

How to Make a Pencil

by Aaron Benanav

Capitalism is over, if you want it.

What would a socialist economy look like? The answers to this question vary, but most of them involve planning. A capitalist economy is organized through the interaction of prices and markets. A socialist economy, by contrast, would be “consciously regulated ... in accordance with a settled plan,” to borrow a line from Marx. But how would such a plan be made and implemented? This has been a matter of sharp debate among socialists for more than a century.

One camp has placed particular emphasis on computers. These “digital socialists” see computers as the key to running a planned economy. Their focus is on algorithms: they want to design software that can take in information on consumer preferences and industrial production capacities—like a gigantic sieve feeding into a data grinder—and output the optimal allocations of resources.

Over the years, there have been a number of experiments along these lines. In the 1960s, the Soviet mathematician Victor Glushkov proposed a nationwide computer network to help planners allocate resources. With the help of the English cybernetician Stafford Beer, Salvador Allende's administration in Chile tried something similar in the 1970s, called Cybersyn. Neither project got very far. Glushkov's idea ran into resistance from the Soviet leadership, while Pinochet's coup ended Cybersyn before it was fully implemented. However, the dream lives on.

Today, digital socialism could obviously do much more. The internet would make it possible to funnel large quantities of information from all over the world into planning systems, almost instantaneously. Gigantic leaps in computer power would make it possible to process all of this data rapidly. Meanwhile, machine learning and other forms of artificial intelligence could sift through it, to discover emergent patterns and adjust resource allocations appropriately. In *The People's Republic of Walmart*, Leigh Phillips and Michal Rozworski argue that large companies like Walmart and Amazon already use these digital tools for internal planning—and that they now need only be adapted for socialist use.

While there are certainly emancipatory potentials here, they are far from adequate to the task of planning production in a post-capitalist world. The digital socialist focus on algorithms presents a serious problem. It risks constraining the decision-making processes of a future socialist society to focus narrowly on *optimization*: producing as much as possible using the fewest resources. To travel down this road is to ignore and discard vast amounts of qualitative information, which remains crucial to achieving many of the ends and goals of a socialist society.

After all, the societies of the future will want to do more than just produce as much as possible using the fewest resources. They will have other goals, which are more difficult to quantify, such as wanting to address issues of justice, fairness, work quality, and sustainability—and these are not just matters of optimization. This means that, no matter how powerful the planning algorithm, there will remain an irreducibly political dimension to planning decisions—for which the algorithm’s calculations, no matter how clever, can only serve as a poor substitute. Algorithms are essential for any socialist planning project because they can help clarify the options among which we can choose. But human beings, not computers, must ultimately be the ones to make these choices. And they must make them together, according to agreed-upon procedures.

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This is where planning protocols come in. They streamline decision-making by clarifying the rules by which decisions are made. Deployed in concert with algorithms, protocols enable a range of considerations—besides those available to an optimization program—to enter into the planning process. We might say there is a division of labor between algorithms and protocols: the former discard irrelevant or duplicate options, clarifying the decisions to be made via the latter.

Putting both algorithms and protocols to work, people can plan production with computers in ways that allow their practical knowledge, as well as their values, ends, and aims, to become integral to production decisions. The result is something that neither capitalism nor Soviet socialism allowed: a truly human mode of production.

The Price Is Right

Any serious attempt at socialist planning has to reckon with the problems posed by the “socialist calculation debate,” a decades-long argument that has influenced how generations of socialists have imagined a post-capitalist future. The right-wing Austrian economist Ludwig von Mises kicked off the debate in 1920 with “Economic Calculation in the Socialist Commonwealth,” a full-frontal assault on the feasibility of socialist planning.

At the time, this wasn’t just a theoretical question. The revolution was already well underway, not only in Russia, but also in Germany, and very nearly in Italy and other countries. Socialists claimed that, with the capitalists cast aside, they could use modern machinery to construct a new type of society, one oriented around human needs, rather than profit. Everybody would get access to the goods and services they needed, while working less.

Mises argued that socialists were wrong on both counts. Instead, people in a socialist society would work more hours and get less for it. That’s because, in his view, the efficiency of modern economies was inextricably connected to their organization via the market, with its associated institutions of money and private property. Get rid of these institutions, and the technologies developed over the course of the capitalist era would become

fundamentally worthless, forcing societies to regress to a less advanced technological state.

