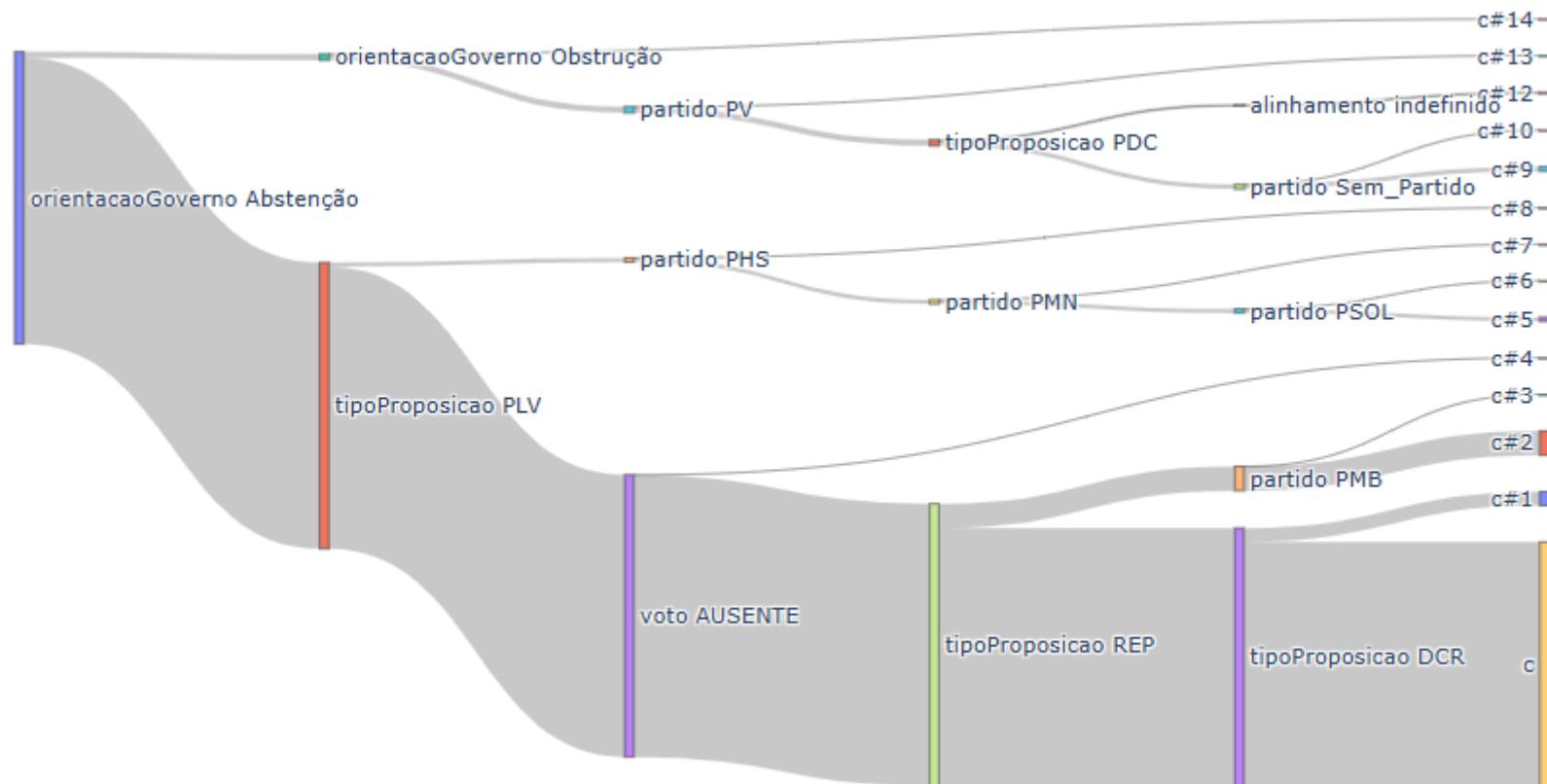
**Figure 39.** The cluster rule path for node 5-7.

- **Cluster Lvl 5-9:** A group of 84 trajectories that have occurrences of PDC proposition (tipoProposicao/PDC), government orientation as Abstention (orientacaoGoverno/Abstenção) and Undefined alignment (alinhamento/Indefinido), besides all of them do not have the government orientation as Obstruction (orientacaoGoverno/Obstrução) and they are not from PV party (partido/PV).



**Figure 40.** The cluster rule path for node 5-9.

The Sankey diagram, Figure 41, shows another way to visualize the tree. It facilitates to visualize the concentration of the number of trajectories for the clustering result.



**Figure 41.** Sankey diagram with 14 clusters (*leaf nodes*).

### 3.1.3 Insights

We hypothesize that the MVR strategy finds rules that are mostly related to the characteristic of the selected aspects separate the data with occurrences above the average. MVR reveals rules that show the quantity of data that generally have occurrences of the aspects. On the other hand, the MV strategy shows a opposite behavior, that is, MV focus on the rules that show the amount of

data that generally do not have occurrences of the selected aspects. Thus, we can see the concentration of the data in the tree according to the chosen strategy.

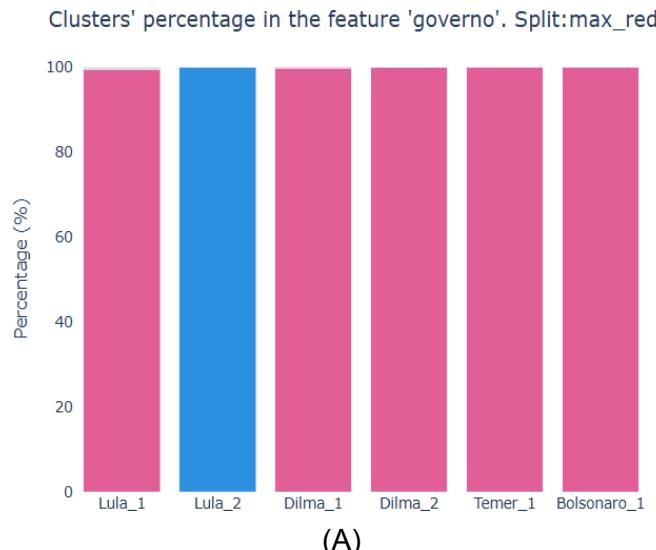
We also note that both trees on the opposite side where the trajectories are concentrated have clustered few trajectories which can reveal outliers. However, the MV strategy generated a tree that has more clusters with few trajectories than MVR strategy. So, the MV strategy can be more suitable for outliers that, in average, shows a small number of occurrences greater than the average threshold.

### 3.1.3.1 MVR

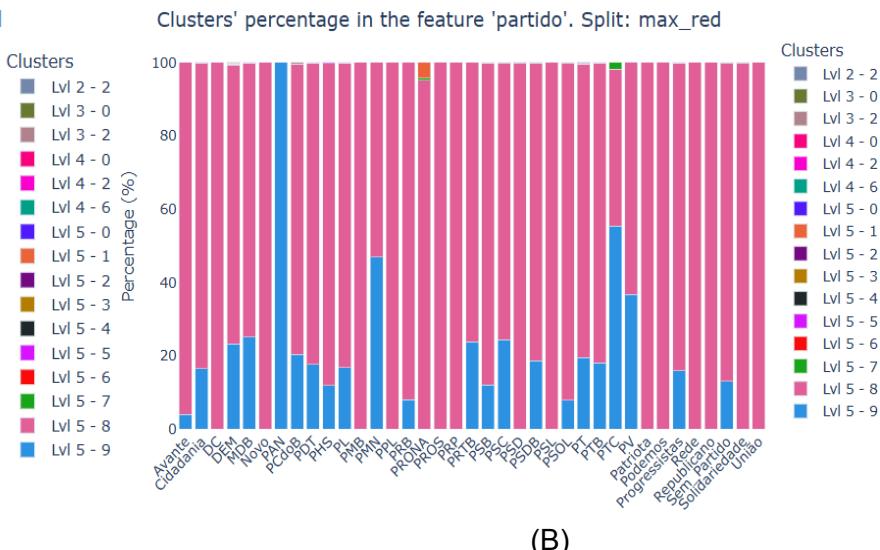
#### 1 All governments

This feature approach identified 16 clusters where **97.48%** of the trajectories are grouped into two clusters using the MVR strategy. We note that the data separation had as its last aspect the Lula2 Government. With this, the groups (node 5-8 and node 5-9) of trajectories that have the same voting pattern until the point of separation which is the Lula2 government. Cluster node 5-9 has 3751 trajectories corresponding to **22.02%** of the data while cluster node 5-8 has 12857 trajectories corresponding to **75.46%** of the clustered data.

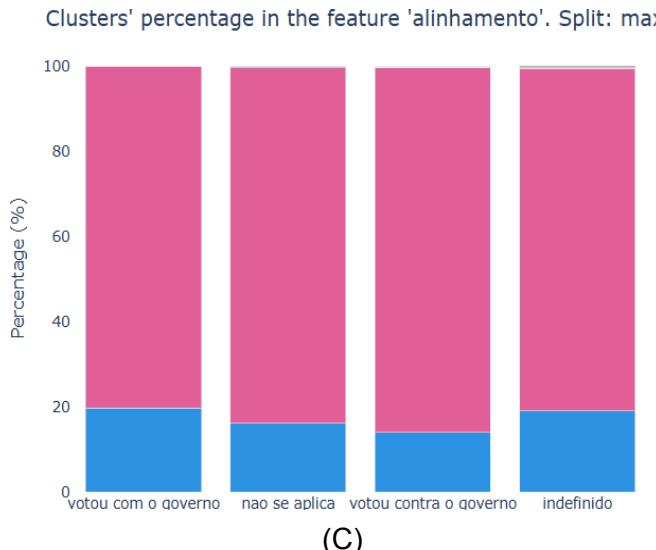
Regarding the outlier, cluster node 5-3, there was only 1 trajectory of a parliamentarian from the PT party who voted against the Bolsonaro government's guidance at a given time for the MPV and PL propositions.



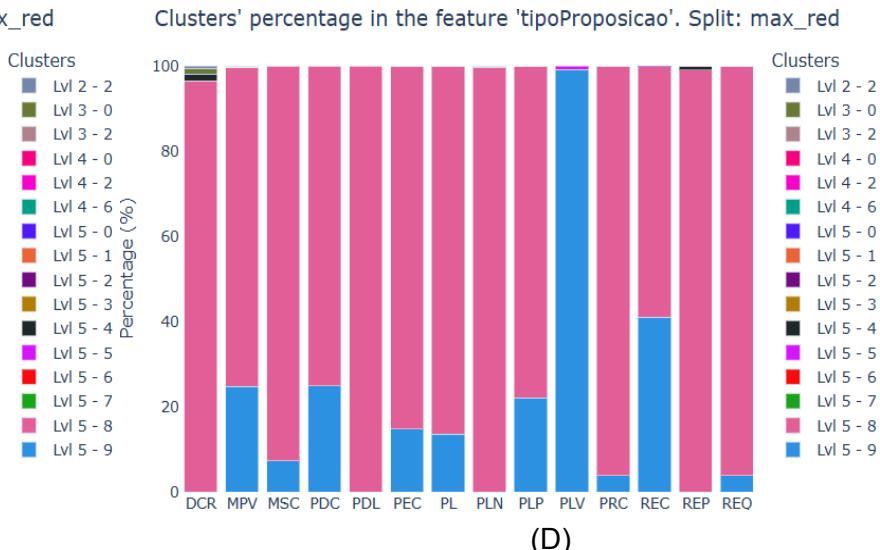
(A)



(B)



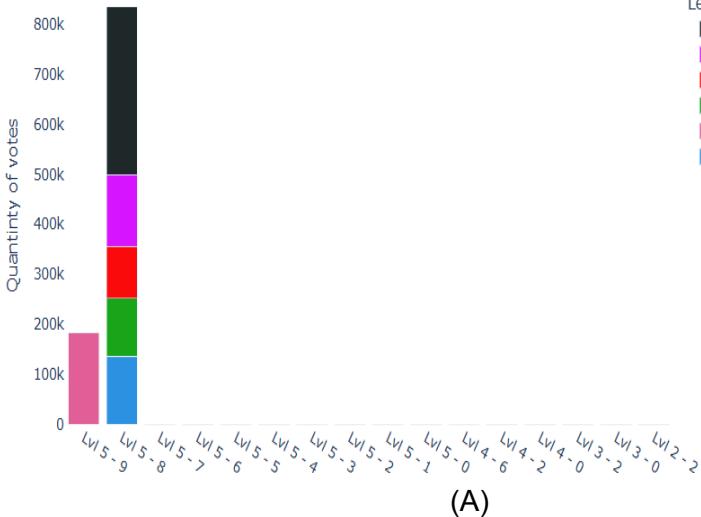
(C)



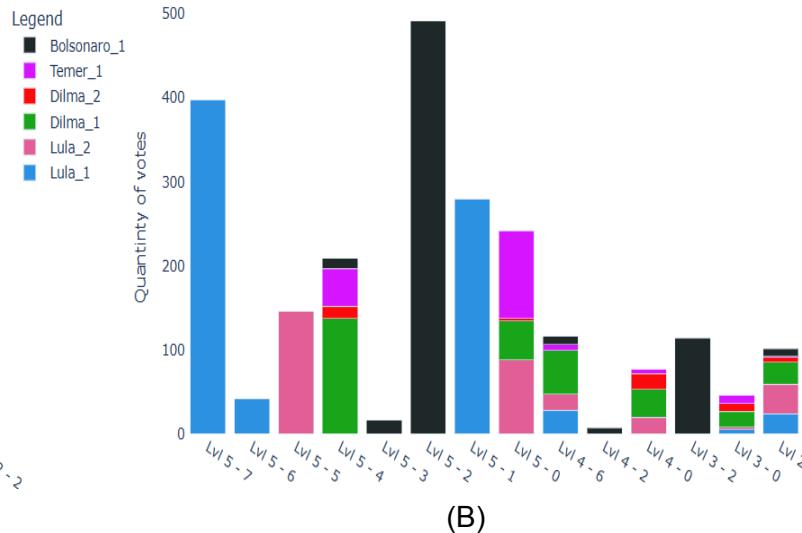
(D)

**Figure X.** Clusters' percentage in the features using MVR. (A) Government (Governo), (B) Party (Partido), (C) Government's alignment (Alinhamento) and (D) Proposition (Tipo proposição).

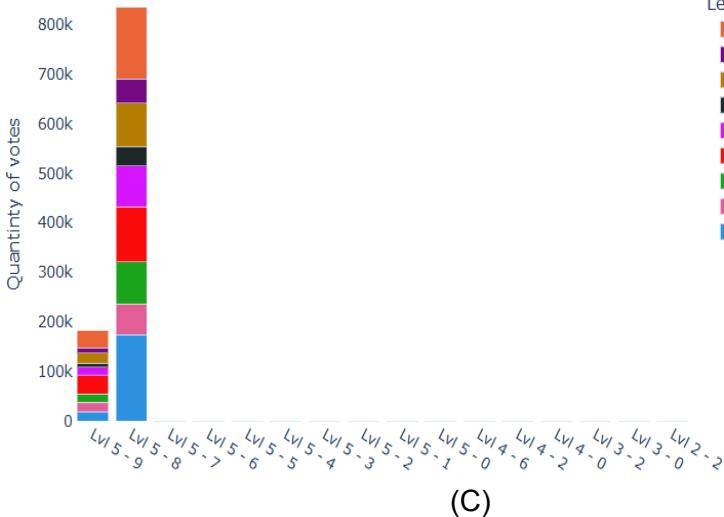
Feature 'governo'; Split: max\_red.



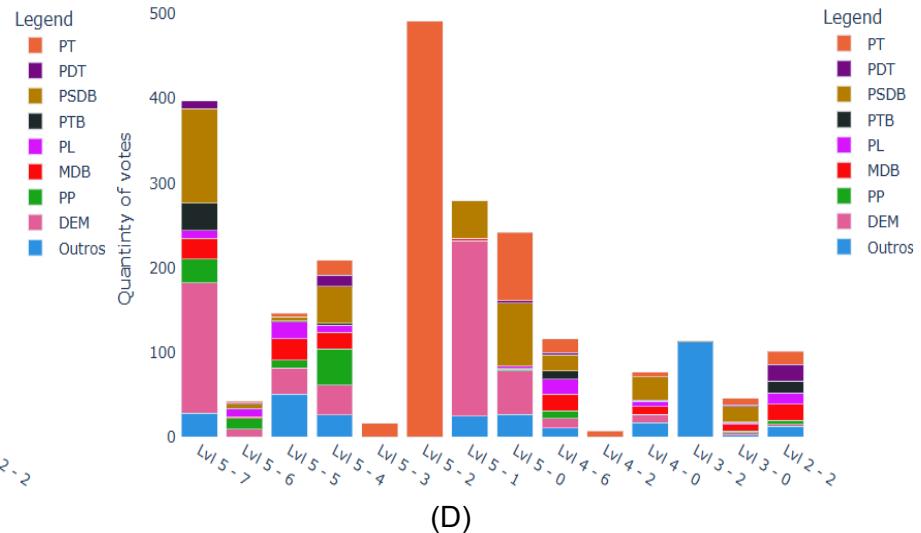
Feature 'governo'; Split: max\_red.



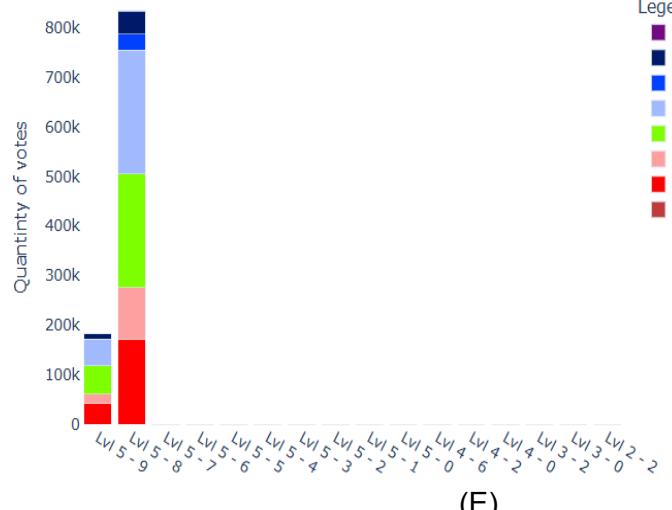
Feature 'partido'; Split: max\_red.



Feature 'partido'; Split: max\_red.



Feature 'esp\_pol\_partido'; Split: max\_red.

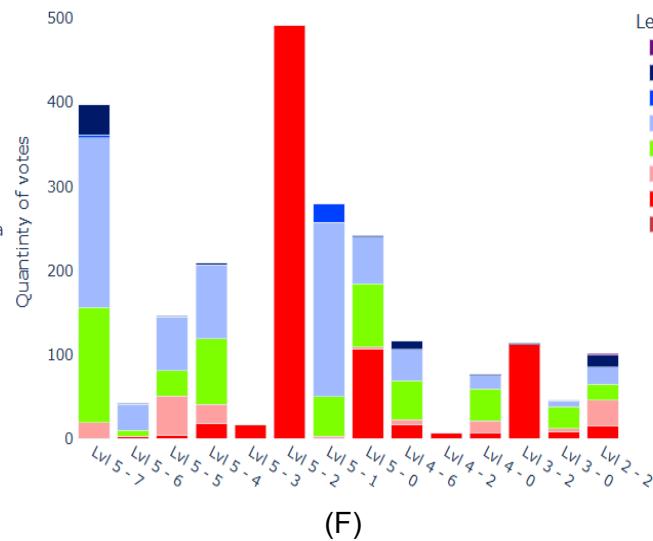


Legend

- Indefinido
- Extrema-direita
- Direita
- Centro-direita
- Centro
- Centro-esquerda
- Esquerda
- Extrema-esquerda

(E)

Feature 'esp\_pol\_partido'; Split: max\_red.

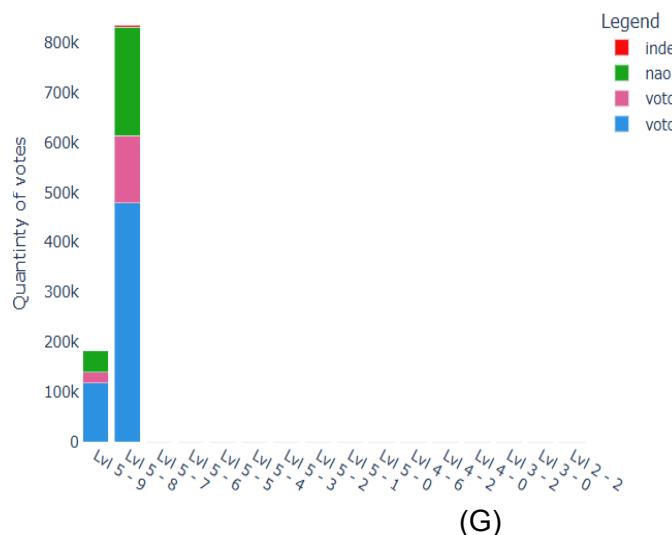


Legend

- Indefinido
- Extrema-direita
- Direita
- Centro-direita
- Centro
- Centro-esquerda
- Esquerda
- Extrema-esquerda

(F)

Feature 'alinhamento'; Split: max\_red.

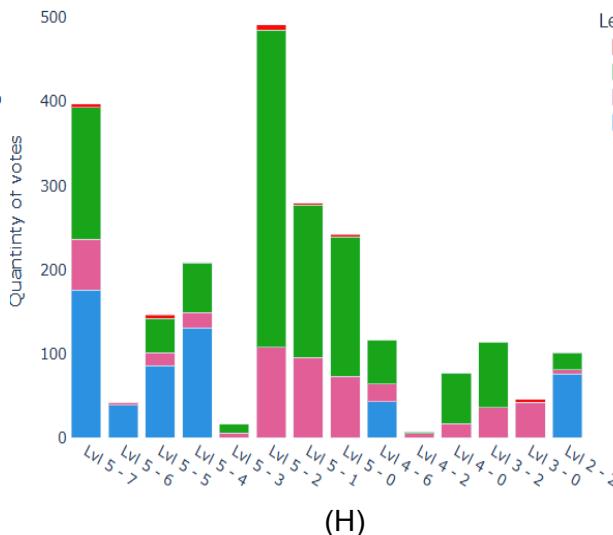


Legend

- indefinido
- nao se aplica
- votou contra o governo
- votou com o governo

(G)

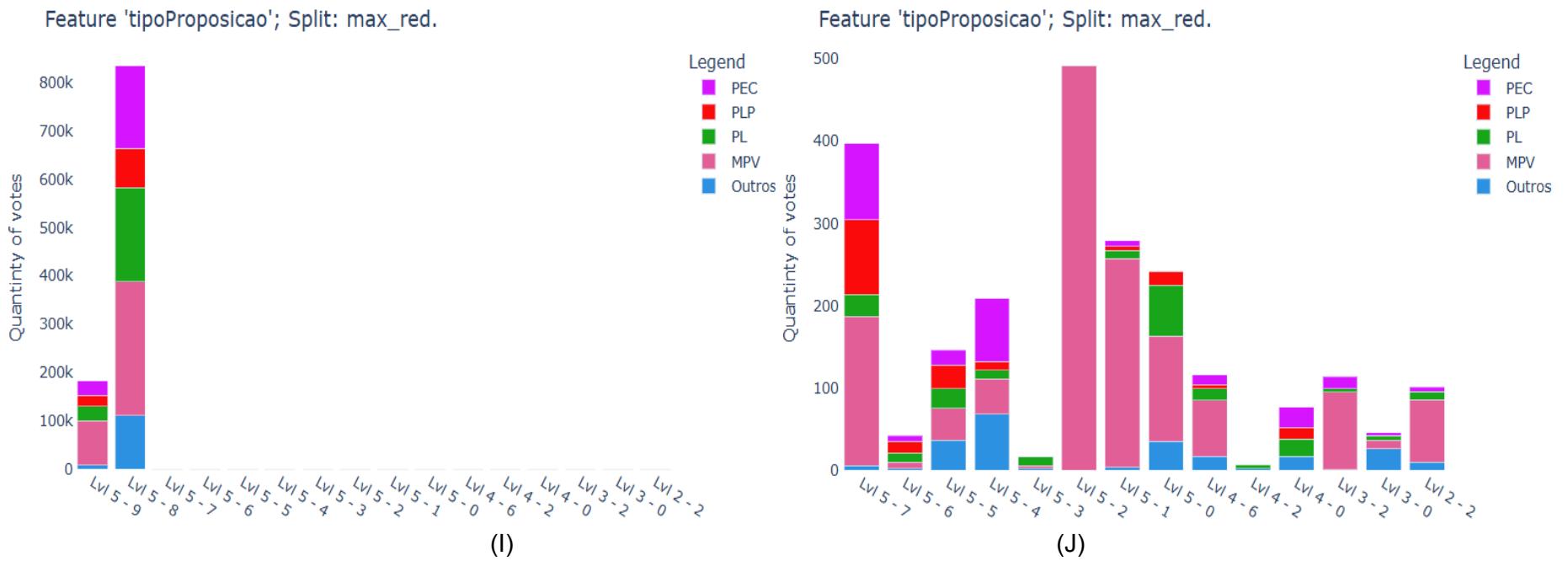
Feature 'alinhamento'; Split: max\_red.



Legend

- indefinido
- nao se aplica
- votou contra o governo
- votou com o governo

(H)



**Figure X.** Quantity of votes per cluster for some features using MVR. The left side shows all cluster (A, C, E, G and I) while the right side (B, D, F, H and J) does not show two clusters with the majority of votes. (A-B) Government (Governo), (C-D) Party (Partido), (E-F) Political spectrum (espectro político), (G-H) Government's alignment (Alinhamento) and (I-J) Proposition (Tipo proposição).

- Cluster node 5-8:
  - 75.47% of the clustered trajectory data.
  - Date range: 2003-02-25 to 2022-04-27
  - It is a cluster that does not have any occurrence of votes during the Lula-2 term (2007 to 2010).
  - 40.13% of the votes in this cluster occurred during Bolsonaro-1 term.
  - Regarding the alignment aspect, 57.37% of the votes were on favor to the government. Furthermore, 22.64% of the votes in cluster were on favor to the government during the Bolsonaro-1 term (2018 to 2022).
  - Assuming the alignment aspect (57.37%), the majority of these votes are split into 5 types of propositions, that are MPV (20.73%), PEC (12.35%), PL (11.44%), PLP (5.85%) and REQ (5.83%) propositions corresponding to 56.2% of the votes in this cluster.

For example, MAT-Tree identified a group of 12857 trajectories voted on period different of Lula2 government (governo [Lula2]) that followed the government's guidance (alinhamento [votou com o governo]), then voted Yes (voto [Sim]) to some proposition, and voted No (voto [Não]) where this group followed the Yes government's guidance (orientacaoGoverno [Sim]).

Notes!

Rule path: the straight line direction (blue nodes).

Neighbor node: the other path/cluster from the

same parent node aspect of a given

node in the rule path (gray nodes).

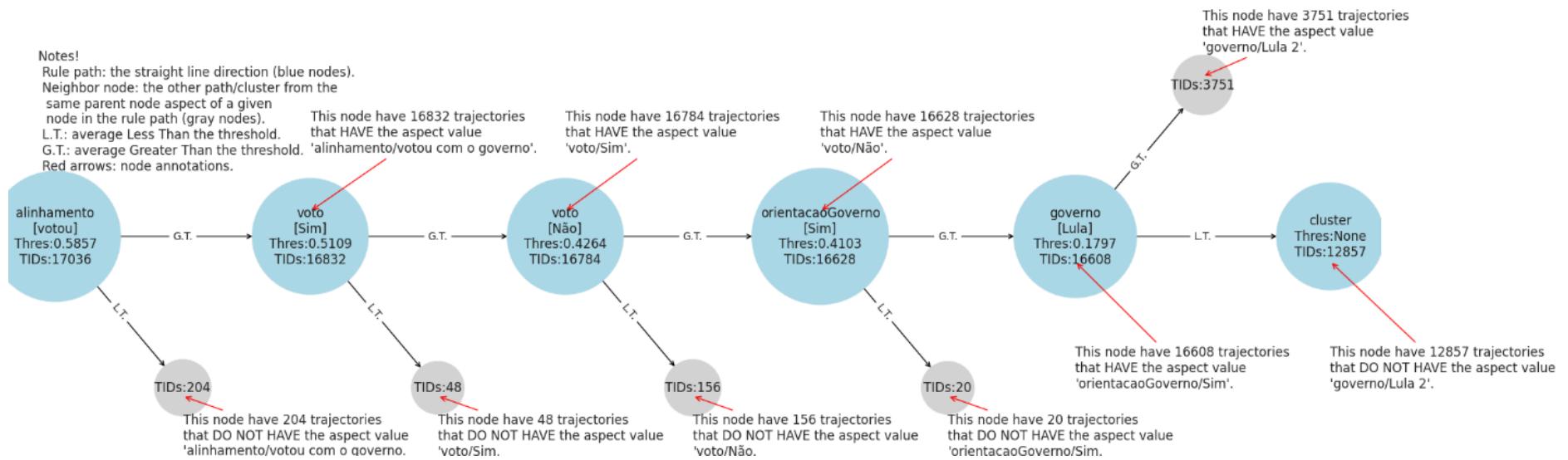
L.T.: average Less Than the threshold.

This node have 16832 trajectories  
that HAVE the aspect value  
'alinhamento/votou com o governo'.

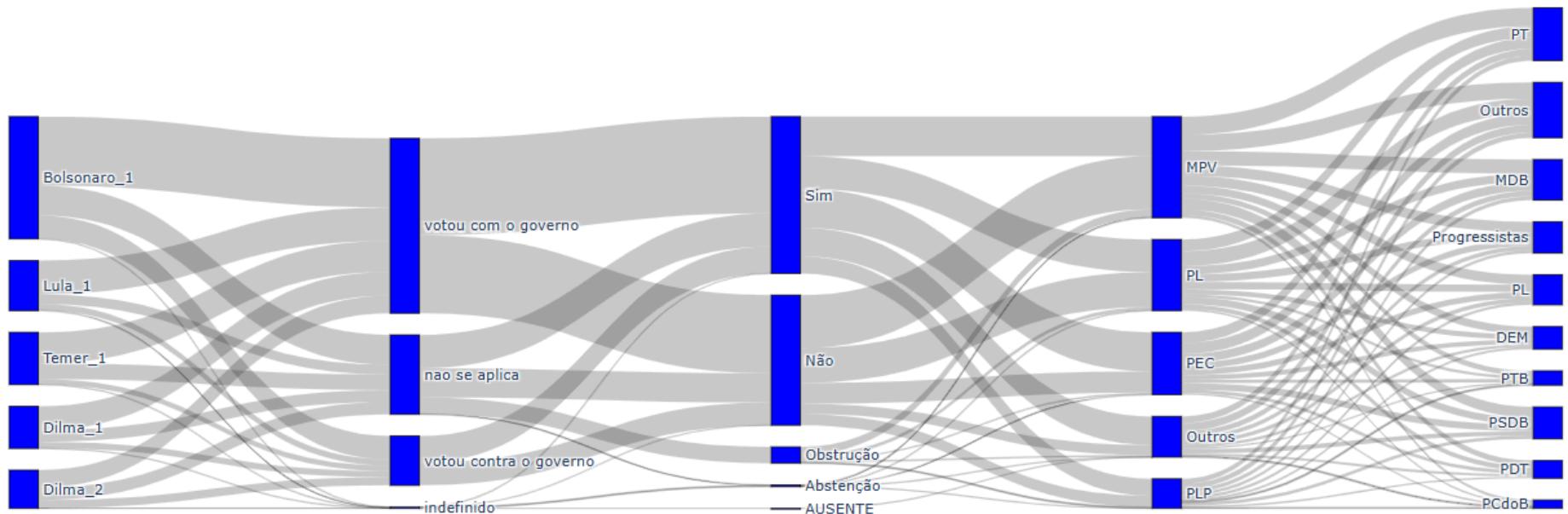
G.T.: average Greater Than the threshold.

'alinhamento/votou com o governo'.

Red arrows: node annotations.



Node: Lvl 5 - 8; Split: max\_red  
TIDs: 12857; Unique deputies: 1625; Total votes: 833881.  
from 2003-01-04 to 2022-12-04



- Cluster node 5-9:
  - 22.02% of the clustered trajectory data.
  - Date range: 2007-02-06 to 2010-12-15.
  - It is a cluster of trajectories that contains only votes during the Lula-2 government (2007 to 2010).
  - Regarding the alignment aspect, 64.44% of the votes were in favor of the Lula-2 government's guidance.
  - Assuming the alignment aspect (64.44%), the majority of these votes are split into 4 types of propositions: MPV (32.67%), PEC (12.30%), PL (9.36%), and PLP (8.09%) corresponding to 62.42% of the votes in this cluster.

For example, MAT-Tree identified a group of 3751 trajectories that voted during the Lula2 government (governo [Lula2]) that followed the government's guidance (alinhamento [votou com o governo]), then voted Yes (voto [Sim]) to some proposition, and voted No (voto [Não]) where this group followed the Yes government's guidance (orientacaoGoverno [Sim]).

Notes!

Rule path: the straight line direction (blue nodes).

Neighbor node: the other path/cluster from the

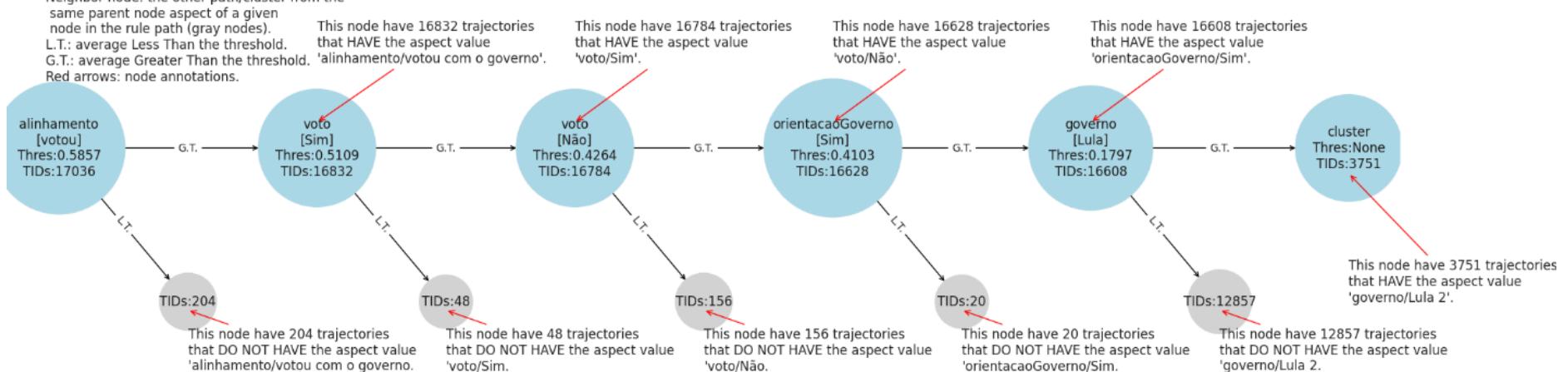
same parent node aspect of a given

node in the rule path (gray nodes).

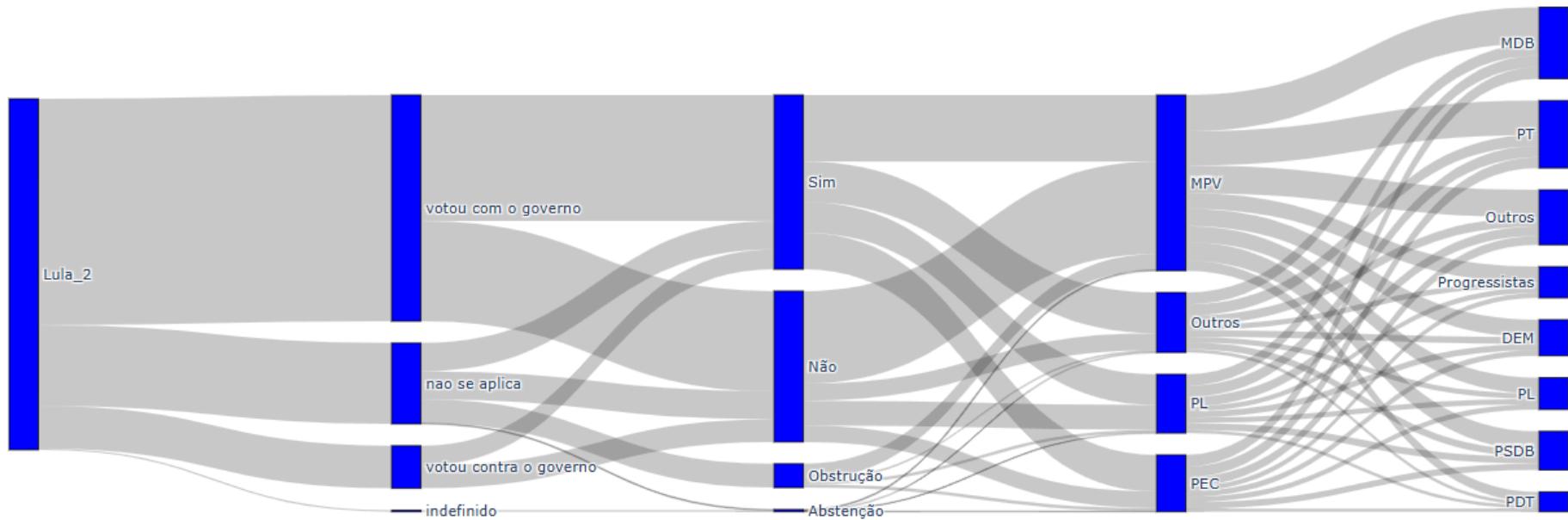
L.T.: average Less Than the threshold.

G.T.: average Greater Than the threshold.

Red arrows: node annotations.

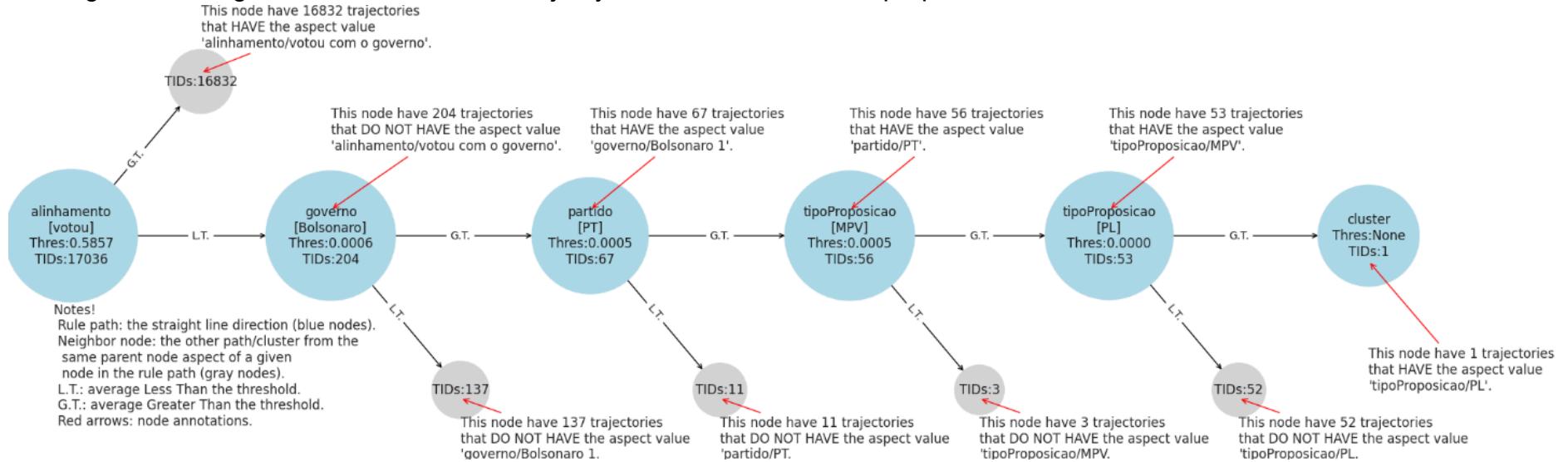


Node: Lvl 5 - 9; Split: max\_red  
TIDs: 3751; Unique deputies:621; Total votes: 183189.  
from 2007-02-04 to 2010-12-15



- **Cluster node 5-3:**

For example, MAT-Tree identified a outlier cluster with 1 trajectory from PT party that do not voted with the Bolsonaro government guidance at all, and the majority of the votes are on PL propositions.



Node: Lvl 5 - 3; Split: max\_red  
TIDs: 1; Unique deputies:1; Total votes: 16.  
from 2019-02-04 to 2019-12-03

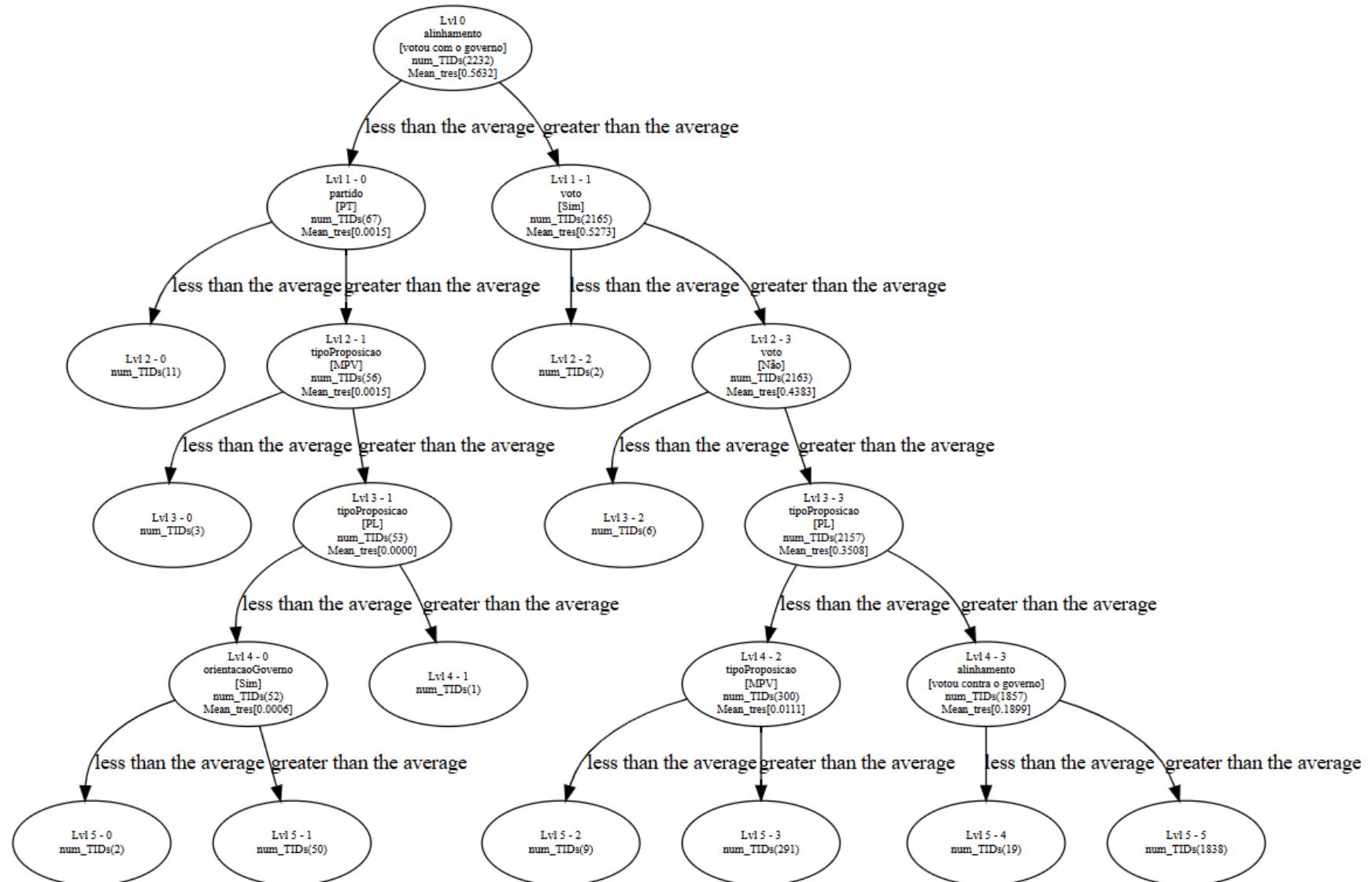


## 2 Dataset by government

### 2.1 Bolsonaro

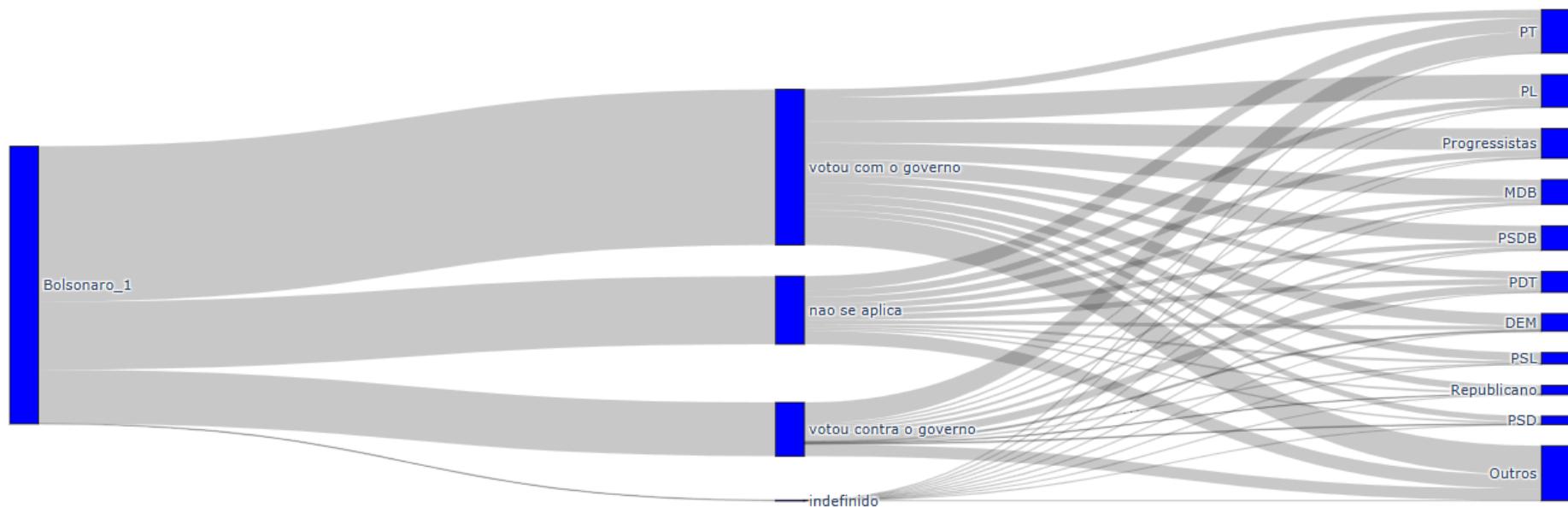
This dataset has 2,232 trajectories with a total of 335,262 votes from 560 deputies distributed into 33 parties. Running the MAT-Tree with MVR identified 11 clusters, where **95.38%** of the data is grouped into two clusters. Node 5-5 grouped **82.37%** corresponding to 1838 trajectories while node 5-3 grouped **13.01%** corresponding to 291 trajectories.

- Tree

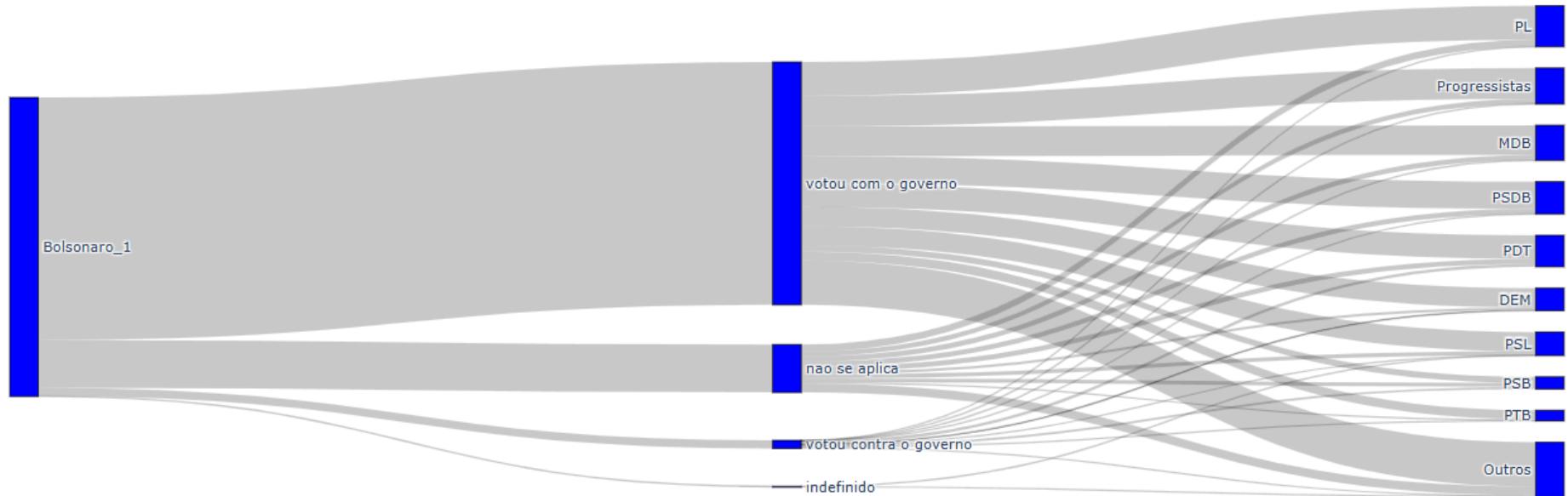


- Sankey

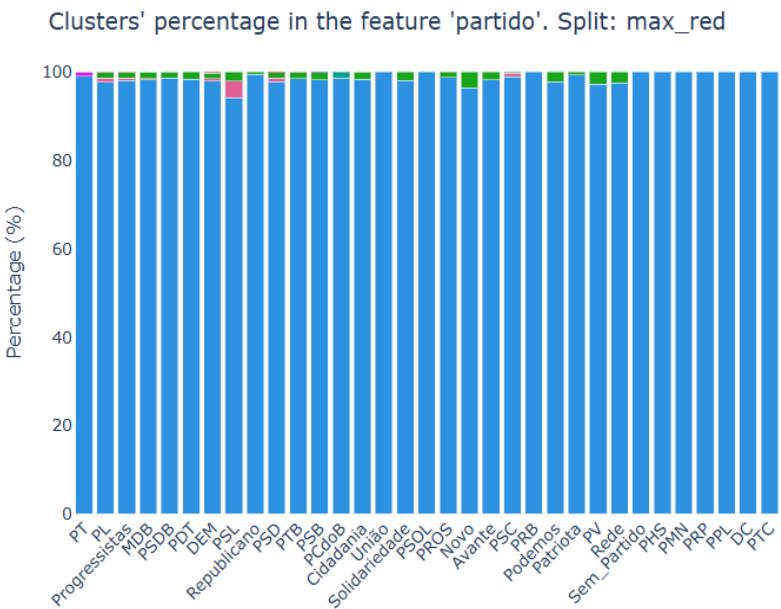
Node: Lvl 5 - 5; Split: max\_red  
TIDs: 1838; Unique deputies: 537; Total votes: 329371.  
from 2019-01-10 to 2022-12-04



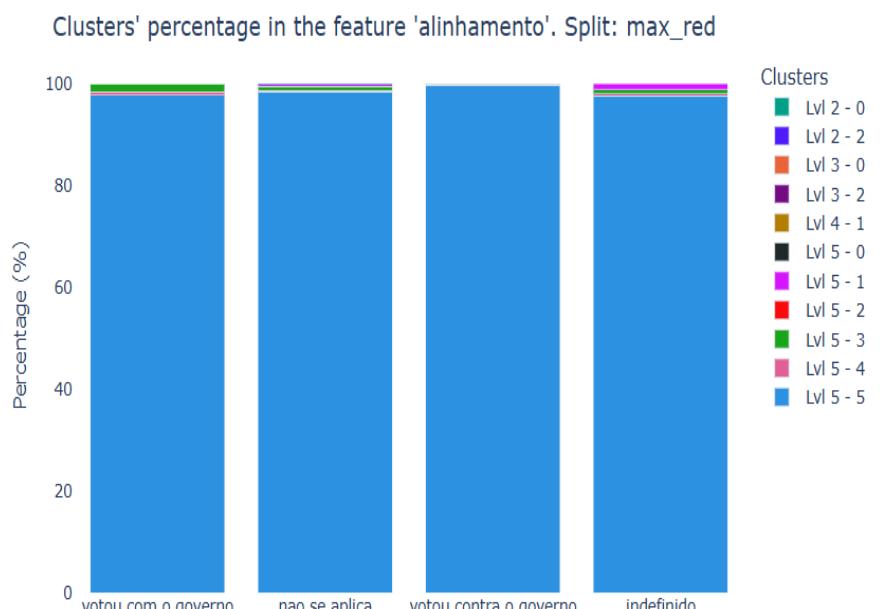
Node: Lvl 5 - 3; Split: max\_red  
TIDs: 291; Unique deputies: 289; Total votes: 3754.  
from 2019-02-13 to 2022-05-04



- Stacked bar
  - Clusters' percentage in the feature



(A)



(B)

Clusters' percentage in the feature 'tipoProposicao'. Split: max\_red

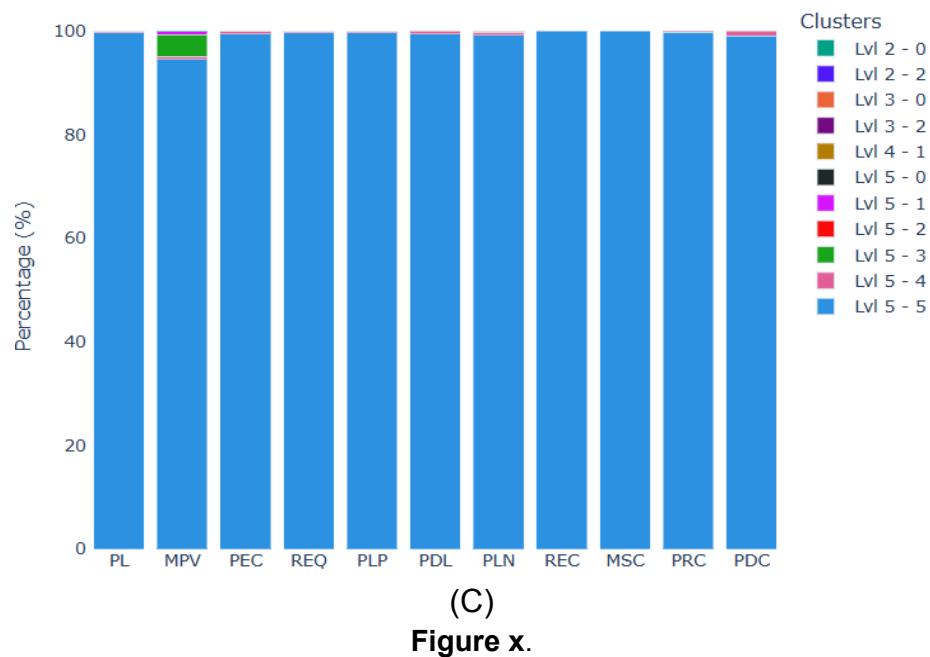
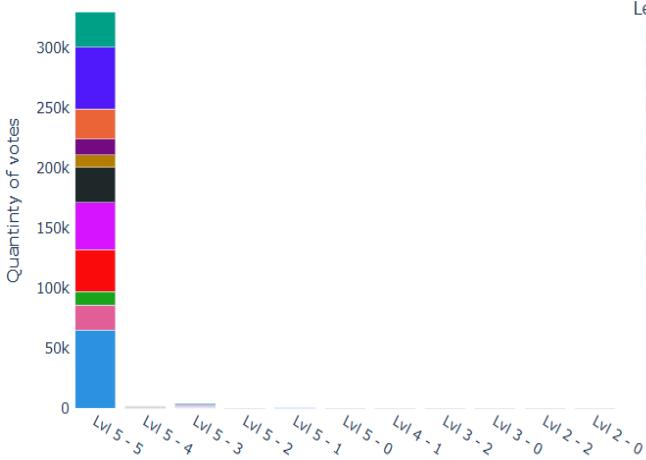


Figure x.

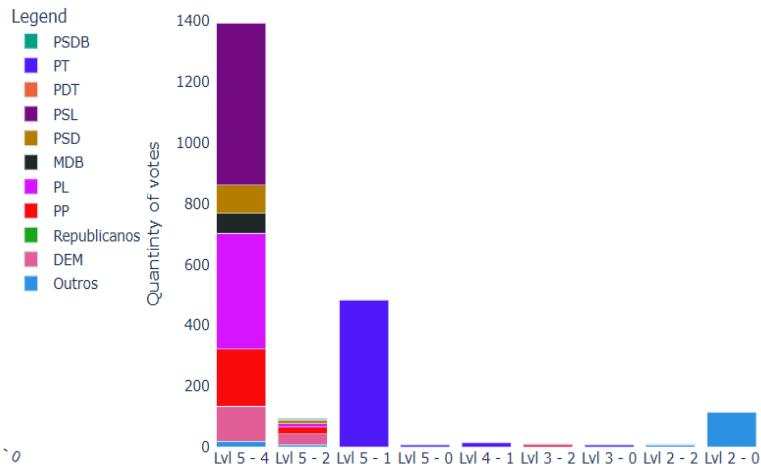
- Number of votes by feature value in the cluster

Feature 'partido'; Split: max\_red.



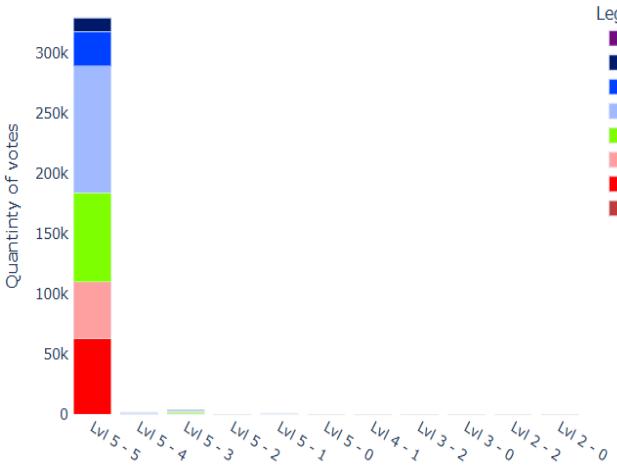
(A)

Feature 'partido'; Split: max\_red.



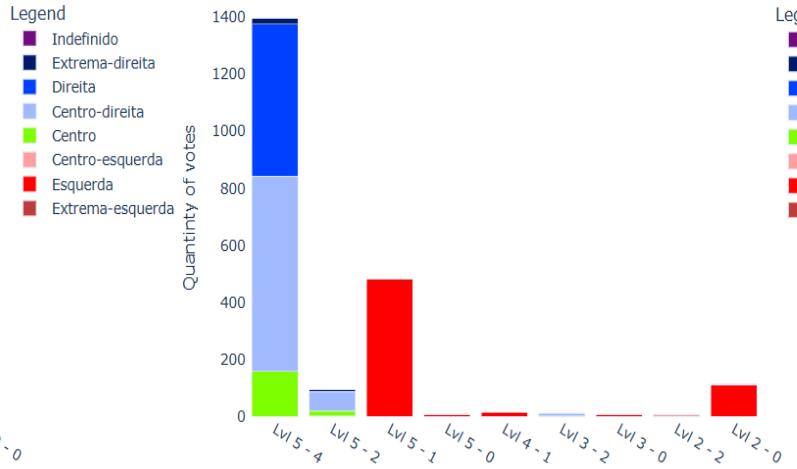
(B)

Feature 'esp\_pol\_partido'; Split: max\_red.



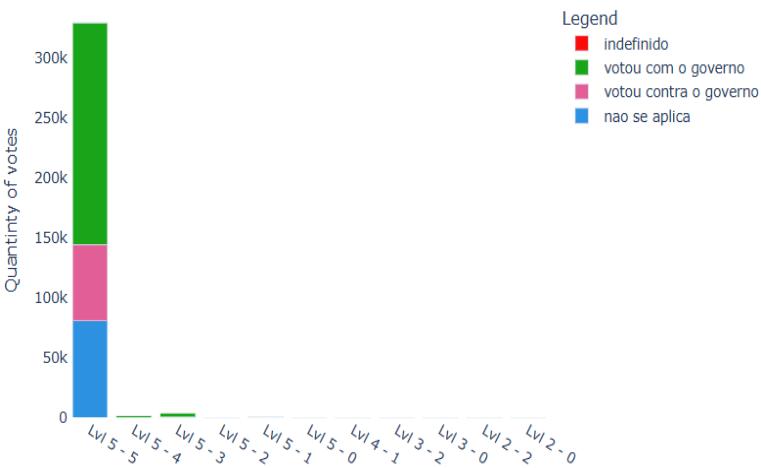
(C)

Feature 'esp\_pol\_partido'; Split: max\_red.



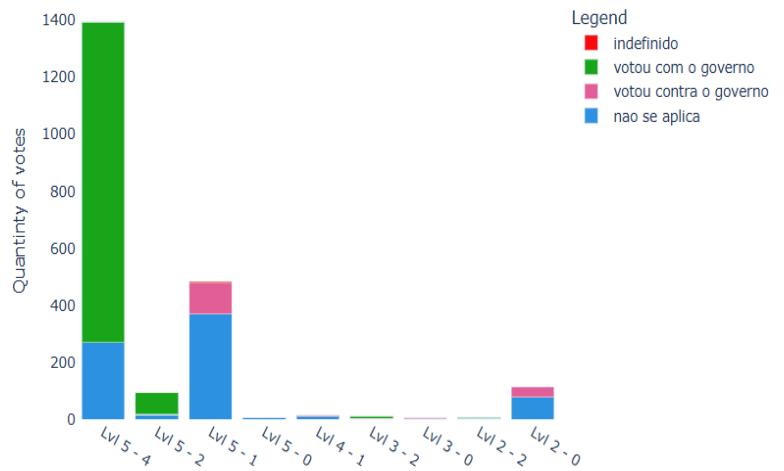
(D)

Feature 'alinhamento'; Split: max\_red.



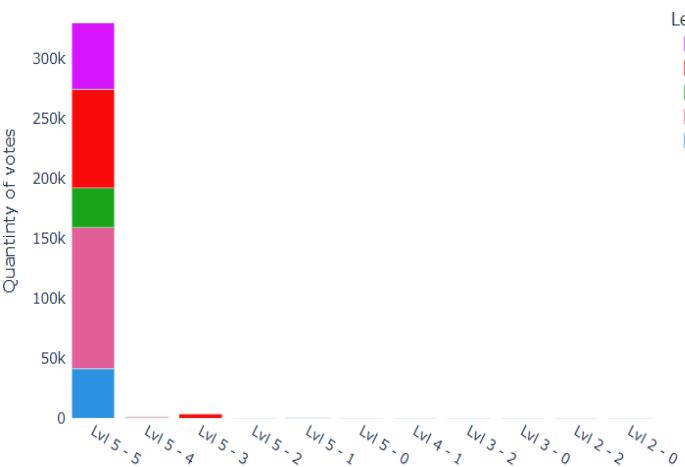
(E)

Feature 'alinhamento'; Split: max\_red.



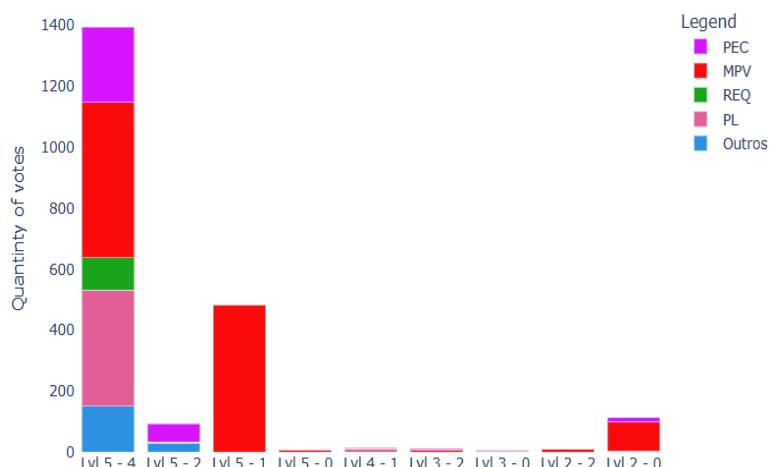
(F)

Feature 'tipoProposicao'; Split: max\_red.



(G)

Feature 'tipoProposicao'; Split: max\_red.



