Direct Democracy

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Abstract — **"Direct Democracy" (DD) is the idea of replacing all the rulemaking tasks of the legislature, and perhaps the higher courts and some parts of the executive branch, by direct votes by the citizens themselves. This is beginning to be technically feasible thanks to the rise of the internet and the development of strong cryptographic algorithms.**

We (1) propose a rough design of perhaps the best way to implement DD – called "democracy by jury." A random anonymous subsample of the population ("jury") is selected to decide each issue. Each jury member has the option of dodging jury duty by finding somebody else (hopefully with more expertise and dedication) willing to take on that duty in his stead. Larger juries are used for issues with more campaign spending (all such spending must be disclosed publically). (2) There are arguments for the superiority of this to all other plans for democracy on fundamental grounds of greater unbiasedness, corruption-resistance, expertise brought to bear, and labor reduction. (3) We outline the debate about whether DD is a good or bad idea by presenting many examples from history which argue for or against it. (4) The fundamental primitive operations inside democracy by jury are new and interesting cryptographic problems. Our main original contribution is to state and solve those problems.

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1 Direct democracy

The rise of the internet has made it technically possible in principle to have a new form of government – no government. More precisely, all the rulemaking tasks of the legislature, and perhaps the higher courts and some parts of the executive branch, would instead be accomplished by the citizens themselves, by direct vote on everything.

This is a very interesting idea. It is extemely unclear how well it would, or could, work. Estimates range from "far superior to indirect democracies" to "a complete disaster." This is an experimental question. I would like to see some small direct democracy governments set up to see the experimental results.

Just thinking about it can get us somewhere, however; and furthermore, many things throughout history can already be regarded as experimental data. We make a rough proposal of what we believe is the best way to implement DD – we call it "democracy by jury" – examine its merits and demerits in the light of historical evidence, and explain how cryptographic and internet technology would make it posible.

2 Design principles

The shear volume of laws considered and passed by modern legislatures *alone* suffices to present a major hurdle. Most US legislators do not read many laws they vote on. Just counting the number of pages and the (often short) time allowed

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[1]US Senator Mike Gravel once estimated that 75% of congresspeople did not read 75% of the bills they voted on, whereupon Senator Alan Cranston replied that he thought a better estimate was 90 and 90. A recent example [23]: the 3000-page 14-inch-thick omnibus spending bill passed in November of 2004 contained a 1-paragraph provision giving Congressional chairmen and staff members the right to examine citizen's tax returns without regard to privacy protections. This overturned reforms enacted after the Nixon Watergate scandals in reaction to the Nixon administration's rifling of private tax returns to enable IRS harassment of members of his "enemies list" and to enable him to shake down rich contributors for money. According to the New York Times [23]: "Once the provision was [accidentally] found, everyone felt compelled to denounce it. Senator Charles Grassley, the Iowa Republican, growled that it summoned 'the dark days in our history when taxpayer information was used against political enemies.' The Senate declared the clause void, forcing G.O.P. leaders in the House, where the gambit originated, to sheepishly follow suit... Embarrassed solons had to admit they had no idea what other dangerous items might be in the bill." Bill Frist, the Senate majority leader, said he had "no earthly idea how that got in there."

to read them (as well as occasional interviews with legislators themselves) proves that.[1] Consider the general public (who have *other* full time jobs) being asked to vote on thousands of pages of tax law written in legalese.

Underlying principles of voter-selection: We have seen in §1 of [30] that only a *random* sample of the population will have, in expectation, the same self-interests as the population as a whole, i.e. will be unbiased. Simple arithmetic shows that it is impossible to have all voters vote on everything; the shear amount of work required do a good voting job forces only a *small subset* of voters to vote on each bill, on average.[2] Also, it is unfair to the many voters who are not permanently welded to the internet to expect them to be. (At present, many Americans refuse to touch a computer.) So: to reduce the work and reduce the computer-dependence it is essential to get a small random sample of voters to vote on each issue.

But, we want that random sample to be random in every way *except* one – we want our voters magically to have greater than usual expertise and dedication concerning whatever subject they are voting on.

It is undoubtably the case that, most of the time, the top 100 unbiased experts in the USA on any given subject would make a better decision about it than the US legislature. The problem is: how are those "unbiased experts" to be selected? And if they *were* "selected," would that not defeat the goal of "direct" democracy? And, even assuming they somehow were correctly selected, then, how would we prevent their 100 voices from being drowned out by the vast ocean of other, far less expert voters? If anyone could vote on anything, then one might expect all power to pass to those who formulate the ballots and those who run vast media-manipulation campaigns, and that these effects would drown out the voices of the experts.

Our "DD by jury" proposal: Here is a voter-selection plan designed to fulfil those principles, and also to fulfil the direct-democracy theme of decentralized decision-making. Begin by selecting 9999 random anonymous voters by use of a cryptographically strong verifiable random number generator.[3]

Each of these voters could optionally pass on their duties to somebody, selected by them, whom they judge to be more expert than they themselves (and suitably biased or unbiased, in their view) – if that person agreed.[4] That next person could in turn find somebody else to pass on the duty to, up to some length-limit (we suggest 4 people) on each such chain. Then these (now hopefully fairly expert but otherwise random) voters would perform the actual vote.

Corruption-proofing via variable jury size: Require all those spending money on advertising about some issue under jury consideration, to *disclose* how much money they spend and who they are. Now increase the jury size for the high-spending issues to make it roughly proportional to the money spent.[5] This idea is very important. It would have three benefits:

1. It prevents corruption because there is not enough money to bribe that many jurors. The most important issues, indeed, might be voted on by *everyone*. It is either impossible to bribe the entirety of society – or even if it is possible, it might be argued that whatever an entirely-bribed society decides, is good!
2. It causes the most important issues to be voted on by more people, giving the resulting decision more legitimacy and causing more mental effort to be expended.
3. The fact that everybody participates in deciding the most important issues causes greater societal morale and feeling of participation [12], while the fact that the less-important issues are decided by smaller juries saves time for everybody else.

Underlying principles of ballot design: Whoever formulated the questions to be voted on would have tremendous power. There are many illustrations of how, by correct choice and sequencing of questions, it becomes possible get a set of voters to vote precisely the opposite way they would have otherwise. Here is a simple example of Farquharson 1969. A drunkard, a miser, and a health freak vote on building a dormitory. Their views:

Miser: Hold on to the money and do not build yet.
Health freak: Build it now. But of course, do not include a bar in the building design.
Drunkard: OK to build it, but of course we need a bar.

If the choices are

1. no house
2. house but no bar
3. house with bar

then the Miser would value these three options as $1 > 2 > 3$, the Health freak as $2 > 1 > 3$, and the Drunk $3 > 1 > 2$. Then option 1 is the Condorcet winner and would win either a Condorcet or Borda vote. *But*, if the Health Freak formulated the questions, he would first ask: "let us first vote on the key question: should we build a house, or keep the money?" Building the house would win. Then the next question would

[2] The total amount of US federal legislation that is published in the *Federal Register* [9] amounted to 78,851 pages in 2004, weighing hundreds of pounds. This does not include preliminary drafts, etc. So round this off to 100,000 pages. If the present "DD-by-jury" proposal were adopted, with each jury consisting of 10^4 people and voting on a *10*-page chunk of legislation, then that number of pages could be handled by the 10^8 US voters each year – with everything actually being scrutinized and voted on for a change.

[3] This is an interesting cryptographic problem. We want observers to be convinced we are genuinely selecting unpredictably-random voters, but without actually revealing their identities. This problem *is* soluble, and its formulation and solution are discussed in §4.

[4] This same kind of buck-passing idea was independently invented by James Green-Armytage in web-posts about his notion of DD. Green-Armytage called the selected more-expert voter the "proxy" of the original voter. However, Green-Armytage's proposals were deficient compared to ours in the following ways:
(a) Green-Armytage had in mind direct democracies where *every* voter votes on *every* issue (except for votes supplied by proxies) – we regard this as an infeasibly large amount of work and instead insist on random subsets of voters – "juries" – one jury per issue;
(b) Green-Armytage's proxies were preselected by voters issue-independently, whereas we have in mind proxies selected by jury members *after* finding out the issue.
The fact that our proposed proxy selection method can reach top levels of expertise in fewer than 6 steps seems proven by Milgram's "**small world**" letter-delivery experiment [22] suggesting that everyone in the USA is linked to everyone else by a chain of acquaintances with average length ≤ 6.

[5] E.g., so that the total amount of money spent amounts to no more than 1 day worth of the per capita average wage, per juror.

be "Now that we are building it – should it include a bar?" No bar would then win, and we would get option 2. *But* if the drunkard formulated the questions, he would design a house and very deeply buried in the details of the plans, where he hoped nobody would notice it (because it would never occur to them to even ask about bars) would be a bar. He would then ask: "should we build this fine house design?" If anybody noticed the bar, he might then argue to the Miser: "We've already spent all this money getting a design drawn up, and it would be a pity to spend lots more money and time redoing everything just to omit the bar." Probably this would lead to option 3.

There are countless examples in parliamentary experience of bills being "poisoned" by additions of "riders," or conversely of riders which otherwise could never pass being carried to passage by attachment to some large and desirable bill.

It is also a very common experience of pollsters that by rephrasing some poll question, you can get the pollees to return significantly different answers, even though the two questions are logically equivalent. By clever phrasing it is even possible to get pollees to approve both a proposition *and* its logical opposite.

For example, in the November 1998 CTV National Angus Reid Poll, Canadians were asked how they felt about the euthanasia as a "right to die." The result was that 76% supported it, including 82% in British Columbia. But in a different poll of B.C. alone (commissioned by the Euthanasia Prevention Coalition of B.C. and conducted by Market Explorers), only 54% support was found! How can we explain this enormous discrepancy?

The first poll's question was

> One issue that's received attention lately concerns the 'right to die' - that is, whether a person who is terminally ill and wants to die before enduring the full course of the disease, should have the right to take their own life. As a moral question, do you personally support or oppose the concept of people having the 'right to die?'

The second poll's question was

> It is not legal to deliberately end another person's life with a pill overdose or a lethal injection. Some people consider this a way to end pain, other people consider it killing. If euthanasia is defined as deliberately ending another person's life with a pill overdose or lethal injection, do you oppose or favour legalizing it?

Another example is abortion. A January 1998 Wirthlin poll commissioned by the Family Research Council found that 61% of Americans disagree that "abortion should be permitted after fetal brainwaves are detected," and 58% agree that "abortion should not be permitted after the fetal heartbeat has begun." (Note: according to the FRC, fetal brainwaves can be detected as early as the sixth week of pregnancy, and fetal heartbeat usually begins between days 18 and 21.)

On the other hand, a Fox News Poll also in January 1998 found that 64% of respondents wanted to "let *Roe v Wade* stand" (where earlier the same Poll question had claimed that "*Roe v Wade* made abortion in the first three months of pregnancy legal.")

These two results evidently directly contradict. For a third result, consider an NBC News/Wall Street Journal poll in January 1997; it found that when asked

> Which of the following best represents your views about abortion? **A:** The choice on abortion should be left up to the woman and her doctor. **B:** Abortion should be legal only in cases in which pregnancy results from rape or incest or when the life of the woman is at risk. *or* **C:** Abortion should be illegal in all circumstances.

60% of respondents went for choice A, 26% for B, 11% for C, and 3% were unsure.

Given these facts, it might be thought that sophisticated question-designers would have almost all power, and the voters then would be mere putty in their hands. If so, the whole idea of "direct democracy" would be largely an illusion.

So we need a question-designing procedure with unbiasedness properties. The closest I've been able to come to designing such a procedure is as follows.

Our proposal for ballot design (sketch): To have many alternate versions of each question, posed by many different people of opposed views. For example, suppose we allow anybody to pose a ballot question. *But*, then, anybody else can propose an alternate version of the same question, or alternate choice of possible answers to it, and bundle it with the original question. Each question could have many possible answers besides just yes and no, and the eventual job of the voters would be to select one, or equivalently to select which of the many possible versions of each proposition, to pass.

