UNIVERSITÉ PARIS I PANTHÉON SORBONNE
UFR 02 : Sciences économiques
Master 2 : Économie et sciences humaines
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VERS LA MACHINE À GOUVERNER

Herbert Simon and the Impossibility of a Democratic Computer

présenté par
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sous la direction de
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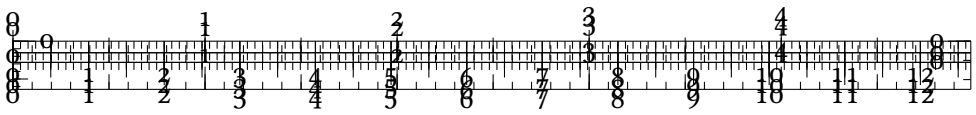
https ://github.com/sync0/memoire_m2

Nature (the art whereby God hath made and governs the world) is by the art of man, as in many other things, so in this also imitated, that it can make an artificial animal. For seeing life is but a motion of limbs, the beginning whereof is in some principal part within, why may we not say that all automata (engines that move themselves by springs and wheels as doth a watch) have an artificial life ? For what is the heart, but a spring ; and the nerves, but so many strings ; and the joints, but so many wheels, giving motion to the whole body, such as was intended by the Artificer ? Art goes yet further, imitating that rational and most excellent work of Nature, man.

Thomas Hobbes, *Leviathan*



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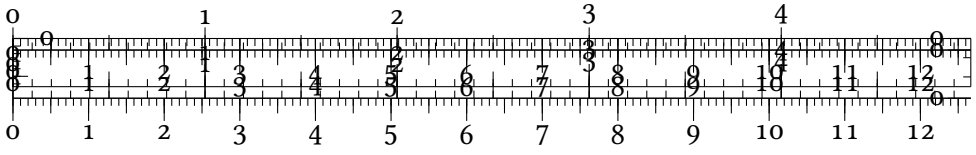

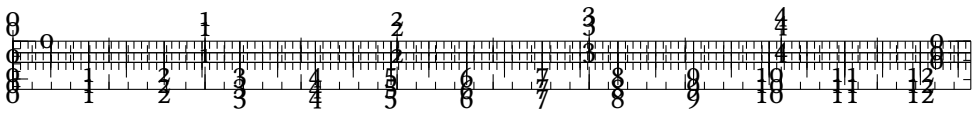

Abbreviations

ARCHIVAL SOURCES

When citing archival materials, I indicate their location within the following archives:

HSCM: Herbert Simon Papers, Carnegie Mellon University Archives.

ENPC : École nationale des ponts et chaussées.

BNF : Bibliothèque nationale de France.

I accessed them through their respective on-line repositories.

HSCM: Carnegie Mellon University Libraries Digital Collections.

ENPC : Bibliothèque numérique patrimoniale des ponts et chaussées.

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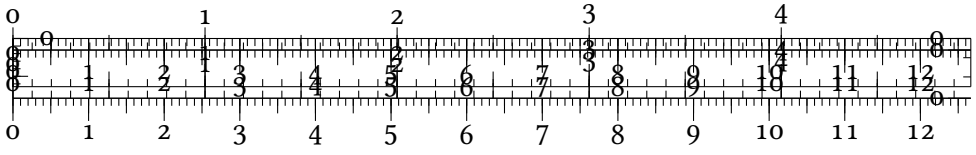

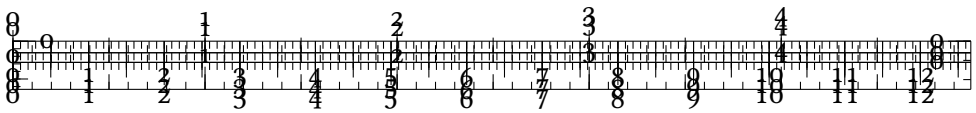

Acknowledgements

This Master's thesis, even with all its shortcomings, would have been impossible to write without the help of many people.

I would like to thank my Master's thesis adviser, professor Jean-Sébastien Lenfant, for his patience and dedication, and professors Annie L. Cot and Jérôme Llalement for their support to all the students at the *Réseau en Épistémologie et en Histoire de la Pensée Économique Récente* (REHPERE) at Paris 1 University.

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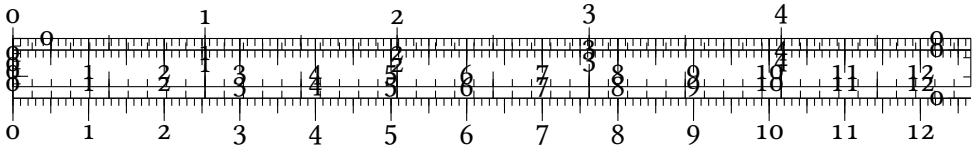
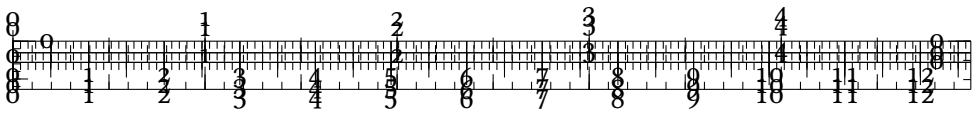
Moreover, rummaging through the Herbert Simon Papers would have been impossible without the assitance of Emily Davis at Carnegie Mellon University Libraries.

I would like to thank my wife's family and my own for their love and support. Last but not least, I would like to thank my wife, Min Jung; this text is dedicated to her.

Carlos Alberto Rivera Carreño
May 18, 2019
Bagneux, France





Note aux lecteurs francophones

Le fait que ce mémoire fut préparé au sein d'une université française m'oblige moralement à …aux lecteurs francophones.

Ce mémoire traite de la relation entre l'histoire du concept de travail, l'histoire de l'orinateur, l'histoire de l'intelligence, et la pensée de Herbert Simon. J'essai de replacer l'histoire de travail au sein des questions sur l'application des analogies entre les sciences sociales et les sciences naturelles.

Dans le premier chapitre je raconte …

Dans le deuxième chapitre je raconte …

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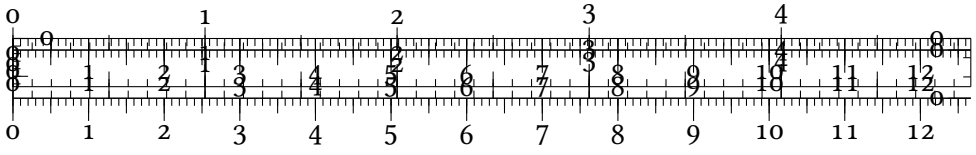

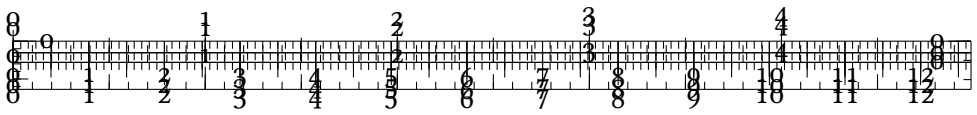

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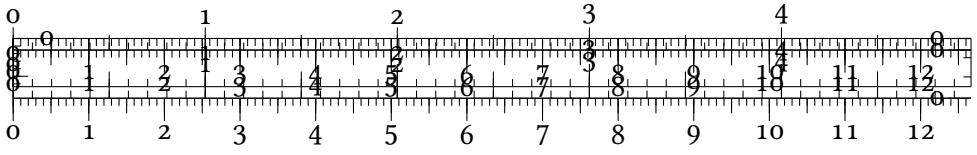

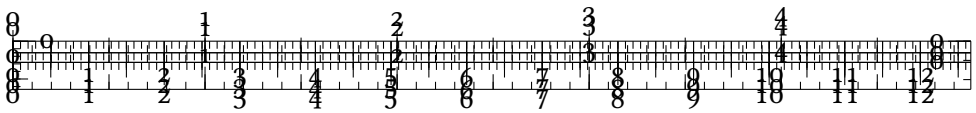

Preface: Science and History

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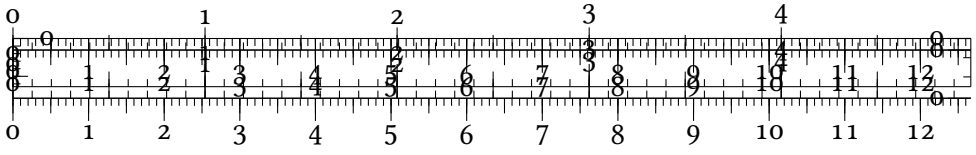

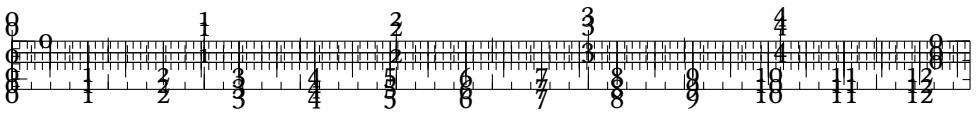

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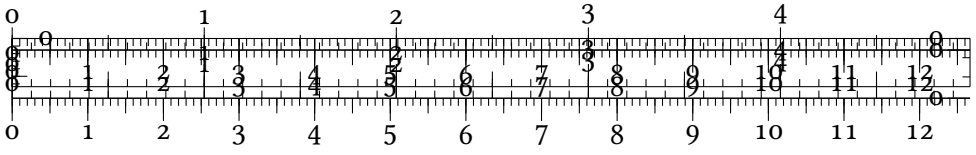
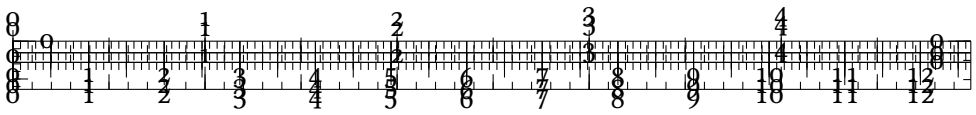




1

Introduction

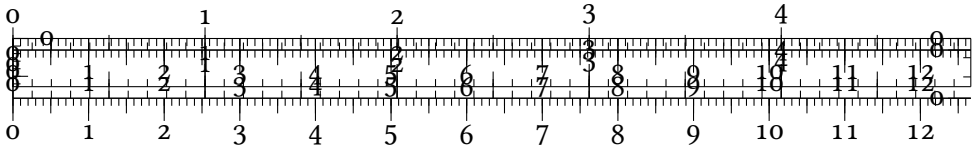
TS: The dominant "technicist" view of the influence of ICTs on the future of work and its organization is inadequate because it ignores that thoughts on machine intelligence, automation, and sociotechnical systems for the conduct of workers have been strongly connected since at least the nineteenth century.

