

Project No.	Project Title	
2021 -01-265	Machine Learning for Improving Participatory Budgeting Algorithms	
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## Abstract

Participatory budgeting (PB) is part of participatory democracy – a concept that promotes public participation in various public decision-making forums. It is a common approach that allows citizens/residents to decide how to allocate part of the municipal or national budget. The focus in our study is on the final voting stage of the PB process. At this final stage, we assume that the project proposals, project costs and main budget are known. Our goal is to build a machine that will help the head of the community or organization to choose the most suitable projects based on the votes of the voters.

To prevent an election result that is disproportionate to the voting population, we specifically focus on the harmonic sequence of weights and in particular, the Proportional Approval Voting (PAV) rule. PAV works by looking at how "satisfied" each voter - the calculated satisfaction with any particular result for an individual voter is a function of how many of the elected candidates the individual originally voted for. We implement the algorithm with integer programming in order to maximize the voters "satisfaction".

Calculating winners under the PAV rule is a computationally hard problem so we built a machine that test the algorithm, verify its feasibility and helps the organization understand how long it will take to use it depending on the input. Our model receives the voters' votes, extracts relevant features from it and predicts the calculation time of the realization of the PAV rule. We chose to test the model with data generated by three common sampling algorithms that simulate reality.

The model we built well predicts the calculation and operation times of the weighting algorithm; the error (the percentage deviation from the real value) is relatively low - an average of 8.5%, showing feasibility of our approach; our approach thus will help and support the decision maker and contribute to understanding computational issues of PB processes.

**Keywords:** Participatory budgeting, Proportional Approval Voting, Integer programming, Machine learning