The rest of this book provides many useful tools to help make this all possible. For example, *reweighted range voting* [30] would be an excellent tool to winnow numerous possible versions of a proposition down to only 5 for later use in a genuine vote. Propositions could, say, not be voted on until they had jumped an increasing-height sequence of hurdles and revisions. For example, we could require:

1. Any author of a proposition must create a web site outlining arguments in its favor.
2. Propositions cannot be voted on until they have been downloaded and read by at least 49999 people over at least 30 days, with at least 9999 of them willing to sign a statement saying "I've read it and it's worth voting on this." (There could be several such approval stages, with an increasing number of votes required each stage.)
3. Propositions must be ≤ 10 pages long.
4. There should be lower and upper *time limits* for deciding the fate of each proposition.

By use of voting techniques such as *range voting* [29], ballot questions with multiple possible alternatives can be handled without the great devastation that happens in multichoice plurality voting due to "vote splitting" and "wasted vote" pathologies.

3 Is direct democracy a good idea?

One view: average voters are dumb as stones, and they would do a terrible job at governing themselves. Opposed view: They would do a far superior job of governance than elected representatives! It seems to be possible to continue endlessly presenting arguments for either side in this debate. Indeed such debate *has* continued for hundreds of years at least, e.g. James Madison, a US Founding Father and DD-opponent,[6] said in the *Federalist Papers #55:*

> In all very numerous assemblies, of whatever characters composed, passion never fails to wrest the scepter from reason. Had every Athenian citizen been a Socrates, every Athenian assembly would still have been a mob.

On the other hand, it might be argued that, even if Madison was correct about this, for referenda conducted with considerable time to think about it beyond that possible in a 1-day assemblage, his concerns about "passion" would be misplaced.

Voters are ignoramuses? A 1997 CNN/Time poll [4] showed that 80% of Americans thought their government was hiding knowledge of the existence of extraterrestrial life forms. 40% believed that "supernatural intervention will bring an end to human history" according to an October 2001 Washington Times poll. In a May 2001 Gallup poll, 50% believed in "ESP or extrasensory perception," but only 36% in "telepathy."

About half of Americans polled in March 2000 said that Darwinian evolution was "far from being proven scientifically," and nearly a third of US *college graduates* still believe in "the biblical account of creation" with 45% believing that God created human beings "pretty much in (their) present form at one time or another within the last 10,000 years."[7] The *Cleveland Plain Dealer* in a June 2002 poll found that given a choice of 5 sentences describing (1) "Darwinian evolution," (2) "intelligent design," (3) "theistic evolution," (4) "old-Earth creationism," and (5) "new-Earth creationism," choice #5 won[8] with 29% of the voters. Choice #1, in contrast,[9] got only 13% of the votes, tying with choice #4 as least popular.

A Gallup poll in June 1999 indicated that one-third of Americans believe "The Bible is the actual word of God and is to be taken literally, word for word."[10] (This is quite odd considering that a British survey of 103 Roman Catholic priests, Anglican bishops, and Protestant ministers/pastors showed that: 97% do not believe the world was created in six days, and 80% do not believe in the existence of Adam and Eve.)

In 2001 the US's National Science Foundation surveyed 1,500 people nationwide and found that half of those polled believed that humans and dinosaurs co-existed on Earth. Only 22% of them understood what a "molecule" is, only 45% knew what DNA was and that lasers don't work by focusing sound waves, and only 48% knew that electrons were smaller than atoms. Lilienfeld et al. [19] found that 34% of circumcised men were unaware they were circumcised.

To name one issue which strikes close to my heart, my own polling experience indicates that 90% of US voters (year 2004) have never considered the idea that any other voting system besides the plurality system is possible.

Although US House and Senate members often show no great evidence of wisdom, it seems safe(?) to say that most would have outscored the US public on most of the below:

Immediately after Bush's victory in the November 2004 US presidential election, polls found that 72% of Bush voters believed that Iraq possessed Weapons of Mass Destruction immediately prior to the American invasion in March 2003. A majority believed that the federal government's own Duelfer Report, which afterwards ascertained that Iraq had no significant weapons or weapons programs, actually came to the opposite conclusion.

75% of Bush voters believed that Iraq provided substantial aid to Al Qaeda, even though the CIA and the bipartisan 9/11 Commission concluded otherwise; indeed 55% said that the 9/11 commission *found* such a link. Less than one-third of the Bush voters understood that most of world opinion opposed the US invasion of Iraq. 69% believed Bush supported the Comprehensive Nuclear Test Ban Treaty and 72% thought he supported a treaty banning landmines; in fact in both cases the opposite was true.

A survey by the Middle Tennessee State University found this about Tennesseans who said they were "interested" in the Bush-Kerry 2004 contest: When asked which candidate (Bush or Kerry) wanted to roll back the tax cuts for people making over $200,000/year, only 50% correctly named Kerry; 23% of voters incorrectly thought it was Bush and 27% didn't know.[11] Only 42% of voters knew that Bush wanted to let younger workers put some of their Social Security withholdings into their own personal retirement accounts; 19% incorrectly thought Kerry supported that, and 40% said they didn't know. Overall, when quizzed which candidate held which view on 5 such issues, Tennesseans' average score was 2 out of a possible 5 correct answers.

The 2002 annual National Geographic Society Survey found that only 71% of 56 young American adults (ages 18-24) could locate the Pacific Ocean on a world map with labels removed. This was not because Americans are more ignorant than citizens of other countries; the same percentage arose when the young adults were surveyed elsewhere in the world (in all 300 were surveyed in Canada, France, Germany, Italy, Japan, Mexico, Sweden, Britain, and the US).

Despite the coverage of the "September 11" attack, 83% of young American adults could not locate Afghanistan on the map; less than half could point to Israel, only 13% could locate Iraq, and fewer than 24% Saudi Arabia. (The 1986 NGS survey had found 95% of American college freshmen could not

[6] The USA's founding fathers were mainly extracted from moneyed aristocracy and not surprisingly proposed a highly elitist democracy design.

[7] Amazingly, this seems to be an *American* delusion. Over 80the 1993 International Social Survey (Americans the same survey: 44%).

[8] Precise phrasing: "God created the universe exactly as the Bible describes, in a period of six days, and the world is less than 10,000 years old. God made all living things, including humans, in the form they appear now, and there has been no evolution."

[9] Precise phrasing: "All living things on Earth came from a common ancestor and over millions of years evolved into different species due to natural processes such as natural selection and random chance."

[10] Gallup had asked Americans the same question in 1963 and found *two*-thirds were biblical literalists.

[11] This suggests that 23% of the Kerry-responders were guessing, in which case really about 73% of the voters did not know.

locate Vietnam.) Further, only 30% could point to New Jersey on a *US* map. Some 11% could not even locate the USA *itself* on the world map.

Fewer than 25% of young adults in France, Canada, Italy, Britain or the US could name four countries which officially acknowledge having nuclear weapons. Only 40% could identify China and India as the two countries with populations of a billion or more. (30% of young *US* adults thought the *US* had a billion or more people; actually its population was 288 million.)

A 1991 American Bar Association poll found that only 33% of Americans knew what the "Bill of Rights" was.

A 1987 survey found that 45% of adult respondents believed that Karl Marx's communist dictum "from each according to his abilities, to each according to his needs" was in the U.S. Constitution. A 1977 poll found that only 33% of respondents knew that governors did not have the power to veto state court rulings.

In 1988, 74% of the US public did not know the name and party of even one local congressional candidate.

A 1996 Washington Post/Harvard survey found that **over 50% of Americans agreed that "Politics and government are so complicated that a person like me can't really understand what's going on."** In particular only 26% knew the term of office of a U.S. senator was 6 years and less than half that a Congressman serves a 2-year term.

Voters are prone to fickle, illogical, and passionate changes in opinion. In late August of 2001, 50% of US citizens polled said they "approved of the way president G.W.Bush was handling his job," with 38% disapproving. But by early October, Bush's approval rating had shot up to 90% and his disapproval rate had dropped to 5%. Why? During the intervening month of September, the infamous 9/11 airplane attacks had occurred. Logically, these should not have affected the judgement of how Bush was doing his job, since obviously Bush was not the one who ordered those attacks. [12] By late October, Bush's approval ratings had dropped to 62% and his disapproval rate had re-risen to 28%.

Bush himself had long been aware of this phenomenon, considered it important to exploit it, and regarded his father as having mistakenly inadequately exploited it for political gain during his presidency. Nor was Bush alone in this view. Consider the following exchange between Hermann Goering (Hitler's second in command) and psychologist Gustave Gilbert in Goering's prison cell in 1946.

GOERING: Why, of course, the people don't want war. Why would some poor slob on a farm want to risk his life in a war when the best that he can get out of it is to come back to his farm in one piece. Naturally, the common people don't want war; neither in Russia, nor in England, nor in America, nor for that matter in Germany. That is understood. But, after all, it is the leaders of the country who determine the policy and it is always a simple matter to drag the people along, whether it is a democracy, or a fascist dictatorship, or a parliament, or a communist dictatorship.

GILBERT: There is one difference. In a democracy the people have some say in the matter through their elected representatives, and in the United States only Congress can declare wars.

GOERING: Voice or no voice, the people can always be brought to the bidding of the leaders. That is easy. All you have to do is tell them they are being attacked, and denounce the pacifists for lack of patriotism and exposing the country to danger. It works the same in any country.

This suggests that it is unwise to ask voters to decide anything without a good deal longer than 1 month to think about it. However, sometimes decisions need to be made quickly! Voters simply may not be capable of accumulating a large amount of data relevant to some emergency as quickly as professional politicians could. (Although: perhaps internet "blogs" could allow it.) If so, then some number of the latter will always be needed – for dealing with sudden emergencies if nothing else – plus somebody is always going to be needed to actually *do* whatever the voters decide. That means *there will always be some need for some elected officials.*

Riposte. It is also possible to find numerous examples of the stupidity of elected officials.

On 15 January 1897, bill #246 in the Indiana House of Representatives legislated $\pi = 16/\sqrt{3} \approx 9.2$. The key sentence in its text read: "Be it enacted by the General Assembly of the State of Indiana: It has been found that the circular area is to the quadrant of the circumference, as the area of an equilateral rectangle is to the square on one side." The bill was duly passed by a vote of 67 to 0 on 5 Feb. 1897. The main point was that the free use of these brilliant discoveries was to be granted throughout the state of Indiana, whereas everybody outside of Indiana would be forced to pay royalties. Fortunately, the bill was not also passed by the Indiana Senate, thanks to the fact that a Perdue University mathematics professor named C.A.Waldo happened by accident to be attending the Senate debates that day and organized some resistance. The bill was then tabled, and as far as is known has remained on the table ever since.[13]

The British effectively killed the development of UK road automobiles throughout the 19th century by passing a law that self-propelled vehicles on public roads in Britain must be preceded by a man on foot waving a red flag and blowing a horn. The technological lead passed then to the Germans and Americans, never to return. (Law was repealed in 1896.)

In 1940 the Connecticut Supreme Court of Errors upheld the state Comstock statute that made the use of contraceptives illegal and denied any exception to allow prescription by physicians. The Comstock laws were passed in the 1870s. Only in 1972 did Massachusetts legalize distributing and selling contraceptives to women.

As of 1960, all US states had anti-sodomy laws. For example, in 1995, a law remained on the books in South Carolina making the "abominable crime of buggery" a felony subject to a 5 year jail term and $500 fine. However on 13 November 2002 a 6-3 US Supreme Court decision struck down a Texas law

[12] Indeed, since Bush failed to prevent the attacks and ignored an August 6 warning titled "Bin Laden determined to strike in US" that the FBI had detected "patterns of suspicious activity in this country consistent with preparations for [airplane] hijackings"; and he responded, if anything, execrably to the attacks, logic would presumably have predicted a *decline* in Bush's ratings.

[13] This account is from Lee Larson of the Department of Mathematics, University of Louisville, Kentucky.

banning private consensual sex between adults of the same sex, presumably simultaneously invalidating all similar laws.

Internet bloggers are geniuses? In 1999, Garry Kasparov (then World Chess Champion) agreed to play the white side of a chess game, via the Internet, against the entire rest of the world in consultation, with the World Team moves to be decided by plurality vote from among the legal alternatives at a rate of 1 move (two halfmoves) per two days. The software was written by sponsor Microsoft Corp. There were over 58,000 different World team voters. One year earlier (former World Champ) Anatoly Karpov had won a similar match vs. the world, apparently effortlessly, despite taking black.