To illustrate Mises's point, let's take a simple example: the manufacture of a pencil. The manager of a pencil-making factory has to make many production decisions, because there are many ways to make a pencil out of its component parts. How does a pencil maker decide how to produce his "final good," the pencil, out of all the possible "intermediate goods," the various types of graphite, wood, paint, and other things that go into making it?

In a capitalist society, he begins by checking the price catalog, where he discovers that graphite A costs 35 cents per pound, while graphite B costs 37 cents. If either works, his choice is clear. This manager can perform the same price test for all the relevant inputs, in order to arrive, quickly and accurately, at the most rational way to make a pencil. He does not need to understand how all the activities of society add up to an overall economy.

Prices allow the pencil makers to quickly set aside numerous procedures for making pencils that would result in functioning pencils, but at the cost of squandering natural or labor resources better employed elsewhere. If given tons of the finest quality Cocobolo or Osage Orange lumber, the pencil makers could undoubtedly make good pencils. But this would be a waste if some other tree, like the humble cedar, provided lumber that worked just as well.

Of course, the prices that pencil makers use to make production decisions are not just random numbers. They are expressions of a living market society, characterized by decentralized decision-making, involving large numbers of producers and consumers. Markets place pressure on all producers to get

prices right. If it proves possible, for example, to make pencils more cheaply without sacrificing quality by using a new technique, the firm that does so will earn a sizable profit. New information about pencil production possibilities will show up in the system as a lower pencil price.

Each producer can make rational decisions about what and how to produce, only because a struggle for market supremacy forces producers to maximize their revenues and minimize their costs. All of these market-dependent producers absorb information to the best of their abilities, make decisions, and take risks in search of new production possibilities and the corresponding monetary rewards. Socialist planners couldn't possibly reproduce such a complex system, Mises believed, because they would never have more information than market participants mediated through the price mechanism.

Ultimately, prices tell producers which production possibilities have any chance of turning a profit. Without prices, Mises argued, the rational allocation of assets becomes impossible.

Fatal Errors

What's striking about Mises' description of capitalism is that it is already highly algorithmic. In his account, the managers of the pencil factory behave like a computer program. They collect price information about intermediate inputs and then follow a simple rule: choose the cheapest option for each input that does not lengthen production time or lead to an unacceptable reduction in demand.

Many socialists responded to Mises's challenge by accepting his basic premise and then trying to write their own algorithm. In other words, they wanted to show that planners could create

a substitute for the price system that could generate enough information to arrive at the correct production decisions for a socialist society.

The Polish economist Oskar Lange and the Russian-British economist Abba Lerner were the first to develop this idea. Their proposals, worked out over the course of the 1930s and 1940s, involved socialist planners “feeling” their way towards the right prices through trial and error. For example, planners might set the price of an intermediate good required to make a pencil, and then adjust that price as necessary, until the supply of the final good matched consumer demand. A series of approximations would get closer and closer to the true result, much like a computer calculating pi through a sequence of slight additions or subtractions.

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When Lange and Lerner were writing, modern digital computing didn’t exist. But at the end of Lange’s life, as computers emerged, he discussed the possibility that they could perform this price-guessing work far better than humans. This line of thinking has been taken up by contemporary digital socialists, who point to developments in applied mathematics as evidence that we could do away with the price system, calculating optimal allocations of resources with advanced forms of programming instead.

After all, we have more data than ever before, as well as an unprecedented amount of processing power with which to perform computations on that data. Gigantic firms like Walmart and Amazon are already using advanced algorithms to put all this data to work to plan their internal operations. So, can the promise of algorithmic socialism finally be fulfilled?

Not so fast. Advocates of algorithmic socialism misunderstand Mises's position in the socialist calculation debate, and thus fail to respond adequately to his criticisms. For Mises, the challenge is how to allocate intermediate goods to producers of final goods. That's not something companies like Walmart and Amazon do, for the simple reason that these companies distribute goods rather than make them. The firms supplying pencils to Amazon and Walmart still rely on market signals to figure out the best way to make their product.

As Mises's student Friedrich Hayek later emphasized, an economy is not a set of equations waiting to be solved, either with a capitalist price system or a socialist computer. It is better understood as a network of decision-makers, each with their own motivation, using information to make decisions, and generating information in turn. Even in a highly digitally mediated capitalist economy, those decisions are coordinated through market competition. For any alternative system to be viable, human beings still need to be directly involved in making production decisions, but coordinated in a different way.