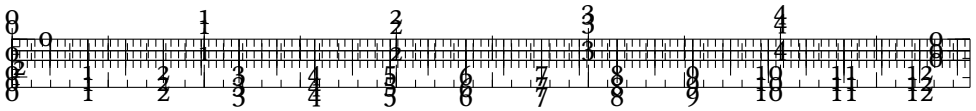
That said, fears of human redundancy are not new, since already in the 19th Sismondi was preoccupied at the unemployment caused by the greater productivity of automatic machinery, he was outraged at the possibility that "the King, alone in an island constantly turning a handle, carry out with automatons all the work of England." Sismondi 1819, p. 330, my translation.

STRUCTURE OF THE THESIS

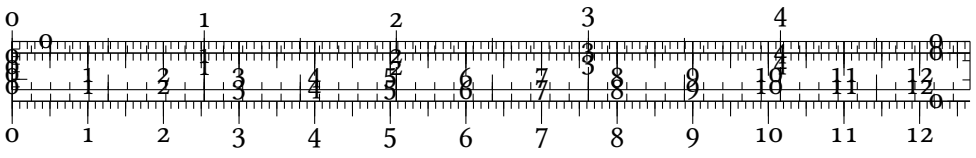
As the recurring interest in de Prony's project for the calculation of the logarithmic tables shows, the dominant "technicist" view of the influence of ICTs on the future of work and its organization is inadequate because it ignores that thoughts on machine intelligence, automation, and sociotechnical systems for the conduct of workers have been strongly connected since at least the nineteenth century.

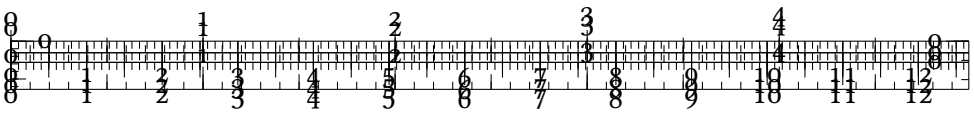
In chapter one, I (1) explain what the dominant "technicist" view is, and (2) criticize it the best I can to show that it is inadequate. The first part of chapter one explains what the technicist view is and uses the example of Autor's article as an ideal-type of this view. The second part of chapter one criticizes the technicist view by showing that it ignores the conventionalist dimension of the wage relation. This is done by discussing the social embeddedness of work in history, culture, and western ideology and discussing the example of the work contract by Supiot.





In chapter two, I should sketch a different view (to the dominant technicist one) by explaining how the recurring interest in de Prony's project shows that thoughts on machine intelligence, automation, and sociotechnical systems for the conduct of workers have been connected since at least the nineteenth century. The first part of chapter two shows that the origins of the computer lie in a technical organization of labor that is related to the factory system and the concept of the division of (mental) labor. The second part of chapter two shows that this fact is not related to technological backwardness or something intimately related to industrial production (as the technicist view would have it), but that since it appear in the thought of Herbert Simon in his opposition to industrial democracy, there is a relation between a concept of the role of man in society, and the crafting of these technologies.





2

Would You Bet Against Sex Robots?

In the first chapter, (1) I explain what the dominant "technicist" view is, and then, (2) I criticize it the best I can to show that it is inadequate.

INTRODUCTION

The dominant technicist view, which analyses the perils of ICTs for the future of work in terms of the possibilities to automate different (categories of) tasks, is inadequate because it ignores the conventionalist dimension of the wage relation by construing work from a realist epistemology.

THE TECHNICIST VIEW

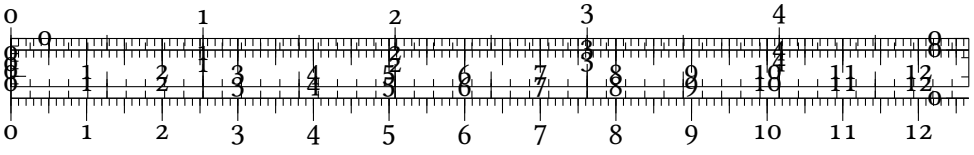
The first part of chapter one explains the technicist view by discussing Autor's article as an ideal type. This will be done by picking certain points from his argument and discussing them in depth.

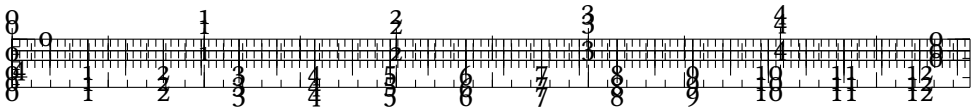
Introduction

As Autor's article shows, the technicist view analyses the perils of ICTs for the future of work in terms of the possibilities to automate different tasks at a low cost.

What is Autor's Take

Autor asks, "Why doesn't automation *necessarily* reduce aggregate employment, even as it demonstrably reduces labor requirements per unit of output produced?". Here, it is necessary to remember that Autor, as is





customary within neoclassical economics, sees employment as depending on productivity and the "demand" of the labor market. His question reflects an understanding of employment as determined by this two factors. Hence, his perplexity could be framed as: If automation reduces the necessity to employ workers at certain tasks, why is it that we do not see a reduction of employment?

> A final point, typically neglected in recent dismal prophesies of machine-human substitution, is that if human labor is indeed rendered superfluous by automation, then our chief economic problem will be one of distribution, not of scarcity. …Here, I recall the observations of economist, computer scientist, and Nobel laureate Herbert Simon (1966), who wrote at the time of the automation anxiety of the 1960s: "Insofar as they are economic problems at all, the world's problems in this generation and the next are problems of scarcity, not of intolerable abundance. The bogeyman of automation consumes worrying capacity that should be saved for real problems …" A half century on, I believe the evidence favors Simon's view. (Autor 2015, p. 26)

Autor begins by pointing out that in 1900, 41 percent of the US workforce was employed in agriculture; by 2000 that share had fallen to 2 percent (Autor 2014), mostly due to a wide range of technologies including automated machinery.

Role of automatic machinery

> Whether the technology is tractors, assembly lines, or spreadsheets, the first-order goal is to substitute mechanical power for human musculature, machine consistency for human handiwork, and digital calculation for slow and error-prone "wetware." (Autor 2015, p. 5)

He concedes that most workplace technologies are designed to save labor.

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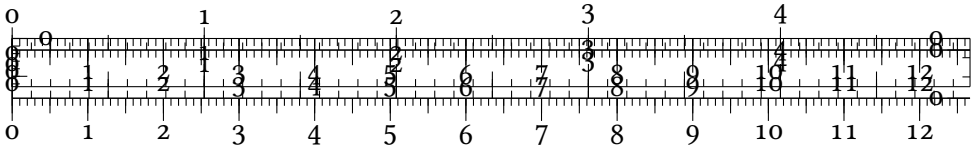
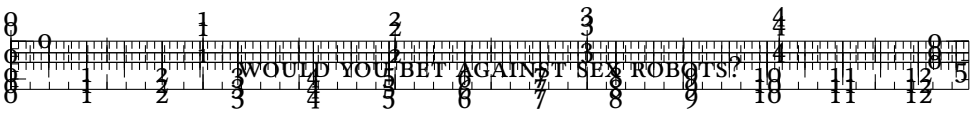
>
> Here Autor's argument has a slight historical problem: the first machine calculators were actually very error-prone, thus, the association of machinery with error-free execution as calculation is concerned is relatively recent, probably only going as far back as Victorian England.





Complementarities

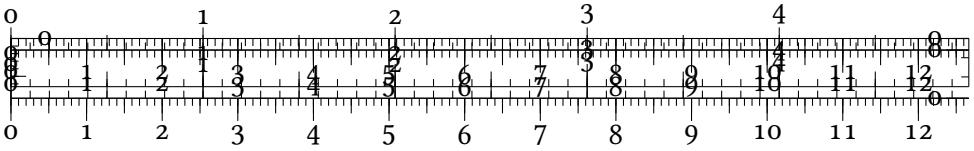
> I argue that the interplay between machine and human comparative advantage allows computers to substitute for workers in performing routine, codifiable tasks while amplifying the comparative advantage of workers in supplying problem-solving skills, adaptability, and creativity. …In many cases, machines both substitute for and complement human labor. Focusing only on what is lost misses a central economic mechanism by which automation affects the demand for labor: raising the value of the tasks that workers uniquely supply. (Autor 2015, p. 5)

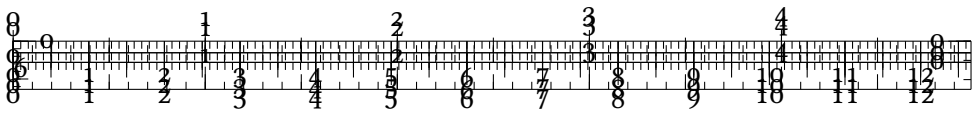
Indeed, a key observation of the paper is that journalists and even expert commentators tend to overstate the extent of machine substitution for human labor and ignore the strong complementarities between automation and labor that increase productivity, raise earnings, and augment demand for labor.

The Two Sets of Tasks

> …we distinguish two broad sets of tasks that have proven stubbornly challenging to computerize. One category includes tasks that require problem-solving capabilities, intuition, creativity, and persuasion. These tasks, which we term "abstract," are characteristic of professional, technical, and managerial occupations. They employ workers with high levels of education and analytical capability, and they place a premium on inductive reasoning, communications ability, and expert mastery. The second broad category includes tasks requiring situational adaptability, visual and language recognition, and in-person interactions—which we call "manual" tasks. Manual tasks are characteristic of food preparation and serving jobs, cleaning and janitorial work, grounds cleaning and maintenance, in-person health assistance by home health aides, and numerous jobs in security and protective services. (Autor 2015, p. 9)

> Stated plainly, the growth of occupational employment across skill levels looks U-shaped earlier in the period, with gains at low-skill and high-skill levels. By the 2000s, the pattern of occupational employment across skill levels began to resemble a downward ramp. In Autor (2015), I present a more detailed breakdown of these patterns, and in particular suggest that the set of abstract task-intensive jobs is not growing as rapidly as





> the potential supply of highly educated workers. (Autor 2015, p. 18)

Finally, here Autor discusses the international dimension of the changes in the US labor market. He mentions, among other things, the rise of China as a premier manufacturing exporter, and its consequences on US workers, reducing employment in directly import-competing US manufacturing industries and depressing labor demand in manufacturing and nonmanufacturing sectors that served as upstream suppliers to these industries (i.e., their subsidiaries).