Although Kasparov won, he said he had never expended as much effort on any other game in his life, and declared it to be the "greatest game in the history of chess." The world team had 4 teenage chess stars as advisors (Etienne Bacrot, Florin Felecan, Irina Krush, and Elisabeth Pähtz), plus GM Danny King provided commentary and often acted as a 5th advisor. King summarized by saying the World should be "proud of itself" for having been able to go toe to toe with Kasparov for nearly 60 moves, including by making more than one "brilliant" move.

Earlier, in 1990/1, Kasparov had won a similar but smaller match against Spanish television viewers and newspaper readers voting by mail, 1.5-0.5. (The TV viewers had advice from a master on TV and perhaps also in the newspapers.) Kasparov had high praise for the Spanish draw as well as the world win.

Before his Spanish experience, Kasparov had thought the match would be a triviality because of the low chess strength of average Spanish television viewers.

All this supposedly proves the extremely and unexpectedly high quality of decision making that could happen via direct democracy.

#	white	black	year	method	opening	result
8	Uzbek TV viewers	S.Yuldachev	2004	TV	Ruy/Marshall	draw
7	B.Kouatly	World	2001	internet	King's Indian Def.	1-0
6	World	IM Hao Yin	2000	internet	Petrov	draw
5	G.Kasparov	World	1999	internet	Sicilian	1-0
4	World	A.Karpov	1996	internet	Caro Kann	0-1
3	G.Kasparov	Spanish TV viewers	1990/1	TV	Nimzo-Indian	1-0
2	Spanish TV viewers	G.Kasparov	1990/1	TV	Sicilian	draw
1	A.Karpov	German TV viewers	1976	TV	English	draw

Figure 3.1. Chess games between strong masters and large numbers of people moving by vote[14]. Kasparov and Karpov were world champions with FIDE ratings in the high 2700s to low 2800s. Kouatly and Yuldachev are grandmasters with FIDE ratings in the low 2500s, and Hao Yin, while also having a rating in the low 2500s, was only an international master, not a grandmaster. ▲

Not so fast. Unfortunately, the Kasparov versus World story also can be used *against* DD proponents!

First of all, the net score of the Kasparov & Karpov vs World & Spain matches was 3.5-0.5, indicating that DD is a weaker decision-making method than world champion chessplayers.

Second, the fact that the world could not even achieve a win in its three games against low-2500-rated players during 2000-2004, *despite* the fact that several chess programs then were *commercially available* with higher ratings (and despite having white in two out of the three games), argues that DD actually weakens the world.

Third, Microsoft, the world's largest software company, couldn't even organize the vote process without messing up. People complained during the match that it was trivial to "game" the move-voting software. Microsoft then ignored the complainers instead of fixing the problems. So finally the complainers intentionally sacrificed the world's queen for nothing to prove their point. *Then* Microsoft noticed, altered the vote so the next-most-popular move won, and covered it all up and pretended no funny stuff had ever happened except on that one move. Then there were charges of a conspiracy. With a large amount of money/reputation at stake, Kasparov obviously had motive to try to hack the votes himself, incidentally – not that I claim he did, but Microsoft did not even take the most elementary precautions. Now in a real web-democracy, it wouldn't just be a few peeved chess whiners attacking the system. The opponents instead might include the entire KGB and NSA, the Russian and Chinese governments, many top corporations, etc., and they might have bribed a lot of programmers inside Microsoft (or whatever its future equivalent might be).

If the score had instead been, say, World 3.5 – K&K 0.5, and Microsoft had run everything perfectly (and note, they had had the Karpov match as preparation and *still* screwed up) *that* would have been a *real* argument for web democracy.

Fourth, chess has some special properties which make it atypically amenable to high quality collective decision making:

1. By posting a public "analysis tree" which can be modified by all, tremendous "parallel processing" is achievable. (Irina Krush maintained just such an analysis tree, which was updated by bloggers worldwide.[15])

[14] Comments on the games: Kasparov expressed admiration for game #2, but in #3 Kasparov was never under much pressure and won with a classy rook sacrifice. #4 was an effortless-looking win by Karpov against a boring, uninspired, and klutzy world, despite Karpov having black. #5 was a superb game which Kasparov eventually won but only by working very hard.

[15] On the other hand, the TV viewers actually performed better – they got one draw against Kasparov and one against Karpov – *without* such a tree and blog, with much fewer and weaker (since earlier) chess computers, and with only some advice from some masters outlining the current options. Under these circumstances it is difficult to understand how such superb performance was possible. The only hypothesis I have is that

2. Chess computers with International Master strength (i.e. superior to over 99% of tournament chessplayers, although still weak compared to world champions) were widely available.[16]
3. There was no particular motivation, such as corruption, religious biases, heavily financed propaganda campaigns, etc. biasing the World into making some wrong move.
4. Chess ratings and titles ("master") provide an easy and effective way to estimate anybody's expertise.
5. Only highly interested chess players participated, and found the process fun.

Genuine governmental decisions would not enjoy these properties.

DD can bring more manpower to bear on decision-making. The amount of labor that DD juries could do to try to reach the correct decision, would in net be far greater than the amount of labor that elected representatives can perform, simply because more manpower would be available. (Nevertheless, by some measures the total amount of voter-hours of labor might actually be *reduced* with DD-by-jury versus the present scenario where everybody votes for their representatives. If 2000 propositions were considered per year, each by 10^4 people, that is 20 million people-decision pairs per year; in the present USA about 10^8 people each make about 5-10 votes per year, for about 25-50 times more people-decision pairs.)

The numerical estimates in footnote 2 make it clear that, e.g., it would be possible for all US legislation to be scrutinized in 10-page chunks with each such chunk being voted on. In contrast, at present, this is not done, and not possible to do, and indeed most legislators do not and cannot *read* most legislation. I suggest that this *alone* could lead to a quantum *leap* in the quality of democracy far beyond that achieveable by legislature!

Caveat: The increased total manpower might not be entirely exploitable.[17]

DD also can bring more manpower to bear on producing ideas. A great many valuable ideas have been proposed which have never, or almost never, managed to reach legislature floors for a vote. (Sadly, they include many of the ideas for better voting systems proposed in this book!)

DD counteracts flaws in indirect democracy. DD is not vulnerable to gerrymandering, but the USA's present congressman system is. In 1986, *all* incumbents in the California state legislature who sought re-election, succeeded. Does that constitute "fair or responsive representation"? "Bossism" and "party/machine politics" have dominated various places in the US at various times, with many decades often having been required to get rid of them. The right kind of DD could overcome that almost immediately.

As of 2004 the highest elected position held by a Republican member of a minority ethnic group, is the Lieutenant Governorship of Maryland. Republican elected officials plainly are not very representative. DD would overcome that immediately.

At present in 2004, the New York State legislature appears permanently trapped in a disfunctional attractor state [5]: It has been unable to pass the state budget on time for 18 consecutive years, is dominated by two political bosses who maneuver things so that over 11,000 consecutive bills, selected by them, have passed without a single defeat, and it has been unable to obey a court order to devise a plan to reform NY public education. If New York had citizen initiatives, they could break it out of this trap.

Committee-chairman "torpedoing," and the prevalence of "pork" again are two well known flaws in legislative democracy which DD would not suffer from.

Because of proxies, DD has the potential to bring more expertise to bear than elected representatives can. The "proxies" idea potentially allows juries to contain a greater fraction of voters with greater expertise than is available in any elected legislature regarding almost any issue.

I estimate[18] that if 30% of voters obtain proxies whom they believe know more than they do, and the maximum permitted length of a proxy chain is 4 people, then that would easily suffice to obtain greater expertise than is achieved by professional legislators.

Elected representatives are comparatively corruptible and biased. In our proposal for DD by anonymous juries, it would be impossible to bribe voters without knowing who they were! Furthermore, even jury members who *voluntarily* revealed their identities in the hope of acquiring bribe money, could be forced to vote by secret ballot [31] – in which case no briber could be sure they'd voted in the desired way.

Further, at present in legislatures, many important decisions are made by powerful non-elected "committee chairmen," party bosses, and the like,[19] or are decided not by vote

the TV viewers, since they were required to provide their moves by physical mail instead of electronically (which was more difficult) may have consisted of a more-dedicated subsample of the population than in the World match, which was enough to compensate for their lessened parallel processing capabilities. If so, that argues in favor of DD "proxies" (§4.3).

[16] In January 1999, several chess programs had already been commercially available for about a year whose strengths, according to the Swedish Chess Computer Association, were about 2575. These computer strengths have increased by about 40 rating points per year during 1999-2004; `shredder8.0` running on a 1.2GHz Athlon machine has rating 2818±34 based on 481 tournament-condition games against FIDE-rated human opponents. The highest rating ever achieved by a human was Kasparov's 2851 in the year 2000.

It would be interesting to see the same sort of experiment repeated but using the oriental game of *go* instead of chess, to control for the effect of computers. (The best go computers have only reached the advanced beginner level of human go strength and therefore would be irrelevant to a high-quality game.) However, there are so many legal moves in go that there might be difficulties in voting. A different interesting experiment would be to try other voting systems (e.g. range voting) instead of plurality vote.

[17] Mark Twain once remarked: if a man can dig a post hole in one minute, it follows by mathematics that sixty men can dig a posthole in one second.

[18] See footnote 4 concerning [22].

[19] A recent example: powerful legislators Ted Stevens and Don Young (R, Alaska) forced a proposal to build one of the world's largest bridges (to connect Port Mackenzie to Anchorage, Alaska) at a cost of $2 billion into the national highway bill of April 2004. Pre-bridge, Port Mackenzie had a single regular tenant and could be reached by a 5 minute ferry ride. Young explained his move as follows: "If you don't do it now, when are you going to do it? This is the time to take advantage of the position [chairman of the House Transportation and Infrastructure Committee] I'm

but by parliamentary maneuvers. Also, many laws are passed as a result of deals ("I'll vote for your bill if you vote for mine") rather than their individual merits.

Those kinds of sham-democracy would be much less of a problem with DD.

Finally, our "random subset" idea enables true unbiasedness among jury members, to a standard well beyond that achieved by any legislature.

These seem *enormous* advantages of DD over democracies with elected representatives.

Caveat: Unfortunately our "proxy" idea, which seems a key ingredient of the plan, *is* susceptible to corruption, since voters could seek out monetary offers and choose the largest bidder to be their proxy. Of course, any financial interaction whatever between voters and their proxies should be *illegal*. But I see no way to set up a system with proxies in such a way as to make corruption *impossible*. Nevertheless we do have a way to greatly lessen its impact: the variable jury-size proposal of §2.

Direct democracy in practice. It is not commonly recognized by those who think DD is a "new and possibly dangerous" idea, that in fact two forms of DD have been used for hundreds of years: Juries and Referenda. Also, the present governmental system of Switzerland may be regarded as a hybrid of direct and indirect democracy. We study these things in the next subsections.

3.1 Juries

Originally, assuming we take the word of the Bible, the duties of juries were performed directly by rulers such as (to name one famous case) King Solomon. Today, however, almost all civil and criminal cases are decided by juries consisting of randomly[20] selected laypeople, and most people believe that this is the best known method. Indeed, the right to be tried by a jury is recognized as a fundamental human right and guaranteed in III.2.3 of the US Constitution, and many of the most prominent democratic thinkers behind that document saw the role of juries as a very high powered one.

Thomas Jefferson remarked to Thomas Paine in 1789[21] "I consider [trial by jury] as the only anchor ever yet imagined by man, by which a government can be held to the principles of its constitution."

Jefferson also remarked to Abbe Arnoux that "It is left... to the juries, if they think the permanent judges are under any bias whatever in any cause, to take on themselves to judge the law as well as the fact. They never exercise this power but when they suspect partiality in the judges; and by the exercise of this power they have been the firmest bulwarks of English liberty." and Alexander Hamilton said in 1804 that "Jurors should acquit, even against the judge's instruction... if exercising their judgement with discretion and honesty they have a clear conviction that the charge of the court is wrong."