As Hayek observed, running a business involves practical reasoning, acquired through years of experience. To reproduce the work of the manager of a pencil factory, a planning algorithm would have to know not only about the supply and demand for each type of graphite used in pencil making, but also about the detailed implications of choosing one type of graphite over

another in that particular production location, with its specific machines and workforce. It is possible that one could formalize all of this knowledge into explicit rules that a computer could execute. However, the difficulties involved in articulating such rules across all workplaces, in all sectors, are simply staggering.

Mises and Hayek were correct to observe that people's participation in decision-making will remain essential for any economy to function. Yet their vision also sets strict limits on who has the opportunity to exercise this agency. In capitalism, the people involved in making production decisions are managers. They represent only a small fraction of the total number of people involved in production, and they do not need to consult all of those other people when making decisions — except insofar as they are forced to do so by law or contract.

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Managers are therefore free to pursue economization within broadly defined limits. If their decisions require that large numbers of workers in a particular town lose their jobs — because the pencil factory is being moved to a place with lower labor costs, for instance — then that is a decision the manager can make without answering to the townspeople. For the market to function, therefore, decision-making power must be concentrated in relatively few hands.

In a socialist society, however, the entire population would control production. Decision-making power would be democratized, and this would almost certainly lead to different kinds of decisions being made. Should people begin to run their own workplaces, they would likely decide to introduce all sorts of changes, such as those related to working conditions, for instance, or to how tasks are organized and assigned. Efficiency, whether calculated in terms of energy use, resource consumption, or labor time, would remain a concern, but it would no longer be the sole concern. It would simply be one of many. Other considerations—dignity, justice, community, sustainability—would also enter the picture.

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These other considerations could not easily be absorbed into a one-dimensional optimization algorithm, however, for the simple reason that there is no reliable way to reduce them all to a single, quantitative unit of account. Even natural units, such as tons of iron or grams of penicillin, would prove inadequate. What is the natural unit of justice? Given these constraints, the most advanced computer on the planet still could not determine the correct production plan because the different choices are rooted in competing values and visions of the good—in other words, they are political choices.

If socialist planning is purely algorithmic, it executes decisions in a similar way to capitalist firms. It reiterates the logics of

capitalism in a different register: what matters is the extraction of the relevant quantitative information from the mess of qualitative life. But it is only in this mess that the content of socialism can be found.

Crafting the Protocol

How can a greater variety of qualitative goals become part of the planning process, to be pursued for their own sake? To answer this question, we need to turn to the work of Viennese philosopher Otto Neurath.

Neurath was one of the original targets of Mises's 1920 broadside against planning. He is remembered today as the theorist of total planning—a phrase that incorrectly conjures the image of social engineers running the economy from a control room. Nothing could be further from Neurath's vision. On the contrary, Neurath argued that a socialist economy would have to be highly democratic—precisely because it could not be purely algorithmic.

For Neurath, the algorithmic character of the price system was a problem to be overcome, rather than something that socialists should try to replicate. In a capitalist economy, managers are able to make clear-cut decisions about cost-effectiveness only because they are allowed to ignore all of the non-economic costs of their decisions, which include destroying communities, immiserating workers, depleting non-renewable resources, and filling the world with garbage. Economically rational decisions at the level of the firm add up to an increasingly irrational society.

Instead of just optimizing for efficiency, then, socialists need to figure out how to incorporate multiple qualitative criteria directly into their planning mechanism. The issue socialists face

is not quantification as such. They could probably quantify many of the criteria relevant to their production process — establishing indexes of sustainability and safety, for example. But to distill all such relevant indicators to one unit of account suggests a degree of commensurability between goals that is exactly what socialists would want to overcome.

A capitalist society that wants to reduce pollution needs to set legal limits on how much each factory can pollute, allowing those firms to continue to optimize their production strategies, but under new restrictions. That, in turn, creates incentives for pencil factories to get around those restrictions — and if they can figure out how to pollute without getting caught, those firms can make large profits. By contrast, a socialist society would want to take pollution reduction as a goal to be pursued for its own sake. It would look for ways not just to limit pollution at the pencil factory but to positively improve the environment — increasing air quality, planting trees, and so on — wherever doing so does not rule out the pursuit of other goals.

