Reducing the Trusted Constituent Base with the LCF Approach

or

Hillary: The Next 700 Elections

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Abstract: In order to form a more perfect union, we address the issue of election robustness. We introduce the LCF (Logic of Congressional F*ckery) approach for minimizing the TCB (Trusted Constituent Base) of an election process. We evaluate our approach on the American presidential election process and show that it compares favorably with traditional approaches for election robustness.

1. Introduction

Due to the finite length of the human lifespan, all forms of government presently require a method of repopulating themselves. At present, the most popular method is that of an *election,* an event in which people called *constituents* collectively decide on their rulers with varying levels of freedom. A singular advantage of the Election Method is the illusion of agency granted to the masses, which is widely considered to be the most effective method of suppressing public unrest. The great risk of the Election Method is that is the issue of *robustness*: in most implementations of the Election Method, there is a risk that the *constituents* will elect incorrect leaders. This had led to the proposal of many interesting election verification methods, but this is still an open problem with much work to be done.

2. Related Work

Every nation with an election system has faced this problem, and thus the literature is vast. In this section we outline methods used by various nations.

Definition 1: Trusted Constituent Base: We say that an electoral process has a Trusted Constituent Base if α is the fraction of voters that must be trusted to vote correctly to achieve a proper outcome. It has been shown that systems with $\alpha <= 0.01$ can be verified in linear time, but verifying systems with $\alpha > 0.01$ is NP-Hard (it is unknown whether it is also in NP). Thus the goal of verification technique is to achieve $\alpha = 0.01$. Failing that, lower α leads to more tractable verification in practice, even when the problem remains NP-Hard in theory.

1.1. United States

The United States, despite its immense wealth and power, has long struggled to verify its election processes. The verification methods currently used in the United States are widely considered insufficient, but are illustrative and form the foundations for more sophisticated

techniques:

First-Past-The-Post: A common building block of election verification systems is to count votes in strange ways that skew the distribution of power. The most basic method is the *First-Past-the-Post* algorithm, which exploits integrality issues. In a multi-position election, one can easily justify absolute power to whichever contestant achieves a plurality of votes. This method alone achieves $\alpha = 0.50$. At the time, FPTP was considered a heroic breakthrough, but has long since been pushed to its limits.

Amphibian Partitioning: This method, pioneered by Gerald Mander, observes that an election can be partitioned into *districts*, where each district is counted as an individual vote. In an optimal partitioning, an election can be won with (arbitrarily close to) half of all districts, each winning with half of the available results, leading to $\alpha = 0.25$. But this number belies the true power of the Partitioning approach: in multi-position elections containing *minority constituents* (those who, when adequately partitioned, have a majority in no districts), can effectively reduce the representation factor of a sub-constituency to 0. However, optimizing representation factors is outside the scope of this paper.

Weighted Partitioning: In a straightforward extension of Amphibian Partitioning, all districts are given a fixed additional number of votes in order to strengthen the votes of the least populous districts. Since votes in small districts are the more powerful, the verification burden is reduced. By increasing the number of votes uniformly across districts, a semblance of democracy is maintained, minimizing risk of unrest. In principle, this technique can achieve arbitrarily low α-value. In practice, this method has a small effect on α-value, because excessive use creates some risk of public unrest. It is worth noting that, nevertheless, this technique has successfully been used to ensure the correctness of several previous presidential elections, including the 2000 election of George W. Bush, widely considered one of the most difficult verification projects in recent memory.

Indirection Escape Hatches: The *Electoral College* includes an escape hatch by which the unified vote of a mere 270 unelected government drones overrides the will of the electorate. Historically, numerous electors have tried to use this mechanism, but have never coordinated well enough to overturn an election. In principle this method has the incredibly low α-value of .0000001, but suffers from a greatly increased risk of political unrest. And this begins to expose an underlying theme in election verification: Simply reducing the number of individuals involved is trivial. The difficulty lies in maintaining stability of government.

Higher-Order Indirection Escape Hatches: One approach for reducing unrest is to target less-publicized but equally-important elections. In a two-party system, general elections are effectively useless: the entire political race is decided during primary elections, whose conduct is watched much less closely. Thus there exists an escape hatch for primary elections in the form of Superdelegates (higher-order delegates or HODs), which can vote as they wish, with the same impact as hundreds of thousands of people. In current implementations, this approach

has α-values on the same order as Amphibian Partitioning (since only a constant fraction of votes are assigned to Superdelegates), but when the techniques are combined they can achieve an α-value below .1 without causing noticeable unrest.

1.2. China

China has long used B-Trees to obtain incredibly low α-values. The main insight of the Chinese election process is that the standard parliamentary system is a two-level B-Tree with high branching factor, and that the total number of trusted votes is equal to the number of children at the root. By removing the 2-level restriction on the B-Tree, the Chinese system can result in arbitrarily low branching factors, and thus an arbitrarily-low constant number of trusted votes.

While many of the other α-reduction approaches mentioned in this paper run into issues due to civil unrest, the Chinese system seems surprisingly successful, due in large part to a long-standing communalist culture in which many people [这里, Mandarin 1970] see no need for personal agency in the political process as long the resulting government achieves the pragmatic goals they desire for the nation [Mandarin, Gerry 1956].

It appears that here the advantages are not in electoral tricks so much as choice of cultural values. Recent work has attempted to modify the American election process by importing sufficient numbers of Chinese people [CMU Admissions, 2016], but it is unclear whether this has had the intended effect.