Hamilton's and Jefferson's views that the power of juries shall be above that of judges were in fact written into certain state constitutions, e.g. Article I, section 19, Constitution of the State of Indiana says that "In all criminal cases whatsoever, the jury shall have the right to determine the law and the facts." Even more strongly, it was stated by the 4th Circuit Court of Appeals, in *United States versus Moylan* (1969) that

> If the jury feels the law is unjust, we recognize the undisputed power of the jury to acquit, even if its verdict is contrary to the law as given by a judge, and contrary to the evidence... If the jury feels that the law under which the defendant is accused is unjust, or that exigent circumstances justified the actions of the accused, or for any reason which appeals to their logic or passion, the jury has the power to acquit, and the courts must abide by that decision.

This says, in other words, that juries should have also have more decision-making power than the *legislature*, at least concerning the specific case before them.

Nevertheless, "tort reform" advocates (these include both the newly re-elected Bush-Cheney administration, and their 2004 opponents Kerry & Edwards) today are trying to *reduce* the power of civil juries by legislating caps on the monetary damages they can award, or legislating that certain kinds of cases should not be tried by juries at all. Furthermore, many "mandatory sentencing" laws have been passed in the USA which similarly reduce the decision-making power of judges and juries, and there have been many instances (despite the above!) of judges countermanding jury decisions. I personally believe that both "tort reform" and mandatory sentencing laws are, in the main, serious mistakes.

These moves are, indeed, taking the US back toward the status that prevailed in the 1850-1900 "Robber Baron era." Friedman's book [13] offers a fascinating look back at that. In the case *Ryan vs. New York Central Railroad Co.* (1866) the railroad, though its negligent behavior, was found to have caused a fire which spread to consume the plaintiff's house 130 feet away. But the court shrank in horror from the thought that the railroad should be forced to pay damages for this – that requirement could force even well-run businesses to pay heavy insurance costs! An important "trap for unwary plaintiffs" (as Friedman describes it) was the "doctrine of contributory negligence": if the plaintiff was negligent himself, *however slightly*, he could not recover *anything* from the defendant. This "harsh doctrine... was extraordinarily useful... for [allowing judges to dismiss] tort claims from the deliberations of a jury." Another restrictive device was the rule that the right to sue died with the victim. Thus in *Carey v. Berkshire Railroad* (1848) a railroad worker was killed, and his wife was denied damages when she attempted to sue. Consequently it became "more profitable for the defendant to kill the plaintiff than to scratch him."[22] The doctrine of "imputed negligence" caused the negligence of a driver to be "imputed" to his passenger (including children) preventing the latter from recovering damages in personal injury actions.

in, along with Senator Stevens."

[20] Actually, in the US, attorneys get to bias the randomness by rejecting a limited number of jurors whom they think will decide against them.

[21] All these quotes of Jefferson's are ultimately extractible from The writings of Thomas Jeffeerson, Memorial edition, 20 vols. Washington DC 1903-4.

[22] William Prosser: Handbook of the law of torts (3rd ed. 1964) p.924, cited in [13].

All of these doctrines nowadays (2004) seem laughable. They had, however, tremendously important effects. Industries were extremely unsafe. During 1888-1889, one railroad worker died for every 357 employees, and one in 35 was injured. In Illinois in 1876, hundreds of workmen were killed or injured but only 24 recovered damages, totalling \$3655. Meanwhile the same companies paid \$119,288 for the death of livestock[23]!

Severe mandatory sentences were also common in the early US, and often the result was that juries would acquit rather than subject defendants to (in their view) too harsh a punishment. In South Carolina, typical homicide defendants were either acquitted or found guilty only of (the non-capital crime of) manslaughter, e.g. of 33 cases in one district between 1844 and 1858, 18 were acquitted, 10 found guilty of manslaughter, and only 5 convicted of murder (p.283 of [13]). This was quite odd considering that 71.5% of South Carolina defendants generally were found guilty as charged during 1800-1860. In *State v. Bennet* (1815) the South Carolina jury found as "fact" that the goods Bennet had stolen were worth "less... than 12 pence" even though all witnesses had sworn they were of much greater value. This "pious perjury" let them find him guilty of petty rather than grand larceny, which was a capital crime. The appeals court reaffirmed the jury's right to do as it pleased. Many states repudiated the doctrine that juries had the right to decide matters of law – only judges had that right (p.285 of [13]) juries were only to decide facts – but this (as we see here) could be defeated by false "findings" of fact.

Conclusion: It thus appears that attempting to restrict the power of juries has historically been undesirable and can lead to severe and arbitrary distortions. The more severe the restrictions, the more illogical those distortions may become.

As of 2004, the USA's mandatory sentencing laws have been largely responsible for causing a greater percentage of its population to be incarcerated than any other country's.

So, to opponents of DD I say: do you or do you not support trial by jury? And if you do, then what is the difference that makes you support juries but not DD? And if you do not, then with what[24] would you advocate replacing juries?

3.2 Referenda

Referenda too have a long history. In 1788, Massachusetts voters were asked to ratify its State Constitution in a referendum, a practice which later become common. Referenda are guaranteed by the US constitution in the weak sense that all *amendments* to it must be ratified by three-quarters of all states. These states have sometimes made these decisions via referenda, although more commonly the decision was made (which I consider less desirable) via vote of the state legislature. For example, the voters of Iowa in their ineffable wisdom rejected the Equal Rights Amendment twice, in 1980 and 1992 referenda. Many states have laws allowing either citizens, or the legislature, to place propositions on the ballot, such that if the voters approve them, they become law, thus bypassing (and trumping) the legislature. Citizen initiatives are particularly famous for happening in California. Some states allow their state constitutions to be amended in this way.

Entire books have been written examining initiatives and referenda [6][25] with some coming out in favor [26] and others in virulent opposition to them [1][8]. This section summarizes the theoretical arguments and contrasts them with reality.

Direct democracy is anti-minority? The USA's founding fathers were opposed to direct (or "pure") democracy, which is why they instead designed a republic (i.e. indirect democracy). Why? James Madison in the *Federalist Papers* argued

> A pure democracy... can admit of no cure for the mischiefs of faction... there is nothing to check the inducements to sacrifice the weaker party or an obnoxious individual.

The idea here [1] is that nothing stops the people from passing an initiative, by 51-49 vote, which will hurt some minority, e.g. hurt 49% of society, if it helps the majority. In contrast, legislators will be afraid to pass any such resolution and will do their utmost to avoid making the decision at all, and in addition there are "checks and balances" included in most governments which often cause super-majority support to be required to enact measures.

Various examples of anti-minority measures passed by referenda include California's 1996 prop. 209 (ended affirmative action correcting race & sex discrimination in jobs & education) and 1994 prop. 187 (denied education and health benefits to families of illegal immigrants). The latter was supported by White voters 2:1 but opposed by Latino voters by a 3:1 ratio. In 1994, Oregon's Measure 8 required public employees to pay 6% of their salaries toward retirement (effectively cutting their pay 6%). It passed by a tiny ($<$ 1%) margin.

On the other hand, it could be argued that this is an *advantage* of initiatives: *Tough decisions are not avoided!* Drastic changes *can* be made!

Further, it could be argued that legislators, including the USA's founding fathers themselves, *have* often oppressed minorities. For example, the USA's original setup involved slaves and women who were unable to vote. Later, it was legislators – not referenda – who enacted the notorious "Jim Crow" measures which disenfranshised Blacks throughout the USA's South. Meanwhile 130 years of the Swiss direct democracy system (§3.4) has not resulted in oppression of minorities, although they certainly have them (Switzerland has several linguisto-ethno-religious groups, a population containing of 20% foreigners – often resented – and a history of religious wars during 1525-1847). Indeed, several Swiss anti-immigrant measures proposed during the 1960s to 1980s were rejected by popular referendum.

Instead of relying as above on anecdotal evidence, let us consider statistics. B.Gamble [14] found that 78% of antiminority ballot measures pass. But T.Donovan and S.Bowler in two studies in 1998-9 claimed that only 18% of antigay measures passed – which is lower than initiative passage rate generally. On the other hand in 2004, a dozen state constitutional

[23] Walter Licht: *Working for the railroad: the organization of work in the 19th century*, pp.181-208, as cited p.479 of [13], where it is noted that some railroads gave charity or medical expenses to injured workmen and their families voluntarily but took care to do so in a "arbitrary" way to avoid even the appearance of "fixed rules and procedures."

[24] Professional elected judges?

amendments were passed by ballot proposition whose purpose was to outlaw "gay marriage." Schmidt [26] studied "the 189 US state ballot propositions 1976-1984 for which campaign spending data was available" and found that antiminority measures passed less often than the average passage rate (which was 39.9%).

Conclusion: the evidence does not make a clear case about the alleged anti-minority nature of direct democracy versus indirect democracy.

In fact, further, a 1980 study of the Colorado initiative process [27] concluded that "claims that the initiative has worked for the benefit of only one political philosophy or one group of people simply are not accurate."

DD would encourage greedy shortsighted voters to "vote their pocketbooks"? The table on p.39 of [26] argues that major tax cut measures passed on only 3 out of 19 ballot-initiative attempts. Tax increases (e.g. North Dakota, March 1987) have been passed via referendum.

Furthermore, I claim that, on the contrary, it is the *elected* politicians who are shortsighted, and (in the US) generally unable to plan further ahead than their term of office. The USA's recurrent huge national budget deficits are an example of this: from any politician's point of view, it is better to spend now and get the credit for that, while making his *successors* collect taxes and get the blame for that – provided any financial crisis can be staved off for the next few years. But of course, such a policy is detrimental to the country over the long term. Meanwhile, DD *would* be capable of taking measures that were wise in the long term although painful in the short term, and doing it without procrastination. California's Proposition 13 perhaps could be regarded as an example of that.

Tough decisions. Concerning the question of tough decisions: consider the following.

1. The USA's involvement in the Vietnam War was widely recognized to be a mistake well before the US actually pulled out of that war. Polls showed high ($\approx 70\%$) public support for that war in 1965, which dropped below 50% in 1968 and continued to drop to around 30% by the US withdrawal in 1973. Thus a binding referendum in 1968 could have ended the war 5 years earlier and saved over a million lives. Similarly, as of December 2004 it appears from polls that a majority of Americans now believe that the Iraq war was a "mistake." If so, we again face the prospect of many more years of a war from which the populace wants to withdraw.
2. Since the 1970s the USA has seemed incapable of balancing its national budget and the legislature has seemed incapable of taking suitably drastic measures to force balance, causing the fiscal situation to steadily worsen year after year. (In the 35 years 1970-2004 only 4 federal budget surpluses occurred, with the remaining 31 years being deficits, and even these 4 are debatable since the US *debt*, according to the US Bureau of the Public Debt [**?**], has monotonically increased every year between 1960 [$257 billion] and 2004 [$7529 billion]).
3. Although the toxicity and pollution caused by gasoline additive tetraethyl lead were recognized since the 1920s, the US government, thanks to pressure from General Motors Corp., did not do anything about it until it was finally banned in 1986. After the ban the mean blood lead level of Americans dropped by $\approx 75\%$. The lead pollution era is estimated to have decreased the average intelligence of American children by 3-4 IQ points and caused 5000 extra annual deaths. A nationwide initiative might have been able to stop this 50 years earlier.
4. Thousands of tons of antibiotics are put into US animal feeds each year because they enhance growth rates of farm animals often housed in unhygenic conditions. All medical groups disparage this as likely to lead to far faster development of more strains of antibiotic-resistant pathogenic bacteria, possibly leading to an incurable pandemic. (Antibiotic resistance is far more common in today's pathogenic bacteria, e.g. salmonella, than in the past.) It is primarily for this reason that most antibiotics are only legally available to *humans* via doctor's prescription. This all has been recognized for 50 years. But thanks to the farm lobby, the US government has never acted to curtail the practice and there seems no hope that they ever will. Again, here we have a potentially *enormous* benefit which could plausibly be realized by a citizen initiative to ban antibiotics in animal feeds, but which legislatures seem incapable of bringing to us.
5. World oil production will hit an all time peak sometime between 2010 and 2020 and decline thereafter, forcing drastic economic changes. Although this has been understood since the 1960s, US legislators continue to act as though the world oil supply is limitless and no adjustments and forward planning are required. Measures such as high taxes on gasoline, increased construction of wind-energy farms, and government research into breeder reactors, therefore are stymied.
6. "Gun control" remains an issue that US legislators seem fearful to touch.
7. Abortion is also an issue which US legislators have carefully avoided doing anything about ever since the 1973 *Roe v Wade* decision. They've done their best to leave that up to the courts, and when they have acted they've always done so in very indirect and disguised ways.