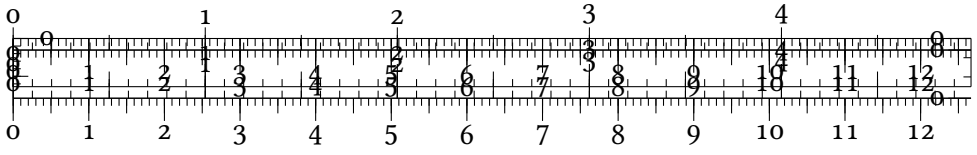
> Of course, these forces are in various ways linked with the spread of automa- tion and technology. Advances in information and communications technologies have changed job demands in US workplaces directly and also indirectly, by making it increasingly feasible and cost-effective for firms to source, monitor, and coordi- nate complex production processes at disparate locations worldwide and altering competitive conditions for US manufacturers and workers. This multidimensional complementarity among causal factors makes it both conceptually and empirically difficult to isolate the "pure" effect of any one factor. (Autor 2015, p. 18)

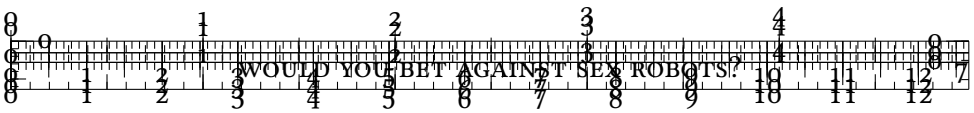
> This essay has emphasized that jobs are made up of many tasks and that while automation and computerization can substitute for some of them, understanding the interaction between technology and employment requires thinking about more than just substitution. It requires thinking about the range of tasks involved in jobs, and how human labor can often complement new tech- nology. It also requires thinking about price and income elasticities for different kinds of output, and about labor supply responses. (Autor 2015, p. 18)

Polarization of the job Market

Changes in technology do alter the types of jobs available and what those jobs pay. In the last few decades, one noticeable change has been "polarization" of the labor market, in which wage gains went disproportionately to those at the top and at the bottom of the income and skill distribution, not to those in the middle. I will offer some evidence on this phenomenon. However, I will also argue that this polarization is unlikely to continue very far into the foreseeable future.

Autor claims that the elasticity of labor supply can mitigate wage gains. Namely, a flow of new workers can temper any wage gains that would





emanate from complementarities between automation and human labor input.

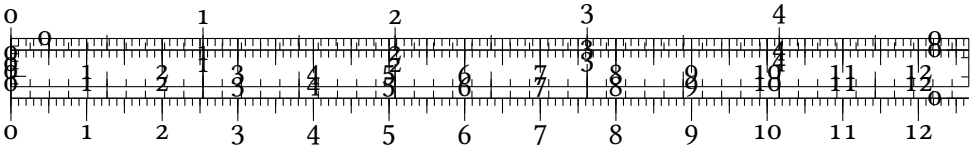
> Even if automation does not reduce the quantity of jobs, it may greatly affect the qualities of jobs available. (Autor 2015, p. 7)

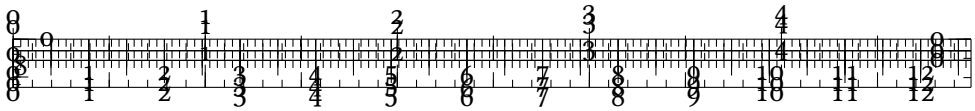
> But the scope for this kind of substitution is bounded because there are many tasks that people understand tacitly and accomplish effortlessly but for which neither computer programmers nor anyone else can enunciate the explicit "rules" or procedures. I have referred to this constraint as Polanyi's paradox, named after the economist, philosopher, and chemist who observed in 1966, "We know more than we can tell" (Polanyi 1966; Autor 2015). (Autor 2015, p. 9)

Autor then discusses the phenomenon of "job polarization" (Goos and Manning, 2003) in which the simultaneous growth of high-education, high-wage jobs at one end and low-education, low-wage jobs at the other end occurs at the expense of middle-wage, middle education jobs. Autor believes this is the case since, following his characterization of tasks between *abstract* and *manual*, both are found at opposite ends of the skill spectrum–in professional, managerial, and technical occupations on the one hand, and in service and laborer occupations on the other.

Labor supply to manual task-intensive occupations is intrinsically elastic, due to their generally low education and training requirements. This insight does not preclude the possibility that wages in manual tasks will rise, at least to some extent. As Baumol (1967) observed, even absent productivity growth in technologically lagging occupations, wages in these occupations must rise over time with societal income to compensate workers for not entering other sectors (again, assuming that demand for these activities is relatively inelastic). But it does suggest that wage increases in these jobs will be restrained to some extent by the labor supply response, including from workers displaced in other sectors of the economy.

This citation summarizes Autor's thoughts on the effects of automation on manual task-intensive activities. Briefly, he believes that they are weakly complemented by computerization, difficult to outsource, and face and elastic labor supply that reduces their likelihood of wage increases due to increased demand. Autor claims that in a 2013 paper with Dorn, he presents evidence that wages for manual-tasks occupations rose during the 1990s when labor markets in the United States were extremely tight, but after 2000 wages fell with the expansion of manual task-intensive service occupations.





Conclusion

My point of view is that many of the various analysis on this matter are marred by their narrow scope that only focuses on the possible impact of new technologies on what economista call macroeconomic varibales. Briefly put, the videws of neocalssical or mainstream economists, whether optimists or pessimists are decided on whatever the economist thinkgs that the impact of these technologies will be on macroeconomic variables such as investment, consumption, employments, wages, etc.

THE HISTORICITY OF THE WAGE RELATION

> *The second part of chapter one criticizes the technicist view by showing that it ignores the conventionalist dimension of the concept of work, which for the purposes of the kind of work discussed by Autor et al., is the historical and cultural specificity of the wage relation. To show this historical and cultural specificity of the work concept, I will refer to the example of work in Mesopotamia (in the context of the bi-metallic monetary system), and the work contract in French Law as discussed by Alain Supiot. [In case of running out of time, just go for Supiot, which might be the easiest to read in a short amount of time]*

Introduction

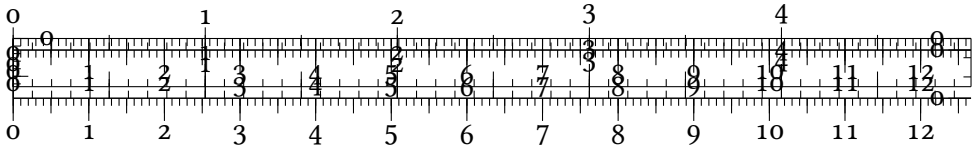
One of the shortcomings of the paper, which is not specific to it but to economists, is the social ontology that undergirds it. Economists–whether critical or favorable to the social system of production, exchange, and distribution–tend to presuppose the existence of an order more or less strictly determined by laws and tendencies.

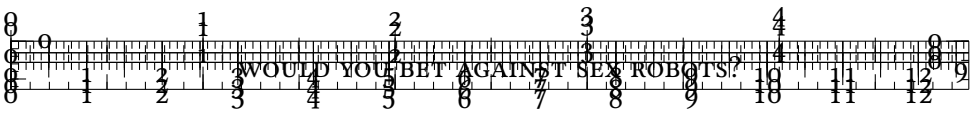
The problem with Autor's interpretation of what a job is, is that he basically thinks that a job is just a collection of tasks, so he is essentially leaving out the important part of the fact that a job is defined in Law and that it entails certain rights and responsibilities.

However, the limit of these studies is that they interpret the challenge of automation by artificial intelligence as simply that of estimating with a macroeconomic model the impacts of the substitution of capital for labor in employment rates, wages, etc.

My position is that this way of framing and analysing the problem is not very interesting and offers very little insight on the wider issue of the changes portended by artificial intelligence.

My position in this thesis is that, just as Schaffer (1994) did for the analysis of automation in Victorian Great Britain, we should analyze the changes of automation not just as a question of changes in employment





but as a question of changes of labor, the nature of work, and the nature of the social organization of production.

The visibilization of the automatic machines of the factory rendered invisible the workers whose lives and bodies were reorganized around it.

When Autor claims that "Focusing only on what is lost misses a central economic mechanism by which automation affects the demand for labor", one can notice immediately the belief in economic laws in and economic orderly system that somehow operate to compensate the disequilibrium caused by automation. My point is that this belief in an economic order, economic laws, system-wide logic, or whatever term the author favors, prevents an understanding of social change. Whatever the method of analysis used, a surreptitious belief in the *harmonies economiques* (or otherwise, what have been called *invisible hand* explanations) prevents the comprehension of social change, for any change is construed as being countered or compensated by a social *force*, which guarantees that the immanent stability of the system, its *economy*, remains in balance.

This *invisible hand* element is present in Autor's paper when he support his claim for the mitigated effects of worker redundancy thanks to automation "raising the value of the tasks that workers uniquely supply". The reason this is the case is that he assumes that there are tasks that workers uniquely supply, and thus, those who can perform such tasks will not only be still employed, but will see their earnings increased due to *economic laws*.

Note here, that even though, many an economist would feel embarrassed to use the term *economic law*, the fact that it is avoided does not detract from the fact that it still encapsulates the belief of economists on an economic order (whether in equilibrium as in neoclassical economics, or in constant contradiction and movement as in Marxism) that regulates social processes.

What is at stake here, I argue, is not whether machines will replace humans in every single task. Rather, the question that automation raises is that of the place of the human in the production and reproduction of society.