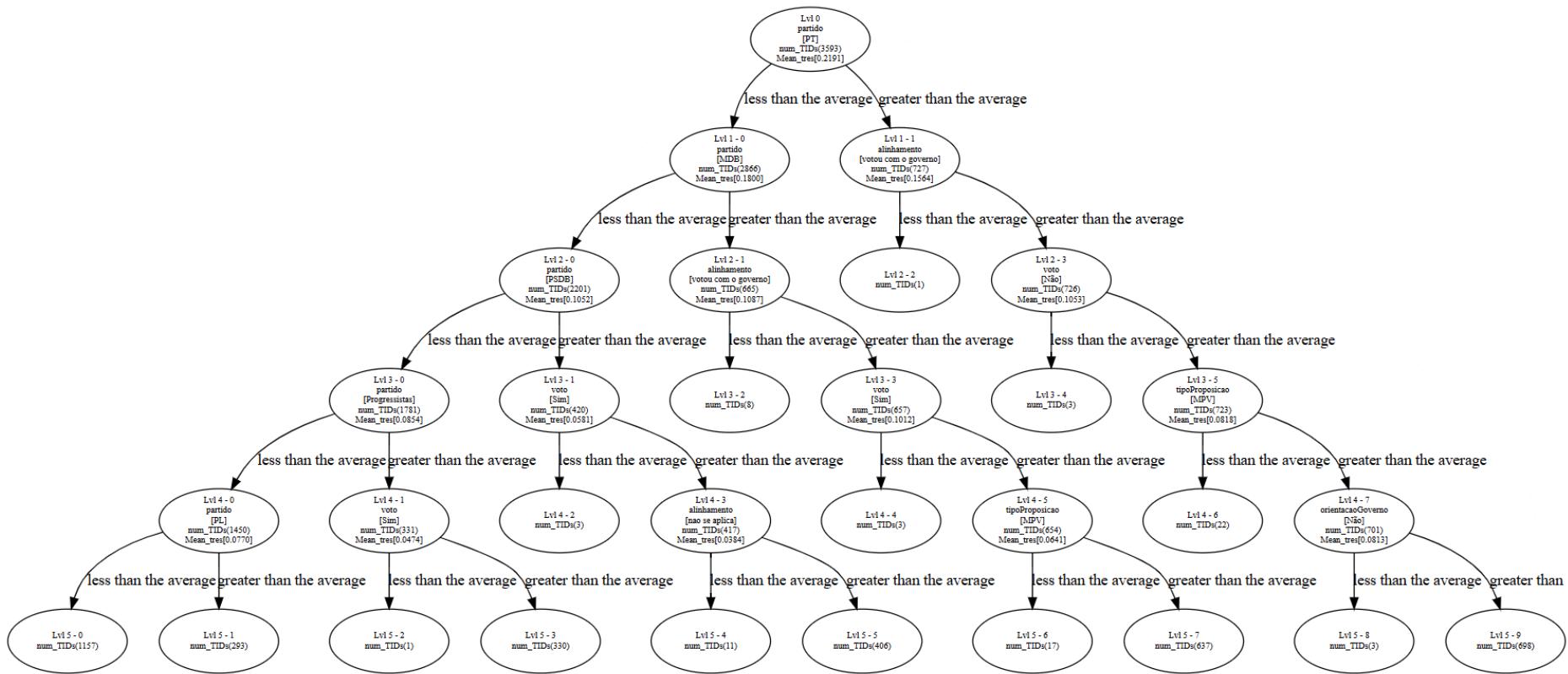
(H)

**Figure X.** Quantity of votes per cluster using MVR during the Bolsonaro government. The left side shows all cluster (A, C, E and G) while the right side (B, D, F and H) does not show two clusters with the majority of votes. (A-B) Party (Partido), (C-D) Political spectrum (espectro político) , (E-F) Government's alignment (Alinhamento) and (G-H) Proposition (Tipo proposição).

## 2.2 Dilma (*first term*)

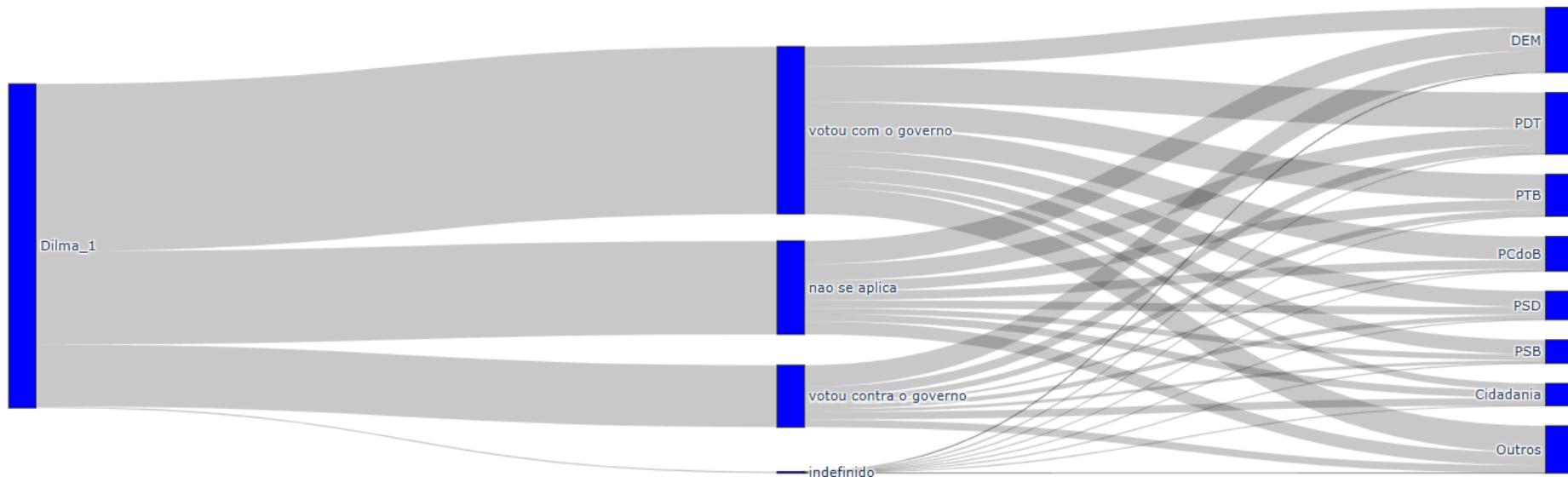
This dataset has 3,593 trajectories with a total of 115,287 votes from 649 deputies distributed into 26 parties. Running the MAT-Tree with MVR identified 16 clusters, where **51.63%** of the data is grouped into two clusters. Node 5-0 grouped **32.2%** corresponding to 1157 trajectories while node 5-9 grouped **19.43%** corresponding to 698 trajectories.

- Tree

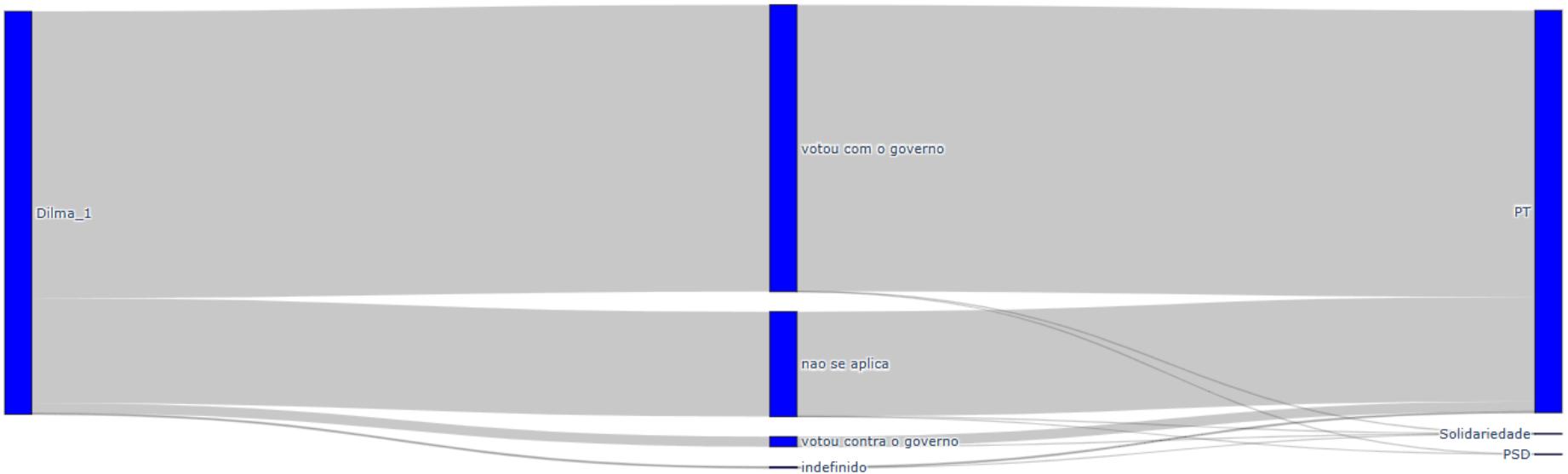


- Sankey

Node: Lvl 5 - 0; Split: max\_red  
 TIDs: 1157; Unique deputies: 282; Total votes: 37330.  
 from 2011-01-09 to 2014-12-17

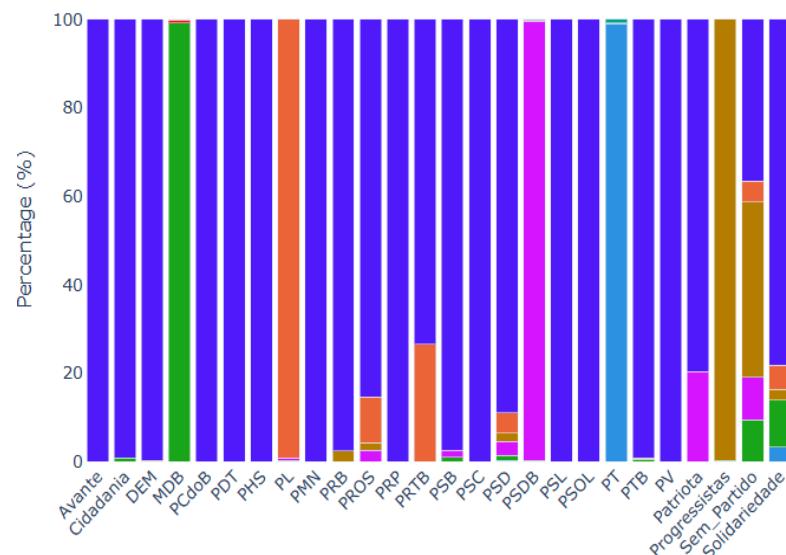


Node: Lvl 5 - 9; Split: max\_red  
TIDs: 698; Unique deputies: 118; Total votes: 25063.  
from 2011-01-09 to 2014-12-17



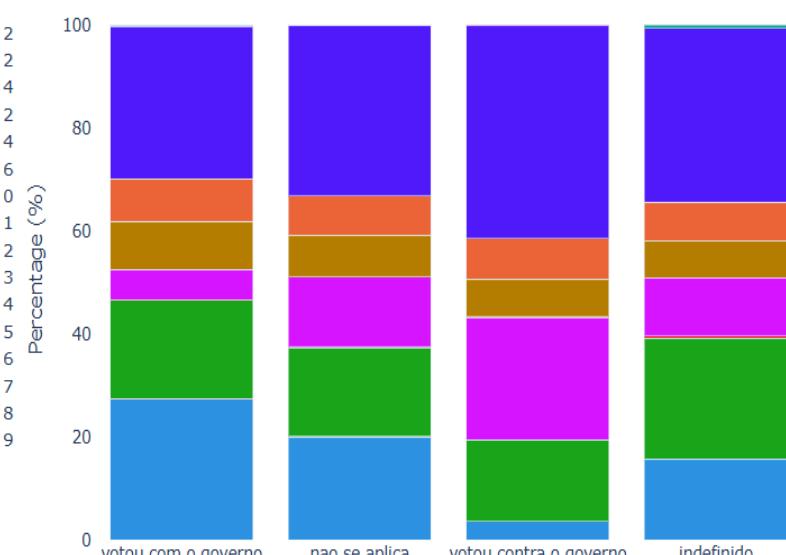
- Stacked bar
  - Clusters' percentage in the feature

Clusters' percentage in the feature 'partido'. Split: max\_red



(A)

Clusters' percentage in the feature 'alinhamento'. Split: max\_red



(B)

Clusters' percentage in the feature 'tipoProposicao'. Split: max\_red

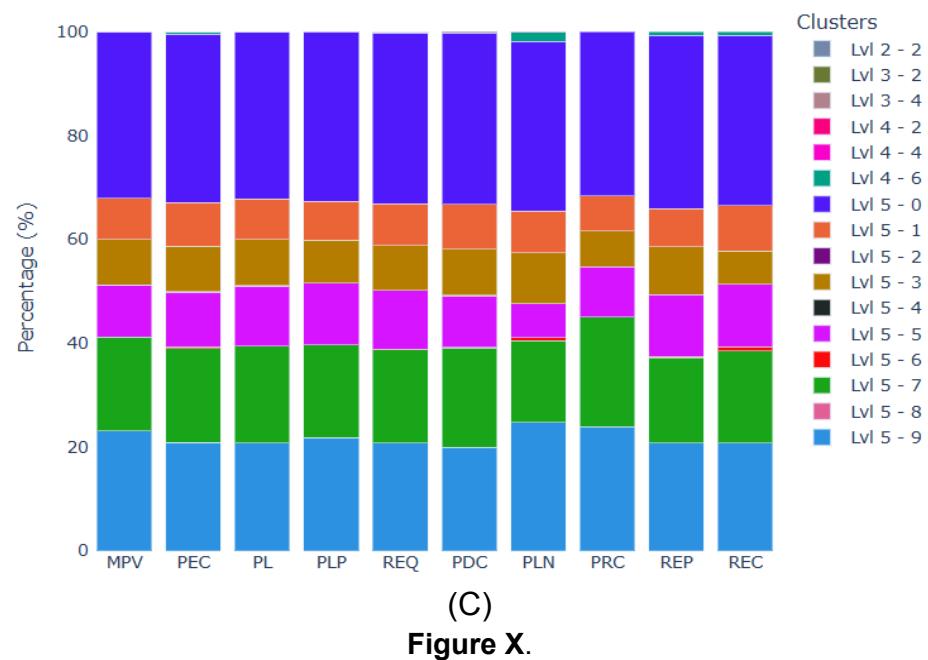
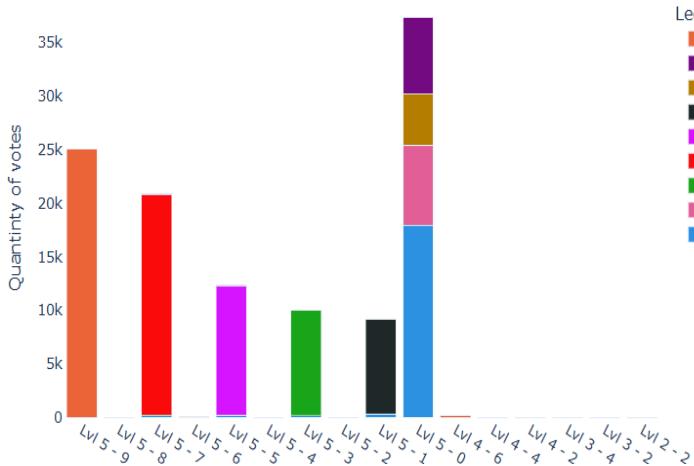


Figure X.

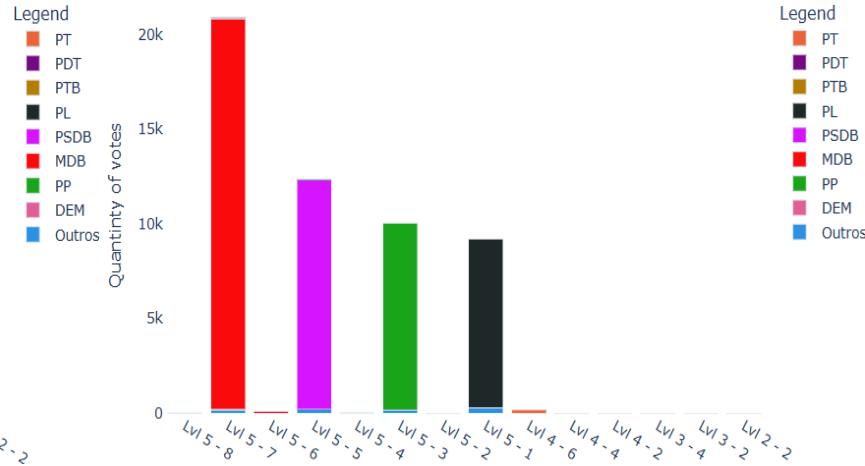
- Number of votes by feature value in the cluster

Feature 'partido'; Split: max\_red.



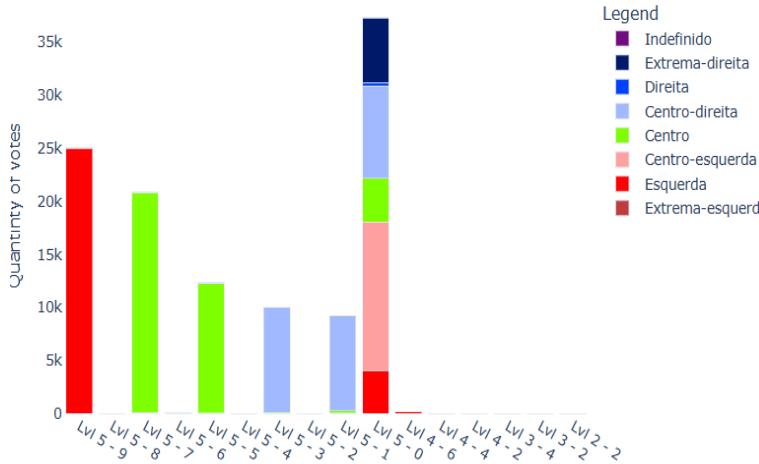
(A)

Feature 'partido'; Split: max\_red.



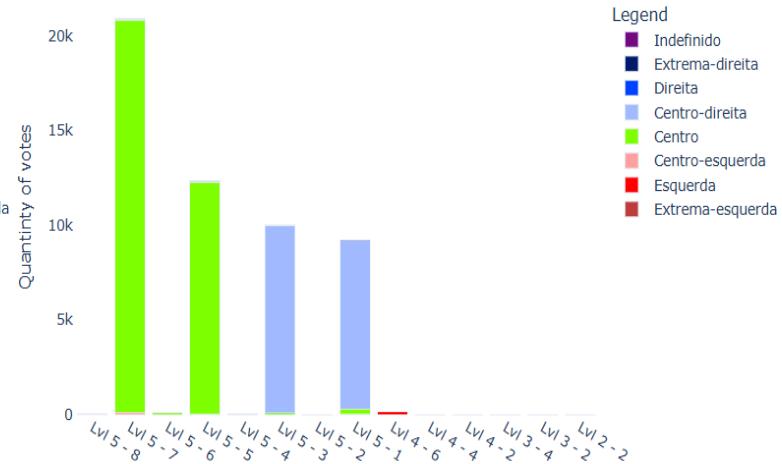
(B)

Feature 'esp\_pol\_partido'; Split: max\_red.



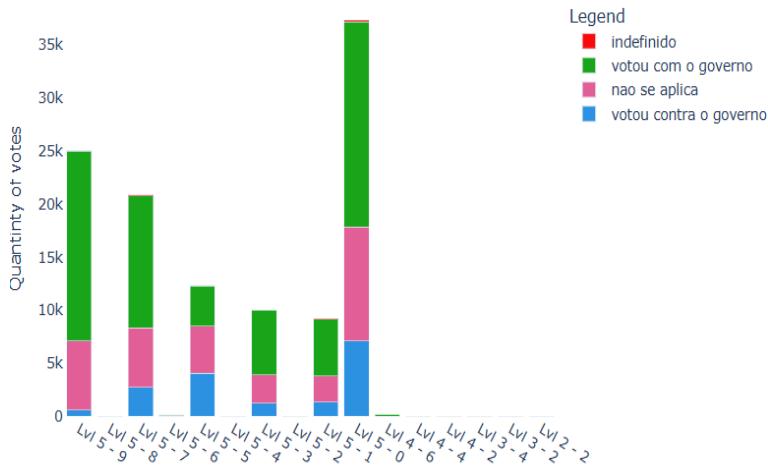
(C)

Feature 'esp\_pol\_partido'; Split: max\_red.



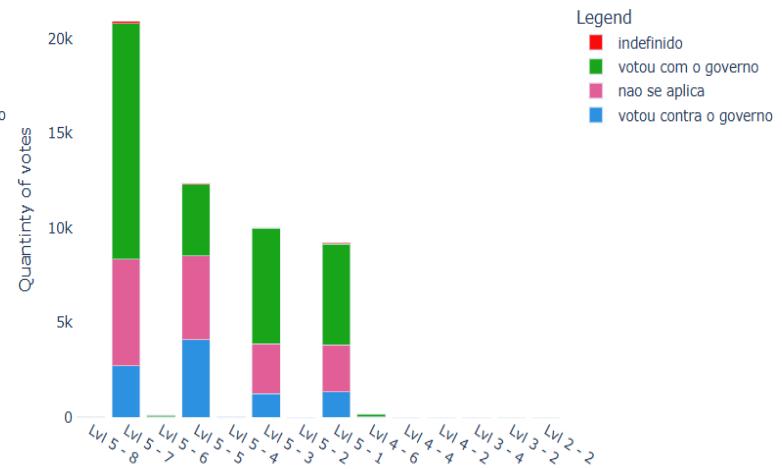
(D)

Feature 'alinhamento'; Split: max\_red.



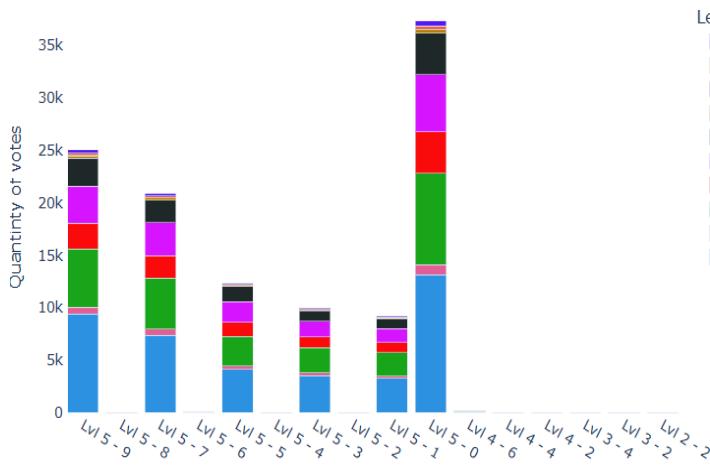
(E)

Feature 'alinhamento'; Split: max\_red.



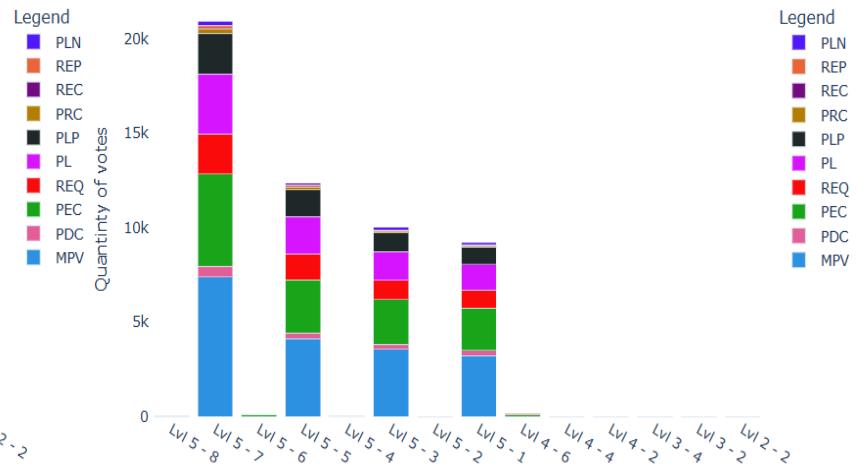
(F)

Feature 'tipoProposicao'; Split: max\_red.



(G)

Feature 'tipoProposicao'; Split: max\_red.



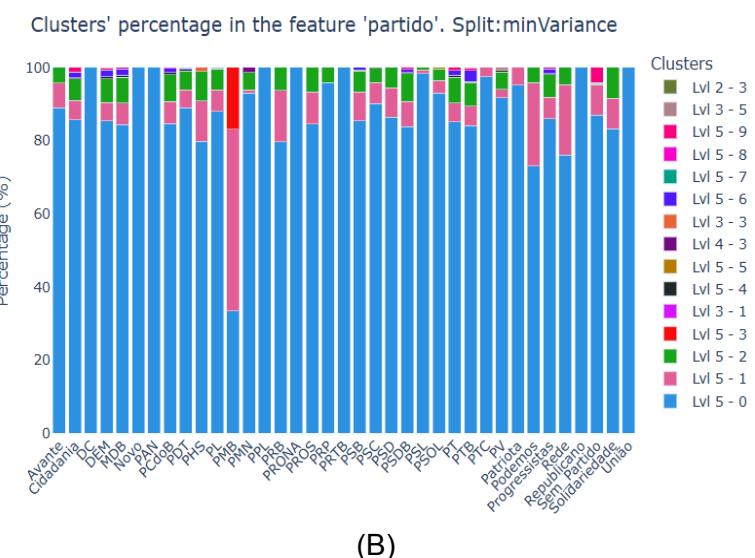
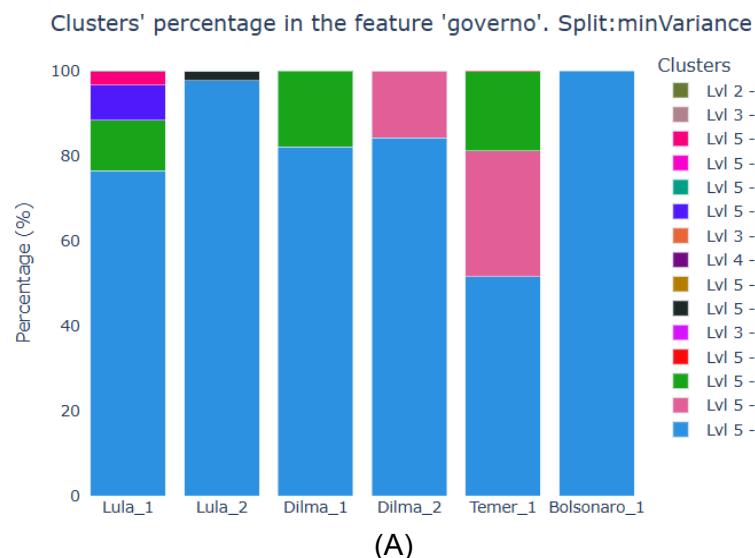
(H)

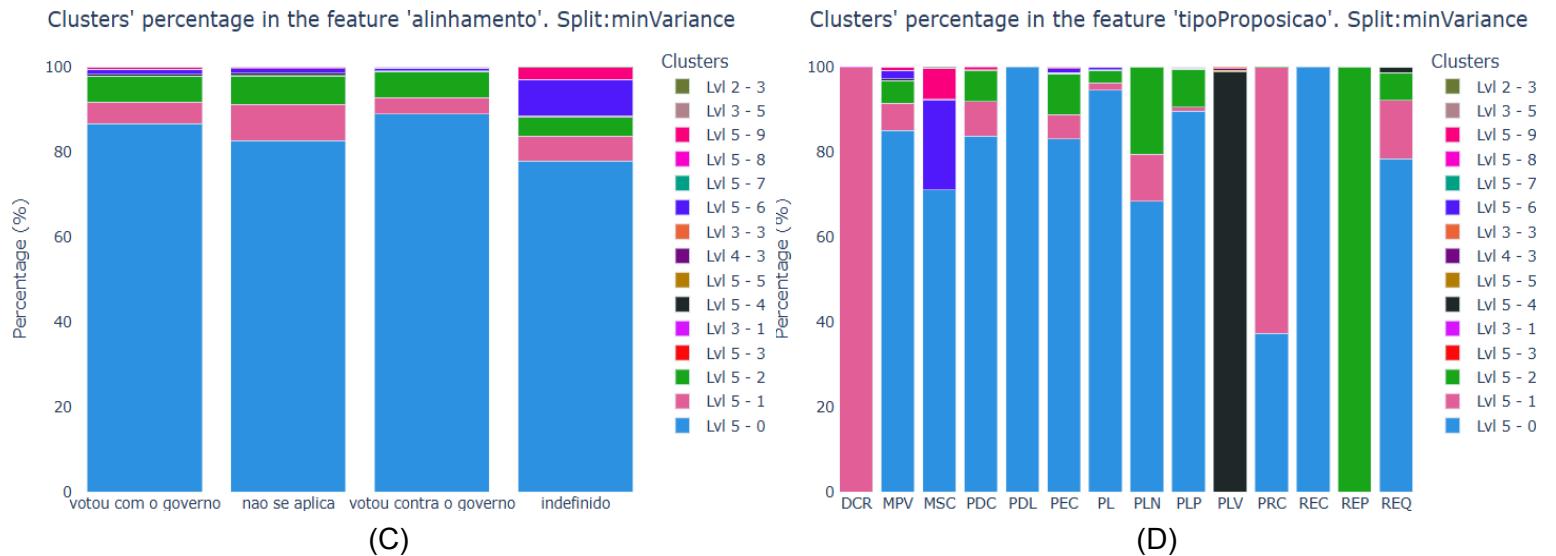
**Figure X.** Quantity of votes per cluster using MVR during the first government of Dilma. The left side shows all cluster (A, C, E and G) while the right side (B, D, F and H) does not show two clusters with the majority of votes. (A-B) Party (Partido), (C-D) Political spectrum (espectro político) , (E-F) Government's alignment (Alinhamento) and (G-H) Proposition (Tipo proposição).

### 3.1.3.2 MV

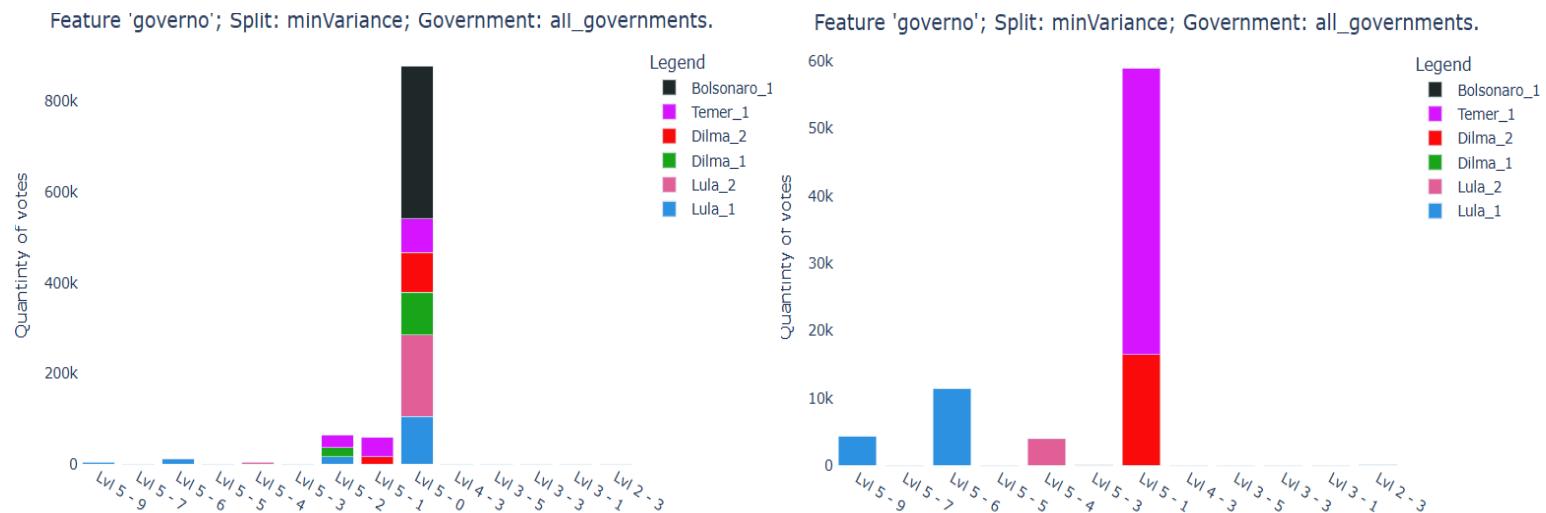
#### 1. All governments

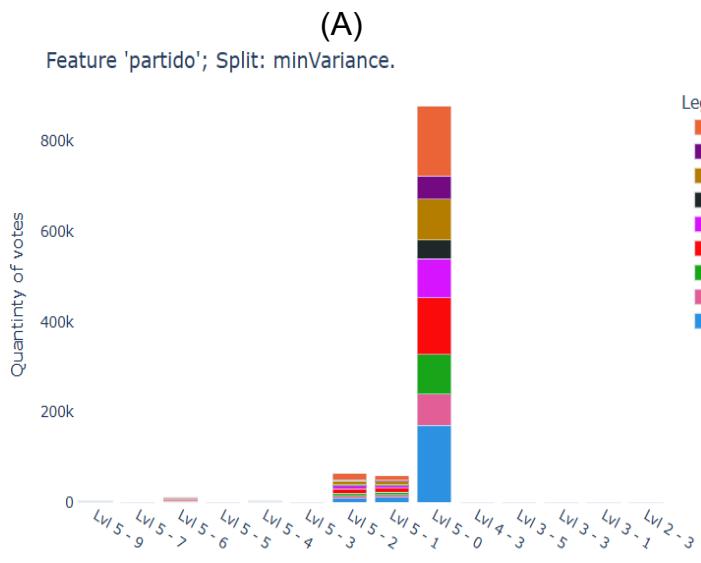
This feature approach identified 14 clusters with **91.8%** of the trajectories grouped into two clusters where the MV strategy shows a difference in the last aspect. Cluster node 5-0 with 14228 trajectories (**83.52%**) is a group of trajectories with the pattern of not voting on PL, REP and DRC type propositions, while cluster node 5-2 with 1412 trajectories (**8.28%**) is a group with a pattern where all parties, with the exception of PMB, did not vote on PLV propositions but voted on REP. Regarding the outlier group, cluster 5-5, it refers to 1 trajectory of a PSOL parliamentarian who voted for a PLV proposition and did not follow the Abstention vote guidance given by the government.



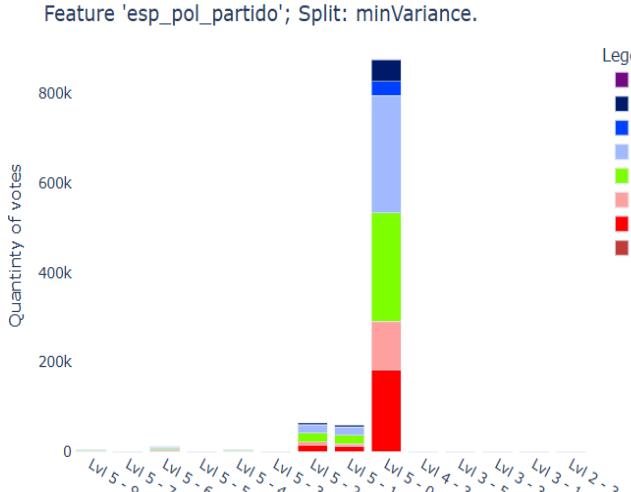


**Figure X.** Clusters' percentage in the features using MV. (A) Government (Governo), (B) Party (Partido), (C) Government's alignment (Alinhamento) and (D) Proposition (Tipo proposição).

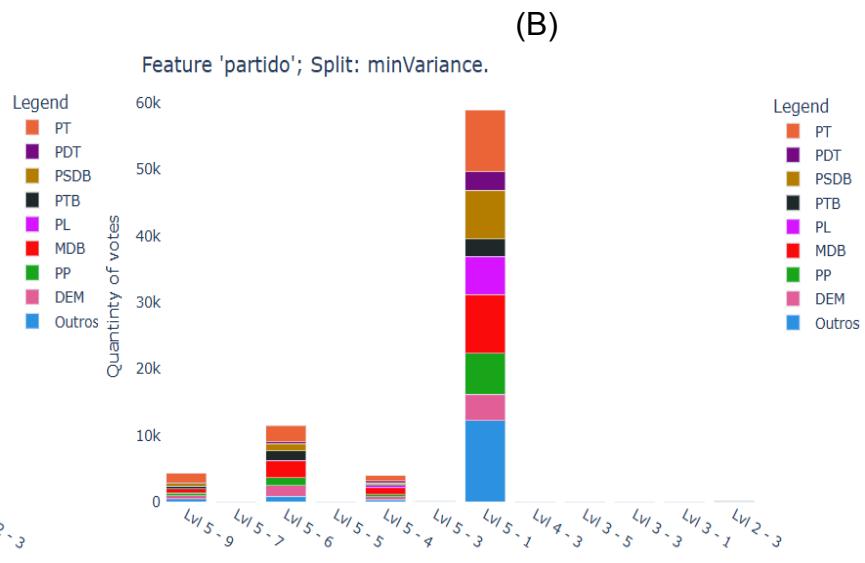




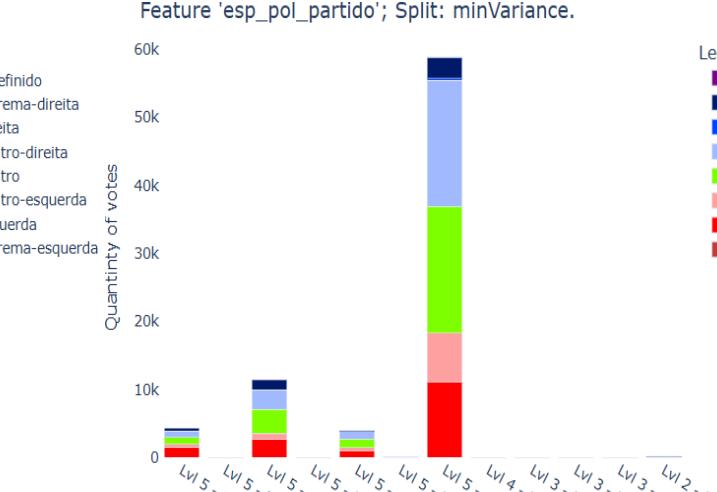
(C)



(E)

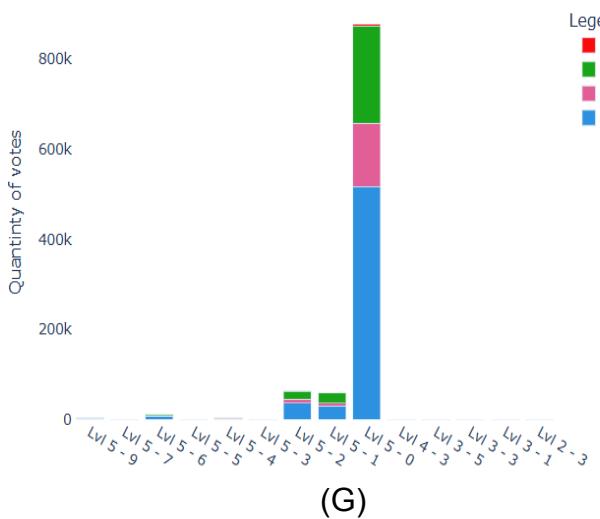


(D)

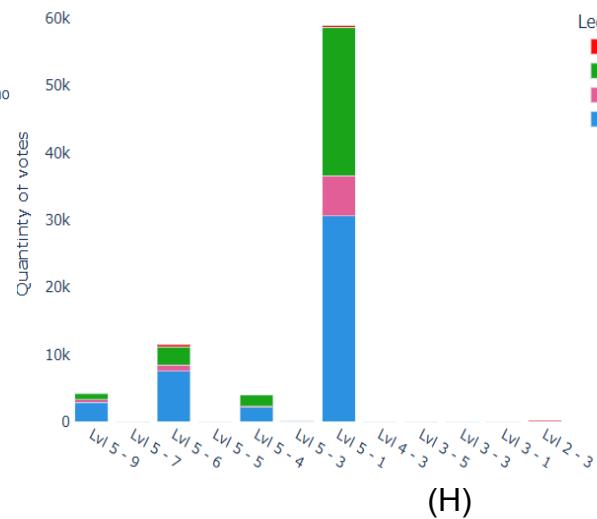


(F)

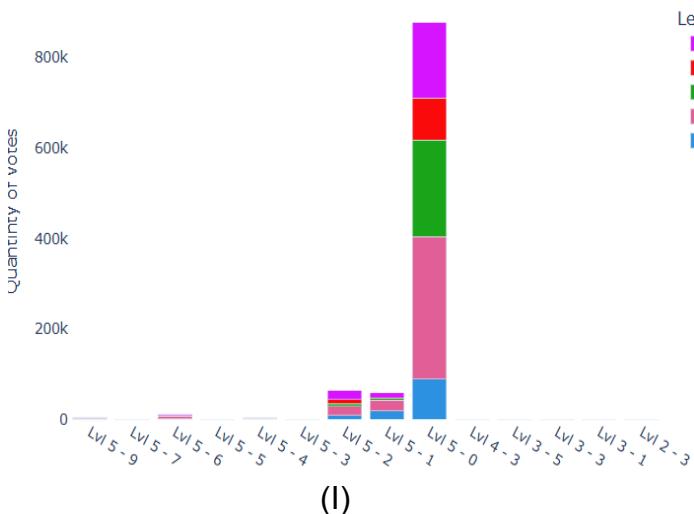
Feature 'alinhamento'; Split: minVariance.



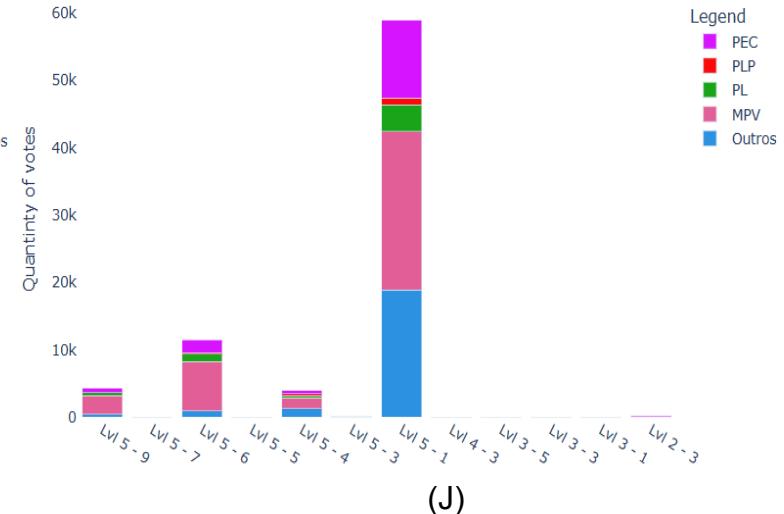
Feature 'alinhamento'; Split: minVariance.



Feature 'tipoProposicao'; Split: minVariance.



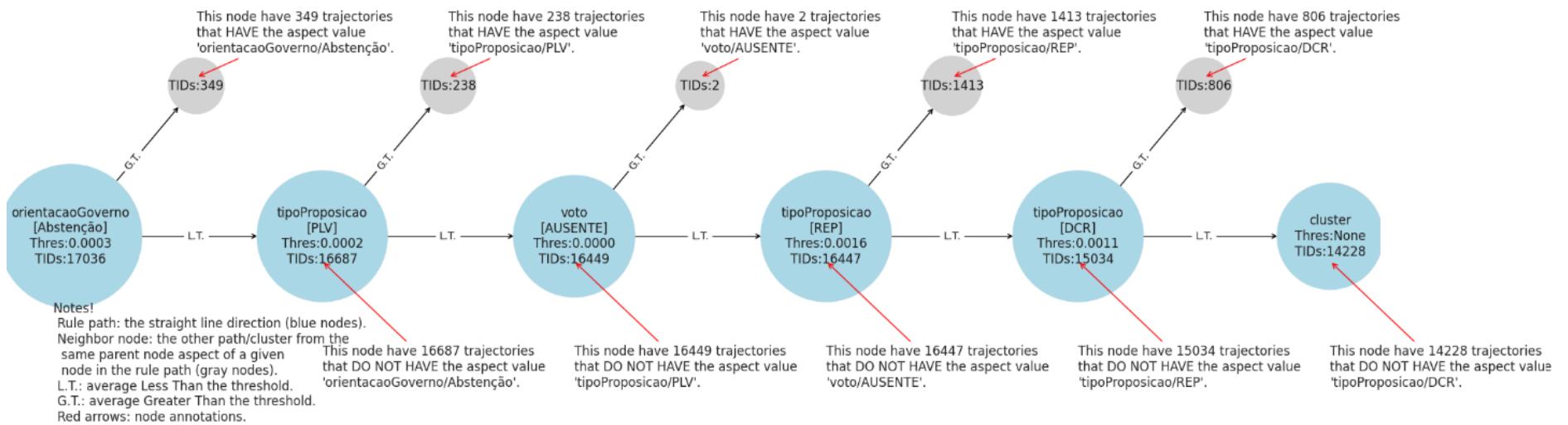
Feature 'tipoProposicao'; Split: minVariance.



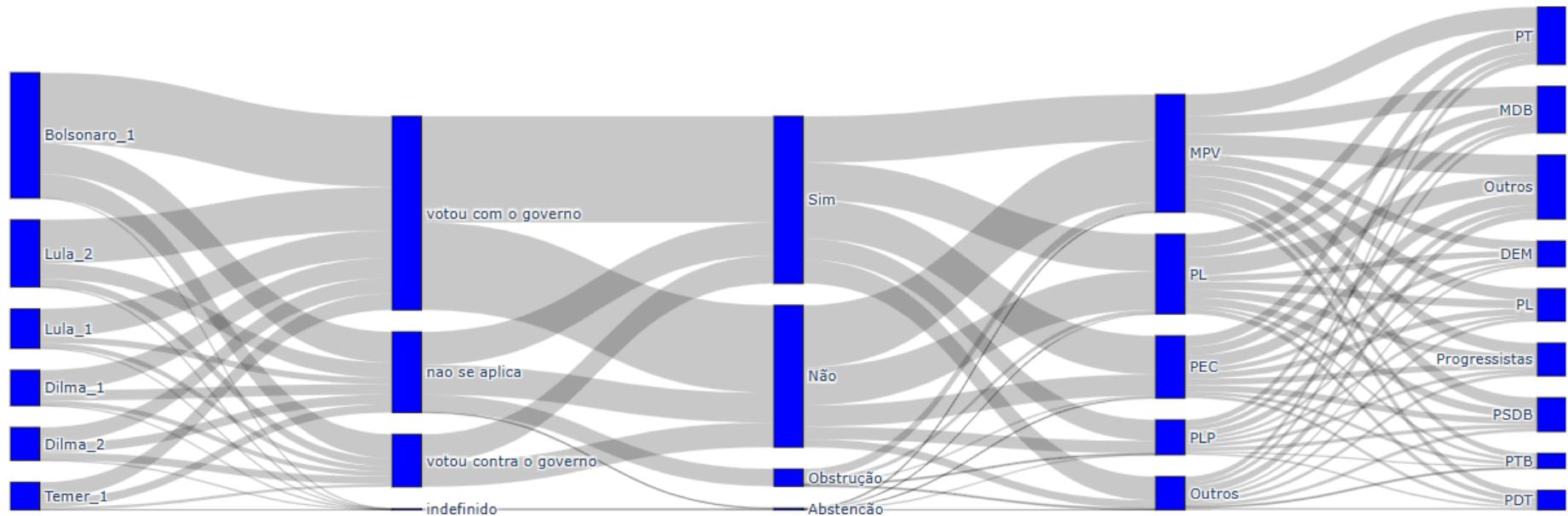
**Figure X.** Quantity of votes per cluster for some features using MV. The left side shows all cluster (A, C, E, G and I) while the right side (B, D, F, H and J) does not show two clusters with the majority of votes. (A-B) Government (Governo), (C-D) Party (Partido), (E-F) Political spectrum (espectro político) , (G-H) Government's alignment (Alinhamento) and (I-J) Proposition (Tipo proposição).

- Cluster node 5-0:
  - 83.52% (14228 trajectories) of the clustered trajectory data.
  - Date range: 2003-01-04 to 2022-12-04.
  - It is a group that historically did not vote on PLV, REP and DCR propositions.
  - 38.25% of the votes in this cluster occurred during Bolsonaro government. Moreover, 21.54% of the data in this cluster voted in line with the Bolsonaro government.

For example, MAT-Tree identified a group of 14228 trajectories that do not have voted Propositions like PLV, REP, and DCR (tipoProposicao PLV/REP/DCR) beside it does have few occurrences of government's guidance Abstention (orientacaoGoverno/Absteção), and vote Absent (voto/Ausent).

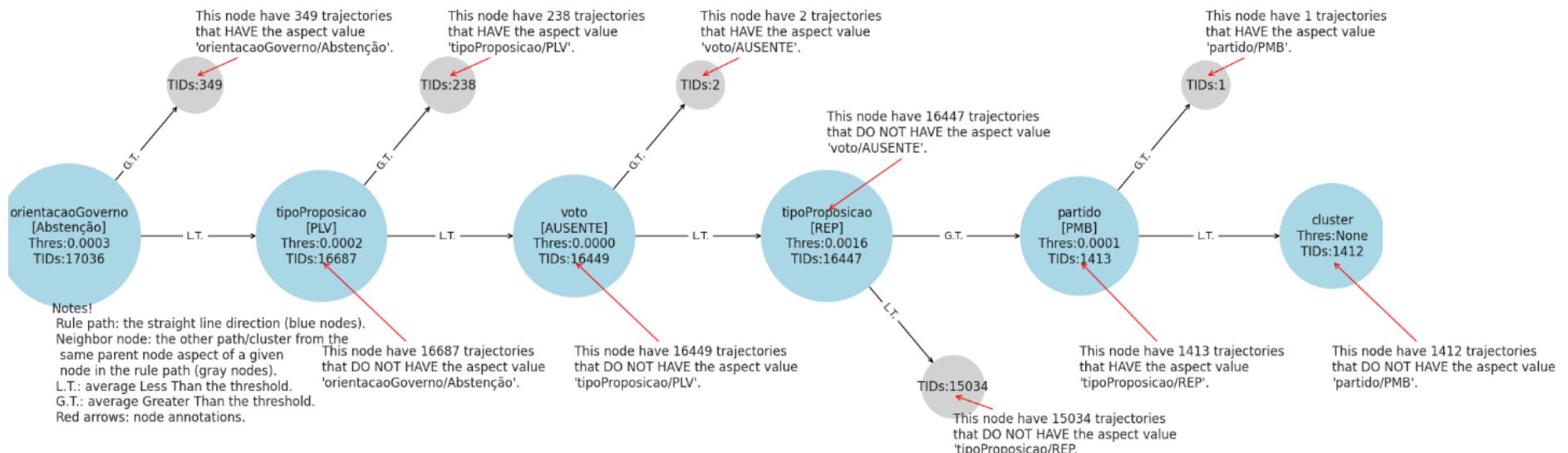


Node: Lvl 5 - 0; Split: minVariance  
TIDs: 14228; Unique deputies: 1776; Total votes: 876490.  
from 2003-01-04 to 2022-12-04

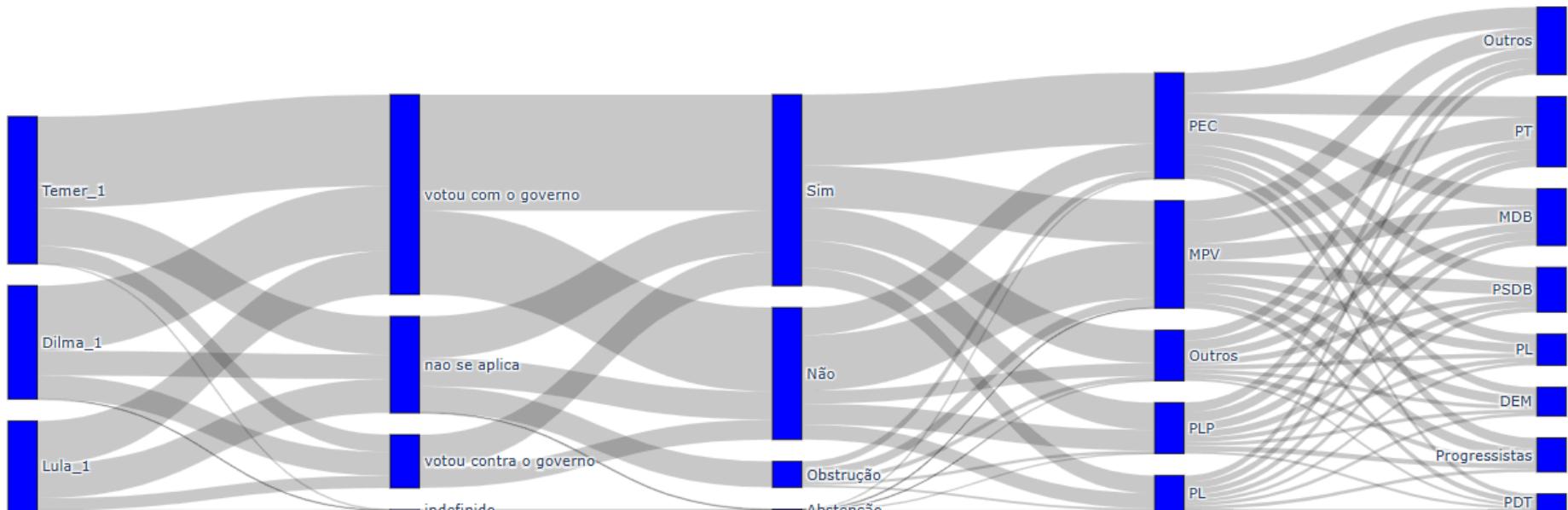


- Cluster node 5-2:
  - 8.28% of the clustered trajectory data.
  - Date range: 2006-01-17 to 2016-12-20.
  - It is a group that did not follow the government's guidance to vote Abstention, did not vote on PLV propositions but all REP propositions are present on this cluster.
  - 41.99% of the votes in this cluster occurred during the Termer's government (2016 to 2019).
  - 26.03% of the data in this cluster voted in line with Termer's government.

For example, MAT-Tree identified a group of 1412 trajectories that do not have occurrences of government orientation as Abstention (orientacaoGoverno/Abstenção), PLV propostion (tipoProposticao/PLV), Absent vote (voto/AUSENTE) with PMB party (partido/PMB) out of this group, but all trajectories have occurrence of REP proposition (tipoProposicao/REP).

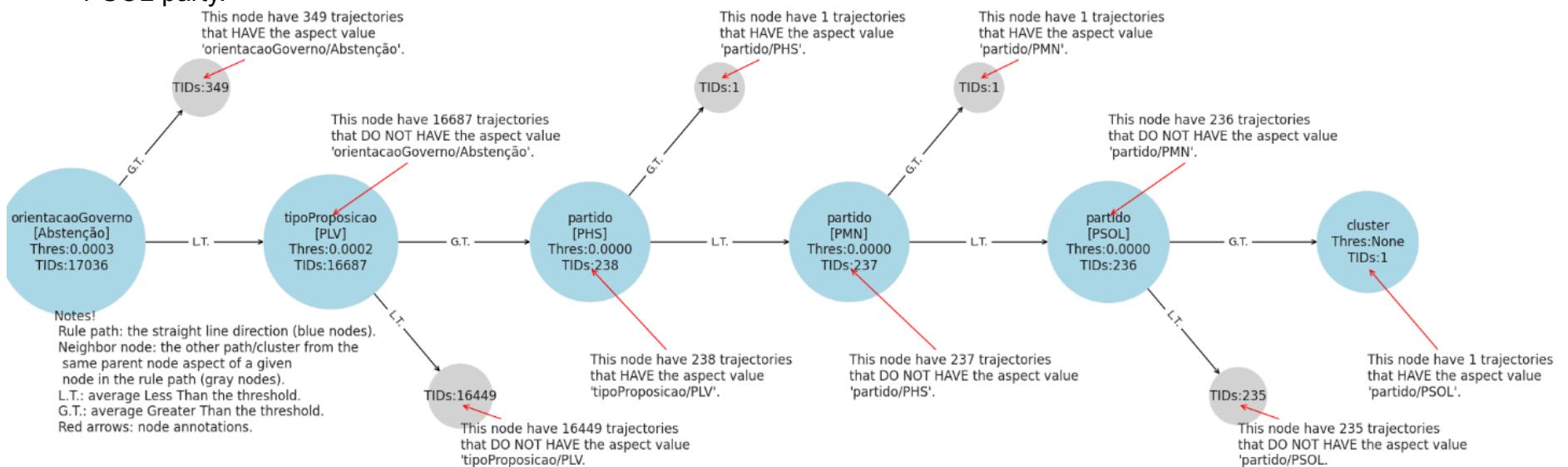


Node: Lvl 5 - 2; Split: minVariance  
TIDs: 1412; Unique deputies: 867; Total votes: 63755.  
from 2006-01-02 to 2016-12-20

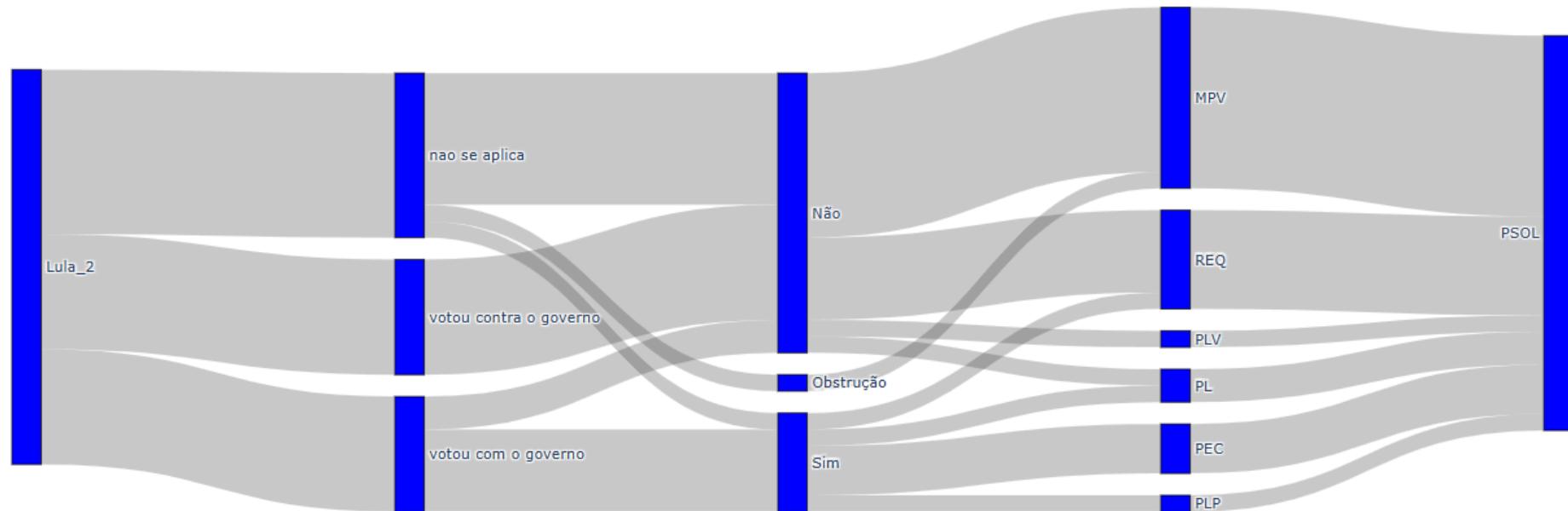


- Cluster node 5-5:
  - It is a group of 1 trajectory from PSOL party that did not follow the government's guidance to vote Abstention and the number of votes for PLV proposition was greater than the threshold.

For example, MAT-Tree identified a outlier cluster with 1 trajectory that voted on PLV proposition (tipoProposicao/PLV) which is from PSOL party (partido/PSOL), and does not have occurrences of government orientation as Abstention (orientacaoGoverno/Abstenção) where the parties PHS and PMN (partido PHS/PMN) were relevant to this trajectory from PSOL party.



Node: Lvl 5 - 5; Split: minVariance  
 TIDs: 1; Unique deputies:1; Total votes: 24.  
 from 2010-01-12 to 2010-12-15

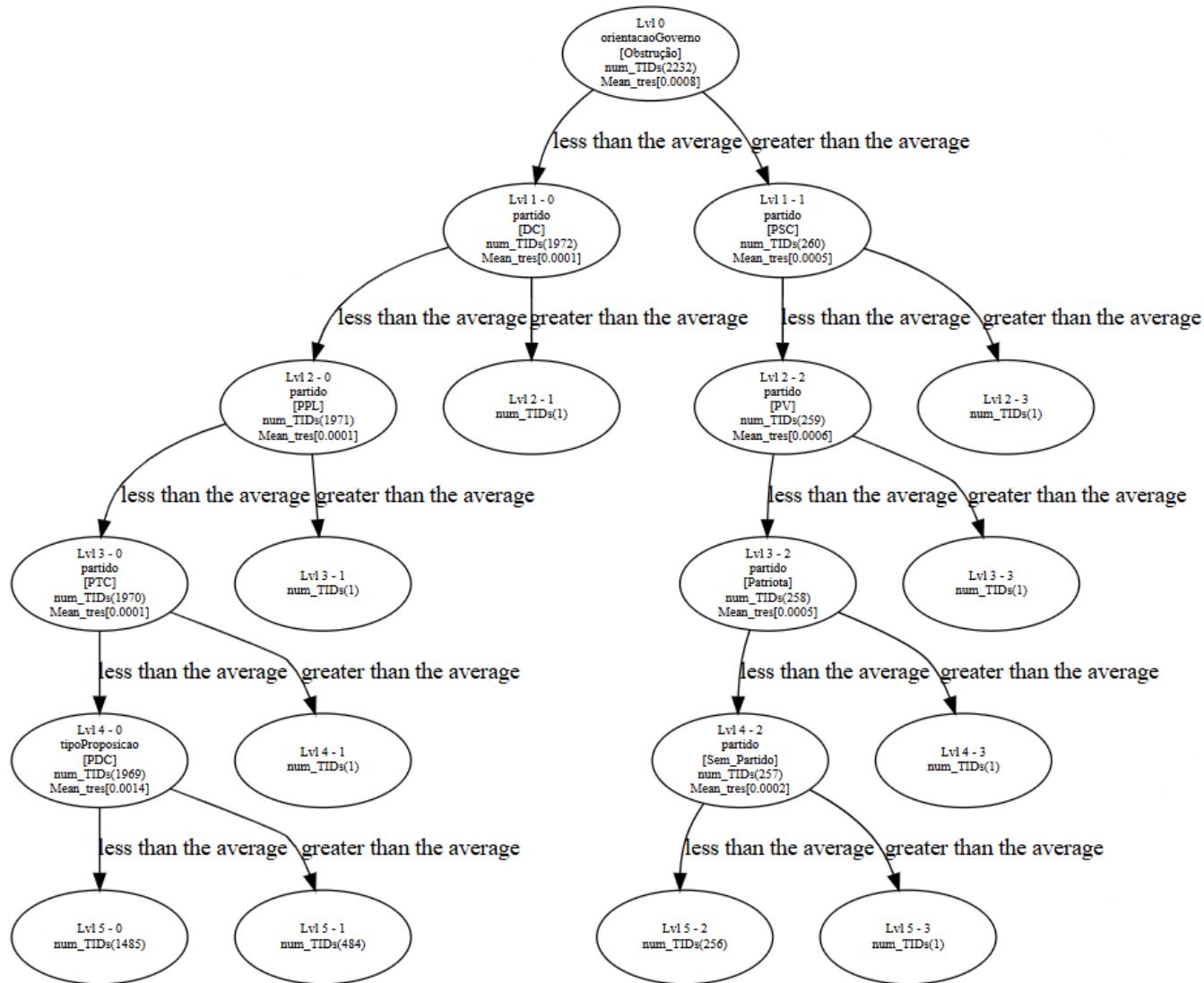


## 2. Dataset by government

### 2.1 Bolsonaro

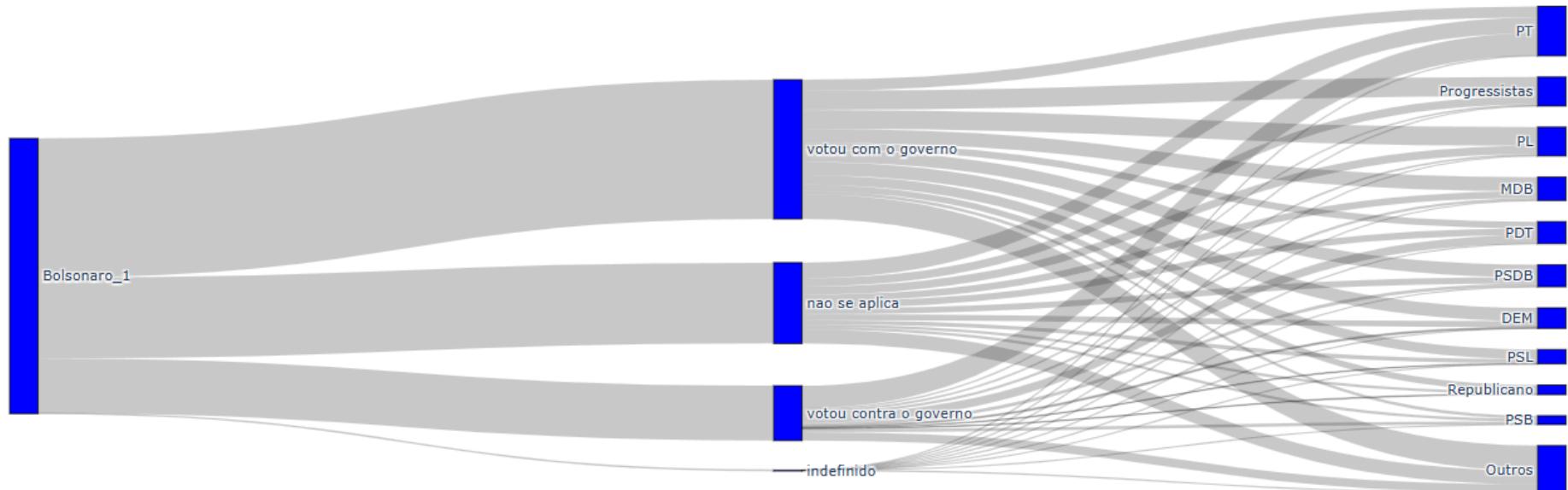
This dataset has 2,232 trajectories with a total of 335,262 votes from 560 deputies distributed into 33 parties. Running the MAT-Tree with MV, it identified 10 clusters where **88.22%** of the data is grouped into two clusters. Node 5-0 grouped **66.54%** corresponding to 1485 trajectories while node 5-1 grouped **21.68%** corresponding to 484 trajectories.