Such an approach requires far more than mere optimization. Rather than trying to convert all of the qualities and quantities of life into a unifying metric that can be algorithmically optimized, we need to find a way to deal with those qualities and quantities on their own terms. We need to be able to make planning decisions on the basis of multiple, incommensurable criteria, and to coordinate these decisions across society. To do this, we must have agreed-upon procedures for making such decisions collectively — protocols.

There are many ways to design a planning protocol. It could be as simple as a population-wide vote, with the majority deciding the outcome. Or it could take the form of a complex bidding procedure, like an auction. A protocol could even be a game,

with a set of rules that specifies who can play, what actions each player can take, and what real-life allocations result from different outcomes. There are many possibilities, but the unifying theme is the need to craft protocols that allow actual human beings to make holistic decisions that take a variety of criteria into account.

Neurath laid out his version of a planning protocol—a term that he did not himself use—in “Economic Plan and Calculation in Kind,” an essay he wrote in 1925. Planning begins with expert planners reducing the “unlimited number of economic plans” that are “possible” down to a few “characteristic examples.” These planners do the algorithmic calculations, which clarify the options among which people must decide. People are then presented with these options for direct comparison. They evaluate a few different plans across multiple criteria and decide which they prefer: listening to comments, voicing their concerns, and taking a vote.

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Neurath believed that such a process would enable a particular kind of rationality to emerge. Even where it proves impossible to make clear and precise calculations, he argued, we can still decide rationally. However, the rationality we deploy will be a practical and political rather than purely algorithmic. People will have a chance to voice both their concerns and their desires, before arriving at collective decisions about how to shape, constrain, and direct the production process. They will balance how

much they want to consume against how much they want to work. They will weigh their need for energy to heat their homes and power their workplaces against values of ecological sustainability and intergenerational justice. They will decide how much of their time and resources would be set aside for expanding or transforming production and how much for cultural, athletic, and intellectual activities.

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In Neurath’s model, decisions made collectively, at the highest level, would then filter down through the rest of the economy, to be implemented across various industries and workplaces. But how would that work exactly? How are local production decisions made? What happens if conflicts or collisions arise — for instance, between the decisions of society as a whole and the demands of workers in pencil factories, producing goods to meet society’s needs?

These complexities suggest that what we need is not one society-wide protocol but many protocols — many structured forms of communication that enable people to reach decisions together. Algorithms would have an important role to play. They would codify what philosopher John O’Neill describes as “rules of thumb, standard procedures, default procedures, and

institutional arrangements that can be followed unreflectively and which reduce the scope for explicit judgements,” streamlining the planning process so it doesn’t become an endless series of meetings. At the same time, we would need some set of rules for how to tie all of the protocols together, and to integrate them with the algorithms, in order to create a unified planning apparatus based on software that is easy to use, transparent in its outcomes, and open to modification.

After all, even if we incorporate qualitative goals into our planning, we still have to solve the socialist calculation problem. Producers still have to make decisions that add up into a coherent production plan.

Freely Associated Producers

Neurath’s emphasis on democratic decision making was essential. But by proposing the idea of the protocol, he raised more questions than he could answer, especially with the limited technologies available to him at the time. Towards the end of his life, Neurath spent years trying to determine how semi-literate peasants and urban workers could be incorporated into a planning protocol, via the distribution of simple graphical representations that he called isotypes.

Today, literacy is widespread across the world, and cell phones are common even in remote areas. The possibilities for protocol socialism are correspondingly enlarged. However, true democratic decision-making about production cannot simply be a matter of a perpetual social-media plebiscite scrolling across one’s phone screen—for the simple reason that many individuals lack the practical knowledge necessary for making most production decisions.

Participation in making each decision, therefore, generally needs to be limited to those involved in and affected by each decision being made, with only decisions that concern everybody being brought to society as a whole. Coordination should take place, in other words, mostly within and between associations. These associations might be composed of producers, consumers, or other groups of people with common identities and interests.

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Neurath saw this future dimly, through the lens of the social mobilizations of his time. During World War I, masses of workers joined militant rank-and-file movements demanding workplace democracy, including the Industrial Workers of the World in the US, the Shop Stewards Movement in the UK, the councilists in Germany, and the anarcho-syndicalists in Spain, France, and Italy. An issue that arose in these organizations was how to coordinate production among worker-controlled workplaces. Too often, theorists turned to market prices or price-like labor-time calculations for the answer, anticipating the later Lange-Lerner model of an algorithmic socialism.