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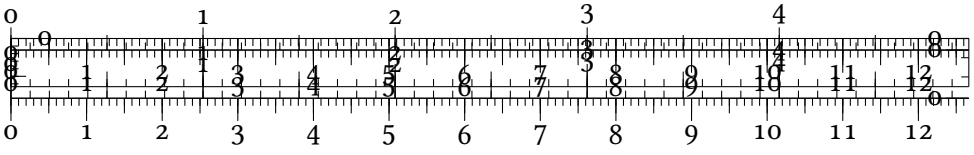
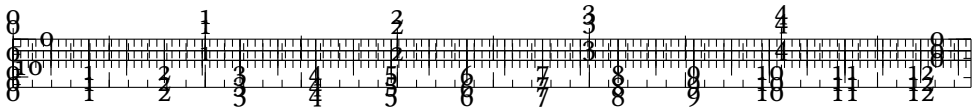
> Here, the author's position is clear. He believes that automation brings new complementarities into play in the job market, and thus, that mitigates the unemployment caused by worker redundancy.
>
> However, here we see one of the problems of the realist epistemology mentioned previously. After all, the job market is taken as a realistic entity, and its conventionalist character is not recognized. How technical changes affect employment will also depend on the conventions for employment and its legal regulations. As Schaf-





> fer (1994) points out, this conventions are not a side show, but a necessary prerequisite for technical change.
>
> Notice that nowhere in the document does he discuss the worsening of working conditions due to technology. Notice how he mention "restaurant meals, cleaning services, haircare, and personal fitness" as sectors where since demand for them appears strongly income-elastic, rising productivity in technologically leading sectors may boost employment in these activities.
>
> We need not worry, we can all work providing services for the rich. That's the good life.

Notice that by dividing tasks between "abstract" and "manual", Autor distinguishes between those that require problem-solving, intuition, creativity, and persuasion on the one hand, and those that require situational adaptability, visual and language recognition, and in-person interactions. His distinction is not at all clear.

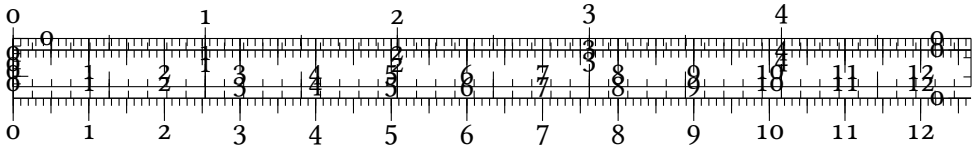
Although Autor does include problem-solving as one of the components of what he terms "abstract" tasks, and although he even cites Herbert Simon, who, along with Allen Newell, was one of the great proponents of the importance of problem-solving in social systems, he does not seem to have taken in Simon's message. For Simon, problem-solving was a sort of metacategory to describe all processes of a subsystem (a person, a firm, a mechanical component, etc.) to adapt to a larger system (i.e., its environment). In fact, the latter Simon even attempted to simulate something as rarefied as scientific expert problem-solving. As Sent claims, "Like managers in political and administrative organizations, agents in economic systems and problem-solvers in cognitive psychology, scientists are boundedly rational in dividing goals into subgoals, employing heuristics and satisficing. Furthermore, the scientists themselves are complex, hierarchical systems." (Sent 2001).

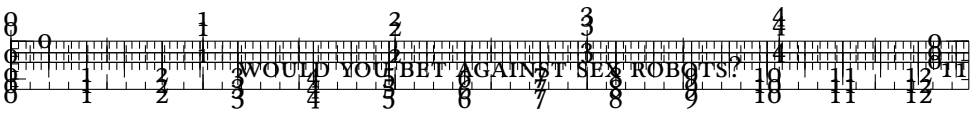
Notice how here, Autor turns upside down the discourse of Babbage, for Autor believes that it is abstract and not manual tasks that can be most easily automated. Although Autor's claims do not constitute a valorization of manual tasks, he does seem to believe that *those* are the jobs most difficult to be replaced by machines.

Autor simply leaves aside the wider issues of the limit between nature and artifice, between man and machine.

Autor's division of tasks is misleading in explaining the lack of introduction of automation for certain jobs. One of the reasons for not replacing, say hotel check-in staff, is not necessarily that automating their tasks presents a technical difficulty; in other words, the continual usage of humans for this job has nothing to little to do with the nature of the task in question.

On the one hand, one reason is economical: such robots do not exist yet, and thus, it remains cheaper for a business to employ humans. And, yes





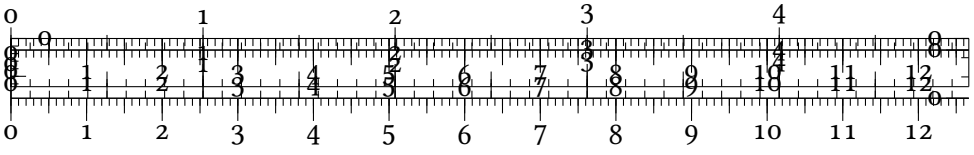
humans for this particular task are still more flexible than robots, in the sense that most artificial intelligence today is task-specific.

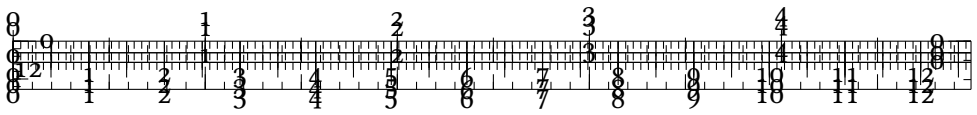
Nonetheless, another reason to employ humans is the fact that there *are* people to be employed. This might seem trivial, since economists, who like Autor, are in the business of producing models, tend to abstract from the social conditions of possibility. But this, I believe is a crucial thing to take into account in the evolution of work and employment. As studies of ancient Mesopotamia have shown, the problem for these *economies* was not *unemployment* but lack of population to be employed (mostly by the palace and temples) to do all the tasks. And, this was due to a social and institutional configuration in which most of the people, then peasants, were not alienated from their means of subsistence (specifically arable land), and thus, they kept not only a certain independence vis-à-vis public authorities, but also vis-à-vis other possible *employers*. That is to say, the vast majority of people, the peasantry, had very little need or incentive to work for others, when they could just work for themselves. This fact, is passes inadvertently in contemporary literature on the "labor market," which ignores that it is very hard to convince people to willingly work for oneself. One must explain the social conditions that make a majority of the population be willing to sell their labor in exchanges for wages, what in the french sociology of work (*sociologie du travail*) is called *le salariat* (i.e.„ the institution of wage earning). The *salariat* passes inadvertently in economic analysis of the job market, but I claim that one must understand the changes brought by automation not in terms of the relation of technology to concrete tasks, but rather in relation to the social conditions of salariat.

Essentially Autor's analysis rests on the claim that the correct way to analyze the changes brought by automation on employment is better understood through the relation between the technical possibilities of automation and the technical character of the concrete tasks that make part of jobs.

My claim is that his analyzes has two important shortcomings: First, the question that interests or worries computer scientists is not simply the effects of ICTs on the *rate* of unemployment. This question, which has been treated extensively, in my humble opinion, is not very interesting. I think that what computer scientists wonder about are the changes that these technologies will bring on work, and the employment relation. One measure of this, is the current historical meeting point between crypto-currencies and anarchist politics. The potential that crypto-anarchists see, for example, in these technologies is the organization of economic activity that escapes subordination to the state, and thus guarantees more individual freedom.

In addition to Autor's framing the question as just a matter of estimating the impact of automation on the rate of unemployment, his second shortcoming is to try to estimate the impact on the rate of employment (and wages) by analyzing the problem of automation in relation to the technical character of the tasks being automated. My claim is that the question of





the technical changes brought by automation should be analyzed instead in relation to the changes to the social conditions of the employment relation, and not in relation to the particular, technical character of the tasks being automated.

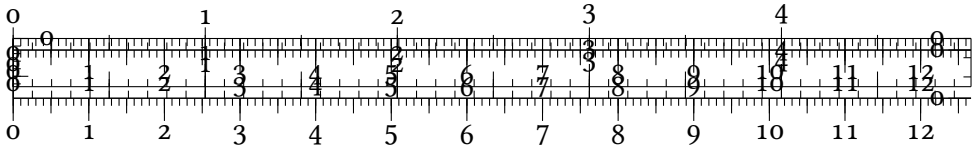
As an example of this shortcoming, see how Autor claims that "the elasticity of labor supply can mitigate wage gains". But here we must wonder, why is it that there is any labor supply. This might seem a moot point or avoiding the question. But in fact, most contemporary analyzes of the "labor market" tend to assume the very difficult problem of how to get people to work for a wage. As studies of ancient Mesopotamia have shown, the problem for these ancient *economies* was not *unemployment* but lack of population to be employed (mostly by the palace and temples) to do all the tasks required. And, this was due to a social and institutional configuration in which most of the people, then peasants, were not alienated from their means of subsistence (specifically arable land), and thus, they kept not only a certain independence vis-à-vis public authorities, but also vis-à-vis other possible *employers*. The reason to bring this example up, is that the employment relation (or what French sociology of work has more accurately called the *salariat*) depends on certain social and institutional conditions that analyzes such as Autor's assume will not change with the development of the ICTs.

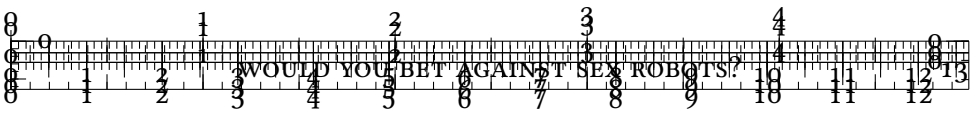
[The importance of the alienation of people from the means of subsistence, long ago noted by Marx (189X), is important even for the narrow aim of estimating the macroeconomic impact of automation in the labor market. The fact that workers in most of today's cities require a job to pay for the necessities of life, means that, unlike, say a semi-peasant household, today's workers will demand high wages, since they whole depend on them for their subsistence.]

Just to clarify, I am not advocating a technological deterministic view of history here, but I am simply pointing out that these blue sky dreams of the promises of artificial intelligence are not simply connected to simple changes in automated tasks, but to the social and political possibilities opened up by these technologies. That is to say, although it is naive to believe that society will be turned upside down by artificial intelligence, it is equally naive to believe that social conditions of production will remain unchanged. If artificial intelligence brings about any meaningful changes, my point of view is, this will not depend on the particular tasks that it helps automate, such as the discussion is today with self-driving cars, but rather on the changes in the social conditions of production that these changes might bring.

mention the legal changes of the new tehcnologies.