- Tree

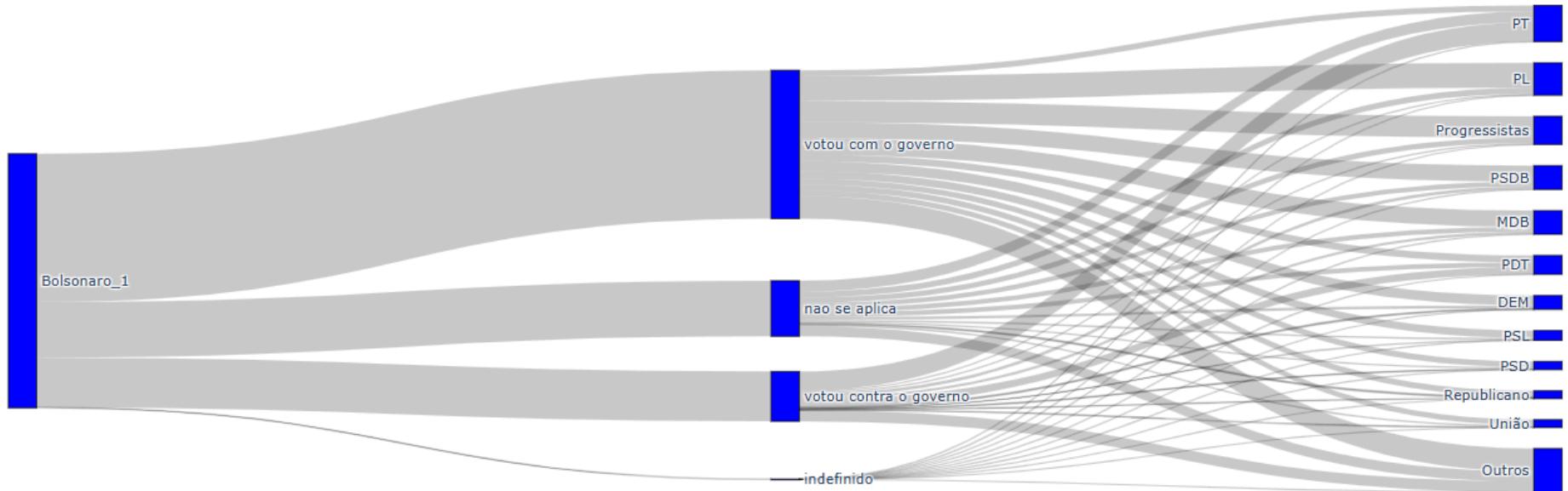


- Sankey

Node: Lvl 5 - 1; Split: minVariance  
TIDs: 484; Unique deputies: 353; Total votes: 111934.  
from 2019-02-04 to 2021-12-21

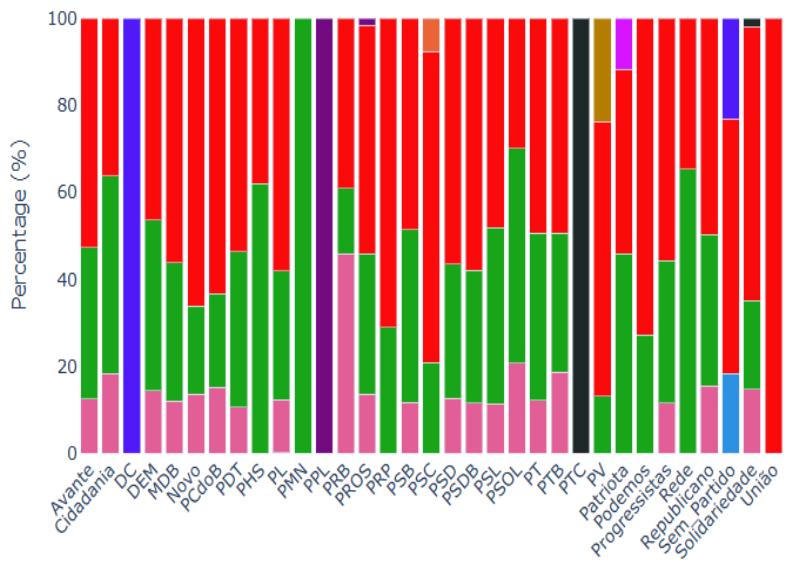


Node: Lvl 5 - 0; Split: minVariance  
TIDs: 1485; Unique deputies: 535; Total votes: 180673.  
from 2019-01-10 to 2022-12-04

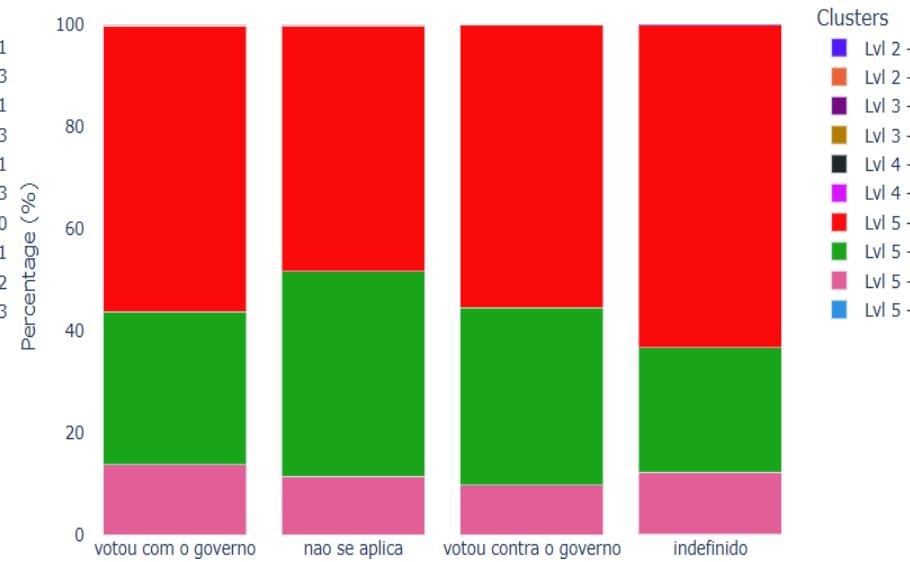


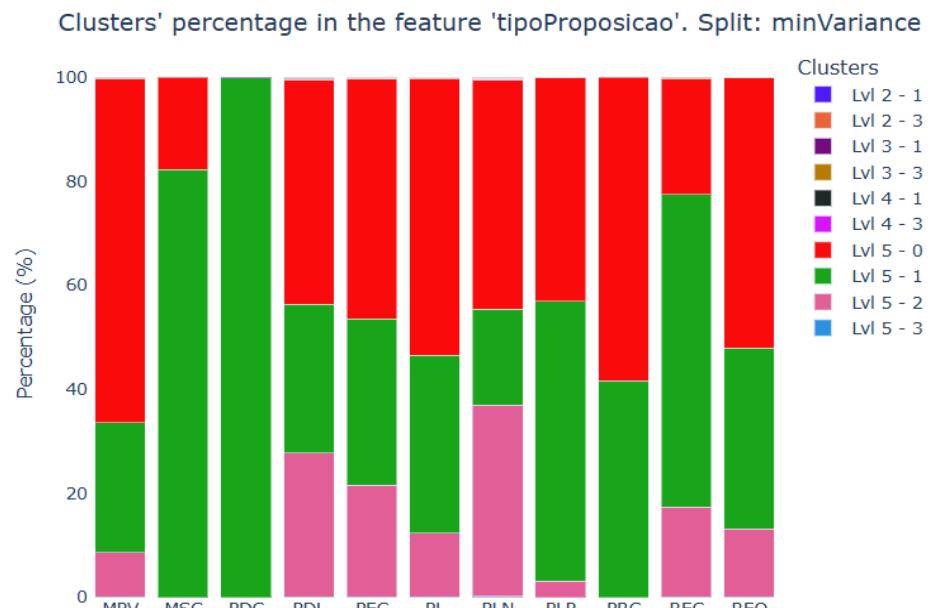
- Stacked bar
  - Clusters' percentage in the feature

Clusters' percentage in the feature 'partido'. Split: minVariance



Clusters' percentage in the feature 'alinhamento'. Split: minVariance

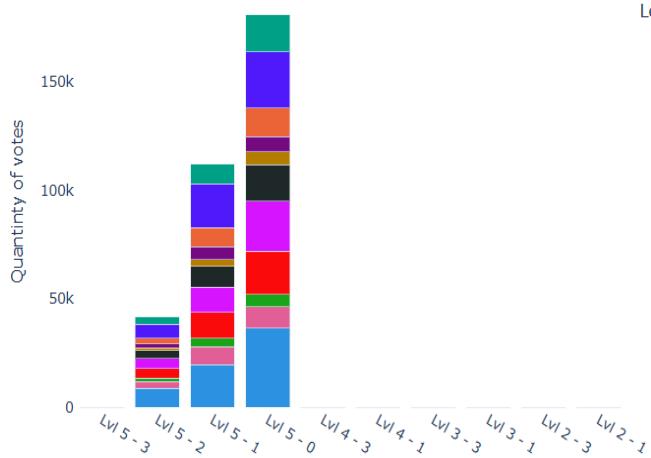




**Figure X.**

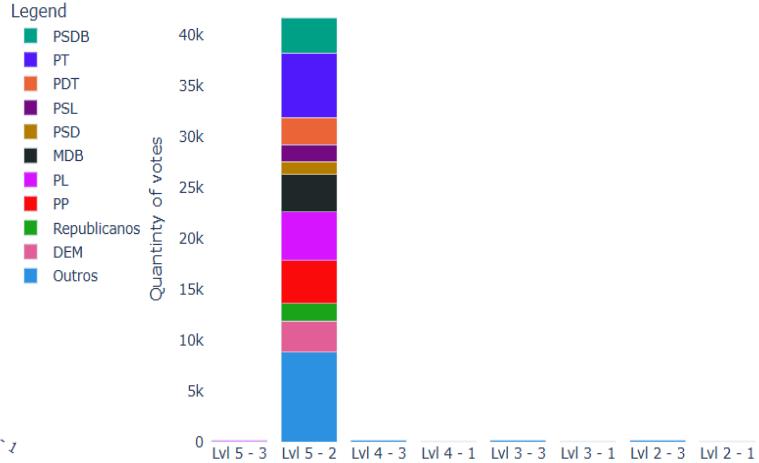
- Number of votes by feature value in the cluster

Feature 'partido'; Split: minVariance.



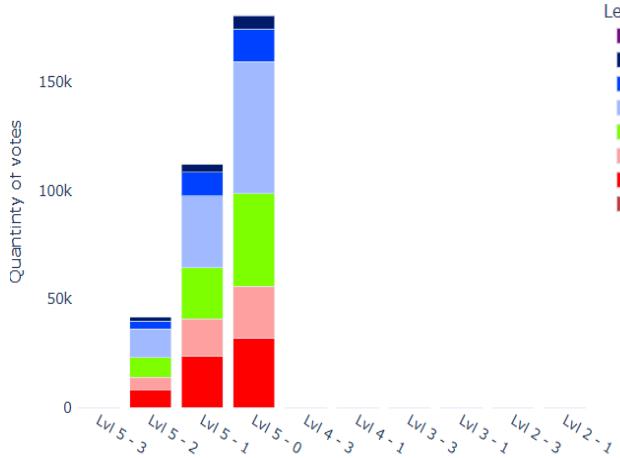
(A)

Feature 'partido'; Split: minVariance.

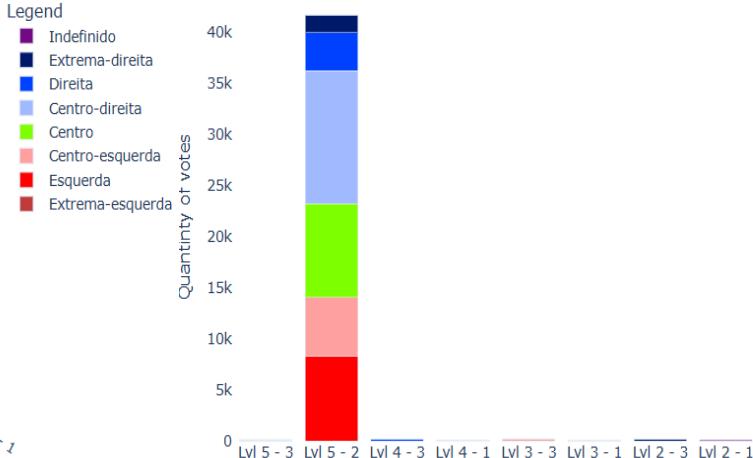


(B)

Feature 'esp\_pol\_partido'; Split: minVariance.

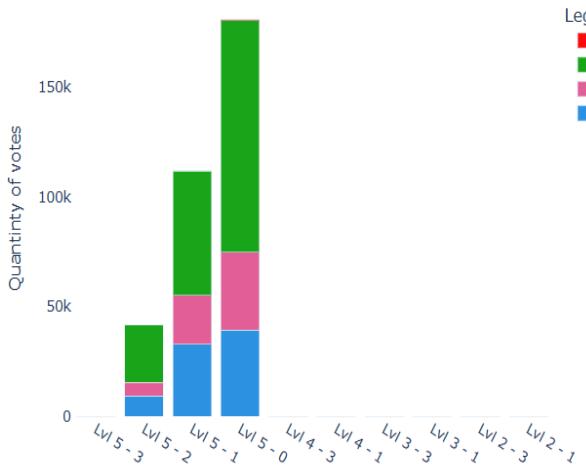


(C)



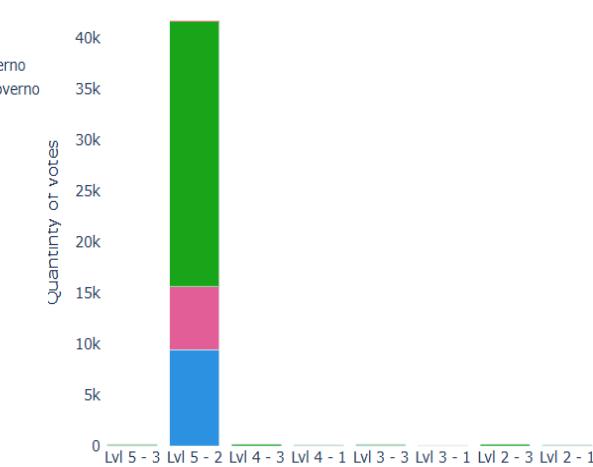
(D)

Feature 'alinhamento'; Split: minVariance.



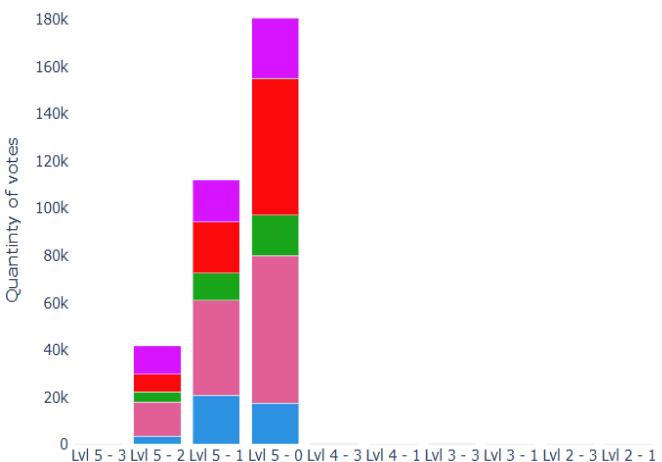
(E)

Feature 'alinhamento'; Split: minVariance.

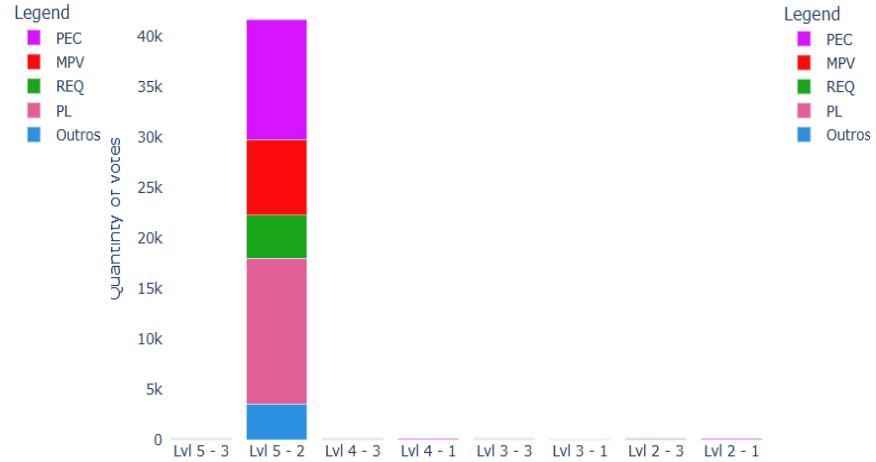


(F)

Feature 'tipoProposicao'; Split: minVariance.



(G)



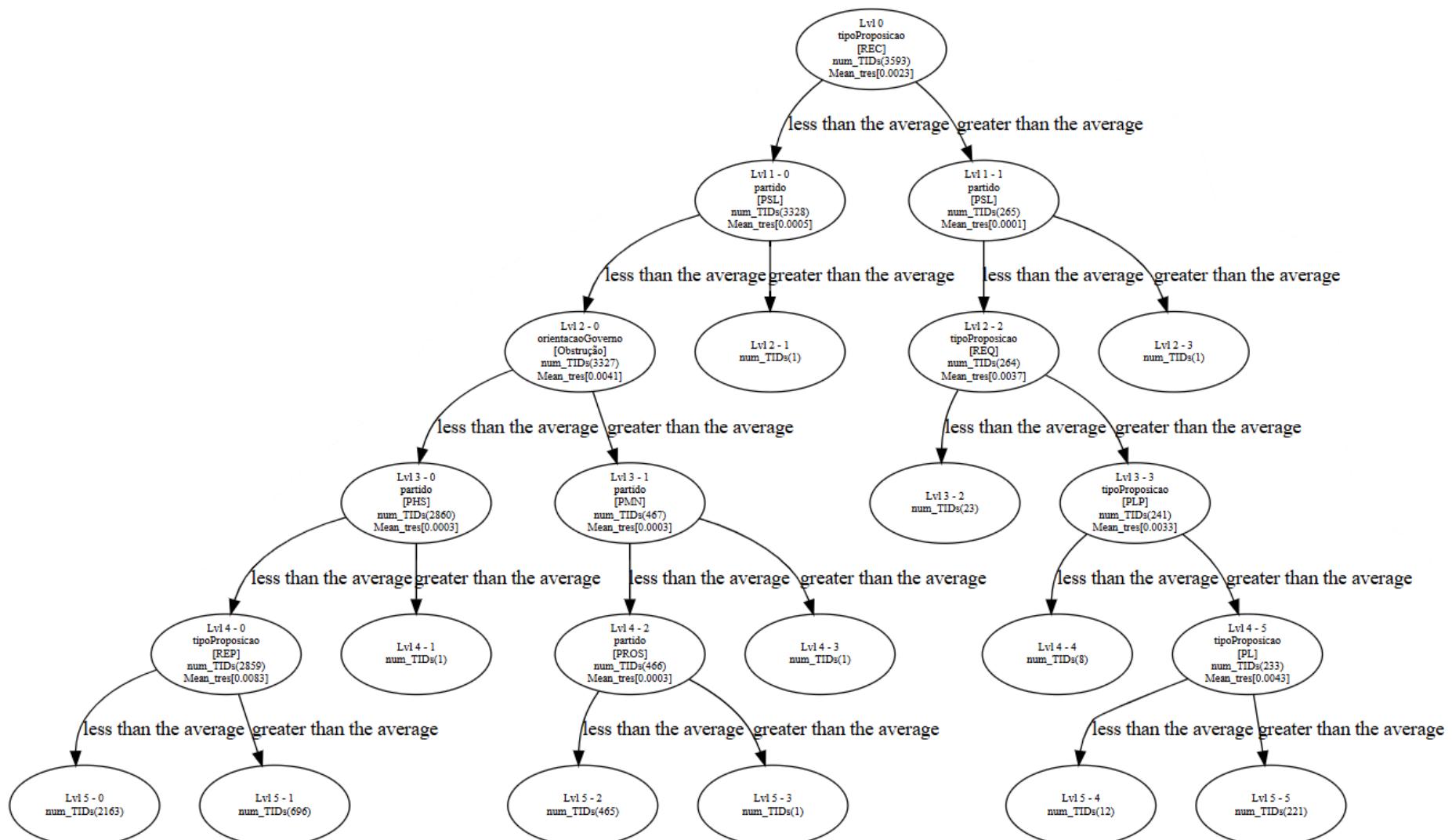
(H)

**Figure X.** Quantity of votes per cluster using MV during the Bolsonaro government. The left side shows all cluster (A, C, E and G) while the right side (B, D, F and H) does not show two clusters with the majority of votes. (A-B) Party (Partido), (C-D) Political spectrum (espectro político) , (E-F) Government's alignment (Alinhamento) and (G-H) Proposition (Tipo proposição).

## 2.2 Dilma (*first term*)

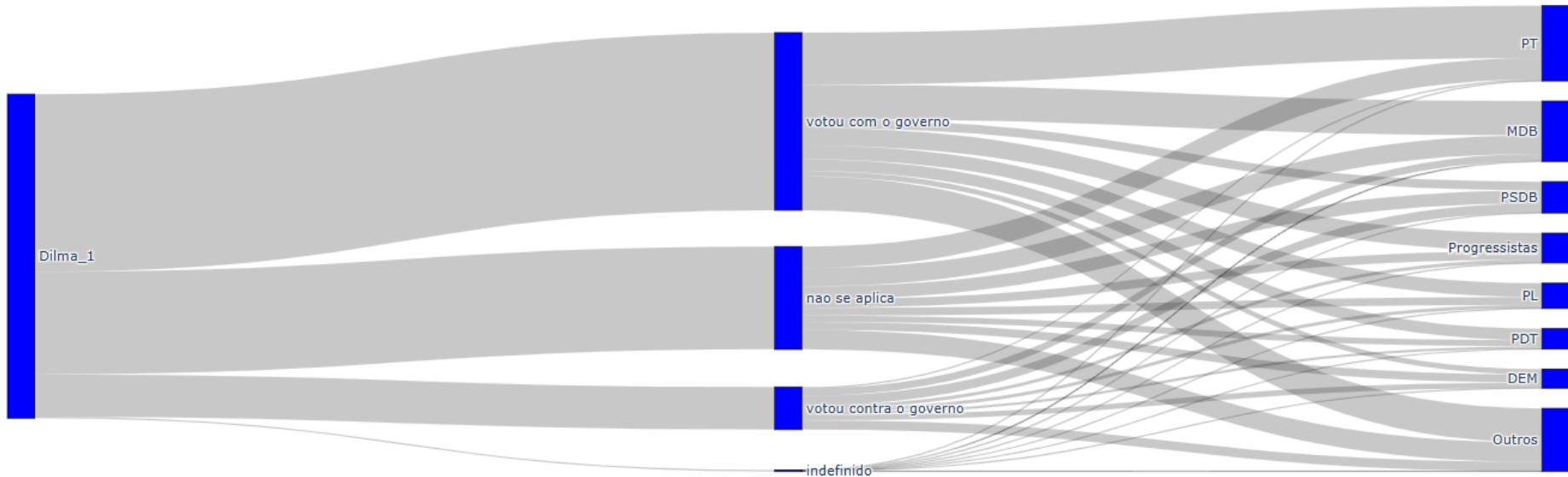
This dataset has 3,593 trajectories with a total of 115,287 votes from 649 deputies distributed into 26 parties. Running the MAT-Tree with MV, it identified 12 clusters where **79.57%** of the data is grouped into two clusters. Node 5-0 grouped **60.2%** corresponding to 2163 trajectories while node 5-1 grouped **19.37%** corresponding to 696 trajectories.

- Tree

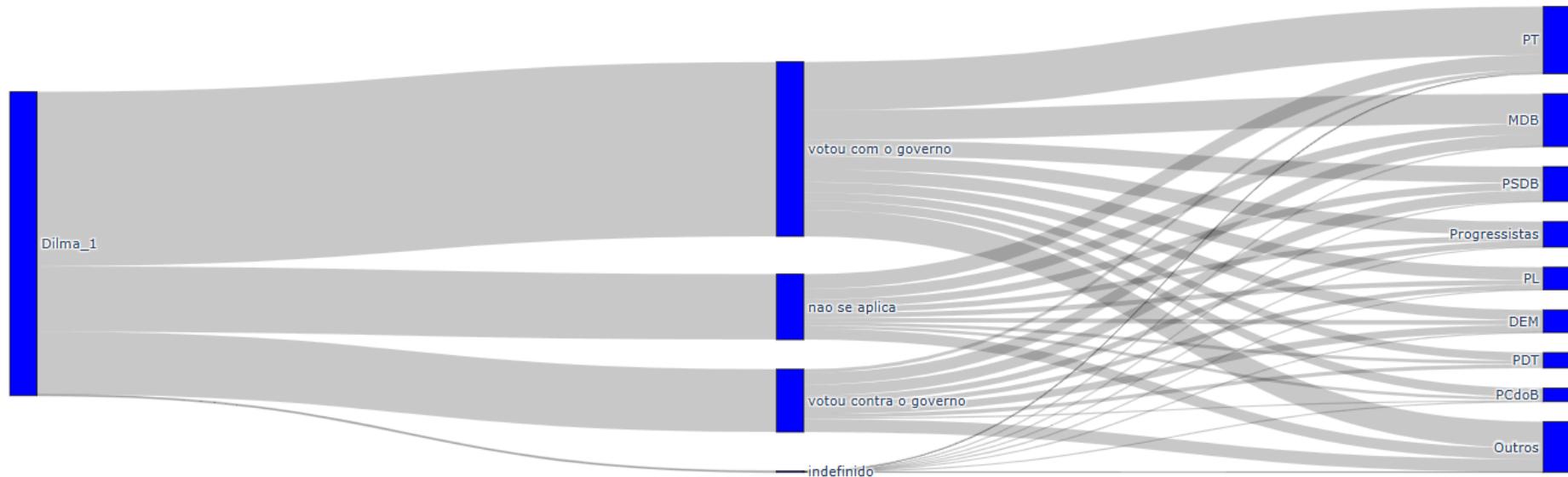


- Sankey

Node: Lvl 5 - 0; Split: minVariance  
TIDs: 2163; Unique deputies: 612; Total votes: 69562.  
from 2011-01-09 to 2014-12-17

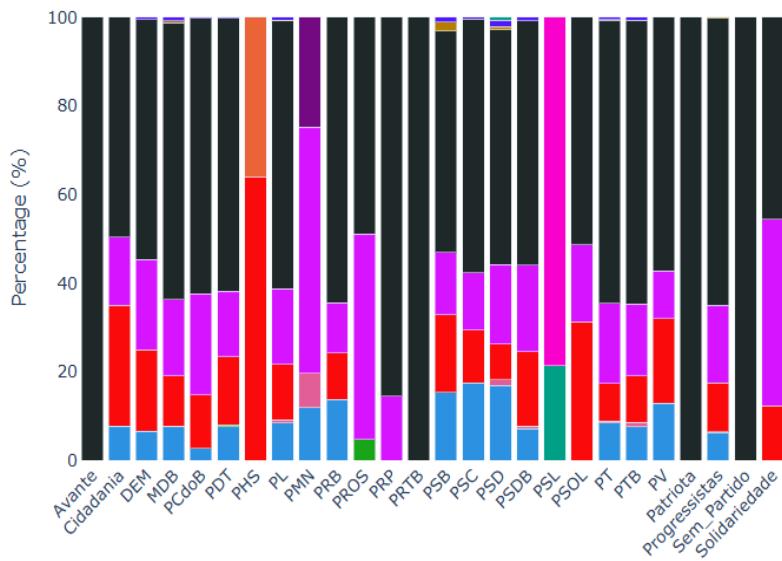


Node: Lvl 5 - 1; Split: minVariance  
TIDs: 696; Unique deputies: 444; Total votes: 20648.  
from 2014-01-04 to 2014-12-17

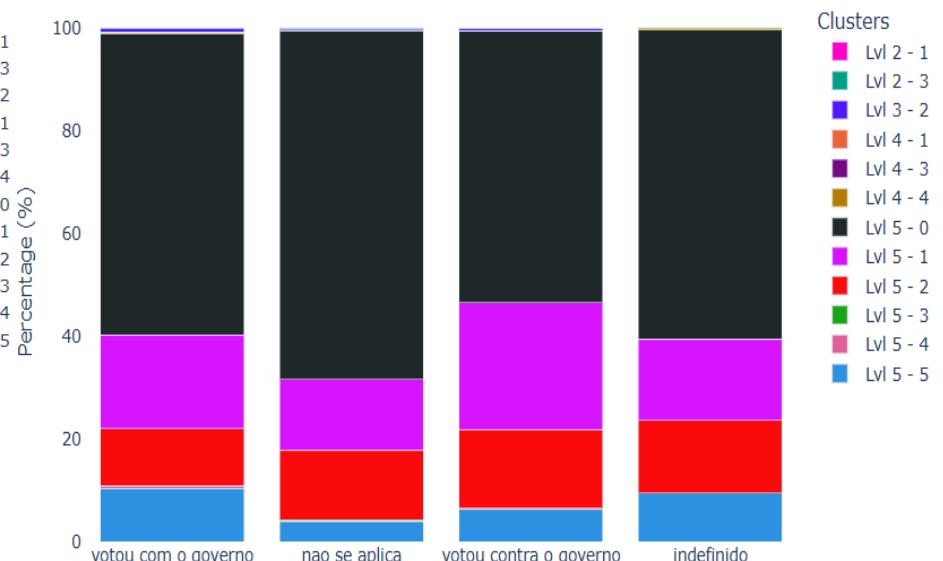


- Stacked bar
  - Clusters' percentage in the feature

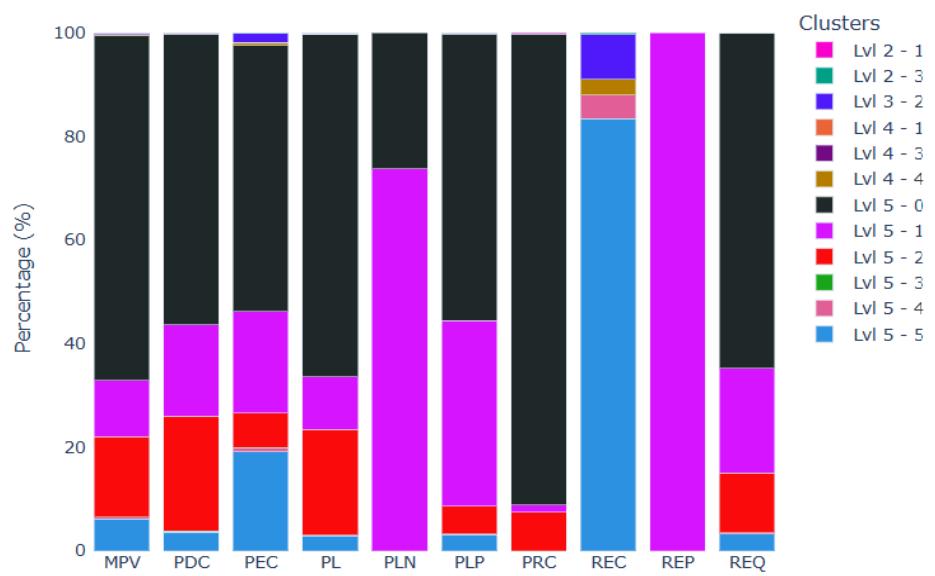
Clusters' percentage in the feature 'partido'. Split: minVariance



Clusters' percentage in the feature 'alinhamento'. Split: minVariance

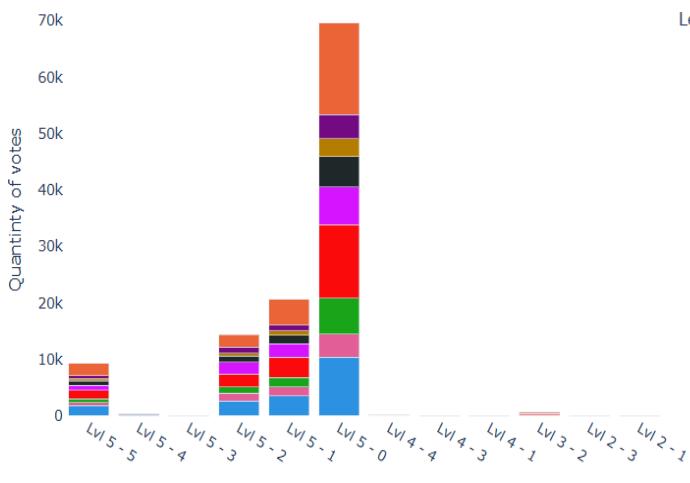


Clusters' percentage in the feature 'tipoProposicao'. Split: minVariance



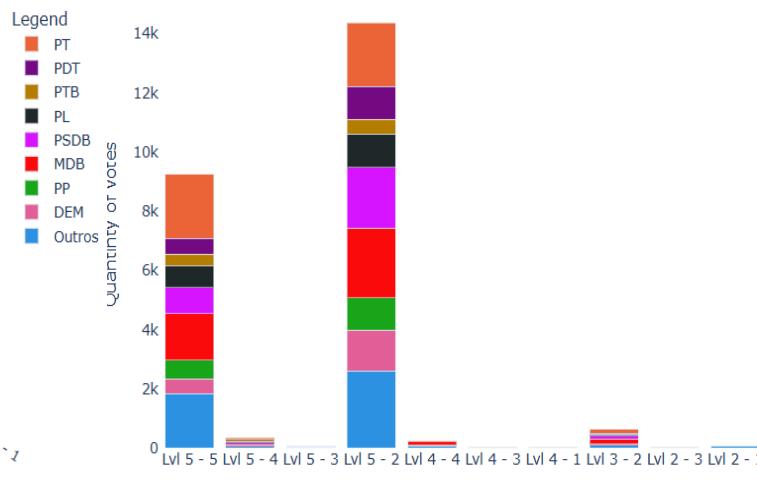
- Number of votes by feature value in the cluster

Feature 'partido'; Split: minVariance.



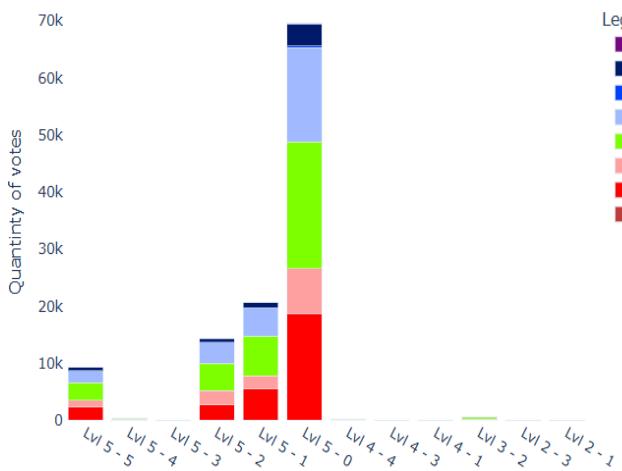
(A)

Feature 'partido'; Split: minVariance.

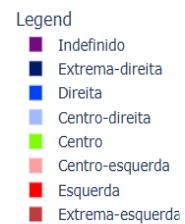


(B)

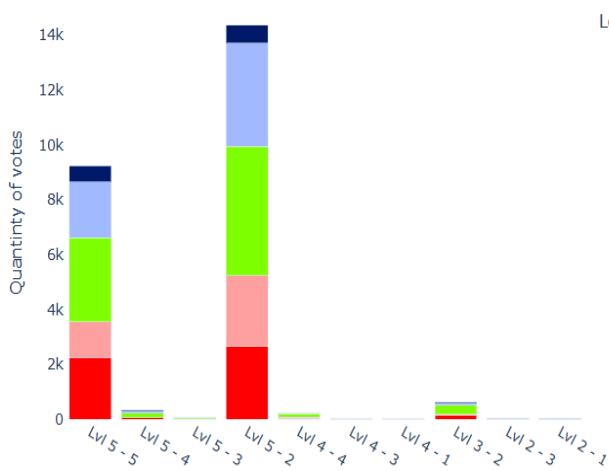
Feature 'esp\_pol\_partido'; Split: minVariance.



(C)

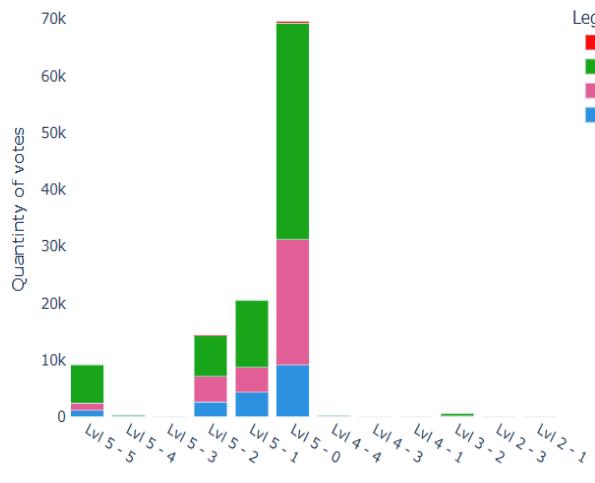


Feature 'esp\_pol\_partido'; Split: minVariance.



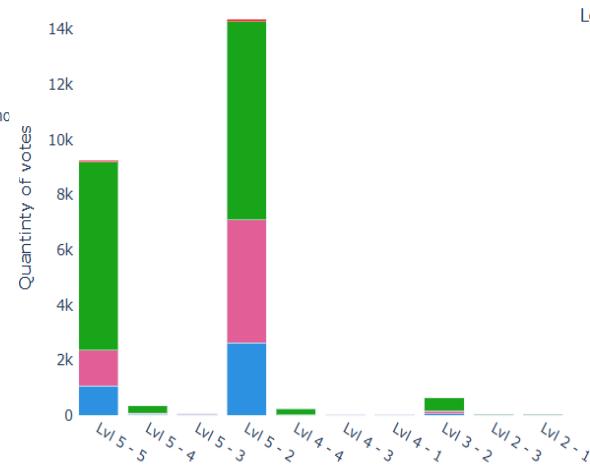
(D)

Feature 'alinhamento'; Split: minVariance.



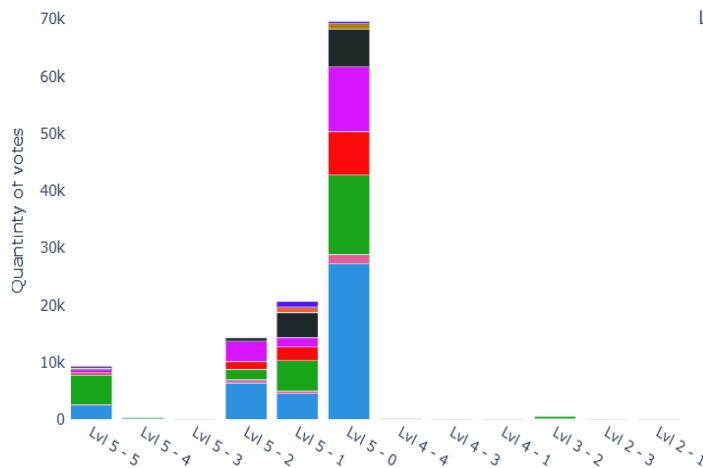
(E)

Feature 'alinhamento'; Split: minVariance.

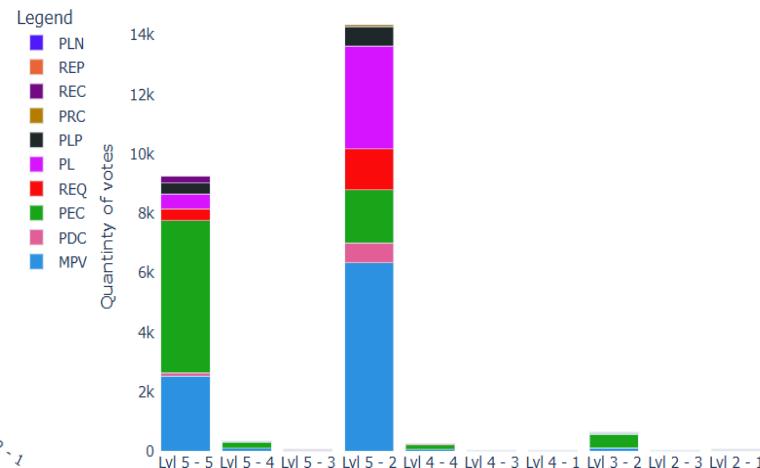


(F)

Feature 'tipoProposicao'; Split: minVariance.



(G)



(H)

**Figure X.** Quantity of votes per cluster using MV during the Bolsonaro government. The left side shows all cluster (A, C, E and G) while the right side (B, D, F and H) does not show two clusters with the majority of votes. (A-B) Party (Partido), (C-D) Political spectrum (espectro político) , (E-F) Government's alignment (Alinhamento) and (G-H) Proposition (Tipo proposição).

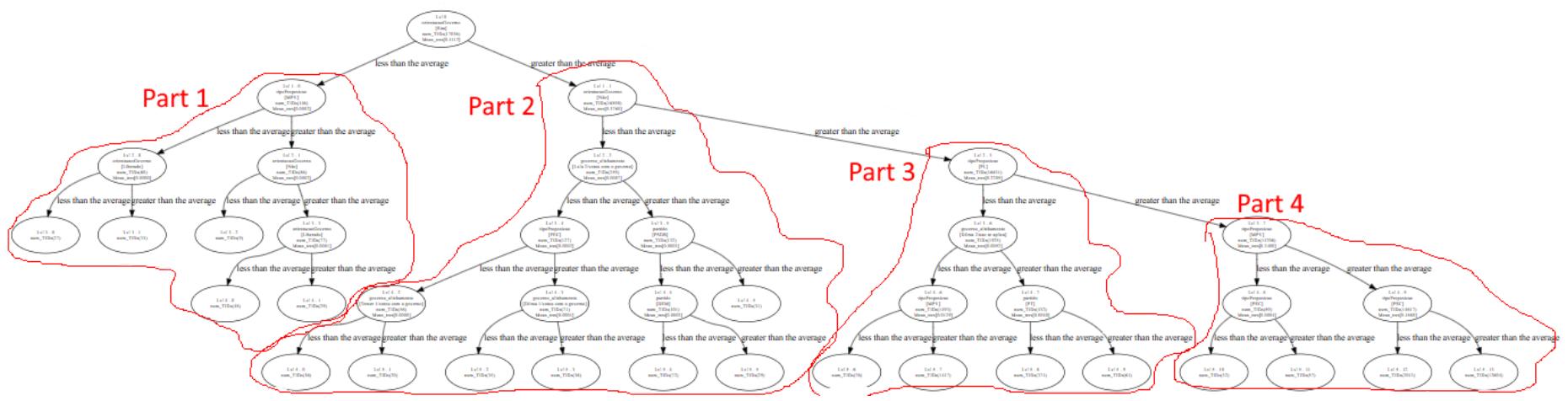
## 3.2 Combined features

We focus on this section to test a feature combination and remove other features. We combined the features *governo* and *alinamento* because this join can facilitate the identification of a parliamentary alignment in the vote. After that, we remove the features *voto*, *governo*, and *alinamento* to reduce the feature space. Furthermore, in the previous experiment, we used the features *partido*, *alinamento*, *orientacaoGoverno*, *voto*, *tipoProposicao*, and *governo*. However, we will use the features ***partido*, *orientacaoGoverno*, *tipoProposicao*, and *governo\_alinhamento* (combined feature)** for this experiment. We show some details for MVR and MV in the following sections.

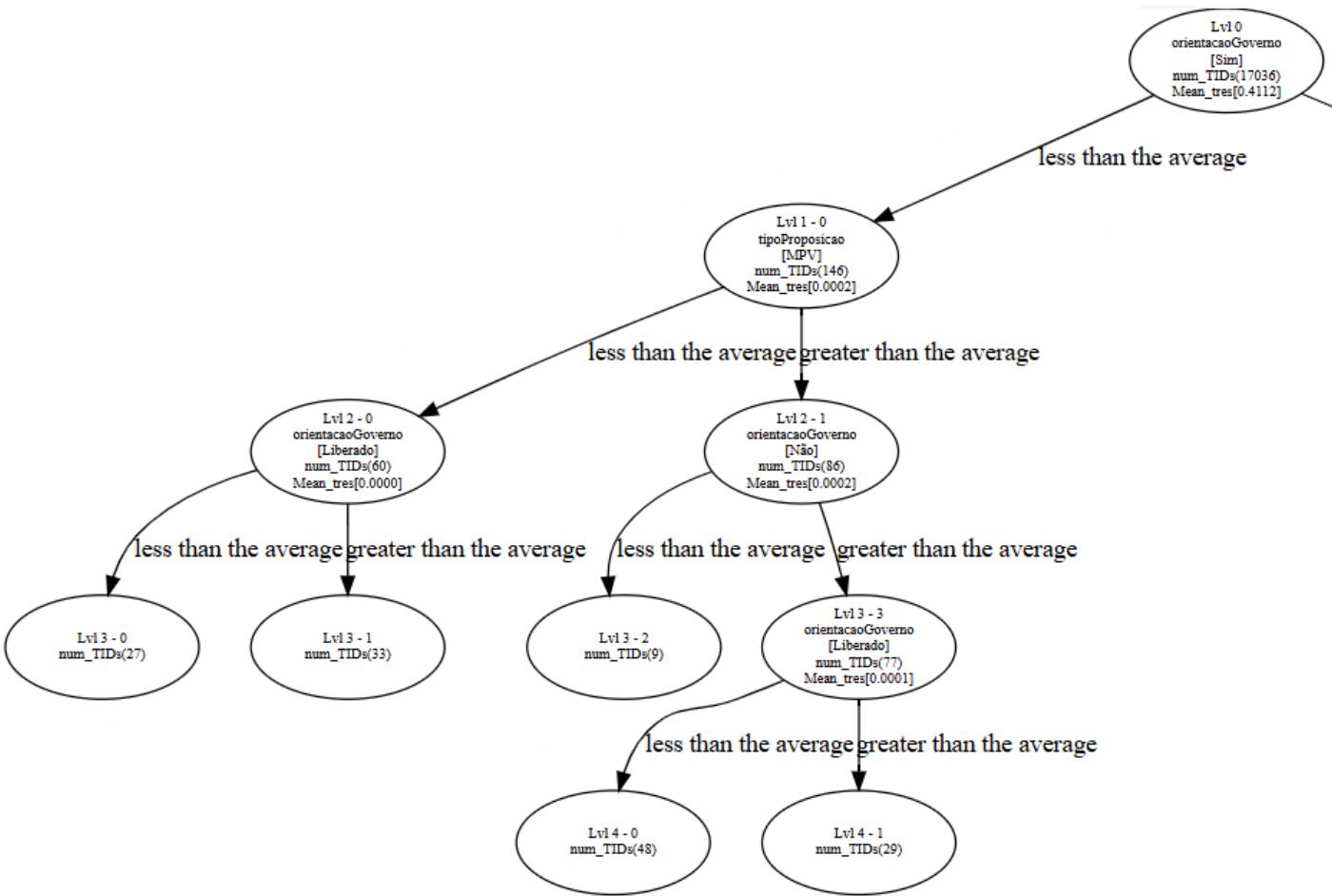
### 3.2.1 Maximum Variance Reduction (MVR)

**Maximum variance reduction** evaluates the mean-variance reduction considering the previously selected aspect (parent node) in both trajectory subsets for each subtree. This method chooses the aspect in the subtree that generates the maximum reduction value regarding the parent node.

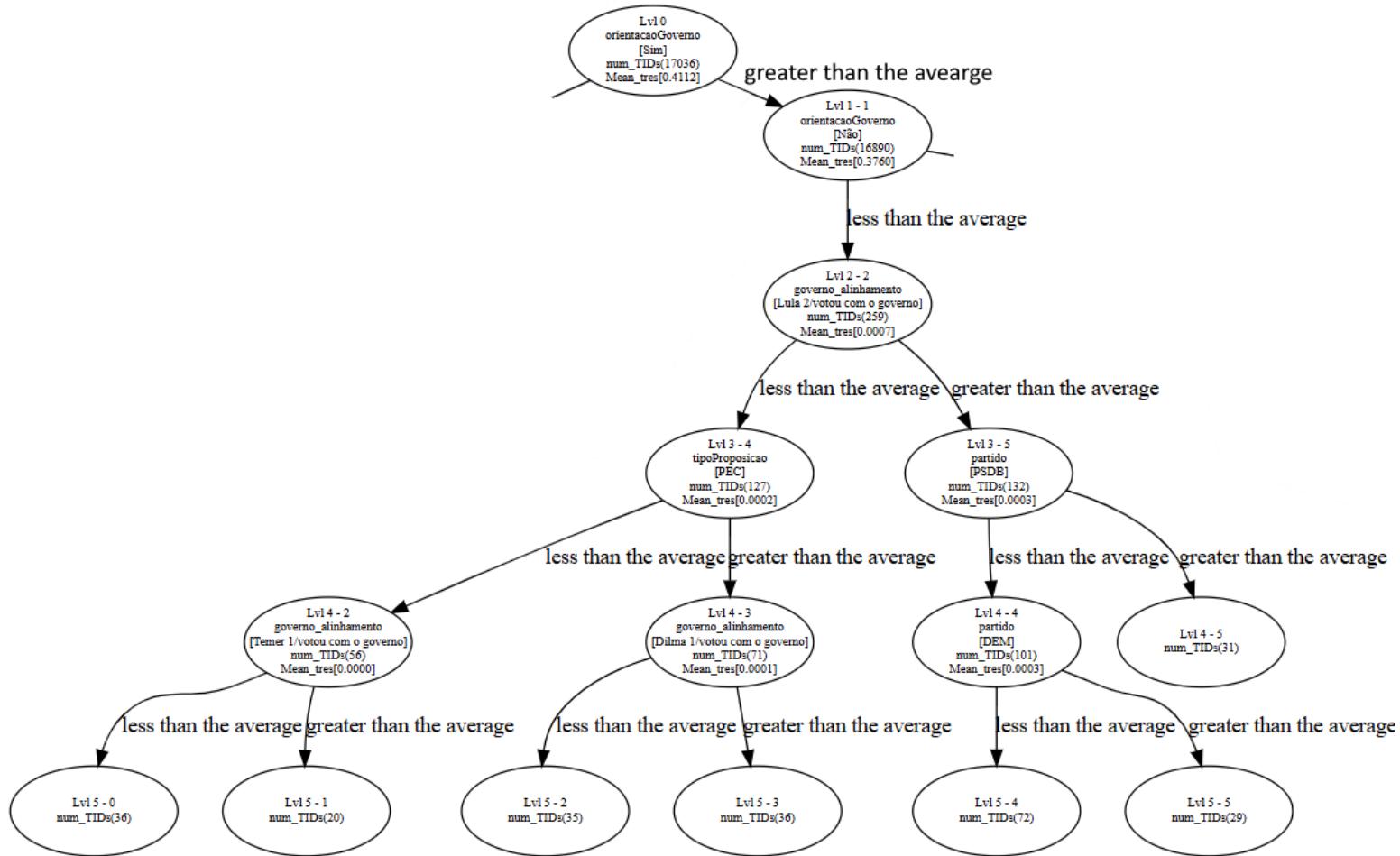
Regarding this selection aspect strategy, we can see in Figure 42 that MAT-Tree identified 20 clusters. Besides, we breakdown Figure 42 into four parts (Figures from 43 to 46) to facilitate the tree visualization. Furthermore, we summarized the main characteristics of Figure 42 in Table 2 such as cluster (node), number of trajectories, cluster entropy, unique labels, and the relevant aspects.



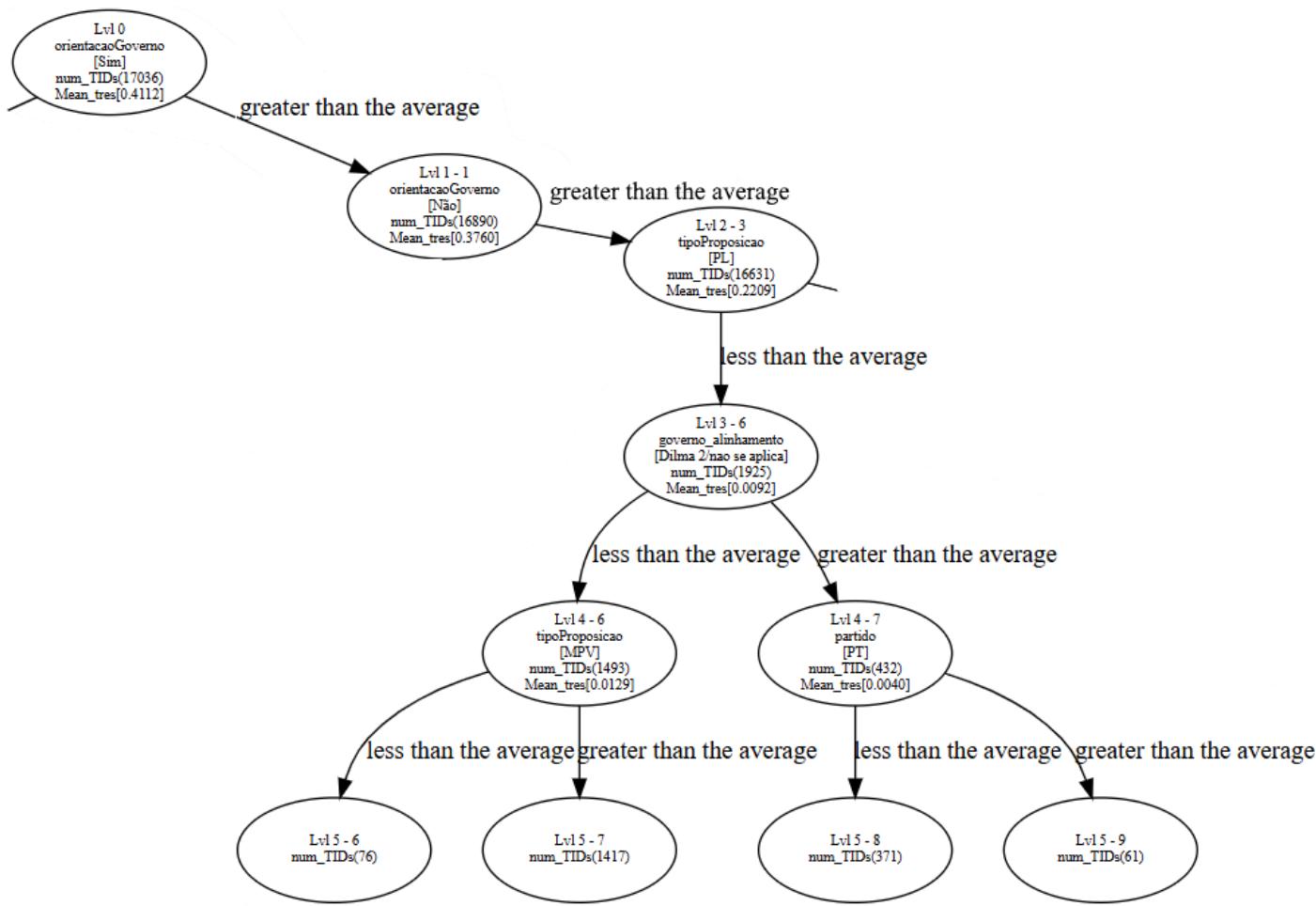
**Figure 42.** Clustering result with 20 clusters from concatenated features.  
Hyperparameters: selection strategy = MVR; max depth = 5; min trajs = 50.



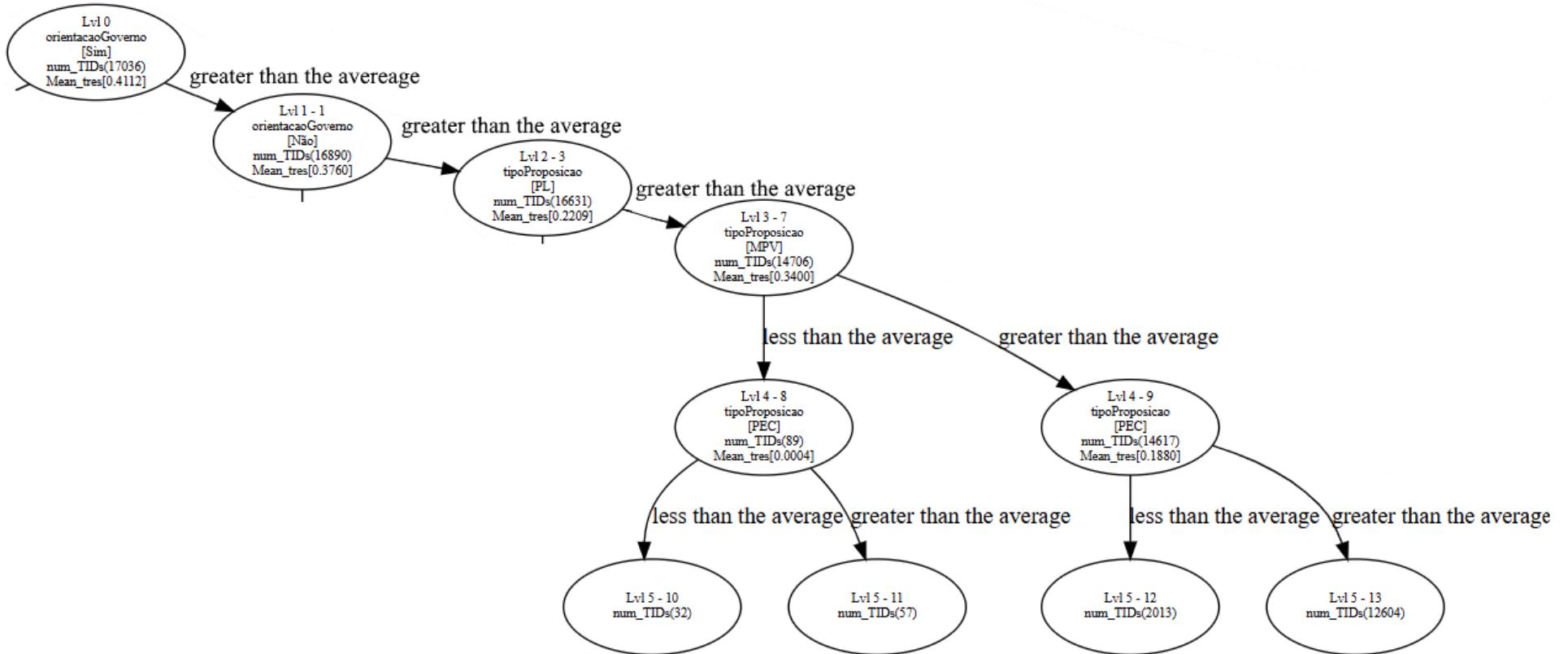
**Figure 43.** 5 clusters from part 1 of the tree.



**Figure 44.** 7 clusters from part 2 of the tree.



**Figure 45.** 4 clusters from part 3 of the tree.



**Figure 46.** 4 clusters from part 4 of the tree.

Table 3 shows the main characteristics of the identified clusters in Figure 42. Such characteristics are the number of trajectories, the entropy, parties in the node, and the selected aspects.