All of these serious problems might have been resolvable once and for all via a nationwide referendum (if one were available), with the benefit of terminating seemingly endless and fruitless debate and allowing actual progress to be made.

Initiatives and the power of moneyed special interests: John Rankin Rogers (populist governor of Washington State 1897-1901) once said:

> I am in favor of direct legislation. The people are helpless against the bribery which is resorted to by the great corporations...

However, it has been counterargued that moneyed interests might actually have *greater* power when decision-making is done by referendum instead of by legislators. That is because there are no spending limits and because naive and ignorant voters supposedly are easily manipulated. David Magleby argues: "Many initiatives are incomprehensible to most voters, especially the less educated. The power of organized interests is clearly enhanced. Courts are placed in jeopardy [when they rule initiatives unconstitutional]."

In California in 1998, $54 million was spent campaigning for and against 12 ballot initiatives. In the same year *all* US *federal* House candidates *together* spent $88 million and the Senate candidates $49 million. So clearly the total amount of money involved in DD may be expected to exceed that involved in indirect democracy. On the other hand, the total amount of money spent *per recipient* is *vastly* larger in indirect democracy, e.g. (according to the figures above) $256,000 per Federal representative versus about $5 per California voter.

Voters in California referenda often remarked that they found it very useful to know who was funding the various sides in the advertising campaigns. California law forces public disclosure of that information.

Part of Magleby's counterargument is perhaps supported by the case of California Prop. 103. All voters noticed its immediate forcing of a reduction in their auto-insurance bills by 20%. Fewer read its 11,000 words and appreciated the large regulatory apparatus that would ensue, causing a 50% increase in the size of the state insurance regulating department and unclear long-term effects. The promised immediate rebates and rate reductions never came, since that part of the proposition, once passed (by a 51-49% vote), was held up by many years of court challenges.

On the other hand, Rogers' argument is supported by the 1954 Oregon ballot proposition which ended state control of milk prices via subsidy. Meanwhile state-subsidized milk price supports persisted in many Eastern no-referendum states such as New York into the mid-1990s. This was often attacked by the New York State press as an outrageous consequence of campaign contributions by the dairy lobby which had sometimes caused milk prices far in excess of other areas.

Schmidt ([26] p35) tabulated spending versus passage-rate data on the 189 US state ballot initiatives 1976-1984 for which campaign spending data was available. He found that in the cases where there was overwhelmingly 1-sided spending (i.e. $>$ 2:1 ratio and $>$$250,000 spent) that spending *did* affect the passage rate, altering it from 39.9% to either 25% or 55% (i.e. by $\pm$15%) depending which side the spending was on. A similar but smaller study by Lowenstein [20] came to a similar conclusion.[25] Schmidt then contrasted this with the effect of money on indirect democracy by noting that, according to Common Cause, in 1978 and 1982, the biggest spenders won 86% of all congressional races. According to data compiled by the Center for Responsive Politics, by 1995 this had risen to 95%; in the 2002 elections, 95% of the House and 76% of the Senate races were won by the biggest spenders, and in the 2004 elections, $\geq$ 95% of the House and 91% of the Senate races were won by the biggest spenders.

One illustration of the power of highly-moneyed pressure groups on the Senate was provided by a vote on 2 March 2004 on a bipartisan liability-shield bill for gun manufacturers. It was supported by the National Rifle Association. Midway through the voting, the NRA changed its stance on the bill for strategic reasons and because of tacked-on amendments (e.g. a renewal[26] of a ban on "assault weapons") and emailed the senators notifying them of this decision. A large number of senators changed their votes, causing a sudden 80-vote swing and the unexpected defeat of the bill! It is inconceivable that such a drastic sudden vote swing could happen on a ballot referendum.

My conclusion: The power of money is large in both direct and indirect democracy – but much larger in the latter!

Poor drafting? Citizen initiatives are often drafted by amateurs and hence rife with ambiguous language and other carelessness. Although examples of this have been cited, my own feeling is that, *usually*, citizen initiatives have far more attention paid to their wording than, and certainly are subjected to far more scrutiny than, most laws.

Bundling? By bundling several questions into one, voters can be made to do things they did not intend. In 1996 a Nevada initiative enacted term limits for legislators, executive branch, and judges. But after separating the questions and a revote, voters passed for first two and rejected the third.

In 1996, Oregon's Measure 40 passed by 59%. After a court overturned it on a technicality, the measure was split into its 7 component parts and revotes were conducted in 1999. Three of the 7 measures (11-to-1 murder verdicts, prosecutor right to insist on jury trial, and weakening of immunity so more evidence admissible) were rejected, while 4 passed.

Hopefully, the lesson to be learned here is that initiatives should consist of *single questions*. But it is hard to define and hence enforce that requirement. Nevertheless it seems clear that legislator-passed laws commit the sin of bundling to a *far* greater degree. While a 3000-page ballot proposition is inconceivable, 3000-page laws are common.

Furthermore, it could be argued that the *entirety* of indirect democracy is just decision-bundling taken to an absurd limit. Every 2-6 years the USA holds another election to review the last 10,000 or so decisions by their leaders and vote for the one or two alternatives who will handle the next 10,000 decisions!

Initiatives in California: California is the state most commonly cited as an example of the citizen-initiative run amok. Large specified chunks of the California state budget and taxes have been permanently devoted to various specified causes as a result of ballot initiatives, with the result that legislators subsequently had greatly reduced flexibility when trying to devise state budgets, which probably contributed to the ultimate result of a gigantic statewide governmental budget shortfall and crisis, which continues as I write this with no resolution in sight.

The two most notoriously large examples of this were "Proposition 13" (passed in 1978 by 65% vote) and "Proposition 98" (passed 10 years later). Prop. 13 *suddenly and drastically* restructured California's finances, probably to a greater extent than any other peacetime state restructuring in US history. It capped property taxes at 1% of *purchase* value, rolled back assesements to their 1975 value, capped increases at 2%/year, placed the *state* (not localities) in charge of divvying up the

[25] Lowenstein concluded that "one-sided spending ... did not constitute a major social problem" since the high-funded side won in 64% of his cases, but nevertheless "in some cases the spending was almost certainly decisive" and the one-sided high-spending campaigns were "plagued by gross exaggeration, distortion, and outright deception."

[26] This renewal had bipartisan and presidential support.

property tax money, only permitted property-value reassessments when the property was sold, and demanded that any new taxes could only be passed by a *two-thirds* majority of the legislature (or local voters for local taxes),

Results: There was a 11 $\to$ 5 \$billion revenue reduction from property taxes in 1979. California schools (which had been funded largely via property taxes), which previously had been funded in top third of US states per-pupil, suddenly dropped into the bottom 16%. Companies and the owners of apartment buildings saved enormously on taxes. Old settlers got a big tax advantage versus recent buyers and those with more transient addresses. (This had an anti-minority effect.) Identical side by side dwellings could be appraised for tax purposes a factor-4 differently and that (and this was later upheld by court decision) became fully legal. The state government decided to divvy up the property tax proceeds among localities by freezing percentages, which seems a silly method (allocation according to population would make more sense) and local governments lost much of their relevance and power, as well as being made to live in permanent fear of a sudden policy change from on high. Long term, prop. 13 may have the unintended consequence of turning California residents into renters instead of owners.

Prop. 98 was then passed largely in reaction to the effects of prop. 13. It mandated that 40% of state revenues must be spent on Kindergarten through 12th grade education. (Actually, this is oversimplified; the mandates were determined by a more complicated formula.)

To judge the cumulative restrictive effect of such things on the state budget, consider that on the 2004 ballot *alone* were these measures:

Prop. 1A: Would keep local property tax and sales tax revenues with local governments. If passed, the proposition would limit the state government to suspend provisions only if the governor declares a fiscal necessity and two-thirds of the legislature agree.

Prop. 63: Would impose a 1% tax on incomes of over \$1 million to fund expanded health services for mentally ill citizens. It would generate approximately \$275 million in 2004-05 and increasing amounts every year after. The state and counties would also be subject to additional expenditures for mental health programs, mirroring the amounts raised by the surcharge.

Prop. 65: Would limit state authority to reduce major local tax revenues. Its restrictions would prevent a major component of the 2004-05 budget plan (a \$1.3 billion property tax shift in 2004-05 and again in 2005-06) from taking effect unless approved by the state's voters. It would permit the state to modify future local tax revenues for the fiscal benefit of the state with state voter approval.

Prop. 67: Would increase the in-state telephone surcharge to fund uncompensated emergency care such as hospital emergency rooms, community clinics and the 911 telephone system. It would also redistribute some existing revenue and change the way that revenue is administered.

Prop. 68: Would require gaming tribes to pay 25% of their "net win" to the state or lose their monopoly on casino-style gambling. If the proposition passes and all tribes do not agree to its rules, casino-style gambling would be open to card clubs and racetracks.[27]

Imagine trying to design a state budget in the face of the mare's nest created by 100 years of such propositions.

On the other hand, propositions 13 and 98 also had positive effects. It has long been recognized that funding public education via local property taxes is fundamentally unfair since it causes students in rich districts to have a relative advantage. It has long been proposed, therefore, that public education should instead be funded out of statewide revenues. Pre-prop.-13 property taxes were also unfair in the sense that assessed values were based on the land's hypothetical highest and best use (as opposed to its actual use), assessments could be reduced by bribing assessors, and future assessments could change drastically and unpredictably. The financial restructuring required to address those unfairnesses, however, has been so vast that no, or at most very few, state legislatures have ever been willing to undertake the job, and hence a sub-optimal system has continued for 100 years with no sign of diminution. By passing props. 13 and 98, California voters immediately broke this logjam and *forced* an enormous restructuring upon the quailing legislators. Polls 10, 20 and 25 years after prop. 13 all showed that Californians continued to think (in retrospect) that it was a good idea, although with a smaller margin of support than its original 65%.

Another problem with California propositions has been: once passed, they do not always take effect! E.g., 1996's "proposition 198" was ratified, then in June 2000 declared *unconstitutional* by the US Supreme Court!

Then (continuing the same theme Prop. 198 began) in 2004 California voters were confronted with "proposition 62," which had been placed on the ballot by a coalition of corporations, business executives and politicians. The full text of it was 20 dense pages of legalese. However, most voters only read the following carefully-deceptively-worded short summary of it:

1. Should primary elections be structured so that voters may vote for any state or federal candidate regardless of party registration of voter or candidate?

2. The two primary-election candidates receiving most votes for an office, whether they are candidates with "no party" or members of same or different party, would be listed on general election ballot.

3. Exempts presidential nominations.

What are we to make of this? Sentence #1 is a question, not a statement, and hence has no legal effect. However, many voters would be misled into thinking the obvious answer to the question was "yes" and hence would vote for proposition 62. What *is* important legally is sentence #2. It is also phrased confusingly (does "two" mean "exactly two" or "at least two"?) but in fact, it evidently means exactly two, and

[27] These summaries of the ballot propositions were prepared by the staff of the Institute of Governmental Studies library at the University of California, Berkeley. The propositions themselves are usually far longer and more detailed than their sumaries.

the effect would be to put the candidates of the top-two membership parties on the ballot automatically and nobody else. Effectively third parties are disenfranshised.[28]

Undoubtably this summary's wording was carefully designed and studied with the aid of "focus groups" to try to ensure that enough CA voters would be stupid enough to fall for it.

And that in fact nearly happened; it got 47% of the vote. Meanwhile proposition 60, which directly contradicted proposition 62, simultaneously passed with 67% of the vote. Since $67 + 47 > 100$, presumably a substantial number of voters simultaneously voted for *both* a proposition *and* its refutation – and it was not at all impossible for both to have passed.

What is going on here? My interpretation of this is that, by clever deceptive phrasing of the ballot proposition summary, the proponents of some proposition can greatly increase its chances of passage. Since the proposition's opponents usually cannot affect its wording their only option (if they have enough warning, time, and funding) is to design a poison-pill counterproposition, which *they* can cleverly deceptively word, and which nullifies the other. Is this ideal democracy in action, or a bad joke?