For example, will the masses of unemployed drivers become part of government job-guarantee programs Wray 2003 that will in turn put more pressure on private sector businesses to improve working conditions? Will





the government instead opt to provide incentives to the private sector to create replacements jobs while providing a basic income to those unable to be profitable employed by private enterprise? Will this new class of state dependents become a pariah class that threatens social cohesion? I think these are the questions that artificial intelligence really brings to the fore. For as Mirowski (2011) claims, there has been a very big change in the social organization of American science since the end of the second world war, passing from a state-led to a private firms-led model of funding and organization of science. And, if there is one area where this is most obvious is in artificial intelligence, where big tech giants such as Google and Facebook are responsible for directing some of the most important research projects in this domain.

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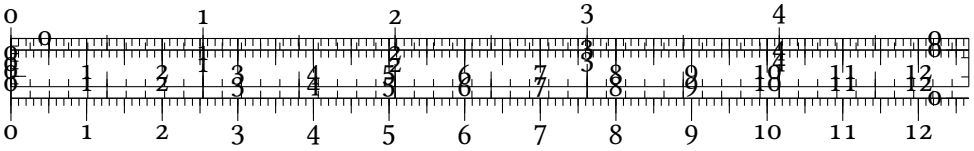
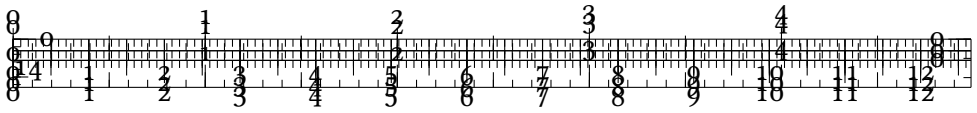
>
> He is wrong to think that the problem is one of scarcity. Scarcity is socially constructed. The biggest problem for our societies is one of distribution. And, here, automation could actually makes things worse, for as Autor rightly points out, more automation is likely going to shift around jobs, instead eliminating completely everyone (though certainly some) out of employment. As he points out, "In simple economic models, this outcome cannot really occur because capital is owned by the economic agents who are presumably also the workers; but, alternatively, the returns could accrue to a narrow subset of agents." So clearly the question with automation is more likely to be, who will benefit from it? Will the gains in productivity be enjoined only by a minority of capital owners, who reap profits, and the propertied classes that can afford these benefits, while vast swats of blue-collar workers are reduced to house servants?

The Social-embeddedness of Work

The article in the edited volume on Labor in the Ancient World by ?? poses the important question that is usually left out of today's writings on the so-called labor market: It is very hard to get people to work for one's account. The explication of why anybody would to choose to work for others is usually "explained" by the division of labor and the mutually advantageous exchange, but the question is left out of why would anyone choose to do this, instead of provide it from the household economy.

We must acknowledge that exchange is culturally situated, and that understanding the economic activity of exchange as a transhistoric phenomenon is a mistake.





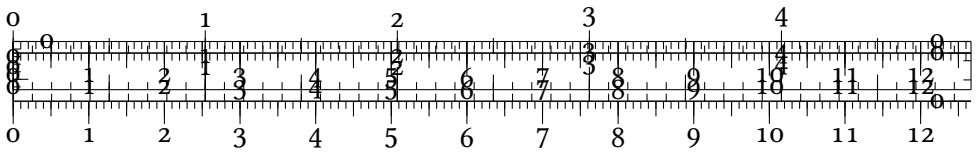
The Work Contract as Example of the Embeddedness of Work

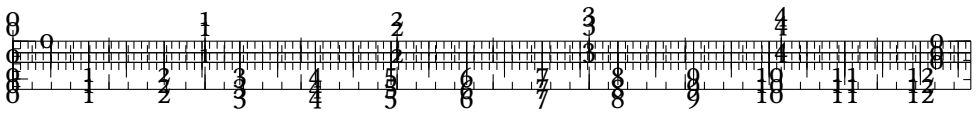
As Alain Supiot has argued, the work contract, at least in the case of French Civil Law, has a history and its related to slavery.

Conclusion

We need a different framework to study the influence of automation in the future of work that takes into account the historicity of the work concept and that leaves out the presupposition of social laws or social regularities. This is not to deny that social regularities exits, but that thinking in terms of regularities does not help to think about change. We should, thus ask the question what is different, in terms of what has changed.

CONCLUSION





3

Did Adam Smith Invent the Digital Computer?

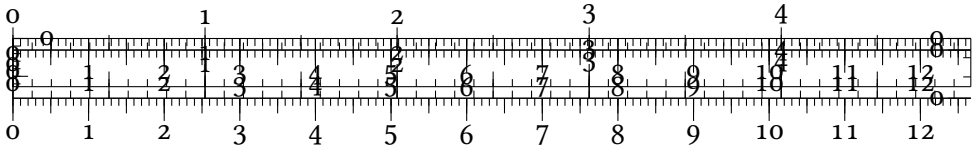
In the second chapter, I should sketch a different view (to the dominant technicist one) by explaining how thoughts on machine intelligence, automation, and sociotechnical systems for the conduct of workers have been connected since at least the nineteenth century.

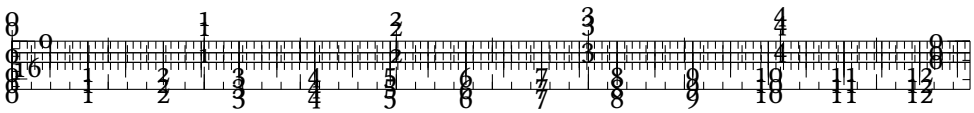
> Nor was the intellectual significance of Babbage's computer understood until the soul found its body a century later. In the absence of a practical realization, the computer did not attract enough attention of sharp minds to reveal its real significance. Even Babbage did not envision his computer as equipotential with the human mind. He did not see that the powers with which he had endowed it in order to enable it to make general arithmetic calculations are the powers the human mind uses in order to think and to understand language. (Simon, 1973, The Next Hundred Years: Engineering Design)

INTRODUCTION

> As you will see, this story shows that physicists and electrical engineers had little to do with the invention of the digital computer–that the real inventor was the economist Adam Smith, whose idea was translated into hardware through successive stages of development by two mathematicians, Prony and Babbage. (Simon and Newell 1958, p. 2)

On November 14, 1957, in an address to the Twelfth National Meeting of the Operations Research Society of America, Herbert Simon advanced the





provocative proposition that “physicists and electrical engineers had little to do with the invention of the digital computer”, for “the real inventor was the economist Adam Smith, whose idea was translated into hardware through successive stage of development by two mathematicians, Prony and Babbage.” Simon and Newell 1958.

MANUFACTURING LOGARITHMS AND WEAVING ALGEBRAICAL PATTERNS

> *The first part of chapter two shows that the concept of the division of (mental) labor lies at the origin of the computer. Therefore, I describe de Prony's project and Babbage's inspiration from it to devise his calculating engines. The idea is to emphasize that Babbage believed that the project was the proof that mental labor could be divided as mechanical labor, and that he came to believe that the laws of the mind were also mechanistic (his engine was an analogy of the world at large). The mechanization of mental labor had portentous consequences for the history of intelligence and the history of economics.*

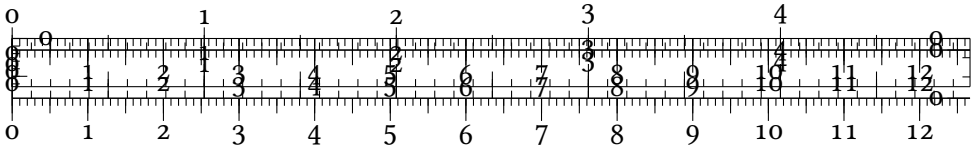
Introduction

The division of labor as embodied in the allocation of tasks in de Prony's project shows, the first large *computing* project was not only a project that showed the efficiency of the distribution of mental labor, but a new form of subordination of the mind to a particular organization of mental work in which workers were not only deprived of control but of full knowledge over the productive process.

Remember to describe what de Prony's project was about

The Division of Labor as the Foundational Concept of the Computer

Gaspard Clair Francois Marie Riche de Prony (1755–1839) was born in Cahmelet in the Beaujolais region of Southern France to a family of the provincial middle bourgeoisie–the social class that would fill the ranks of the Revolution and Empire's bureaucracy Picon, Chicoteau, and Rochant 1984. After an education in the Classics, in 1776, when he was twenty-one, he entered the École des ponts et chaussées in Paris. Prony's life coincides with a period of the institutionalization of French sciences and techniques with the foundation in 1794 of the École polytechnique–where he was appointed professor of analysis and mechanics with Joseph-Louis Lagrange–and the École normale supérieure, and a growing interest of the



savants for applied problems, and the generalization of the application of mathematical formalisms.

A Revolutionary monument to Reason was under construction at the nearby Bureau de Longitudes to supplement the metric system (which had been inaugurated as nature's own measure, eternal and immutable). Although originally commissioned as part of the Cadastre of France, launched in 1791, with Prony as director, the logarithmic tables were in fact never used for that purpose, having been expressly designed for the decimal division of the angles of the quadrant, which, along with the decimal division of time was later abandoned as part of the metric system.

En 1790, l'Assemblée nationale décida de remplacer les anciens impôts par une contribution foncière assise sur le revenu net des propriétés (6). Elle suivait en cela les idées de l'économiste François Quesnay.

Perhaps opportunely, therefore, early on in the new decade de Prony set up a Bureau de Cadastre in Paris, to prepare a detailed map of France to facilitate the accurate measurement of property as a basis of taxation. In connection with this plan, it was decided that a very large set of logarithmic and trigonometric tables would be prepared.

With the adoption of the decimal-based metric system, the Revolutionary government rendered all older trigonometric tables computed using traditional sexagesimal divisions of the circle suddenly unusable, at least for French geodesists and astronomers bound to the new system.

Durant onze années, le Cadastre a réalisé deux sortes de travaux : des cartes et des tables. Nous montrerons ci-après comment ces tâches se sont substituées à l'objectif initial qui était de nature fiscale : établir la répartition de la contribution foncière.

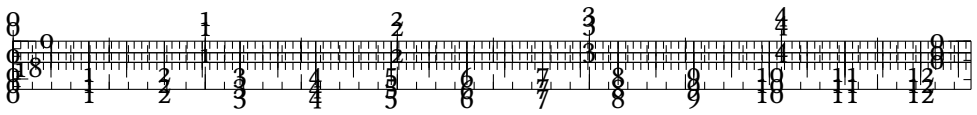
Calculation had not yet become mechanical, the paradigmatic example of preocesses that were mental but not intelligent. Allied with the higher mental faculties of speculative reason and moral judgment, calculation was remote from the realm of menial labor, of the automatic and the habitual.