**Table 3.** Main characteristics of the clusters using MVR strategy. (*LT*): *Less than*; (*GT*): *Greater than*.

Cluster (node)	Characteristics			
	Number of trajectories	Entropy	Unique parties	Relevant aspects (rules)
Lvl 3-0	27	0.885	DEM, MDB, PT, PTB, PL, PDT, PSDB, Progressistas and Cidadania	orientacaoGoverno [Sim] → <sup>LT</sup> tipoProposicao [MPV] → <sup>LT</sup> orientacaoGoverno [Liberado] → <sup>LT</sup> cluster
Lvl 3-1	33	0.9385	DEM, MDB, PT, PSDB, PSB, PV, PSD, Solidariedade, PL, Progressistas, Cidadania and PTB	orientacaoGoverno [Sim] → <sup>LT</sup> tipoProposicao [MPV] → <sup>LT</sup> orientacaoGoverno [Liberado] → <sup>GT</sup> cluster
Lvl 3-2	9	0.8866	DEM, MDB, PT, PSDB and Progressistas	orientacaoGoverno [Sim] → <sup>LT</sup> tipoProposicao [MPV] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>LT</sup> cluster
Lvl 4-0	48	0.885	DEM, MDB, PL, PT, PSDB, Progressistas, Cidadania, PDT, Sem_Partido, PV and PTB	orientacaoGoverno [Sim] → <sup>LT</sup> tipoProposicao [MPV] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>GT</sup> orientacaoGoverno [Liberado] → <sup>LT</sup> cluster
Lvl 4-1	29	0.9106	DEM, MDB, PL, PDT, PT, PSDB, Progressistas, Cidadania, PSC, PSD and PTB	orientacaoGoverno [Sim] → <sup>LT</sup> tipoProposicao [MPV] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>GT</sup> orientacaoGoverno [Liberado] → <sup>GT</sup> cluster

Lvl 4-5	31	0	PSDB	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>LT</sup> governo_alinhamento [Lula 2/Votou com o governo] → <sup>GT</sup> partido [PSDB] → <sup>GT</sup> cluster
Lvl 5-0	36	0.9201	PL, PDT, PT, Progressistas, PCdoB, PSD, DEM, MDB, PSDB, Cidadania and PTB	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>LT</sup> governo_alinhamento [Lula 2/Votou com o governo] → <sup>LT</sup> tipoProposicao [PEC] → <sup>LT</sup> governo_alinhamento [Temer 1/votou com o governo] → <sup>LT</sup> cluster
Lvl 5-1	20	0.9414	DEM, MDB, PL, PSDB, PSC, Podemos, PDT, Progressistas and PTB	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>LT</sup> governo_alinhamento [Lula 2/Votou com o governo] → <sup>LT</sup> tipoProposicao [PEC] → <sup>LT</sup> governo_alinhamento [Temer 1/votou com o governo] → <sup>GT</sup> cluster
Lvl 5-2	35	0.9382	MDB, PDT, PT, PSDB, Progressistas, PTB, PSD, DEM and PL.	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>LT</sup> governo_alinhamento [Lula 2/Votou com o governo] → <sup>LT</sup> tipoProposicao [PEC] → <sup>GT</sup> governo_alinhamento [Dilma 1/votou com o governo] → <sup>LT</sup> cluster

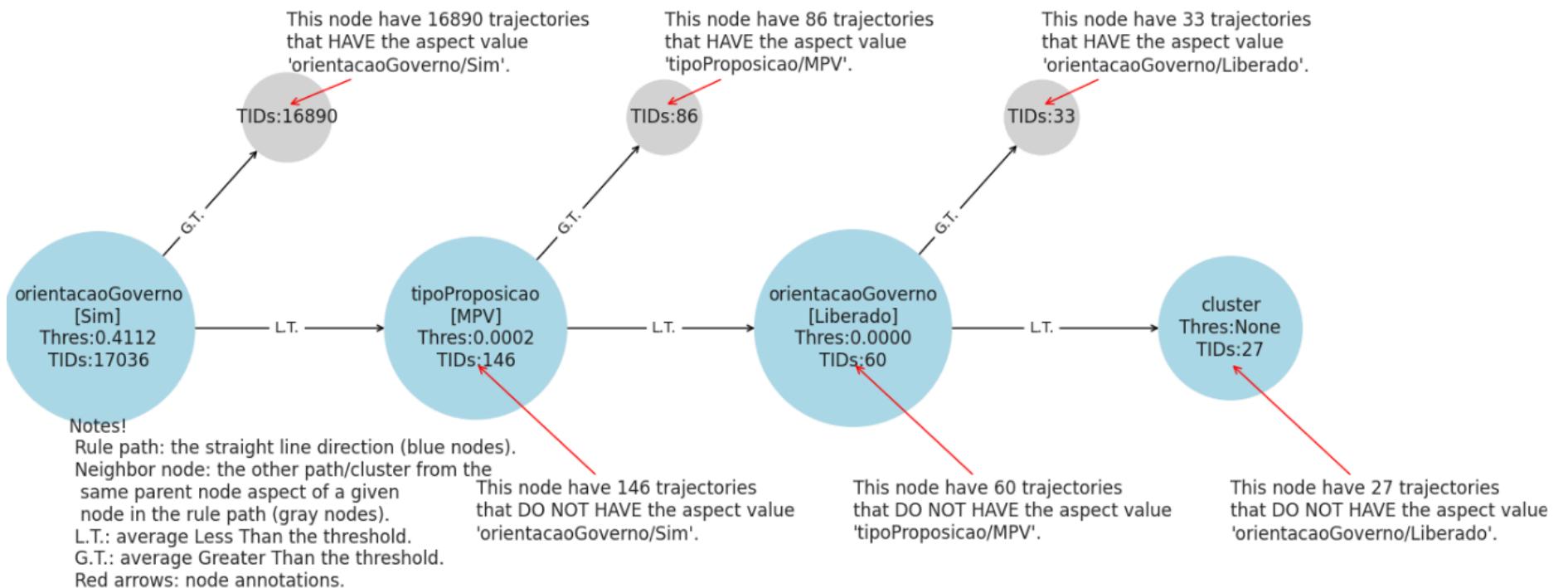
Lvl 5-3	36	0.8912	MDB, PL, PT, PSDB, Progressistas, Cidadania, PSB, PSD, PROS, Solidariedade and DEM	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>LT</sup> governo_alinhamento [Lula 2/Votou com o governo] → <sup>LT</sup> tipoProposicao [PEC] → <sup>GT</sup> governo_alinhamento [Dilma 1/votou com o governo] → <sup>GT</sup> cluster
Lvl 5-4	72	0.8609	MDB, PL, PDT, PT, Progressistas, Cidadania, PTB, PHS, PSC and PCdoB	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>LT</sup> governo_alinhamento [Lula 2/Votou com o governo] → <sup>GT</sup> partido [PSDB] → <sup>LT</sup> partido [DEM] → <sup>LT</sup> cluster
Lvl 5-5	29	0	DEM	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>LT</sup> governo_alinhamento [Lula 2/Votou com o governo] → <sup>GT</sup> partido [PSDB] → <sup>LT</sup> partido [DEM] → <sup>GT</sup> cluster
Lvl 5-6	76	0.8641	DEM, MDB, PL, PTB, PDT, PT, PSDB, Progressistas, Cidadania, PSB, PRB, PSD, PROS and Solidariedade	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>GT</sup> tipoProposicao [PL] → <sup>LT</sup> governo_alinhamento [Dilma 2/nao se aplica] → <sup>LT</sup> tipoProposicao [MPV] → <sup>LT</sup> cluster

Lvl 5-7	1417	0.7596	DEM, MDB, PL, PDT, PTB, Sem_Partido, PT, PSDB, Patriota, Progressistas, PSB, Cidadania, PCdoB, PRONA, PSOL, PSC, PSD, PV, PMN, PRB, PSL, PRTB, Avante, PROS, Solidariedade, Podemos, REDE, Rede, Novo and Republicano	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>GT</sup> tipoProposicao [PL] → <sup>LT</sup> governo_alinhamento [Dilma 2/nao se aplica] → <sup>LT</sup> tipoProposicao [MPV] → <sup>GT</sup> cluster
Lvl 5-8	371	0.8299	DEM, PL, PSD, MDB, PSDB, Cidadania, PMB, PTB, PCdoB, Sem_Partido, PDT, PHS, Podemos, PV, PSC, Patriota, Progressistas, PSL Solidariedade, Avante, PSB, PSOL, PTC, PRB, PROS, PMN and REDE	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>GT</sup> tipoProposicao [PL] → <sup>LT</sup> governo_alinhamento [Dilma 2/nao se aplica] → <sup>GT</sup> partido [PT] → <sup>LT</sup> cluster
Lvl 5-9*	61	0.1481	PT, PROS and PCdoB	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>GT</sup> tipoProposicao [PL] → <sup>LT</sup> governo_alinhamento [Dilma 2/nao se aplica] → <sup>GT</sup> partido [PT] → <sup>GT</sup> cluster
Lvl 5-10	32	0.8865	MDB, PL, PROS, PT, PSDB, Progressistas, PRB, DEM, PDT and PTB	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>GT</sup> tipoProposicao [PL] → <sup>GT</sup> tipoProposicao [MPV] → <sup>LT</sup> tipoProposicao [PEC] → <sup>LT</sup> cluster

Lvl 5-11	57	0.8621	DEM, MDB, PT, PSDB, Progressistas, Cidadania, PTB, PSC, PSL, PROS, Solidariedade, PL, PDT and PCdoB	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>GT</sup> tipoProposicao [PL] → <sup>GT</sup> tipoProposicao [MPV] → <sup>LT</sup> tipoProposicao [PEC] → <sup>GT</sup> cluster
Lvl 5-12	2013	0.7573	DEM, PL, PSDB, MDB, Sem_Partido, PSD, PDT, Avante, Podemos, PHS, PT, PSOL, PCdoB, Progressistas, Cidadania, PV, PSB, PTB, PRP, PSC, PSL, PPL, PMN, PRB, Solidariedade, PRTB, Patriota, PROS, REDE, Novo and Republicano	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>GT</sup> tipoProposicao [PL] → <sup>GT</sup> tipoProposicao [MPV] → <sup>GT</sup> tipoProposicao [PEC] → <sup>LT</sup> cluster
Lvl 5-13	12604	0.7070	DEM, PL, PSDB, MDB, Sem_Partido, PSD, PDT, Avante, Podemos, PHS, PT, PSOL, PCdoB, Progressistas, Cidadania, PV, PSB, PTB, PRP, PSC, PSL, PPL, PMN, PRB, Solidariedade, PRTB, Patriota, PROS, REDE, Novo and Republicano	orientacaoGoverno [Sim] → <sup>GT</sup> orientacaoGoverno [Não] → <sup>GT</sup> tipoProposicao [PL] → <sup>GT</sup> tipoProposicao [MPV] → <sup>GT</sup> tipoProposicao [PEC] → <sup>GT</sup> cluster

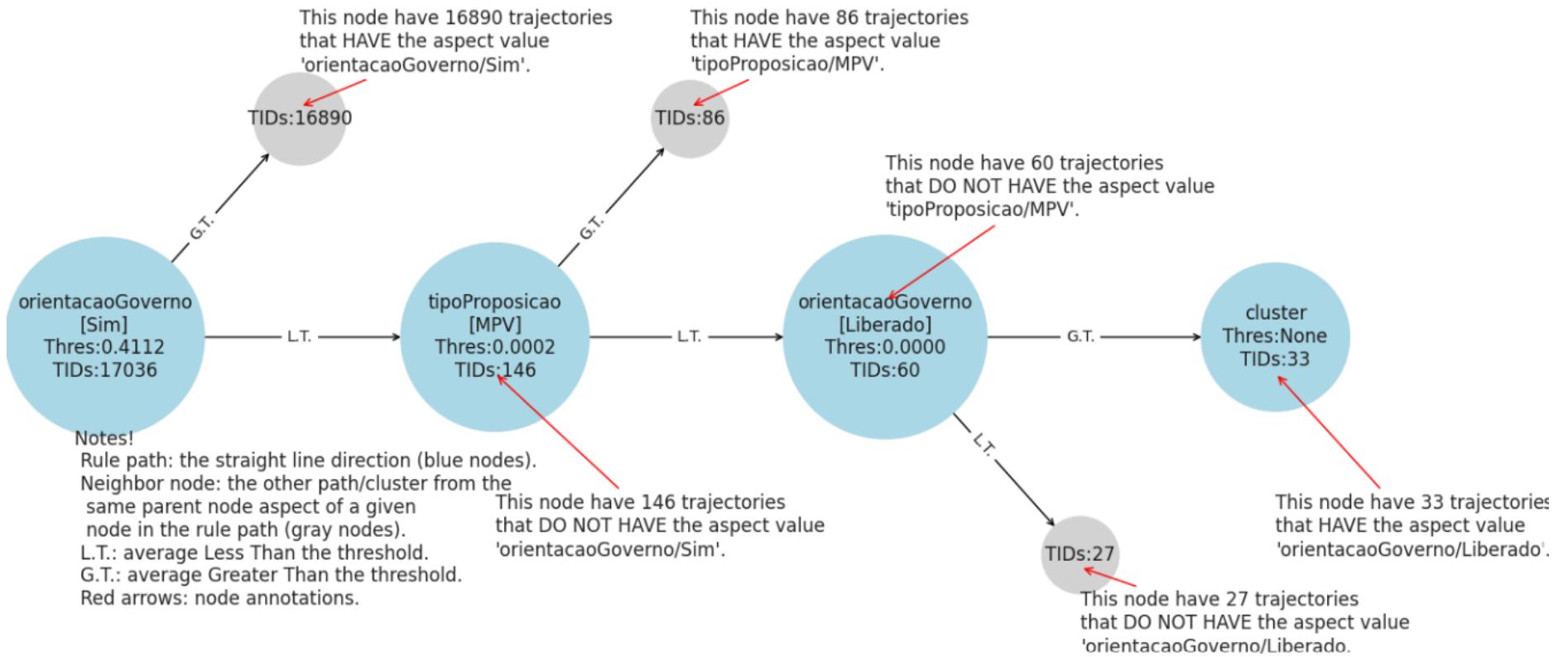
In addition, we present the meaning of the rules represented by the relevant aspects in Table 3 as follows.

- Rules meaning
  - **Cluster Lvl 3-0:** A group of 27 trajectories that had the number of occurrences less than average threshold. This group basically does not followed the government orientation Yes and Liberate (orientacaoGoverno [Sim/Liberado]) for propositions different of MPV (tipoProposicao [MPV]).



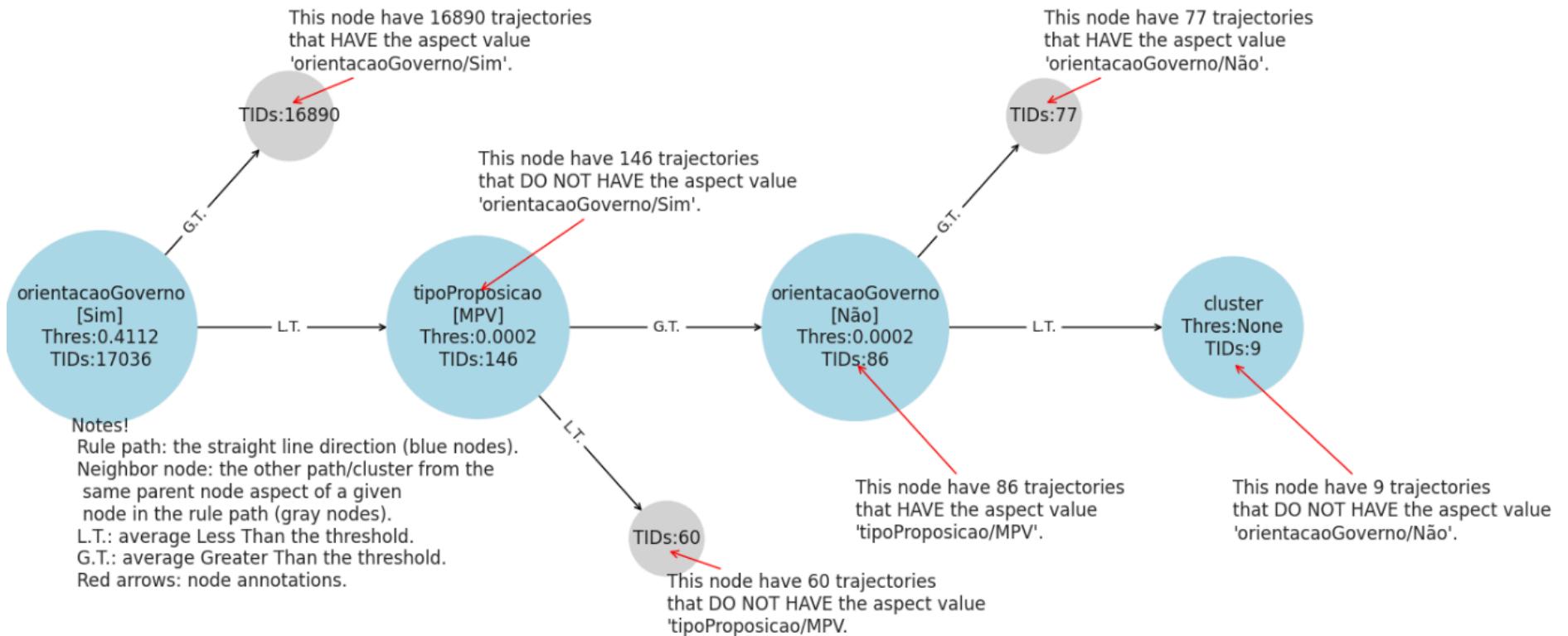
**Figure 47.** The cluster rule path for node 3-0.

- **Cluster Lvl 3-1:** A group of 33 trajectories that had two aspects with occurrences less than average and one greater than the average. This group does not follow the government orientation Yes (orientacaoGoverno [Sim]) as well as did not vote on MPV propositions (tipoProposicao [MPV]), but at the end followed the Liberado from government orientation (orientacaoGoverno [Liberado]).



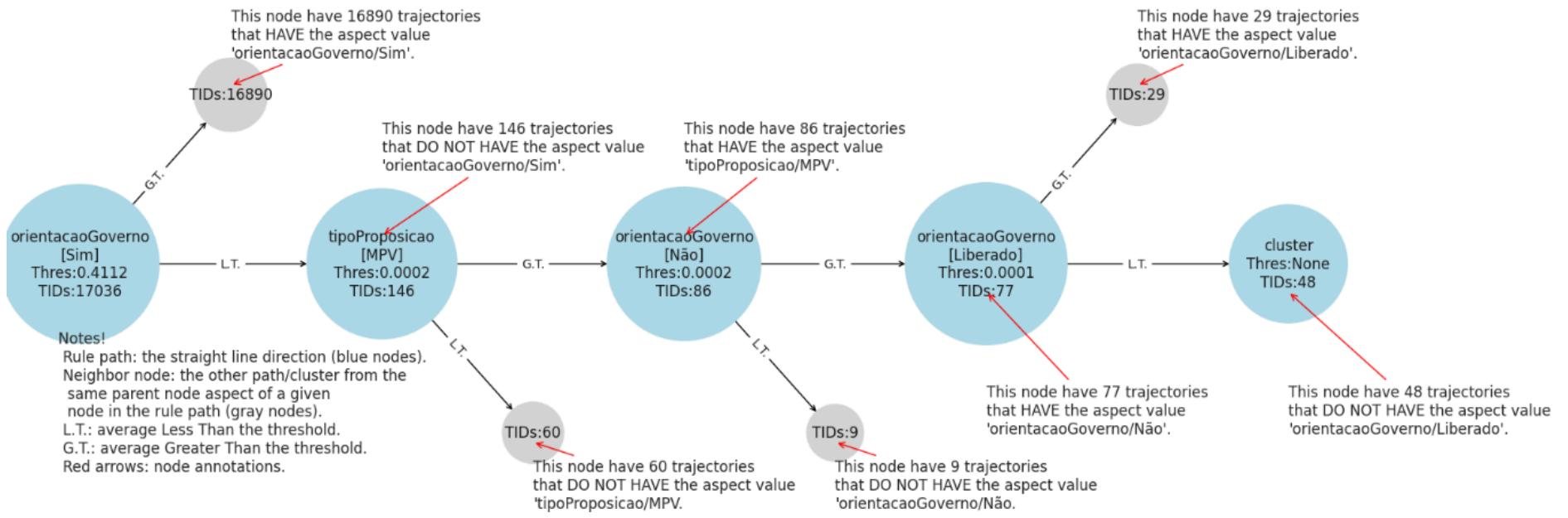
**Figure 48.** The cluster rule path for node 3-1.

- **Cluster Lvl 3-2:** A group of 9 trajectories that do not followed the government orientation Yes (orientacaoGoverno [Sim]), then voted MPV propositions (tipoProposicao [MPV]), but concluded does not following the government orientation No (orientacaoGoverno [Não]).



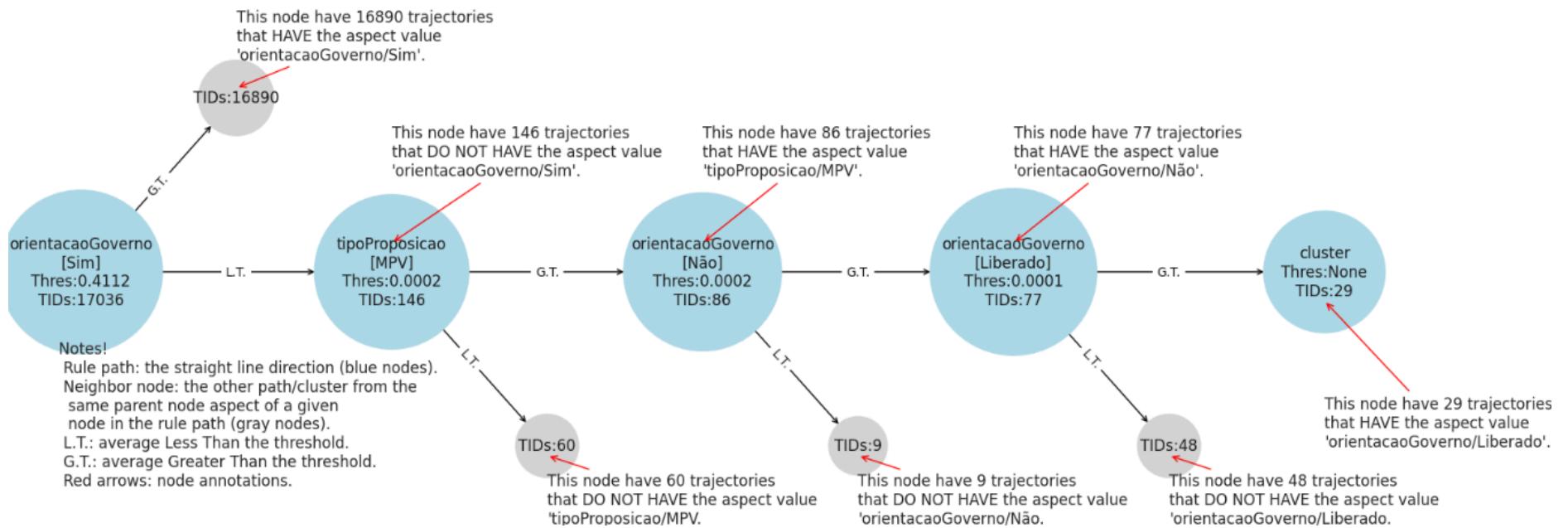
**Figure 49.** The cluster rule path for node 3-2.

- **Cluster Lvl 4-0:** A group of 48 trajectories do not followed orientation Yes from the government (orientacaoGoverno [Sim]), then voted on MPV propositions (tipoProposicao [MPV]) and followed the orientation No from the government (orientacaoGoverno [Não]), and conclude do not following the orientation Liberate from the government (orientacaoGoverno [Liberato]).



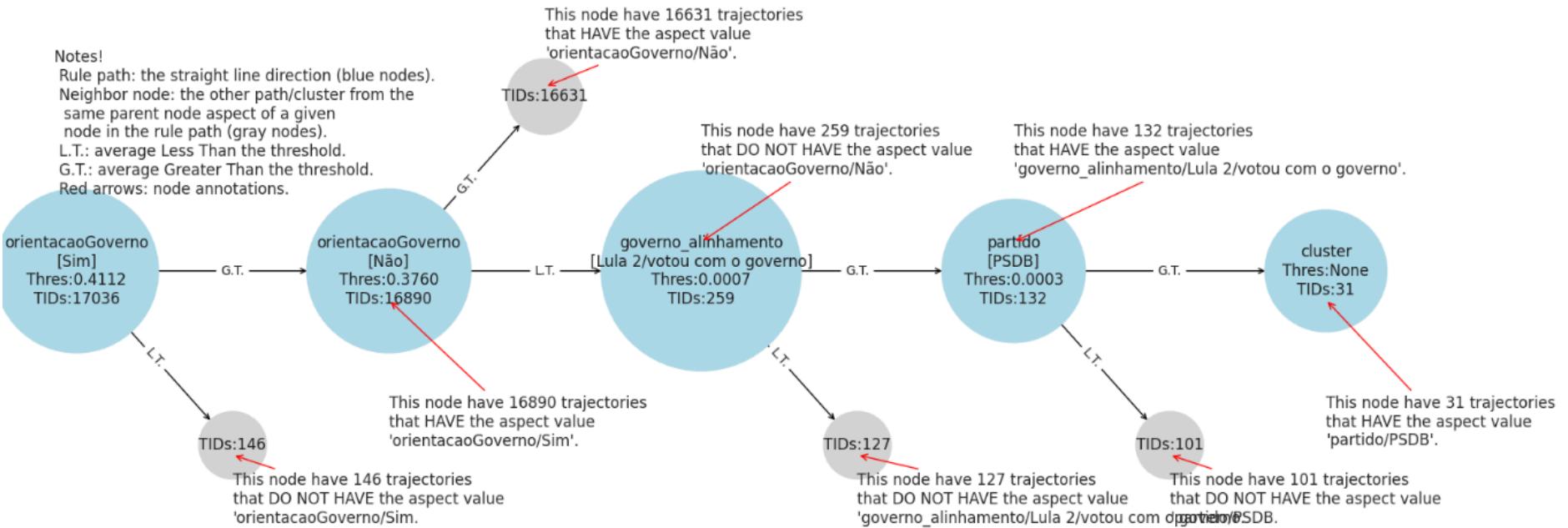
**Figure 50.** The cluster rule path for node 4-0.

- **Cluster Lvl 4-1:** A group of 29 trajectories that initially did not follow the government's guidance for Yes (*orientacaoGoverno [Sim]*), which then supported an MPV proposition (*tipoProposition [MPV]*), and then they continued to support the government's guidance for No and Liberate (*orientacaoGoverno [Não/Liberado]*).



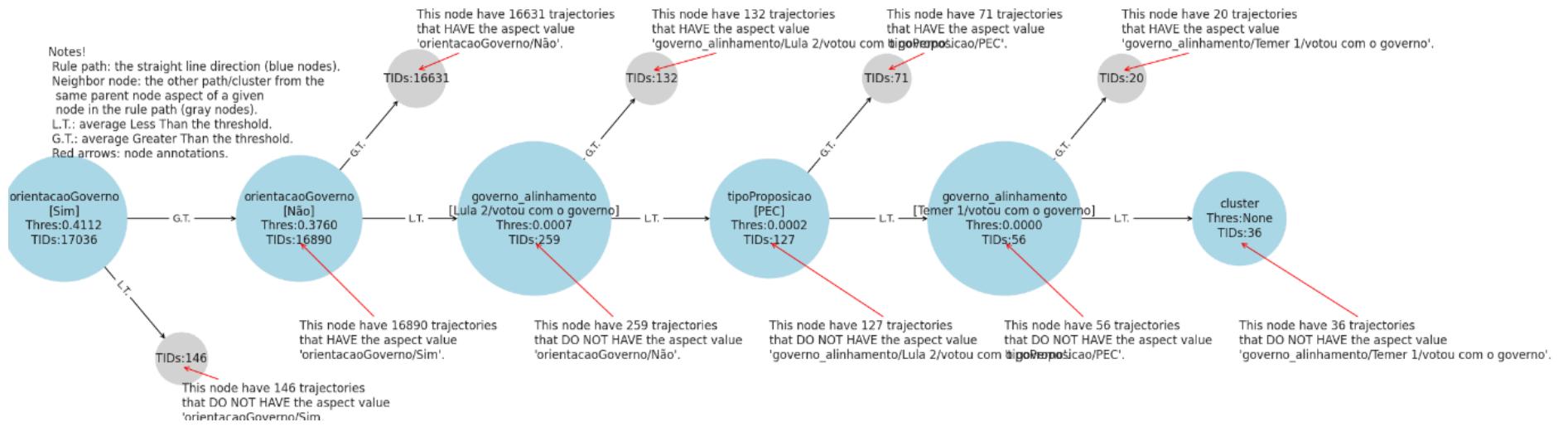
**Figure 51.** The cluster rule path for node 4-1.

- **Cluster Lvl 4-5:** A group of 31 trajectories associated with the PSDB party (partido [PSDB]) that supported the voting orientation of the Lula2 government (governo\_alinhamento [Lula2/Votou com o governo]), where they initially supported the government's orientation for Yes and then for No (orientacaoGoverno [Yes/Não]) before supporting the government.



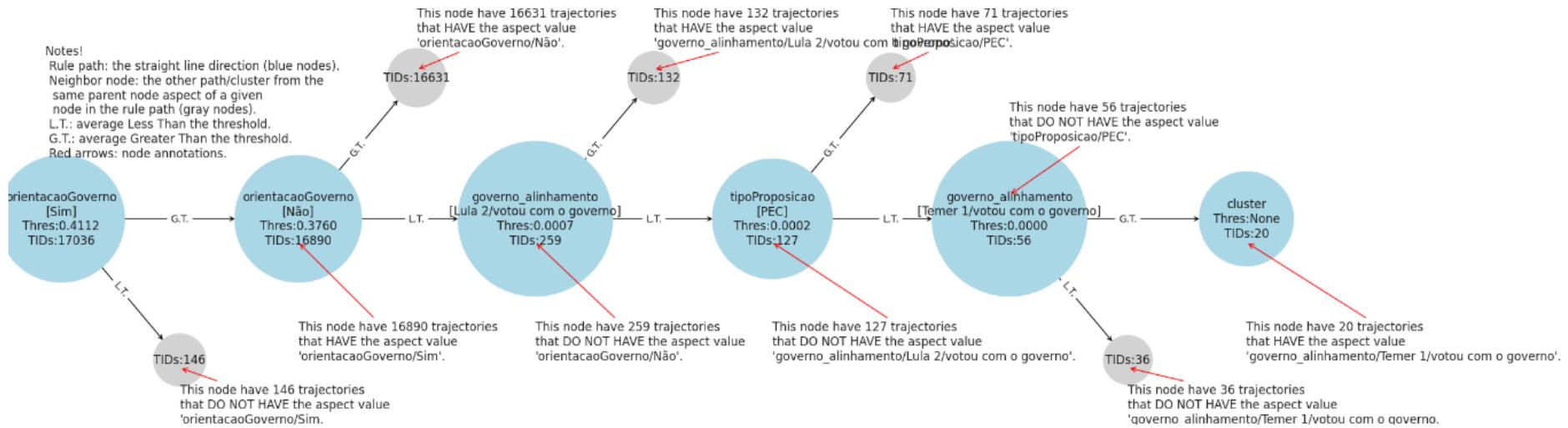
**Figure 52.** The cluster rule path for node 4-5.

- **Cluster Lvl 5-0:** A group of 36 trajectories that initially supported the government's guidance for Yes (orientacaoGoverno [Sim]), that do not followed government's guidance for No (orientacaoGoverno [Não]), that are different of government's alignment for Lula2/Voted with government (governo\_alinhamento [Lula2/Votou com o governo]), then also voted different of PEC proposition (tipoProposicao [PEC]), and concluded that are different of government's alignment for Temer1/voted with government (governo\_alinhamento [Temer1/votou com o governo]).



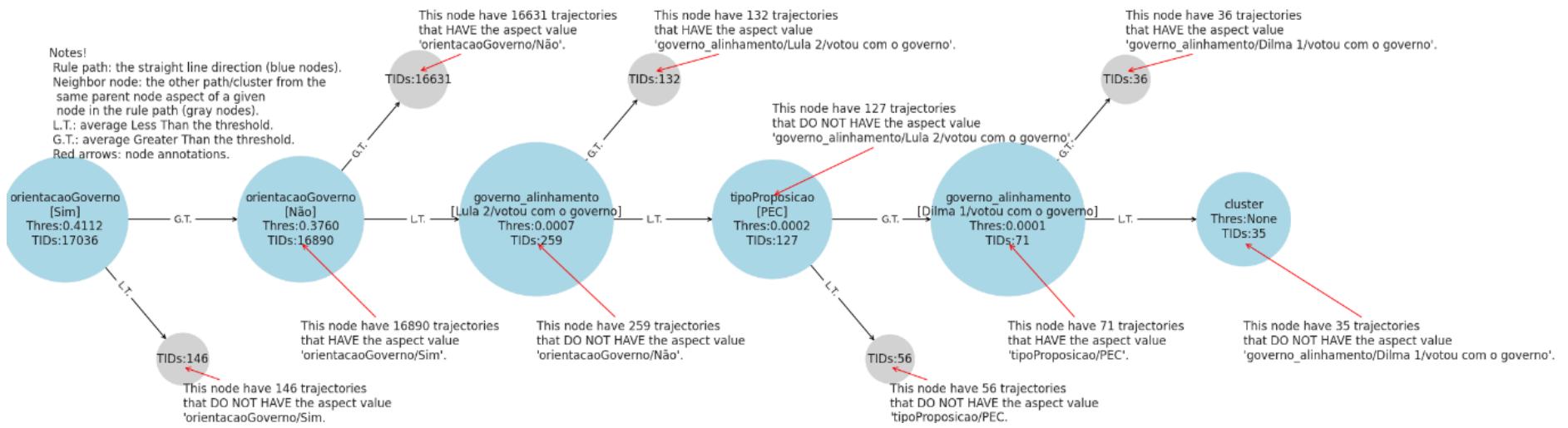
**Figure 53.** The cluster rule path for node 5-0.

- **Cluster Lvl 5-1:** A group of 20 trajectories that voted with the government during the Temer1 mandate (governo\_alinhamento [Temer1/votou com o governo]), which are on propositions different of PEC (tipoProposicao [PEC]), did not vote with the government during Lula2's term (governo\_alinhamento [Lula2/votou com o governo]) and who initially followed the government's guidance for Yes and then did not follow the government guidance for vote No (orientacaoGoverno [Sim/Não]).



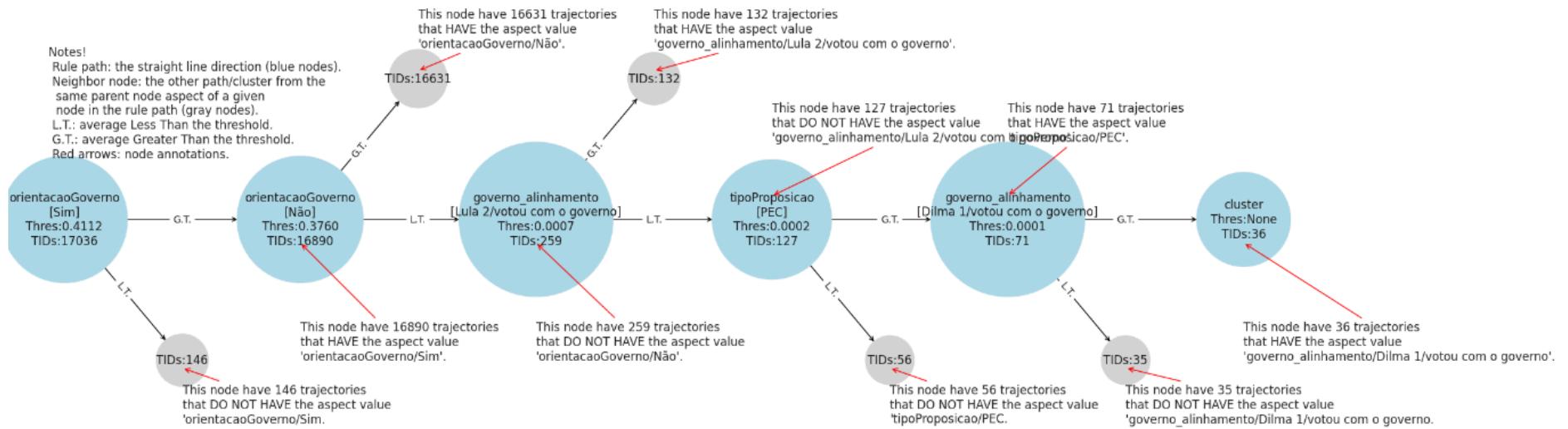
**Figure 54.** The cluster rule path for node 5-1.

- **Cluster Lvl 5-2:** A group of 35 trajectories that voted on government's alignment different of Lula2 and Dilma1 (governo\_alinhamamento [Lula2/votou com o governo and Dilma1/votou com o governo]), where this group voted on PEC propositions (tipoProposicao [PEC]), and initially followed the government's guidance for Yes and then did not follow the government guidance for vote No (orientacaoGoverno [Sim/Não]).



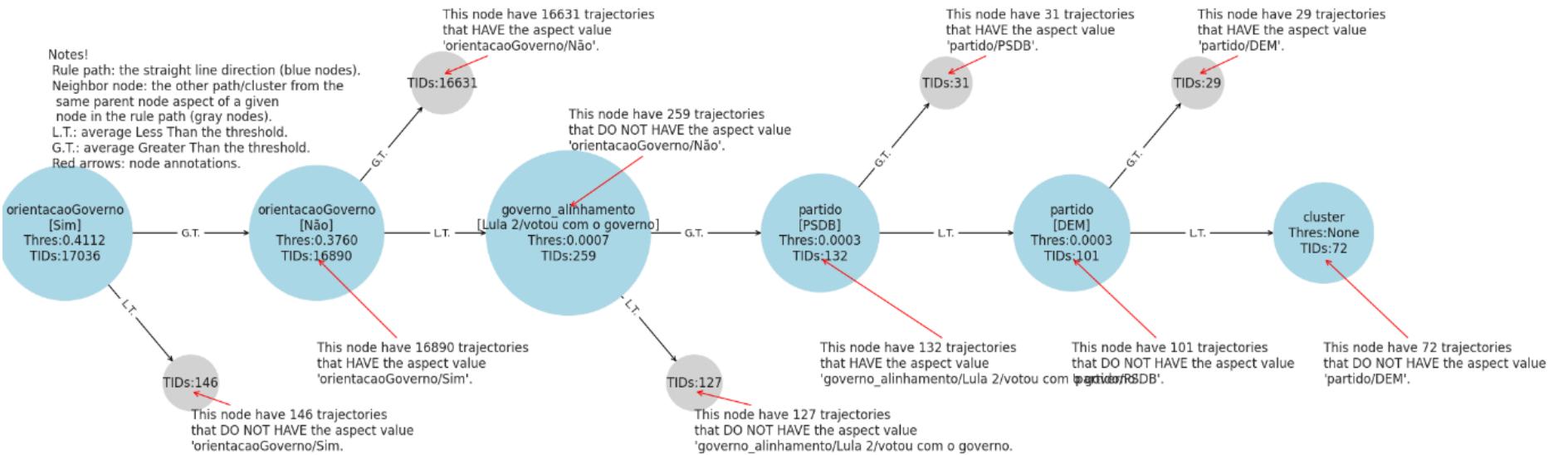
**Figure 55.** The cluster rule path for node 5-2.

- **Cluster Lvl 5-3:** A group of 36 trajectories that voted on PEC propositions (tipoProposicao [PEC]), also voted with the government during the Dilma1 term (governo\_alinhamento [Dilma1/votou com o governo]), where this group followed government's guidance for Yes (orientacaoGoverno [Sim]), then followed government's guidance different of No (orientacaoGoverno [Não]), and these trajectories are different of Lula2 term that voted with the government (governo\_alinhamento [Lula2/votou com o governo]).



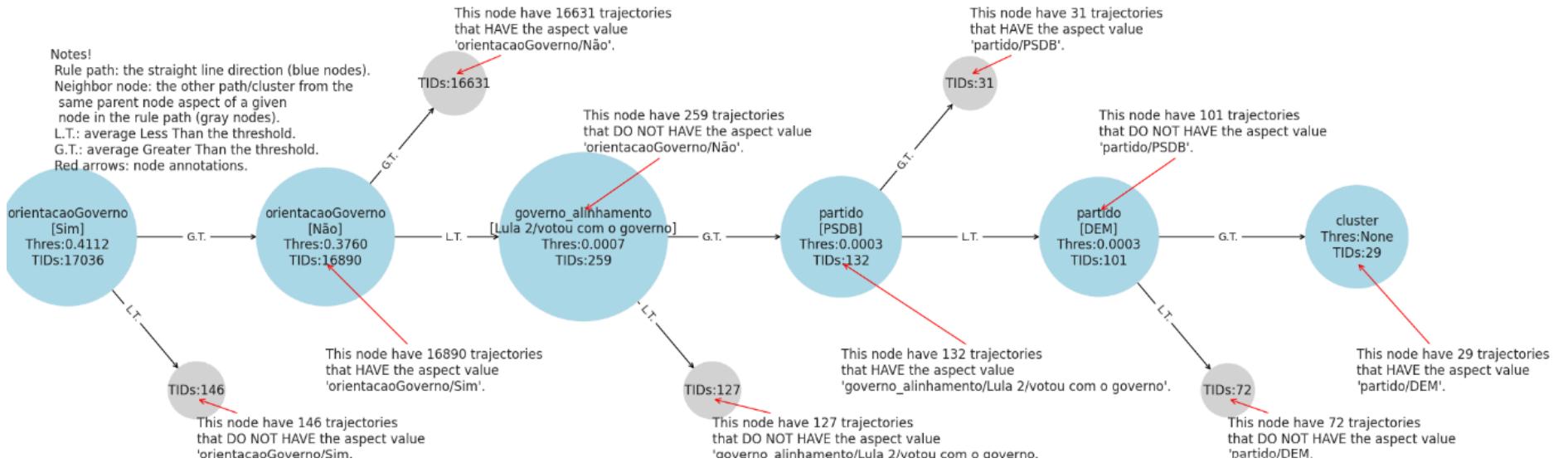
**Figure 56.** The cluster rule path for node 5-3.

- **Cluster Lvl 5-4:** A group of 72 trajectories that voted with the government during the Lula2 term (governo\_alinhamento [Lula2/votou com o governo]), where this group followed the government's guidance vote for Yes and then followed for a vote different for guidance No (orientacaoGoverno [Sim/Não]), and the parties PSDB and DEM are not present (partido [PSDB/DEM]).



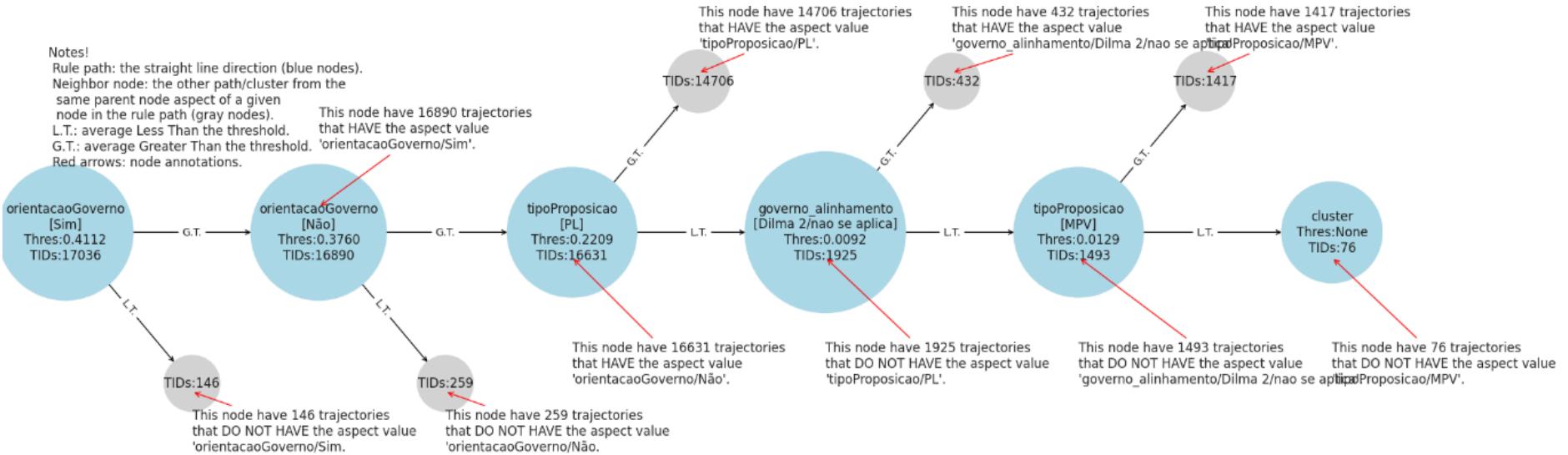
**Figure 57.** The cluster rule path for node 5-4.

- **Cluster Lvl 5-5:** A group of 29 trajectories from the DEM party (partido [DEM]) that voted with the government during the Lula2 term (governo\_alinhamento [Lula2/votou com o governo]), where this group followed the government's guidance vote for Yes and then followed for a different vote of the guidance for No (orientacaoGoverno [Sim/Não]), and then the party PSDB contribute to identify these trajectories from DEM party.



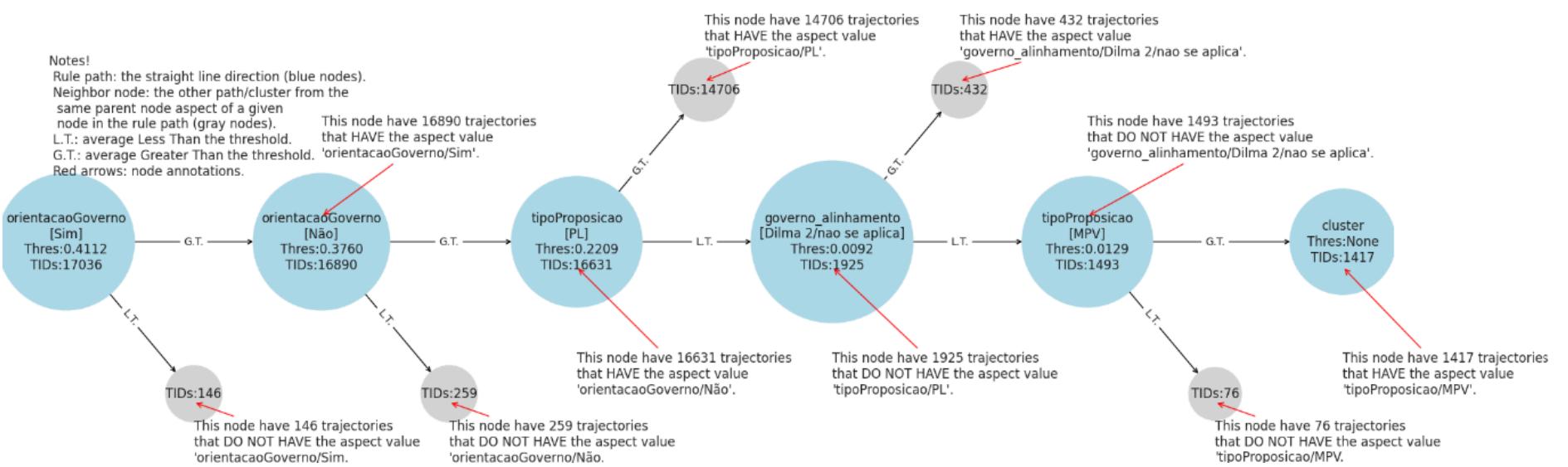
**Figure 58.** The cluster rule path for node 5-5.

- **Cluster Lvl 5-6:** A group of 76 trajectories that initially followed the government's guidance to vote Yes and then No (orientacaoGoverno [Sim/Não]) and voted different of PL and MPV propositions (tipoProposicao [PL/MPV]) which are different of the not applicable vote during the Dilma2 term (governo\_alinhamento [Dimla2/não se aplica]).



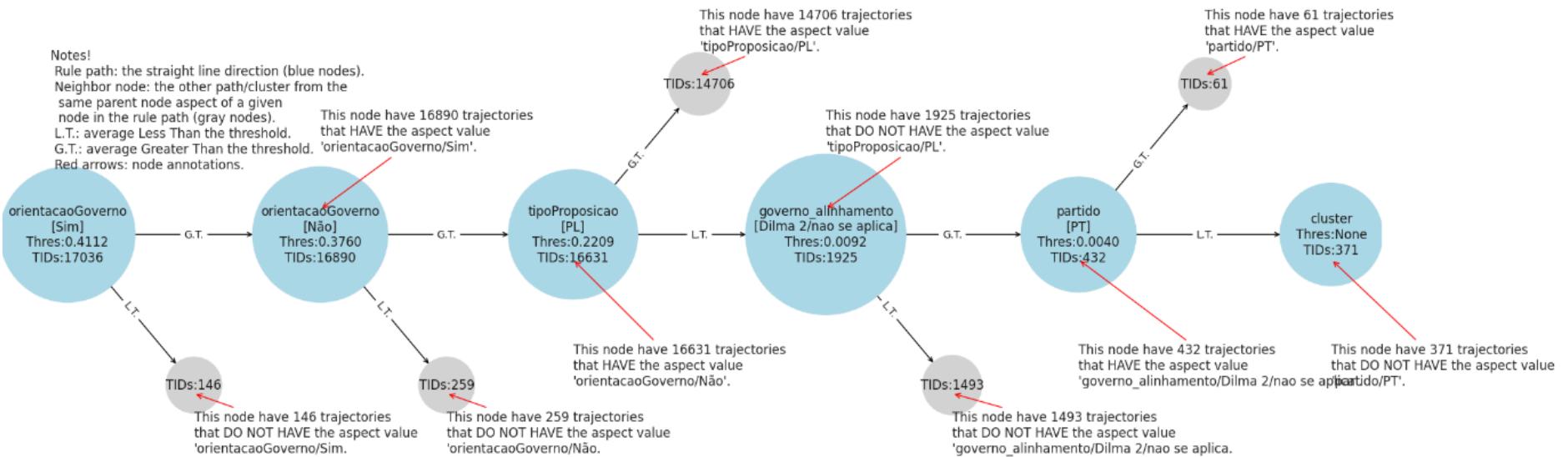
**Figure 59.** The cluster rule path for node 5-6.

- **Cluster Lvl 5-7:** A group of 1417 trajectories that voted on MPV propositions (tipoPropositions [MPV]), followed the government's guide of vote Yes and No (orientacaoGoverno [Sim/Não]), and are different of the not applicable vote during the Dilma2 term (governo\_alinhamento [Dilma2/não se aplica]).



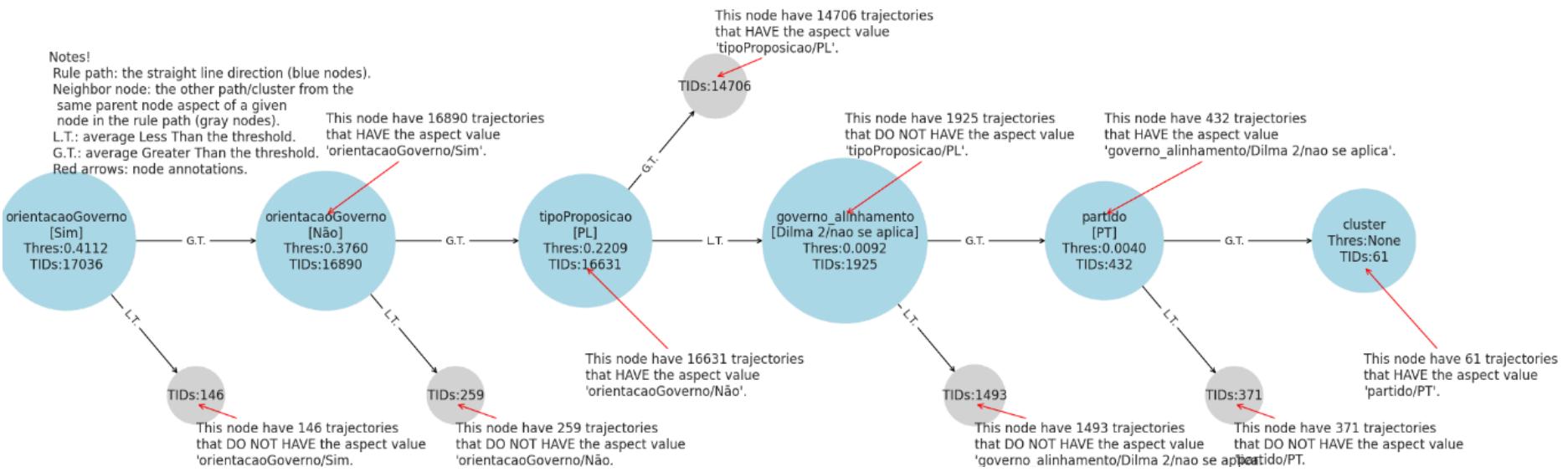
**Figure 60.** The cluster rule path for node 5-7.

- **Cluster Lvl 5-8:** A group of 371 trajectories that are different of PT party, that followed the government's guidance to vote Yes and then No (orientacaoGoverno [Sim/Não]), and followed the not applicable government's guidance during the Dilma2 term (governo\_alinhamento [Dilma2/não se aplica]).



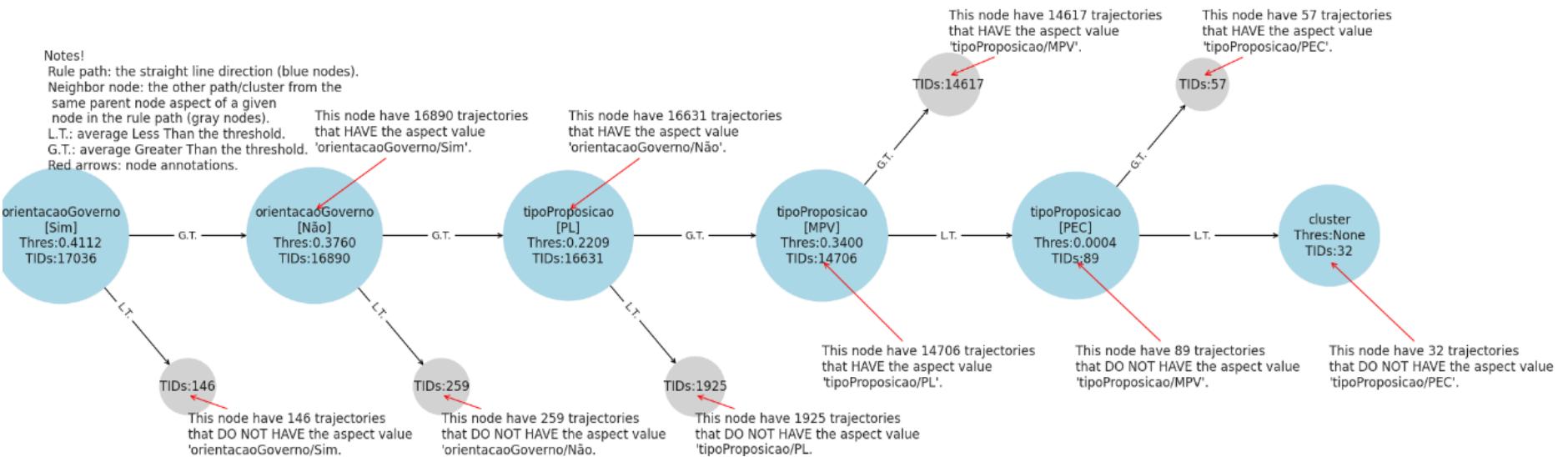
**Figure 61.** The cluster rule path for node 5-8.

- **Cluster Lvl 5-9:** A group of 61 trajectories from PT party that followed the government's guidance to vote Yes and then No (orientacaoGoverno [Sim/Não]), and followed the not applicable government's guidance during the Dilma2 term (governo\_alinhamento [Dilma2/não se aplica]).



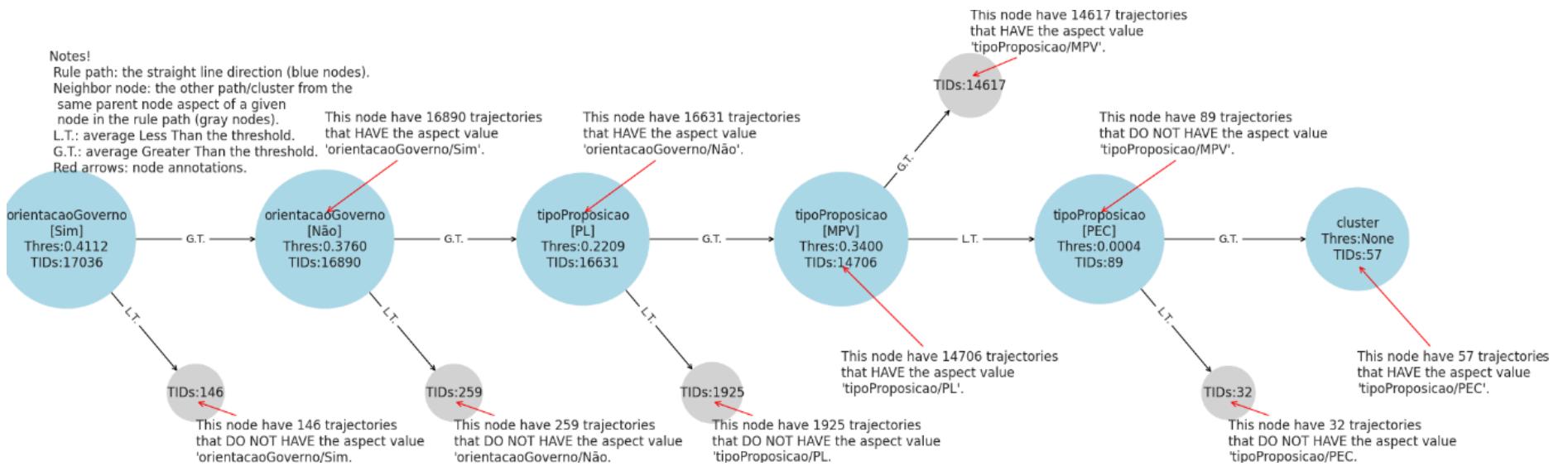
**Figure 62.** The cluster rule path for node 5-9.

- **Cluster Lvl 5-10:** A group of 32 trajectories that voted on PL proposition (tipoProposicao [PL]) and also followed the government's guidance to vote Yes and then No (orientacaoGoverno [Sim/Não]).



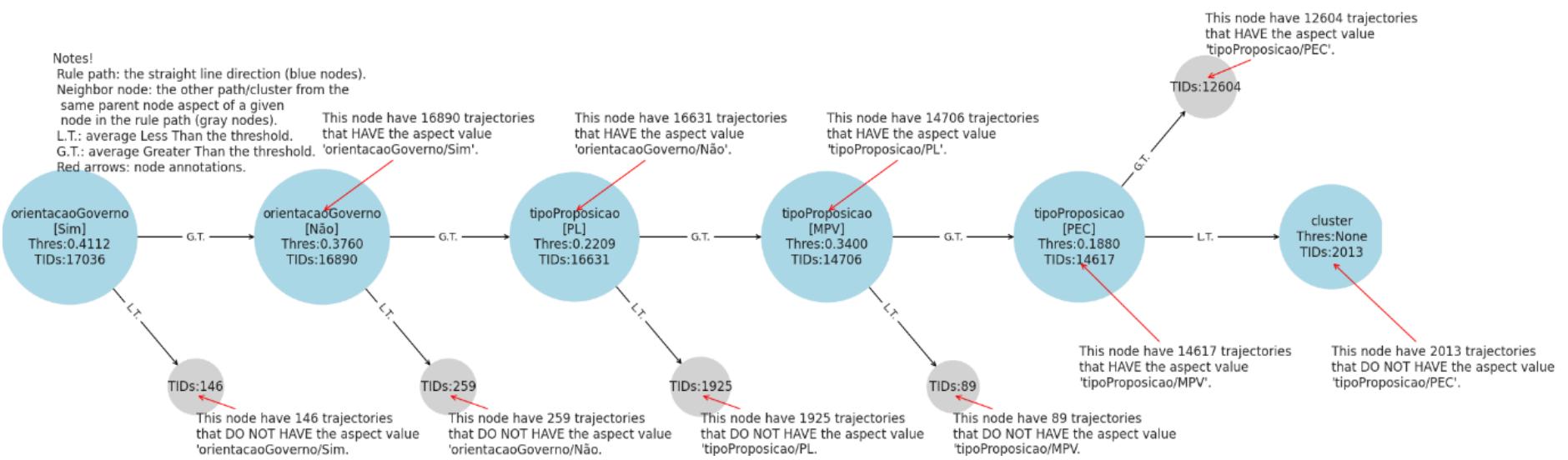
**Figure 63.** The cluster rule path for node 5-10.

- **Cluster Lvl 5-11:** A group of 57 trajectories that voted both on PL and PEC propositions (tipoProposicao [PL/PEC]) and also followed the government's guidance to vote Yes and then No (orientacaoGoverno [Sim/Não]).



**Figure 64.** The cluster rule path for node 5-11.

- **Cluster Lvl 5-12:** A group of 2013 trajectories that voted both on PL and MPV propositions (tipoProposicao [PL/MPV]) and also followed the government's guidance to vote Yes and then No (orientacaoGoverno [Sim/Não]).



**Figure 65.** The cluster rule path for node 5-12.

- **Cluster Lvl 5-13:** A group of 12604 trajectories that voted on PL, MPV, and PEC propositions (tipoProposicao [PL/MPV/PEC]) and also followed the government's guidance to vote Yes and then No (orientacaoGoverno [Sim/Não]).

Notes!

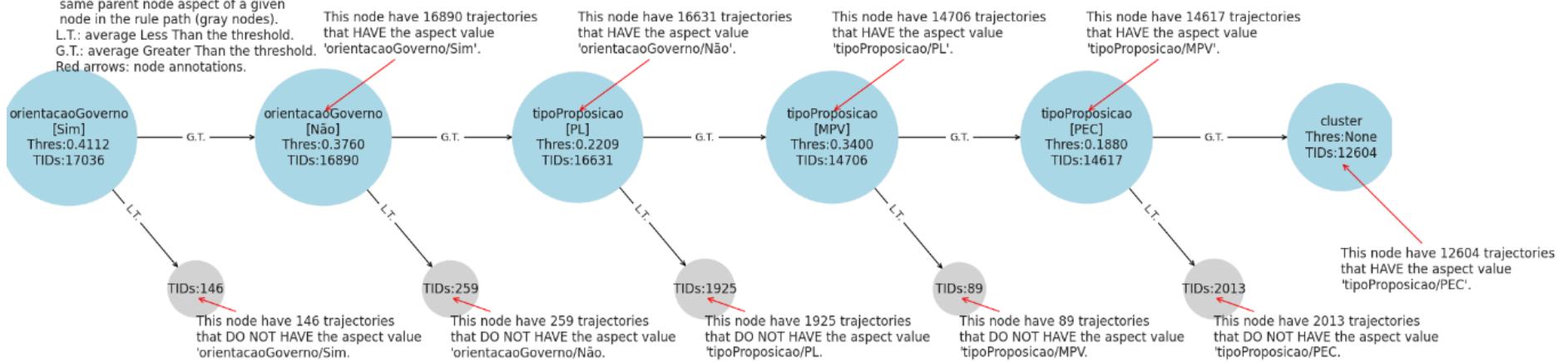
Rule path: the straight line direction (blue nodes).

Neighbor node: the other path/cluster from the same parent node aspect of a given node in the rule path (gray nodes).

L.T.: average Less Than the threshold.

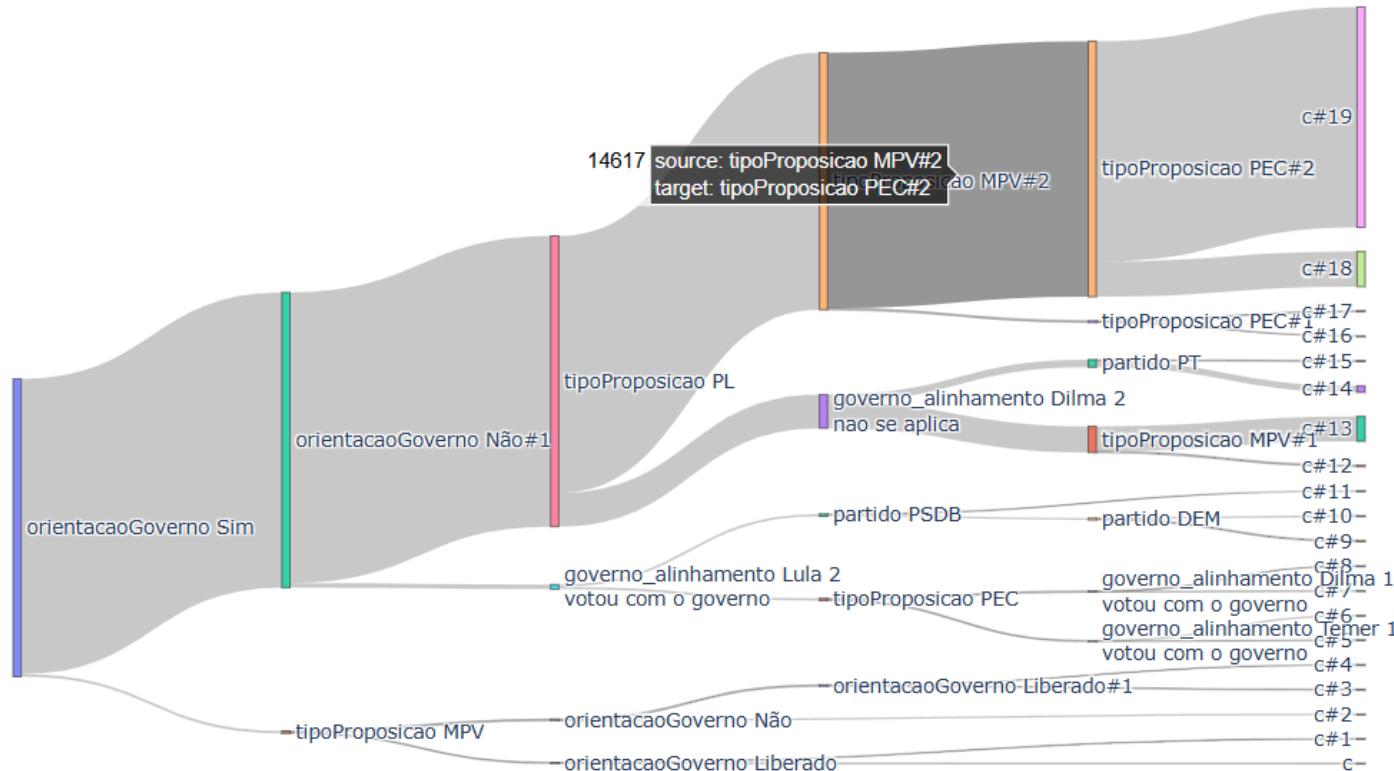
G.T.: average Greater Than the threshold, 'orientacaoGoverno/Sim'.

Red arrows: node annotations.



**Figure 66.** The cluster rule path for node 5-13.

The Sankey diagram, Figure 67, shows another way to visualize the tree. It helps to visualize the concentration of the number of trajectories for the clustering result.

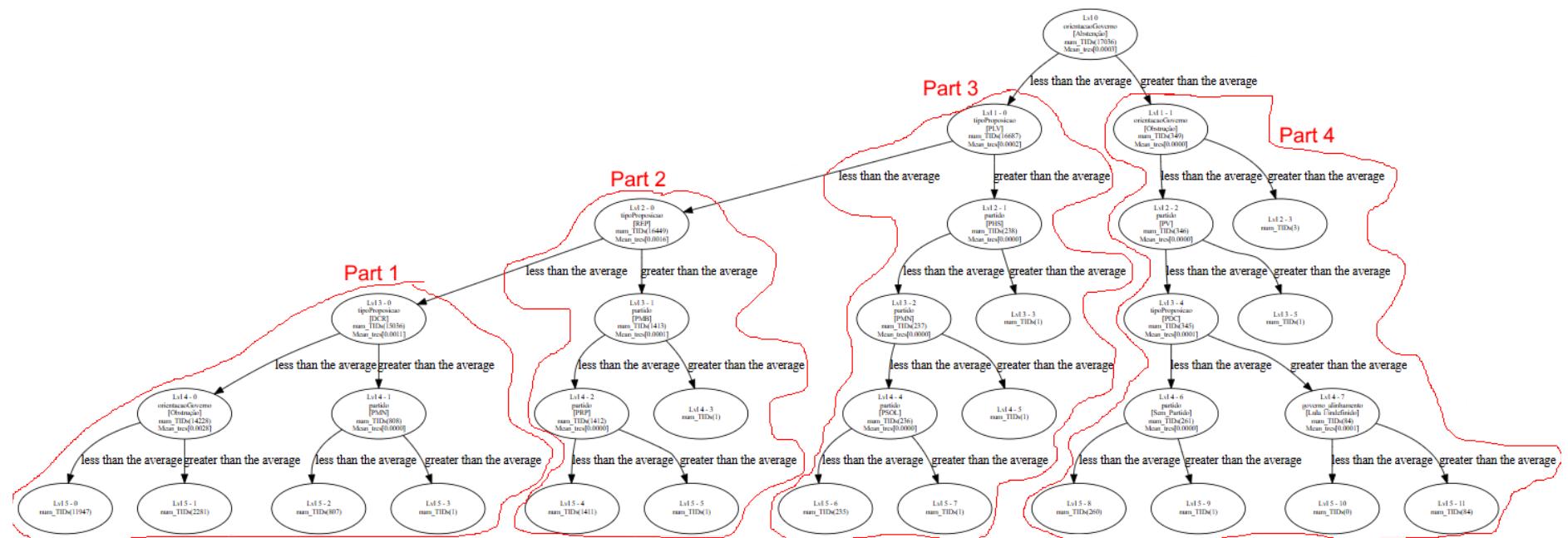


**Figure 67.** Sankey diagram with 20 clusters (*leaf nodes*) using the combined features and MVR strategy.

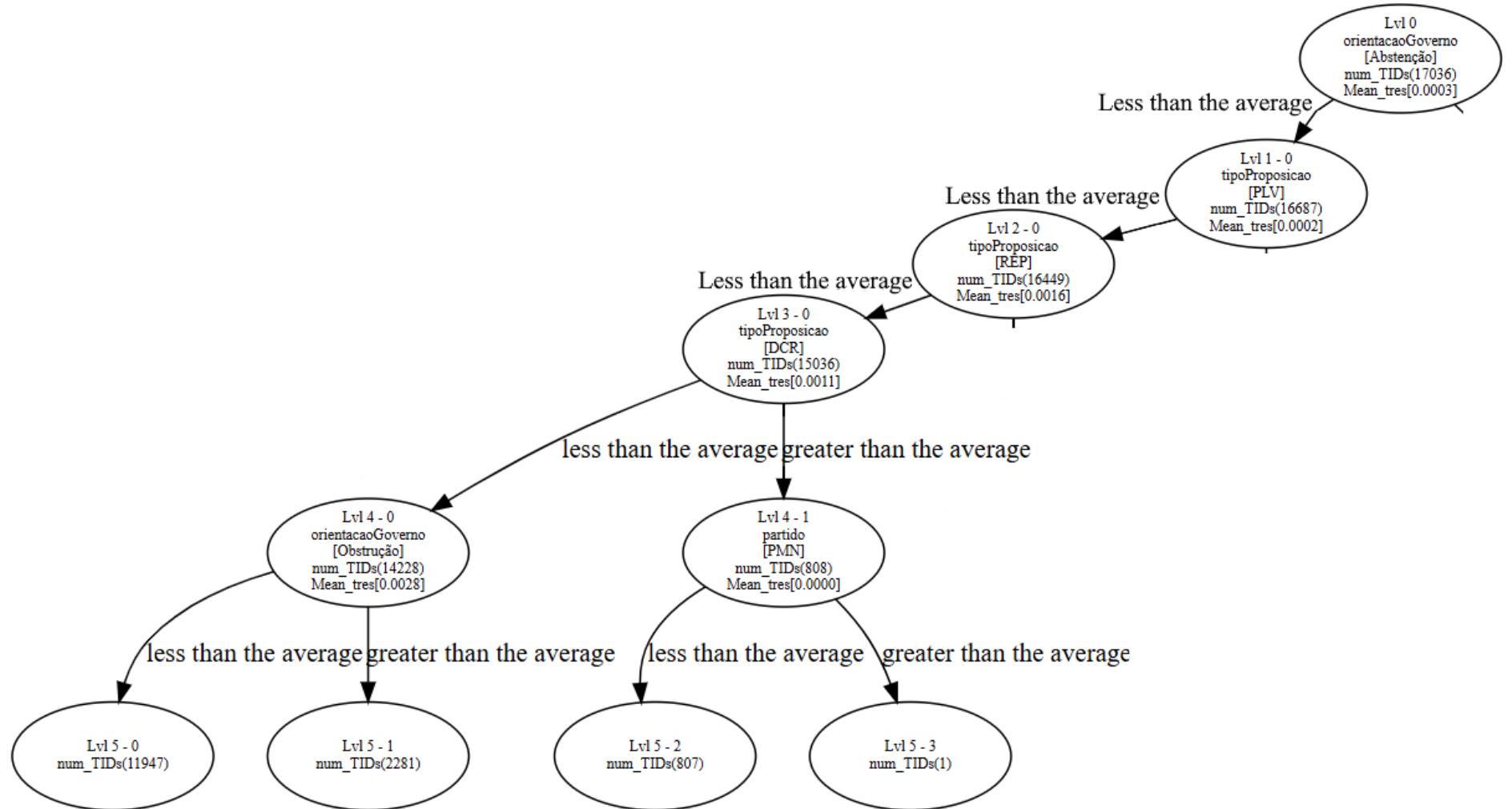
### 3.2.2 Minimum Variance (MV)

**Minimum variance** evaluates the mean variance of an aspect in both trajectory subsets for each subtree. This strategy selects the aspect that generates the smallest mean variance among the subtree (children nodes).