In summary, California ballot propositions are too easy to make, are capable of being 20 detail-filled pages long and confusingly worded, and are too difficult to alter once passed, and consequent effects have sometimes ranged between damaging and ludicrous. But on the positive side they have enabled reforms which were too drastic for the too-timid legislature to do by themselves.

Accomplishments of ballot propositions. Ballot propositions have accomplished a great deal of good. To review their early history: during 1898-1918, twenty US states adopted ballot initiative schemes. Then 29 states forced senators to be directly elected (an idea that previously had been blocked 5 times by the senate itself). The 17th amendment to the US Constitution made this national in 1913, but probably this could never have happened without state ballot propositions. Similarly direct party primaries were adopted, forcing Senators to go to the people to be nominated, rather than merely to the railroads and utilities. From 1900 to 1920 state electorates voted on a total of about 1500 constitutional amendments, passing about 900. Washington State passed a ballot proposition in 1910 awarding women the right to vote (although such a proposition had been defeated on two previous tries), which triggered more Western states to allow women to vote (by 1914 twelve states allowed women to vote, all west of the Mississippi), and ultimately the 19th amendment gave women the vote nationwide in 1920.

It has not been uncommon for voters in referendum states to be faced with between 10 and 30 propositions. In 1998 alone, various state referenda

1. raised minimum wages,
2. banned billboards,
3. decriminalized various drugs including marijuana,
4. expanded casino gambling, including, in Missouri's Proposition 9, allowing gambling in "boats in moats" set back from the river, as opposed to genuinely mobile riverboats,
5. banned many forms of hunting,
6. prohibited some forms of abortion,
7. allowed adopted children to find out their biological parents,
8. caused comprehensive campaign finance reform in Maine.

Other measures passed by state referenda include:

1. In 1912, CA, OR, and WA banned "poll taxes."
2. Arkansas restricted child labor in 1924.
3. In 1930, 12 states banned alcohol. Other states, however, become "wetter" via ballot propositions during 1948-1968.
4. During the 1990s many "term limits" were forced by ballot proposition.
5. In 1993, Washington passed a "3-strikes you're out" mandatory sentencing law by a 75% margin.
6. Oregon by 51-49 vote legalized physician-assisted suicide in 1994.
7. Several "school voucher" laws were passed by ballot proposition.

It could plausibly be argued that several of these measures would never have been enacted by indirect democracy.

In one amusing battle between elected representatives and direct democracy, President W.H.Taft vetoed the inclusion of Oklahoma as an additional state of the Union, because their proposed state constitution included (horrors!) a provision allowing the electorate to un-elect sitting judges. This provision was then deleted from the Oklahoma Constitution, Oklahoma was duly admitted to the Union, and then the judge-recall provision was re-inserted into the Oklohoma Constitution by statewide referendum!

Conclusion: Certainly, individual ballot initiatives have had flaws. But theoretical claims and fears that they systematically underperform laws passed by legislators seem either refuted, unsupported, or at best unconvincingly supported by evidence. Meanwhile, there are very strong reasons to believe that ballot initiatives can accomplish feats that are essentially *impossible* for legislators, and we have given examples that are so serious that the fates of major nations, and indeed of all humanity, may ride upon such issues. Furthermore, there are serious flaws that clearly legislatures are subject to, that clearly DD is not subject to. In particular legislatures are capable of reaching permanently disfunctional states from which *only* citizen initiative overrides can hope to extract them in a reasonable amount of time. My conclusion, therefore, is clear: ballot initiatives must be supported.

The stronger conclusion that DD should be supported as a wholesale *replacement* for indirect democracy, is, however, not clearly warranted at this time because of our near-total lack of experience with DD. The closest approach to DD that I know of was the Assembly in Ancient Athens. It might be safer to

[28] If, however, the system is combined with a "open" primary, which is not mentioned in this summary, then various peculiar effects could ensue, such as the Democrats, by having a highly competitive multicandidate primary, could find their winner *excluded* from the subsequent final election; on the other hand by having an uncompetitive primary with only a *single* candidate, many voters would not find it strategically worth their while to "vote" for him when instead they could actually have an effect on the Republican primary – in which case the uncontested Democratic winner could again find himself excluded from the final election!

try a *combination* of DD and indirect democracy. That has been tried, in Switzerland.

3.3 Athens

Athens [24][28][33] was a democracy for most of the time between 508 and 322 BC, one of the longest-lived (perhaps the longest – it depends on one's definitions) democracies which has yet existed. Furthermore, even after the Macedonian takeover in 322 BC – after which point the power of Athens (and all City-States of its ilk) was permanently reduced – many democratic institutions persisted for another 50 years or so, as well as spreading elsewhere in the Macedonian empire, with elections known to have happened in various places, especially Rhodes, throughout the next 200 years. Athenian "citizens," that is, comparatively rich males[29] over 18 years old were eligible to attend assemblies (held about once very 10 days starting at dawn). In 458 BC lower class males became eligible to hold office. Although $\approx$ 45,000 citizens theoretically existed, typically about 6,000 attended assemblies. There, any man with a loud enough voice could debate legislation whereupon it could be enacted by vote. Mainly there was no formal vote counting, but merely a show of hands, but sometimes votes were conducted by counting of pebbles, the earliest form of secret ballot. There have been some (disputed) claims that in practice Athenian assemblies tend to have been dominated by rich leaders.

The assembly could dispatch ambassadors, conduct audits and impeachments, order generals around, order wars, massacres, and killings, and exile disliked citizens. Any law passed by the Assembly had to be proposed by some one person, whose name appeared at the beginning of the statute. If the citizens later thought the law or decision was a mistake, they could attack it in court as being contrary to Athenian principles. If the law were thus challenged within a year and found lacking, its proposer was fined a sum that would bankrupt almost any citizen.

The Athenians also had a "Council of 500" consisting of men aged$\geq$ 30 chosen randomly from candidates proposed by the surrounding districts. They had special machines, based on an urn of black and white pebbles drained by a tube with pegs enabling the withdrawal of a single pebble, to provide random bits (pictured in [32]). These men served 1-year terms and were forbidden to serve consecutive terms or more than 2 terms total. The Council prepared the agenda for each Assembly and recorded its results. (During some periods the council had only 30 members, not 500.)

The Athenians also had large odd-cardinality juries, chosen at random, to decide criminal cases by majority vote. The Athenian governmental system later served as the inspiration for "New England Town Meetings."

How successful was Athens? "For 200 years [Athens was] the most prosperous, powerful, stable, internally peaceful, and culturally by far the richest in Greece [and therefore the world]," says Moses I. Finley [10].

Nevertheless, many observers contended that the Athenian system had its flaws (although disputing precisely what they were). One example: In the winter of 415 BC, the Athenian Assembly voted to invade Sicily despite the fact that (according to Thucydides) its members were "for the most part ignorant both of the size of the island or its number of its inhabitants." (The invasion ended in disaster for the Athenians.)

The Athenian kind of government evidently cannot be scaled up beyond the size of one town, and *that* clearly was what ultimately doomed it. Athens, despite its relative riches and success, was just one city-state, surrounded by other (non-democratic) ones – all of them often at war with one another. And to the extent Athens conquered other places, it was never for (and could not be for) the purpose of incorporating them into its democracy. These factors left Athens helpless before the giant Macedonian (and later Roman) Empire.

3.4 Switzerland

Switzerland [18][11][7] is a **hybrid of representative and direct democracy** set up in largely its present form (via the adoption of a constitution) in 1848 with the major constitutional revision enacting referenda in 1874.[30] Each component counteracts the other. There is a bicameral parliament with no term limits (presently dominated by 4 major parties), who in turn select a 7-member "federal council" and "cabinet ministers" to serve as the executive branch and select the 48 Supreme Court members for 6-year terms.[31] Note the absence of any single "president"; the situation is more like a seven-member committee as "president." (Council members cannot be recalled by the legislature before completion of their 4-year terms, unlike in most parliamentary democracies where they would be vulnerable at any time to a "vote of no confidence.")

Voters may either propose *initiatives* to be voted upon, or can object to all laws (except for the budget[32]) passed by the legislature, demanding a vote to overturn them. For an initiative to be placed on the ballot requires 100,000 signatures collected within 18 months. A *referendum* objecting to a law, however, requires only 50,000 signatures collected in

[29] Slaves and women were excluded; and later "citizens" had to have the right heredity, consequently it has been estimated that only about 40% of males were eligible to participate, comparable to Britain after the first Reform Act of 1867.

[30] The first US states adopted initiatives and referenda in the late 1890s. Although other democracies, most notably Australia and New Zealand, sometimes hold nationwide referenda, Switzerland is clearly in a class by itself: during 1945-2000 it held about twice as many referenda as all other countries *combined*.

[31] Switzerland is also unusual in having a comparatively low-powered central government compared to its Canton governments; the Federal government consumes about 30% of the revenue, the Cantons 40%, and localities 30%. About 20% of the Supreme Court judges do not have law degrees, and the Federal parliament normally meets only 12 weeks per year. Swiss MPs get paid only about half the monthly wages of MPs in comparable countries. Decentralized rule of this sort has the advantage, in principle, that if any Canton manages to politically self-destruct, the others could take it over and fix it. (This in fact happened once in the Canton now called Jura. After a separatist struggle during 1947-1978 which involved some riots, sabotage, and other violence, the Swiss by national referendum approved splitting Bern Canton into two, with individual localities voting piecewise on which Canton to belong to.) Also, its inhabitants could leave. With just a single large government, "all of society's eggs are in one basket." Unfortunately, US law contains no explicit provision for such a peaceful state-takeover process. In Switzerland anytime the need was felt, it could be enacted by a nationwide initiative. Also, decentralized budgetary control has the advantage that it eliminates "pork."

[32] This exception for the budget is perhaps unwise.

100 days. (The total population of Switzerland was 7.3 million in 2000.) The referenda *threat* forces the government to follow the will of the people quite closely even without necessarily actually having a referendum. Finally, all proposed *constitutional amendments* and *major treaties* are decided by obligatory plebiscite and must first (and also) be approved by the legislature. Popular votes take place typically 4 times per year with 1-9 national issues per election (plus district issues).

The Swiss also have a system of *petitions* which must by law be *considered and answered* by the government, although without any requirement for actual action.

The Swiss Constitution was rewritten in a terser but essentially equivalent way in 1999 (now about 11,000 words) and the new version adopted in 2000 by 59-41% national vote [34]. *Over half* of the provisions currently in it were derived from popular ballot initiatives or referenda, making it, in detail, by far the most popularly-approved national constitution. The Swiss Constitution is amended about once per year, i.e. about 25 times faster than the US one. Unlike in the US, there is no constitutionally mandated separation of Church and State. The Swiss Supreme Court does not have the power to invalidate Federal laws as unconstitutional, but does have that power for Canton and local laws. The Swiss direct-democracy viewpoint also has permeated into the design of its military forces. Swiss men have obligatory military service and training, and nearly every adult male up to 60 years of age owns a military rifle and is theoretically willing to take up arms within a day or two. All the major transportation choke points (bridges, tunnels) in the country are equipped with mines ready to destroy them, and the country is dotted with air raid shelters and underground storage depots.

Swiss taxes include income, corporate income, capital gains, and wealth taxes but Swiss voters have repeatedly rejected a value-added tax. The Swiss have comparatively low voter turnout among European nations (50-60% in National and 30-40% in Cantonal elections) which perhaps is a sign that their direct democracy system represents too much work and that a DD-by-jury system would be better. On the other hand, it could be argued that the present turnout is high enough so that no action needs to be taken. We further remark that a 1977 US poll ([6] p.71) asking voters "Would you be more inclined or less inclined to go to vote if you could vote on issues as well as on candidates?" resulted in 74% saying "more," 7% "less" and 13% "no difference." Meanwhile Schmidt ([26] p.28) contrasted voter turnouts in US states with citizen-initiative and without, and found 4.4% higher average turnout in the former (3.1% higher in presidential election years and 6.2% higher in non-presidential years).