Astonishing feats of mental arithmetic were soon to beocme the province of the idiot savant and the sideshow attraction, no longer the first augury of profound mathematical gifts

Calculation took on the dull, patient associatoins of repetitive and ill-paid bodily labor, ranked as the lowest of the mental faculties.

This part explain de whole story of Prony's project, here we mobilize Daston.

Prony gave some details of the project in a 'Notice' read to the classe des sciences mathematiques et physiques in 1801, soon after it was finished. The personnel were divided into three sections according to the work they did. The first section contained a handful of mathematicians, including A. M. Legendre, C. A. Prieur de la Cote d'Or, and Lazare Carnot; the former two were also involved with the reform of weights and measures, and latter two also acted as influential political figures. They chose the mathematical



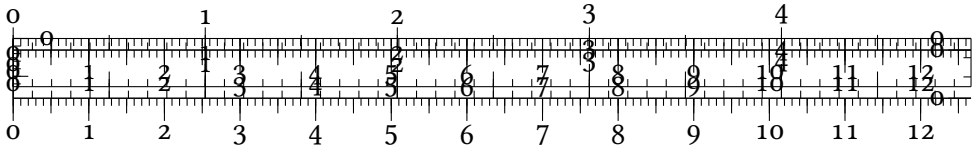
formulae to be used for calculation and checking, and also considered the choice of initial values of the numbers or angles, the number of decimal places to be adopted in each table, and so on. The second section comprised several 'Calculators', including the mathematicians A. M. Parseval (of the well-known formula in infinite series) and the textbook writer J. G. Gamier, who determined the values, and the differences of various orders, that needed to be calculated. They also prepared a page of tables for the numerical work by laying out the columns of the chosen values and the first row of entries, and preparing the instructions on the preparation of the remaining entries on the page. These calculations were done by the third section, a large team of between 60 and 80 assistants. Many of these workers were unemployed hairdressers; one of the most hated symbols of the ancien regime had been the hair-styles of the aristocracy, and the obligatory reduction of coiffure 'as the geometers say, to its most simplest expression' left the hairdressing trade in a severe state of recession.Thus these artists were converted into elementary arithmeticians, executing only additions and subtractions.

> A cette epoque, Messieurs, UN grand changement, s'etait opere dans la coiffure des hommes et des femmes. On l'avait reduite, come disent les geometres, *a sa plus simple expression.* UN coiffeur suffisait desormais au travail qui en occupait dix auparavant, et une foule de perruquiers se traouvaient tout a' coup sans moyens d'existence.
>
> M. de Prony concut l'idee de transofmer ces perruquiers en calculateurs, et de les faire concurir a' l'execution de ses grands tables. (Le Normand and Moléon 1824, pp. 210–211)

At the apex were a handful of "excellent mathematicians" [*géomètres d'un très grand mérite*] who would devise the analytic formulae to be used of the calculation ; below them seven or eight "calculators" [*calculateurs* ; sometimes also called *algébristes*] trained in analysis who would deduce form these formulas the numbers needed to begin actual computations ; and at the base were seventy or eghty perons [*individus* ; also *ouvriers*] knowing only the rudiments of arithmetic who would perform millions of additions and subtractions and enter the values by hand into ruled folio volumes specially laid out of the purpose. By means of these "manufacturing" methods, as Prony later called them, two copies of the tables, each consisting of seventeen manuscript volumes plus instructions, were completed by 1801.

In so doing, it pushed calculation away from intelligence and towards work.

Work and mechanical were closely linked in both French and English usage until the middle decades of the nineteenth century, and the middle



term that joined them was the laboring body. Work taxed the body but not the mind ; even the most deft manipulations of “rude mechanicals” were ascribed to habit and instinct rather than thought.

> Il est intéressant de faire ici le rapprochement des définitions que donne l’Encyclopédie de l’« artisan » et de l’« artiste » (t. I, p. 745) : le premier est « le nom par lequel on désigne les ouvriers qui professent ceux d’entre les arts mécaniques qui supposent le moins d’intelligence. On dit d’un bon Cordonnier que c’est un bon artisan, et d’un habile Horloger que c’est un grand artiste ». Par « artiste », on entend les « ouvriers qui excellent dans ceux d’entre les arts mécaniques qui supposent l’intelligence ; et même à ceux qui, dans certaines Sciences, moitié pratiques, moitié spéculatives, en entendent très bien la partie pratique ; ainsi on dit d’un Chimiste qui fait exécuter adroitement les procédés que d’autres ont inventés, que c’est un bon artiste ; avec cette différence que le mot artiste est toujours un éloge dans le premier cas, et que, dans le second, c’est presque un reproche de ne posséder que la partie subalterne de sa profession ». — On voit que nous sommes encore fort loin des contenus et résonances actuels. (Friedmann 1953, p. 55)

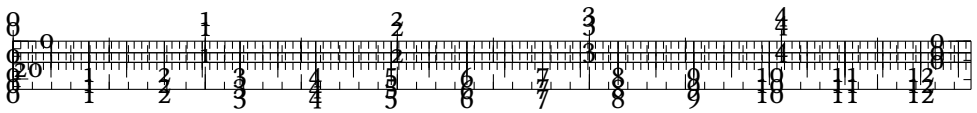
Si la démarche de Prony demeure isolee, dans un contexte de production encore largement traditionnel, elle marque tout de même l’ouverture d’un novueau front. L’organisation du travail devient raient une affaire d’ingénieur, même si le cahntier ne suit pas le mouvement, et si l’industrialisation se fait encore attendre.

Les tables du Cadastre prennent une connotation tout aussi politique que scientifique. Les méthodes employees pour venir à bout de cette tâche gigantesque traduisent qant à elles des enejxy de rationalisation sociale. Concrètement, cette divsion du travail se manifaste par une organisation hiérarchique des compétences.

The Ghost in Babbage's Engines

Halfway through the nineteenth century, the categorical distinction between the phenomena of mind and matter vanished under the influence of developments within psychophysiology. This enabled economists such as Jevons to transgress the boundaries traditionally set to the tools of the natural sciences might be used to disclose the laws of the mind.

They all form instantiations of Lord kelvin’s dictum (Thomson [1884] 1987, 111, also 296) that we can only understand something if we can make a mechanical model of it. Babbage’s Difference Engines and the new formal



logic developed by Boole, De Morgan, and Jevons were driving forces in the development of mechanical reasoning in all these senses.

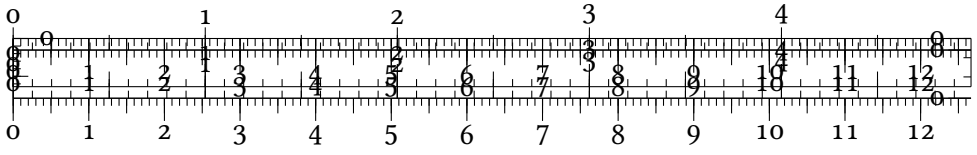
Babbage's calculating engines project emerged out of a growing need for precise and accurate tables by the quickly industrializing British economy. These tables were necessary, among other things, for navigation and for insurance companies that were rapidly growing in importance.

There were so many faults that could be made in the production of numerical tables, in the computations of the "avalanche of numbers" comprised in them, in the copying of the outcomes, and in the various stages of the printing process that Herschel and Babbage spent many hours checking these tables themselves for their own scientific purposes. One one such occasion, as the story goes, Babbage exclaimed in exasperation that the wished these computations had been made by "steam" (see for example, Swade 2000, 15).

Indeed, soon afterwards, in a pamphlet of 1822 on 'the application of machinery to the purpose of calculating and printing mathematical tables'—his main publication for securing governmental support for production of the Difference Engine–he gave some account of de Prony's project and noted that mechanical methods would speed up the process of calculation. Clearly he was struck by de Prony's production of the tables following an industrial process, and was hoping to imitate the process by mechanical means. In his book on manufactures, he rehearsed some of the same material on de Prony's project and on mechanical calculation.

> In other cases, mechanical devices have substituted machines for simpler tools or for bodily labour. The artist has been furnished with command of power beyond human strength, joined with precision surpassing any ordinary attainment of dexterity. He is enabled to perform singly the work of a multitude, with the accuracy of a select few, by mechanism which takes the place of manual labour or assists its efforts. But the invention, to which I am adverting, comes in place of mental exertion : it substitutes mechanical performance for an intellectual process : and that performance is effected with celerity and exactness unattainable in ordinary methods, even by incessant practice and undiverted attention. (Colebrooke 1823, p. 223)

Prony's approach showed Babbage that it was possible to mechanize not only physical, but also mental, labor. His interest in the French project fits into his wider perception of algorithmic procedures in "mathematics, science, and other walks of life" (Grattan-Guinness 1992, 34). Babbage emphasized in *Machinery and Manufactures* ([1835] 1963), still one of the most fascinating studies on the emerging mechanization of the economy,



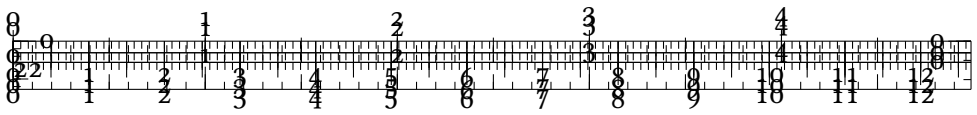
that the lowest task of Prony's project was "almost" a form of mechanized mental labor. Babbage designed his Difference Engine to mechanize this lowest stage of computing. Its method of computation ingeniously incorporated the method of differences in its wheels and gears, hence its name. Babbage's Difference Engine promised to fulfill all requirements Herschel and Babbage had been lamenting about : It saved calculation time and produced accurate and precise numbers. The computations would be more accurate than when done by a human individual–for machines, as opposed to humans, were thought not to make unpredictable mistakes. An attached printer would prevent errors in transcribing the outcomes. By thus excluding human interference from the whole process of computing and printing, all sources of faults–human faults–would be prevented, and the numbers would be precise, accurate, reliable, and reproducible. All this, of course, was based on the assumption that the machine itself operated flawlessly, a matter of great concern to Babbage. For all his calculating engines, he designed automatic checks and stops to secure its proper working.