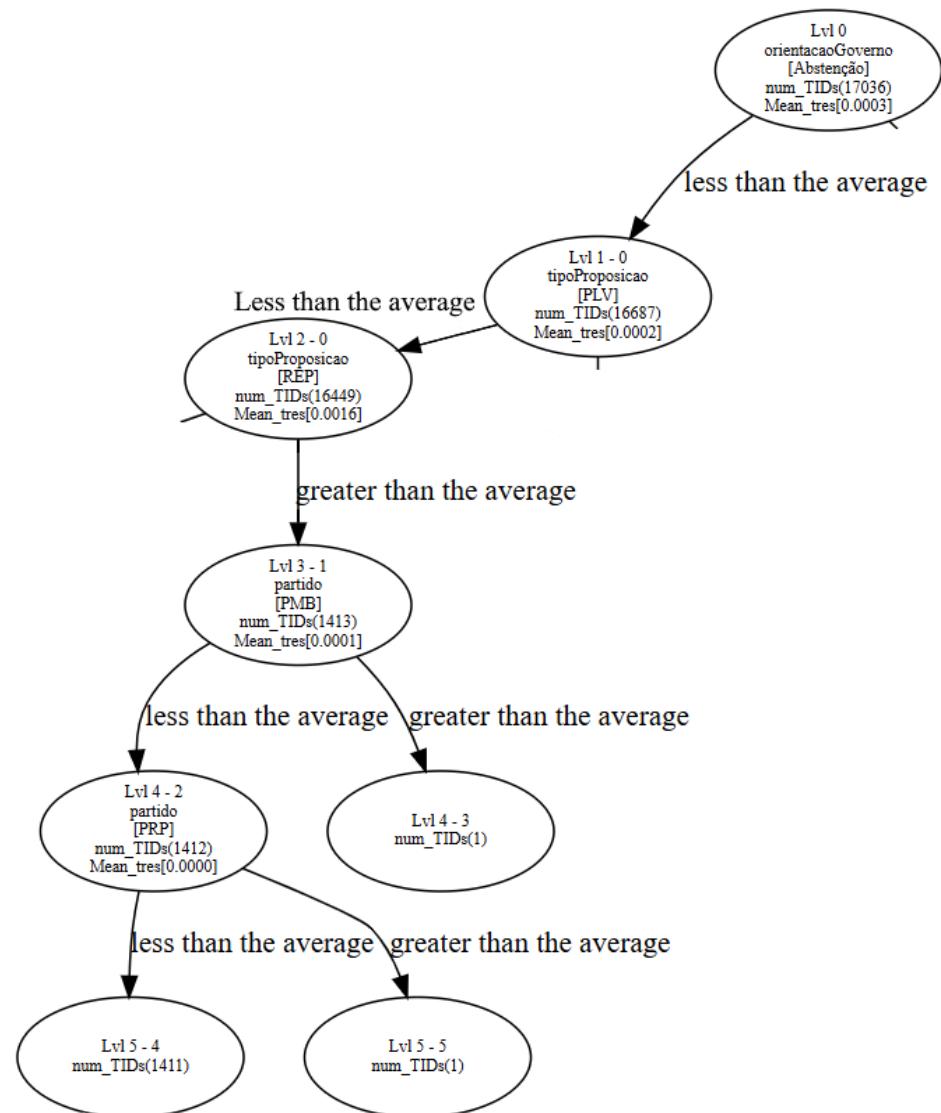
Regarding this selection aspect strategy, we see in Figure 68 that MAT-Tree identified 16 clusters. Besides, we breakdown Figure 68 into four parts (Figures from 69 to 72) to facilitate the tree visualization. Furthermore, we summarized the main characteristics of Figure 68 in Table 4 such as cluster (node), number of trajectories, cluster entropy, unique labels, and the relevant aspects.



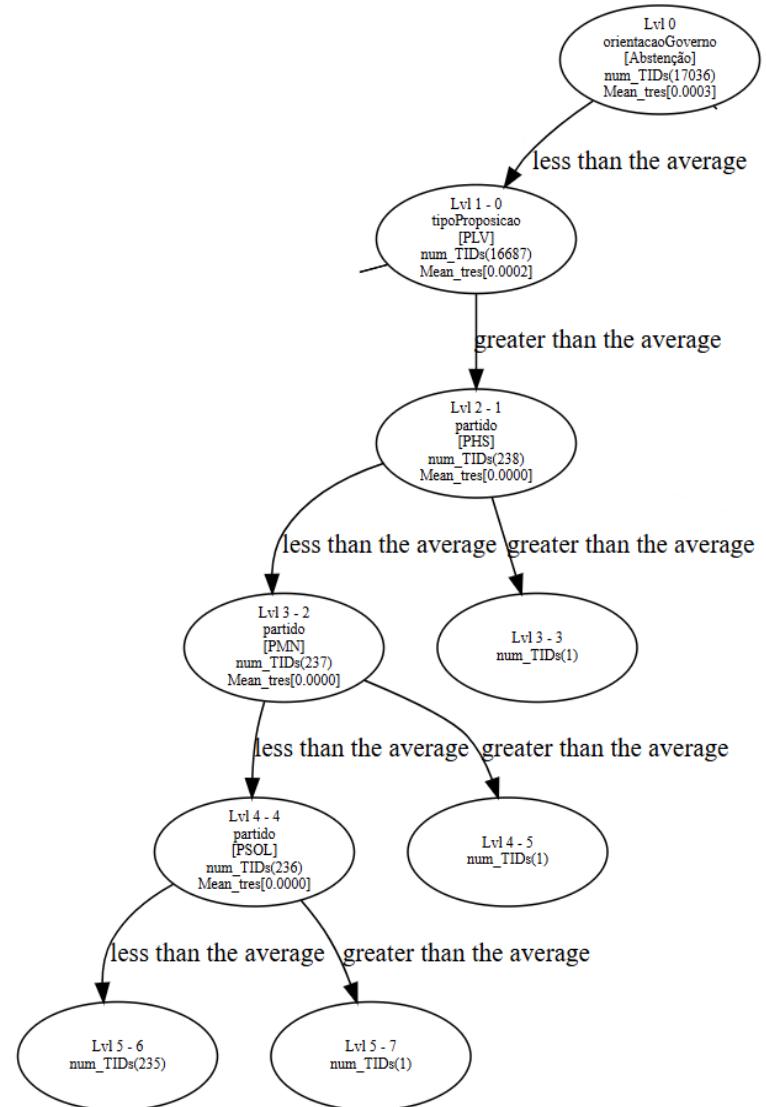
**Figure 68.** Clustering result with 16 clusters from concatenated features.  
Hyperparameters: selection strategy = MV; max depth = 5; min trajs = 50.



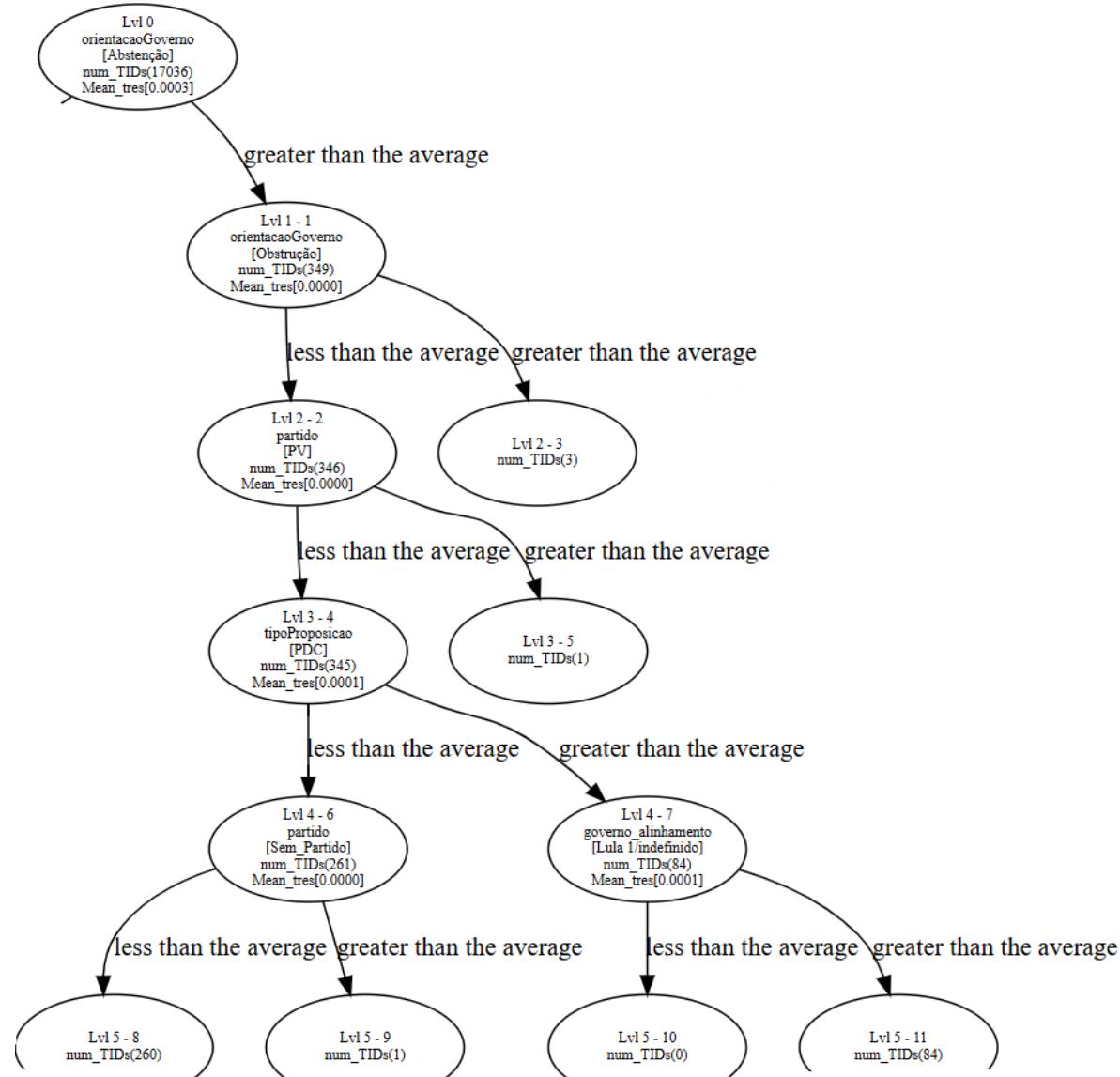
**Figure 69.** 4 clusters from part 1 of the tree.



**Figure 70.** 3 clusters from part 2 of the tree.



**Figure 71.** 4 clusters from part 3 of the tree.



**Figure 72.** 5 clusters from part 4 of the tree.

Table 4 shows the main characteristics of the clusters in Figure 68. Such characteristics are the number of trajectories, the entropy, parties in the node, and the selected aspects.

**Table 4.** Main characteristics of the clusters using MV strategy. (*LT*): *Less than*; (*GT*): *Greater than*.

Cluster (node)	Characteristics			
	Number of trajectories	Entropy	Unique parties	Relevant aspects (rules)
Lvl 2-3	3	1	DEM, PTB and PSDB	orientacaoGoverno [Abstenção] $\rightarrow^{GT}$ orientacaoGoverno [Obstrução] $\rightarrow^{GT}$ cluster
Lvl 3-3	1	0	PHS	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{GT}$ partido [PHS] $\rightarrow^{GT}$ cluster
Lvl 3-5	1	0	PV	orientacaoGoverno [Abstenção] $\rightarrow^{GT}$ orientacaoGoverno [Obstrução] $\rightarrow^{LT}$ partido [PV] $\rightarrow^{GT}$ cluster
Lvl 4-3	1	0	PMB	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{LT}$ tipoProposicao [REP] $\rightarrow^{GT}$ partido [PMB] $\rightarrow^{GT}$ cluster
Lvl 4-5	1	0	PMN	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{GT}$ partido [PHS] $\rightarrow^{LT}$ partido [PMN] $\rightarrow^{GT}$ cluster

Lvl 5-0	11947	0.7175	DEM, Sem_Partido, MDB, PL, PTB, Progressistas, Solidariedade, PSD, União, Republicano, PSB, PSC, PSDB, Cidadania, PDT, PTC, PROS, PSL, PHS, Podemos, PRP, PT, PSOL, Patriota, PRONA, PRB, Avante, PCdoB, REDE, PMN, PV, PMB, PPL, PRTB, DC, Rede and Novo	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{LT}$ tipoProposicao [REP] $\rightarrow^{LT}$ tipoProposicao [DRC] $\rightarrow^{LT}$ orientacaoGoverno [Obstrução] $\rightarrow^{LT}$ cluster
Lvl 5-1	2281	0.7501	DEM, Progressistas, PL, PSDB, MDB, Sem_Partido, PSD, PTB, Avante, Podemos, PHS, PDT, PSC, Solidariedade, PROS, PCdoB, PT, PSB, PV, Cidadania, PAN, PSOL, PSL, PTC, PMN, PRB, Republicano, PRP, Patriota, PMB and Novo	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{LT}$ tipoProposicao [REP] $\rightarrow^{LT}$ tipoProposicao [DRC] $\rightarrow^{LT}$ orientacaoGoverno [Obstrução] $\rightarrow^{GT}$ cluster
Lvl 5-2	807	0.816	PRB, DEM, PL, MDB, PSD, PSDB, Cidadania, PMB, PTB, PDT, PHS, PT, Podemos, PSC, Patriota, Progressistas, PSL, Solidariedade, PCdoB, Sem_Partido, Avante, PSB, PSOL, PV, PTC, PROS and REDE	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{LT}$ tipoProposicao [REP] $\rightarrow^{LT}$ tipoProposicao [DRC] $\rightarrow^{GT}$ partido [PMN] $\rightarrow^{LT}$ cluster
Lvl 5-3	1	1	PMN and Podemos	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{LT}$ tipoProposicao [REP] $\rightarrow^{LT}$ tipoProposicao [DRC] $\rightarrow^{GT}$ partido [PMN] $\rightarrow^{GT}$ cluster
Lvl 5-4	1411	0.7595	DEM, MDB, PL, PRB, PDT, PT, PSDB, Progressistas, Cidadania, PCdoB, PTB, PSB, PSOL, PSC, PV, PMN, PSL, PHS, Avante, PSD, PROS, Solidariedade, Podemos, REDE and Sem_Partido	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{LT}$ tipoProposicao [REP] $\rightarrow^{GT}$ partido [PMB] $\rightarrow^{LT}$ partido [PRP] $\rightarrow^{LT}$ cluster

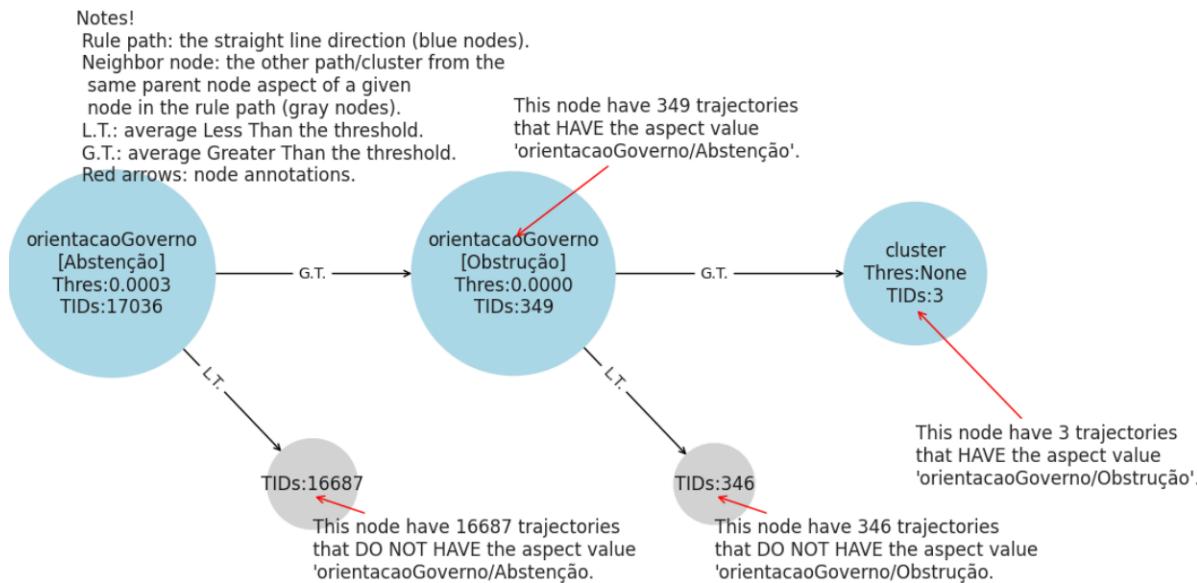
Lvl 5-5	1	0	PRP	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{LT}$ tipoProposicao [REP] $\rightarrow^{GT}$ partido [PMB] $\rightarrow^{LT}$ partido [PRP] $\rightarrow^{GT}$ cluster
Lvl 5-6	235	0.8473	DEM, MDB, PL, PDT, PT, PSDB, Progressistas, Cidadania, PCdoB, PTB, PSB, PSC and PV	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{GT}$ partido [PHS] $\rightarrow^{LT}$ partido [PMN] $\rightarrow^{LT}$ partido [PSOL] $\rightarrow^{LT}$ cluster
Lvl 5-7	1	0	PSOL	orientacaoGoverno [Abstenção] $\rightarrow^{LT}$ tipoProposicao [PLV] $\rightarrow^{GT}$ partido [PHS] $\rightarrow^{LT}$ partido [PMN] $\rightarrow^{LT}$ partido [PSOL] $\rightarrow^{GT}$ cluster
Lvl 5-8	260	0.8704	DEM, Progressistas, MDB, PL, PDT, PT, PSDB, Cidadania, PCdoB, PTB and PSB	orientacaoGoverno [Abstenção] $\rightarrow^{GT}$ orientacaoGoverno [Obstrução] $\rightarrow^{LT}$ partido [PV] $\rightarrow^{LT}$ tipoProposicao [PDC] $\rightarrow^{LT}$ partido [Sem_partido] $\rightarrow^{LT}$ cluster
Lvl 5-9	1	0	PDT, Sem_Partido and Cidadania	orientacaoGoverno [Abstenção] $\rightarrow^{GT}$ orientacaoGoverno [Obstrução] $\rightarrow^{LT}$ partido [PV] $\rightarrow^{LT}$ tipoProposicao [PDC] $\rightarrow^{LT}$ partido [Sem_partido] $\rightarrow^{GT}$ cluster

Lvl 5-11	84	0.8436	DEM, MDB, PDT, PT, PSDB, Progressistas, Cidadania, PTB, Sem_Partido and PCdoB	orientacaoGoverno [Abstenção] $\xrightarrow{GT}$ orientacaoGoverno [Obstrução] $\xrightarrow{LT}$ partido [PV] $\xrightarrow{LT}$ tipoProposicao [PDC] $\xrightarrow{GT}$ governo_alignamento [Lula 1/Indefinido] $\xrightarrow{GT}$ cluster
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In addition, we present the meaning of the rules represented by the relevant aspects in Table 4 as follows.

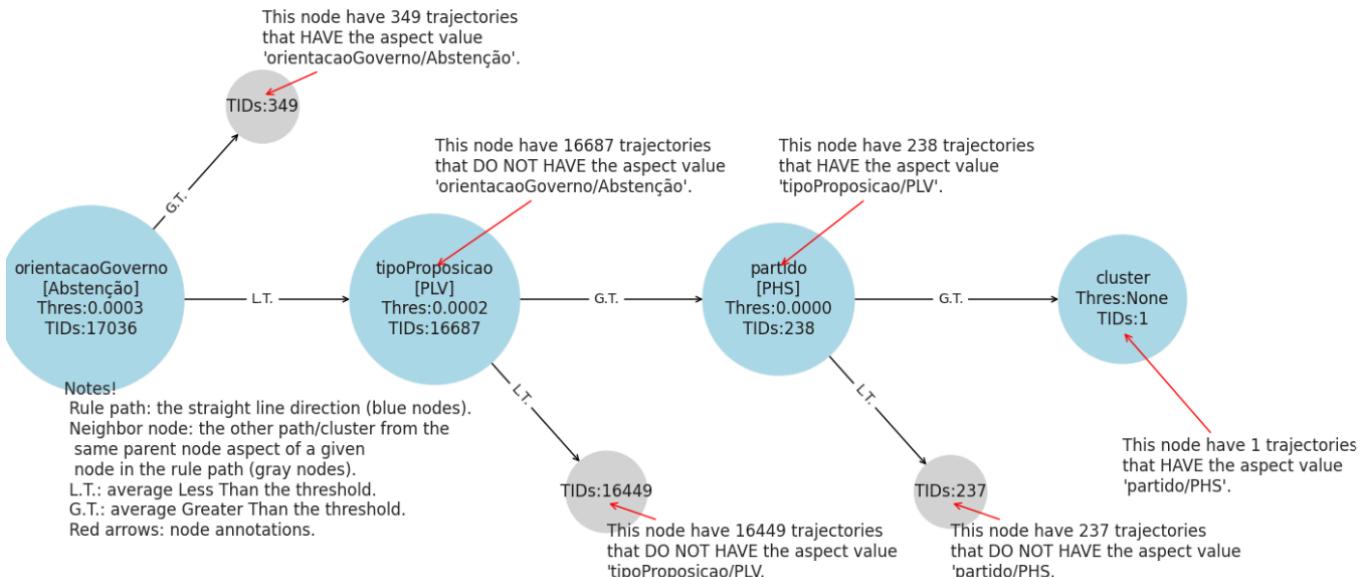
- Rules meaning

- Cluster Lvl 2-3:** A group of 3 trajectories that followed the government's guidance to vote Abstention and Obstruction (orientacaoGoverno [Abstenção|Obstrução]).



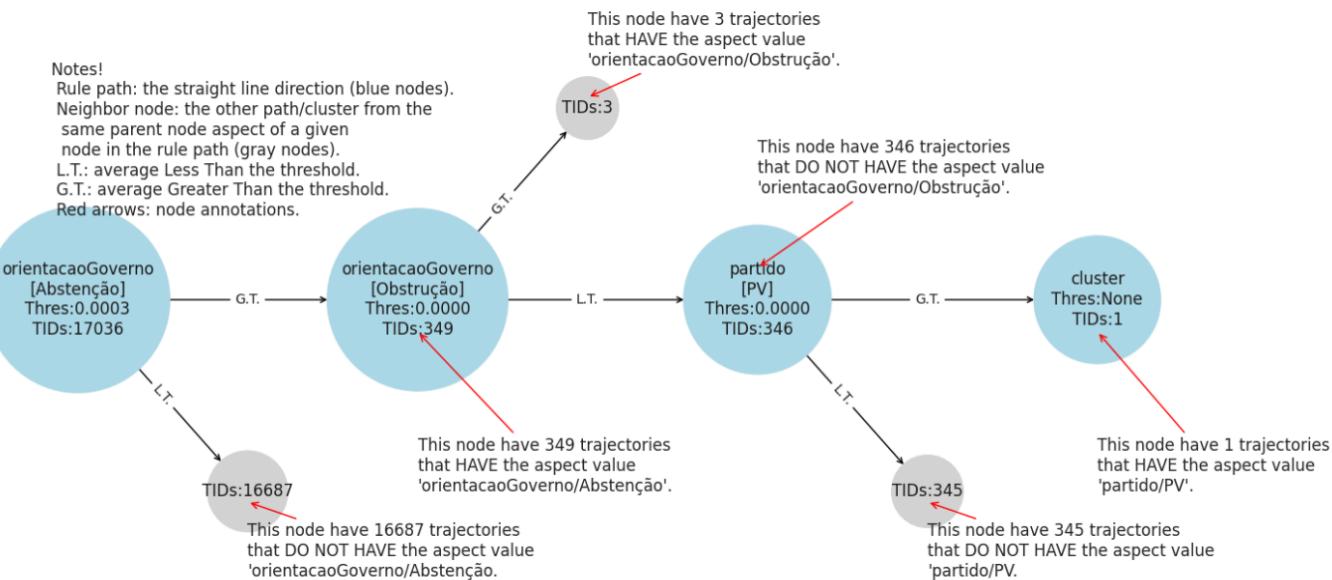
**Figure 73.** The cluster rule path for node 2-3.

- **Cluster Lvl 3-3:** A group of 1 trajectory from PHS party (partido [PHS]) that voted on PLV proposition (tipoProposicao [PLV]) and voted different of the government's guidance for Abstention (orientacaoGoverno [Abstenção]).



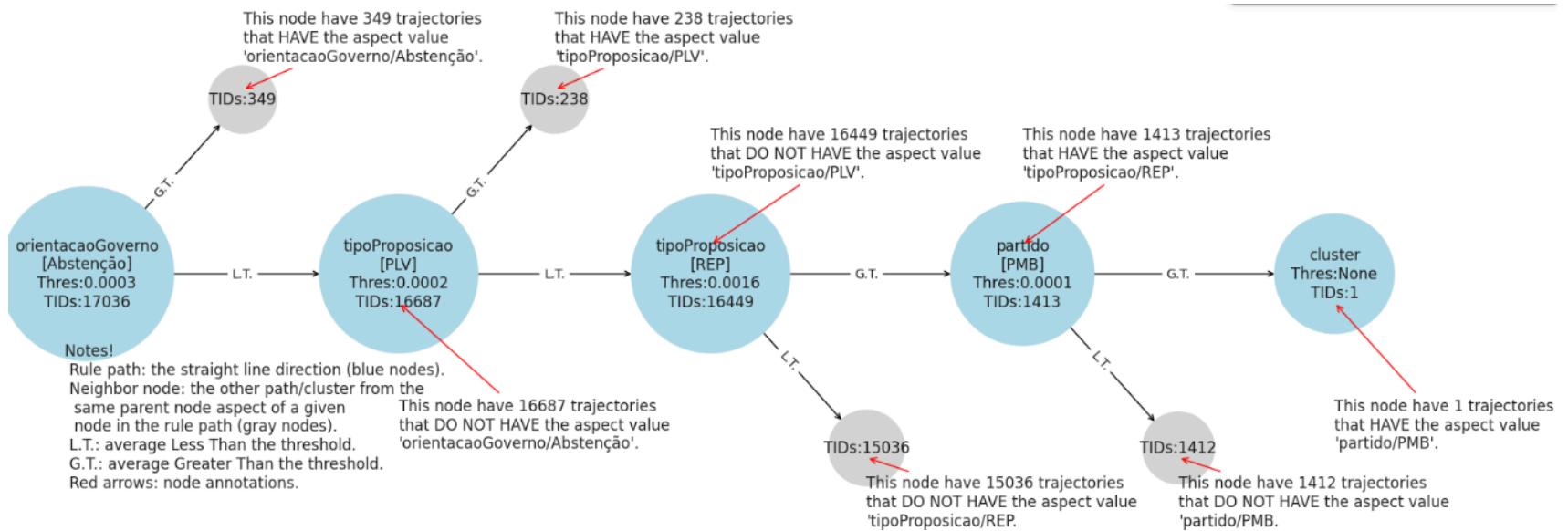
**Figure 74.** The cluster rule path for node 3-3.

- **Cluster Lvl 3-5:** A group of 1 trajectory from PV party (partido [PV]) that followed the government's guidance to vote Abstention (orientacaoGoverno [Abstenção]), and then voted different of government's guidance to vote Obstruction (orientacaoGoverno [Obstrução]).



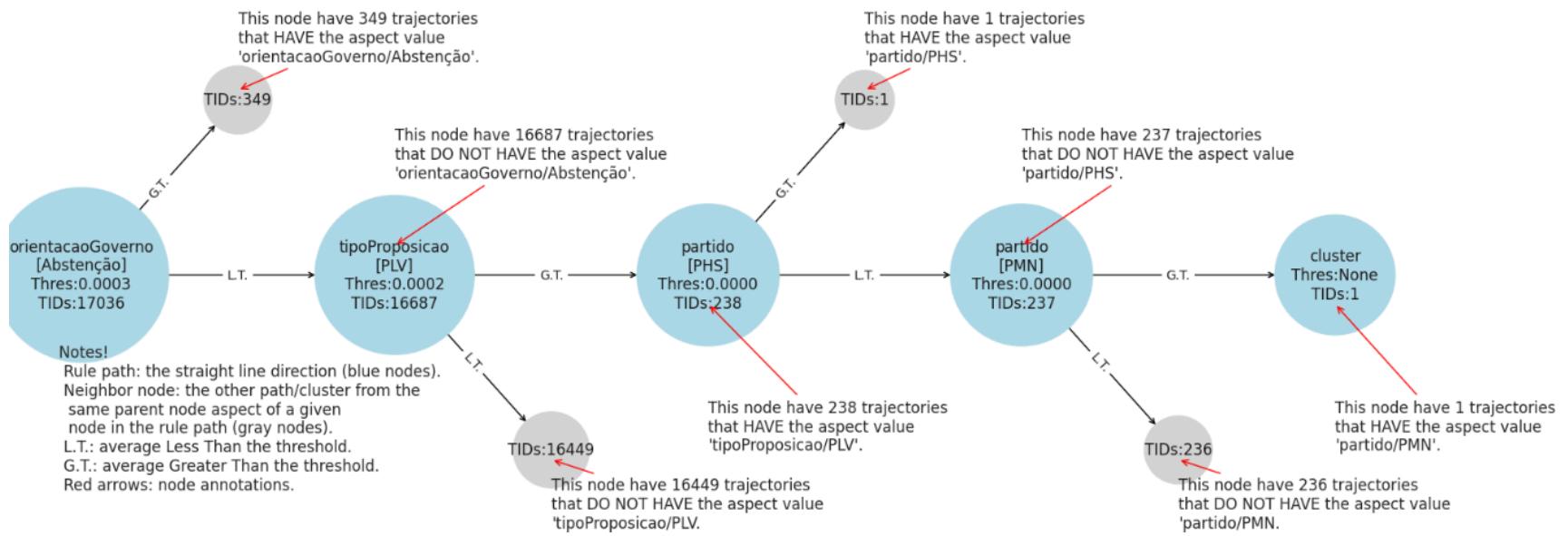
**Figure 75.** The cluster rule path for node 3-5.

- **Cluster Lvl 4-3:** A group of 1 trajectory from PMB party (partido [PMB]) that voted on REP proposition (tipoProposicao [REP]) and voted different of government's guidance to vote Abstention (orientacaoGoverno [Abstenção]).



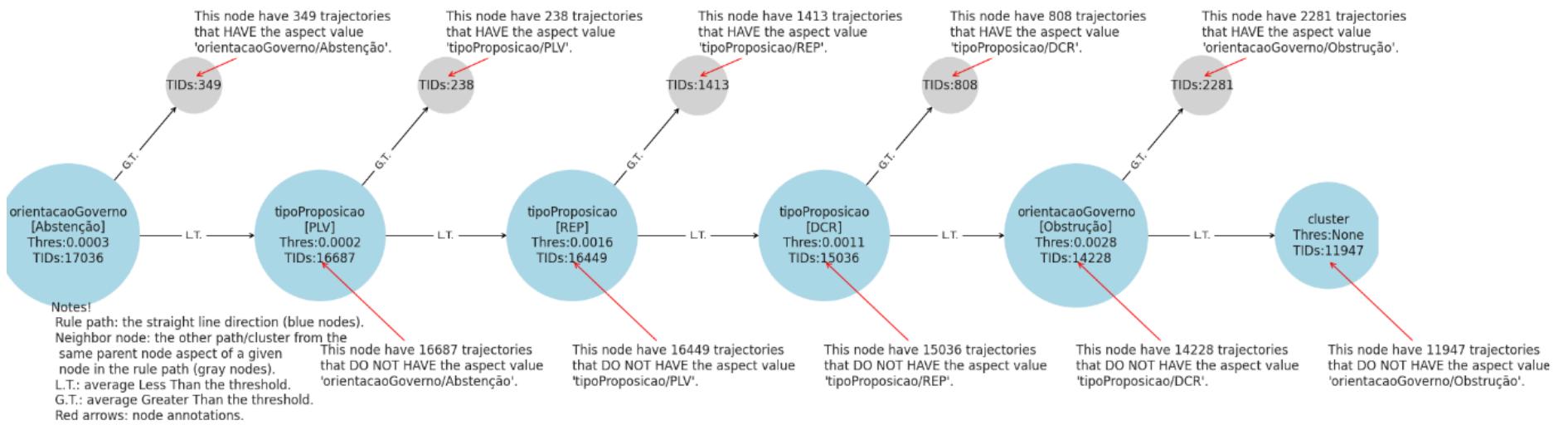
**Figure 76.** The cluster rule path for node 4-3.

- **Cluster Lvl 4-5:** A group of 1 trajectory from PMN party (partido [PMN]) that voted on PLV proposition (tipoProposicao [PLV]) and did not follow the government's guidance to vote Abstention (orientacaoGoverno [Abstenção]).



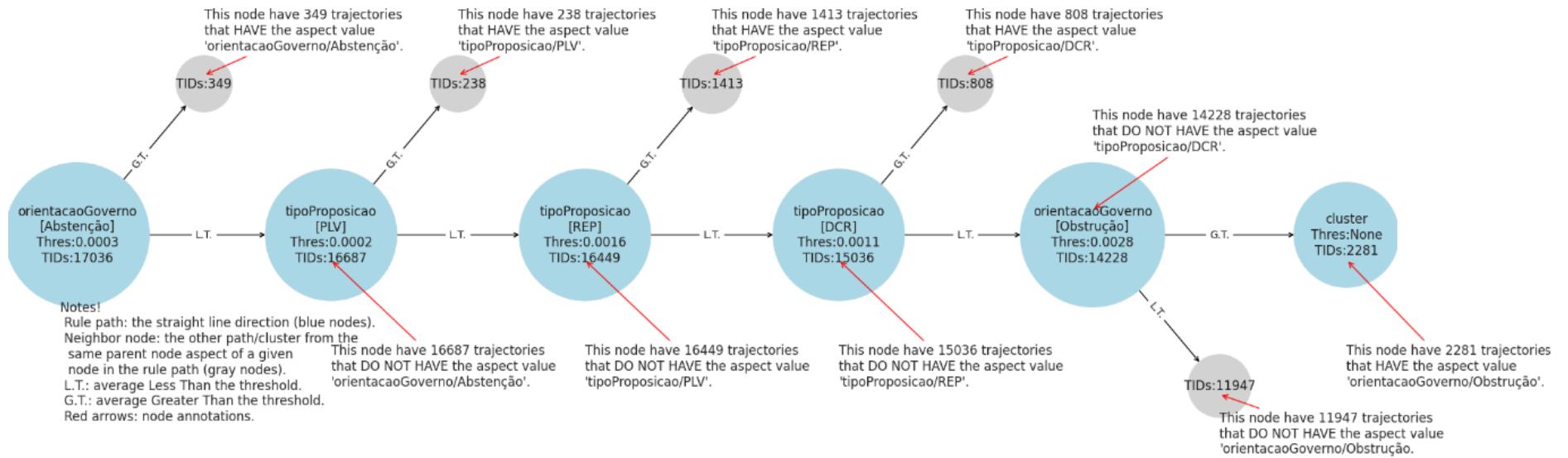
**Figure 77.** The cluster rule path for node 4-5.

- **Cluster Lvl 5-0:** A group of 11947 trajectories that did not vote on PLV, REP and DRC proposition (**tipoProposicao [PLV|REP|DRC]**), and voted different of government's guidance for Abstention and Obstruction (**orientacaoGoverno [Abstenção|Obstrução]**).



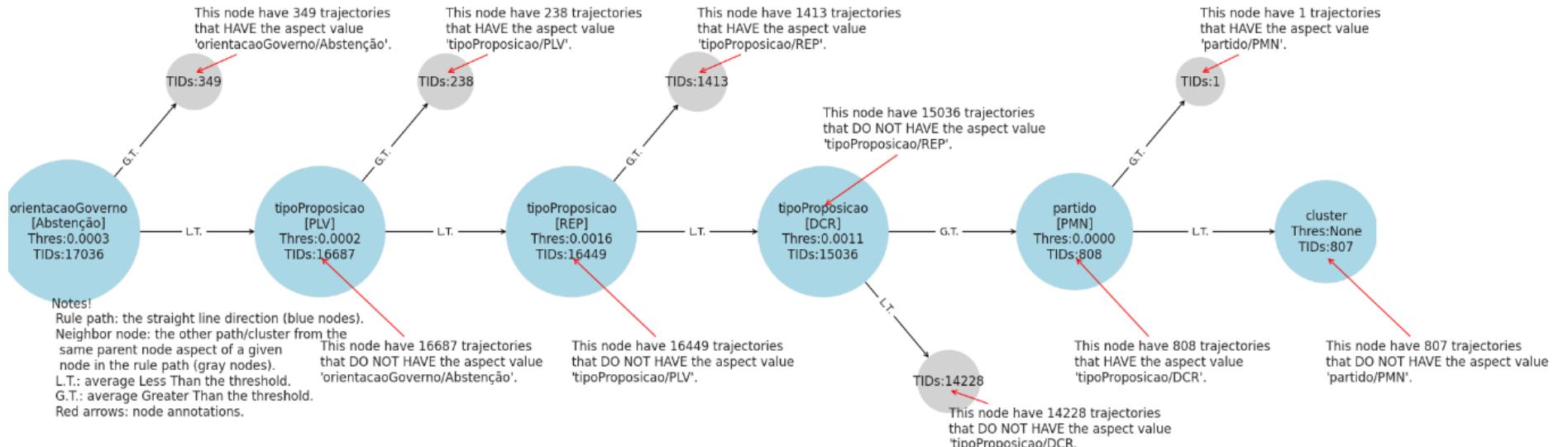
**Figure 78.** The cluster rule path for node 5-0.

- **Cluster Lvl 5-1:** A group of 2281 trajectories that voted different of government's guidance for Abstention (orientacaoGoverno [Abstenção]), then did not vote on PLV, REP and DRC proposition (tipoProposicao [PLV|REP|DCR]), and concluded following the government's guidance to vote Obstruction (orientacaoGoverno [Obstrução]) for some proposition.



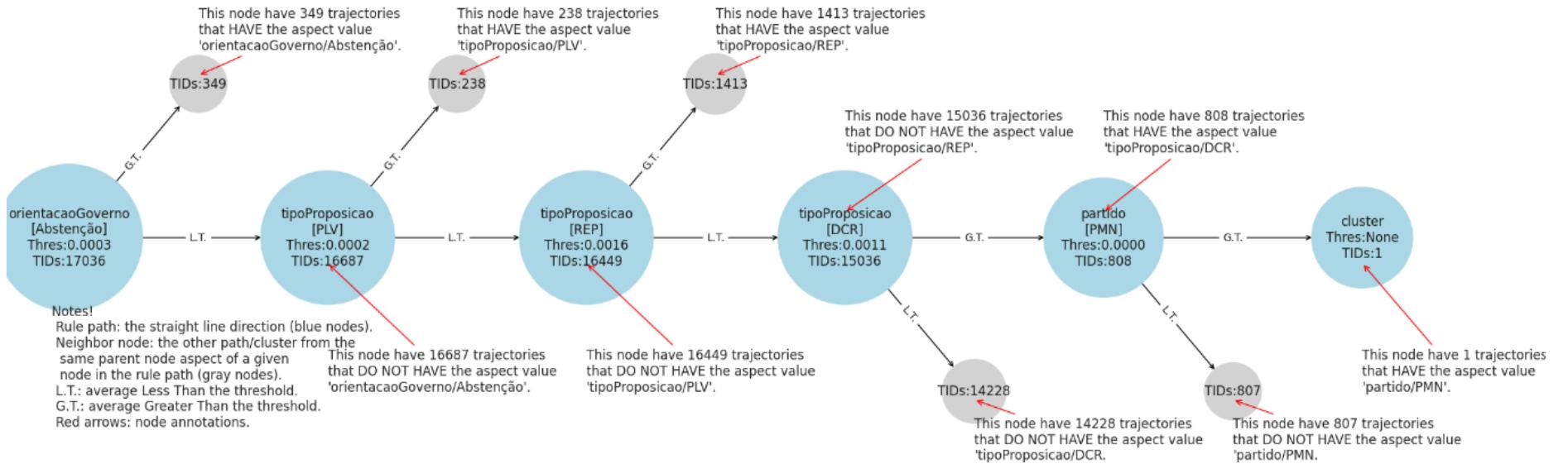
**Figure 79.** The cluster rule path for node 5-1.

- **Cluster Lvl 5-2:** A group of 807 trajectories that voted on DRC proposition (tipoProposicao [DRC]), and did not follow the government's guidance to vote Abstention (orientacaoGoverno [Abstenção]) and the PMN party (partido [PMN]) did not participate.



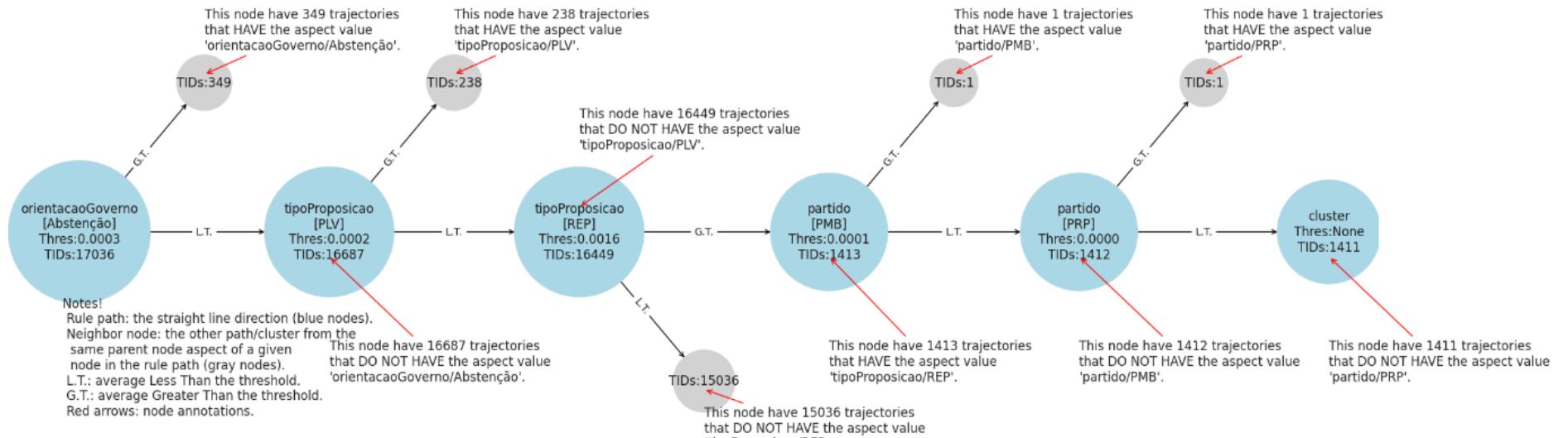
**Figure 80.** The cluster rule path for node 5-2.

- **Cluster Lvl 5-3:** A group of 1 trajectory from PMN party (PMN) that voted on DRC proposition (tipoProposicao [DCR]) and did not follow the government's guidance to vote Abstention (orientacaoGoverno [Abstenção]).



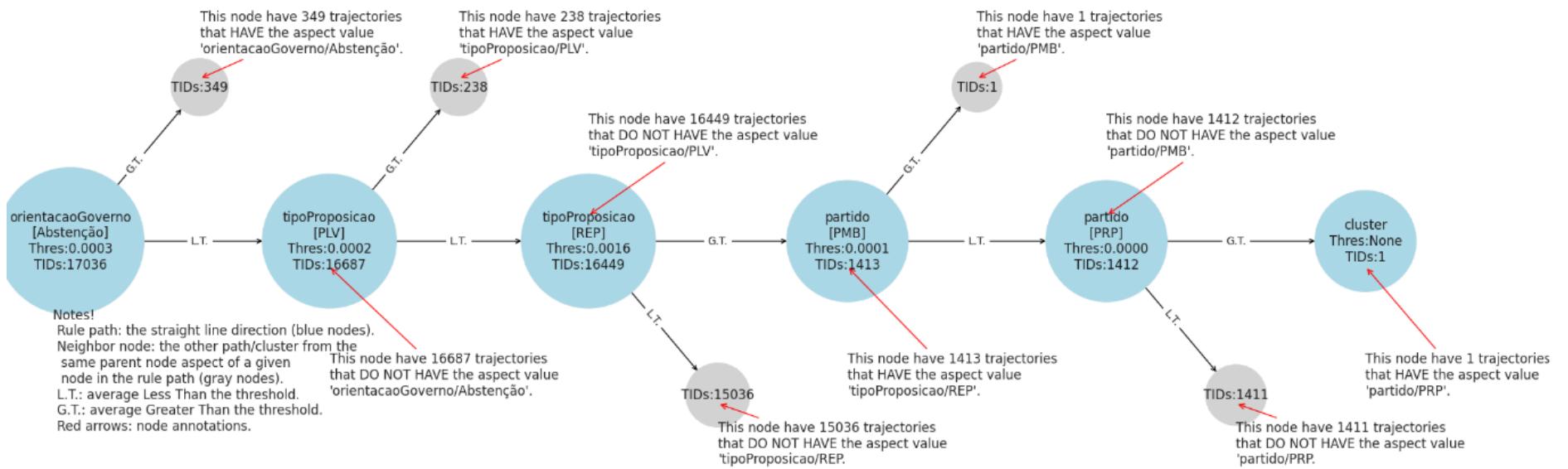
**Figure 81.** The cluster rule path for node 5-3.

- **Cluster Lvl 5-4:** A group of 1411 trajectories that voted on REP propositions (tipoProposicao [REP]), did not follow the government's guidance to vote Abstention (orientacaoGoverno [Abstenção]) and the PRP party did not participate (partido [PRP]).



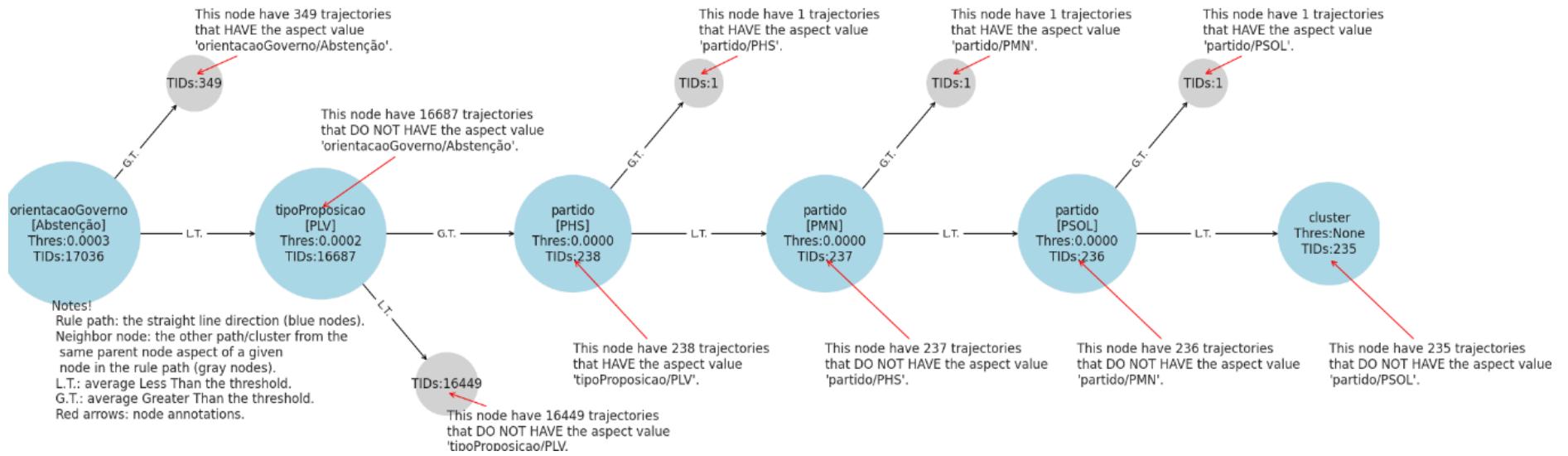
**Figure 82.** The cluster rule path for node 5-4.

- **Cluster Lvl 5-5:** A group of 1 trajectory from PRP party (partido [PRP]) that voted on REP proposition (tipoProposicao [REP]) and did not follow the government's guidance to vote Abstention (orientacaoGoverno [Abstenção]).



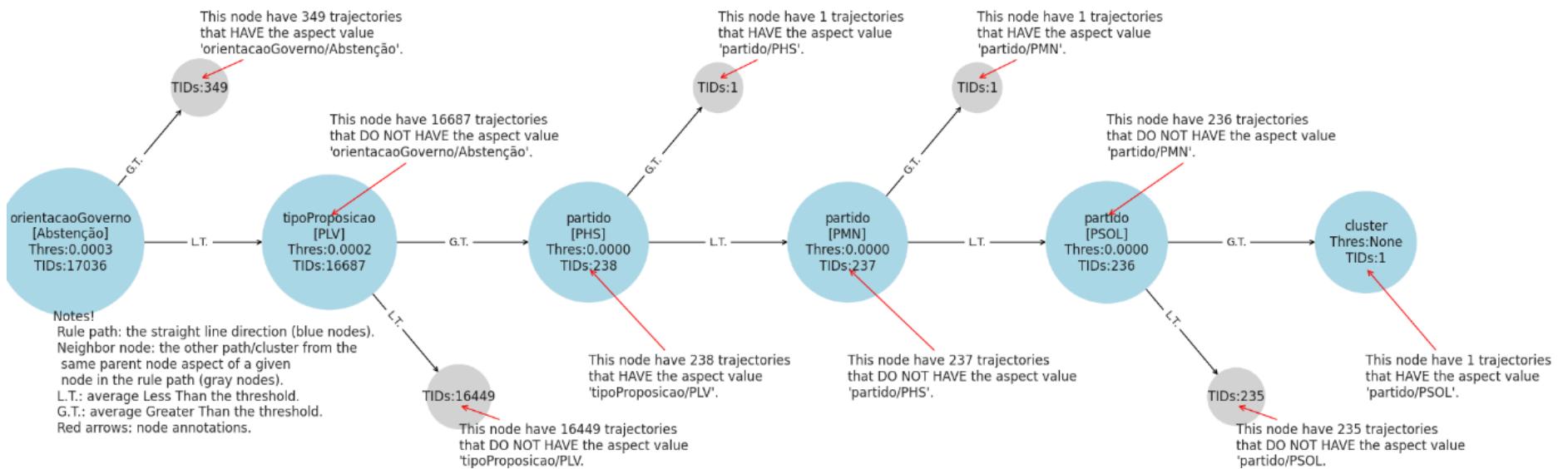
**Figure 83.** The cluster rule path for node 5-5.

- **Cluster Lvl 5-6:** A group of 235 trajectories that voted on PLV propositions (tipoProposicao [PLV]), did not follow the government's guidance to vote Abstention (orientacaoGoverno [Abstenção]), and the PHS, PMN and PSOL parties did not participate (partido [PHS|PMN|PSOL]).



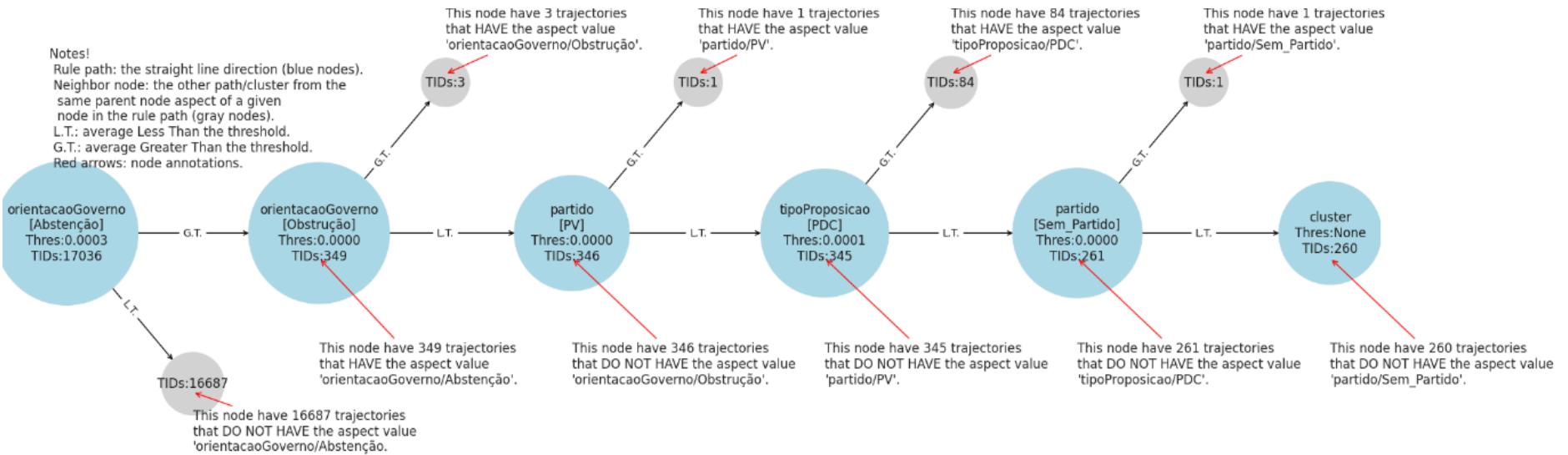
**Figure 84.** The cluster rule path for node 5-6.

- **Cluster Lvl 5-7:** A group of 1 trajectory from PSOL party (partido [PSOL]) that voted on PLV proposition (tipoProposicao [PLV]) and voted different of government's guidance to vote Abstention (orientacaoGoverno [Abstenção]).



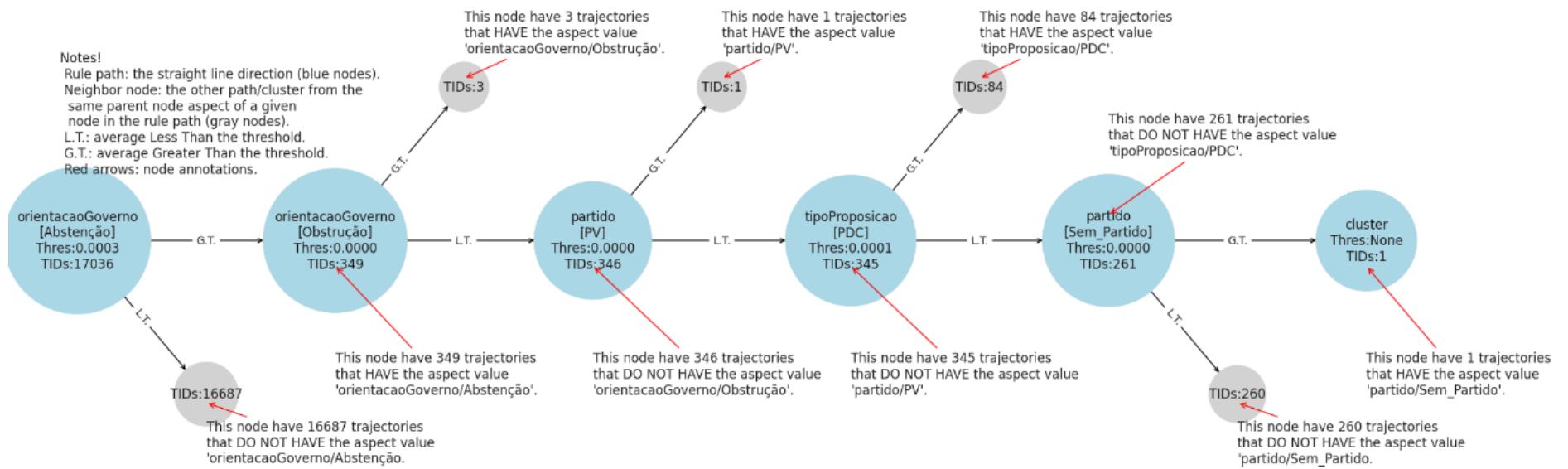
**Figure 85.** The cluster rule path for node 5-7.

- **Cluster Lvl 5-8:** A group of 260 trajectories that followed the government's guidance to vote Abstention (*orientacaoGoverno* [Abstention]), then voted different of government's guidance to vote Obstruction (*orientacaoGoverno* [Obstruction]) for propositions different of PDC (*tipoProposicao* [PDC]), and the PV and Sem\_partido parties (*partido* [PV|Sem\_partido]) did not participate.



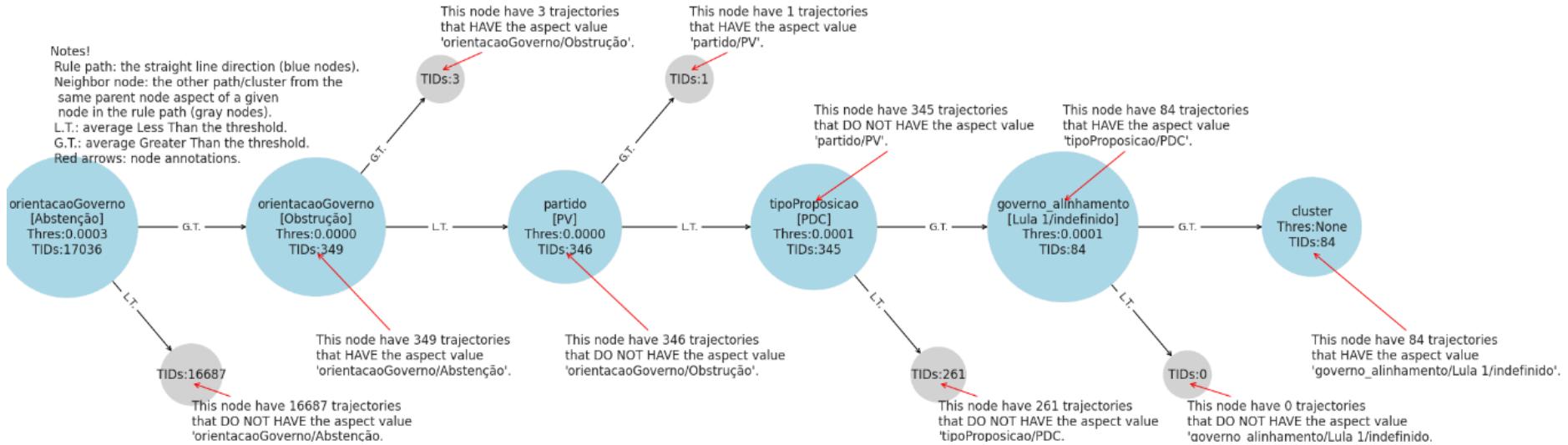
**Figure 86.** The cluster rule path for node 5-8.

- **Cluster Lvl 5-9:** A group of 1 trajectory from Sem\_partido party (partido [Sem\_partido]) that followed the government's guidance to vote Abstention (orientacaoGoverno [Abstention]) for on proposition different of PDC (orientacaoGoverno [PDC]).



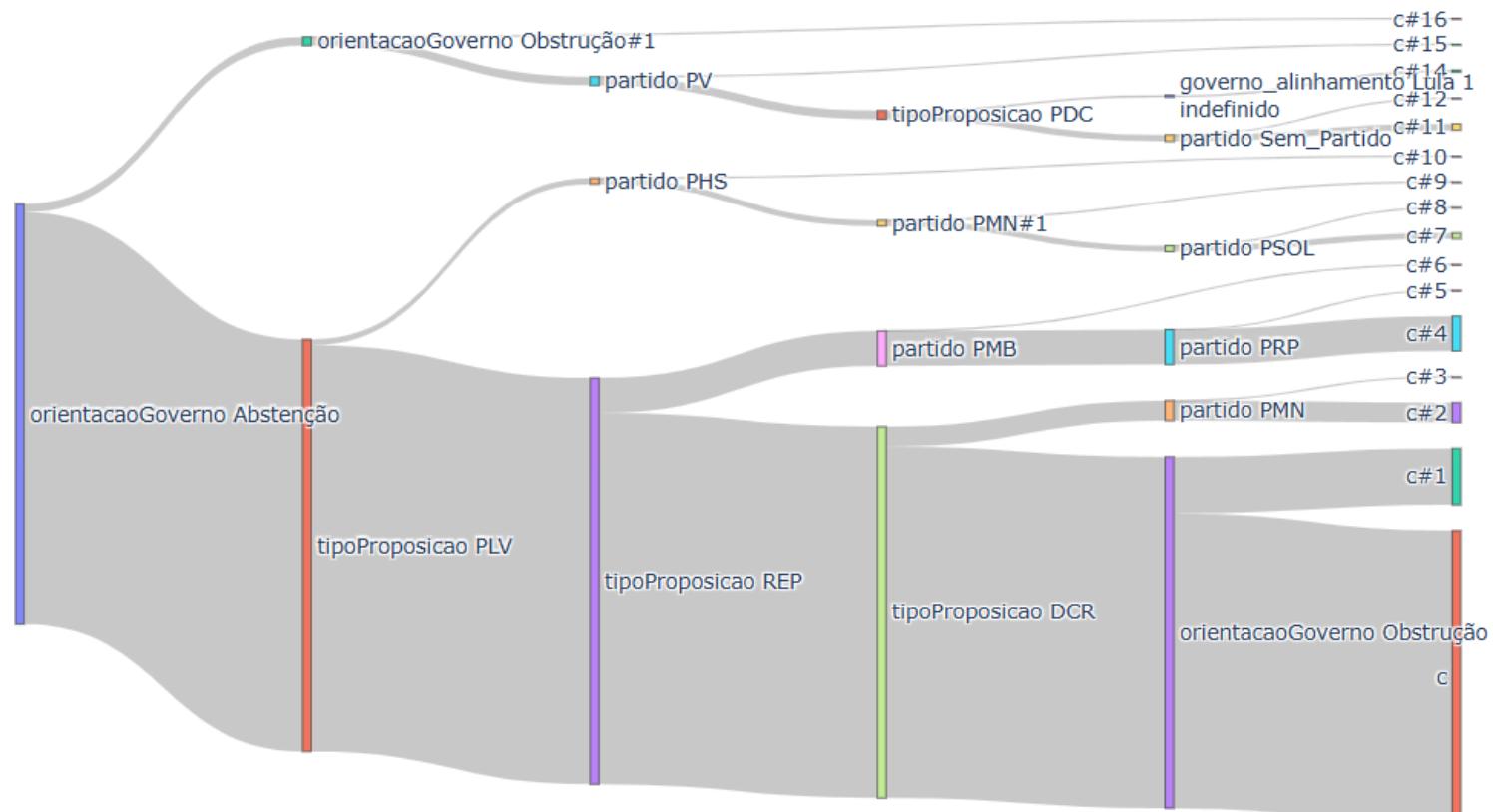
**Figure 87.** The cluster rule path for node 5-9.

- **Cluster Lvl 5-11:** A group of 84 trajectories that followed the government's guidance to vote Abstention (orientacaoGoverno [Obstention]) where the PV party (partido [PV]) did not participate on propositions different of PDC (partido [PDC]), and during the Lula1 term and had the alignment as Undefined (governo\_alinhamento [Lula1/Indefinido]).



**Figure 88.** The cluster rule path for node 5-11.

The Sankey diagram, Figure 89, shows another way to visualize the tree. It helps to visualize the concentration of the number of trajectories for the clustering result.