1.3. Russia

Russia takes a completely different—and frankly somewhat counterintuitive—approach to reducing the TCB: reduce the trusted constituent base by increasing voter turnout. While the >100% turnouts often observed in their larger cities might initially suggest an increased α, we observe that a careful implementation results in the opposite effect. Consider that, by the pigeonhole principle, an election that turns out n more voters than actually exist must incorporate at least n votes corresponding to constituents who have already voted. We define the term *doppelganger* to refer to such constituents. Given that a state, through its voter registration process, is able to select which doppelgangers to admit, a successful implementation of this *superturnout* scheme will admit almost exclusively trusted doppelgangers. We refer to the set of all trusted doppelgangers as the *doppelgang* because each of its members will vote in the same way; with such organization, it's easy to show that a doppelgang accounting for a p% increase in turnout directly reduces α by $p/100$.

1.4. North Korea

Eternal President Kim Il Sung started the Great Democratic People's Leadership Verification Project in 1948, preceding other founding verification projects such as AUTOMATH by several decades. The prosperity of the Democratic People's Republic has provided funding for the Verification Project far exceeding that available in imperialist nations, and thus enabling a

tremendous scope and leading to verification results of which the imperialists are envious to this very day.

After an exploratory period of several years, the Verification Project found focus in the philosophy of Juche, focused on a *trinitarian* ideal based on the following principles

1. Proof automation (자주 or 自主)
2. Representation Independence (자립 or 自立)
3. ~~Masturbation~~ Defensive Design (자위 or 自衛)

This led to promising initial results. After the death of the Eternal President, Eternal Secretary Kim Jong-Il added his military-first or songun (선군 or 先軍) policy which supported a *militant* attitude to the correctness of elections. Now a nationwide priority, Kim Jong-Il built Kim Il-Sung Memorial Verification Centers in every school in Choson. By verifying the process from birth, North Korea has achieved an α-value of 0. However, it should be noted that our savage imperialist nation is far too destitute to engage in such an exhaustive verification program, and thus it is the goal of this paper to achieve a fraction of the North Korean result at a more affordable cost.

2. Approach

The LCF Method (Logic of Congressional F*ckery): The LCF method is based on a fundamental observation: The tension between the desire for a rich verification language and a small Trusted Constituent Base is best resolved by defining powerful special-purpose constructs in terms of extremely general base constructs.

In particular, the LCF uses a single building-block, that of *representative* democracy. Our culture holds democracy sacred, and thus the authors postulate that (a) any approach not based in democracy is bound to produce unrest and (b) any approach that *is* based on democracy has a *leg up*.

Our *representative* approach is based on our analysis of [Kim 48]'s Representation Independence approach. We know from experience that Representation Independence (developing a culture in which constituents do not care at all whether their interests are represented by the government), while effective, is prohibitively expensive. Since reducing cost is primary goal, we take a *representation-aware* approach (constituents receive some form of representation, and are made extremely **aware** of all representation they receive, but we develop methods to prove that the available representations do not interfere with correctness).

On top of the basic functionality of representative democracy, we build the following tactics:

Pork-Barrelling: Pork-Barrelling is an **awareness-based** tactic. In such a vast nation, it is difficult to be aware of every political event across the nation, but quite feasible to be aware of

local political events. This observation leads to the result that election results depend only on a local view of politics, formalized below.

Definition 2: A congress is *locally sound* if each district's local political outlook is positive.
Definition 3: A congress is *globally sound* if every congressperson is elected correctly.

Theorem 1: All locally sound congresses are globally sound.

It is a well known fact in verification that reducing complex global concerns to simple local concerns makes otherwise intractable problems feasible. Pork-barrelling works by reducing the absolute number of contributing factors in an individual election, making certain other techniques more effective.

Curtain-closing: It was observed in our introduction that partitioning schemes are vulnerable to public unrest if used excessively. The main problem is the public attention paid to the shape of voting districts and redistricting process. A main contribution of the work is that closed-curtain redistricting processes, by their very nature, prevent any change in public opinion:

Theorem 2 (The Public Respects the Redistricting Committee): Public opinion is independent of the redistricting action of a secret committee.
Proof Sketch: Secret committees have existential type. It follows from Reynolds' Parametricity Theorem that a voter cannot depend on implementation details of the committee, such as their redistricting results. **Qed.**

3. Evaluation

We evaluated the LCF approach by implementing an electoral proof assistant named Hillary. The Trusted Constituent Base resides entirely in the Hillary/Purge segment of the assistant, consisting only of approximately 8000 Washington DC residents. The vast majority of the code base, used for practical election verification, resides in the Hillary/HEIL framework (Higher-Electoral Induction Logic). Using Hillary/HEIL we have verified the results of several state primaries with a short-term goal of a complete verification of the Democratic presidential nomination, which appears to be well-underway, largely because the unrest-abating tactics such as Pork Barrelling allowed us to greatly increase our usage of the existing Higher-Order Indirection Escape Hatches technique. Upon verifying the nomination we wish as future work to verify the general election, but we make no claims of that ability at this time.

Our collaborators are currently implementing a second proof assistant in the LCF style called HEIL Light, whose Trusted Constitution Base consists of only 400 constituents. However, as of this writing they have verified only local elections, and it is unclear whether anyone but a supreme expert is capable of scaling their proof assistant to a general election.