Prony's approach affected the traditional view of the hierarchy of mental and physical labor, Before Prony started his table project, computations were, for the most part, made by mathematicians themselves for their own purposes (Warwick 1995, 317–8). The routinisation and then mechanization of computing downgraded calculation to the lowest of mental activities, thus equating it with the routine labor executed in the emerging factories. Babbage exploited the comparison of calculation with routine factory labor in straightforwardly paralleling Prony's division of tasks with the division of tasks necessary for the construction of a "cotton or silk-mill". The "multitude of other persons" (the calculators or their mechanical equivalent) used in their employment the "lower degree of skill" (Hyman 1989, 143).

Babbage, writing of the project in 1832, was still obliged to admit that his claim "that the division of labor can be applied with equal success to mental operations" would "appear paradoxical to some of our readers." The labor of mechanicals emptied the task of intelligence ; yet the task at issue, calculation, had been understood to be the very essence of intelligence.

With Babbage's Difference Engine, thoughts on machine intelligence were really only speculations, for it was obvious that the calculating capacities of the machine still involved a considerable amount of separate mental activity that was not captured in mechanical terms. The development of an even more ambitious machine, the Analytical Engine, seemed to overcome these limitations. The new contrivance derived its name from its ability to perform all ordinary analysis.

In contrast to the Difference Engine, the Analytical Engine could be really programmed. In fact, as is well-known, the design showed great similarity with von Neumann's computer design a century later (see Swade 2000). The comparison Babbage made with a silk mill, in *The Economy of Machinery and manufactures*, should be taken literally ; the Analytical Engine incorporates



in its design the architecture of a factory. The Analytical Engine combined the calculation of various functions without the interference of human mind and hand. This was attained by the use of punched cards, an idea that Babbage got when he was working on his book. The idea originated from the famous Jacquard loom, in which a complex mechanism of levers regulated the lifting of the warp in accordance with the desired pattern. This was done by triggering the right set of levers by a role of punched cards. These cards activated a system of levers to lift the intended column of gears. (Maas)

Here we mobilize Schaffer.

Babbage's Analytical Engine, a mechanical computer, was inspired by and modeled on a new social organization of work : the large-scale division of labor, as evidenced in the English machinetool industry and in the French government's manufacturing of logarithmic and trigonometric tables for the new decimal system in the 1790s.

That said, we can interpret Lovelace's oft-repeated citation that "the Analytical Engine *weaves algebraical patterns* just as the Jacquard-loom weaves flowers" (Lovelace, 25) in a more mundane form. Those who operated the Jacquard-loom

"In enabling mechanism to combine together *general* symbols in successions of unlimited variety and extent, a uniting link is established between the operations of matter and the abstract mental processes of the most abstract branch of mathematical science." (Lovelace, 25)

Babbage's severe blow to traditional categories of natural theology and moral philosophy was only convincing, however, on the assumption that the caprices of his calculating engines served as analogies to the world at large, the natural and the moral, which is more or less a definition of mechanical reasoning : to understand the world by means of machines. (Maas)

Gesturing toward the urgent issues of technological redundancy and the subordination of the labor process, Colebrooke's remark provides the theme of my story of the connection which Babbage helped forge between the development of machinofactures and the design of intelligent machines. In early nineteenth-century Britain the word *intelligence* simultaneously embodied the growing system of social surveillance and the emerging mechanization of natural philosophies of mind.

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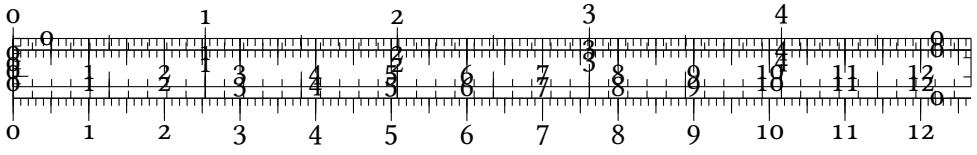
>
> This is key in the discourse on the upcoming changes of artificial intelligence in the workplace. Automation renders invisible the labor, the people who have to work to device these systems.

> Another of the uses which the slightest attention to the details of this notation irresistibly forces upon our notice, is to exhibit,



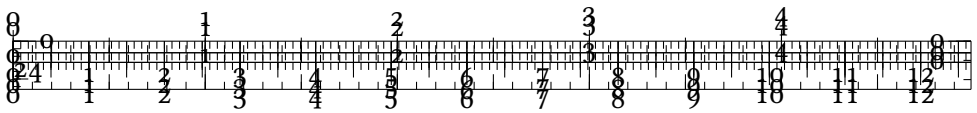
> in the form of a connected plan or map, the organization of an extensive factory, or any great public institution, in which a vast number of individuals are employed, and their duties regulated (as they generally are or ought to be) by a consistent and well-digested system. The mechanical notation is admirably adapted, not only to express such an organized connection of human agents, but even to suggest the improvements of which such organization is susceptible—to betray its weak and defective points, and to disclose, at a glance, the origin of any fault which may, from time to time, be observed in the working of the system. (Lardner in the Edinburgh Review in H. P. Babbage 2010, p. 78)

The replacement of individual human intelligence by machine intelligence was as apparent in the workshop as in the egnines. This task was both *politically* and *economically* necessary.

> One of the most singular advantages we derive from machinery is in the check which it affords against the inattention, the idleness, or the knavery, of human agents. (C. Babbage 2009, p. 39)

What happened in the reogrganization of production in the system of production of pulley blocks for the Royal Navy between 1795 and 1807 was that machinery wasnt there just to make the process more productive. Machinery was there to set the standard of what the ideal behavior of the workforce should be : obedient, fast, coordinated, etc. Machines were not replacements of workers as much as they were idealized version of the working body. Machines were organized as an idealized workforce under the gaze of the sociotechnical manager : Taylorism *avant la lettre*. Later, once the application of machinery was thorough, and workers were required to *adapt* to new working conditions, they weren't passibily adapting to an inocous technical change ; they were conforming to idealized versions of themselves.

In this example one notices the contradictions of the analysis of the organization of work from the perspective of political economy. Political economy is not just a rationalization of social organization carved out of theology. Rather political economy has in its core the belief in natural principles of organization (laws) of systems. Whether one thinks of this laws as tending towards welfare (as economic Liberalism) or catastrophe (as in Marxist political economy), one has to question the possibility of an analysis of the organization of work from this perspective : that is to say, the perspective of a kind of order, regulating principle, or homeostatic mechanisms. Whether one talks of economics as a more scientific descendant of



political economy, does not respond to the implications of this thinking in terms of laws or immanent orders. Is it possible to reconcile this perspective with our call for a conventionalist epistemology ? My short answer is no.

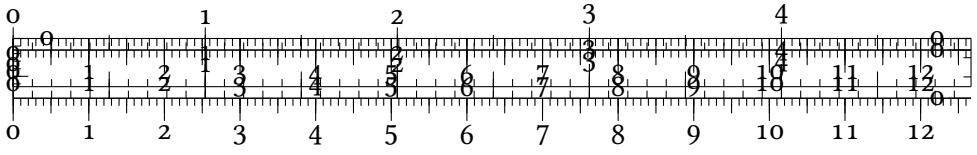
> ...economic rationality fought with traditional forms of exchange, or, following Michel Foucault, with Benthamite strategies for the surveillance of the body in the illuminated spaces of the Panopticon. Babbage's campaigns for machine intelligence take their place alongside these more familiar strategies for the reconfiguration of the productive body. (Schaffer 1994, p. 214)

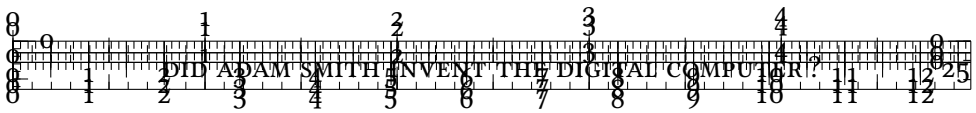
Conclusion

THE IMPOSSIBILITY OF A DEMOCRATIC COMPUTER

> *The second part of chapter two discusses Herbert Simon's article* What is Industrial Democracy *in relation with his thinking about the nature of hierarchical systems. I should use the articles on Functional Analysis and Organizations to show his understanding of general systems. The problem is that Simon thought that organizing a society was akin to building a computer program. I should discuss the dangers of his erasing the limit between nature and artifice, for, in the case of the work contract, the relations of subordination it implies are then naturalized.*
> *So the problem, is that by using Simon's framework to understand sociotechnical systems, we are naturalizing subordination. Therefore, while I cannot pronounce on the application for technical problems, I would argue that this can only be thought as exclusively technical problems in the context of his thinking about the goals of organizations.*
> *It should be noted that the notion of program, actually predate computer programs, and in the case of Simon, it was first used in the context of his thinking about organizations.*

The second part of chapter two shows that this fact is not related to technological backwardness or something intimately related to industrial production (as the technicist view would have it), but that since it appear in the thought of Herbert Simon in his opposition to industrial democracy, there is a relation between a concept of the role of man in society, and the crafting of these technologies.





Introduction

Structural-functionalism and Ontological Monism

Here I should discuss the problems of the

> We will say that B exercises authority over W if W permits B to select x. That is, W accepts authority when his behavior is determined by B's decision. In general, W will accept authority only if x_0, the x chosen by B, is restricted to some given subset (W's "area of acceptance") of all the possible values. This is the definition of authority that is most generally employed in modern administrative theory. (Simon 1951, p. 294)

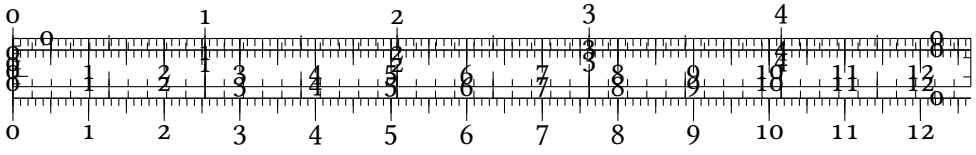
> W will be willing to enter an employment contract with B only if it does not matter to him "very much" which x (within the agreed upon area of acceptance) B will choose or if W is compensated in some way for the possibility that B will choose an x that is not desired by W (i.e., that B will ask W to perform an unpleasant task). (Simon 1951, p. 295)

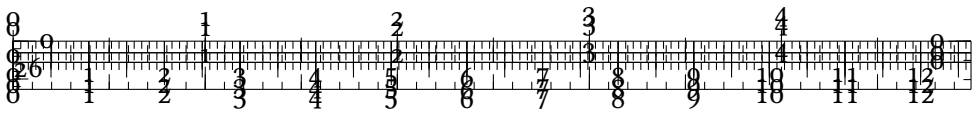
Many social scientists viewed the world as a complex, hierarchic system in which science models the processes and relations that define such systems. Moreover, a "broad church" positivism fostered an enthusiasm for behavioral-function social science.