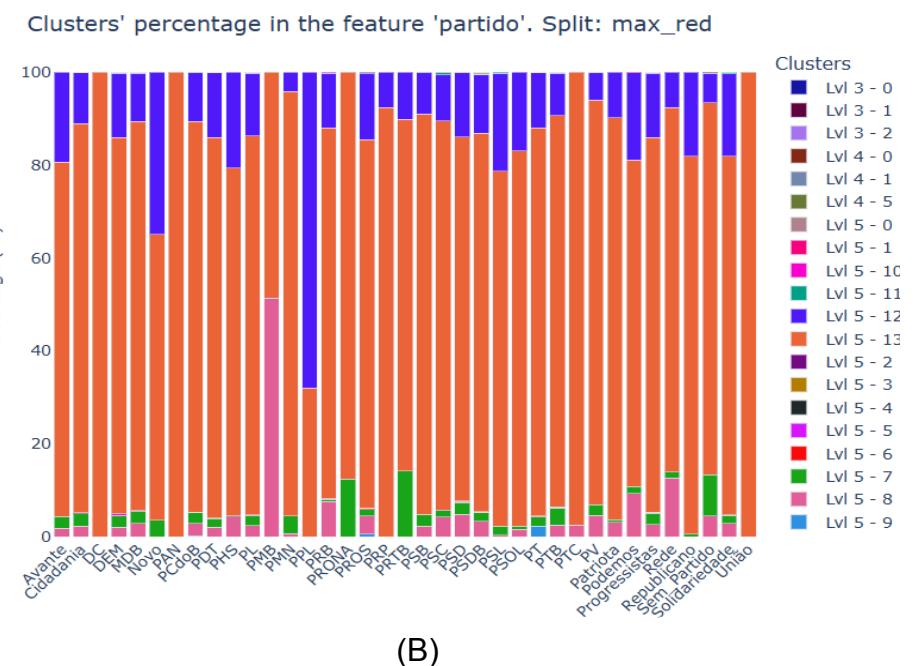
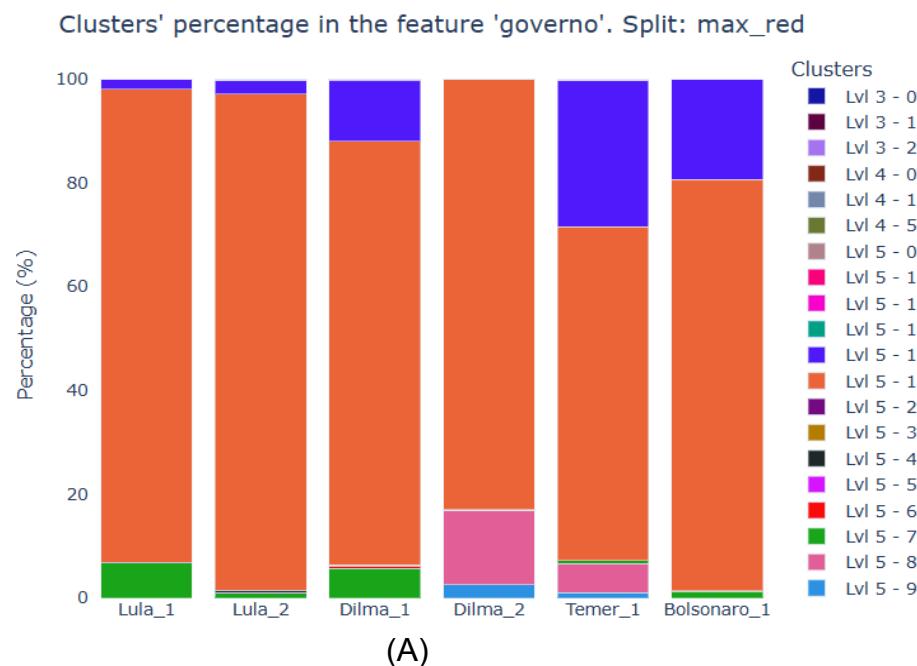
**Figure 89.** Sankey diagram with 16 clusters (*leaf nodes*) using the combined features and MV strategy.

### 3.2.3 Insights

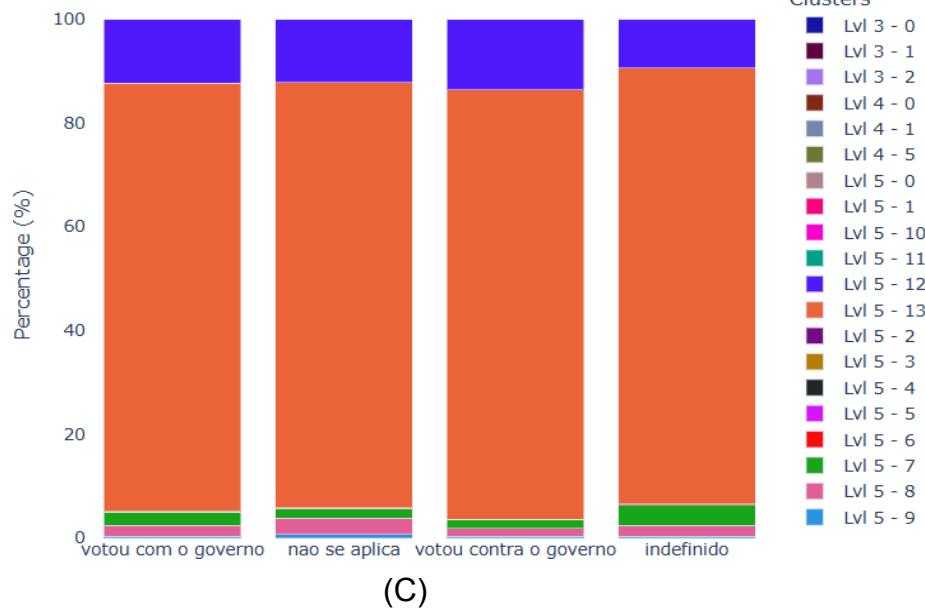
The hypothesis when using the MVR and MV strategy remains the same even when using the combined features. This approach group 85.8% (97.48% - independent features) of the data into two clusters using the MVR strategy while using MV two clusters grouped 83.51% (91.8% - independent features) of the data.

#### 3.2.3.1 MVR

##### 1. All governments

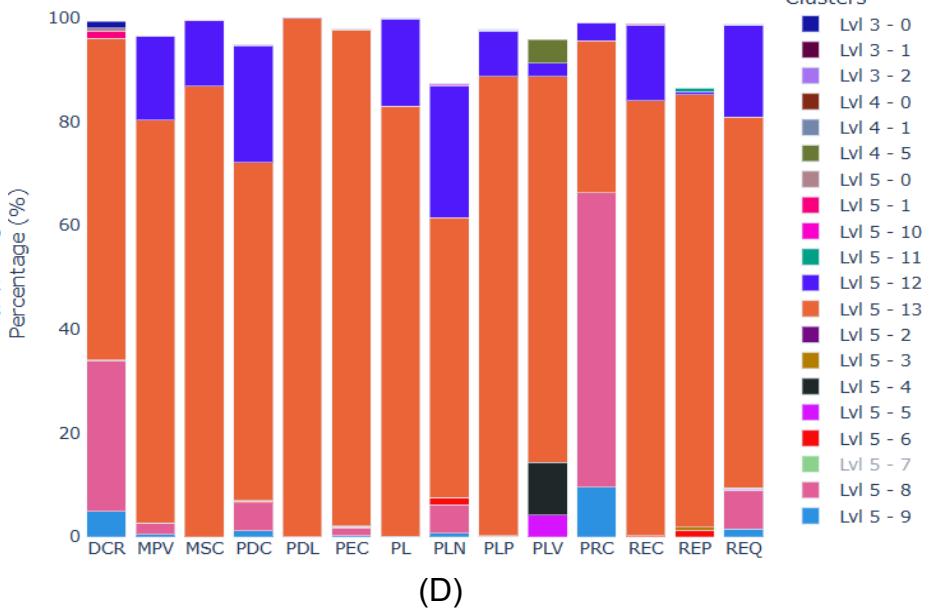


Clusters' percentage in the feature 'alinhamento'. Split: max\_red



(C)

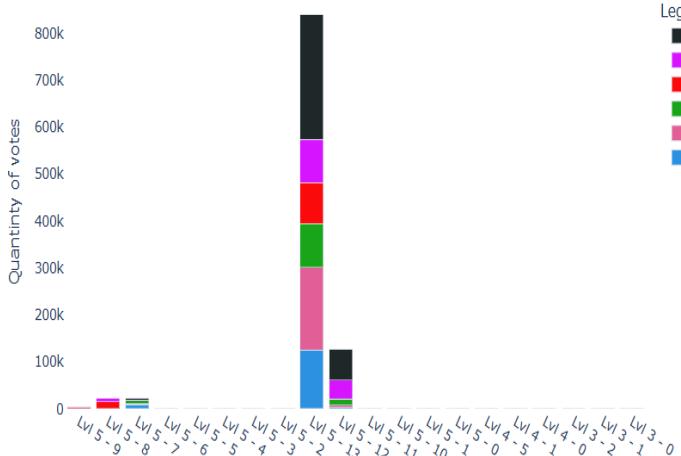
Clusters' percentage in the feature 'tipoProposicao'. Split: max\_red



(D)

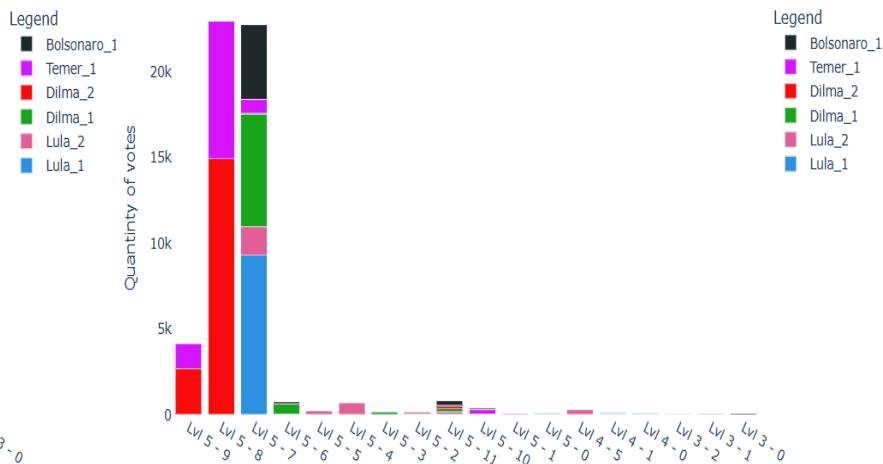
**Figure X.** Clusters' percentage in the features using MVR. (A) Government (Governo), (B) Party (Partido), (C) Government's alignment (Alinhamento) and (D) Proposition (Tipo proposição).

Feature 'governo'; Split: max\_red.



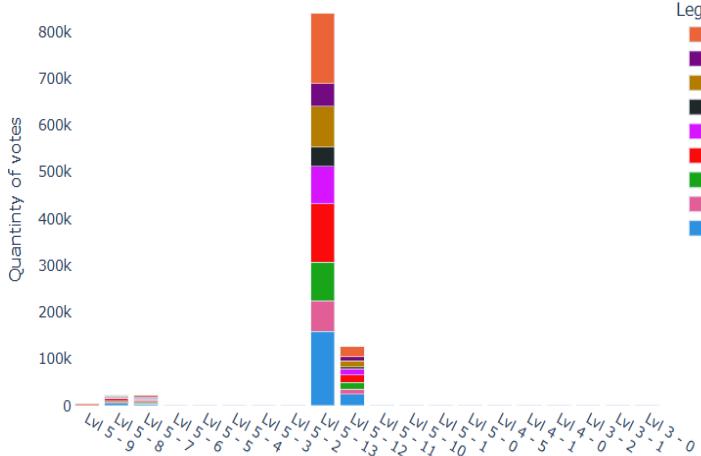
(A)

Feature 'governo'; Split: max\_red.

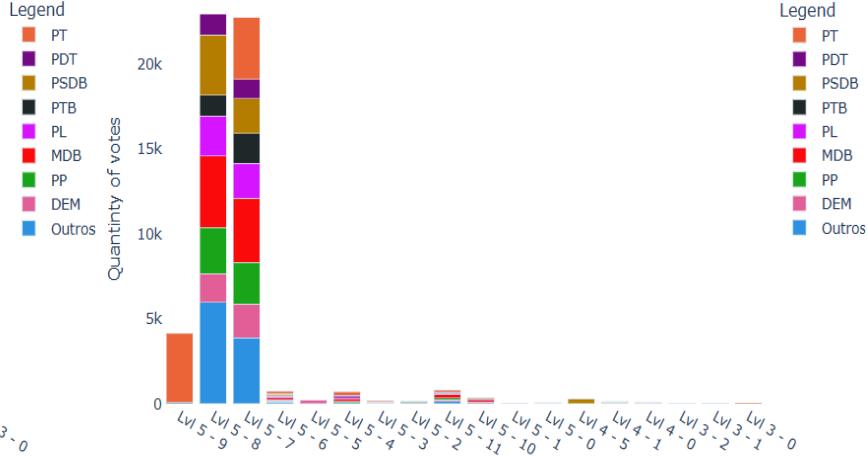


(B)

Feature 'partido'; Split: max\_red.

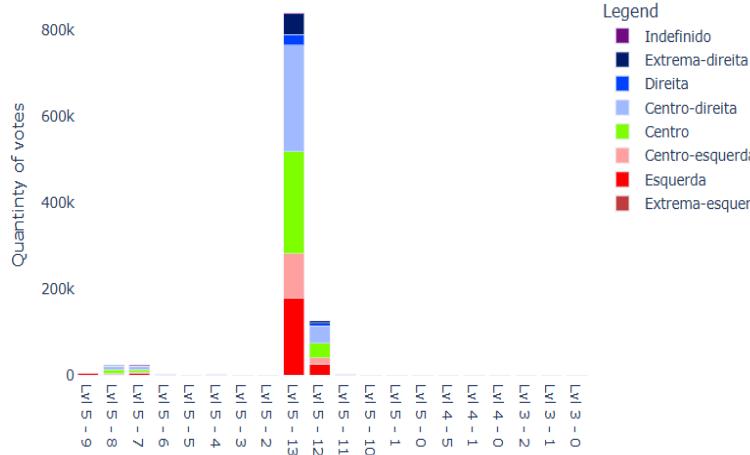


(C)



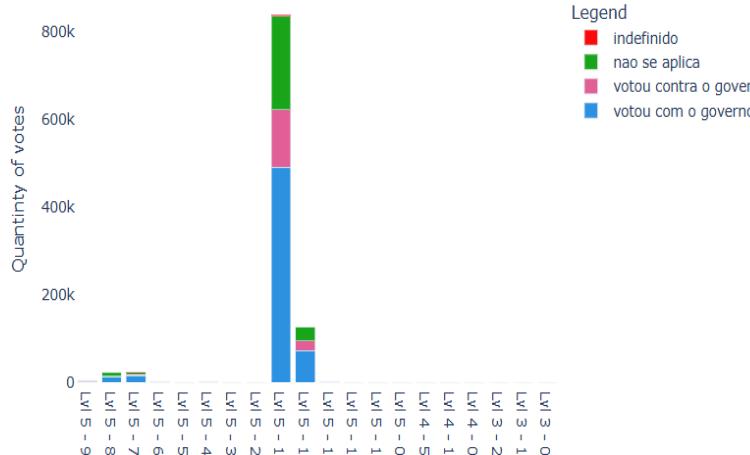
(D)

Feature 'esp\_pol\_partido'; Split: max\_red.



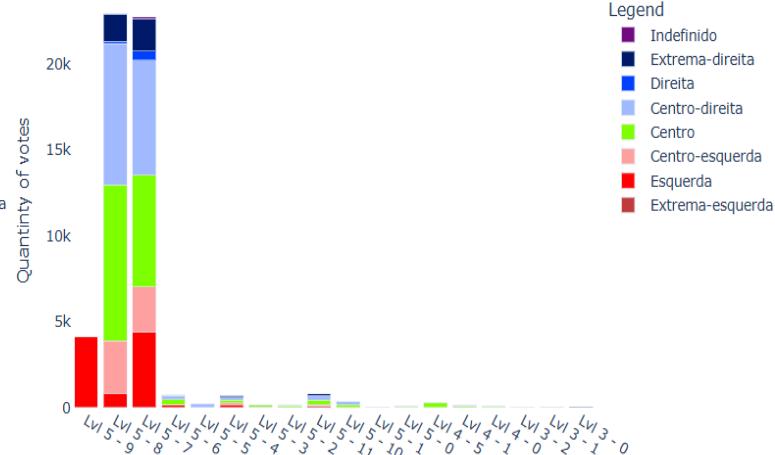
(E)

Feature 'alinhamento'; Split: max\_red.



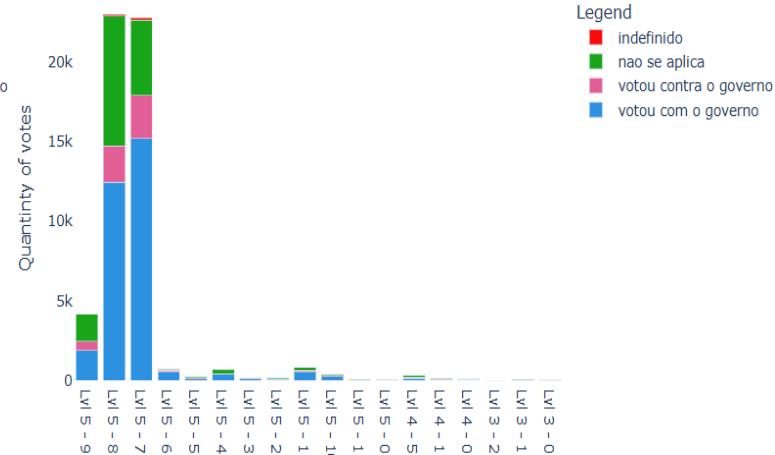
(G)

Feature 'esp\_pol\_partido'; Split: max\_red.

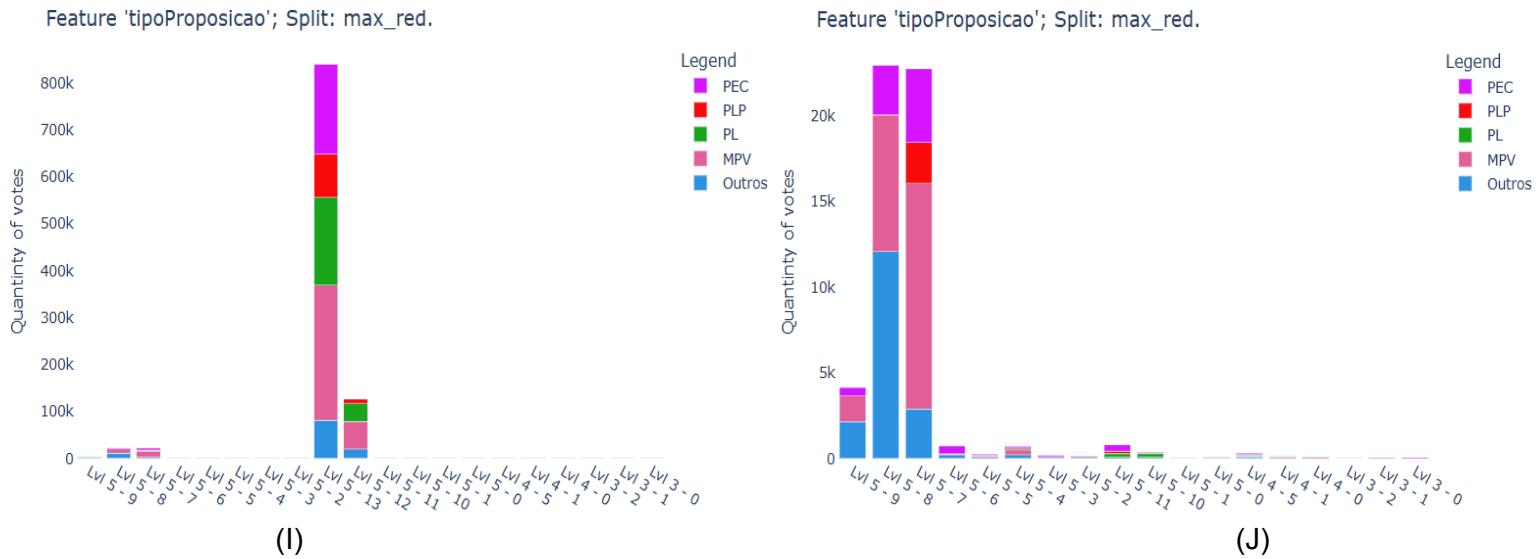


(F)

Feature 'alinhamento'; Split: max\_red.



(H)



**Figure X.** Quantity of votes per cluster for some features using MVR. The left side shows all cluster (A, C, E, G and I) while the right side (B, D, F, H and J) does not show two clusters with the majority of votes. (A-B) Government (Governo), (C-D) Party (Partido), (E-F) Political spectrum (espectro político), (G-H) Government's alignment (Alinhamento) and (I-J) Proposition (Tipo proposição).

- Cluster node 5-12:
  - Cluster node 5-12 has 2013 trajectories (11.82%).
  - It is a group of trajectories that frequently have a number of occurrences greater than the threshold in relation to the government's guidance for voting Yes and No, as well as for votes on PL and MPV propositions. However, it has not voted on PEC propositions.
  - 51.25% of the votes in this cluster occurred during the Bolsonaro's government.
  - 30.58% of the data in this cluster voted in line with Bolsonaro's government.
  - 57.9% of the votes in this cluster were in line with the governments.

For example, MAT-Tree identified a group of 2013 trajectories that voted both on PL and MPV propositions (*tipoProposicao [PL/MPV]*) and also followed the government's guidance to vote Yes and then No (*orientacaoGoverno [Sim/Não]*).

Notes!

Rule path: the straight line direction (blue nodes).

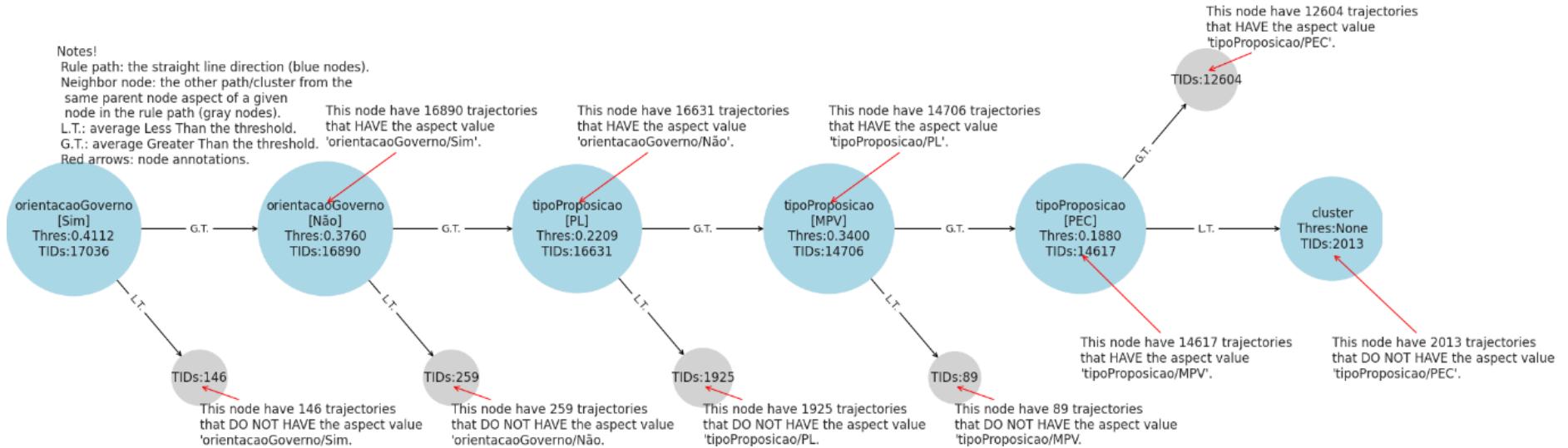
Neighbor node: the other path/cluster from the same parent node aspect of a given

node in the rule path (gray nodes).

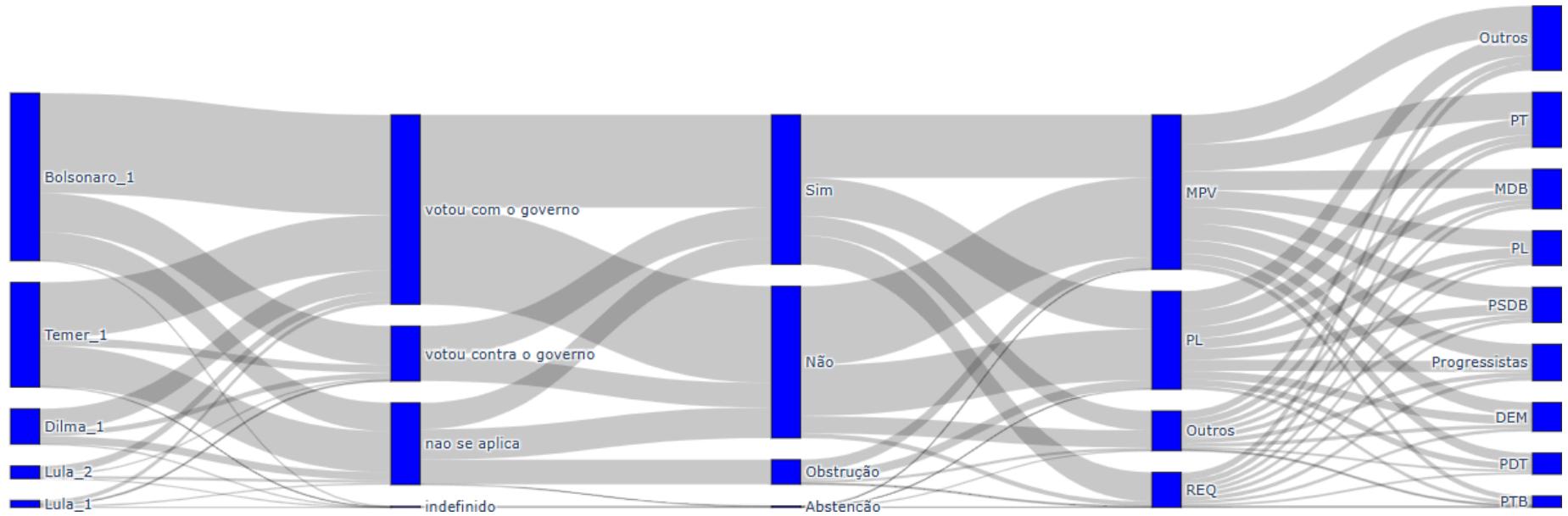
L.T.: average Less Than the threshold.

G.T.: average Greater Than the threshold.

Red arrows: node annotations.



Node: Lvl 5 - 12; Split: max\_red  
TIDs: 2013; Unique deputies: 1070; Total votes: 126337.  
from 2003-01-04 to 2022-04-27



- Cluster node 5-13:
  - 73.98% (12604) of the clustered trajectory data.
  - It is a group of trajectories that frequently have a number of occurrences greater than the threshold in relation to the government's guidance for voting Yes and No, as well as for votes on PL, MPV and PEC propositions.
  - 31.67% of the votes in this cluster occurred in the Bolsonaro government. Lula-2 government was the second place with 20.91% of the votes.
  - 58.63% of the votes were in line with the governments, where 17.49% was during the Bolsonaro term while 13.5% during the Lula-2 term.

For example, MAT-Tree identified a group of 12604 trajectories that voted on PL, MPV, and PEC propositions (tipoProposicao [PL/MPV/PEC]) and also followed the government's guidance to vote Yes and then No (orientacaoGoverno [Sim/Não]).

Notes!

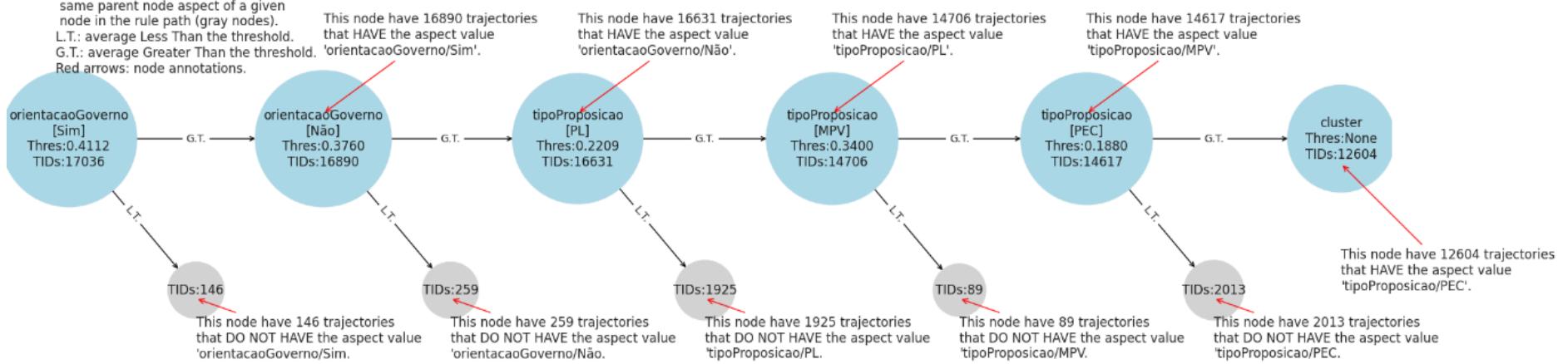
Rule path: the straight line direction (blue nodes).

Neighbor node: the other path/cluster from the same parent node aspect of a given node in the rule path (gray nodes).

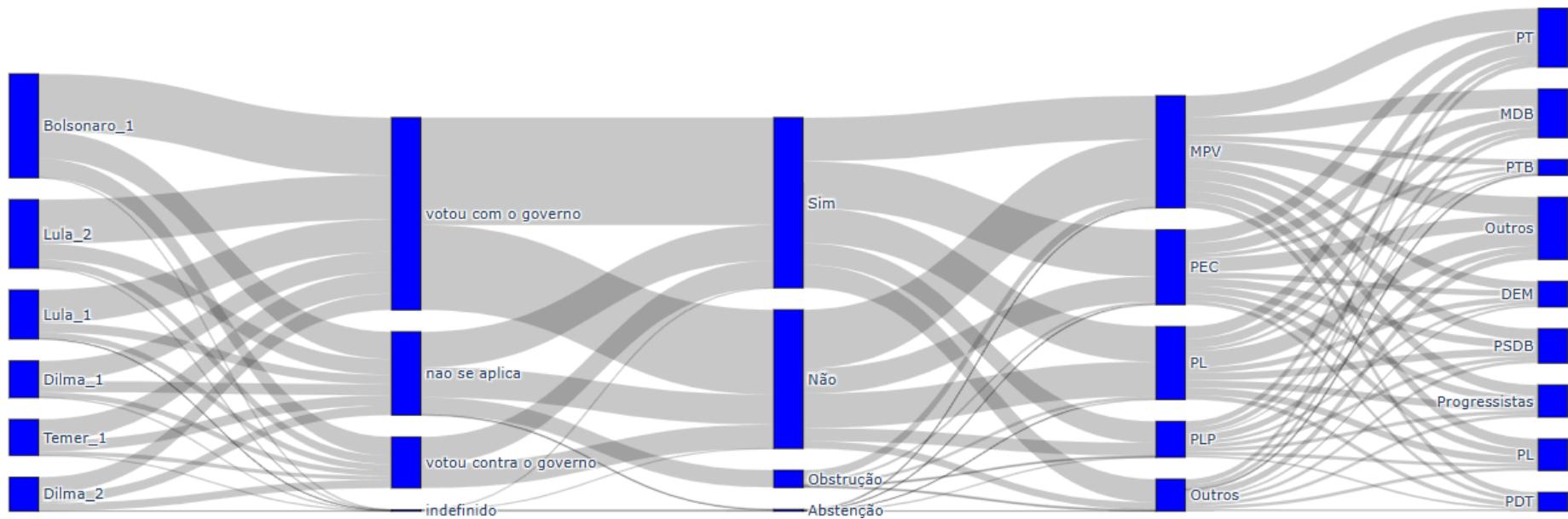
L.T.: average Less Than the threshold.

G.T.: average Greater Than the threshold, 'orientacaoGoverno/Sim'.

Red arrows: node annotations.

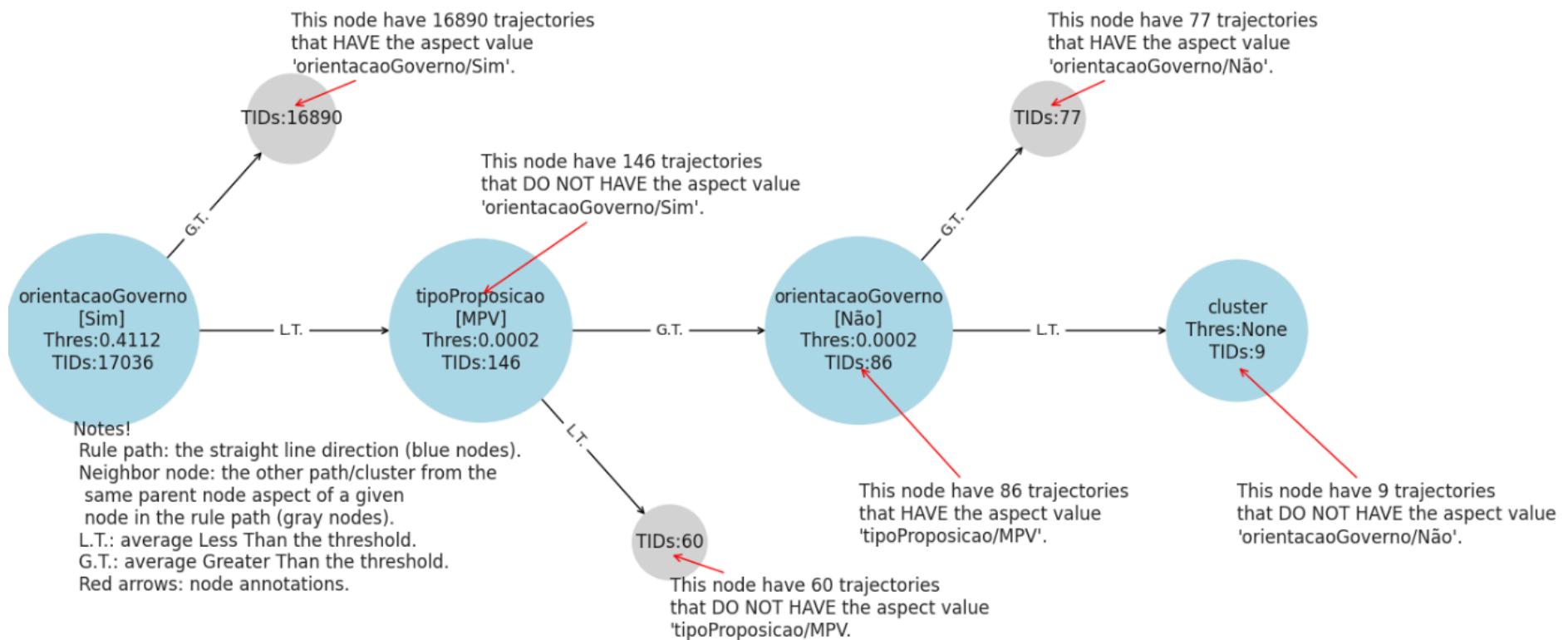


Node: Lvl 5 - 13; Split: max\_red  
TIDs: 12604; Unique deputies: 1687; Total votes: 839109.  
from 2003-01-04 to 2022-12-04

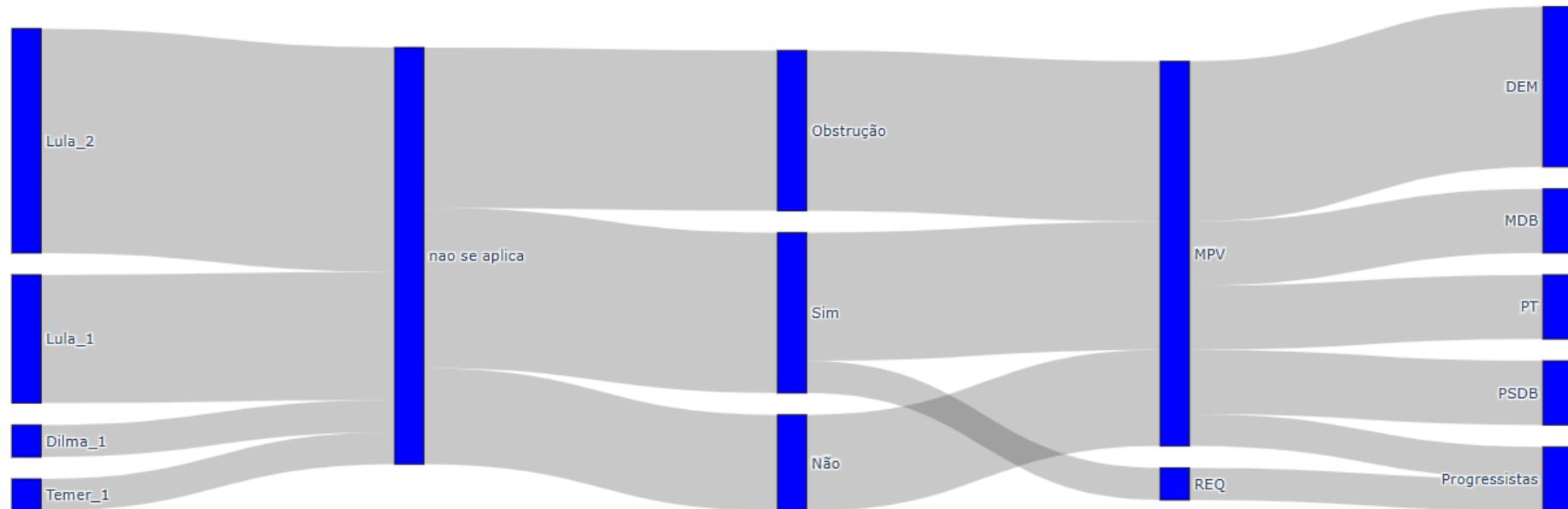


- Cluster node 3-2:
  - It is a group that voted on propositions that the government did not give any guidance to voting.
  - This group has short trajectories with length close to 1 point.

For example, MAT-Tree identified a outlier cluster with 9 trajectories that do not followed the government orientation Yes (orientacaoGoverno [Sim]), then voted MPV propositions (tipoProposicao [MPV]), but concluded does not following the government orientation No (orientacaoGoverno [Não]).



Node: Lvl 3 - 2; Split: max\_red  
 TIDs: 9; Unique deputies: 9; Total votes: 13.  
 from 2004-09-03 to 2018-06-02

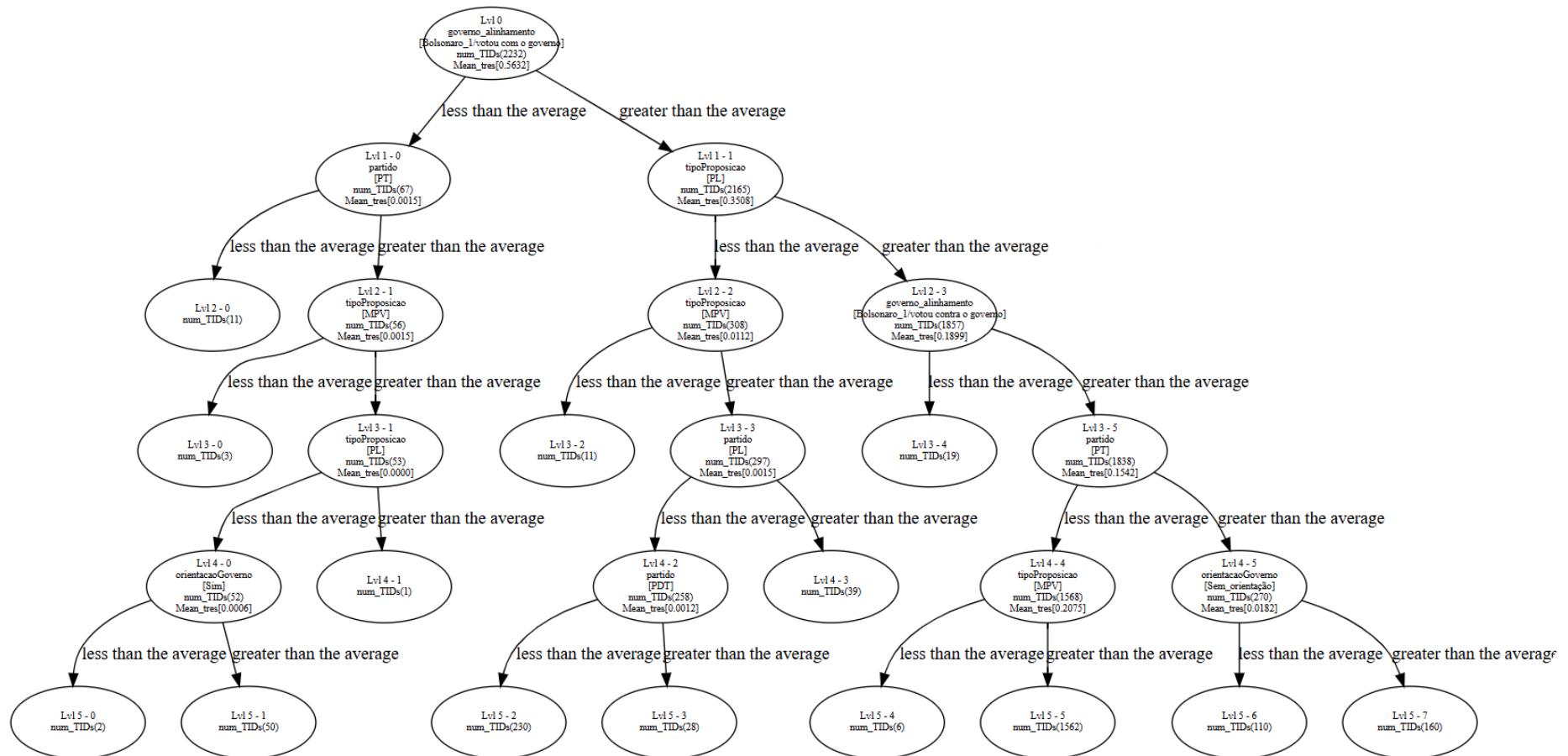


## 2. Dataset by government

### 2.1 Bolsonaro

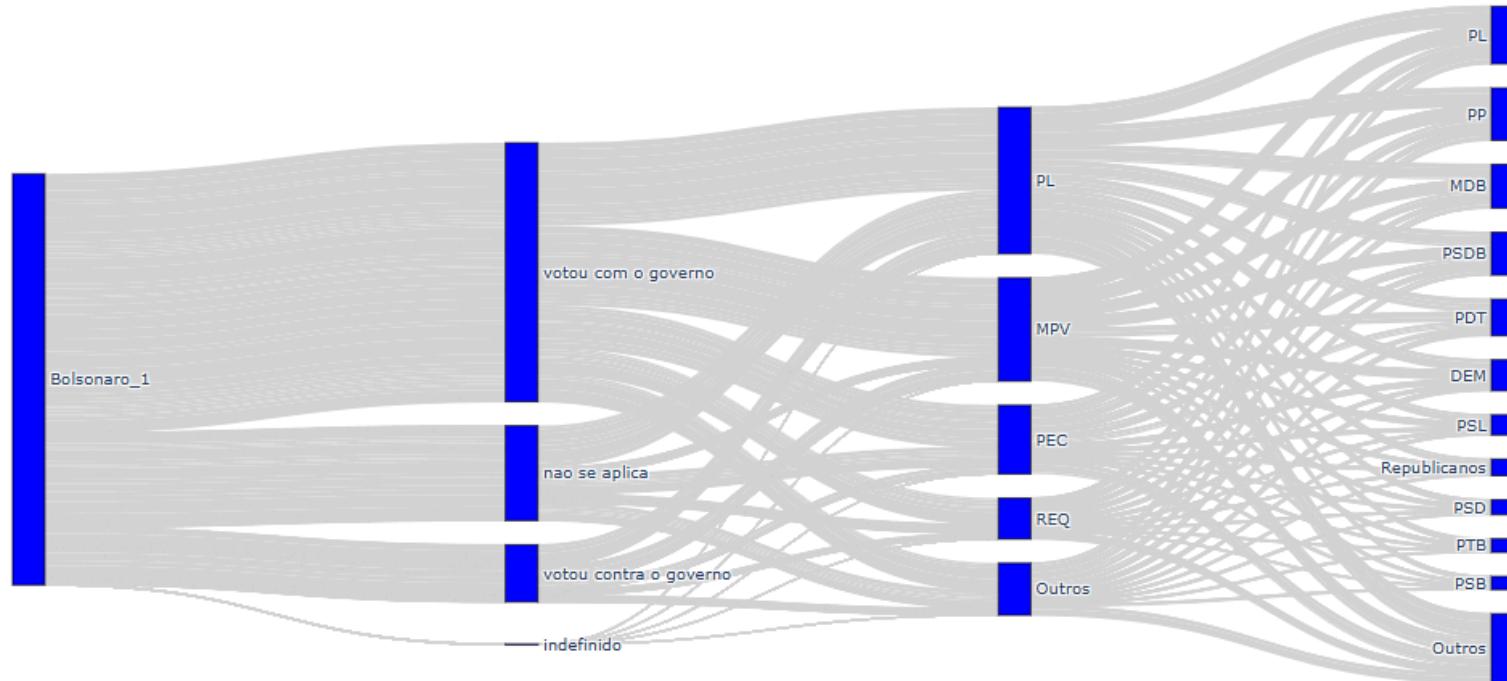
This dataset has 2,232 trajectories with a total of 335,262 votes from 560 deputies distributed into 33 parties. Running the MAT-Tree with MVR identified 14 clusters, where **83.53%** of the data is grouped into two clusters. Node 5-5 grouped **82.68%** corresponding to 1562 trajectories while node 5-2 grouped **0.85%** corresponding to 230 trajectories.

- Tree

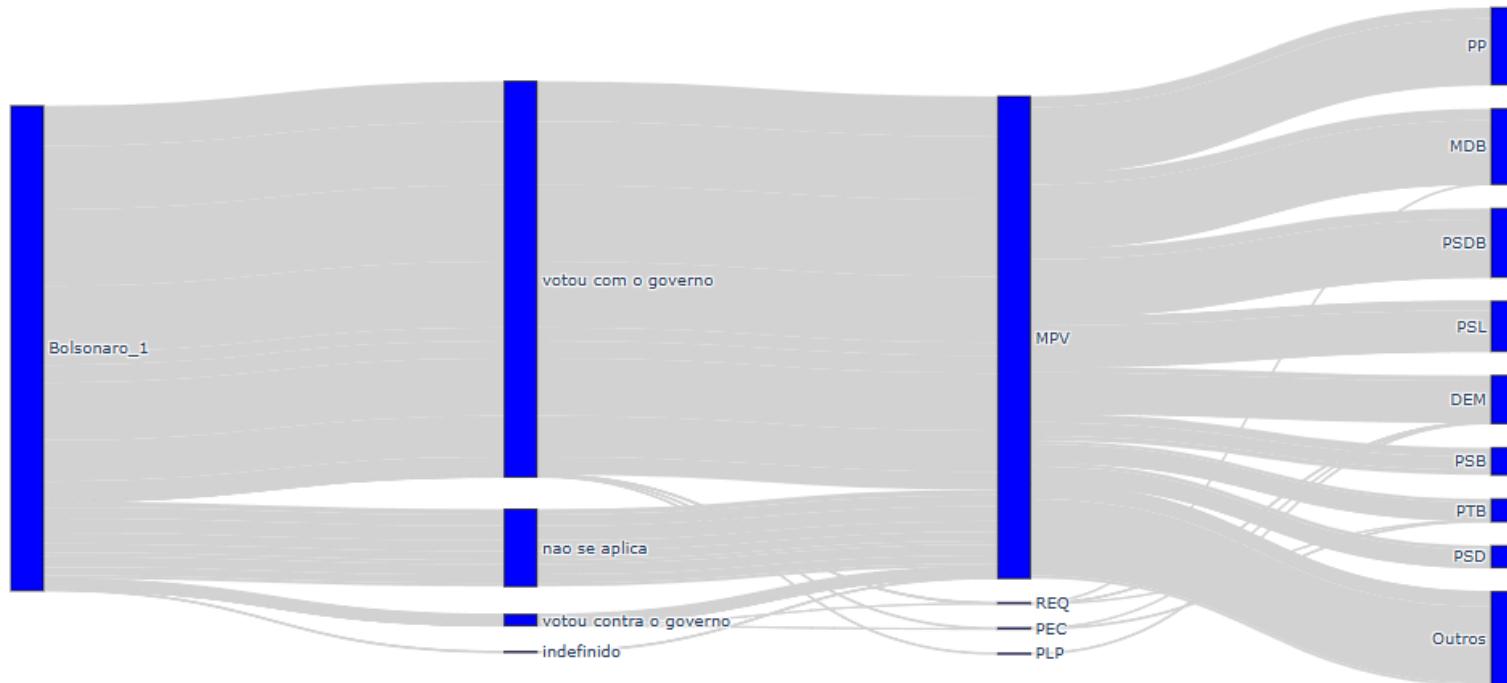


- Sankey

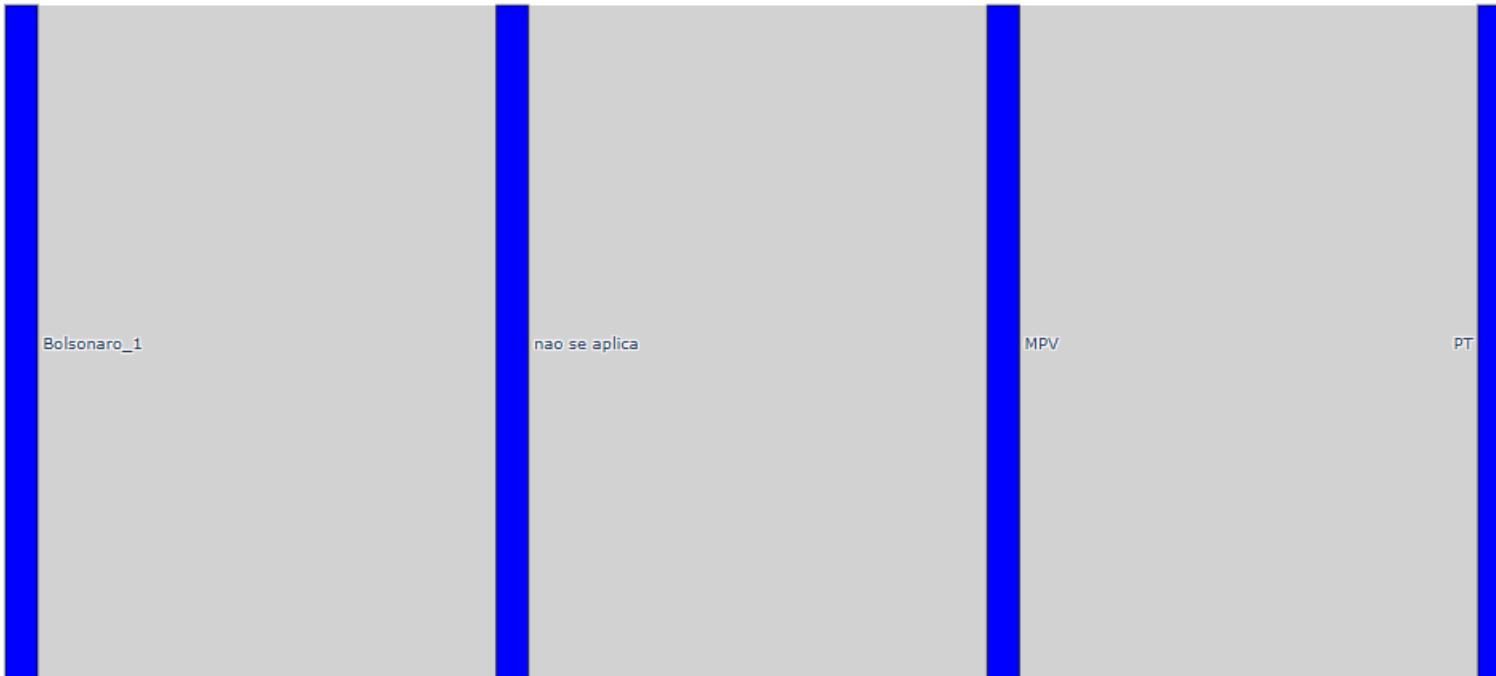
Node: Lvl 5 - 5; Split: max\_red  
TIDs: 1562; Unique deputies: 477; Total votes: 277187.  
from 2019-01-10 to 2022-12-04



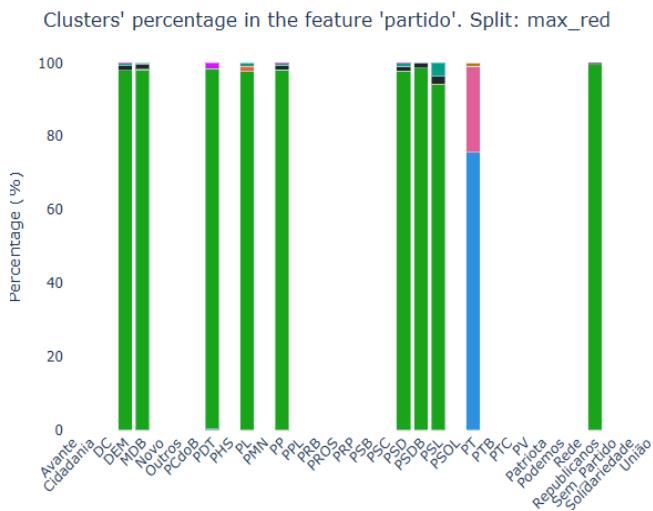
Node: Lvl 5 - 2; Split: max\_red  
TIDs: 230; Unique deputies: 228; Total votes: 2860.  
from 2020-02-17 to 2022-05-04



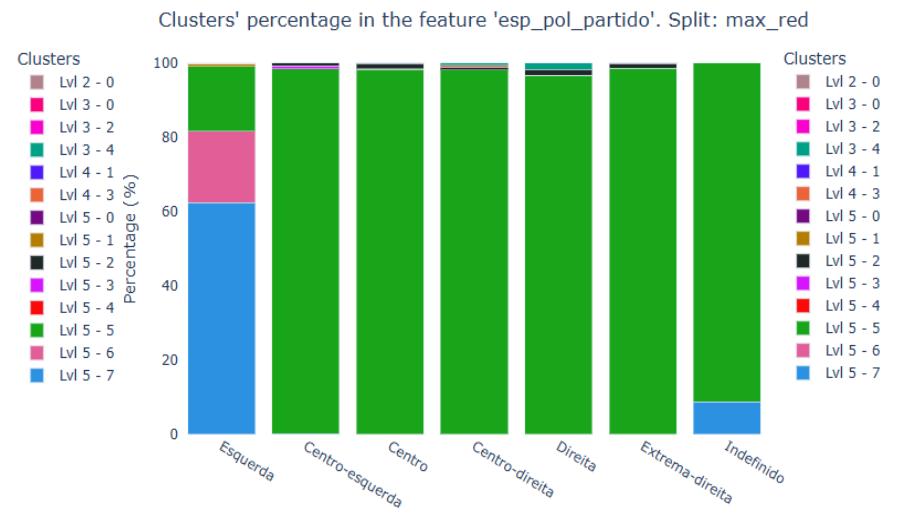
Node: Lvl 5 - 0; Split: max\_red  
TIDs: 2; Unique deputies:2; Total votes: 7.  
from 2020-02-17 to 2020-11-02



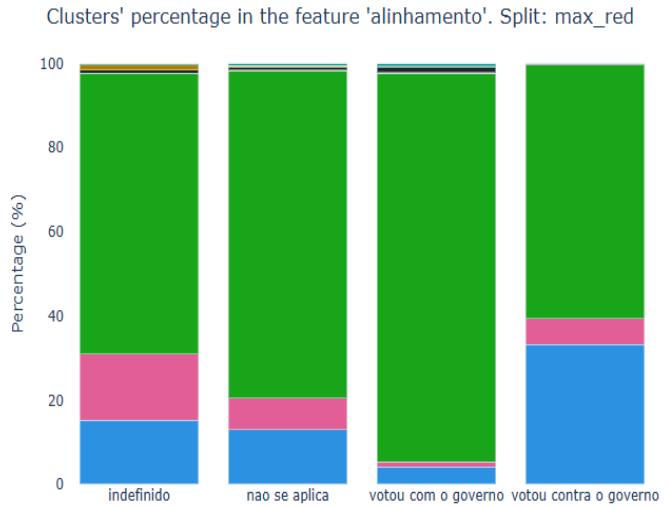
- Stacked bar
  - Clusters' percentage in the feature



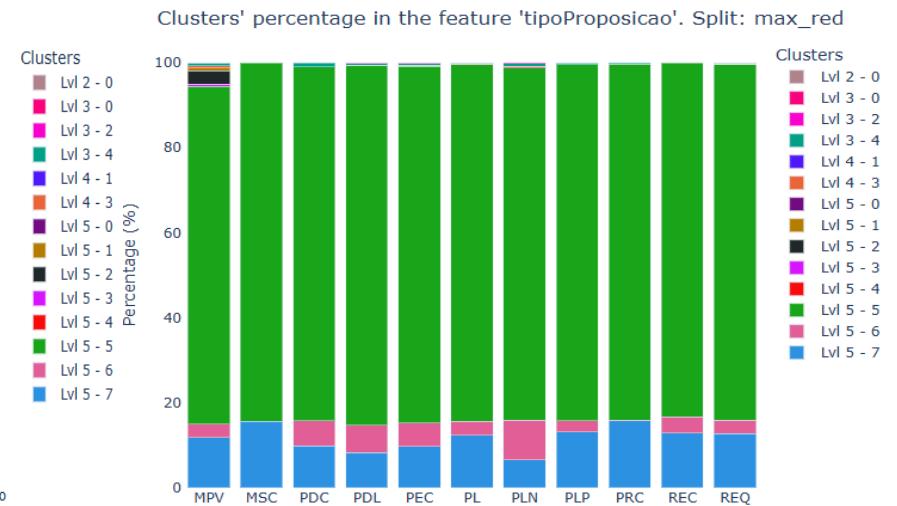
(A)



(B)



(C)

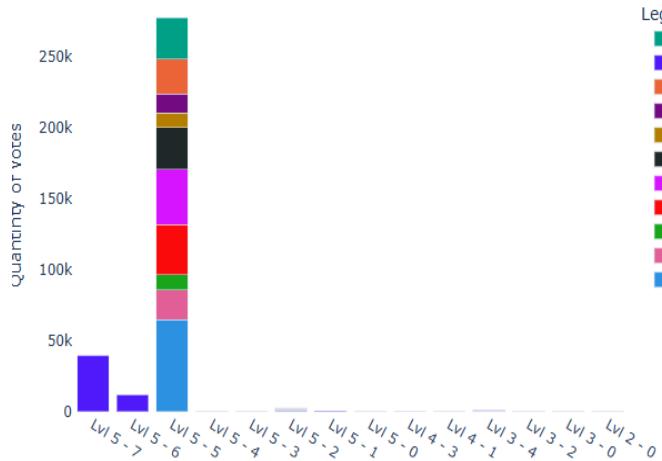


(D)

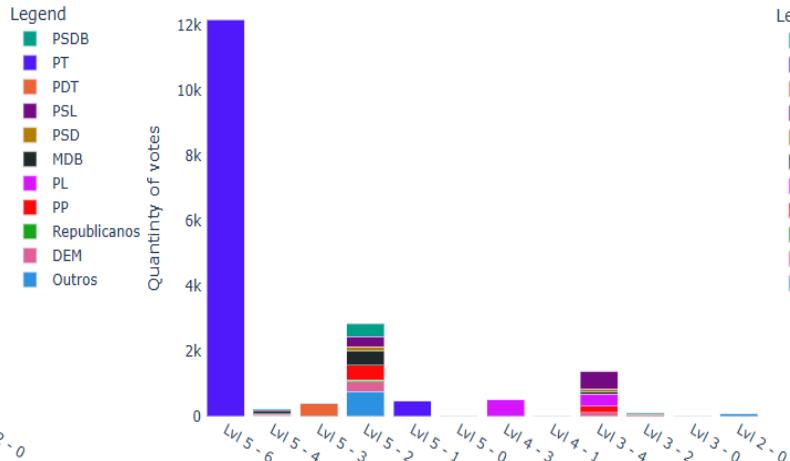
Figure x.

- Number of votes by feature value in the cluster

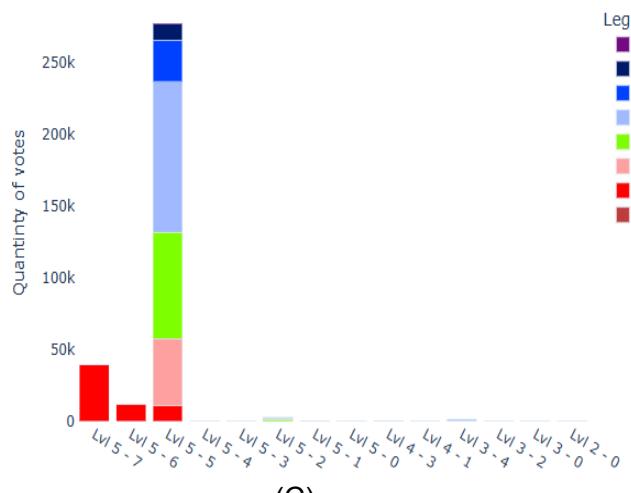
Feature 'partido'; Split: max\_red.



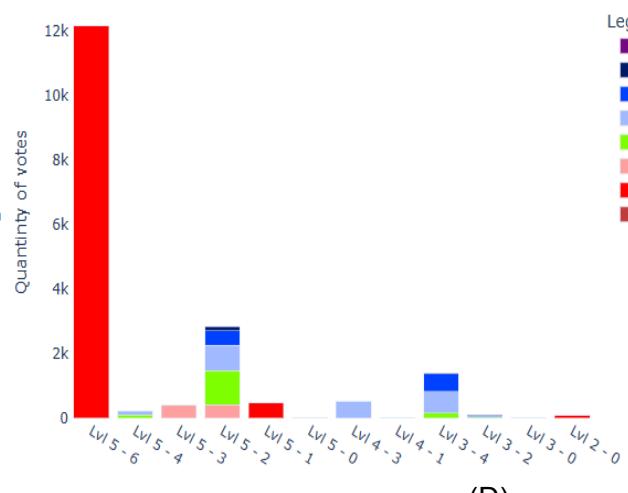
Feature 'partido'; Split: max\_red.



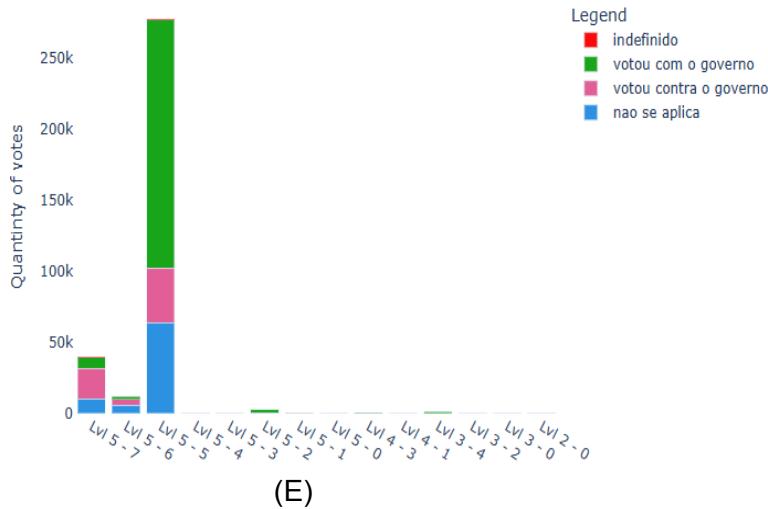
Feature 'esp\_pol\_partido'; Split: max\_red.



Feature 'esp\_pol\_partido'; Split: max\_red.

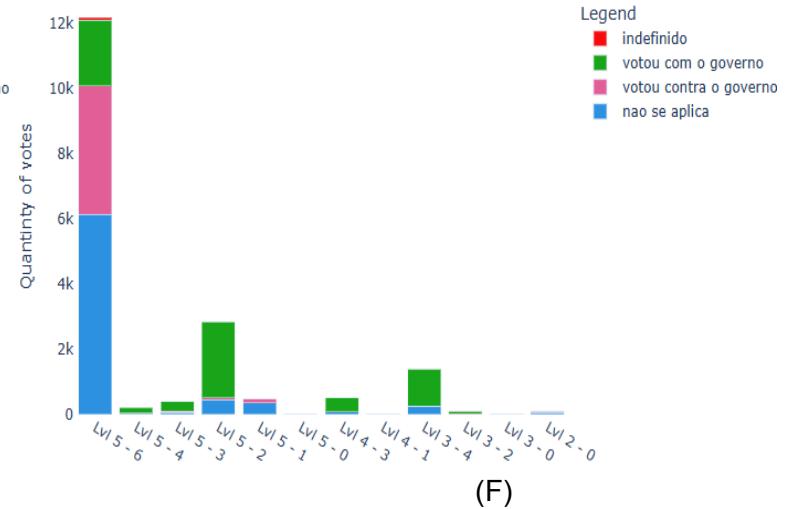


Feature 'alinhamento'; Split: max\_red.