Swiss democracy seems to have been very successful:

1. In 2004, Switzerland's Gross National Income per capita was the third highest in the world (behind Luxembourg and Norway and ahead of the USA and Japan), despite the fact that Switzerland is landlocked and has comparatively few natural resources and inhospitable terrain, [33]
2. violent crime rates below the 20th percentile among European countries (although drug trafficking crime rates seem above median),
3. the lowest death rate of any European country,
4. superb K-12 education as measured by the ability of the Swiss at foreign languages (over 60% of them speak one) and by their performance on math tests,
5. 99% literacy,
6. historically among the highest employment rates in the world,
7. Unlike most democracies, Switzerland's central government has throughout its history had a *balanced* budget, with surpluses being common,
8. Switzerland has avoided participating in any war since 1847.
9. Switzerland's current 7.5% poverty rate is not especially praiseworthy compared to other European nations, but still is lower than most, and in particular is lower than any country in the Americas. (The present 7.5% rate may be an anomaly; historically Switzerland's poverty rate has usually been much lower.)

Polls indicate that 60-70% of Swiss say they are "proud" of their governmental system, which seems a higher satisfaction percentage than most anywhere else. Nevertheless, I believe Switzerland's system could be improved further by, e.g., adopting better voting systems than plurality, e.g. range and reweighted range voting.

4 The jury problem

4.1 The problem

Goal: a society of N people ($N \approx 10^8$) needs to select a random subset of J people ($J \approx 9999$) to serve as a "jury." This is the key step in our proposals for "direct democracy by jury." We desire that this process obey the following properties:

Randomness: The jury really is a random subset, unpredictable by anybody (and indeed unpredictable even by a large number of people working in collusion) and this true-randomness is either verifiable or self-evident.

Notification: All jury members are notified that they have been selected.

Anonymity: If a juror wishes to remain anonymous, then nobody can determine his identity (including other jury members) and indeed no large colluding set of people can determine his identity, until after he has cast his vote, i.e. until after his jury service has ended.

Undodgeability: It is not possible for a jury member to dodge jury duty by pretending he was not selected.

Provability: Any jury member can prove he is a legitimately-selected jury member.

Secrecy: Nobody should know any juror's verdict, but nevertheless all should be able to verify that only legitimate jurors voted, did so at most once, and the correct election result was then computed [31].

These goals naively appear to conflict. But we shall sketch how modern cryptographic algorithms technology nevertheless makes it possible to achieve all of them simultaneously.

[33] Switzerland has no minerals, iron, coal, oil or gas worth speaking of, and only 7% of its land is farmable. Measured in terms of *purchasing power*, Switzerland's 2003 per capita income ranked fourth, i.e. just below the USA's. In 1997, Switzerland had the world's *highest* GDP per capita.

This is the major new result of this paper. At first I was rather proud of myself for accomplishing this, since the cryptographic problem initially appeared difficult. However, eventually I invented more and more and simpler and simpler solutions, so that now, in retrospect, the problem no longer appears very difficult.

We assume each citizen has a publically known ID number x (e.g. his public key), email and internet access, and "untraceable anonymous email" [3] is readily available. (Indeed "blogs" based on the latter will be key for enabling juries to deliberate.) We shall refer often to cryptographic ideas described in [31], where it was explained how seemingly conflicting desiderata about secret-ballot but verifiable voting are nevertheless reconciliable. The necessity of cryptographic techniques for allowing electronic elections to proceed safely and verifiably despite attempts by sophisticated adversaries to undermine them was also discussed in [31].

We shall employ the following ideas (all discussed in [31]): digital signatures, public-key (especially ECC Elgamal) and secret-key cryptography, "commitments," secure hash functions, and the difficulty of the discrete logarithm problem (especially in elliptic curve groups of large prime order).

4.2 Solutions

Cast of characters: There will be several Actors in this story.

JSA_1, JSA_2, etc: There are several mutually distrustful *Jury Selection Authorities* (JSAs) called JSA_1, JSA_2,..., JSA_K for some $K \geq 3$. We shall assume they distrust each other sufficiently that not all of them are willing to collude to defeat the system.

EA: The *Election Authority* receives votes from the jurors and totals them.

Bulletin boards: On which information may be posted that is visible to all.

Voters: The N voters, i.e. potential jury members, are assumed to be pre-known and described on some large publically posted list.

Jurors: The J jurors, $0 < J \leq N$, are a subset of the voters.

First of all, let us show how to achieve **notification**, **anonymity**, **provability**, **undodgeability** and **randomness**. We describe three different solution approaches.

Selection method 1: Mixnet: Each voter supplies an $(K+1)$-time repeatedly ECC-ElGamal encrypted form of a standard-format notification message addressed to himself, to JSA_1. That is, if the message is M, then the encrypted form is the $(K+2)$-tuple

$$(g_0^{r_0}, g_1^{r_1}, g_2^{r_2}, \ldots, g_K^{r_K}, h_0^{r_0} h_1^{r_1} h_2^{r_2} \ldots h_K^{r_K} M) \tag{1}$$

where the g_k and h_k are elements (namely, the public keys for JSA_k, for $k = 1, 2, \ldots, K$, and of the juror for $k = 0$) of some publically known elliptic curve group of large prime order P and the r_k are randomly chosen (by the juror) integers mod P. Then each JSA_k, for $k = 1, 2, \ldots, K$, randomly permutes the N messages while decrypting them using his public key, that is dividing the rightmost entry by $(g_k^{r_1})^{\ell_k}$ where $h_k = g_k^{\ell_k}$ and where the discrete log ℓ_k is JSA_k's secret key. Each JSA_k publically posts his output (which is then taken as input by JSA_{k+1}). After JSA_K is done, the almost-fully-decrypted messages are available:

$$(g_0^{r_0}, h_0^{r_0} M). \tag{2}$$

These N two-tuples then are posted publically, along with a description of the issue that jury needs to decide, information about the date of decision, et cetera. The first J among these are for the selected jurors, and the remaining $N - J$ are unselected jurors. Any voter can determine whether he is on the jury by simply examining the first J posts and seeing if they match his once-encrypted message. He can prove he is a legitimate juror by exhibiting his plaintext message and all his r_k values (all the g and h values are publically known), and demonstrating that the posted encrypted message results.

Any voter may verify that his particular message was permuted and once-decrypted at each stage of the game – and if not, he can prove it by publically posting his r_k values, thus revealing the cheating JSA_k. (There are also ways for external nonvoter observers, by means of interaction with the JSA_k, to acquire high confidence that that JSA_k genuinely performed a shuffle-and-decrypt, see [31].)

So long as at least one JSA_k performs a genuinely random permutation, the product permutation must be random.

To achieve undodgeability, there are several ways to proceed. First, the JSA_k's, *after* the jury is done judging, may publically reveal their permutations and ℓ_k values. They cannot lie when they do so, because at that point everything is public and straightforwardly checkable. The jury membership then becomes obvious to all and dodgers may then be punished. Alternatively, the voters may be required to reveal all their r values, at which point again everything becomes obvious and any dodgers or cheating voters may be punished.

The mixnet method has the disadvantage of fairly large communication and space requirements.

Selection method 2: Modular sum: Each JSA_k, for $k = 1, 2, \ldots, K$, selects an N-tuple of random numbers mod N. A secure hash function of this N-tuple is publically posted. Each voter is notified of their random number by that JSA_k by encrypted signed email. (These emails are readable by that juror only, since only he has his private key. We are assuming public key cryptography. We also assume that outer secret key cryptosystems are employed whose keys are only revealed *later*, after the juror has received all his emails. This prevents a juror from revealing his first-received number to another JSA_k to allow that JSA to send him an appropriately-chosen "random" number.) These emails may also be posted on a public bulletin board (again with the bulletin board only posting the secret key later). If the *mod N sum* of that voter's numbers is between 1 and J inclusive, then he is on the jury. A juror may prove he is a juror by exhibiting his decrypted signed email messages.

So long as at least one JSA_k picks genuinely random numbers, the sums all will be random.

To achieve undodgeability, there again are several ways to proceed. One is: the JSA_k's, after the jury is done judging, may publically reveal their N-tuples. They cannot lie when they do so, because they previously had "committed" to the N-tuple they used, when they pre-posted its hash, and also because each juror has a signed message from each JSA_k giving their number, and also because the encrypted and publically posted emails to each voter may now be verified by anybody. It then becomes obvious to all who was on the jury and dodgers may then be punished.

The sum method has much smaller communication requirements than the mixnet method. But it has the disadvantage that the jury cardinality may only be *approximately*, and perhaps not *exactly*, equal to J. We therefore recommend the sum method whenever J is sufficiently large that this approximation does not matter.

Both the mixnet method and sum method allow selecting many disjoint juries at the same time, e.g. voters $1, \dots, J$ are the first jury, voters $J+1, \dots, 2J$ are the second jury, etc. (or in the sum method, replace the word "voters" with "those whose sum is in the range").

Selection method 3: verifiable random numbers: The two jury-selection methods above depended on having several mutually distrustful JSA_ks. If there is just *one* JSA, then, as we shall now show, it is also possible to force it to select a truly-random jury. The only problem will be that the JSA then will *know* who it chose and thus would be capable of leaking juror identities to interested parties, of trying to intimidate jurors, et cetera. In contast, in the previous two several-JSA solutions, *none* of the JSA_ks, unless they *all* colluded, could know the identity of any juror (if that juror wishes to keep his identity secret). For this reason we do not recommend this third method. (However, elements of this third method may be combined into either of the preceding two methods to provide additional assurance that each of their JSA_k are genuinely producing random permutations or numbers.)

It is as follows. Initially, the JSA solicits from each voter, a random bit. These bits are publically posted. (Alternatively, we could just use the digits of π.) Then the JSA hashes these down to a small number (say 256) of bits then uses a standard secret key cryptosystem such as iterated AES-256 [15] to encrypt these random bits, thus producing a string of pseudorandom bits. These too may be publically posted. Finally, the JSA applies F^{-1} to these bits, where F is a publically known public key encryption function (but whose inverse, i.e. decryption, function F^{-1} is employable only by the JSA) to produce a third set of random bits, which it then uses in some standard manner to select the jury. The JSA then notifies the jurors by encrypted signed emails (readable only by their recipients) and posts those emails on a public bulletin board.

After jury service is over, the JSA can publish the third set of random bits, at which point anybody may verify their validity by applying F to them, and at which point jury dodgers may be punished.

Voting. How do the jurors, once selected, cast their votes?

Essentially, the methods described in [31] for verifiable secret-ballot elections will do the job, after a number of modifications. We shall only describe the modifications.

We assume that every jury casts its vote on "election day" which, let us say, is the first day of the month every 3 months. To do so, all jurors for all juries go to public polling places and cast a vote. Those votes are publically posted in encrypted signed form as usual [31] on a bulletin board under that voter's name. The voter must have his identity verified at the polling place (e.g. by fingerprint or iris scan). This is a weak point in the system, since polling places could turn away disliked voters. However the voter could try again at a different polling place, and also since nobody knows which jury that voter is on, there is less motivation to try to disenfranchise anybody.

Only a voter who can sign the valid digital signature of that voter (public keys for all legitimate voters are pre-posted publically) can vote. A vote will describe which jury it is for. After the election all votes are decrypted and all jurors are revealed so that everybody can verify that only valid voters voted and for valid juries. *But*, the *actual* votes remain in encrypted form at that point – encrypted by both the Juror and the election authority EA. The voters are unable to convince a vote buyer that their vote is something because they cannot recreate it because the EA also encrpyted it (and sent the Juror and "designated verifier" zero knowledge proof [16], convincing to that juror *only*, that its re-encrpytion was valid). The vote totals are computed via the "homomorphic encryption sum" idea reviewed in [31] which never actually reveals those votes, only their sums, and does so in a manner whose correctness is verifiable by all. This secrecy prevents vote selling and coercion.

Proxies. A voter gives his proxy his digital signature secret key so that he may cast that voter's vote for, and sign it for, him, as well as signing it himself. The vote then contains the name of the proxy and of the original voter and a copy of the digitally co-signed contract between the two saying "I VOTER hereby give my vote to PROXY."

4.3 To have proxies or not to have proxies?

The "proxy" idea offers the advantage of allowing juries to have greater expertise than random juries, but without sacrificing the unbiasedness of random ones. Because each juryman can independently decide to replace himself via a proxy (or not) chosen by him, there seems no possible loss and some possible win with this idea. I.e., there seems no way to criticize the proxy idea: it can only be good. It cannot be bad.