The study of decisions-making offered the possibility to reform society through the construction of rational systems, undeterred by the irrationality of the individuals. After all, a decision could be shown to be rational, even if the decider was not. Choices could be rational within the appropriate framework.

> ...for I have long been of the opinion that the problem of how ten billion nerve cells work harmoniously together in the brain is the same problem of how two billion people can work harmoniously together in a society. (Ashby 1953, pp. 1–2)

> Even though we place supreme importance on having democratic control (that is employee control) of political institutions, it does not follow as a matter of logic that we want similar democratic control of the authority in business organizations–as contrasted with controls through markets, through bargaining, and through governmental regulations, or some combination of these. It does not follow as a matter of logic that, simply because voting is the primary mechanism of control at the societal level, it has to be the primary mechanism of control of the level of individual institutions within the society. (Simon 1983, p. 39)





> Functional analysis consists, then, in a correlation between the processes and mechanisms that are operable in a system and the totality of conditions that is sufficient for the maintenance of the invariance of the relations that define the system. At the grossest level of analysis, we analyze "survival" into its component relations ; at finer stages of analysis, we analyze these components into systems of mechanisms, and into the elements of these systems. (Simon 1954, p. 6)

In Simon's picture of homo administrativus man is nothing by himself, but only in relation to an organization.

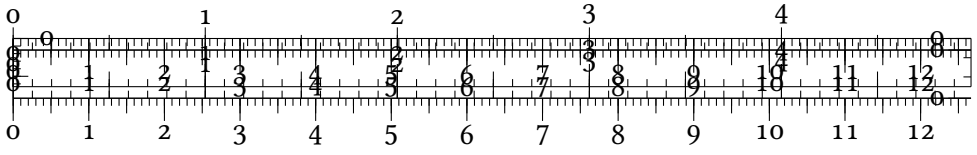
To Simon, organizations were vast decision-making machines specialized vertically into hierarchies in order to coordinate the successive elaboration of decision premises down to the level where specific action can be taken. For Simon, the constraints which organizations posed upon rationality were not "iron cages" of bureaucratic domination, but rather what made rationality possible.

Bounded Rationality Summons Hierarchy

> *Here I discuss the political implications of the concept of bounded rationality, for I contend that*
> *I discuss the anti-democratic consequences of Simon's notion of bounded rationality. The claim is that although Simon himself wasn't personally in favor of authoritarian government, there important anti-democratic implications in terms of workplace democracy*
> *Since the New Deal, thinking of workplace democracy has given place to discussion on living standards with the understanding that people give up their claim on control over the work process in exchange for rising living standards. Today with the floundering of the wage relation (*salariat*), the new proletarian has*

Instead of *homo œconomicus*, Simon's model of man was *homo adaptivus* : the adaptive, problem-solving organism of finite powers that moved in an infinitely complex hierarchically organized environment.

> "Design" offers a solution of how it is done the brain, of how the system, started at any random state, can *automatically* improve its ways of working, improving in ways that are far beyond the comprehension of the units that compose it. It ought, therefore, to be possible, by using the same principle to get a society organised so that it too starts *automatically* to improve its ways of behaving, improving them by reactions that are too clever to be understood by the people that compose it. (Ashby 1953, pp. 1–2)



> It is impossible for the behavior of a single, isolated individual to reach nay high degree of rationality. the number of alternatives he must explore is so great, the information he would need to evaluate them so vast that even an approximation is hard to conceive. Individual choice takes place in a n environment of "givens"—premises that are accepted by the subject as bases for his choice ; and behavior is adaptive only within the limits st by these "givens." (Simon 1997, p. 92)

> Prony himself remarked upon the social oddity represented by "the quite singular gathering of men who had had such different existences in the world" and upon the intellectual anomaly that the fewest computational errors were made by those "who had the most limited intelligence, an automatic existence, so to speak". (Daston 1994, p. 195)

> ...ils ont ete communement au nombre d'environ soixante ou quatre-vingts ; les neuf dixiemes au moins d'entre eux savoient tout au plus les deux ou les quatre premieres regles de l'arithmetique, et ceux qui en savoient davantage n'ont pas toujours ete les moins sujets a erreur. (Riche de Prony 1804, p. 53)

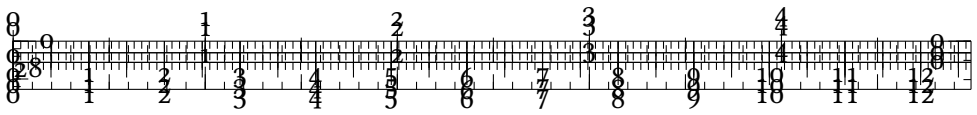
Calculation had up to that point been an intellectual occupation fit for the fines minds and the best society.

> The rational individual is, and must be, an organized and institutionalized individual. (Simon cited in Simon 1997, p. 46)

> Human rationality operates, then, within the limits of a psychological environment. This environment imposes on the individual as "givens" a selection of factors upon which he must base his decisions. (Simon 1997, p. 117)

At this point in my research, I can at most suggest a connection, but given Simon's thinking in organizations, it would be useful to read together his technical work on computing in the light of his work on organizations (as has been suggested by Heyck 2005).

> One function that organization performs is to place the organization members in a psychological environment that will adapt their decisions to the organization objectives, and will provide them with the information needed to make these decisions correctly. (Simon 1997, p. 92)



> We have authority in organizations, based on the employment relation between employee and employer, because it provides a very effective way of organizing human efforts under conditions of uncertainty–under conditions where coordinated action is needed, but where it is not known today in detail what actions will be needed tomorrow. The employment relation permits effective, coordinated action to be carried out by organizations under such conditions of uncertainty. And the employment relation is the primary source of authority in organizations in our society. (Simon 1983, p. 36)

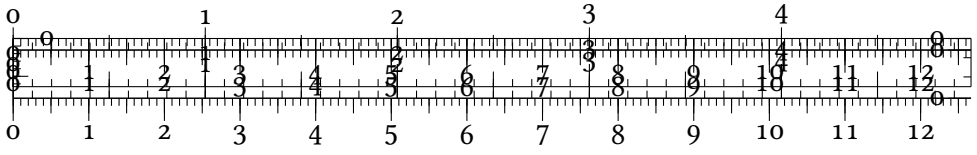
However, here we should note something, one of the pioneers of artificial intelligence Simon 1983, agreed with worker subordination, as he argued that workers should submit to the organizational hierarchy. As Simon defended his attack on industrial democracy : "Employees who are informed and consulted can usually be expected to work more effectively and with more enthusiasm than those whoa re not, and to contribute important elements of expertness out the decision-making process. I suppose that even the conductor of the symphony orchestra asks the concertmaster for suggestions during rehearsals–or if he does not, might improve the orchestra's quality by doing so. But that is a very different matter from organizing the orchestra as a voting body with the members holding formal rights to participate I most of the management decisions".

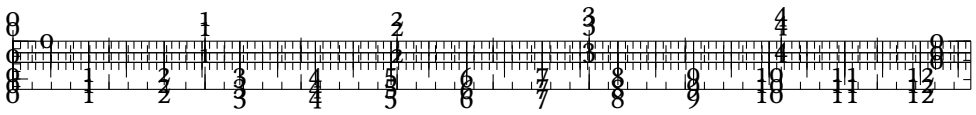
Simon continues : "We must learn that democracy and politics are all part of the same package of imperfect human institutions, constructed of imperfect human beings. We want to have democratic institutions, and the price we pay for them is to put up with the political process, There seems to be no institutional design that gives us the benefits of the one without the costs of the other."

Simon's explanation of the necessity of authority within the employment relation due to the existence of uncertainty is a dangerous naturalization of hierarchy as simply a necessary consequence of the complexity of the environment and our bounded rationality which makes us unable to fully grasp it.

Conclusion

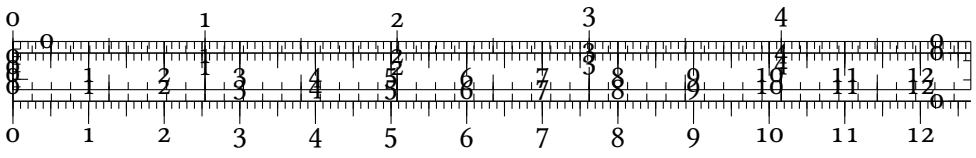
CONCLUSION

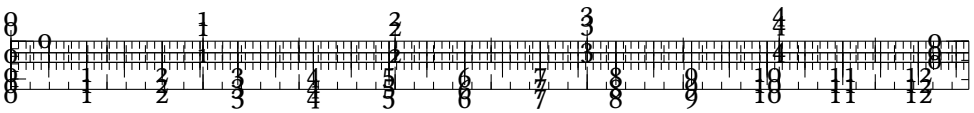




4

Conclusion





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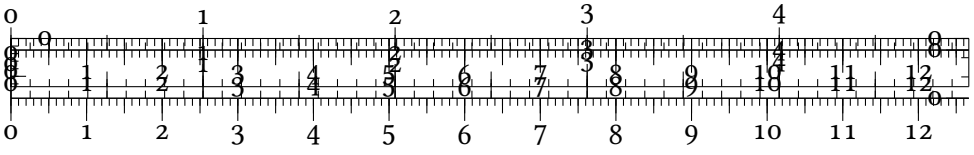

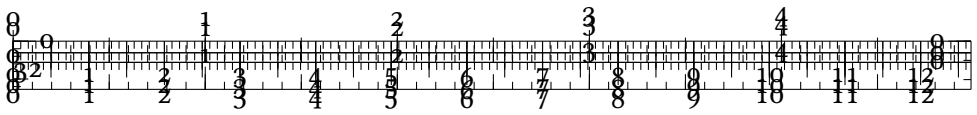

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