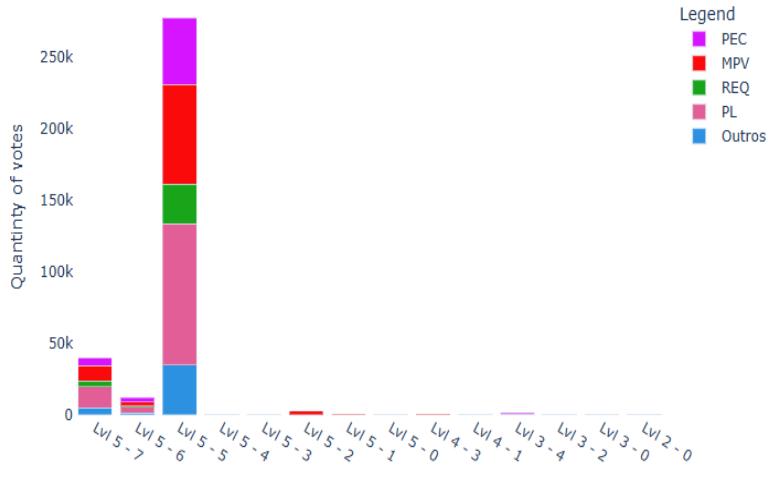
(E)

Feature 'alinhamento'; Split: max\_red.



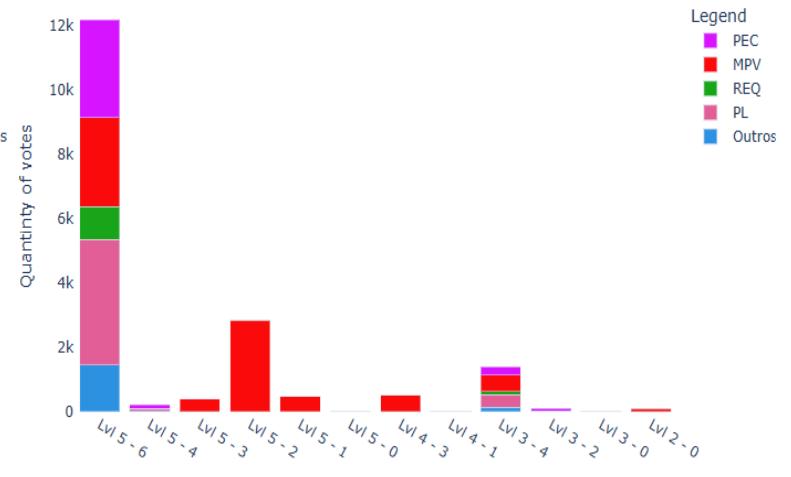
(F)

Feature 'tipoProposicao'; Split: max\_red.



(G)

Feature 'tipoProposicao'; Split: max\_red.



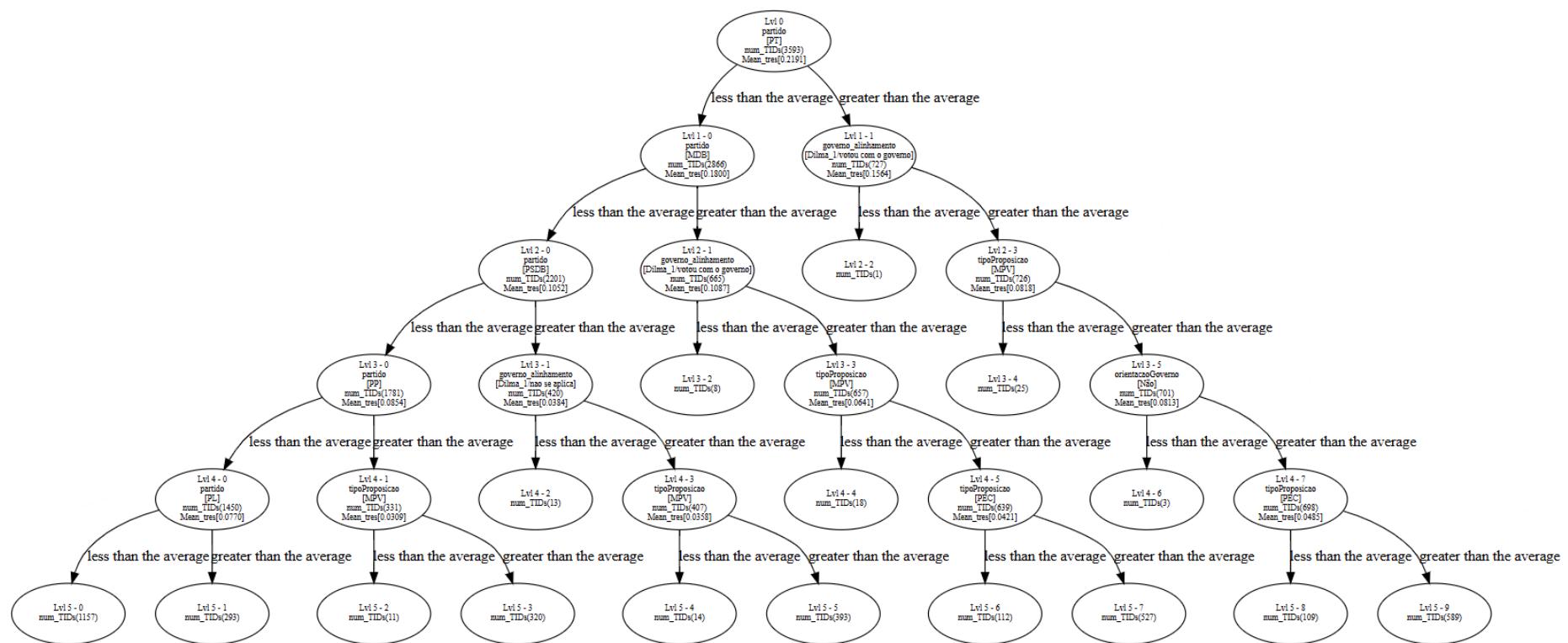
(H)

**Figure X.** Quantity of votes per cluster using MVR during the Bolsonaro government. The left side shows all cluster (A, C, E and G) while the right side (B, D, F and H) does not show two clusters with the majority of votes. (A-B) Party (Partido), (C-D) Political spectrum (espectro político) , (E-F) Government 's alignment (Alinhamento) and (G-H) Proposition (Tipo proposição).

## 2.2 Dilma (*first term*)

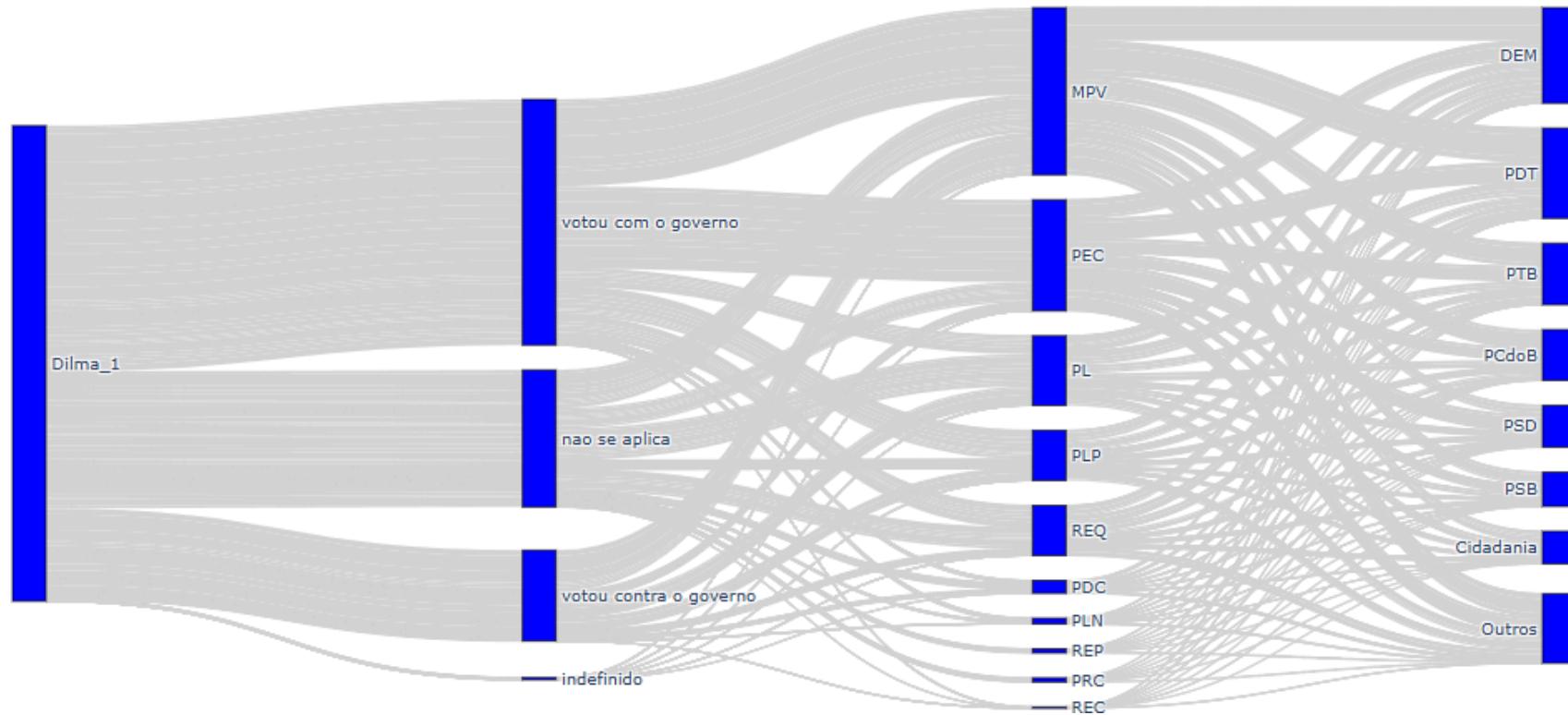
This dataset has 3,593 trajectories with a total of 115,287 votes from 649 deputies distributed into 26 parties. Running the MAT-Tree with MV, it identified 16 clusters where **51.57%** of the data is grouped into two clusters. Node 5-0 grouped **32.38%** corresponding to 1157 trajectories while node 5-9 grouped **19.19%** corresponding to 589 trajectories.

- Tree

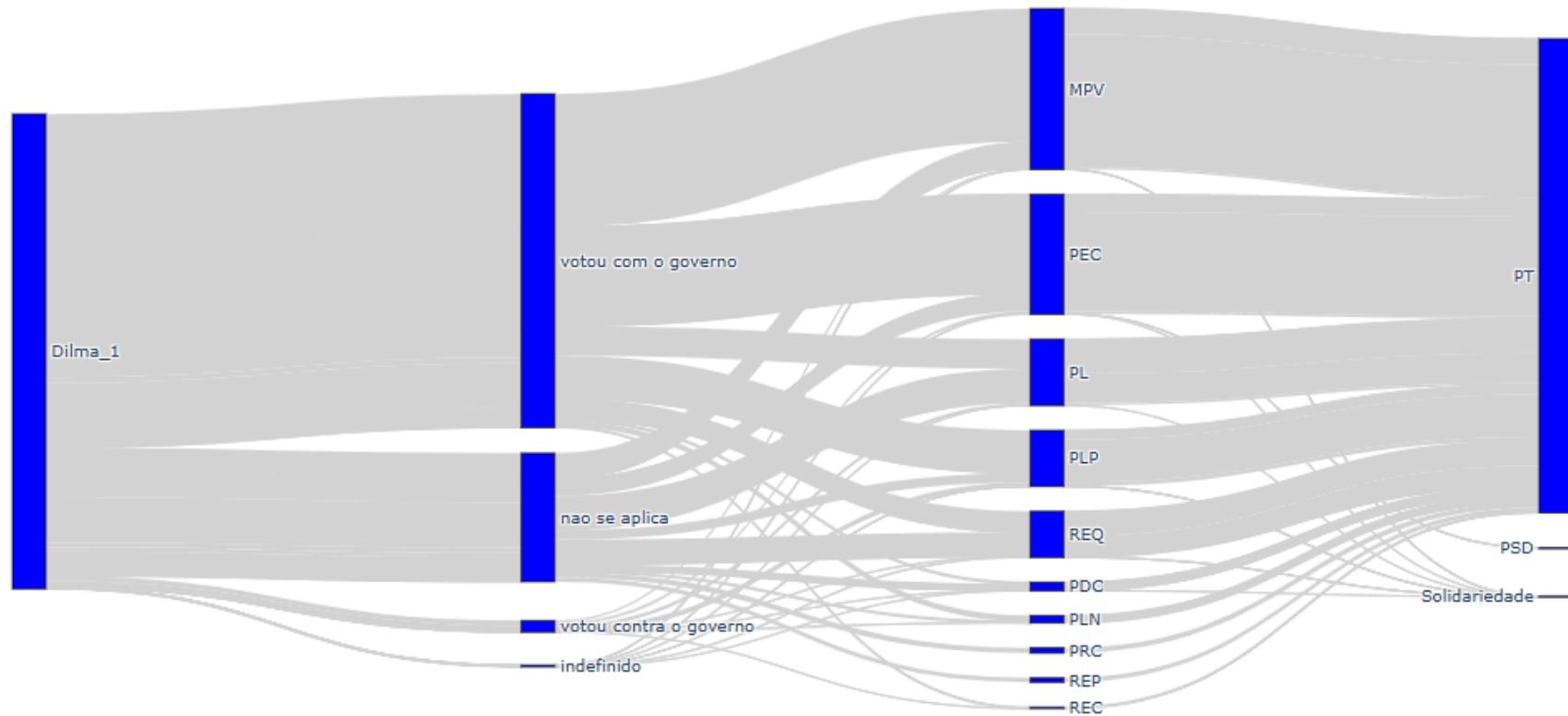


- Sankey

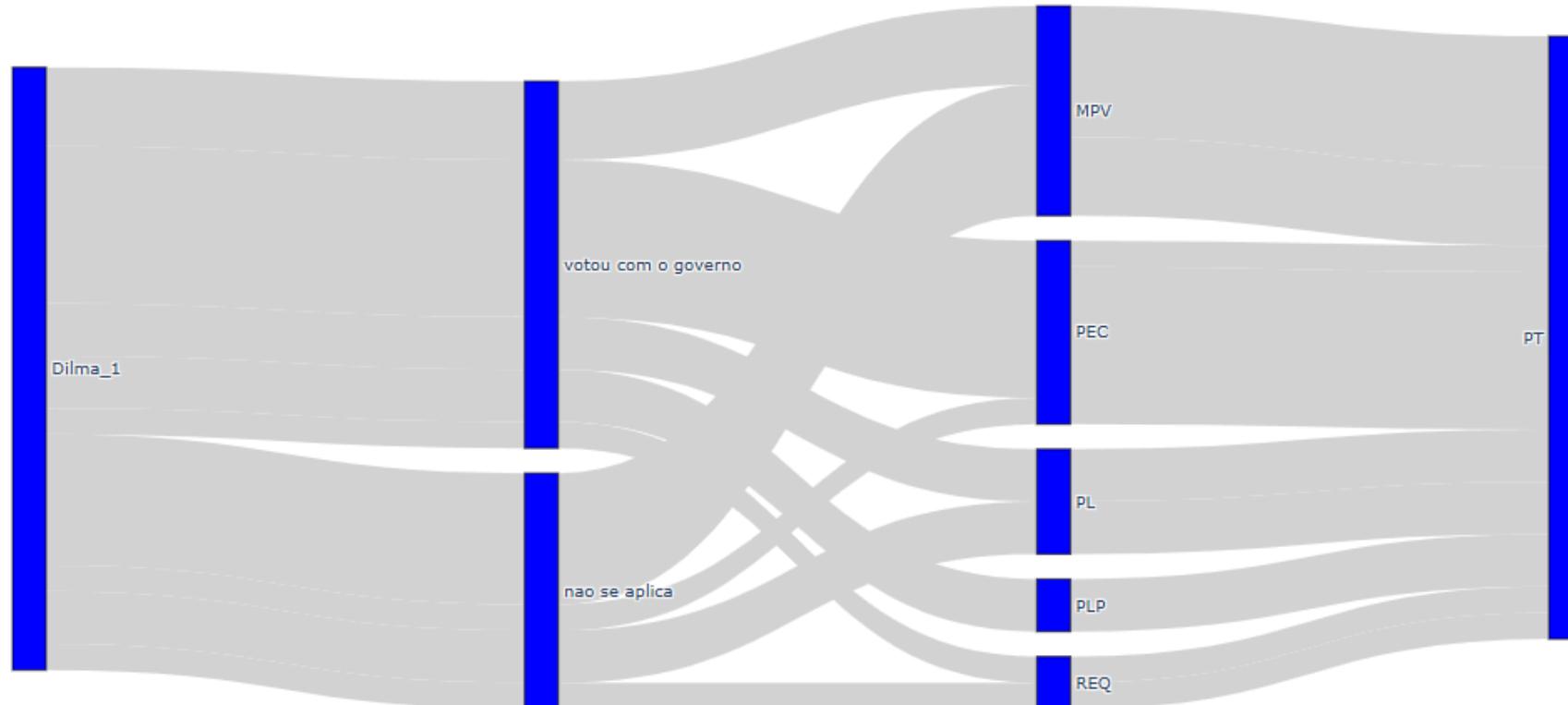
Node: Lvl 5 - 0; Split: max\_red  
TIDs: 1157; Unique deputies: 282; Total votes: 37330.  
from 2011-01-09 to 2014-12-17



Node: Lvl 5 - 9; Split: max\_red  
TIDs: 589; Unique deputies: 111; Total votes: 22126.  
from 2011-01-09 to 2014-12-17

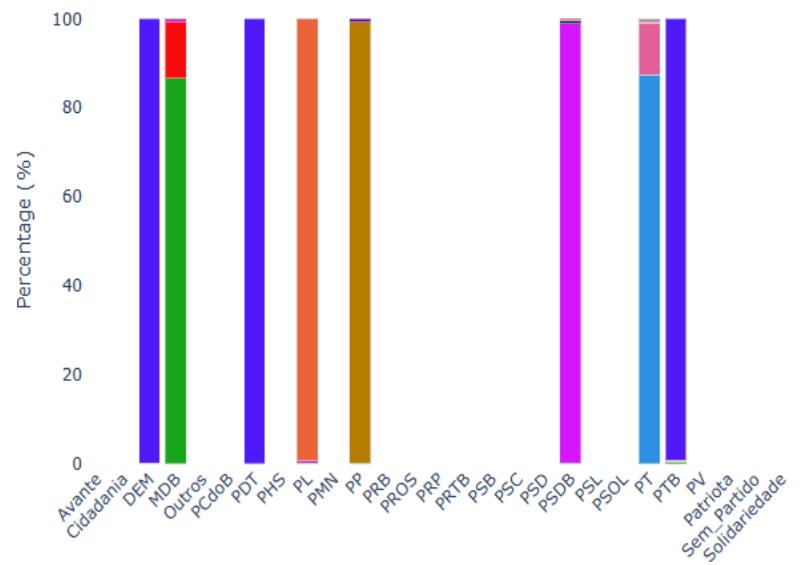


Node: Lvl 4 - 6; Split: max\_red  
TIDs: 3; Unique deputies:3; Total votes: 23.  
from 2012-02-14 to 2012-12-06

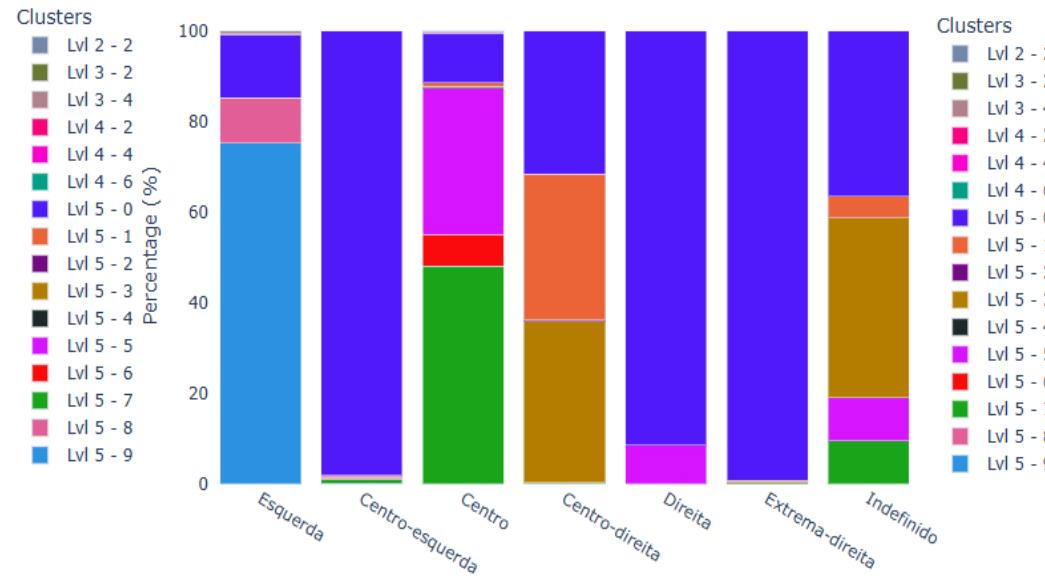


- Stacked bar
  - Clusters' percentage in the feature

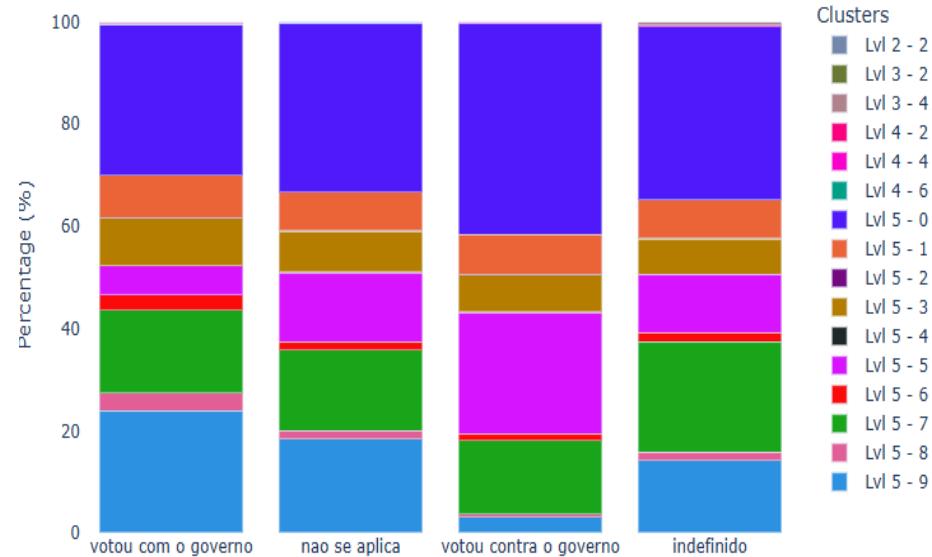
Clusters' percentage in the feature 'partido'. Split: max\_red



Clusters' percentage in the feature 'esp\_pol\_partido'. Split: max\_red



Clusters' percentage in the feature 'alinhamento'. Split: max\_red



Clusters' percentage in the feature 'tipoProposicao'. Split: max\_red

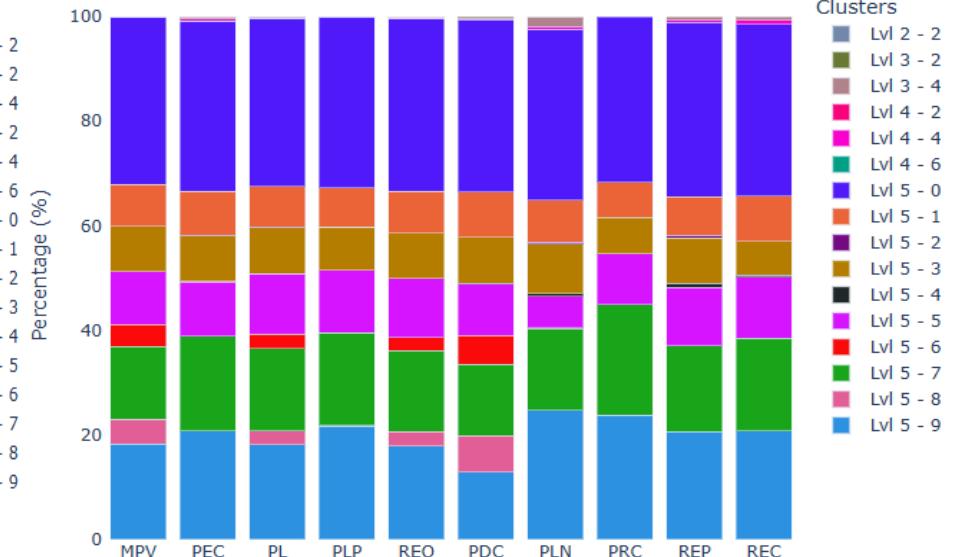
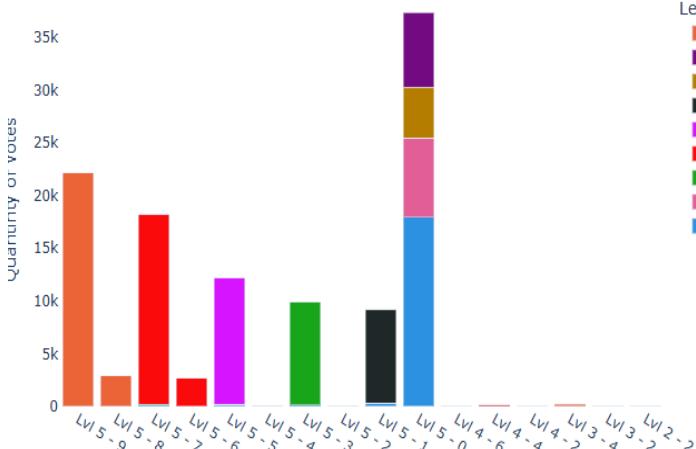


Figure x.

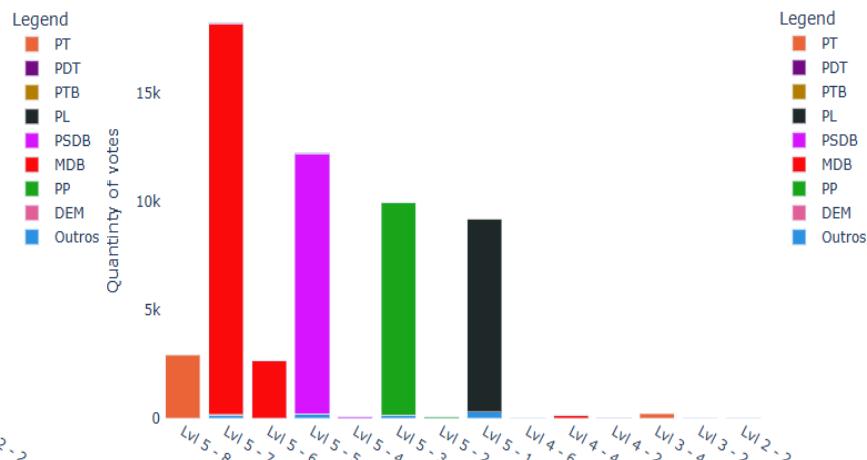
- Number of votes by feature value in the cluster

Feature 'partido'; Split: max\_red.



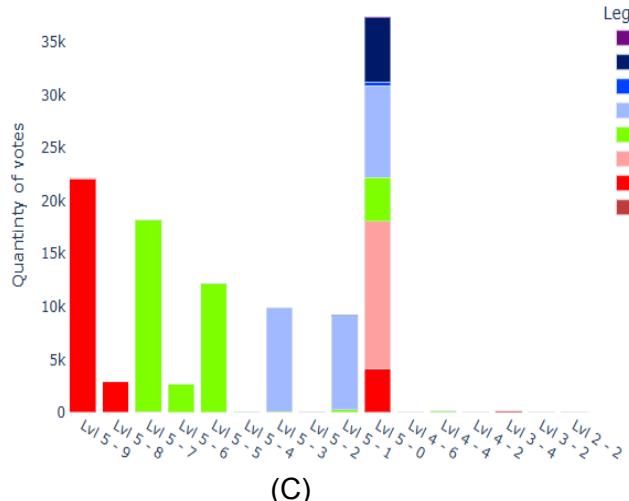
(A)

Feature 'partido'; Split: max\_red.



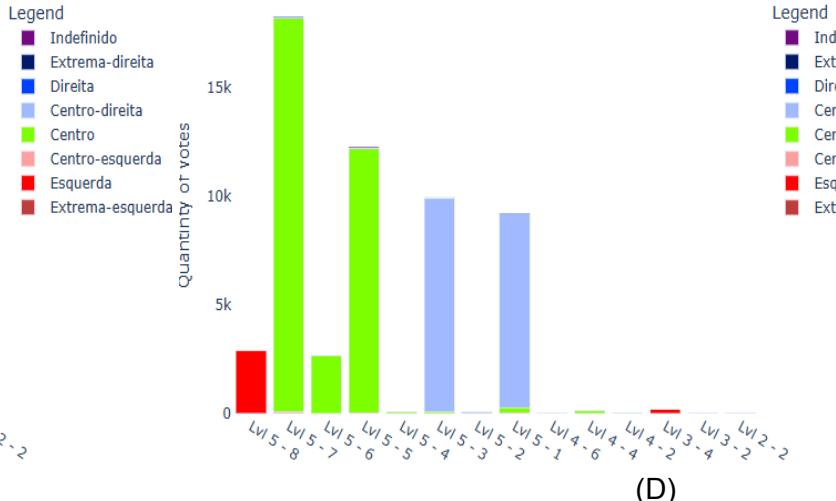
(B)

Feature 'esp\_pol\_partido'; Split: max\_red.



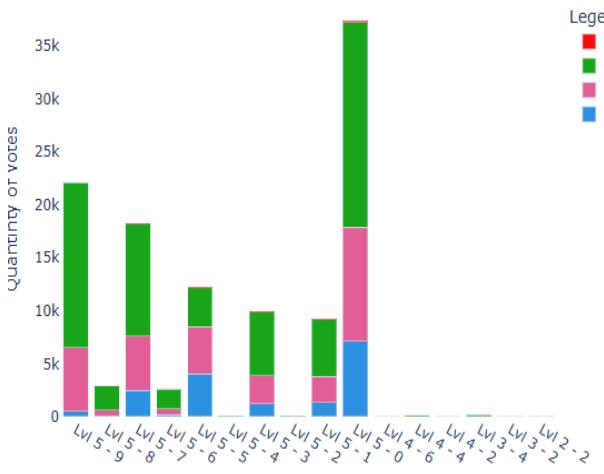
(C)

Feature 'esp\_pol\_partido'; Split: max\_red.



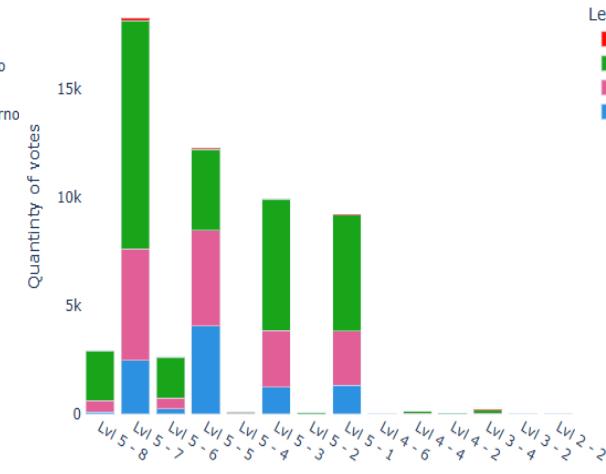
(D)

Feature 'alinhamento'; Split: max\_red.



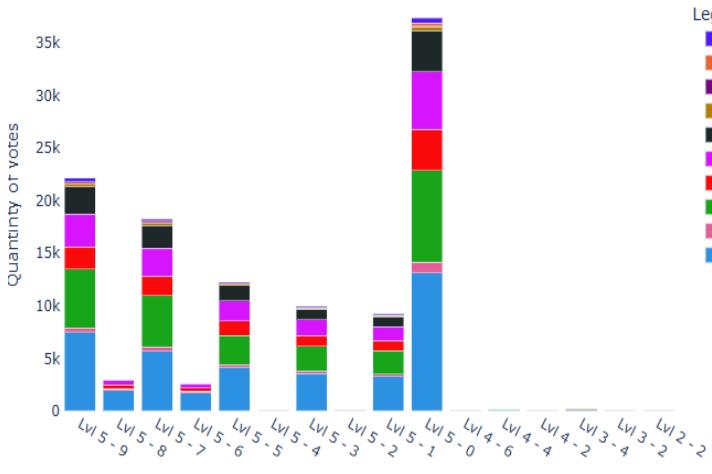
(E)

Feature 'alinhamento'; Split: max\_red.



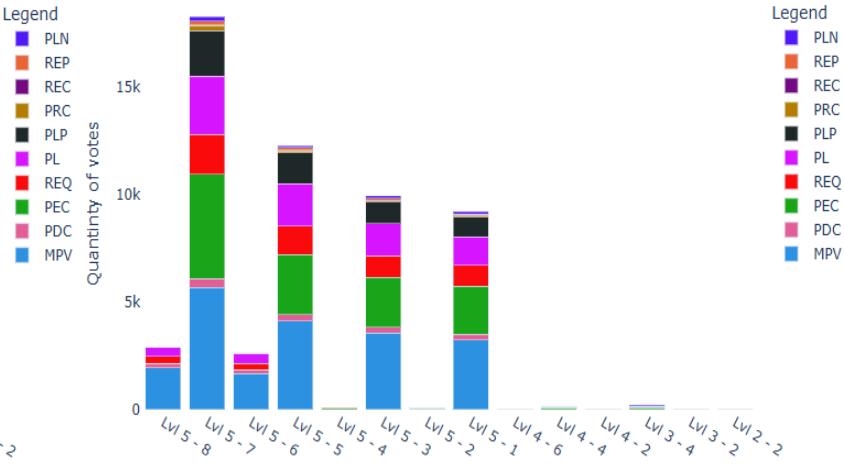
(F)

Feature 'tipoProposicao'; Split: max\_red.



(G)

Feature 'tipoProposicao'; Split: max\_red.

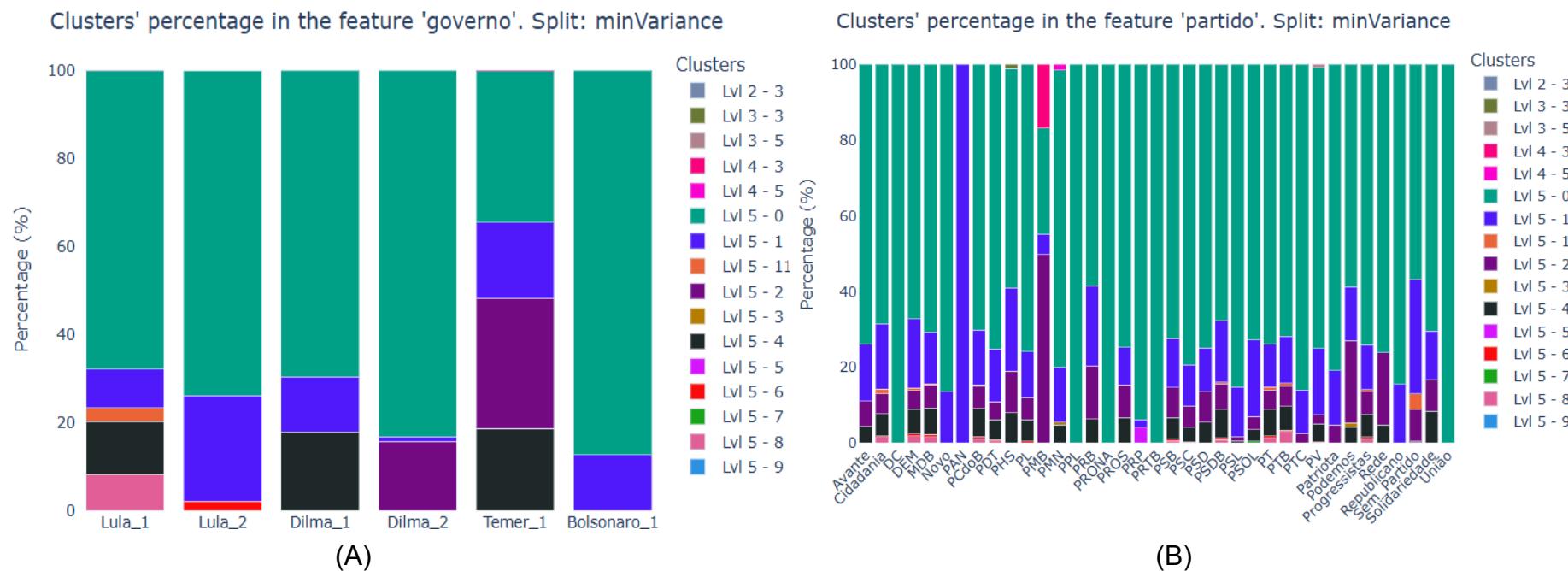


(H)

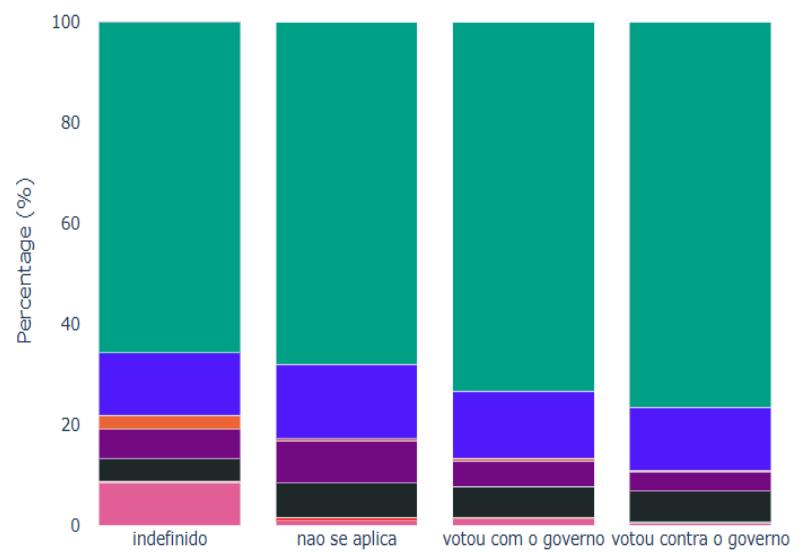
**Figure X.** Quantity of votes per cluster using MVR during the Dilma government. The left side shows all cluster (A, C, E and G) while the right side (B, D, F and H) does not show two clusters with the majority of votes. (A-B) Party (Partido), (C-D) Political spectrum (espectro político) , (E-F) Government's alignment (Alinhamento) and (G-H) Proposition (Tipo proposição).

### 3.2.3.2 MV

#### 1. All governments

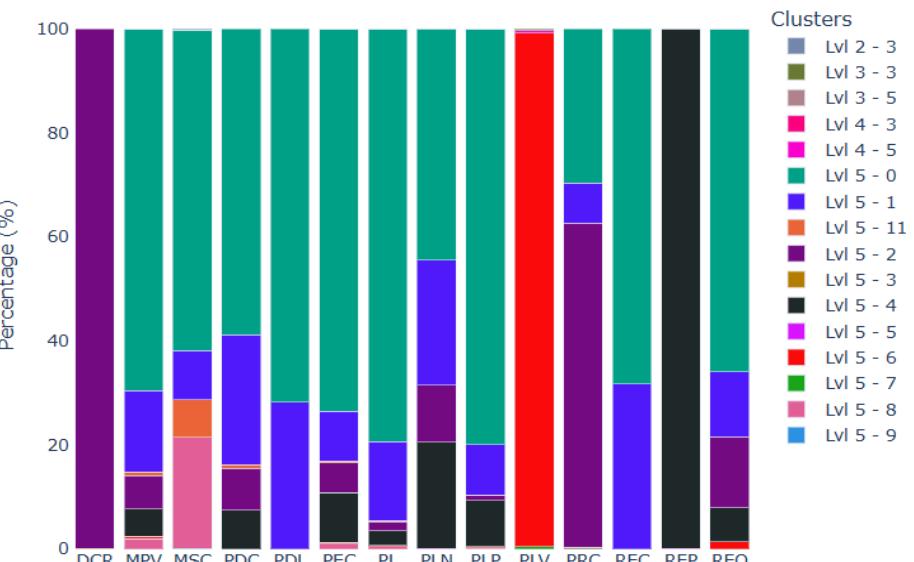


Clusters' percentage in the feature 'alinhamento'. Split: minVariance



(C)

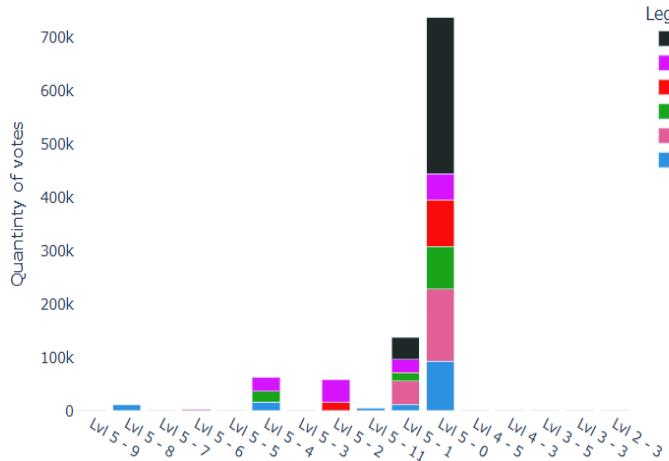
Clusters' percentage in the feature 'tipoProposicao'. Split: minVariance



(D)

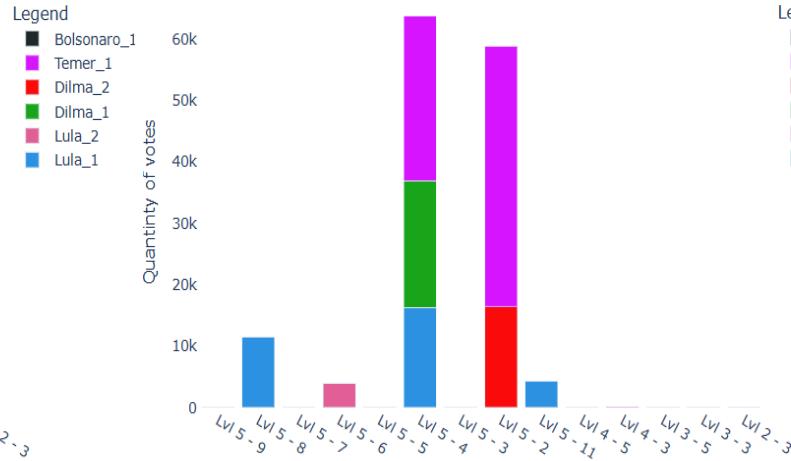
**Figure X.** Clusters' percentage in the features using MV. (A) Government (Governo), (B) Party (Partido), (C) Government's alignment (Alinhamento) and (D) Proposition (Tipo proposição).

Feature 'governo'; Split: minVariance.



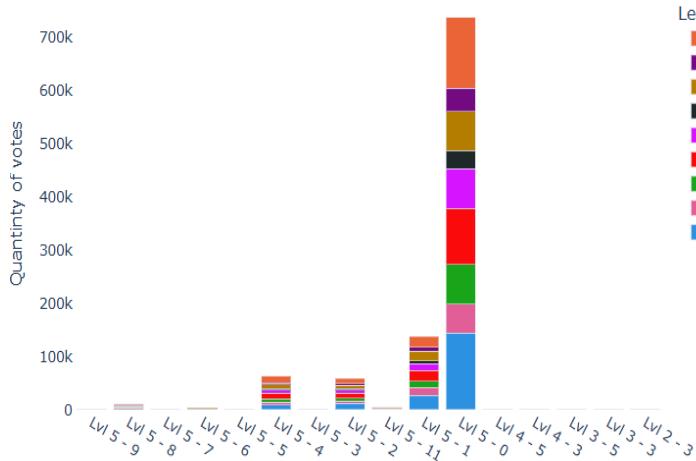
(A)

Feature 'governo'; Split: minVariance.



(B)

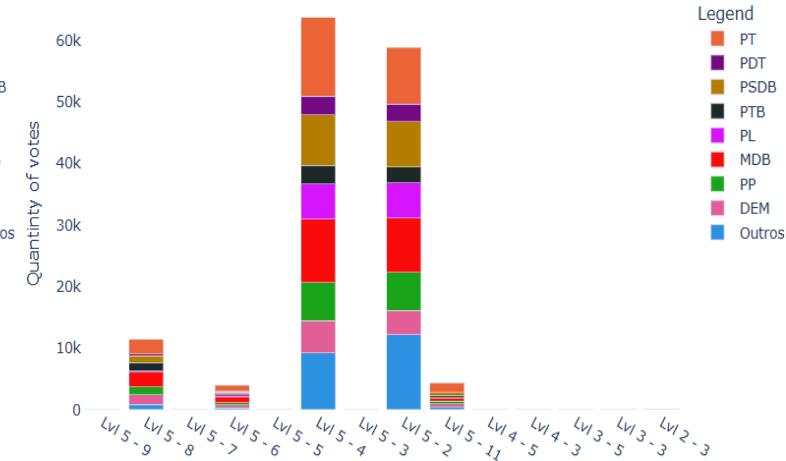
Feature 'partido'; Split: minVariance.



(C)

Legend:  
PT  
PDT  
PSDB  
PTB  
PL  
MDB  
PP  
DEM  
Outros

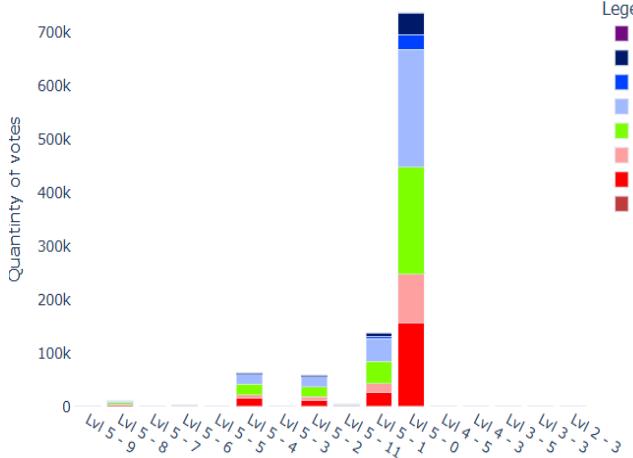
Feature 'partido'; Split: minVariance.



(D)

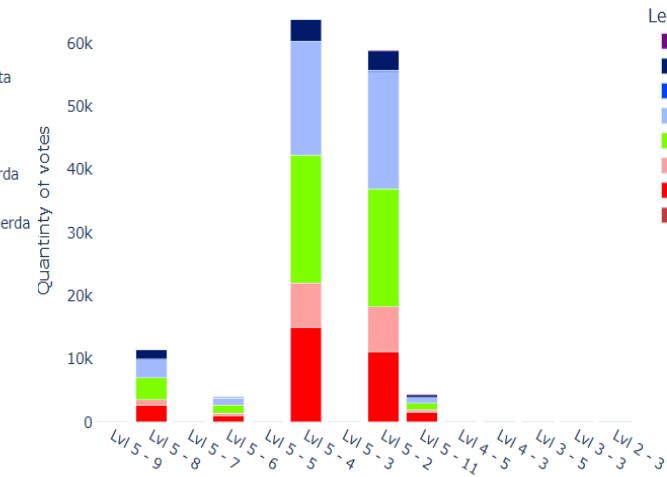
Legend:  
PT  
PDT  
PSDB  
PTB  
PL  
MDB  
PP  
DEM  
Outros

Feature 'esp\_pol\_partido'; Split: minVariance.



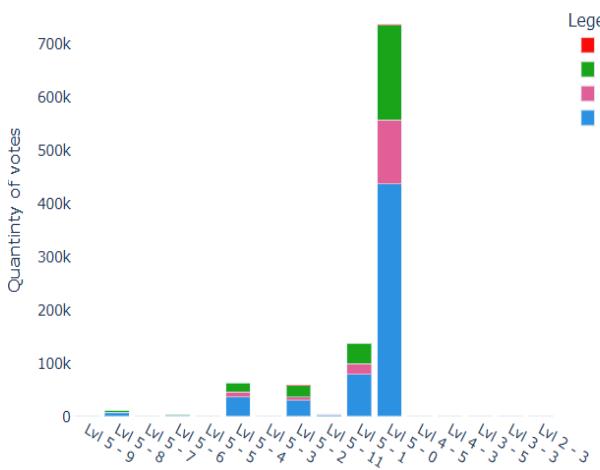
(E)

Feature 'esp\_pol\_partido'; Split: minVariance.



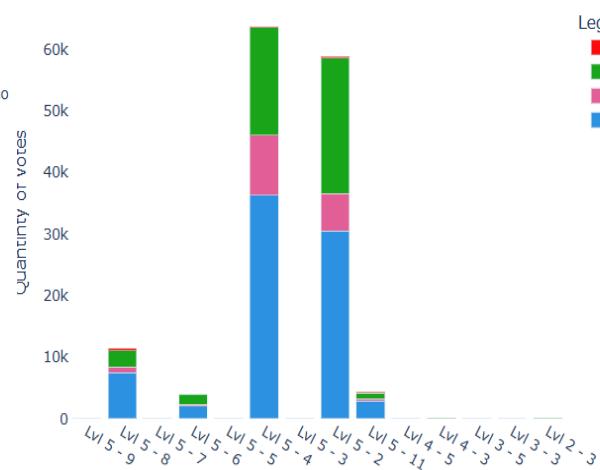
(F)

Feature 'alinhamento'; Split: minVariance.

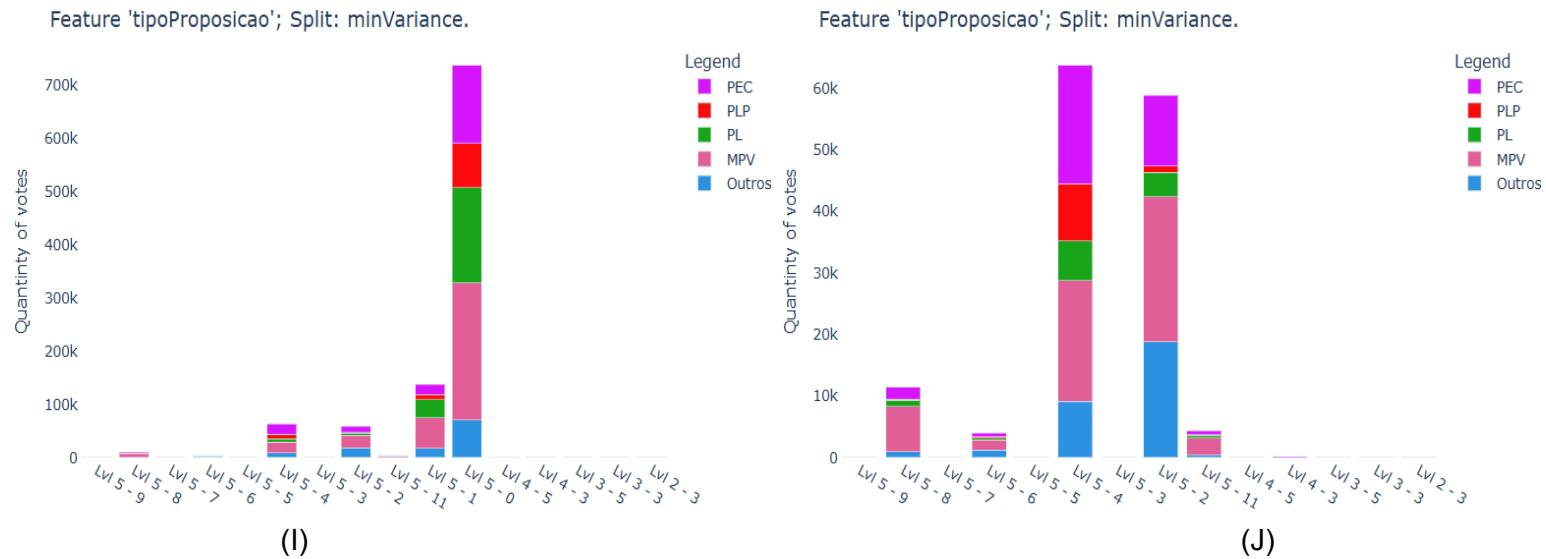


(G)

Feature 'alinhamento'; Split: minVariance.



(H)



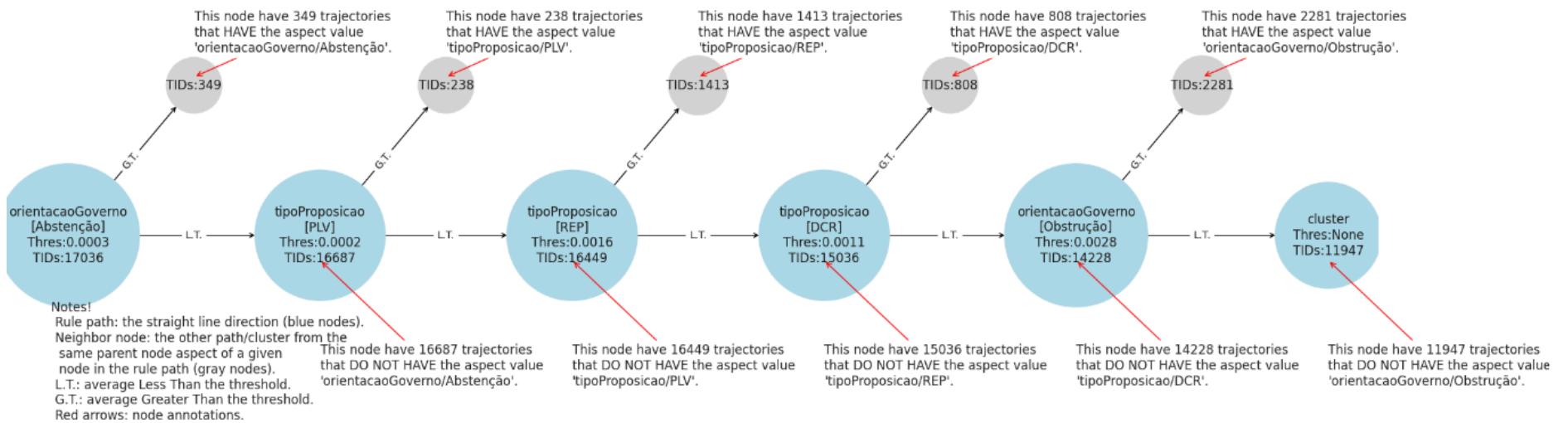
**Figure X.** Quantity of votes per cluster per feature using MV. The left side shows all cluster (A, C, E, G and I) while the right side (B, D, F, H and J) does not show two clusters with the majority of votes. (A-B) Government (Governo), (C-D) Party (Partido), (E-F) Political spectrum (espectro político) , (G-H) Government's alignment (Alinhamento) and (I-J) Proposition (Tipo proposição).

Similar to independent feature approach, we note that the difference between clusters 5-0 and 5-1 is the split side on the last aspect in its path. The MAT-Tree approach on basometro dataset has generated such concentration using the current setup as max\_depth=5 and min\_trajs=50.

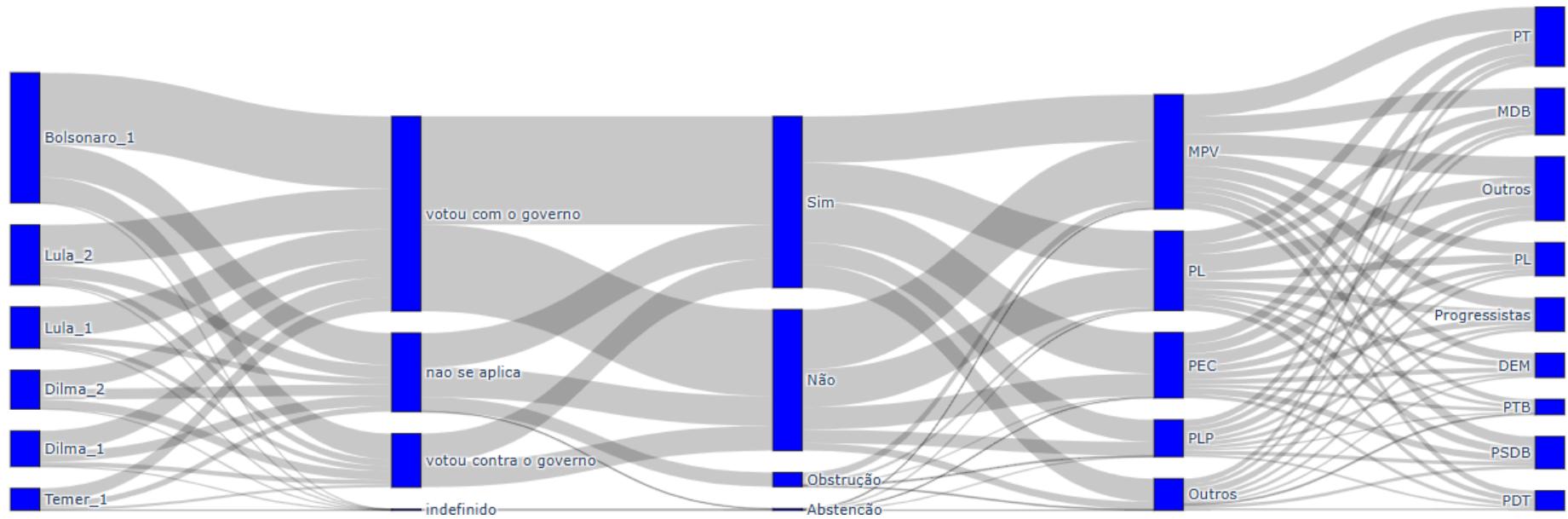
- Cluster node 5-0:
  - 72.12% (11947) of the trajectory clustered data.
  - Date range: 2003-01-04 to 2022-12-04.
  - It is a group that did not vote on PLV, REP and DRC propositions, and voted different of government's guidance to vote Abstention and Obstruction.
  - 39.69% of the votes occurred during the Bolsonaro's government.
  - The majority of the deputies voted in line with the governments corresponding to 59.31% (437711) of the votes.

- All deputies that voted as Obstruction are related to Not Applicable for government's guidance corresponding to 4,32% (31897) of the votes in the cluster.
- Deputies that voted as Abstention corresponds to 0.53% (3922) of the votes, where 0.36% (2621) occurred when the government's guidance was Undefined and 0.18% (1301) for Not Applicable.

For example, MAT-Tree identified a group of 11947 trajectories that did not vote on PLV, REP and DRC proposition (tipoProposicao [PLV|REP|DRC]), and voted different of government's guidance for Abstention and Obstruction (orientacaoGoverno [Abtenção|Obstrução]).

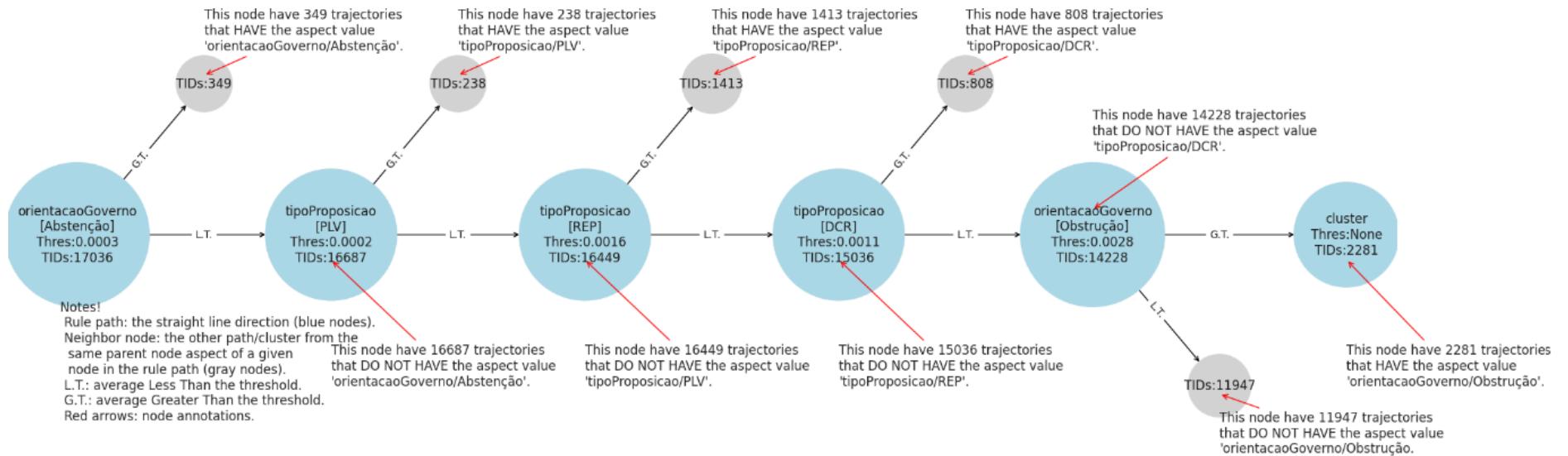


Node: Lvl 5 - 0; Split: minVariance  
TIDs: 11947; Unique deputies: 1762; Total votes: 738000.  
from 2003-01-04 to 2022-12-04



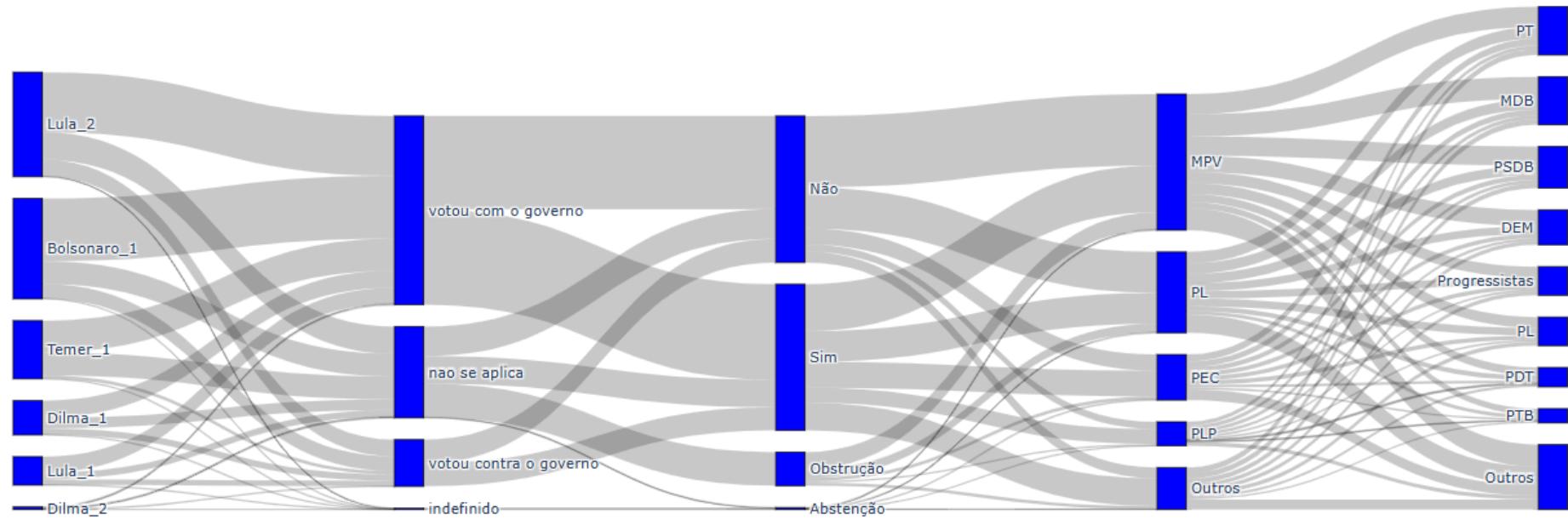
- Cluster node 5-1:
  - 13.39% (2281) of the trajectory clustered data.
  - Date range: 2004-01-06 to 2019-12-17.
  - It is a group that did not vote on PLV, REP and DRC propositions, did not vote when the government's guidance was to vote Abstention, but participated when the government's guidance was to vote Obstruction.
  - 31.83% (44084) of the votes in this cluster occurred during the Lula-2's government (2007 to 2010), while the Bolsonaro's term (2019 to 2022) was the second with 30.59% (42367) of the votes.
  - Bolsonaro's term did not have the majority of the votes because the pattern endup in 2019. Does something happen?
  - The majority of the votes in this group was in line with government's guidance corresponding to 57.56% (79713) of the votes.

For example, MAT-Tree identified a group of 2281 trajectories that voted different of government's guidance for Abstention (orientacaoGoverno [Abstenção]), then did not vote on PLV, REP and DRC proposition (tipoProposicao [PLV|REP|DRC]), and concluded following the government's guidance to vote Obstruction (orientacaoGoverno [Obstrução]) for some proposition.