Except for one problem: as soon as we allow proxies, we open the door to possible vote-selling and corruption! (Voters could sell their votes to proxies.) Now in defense of proxydom, we have argued that the variable-jury-size idea of §2 should keep corruption in check. But it could still exist.

So there might be grounds to prefer *proxyless* jury-based DD. Corruption could be essentially eliminated by eliminating proxies, and making jury service mandatory and inescapable.

The question then becomes: which is worse for society – the corruption we open the door to with proxies, or the expertise lost by forbidding proxies?

It could be argued that jurors could seek and consult experts on their own, without need of any *official* proxy status. However, this would require greater juror labor and hence would happen less often.

Historical evidence for the societal benefit of having more-expert decision makers (such as proxies)**:** The practice of choosing civil servants by systematic competitive examination (as opposed to the ever-popular alternative methods of nepotism, political patronage, and luck) was invented by the Chinese Han dynasty in about 210 BC and employed by them, to varying degrees, until its official abandonment in 1905. Similar systems were later adopted by the British in the 1850s and the USA in 1883. Now while none of these three societies (nor any other known to the author) can be regarded as a "meritocracy" (the Chinese were ruled by "Emperors" and the US and UK by elected officials and political appointees), they thus incorporated some elements of meritocracy, and it could be argued that the Chinese and the British did so to the greatest extent.

How successful was this idea? The Chinese advanced to the point where, during the period from, say, 400-1300, or perhaps 400-1600 AD, they were uncontested as the world's most advanced[34] civilization [2][35]. Similarly the British too were uncontested world leaders during their heyday.

We also point out the 8 **chess games** in table 3.1. Observe that the best the "world" could do in 4 games against 2 world champs, 1 grandmaster, and 1 international master was to get 1 draw (against the IM) and 3 losses. Meanwhile, TV viewers in Spain, Germany, and Uzbekistan managed to get 3 draws and 1 loss in their 4 games versus 3 world champs and a GM. In other words, the TV viewers did better than the internetters, despite the fact that the internet allowed greater participation, easier access, and communication and parallel tree-analysis via "blogs." It is also despite the fact that 3 out of 4 of the TV matches were played in the era before chess computers reached IM strength.

How can this be? One possibility is it is simply a statistical fluke. (Eight chess games is not a lot of data, although it sounds a good deal more impressive when one considers that these games involved about 800 move-decisions.) Another is that precisely *because* the TV matches were more difficult to participate in (since moves had to be submitted by physical mail rather than electronically) only more-dedicated players did so. If this is really the explanation, that would represent further evidence for the superiority of a meritocracy and in favor of proxies. Indeed,

(a) In some fairly easy "forced moves" in the internet games (such as 41...Kc4, in *Kasparov v World*, recommended unanimously by all 4 of the World's advisors plus GM Danny King) over 20% of the world voted to make other moves.[35] So we know that at least 20% of the world's voters were chess idiots. These 20% could easily have swung close votes in unpredictable ways, quite likely leading to loss.

(b) It could be argued that the main reason the World did so well in *Kasparov v World* (before eventually losing) was *not* due to the internet, the blogs, the analysis tree[36], and so forth, but rather, due to the World's advisor Irina Krush, a chess prodigy who won the US Women's Championship at age 14 by an 8.5-0.5 score. Krush found 10...Qe6, a new move which refuted the Sicilian opening line used by Kasparov and plunged him into immediate unknown complications. (In Kasparov's words "from then on, I was fighting for a draw.") The world went with Krush's recommendation on every move from 10 through 50. Kasparov appeared to be gradually regaining ground versus Krush throughout this period by correctly making some extremely difficult decisions, but after move 50, as a specially constructed perfect-play database [21] later showed, the game was a draw.[37]

Now, suppose a large percentage of the players on the internet were to select the best (in terms of some combination of perceived strength and dedication) player they knew to make their move-choice for them, and this proxying could continue for several stages. The result would be a very strong chess team indeed, probably consisting mostly of masters. I do not believe even a chess world champion could beat several thousand chess masters working cooperatively on an analysis tree via a blog.

[34] These Chinese invented gunpowder, rockets, deep drilling for salt and natural gas, pasta, paper, printing (including moveable type, although since their writing was a non-alphabetic system, this was not so useful for them), and banking. They had the best ceramics, steelmaking, and mass-produced crossbows, and invented lacquer, matches, the fishing reel, manned flight in kites to ≈ 1 km altitudes, and seismographs. Their boats were far superior to everybody else's (superior rigging, sails, invention of the rudder, fore-and-aft rig, and centerboard, allowing sailing against the wind, watertight bulkheads, and underwater salvage techniques) and so was their navigation due to their invention of the magnetic compass and of grid-based accurate maps (including the first relief maps), They had the most extensive road and canal networks (invented locks), and the best bridges, such as the "great stone bridge" built in 610 AD, with an arch span of 38 meters, which is still in use today and held the record for about 800 years. They also had the best communications, literacy, and medicine (including understanding the circulatory system 1400 years before William Harvey, and the common use of smallpox vaccinations starting in the 10th century). They had by far the most productive agriculture of their time thanks to terracing, fertilization, irrigation, superior tools and techniques (hoeing, superior iron plows, seed drills, winnowing machines, superior horse harnesses, understanding and use of ecology such as intentional husbandry of predatory insects to use against pests). They had a base-10 number system arguably superior to the West's present one, abacuses, and a standardized base-10 measure system. Meanwhile Europe was trapped in the "dark ages."

[35] In the even more severe case of 17...QxNe4, a totally forced recapture of a Knight, 4.1% of the World voted for other moves which would have lost immediately.

[36] On the other hand, Krush was the one who maintained the analysis tree and was heavily influenced by it. So it clearly is not true that Krush was the only factor responsible for the toughness of the World, but it neverthless seems certain that without her maintaining and expertly summarizing the analysis tree, the World would have been far worse off – i.e., translated into DD terms, this is an argument in favor of "proxies."

[37] That draw was blundered away by the world's 52...Kb2? ignoring Krush's recommendation of 52...Kc1. (Krush's recommended 51...Ka1 was also ignored and would have made the draw more clear than the World's 51...b5?!). Kasparov then blundered with 53.Qh2+?, restoring the draw (53.Qe4 leads to an extremely deep win) but the World returned the favor with 54...b4? (54...Qd5 draws) and finally on 58...Qe4? lost its last chances to pose Kasparov difficult problems with 58...Qf5 (although this still was a perfect-play loss). The entire game was: 1.e4 c5 2.Nf3 d6 3.Bb5+ Bd7 4.Bxd7+ Qxd7 5.c4 Nc6 6.Nc3 Nf6 7.0-0 g6 8.d4 cxd4 9.Nxd4 Bg7 10.Nde2 Qe6! 11.Nd5 Qxe4 12.Nc7+ Kd7 13.Nxa8 Qxc4 14.Nb6+ axb6 15.Nc3! Ra8 16.a4! Ne4 17.Nxe4 Qxe4 18.Qb3 f5! 19.Bg5 Qb4 20.Qf7 Be5 21.h3 Rxa4 22.Rxa4 Qxa4 23.Qxh7 Bxb2 24.Qxg6 Qe4 25.Qf7 Bd4 26.Qb3 f4! 27.Qf7 Be5 28.h4 b5 29.h5 Qc4 30.Qf5+ Qe6 31.Qxe6+ Kxe6 32.g3 fxg3 33.fxg3 b4 34.Bf4 Bd4+ 35.Kh1! b3 36.g4 Kd5! 37.g5 e6 38.h6 Ne7 39.Rd1 e5 40.Be3 Kc4 41.Bxd4 exd4 42.Kg2 b2 43.Kf3 Kc3 44.h7 Ng6 45.Ke4 Kc2 46.Rh1 d3 47.Kf5 b1=Q 48.Rxb1 Kxb1 49.Kxg6 d2 50.h8=Q d1=Q 51.Qh7 b5?! 52.Kf6+ Kb2? 53.Qh2+?! Ka1! 54.Qf4 b4? 55.Qxb4 Qf3+ 56.Kg7 d5 57.Qd4+ Kb1 58.g6 Qe4? 59.Qg1+ Kb2 60.Qf2+ Kc1 61.Kf6 d4 62.g7 1-0.

5 Conclusions

The history of democracy has exhibited a trend toward greater and greater power by the people and relaxation of "elitist" restrictions. Since Athens, the trend we speak of has included the elimination of slavery, the diminution of the powers of the British "House of Lords," the USA's eventual adoption of direct election of Senators and of the President, party primaries voted in by all, the elimination of US "poll taxes" and poll "literacy tests," and the awarding of suffrage to women. In retrospect, in the opinion of most, this trend has been a positive one, and fears of "mob rule" have been unfounded. Direct democracy would be the ultimate endpoint of that trend.

This trend was only made possible because of increasing levels of average education and of available technology. For example, illiteracy rates in the USA dropped below 10% for the first time in the 1910s (they are now about 1%), and at about the same time long-distance high-speed communication, and the machine-counted secret ballot, both also became common. But illiteracy remains above 60% in 10 African countries as of 2004.

The development of the cheap personal computer, the internet, the "blog," and cryptographic algorithms are the further advances that could enable DD.

Certain forms of DD (juries and referenda) have been happening for over 200 years, and a DD-ID hybrid system has been operating in Switzerland for 130 years.

We have proposed a DD plan involving randomly selected "juries" with optional voter "proxies," and self-generated ballot-issues that have to jump an increasing-height sequence of *hurdles* to merit further consideration, and which semi-automatically get adjusted and/or acquire various baggage which renders them more-clearly and less-biasedly phrased. In spite of well-supported arguments that voters are amateurs and ignoramuses, they could under DD nevertheless have some considerable inherent advantages over present-day legislators:

1. Enough manpower to actually *read*, and vote on, each 10-page chunk of legislation independently,
2. Potential for more ideas to be considered as legislation,
3. Far greater unbiasedness,
4. Better freedom from the tyranny of party bosses, committee chairs, and the like,
5. Immunity to "gerrymandering," "logrolling," and "pork,"
6. Potentially far greater expertise (via optional "proxies"),
7. Far superior immunity to corruption and bribery.
8. (Perhaps) Direct democracies may be able to make "tough decisions" without procrastination about issues legislators seem afraid to touch, such as permitting or banning antibiotics in animal feed, doing something massive about the upcoming oil production peak, drastically restructuring state finances, and either permitting or banning abortion.

We have sketched how known cryptographic algorithm ideas can render this scheme ironclad. (There are in fact numerous ways to do that.)

We've presented enough historical evidence to make it fairly convincing that DD is a good idea as an *addition* and *counter-balance* to representative democracy. But there presently is not enough evidence to decide clearly how well it would operate on its *own*, and indeed we've argued that some amount of traditional elected officials will always be needed, both to deal with emergencies with faster reaction times than voters, and to carry out whatever the voters decide to do. So the question seems to be not whether DD is a good idea, but rather *how much* of the government should be DD.

Other important conclusions and parts of the proposal:

1. All substantial financial contributors and contributions to advertising/campaigning related to DD issues should be publically *disclosed*;
2. Large-spending issues should have larger-than-usual juries, selected so the number of jurors grows proportional to the spending, up to including *everybody* in the most severe cases;
3. DD ballot issues should be *single* issues, not bundled, to the extent possible. (One simple mechanism that goes in this direction is a hard limit on the number of characters, or perhaps a variable length limit linked to variable hurdle-heights.)

We also commend the Swiss system of combined representative and direct democracy. This system allows the benefits of having a professional or semi-professional class of legislators and governors, capable of quick action, who nevertheless are forced by the constant **threat** of challenge-referenda to obey the will of the populace quite closely. I think this threat-mechanism is very important since it can garner most of the beneficial effects of having full DD while usually not actually needing to do it. The Swiss, by constitutional law, have initiative and referendum throughout their government at all levels from local to federal.

To contrast the Swiss and DD-by-jury (DDJ) systems: DDJ has theoretical advantages of greater efficiency (i.e. less work per voter), but the Swiss system enjoys the advantage of having a class of professional legislators and governors. Nothing prevents these two ideas from being combined to get the benefits of both.

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