Neurath hoped that councils, guilds, and other associations could find another way forward. In particular, he speculated that

they might be able to use planning protocols to make their own direct comparisons between different “ways of working”—taking into account many and varied criteria that could not “be reduced to one single unit”—while collaborating with one another to help fulfill society-wide goals.

Today’s digital technologies might make it easier for such comparisons and collaborations to occur. The association of pencil producers might be algorithmically assigned tokens or “points”—as in economist Daniel Saros’s model of digital socialism—which the association uses to bid on graphite, wood, and other intermediate goods, in an effort to find the best way to make a pencil. Periodically, the association of pencil makers would then meet with other graphite-consuming associations. They would examine existing allocation patterns, consider larger social goals, and alter the graphite allocation protocol accordingly. What would otherwise have been an impossibly long, if not interminable, series of meetings might become, with the help of algorithms and protocols, something more manageable—a streamlined planning process, capable of undertaking complex multi-criteria adjustments.

From any given starting point, the socialists of the future might then begin to alter the overall shape of their productive apparatus. For instance, they might set out to reduce the work week by 10 percent over five years, without a significant loss in productive capacities. Associations of workers and consumers would then consider the options available to them for enhancing productivity levels in the specific areas that concern them. New technologies might improve labor productivity in pencil factories, but require more rapid depletion of forest reserves. Meanwhile, a new way of organizing hospitals might result in less work for nurses, but at the cost of lower-quality elder care.

Where do different associations of workers and consumers stand on these issues?

Associations would make recommendations and reach decisions through the direct comparison of plan options, considering the consequences that each productivity-enhancing innovation would have for other issues that their members care about, such as sustainability and justice. At a certain point, a committee might compare society-wide goals of work reduction to actual achievements, looking at sticking points, theorizing solutions, and adjusting incentives to prioritize certain kinds of labor accordingly.

From this perspective, it is easy to see that a planning process would not emerge fully formed with the push of a button on an algorithmic dashboard. Nor would production be constantly revolutionized—at the cost of dislocating human lives and destroying the environment. Instead, step-by-step adjustments would make the production process ever more rational—in the Neurathian sense, not the capitalist one—across a wide variety of criteria. People themselves would propose, debate, and implement improvements for themselves.

The productive apparatus would have more in common with a “food forest” than a factory—a garden of edible plants, tended for hundreds of years and designed to provide for a multiplicity of needs, spiritual as much as material. It would connect the past to the future, across generations. It would be a common inheritance that made it possible for the masses of humanity to live and work as they wanted. Beyond this shared realm of mutual obligations, an enlarged realm of freedom would progressively open up space for radical experimentation that could be explored by all, without endangering anyone’s material security or individual freedom.

A Dance Club for Pencil Makers

Digital technologies will assist in the construction of a socialist society, but the role they will play needs to be clarified. We do not want software to substitute for the price mechanism. No matter how digitally mediated a socialist society becomes, it will never be able to escape the need for democratic deliberation at all levels. Human beings are never simply rule followers. They look beyond the rules, sometimes for social benefit, sometimes for personal advantage, and often for both.

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At the same time, we have to accept that deliberating endlessly is undesirable and doomed to failure. To function at all, a society that replaces the single-minded focus on cost control with multi-criteria decision-making must use algorithms to help clarify the choices to be made and protocols to help structure the way it makes these choices. We cannot rely on a single, unified mechanism for this purpose; we will need many. And open-ended debate must modify these mechanisms when they generate bad results or threaten to give rise to new forms of domination.

In designing our protocols and our algorithms, it is crucial to remember that the point of this process of social transformation is not only to make work better, but also to work less. Too often, socialists have seen work as the highest realization of human freedom. In truth, work will never be an entirely free activity. But

in a world no longer beholden to the capitalist growth imperative, advanced technologies can substantially reduce the amount of work demanded of any individual. With greater free time and available space, all individuals will be able to develop their personalities outside of a work-centric identity.

The world's pencil makers would be free to invest themselves in a much wider range of ends, whether starting specialized gyms or dance clubs, joining theatre troupes, or forming amateur scientific societies. A rich and varied life beyond work is only possible if work is organized in a way that is fair, rational, and resistant to whatever forces might emerge to subjugate human beings once again. Instead of waiting for a breakthrough in artificial intelligence to achieve this goal for us, we should begin to develop the protocols of the future today. ~~~

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