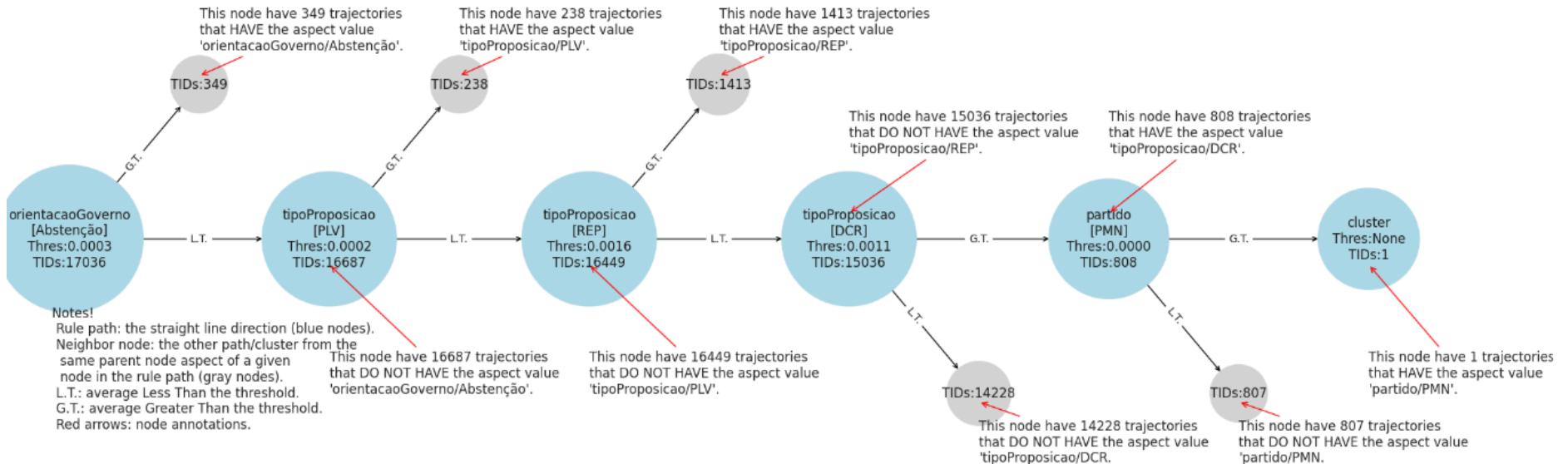
Node: Lvl 5 - 1; Split: minVariance

TIDs: 2281; Unique deputies: 1132; Total votes: 138490.  
from 2004-01-06 to 2019-12-17

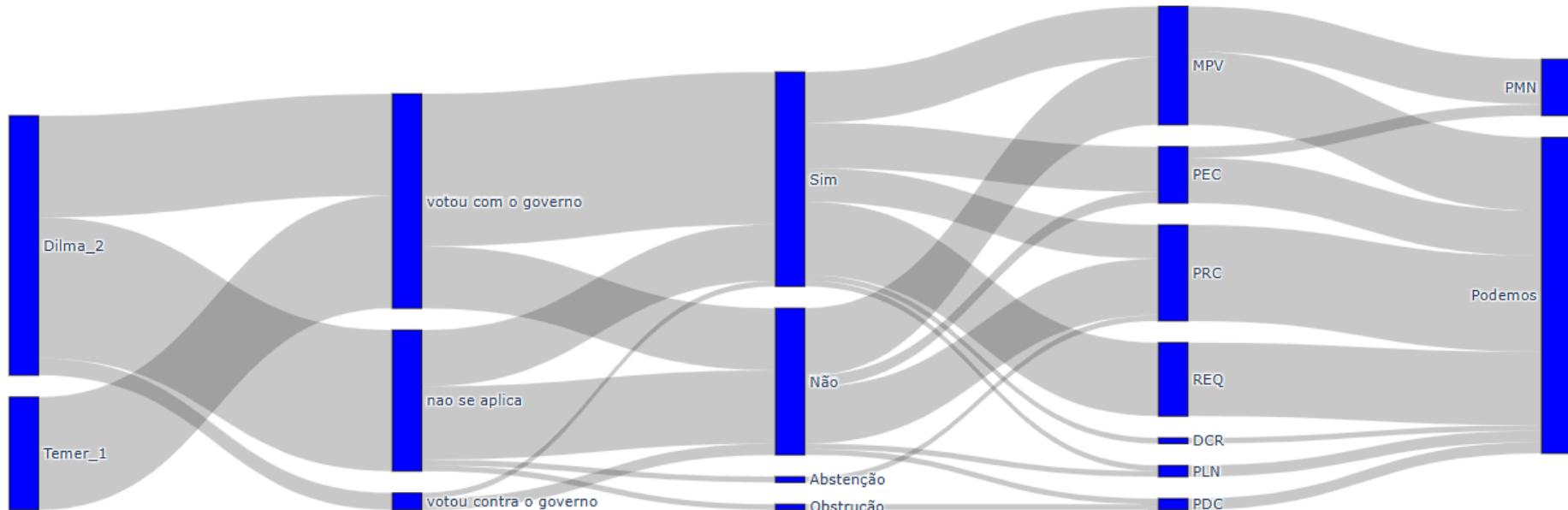


- Cluster node 5-3:
  - Date range: 2016-01-03 to 2016-09-03
  - This group is related to one trajectory of a deputy that did not vote on PLV and REP propositions, where the number of votes to DRC proposition was greater than the threshold and the deputy changed of party.

For example, MAT-Tree identified a outlier cluster with 1 trajectory from PMN party (PMN) that voted on DRC proposition (tipoProposicao [DRC]) and did not follow the government's guidance to vote Abstention (orientacaoGoverno [Abstenção]).



Node: Lvl 5 - 3; Split: minVariance  
 TIDs: 1; Unique deputies:1; Total votes: 66.  
 from 2016-01-03 to 2016-09-03

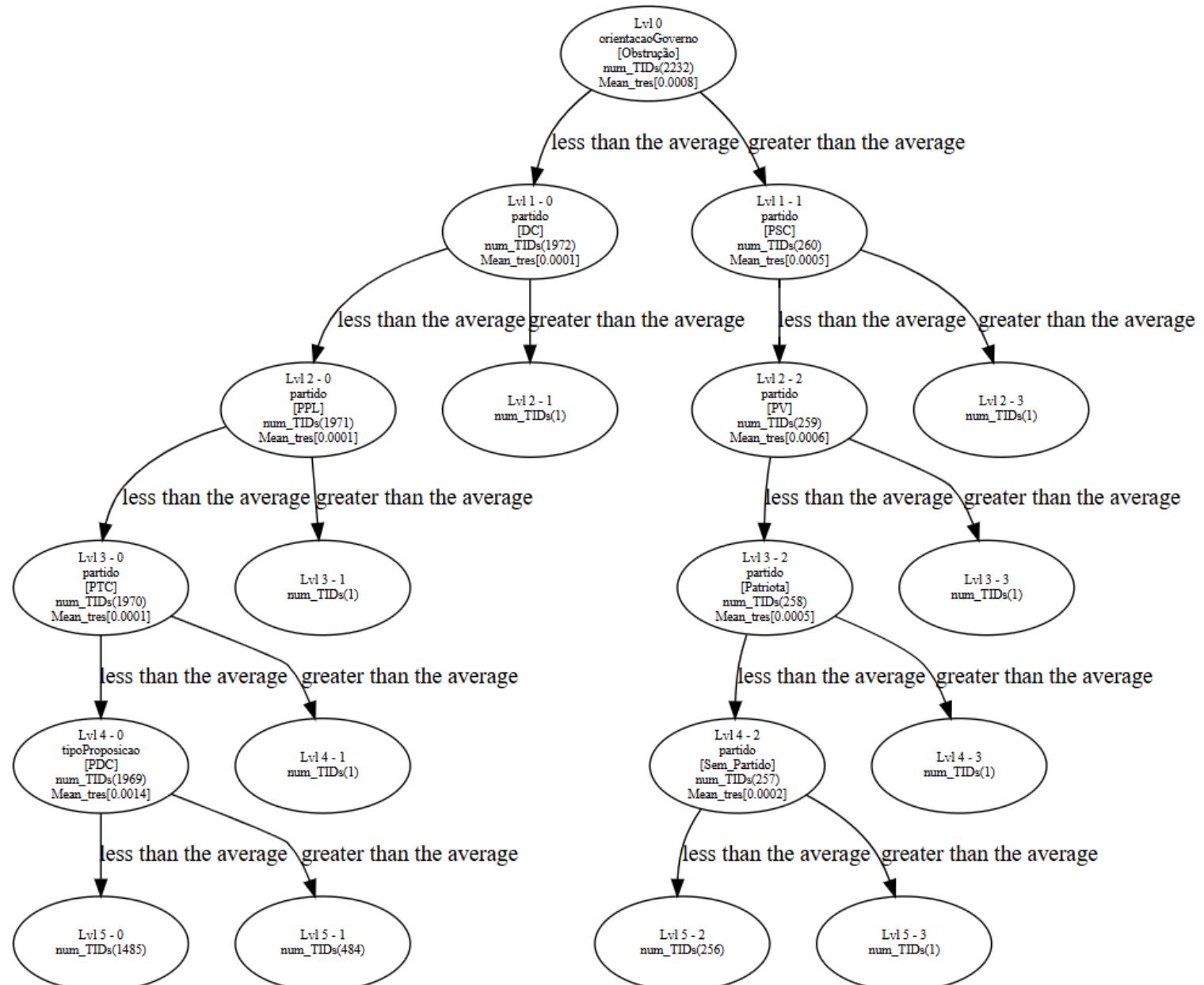


## 2. Dataset by government

### 2.1 Bolsonaro

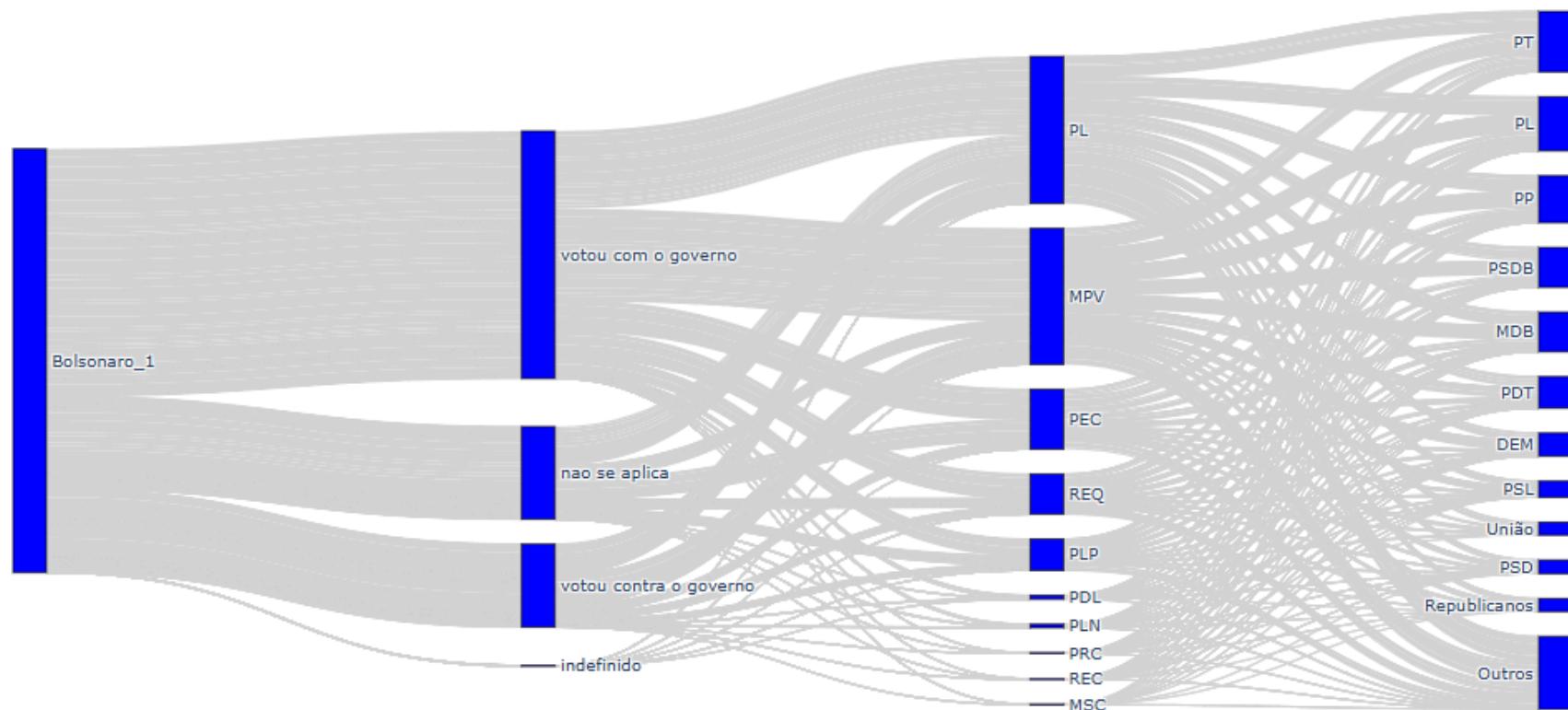
This dataset has 2,232 trajectories with a total of 335,262 votes from 560 deputies distributed into 33 parties. Running the MAT-Tree with MVR identified 10 clusters, where **87.28%** of the data is grouped into two clusters. Node 5-0 grouped **53.89%** corresponding to 1485 trajectories while node 5-1 grouped **33.39%** corresponding to 484 trajectories.

- Tree

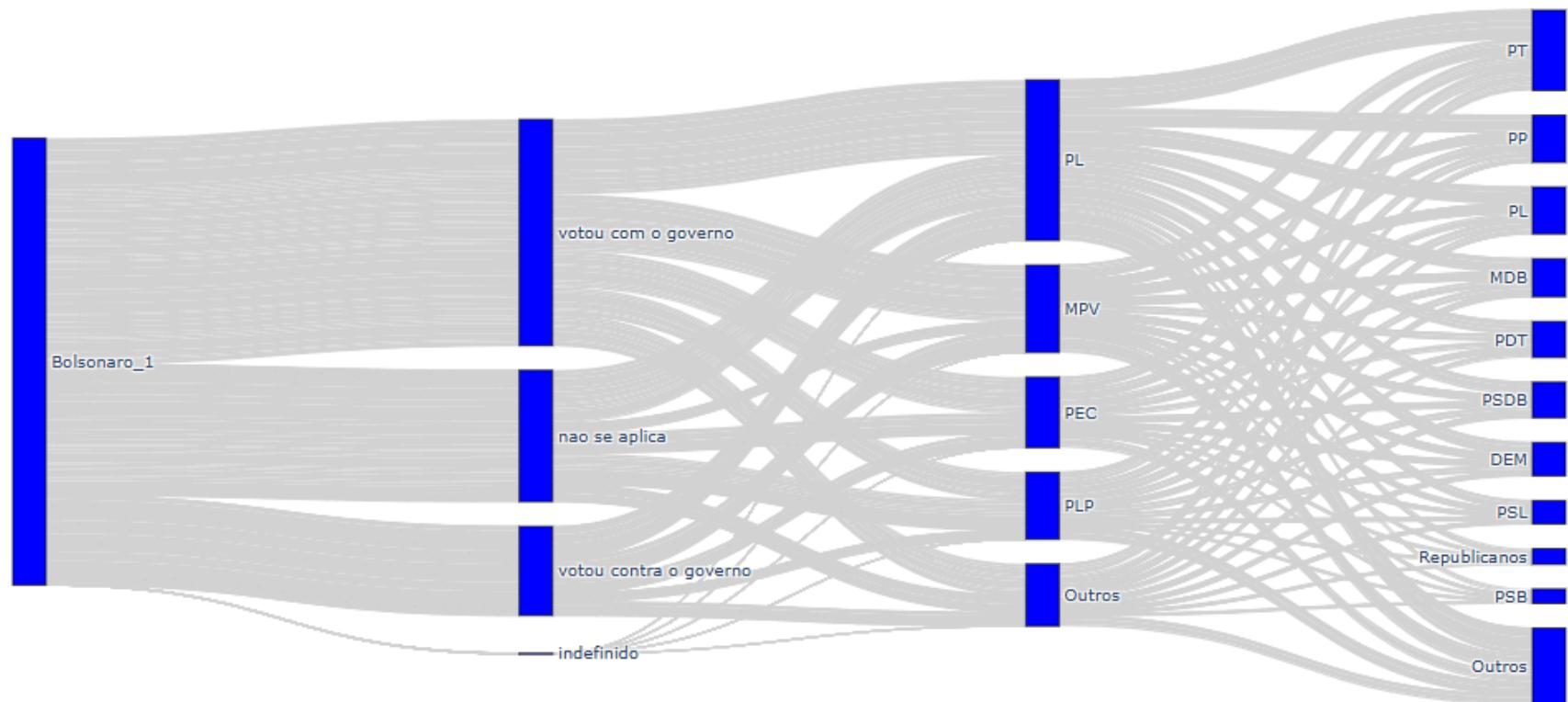


- Sankey

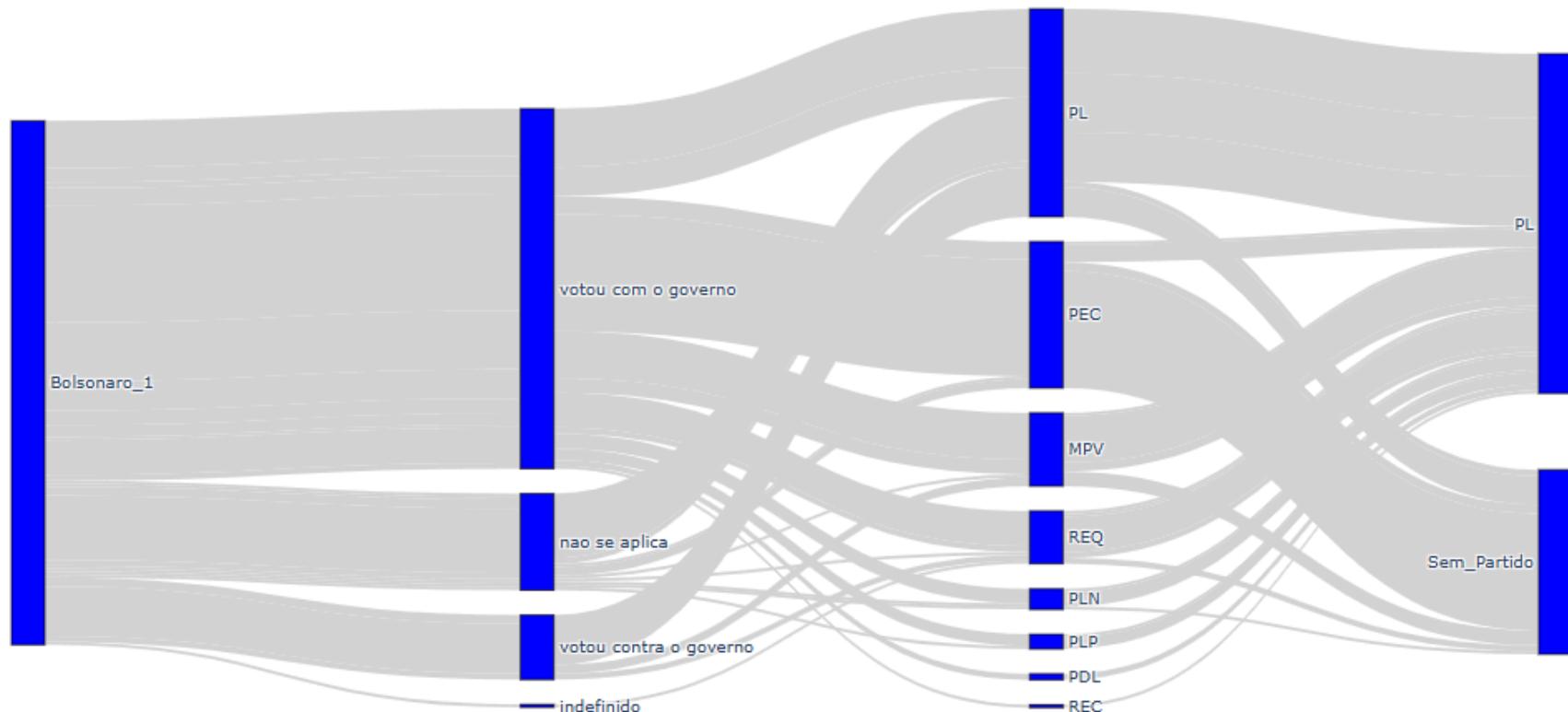
Node: Lvl 5 - 0; Split: minVariance  
 TIDs: 1485; Unique deputies: 535; Total votes: 180673.  
 from 2019-01-10 to 2022-12-04



Node: Lvl 5 - 1; Split: minVariance  
TIDs: 484; Unique deputies: 353; Total votes: 111934.  
from 2019-02-04 to 2021-12-21

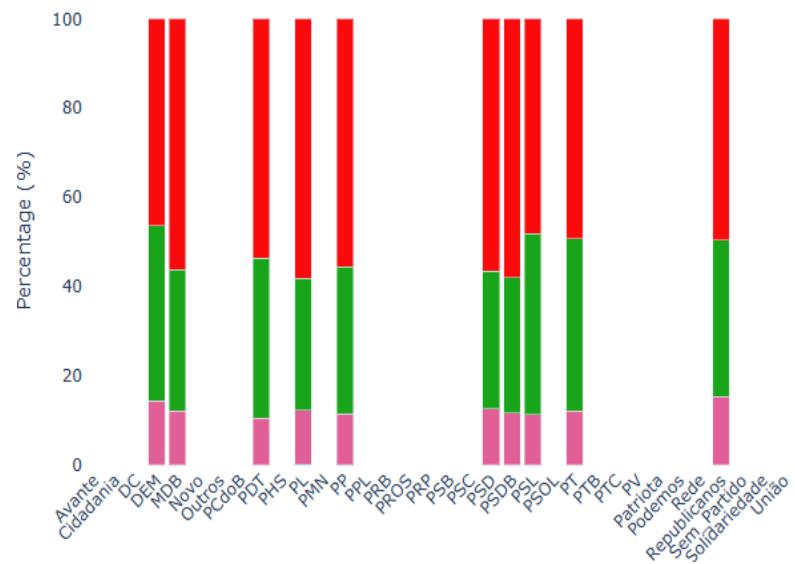


Node: Lvl 5 - 3; Split: minVariance  
TIDs: 1; Unique deputies:1; Total votes: 179.  
from 2019-01-10 to 2019-12-17

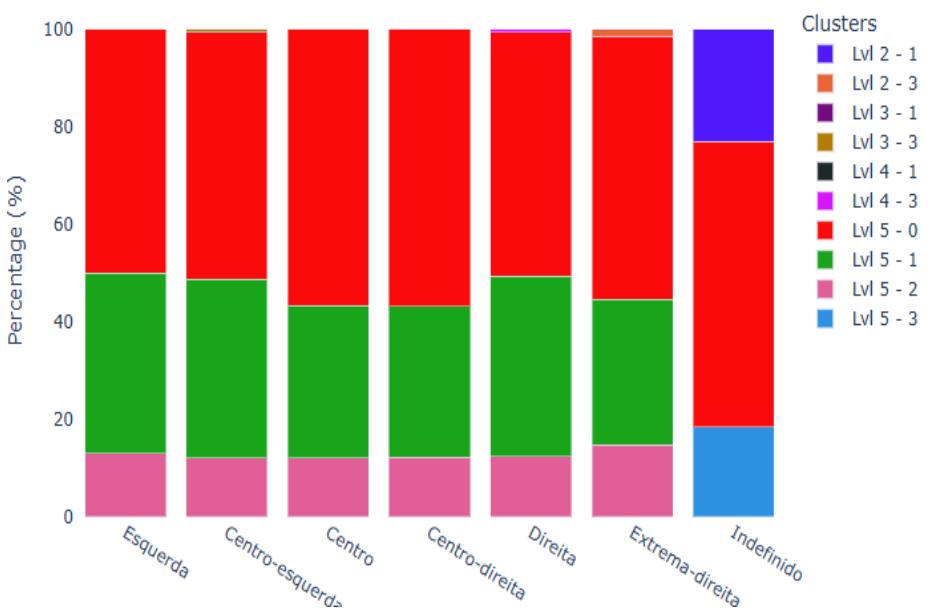


- Stacked bar
  - Clusters' percentage in the feature

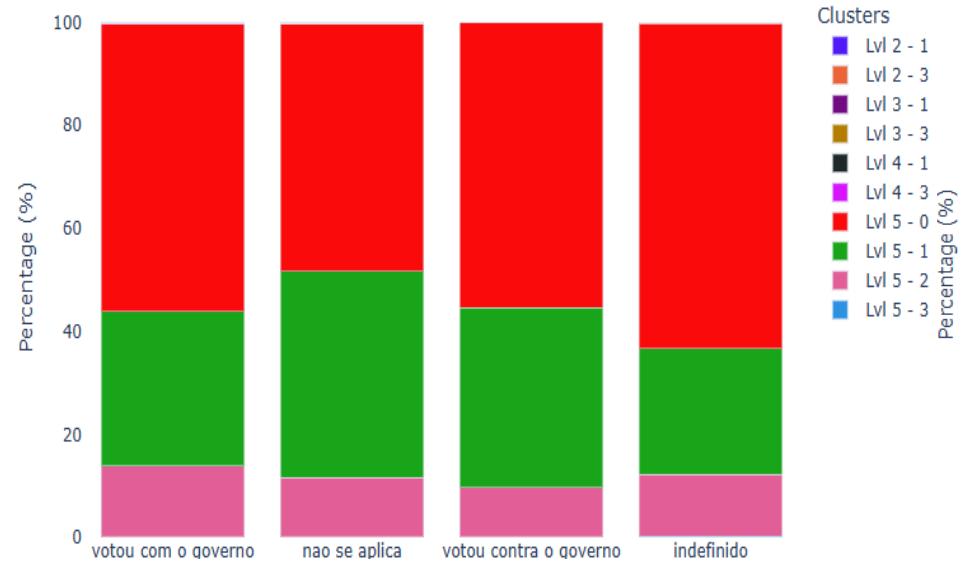
Clusters' percentage in the feature 'partido'. Split: minVariance



Clusters' percentage in the feature 'esp\_pol\_partido'. Split: minVariance



Clusters' percentage in the feature 'alinhamento'. Split: minVariance



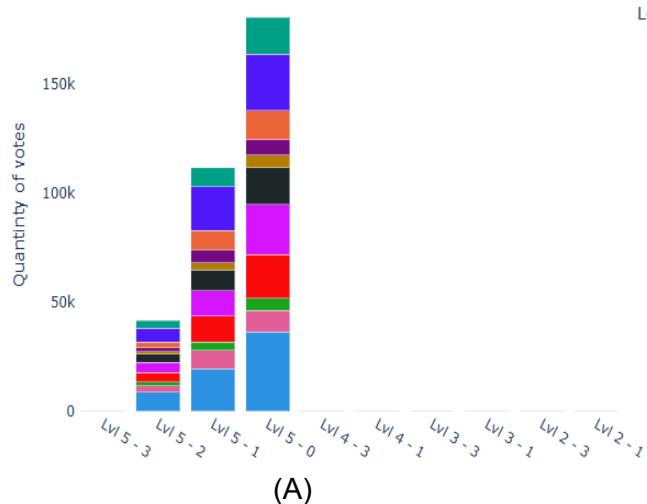
Clusters' percentage in the feature 'tipoProposicao'. Split: minVariance



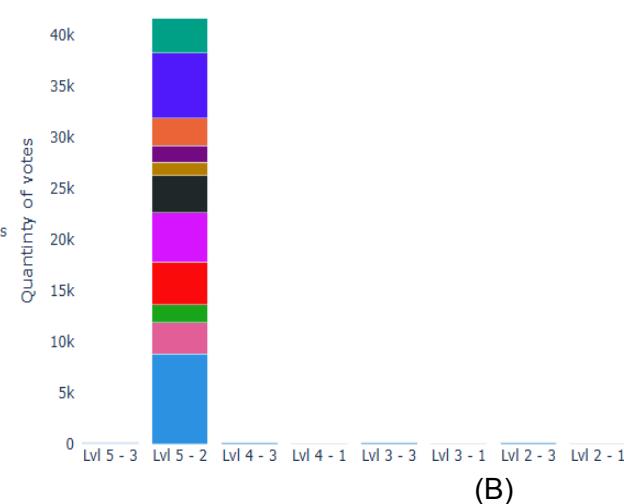
Figure x.

- Number of votes by feature value in the cluster

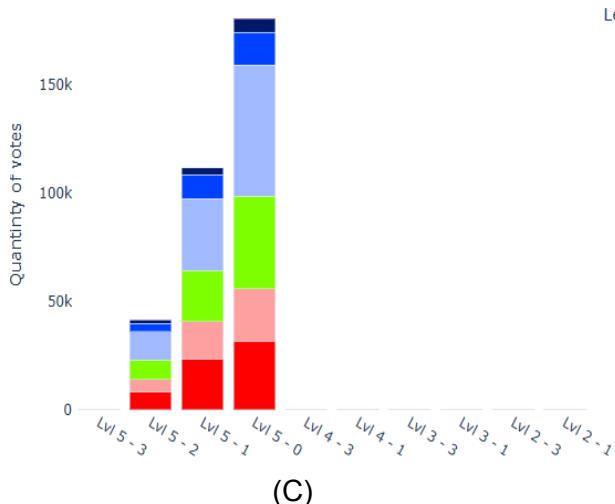
Feature 'partido'; Split: minVariance.



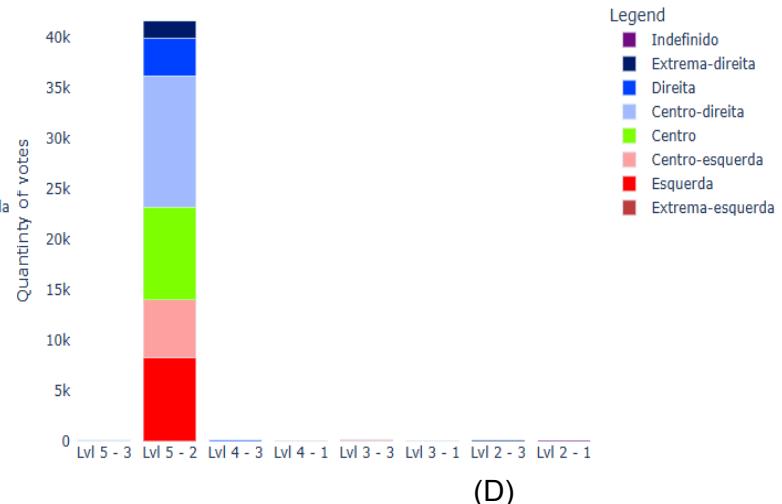
Feature 'partido'; Split: minVariance.



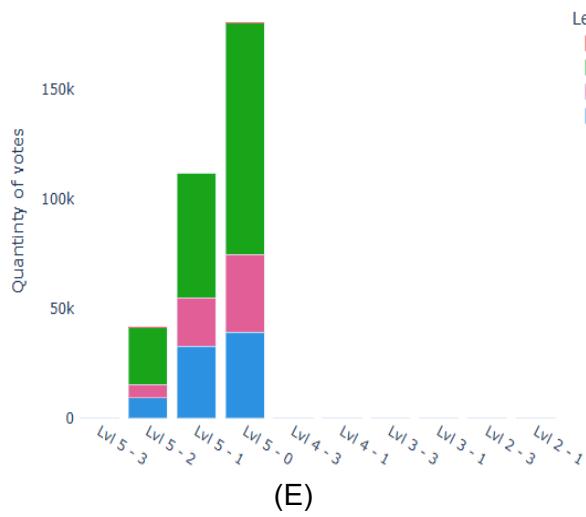
Feature 'esp\_pol\_partido'; Split: minVariance.



Feature 'esp\_pol\_partido'; Split: minVariance.

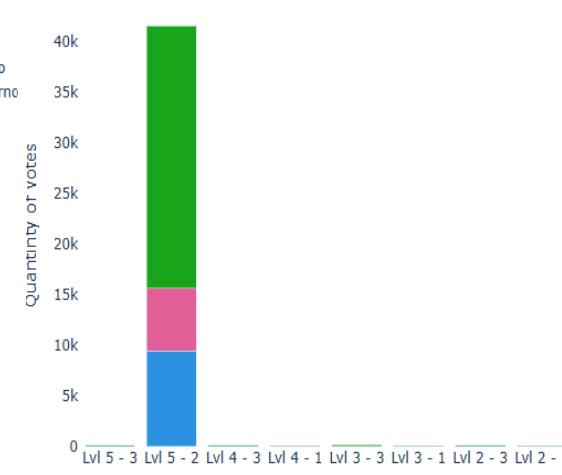


Feature 'alinhamento'; Split: minVariance.



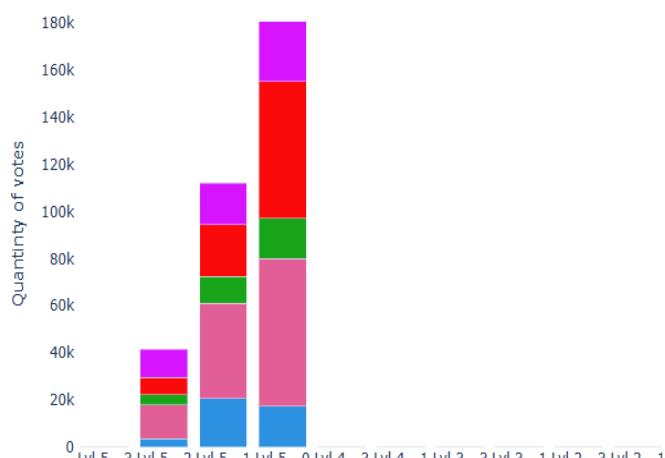
(E)

Feature 'alinhamento'; Split: minVariance.



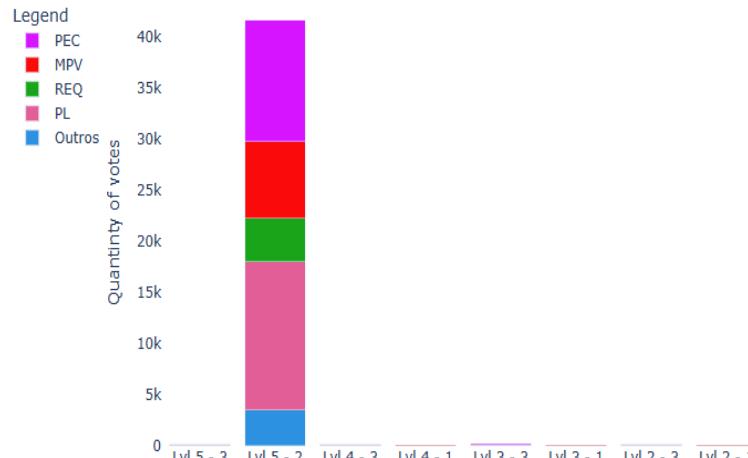
(F)

Feature 'tipoProposicao'; Split: minVariance.



(G)

Feature 'tipoProposicao'; Split: minVariance.



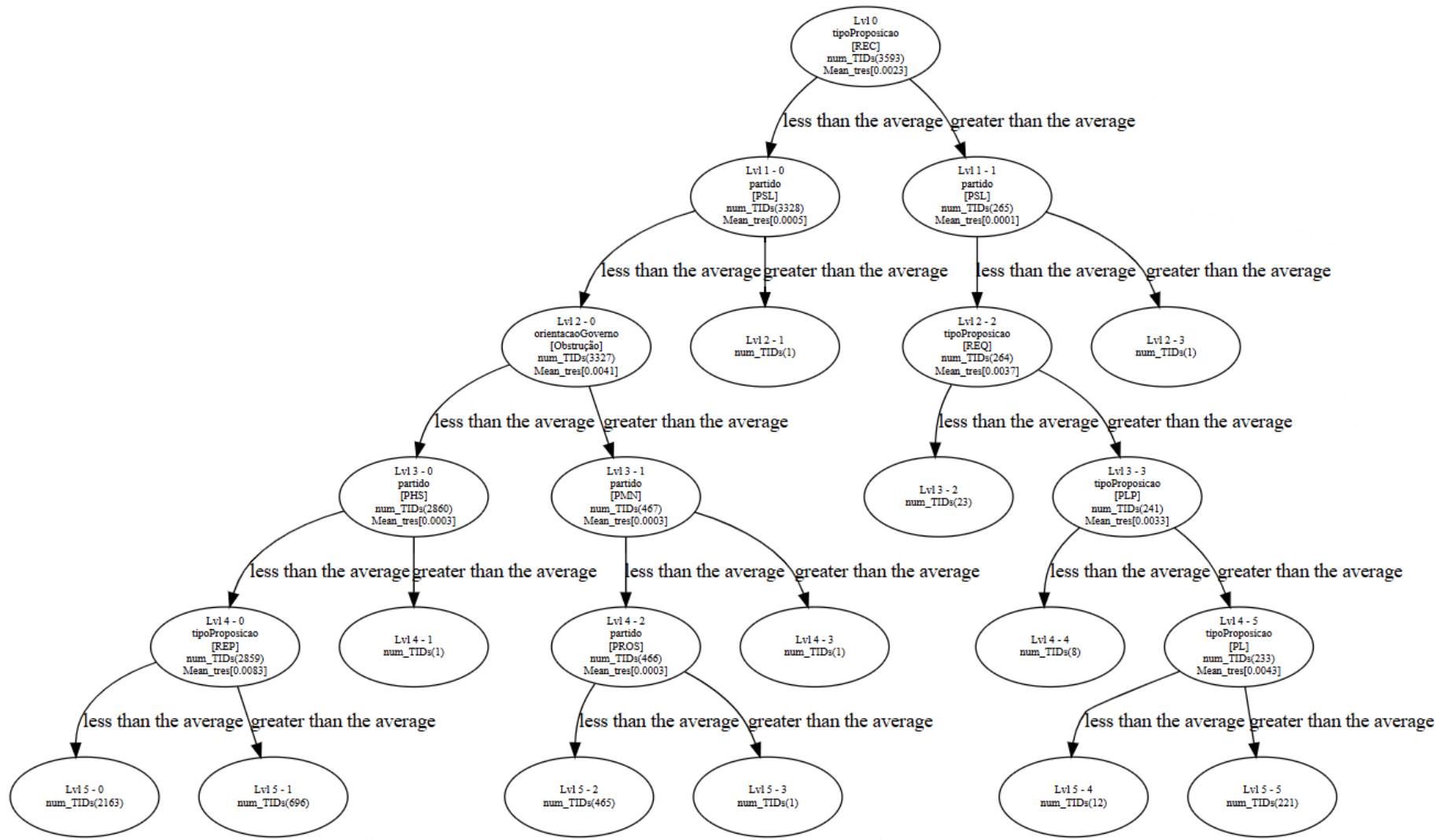
(H)

**Figure X.** Quantity of votes per cluster using MVR during the Bolsonaro government. The left side shows all cluster (A, C, E and G) while the right side (B, D, F and H) does not show two clusters with the majority of votes. (A-B) Party (Partido), (C-D) Political spectrum (espectro político) , (E-F) Government 's alignment (Alinhamento) and (G-H) Proposition (Tipo proposição).

## 2.2 Dilma (*first term*)

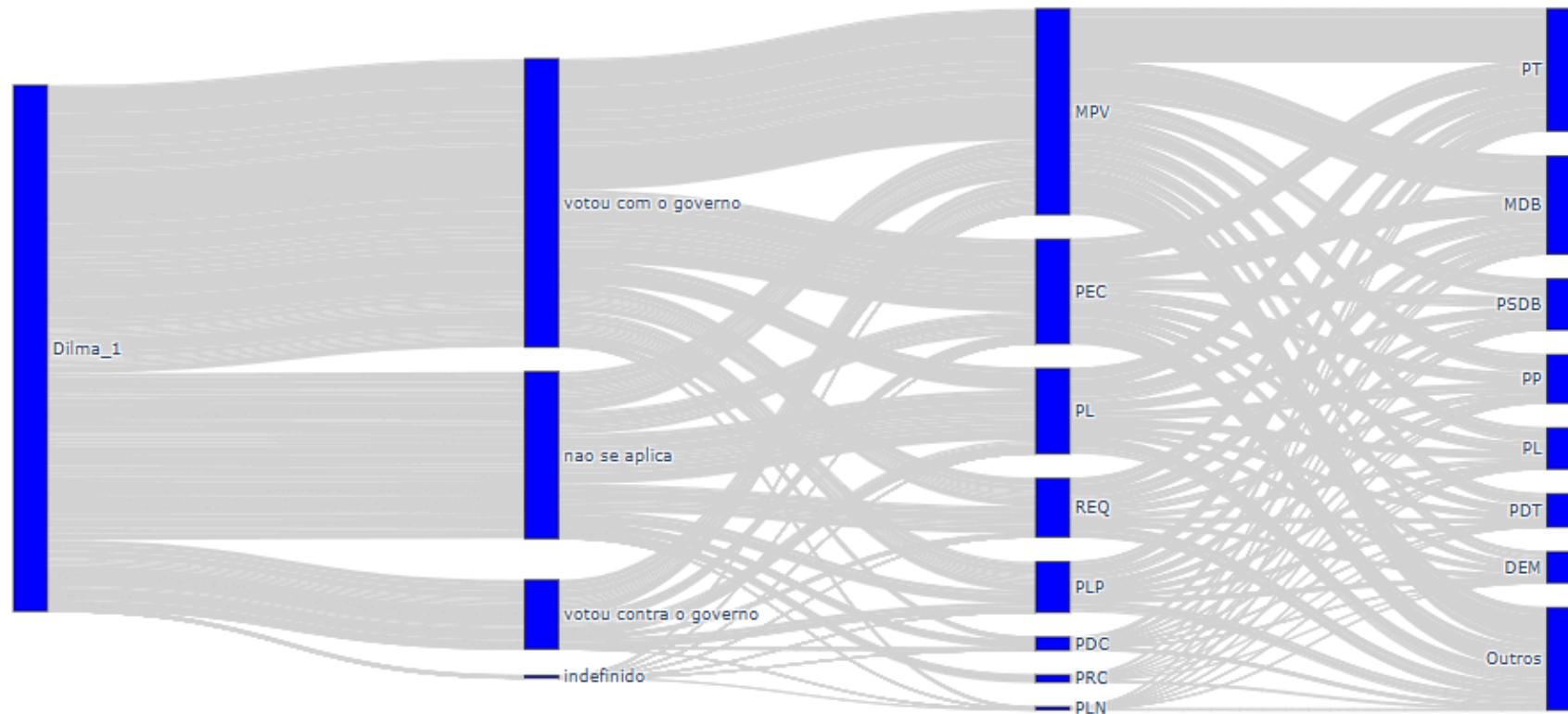
This dataset has 3,593 trajectories with a total of 115,287 votes from 649 deputies distributed into 26 parties. Running the MAT-Tree with MV, it identified 12 clusters where **78.25%** of the data is grouped into two clusters. Node 5-0 grouped **60.34%** corresponding to 2163 trajectories while node 5-1 grouped **17.91%** corresponding to 696 trajectories.

- Tree

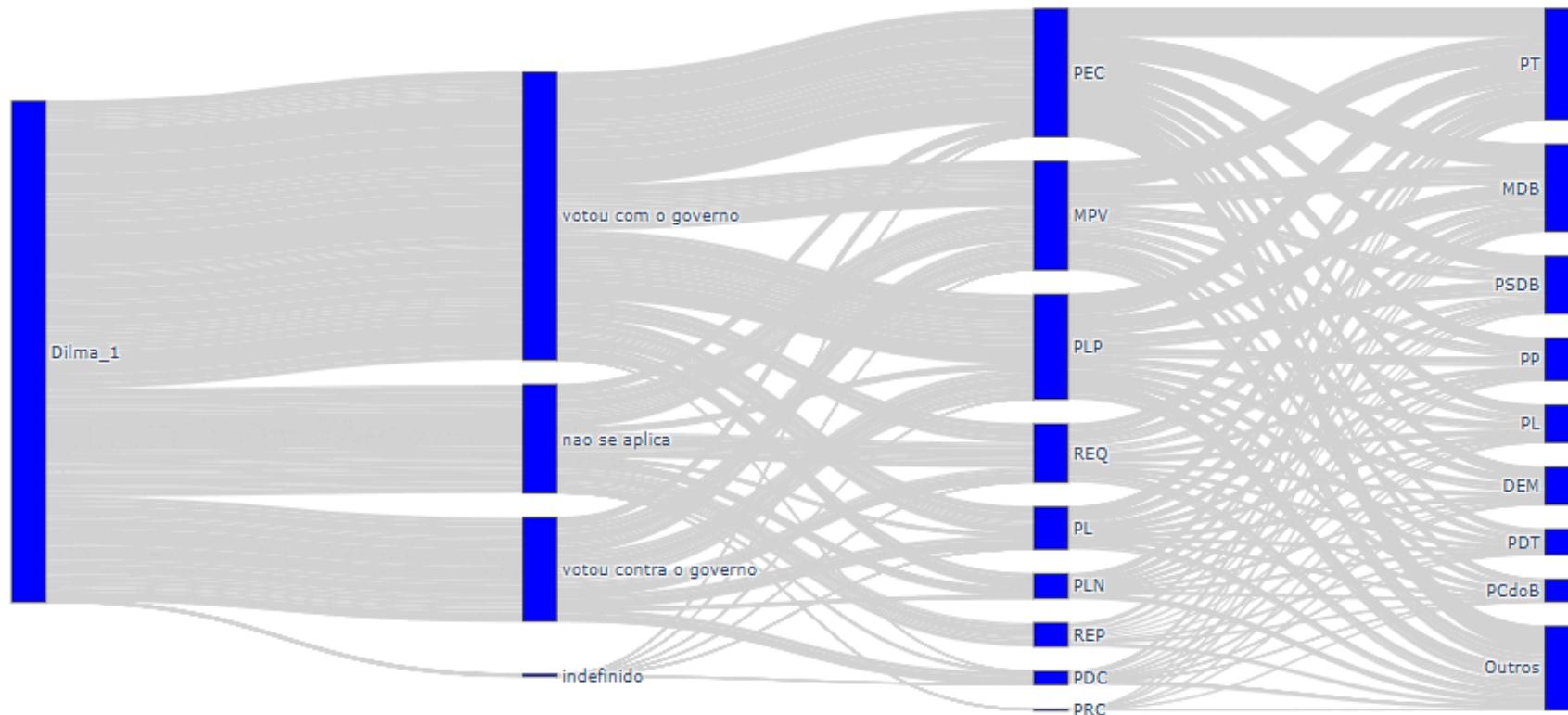


- Sankey

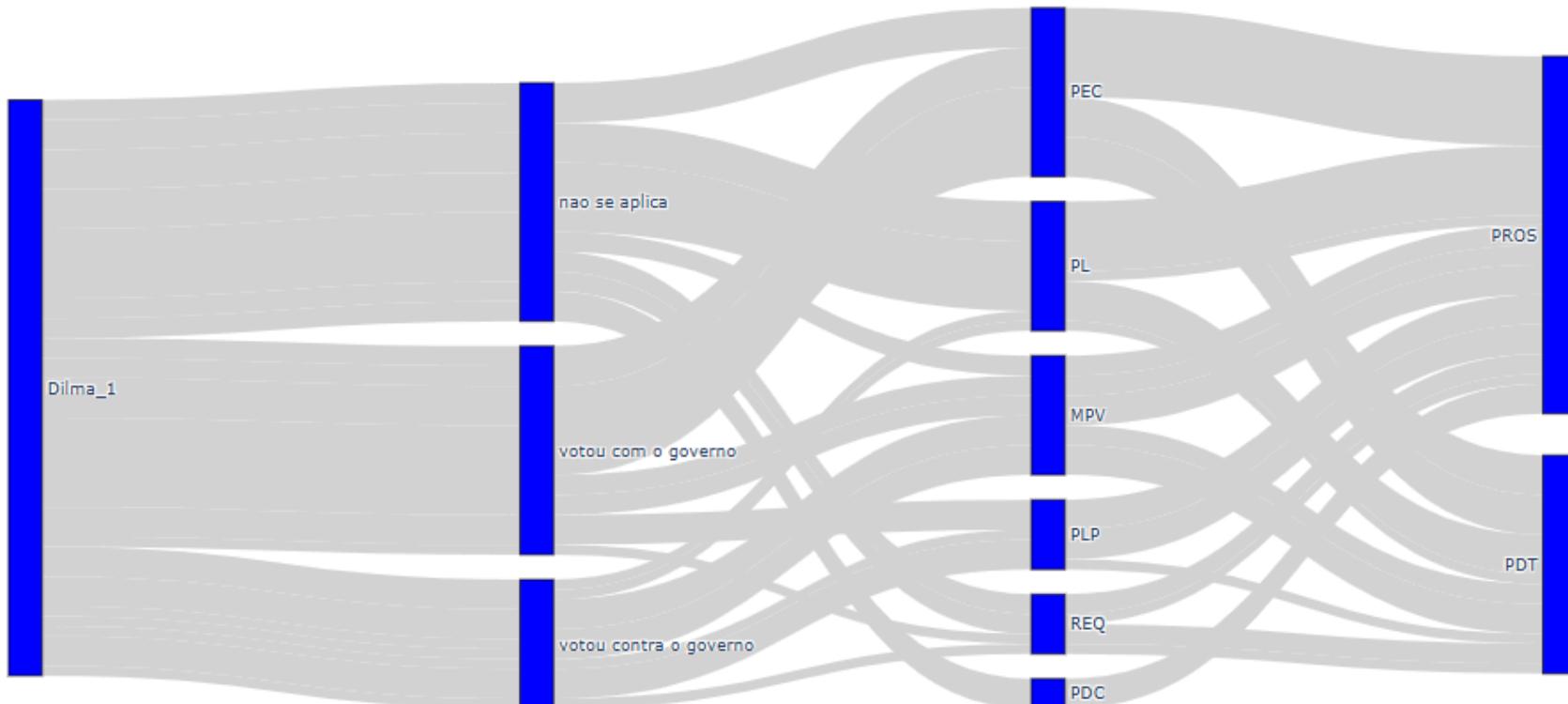
Node: Lvl 5 - 0; Split: minVariance  
TIDs: 2163; Unique deputies: 612; Total votes: 69562.  
from 2011-01-09 to 2014-12-17



Node: Lvl 5 - 1; Split: minVariance  
TIDs: 696; Unique deputies: 444; Total votes: 20648.  
from 2014-01-04 to 2014-12-17

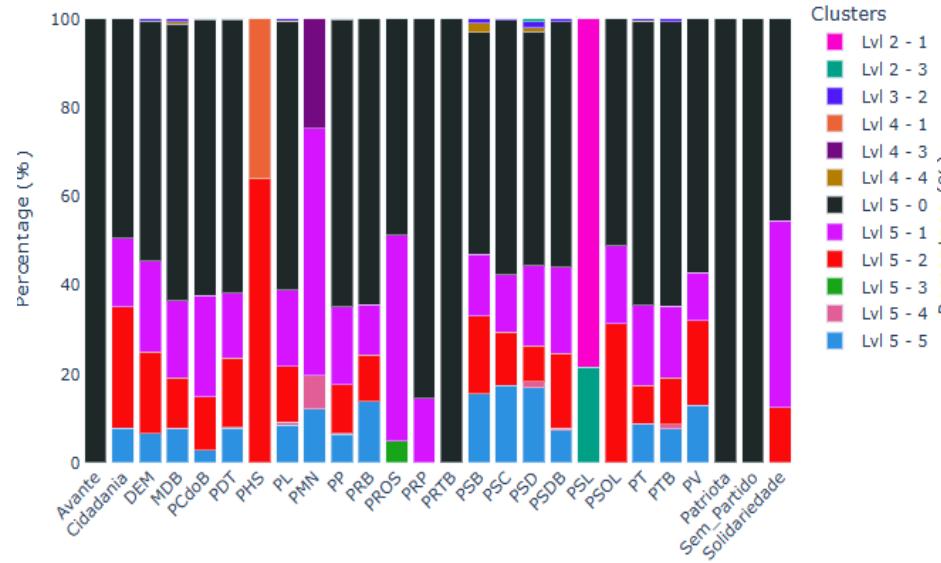


Node: Lvl 5 - 3; Split: minVariance  
TIDs: 1; Unique deputies:1; Total votes: 58.  
from 2013-01-10 to 2013-12-17

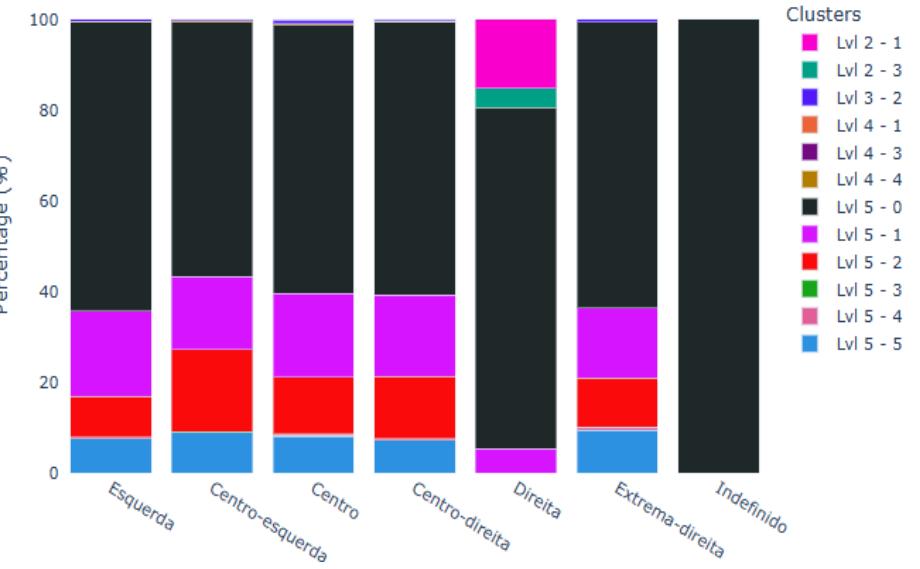


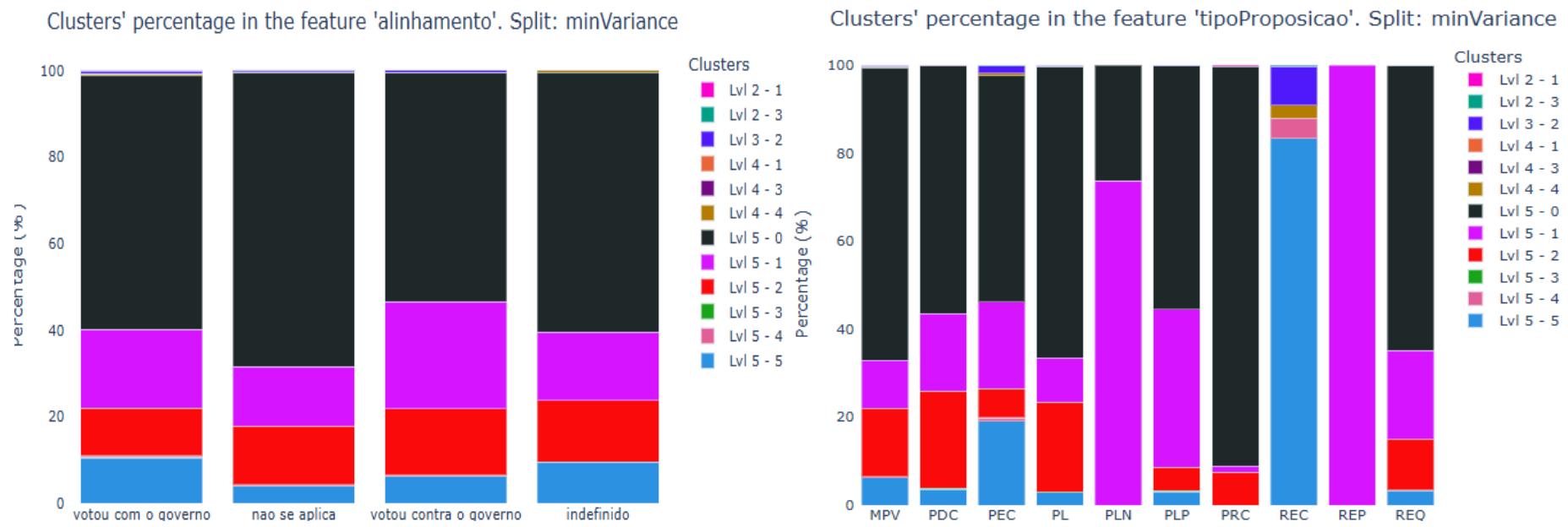
- Stacked bar
  - Clusters' percentage in the feature

Clusters' percentage in the feature 'partido'. Split: minVariance



Clusters' percentage in the feature 'esp\_pol\_partido'. Split: minVariance

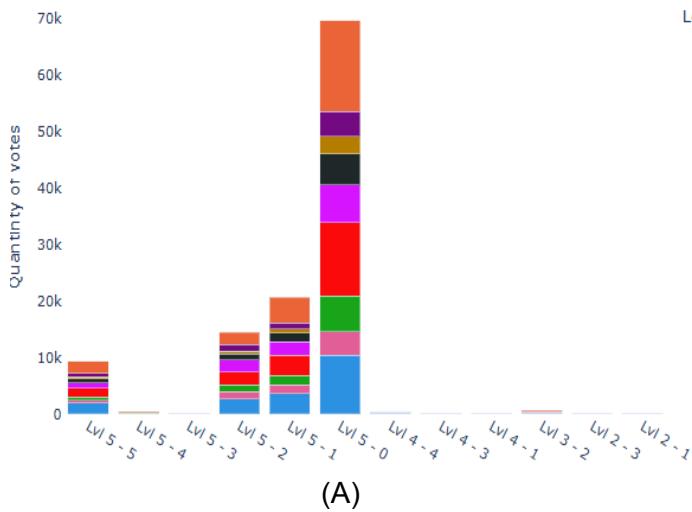




**Figure x.**

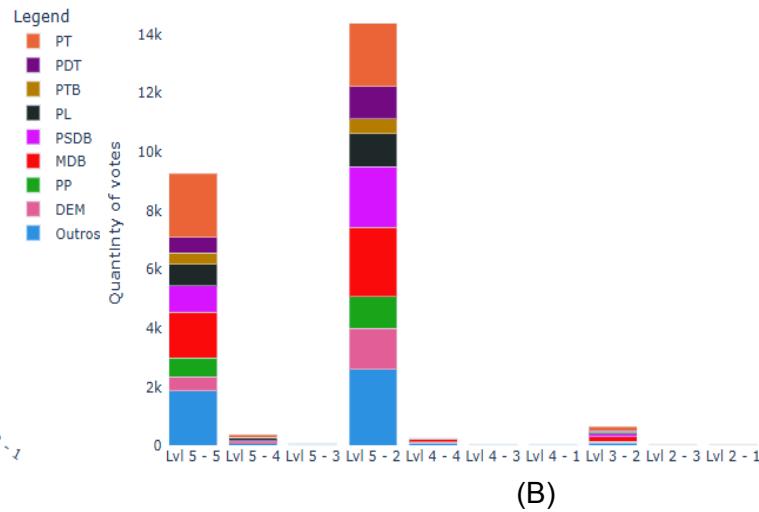
- Number of votes by feature value in the cluster

Feature 'partido'; Split: minVariance.



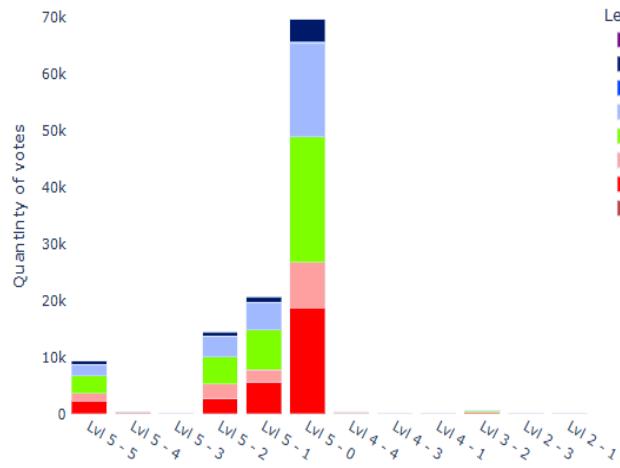
(A)

Feature 'partido'; Split: minVariance.

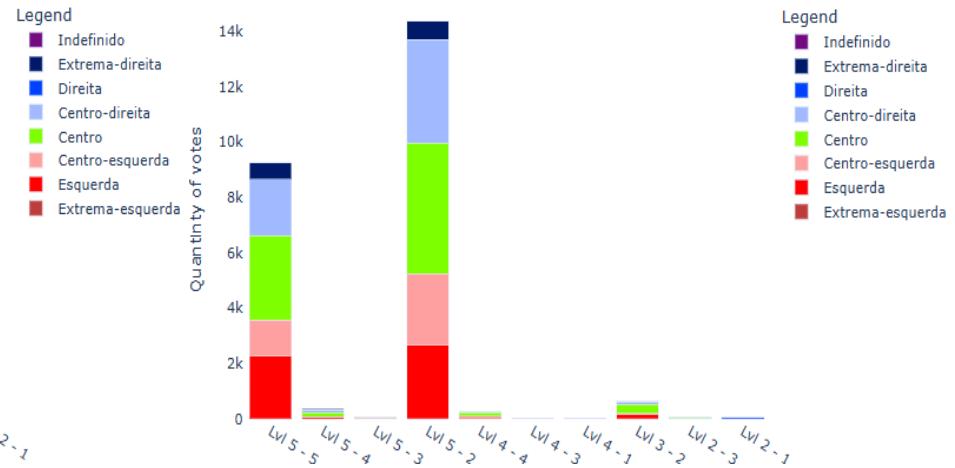


(B)

Feature 'esp\_pol\_partido'; Split: minVariance.

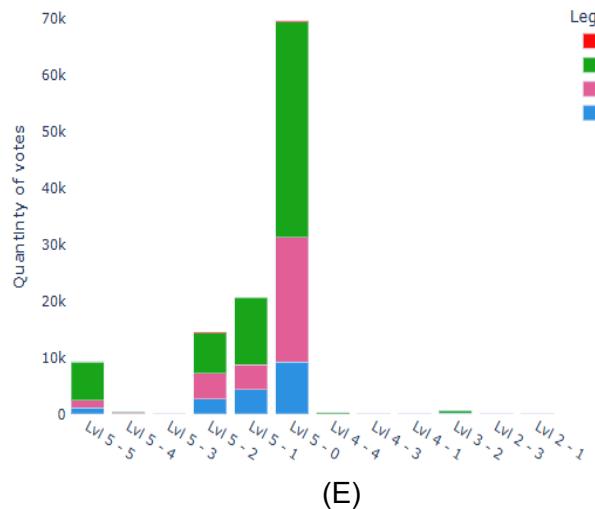


(C)



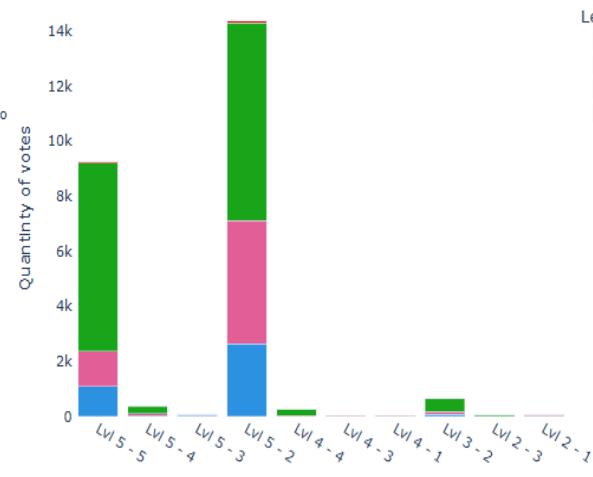
(D)

Feature 'alinhamento'; Split: minVariance.



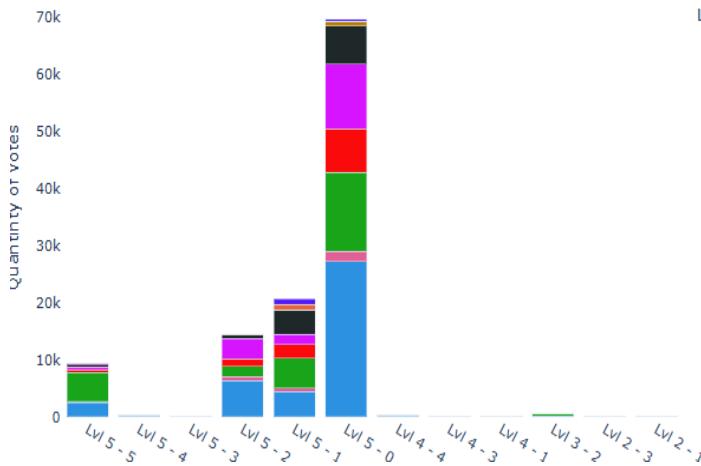
(E)

Feature 'alinhamento'; Split: minVariance.



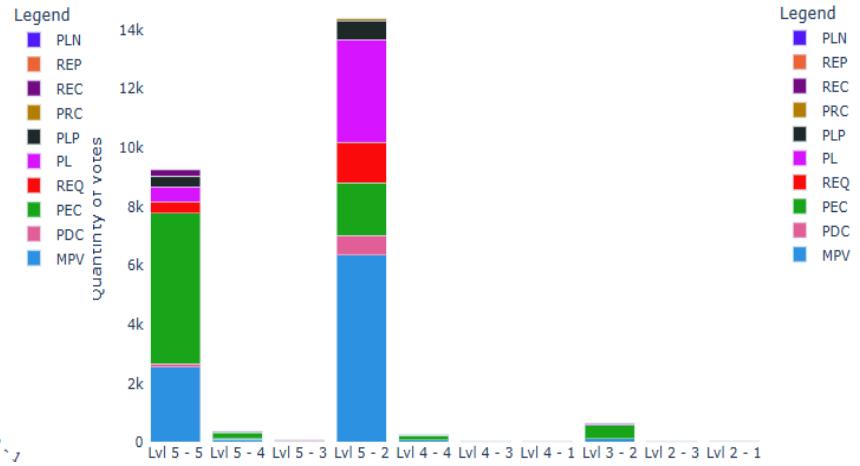
(F)

Feature 'tipoProposicao'; Split: minVariance.



(G)

Feature 'tipoProposicao'; Split: minVariance.



(H)

**Figure X.** Quantity of votes per cluster using MVR during the Dilma government. The left side shows all cluster (A, C, E and G) while the right side (B, D, F and H) does not show two clusters with the majority of votes. (A-B) Party (Partido), (C-D) Political spectrum (espectro político) , (E-F) Government 's alignment (Alinhamento) and (G-H) Proposition (Tipo proposição).