Nothing New Under the Sun? Computational Humanities and the Methodology of History

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Abstract

The example of historiography shows that quantitative methods have already been part of the humanities for a long time. Such methods alone therefore cannot be constitutive of the computational humanities (CH). It is also problematic and unsustainable to conceive it as a kind of "toolbox" of quantitative methods, as it places CH outside of the methodological traditions of the humanities disciplines. Instead, we need to remember that disciplines are defined by their research objects and the research questions they tackle. This means that we need to distinguish between applied and theoretical CH, and that applied CH must be firmly placed in the methodological scope and tradition of their mother disciplines. We posit that the supposed dichotomy of qualitative and quantitative methods is fallacious: neither will quantitative methods replace qualitative approaches in history, nor are they unnecessary—they are complementary.

Keywords

computational humanities, methodology, history, historiography

1. Introduction

Computational humanities research—and thus *computational humanities* (CH) as a field—are commonly associated or even equated with the use of quantitative methods. This seems to be particularly true for computational research in history, typically referred to as *digital history* or (less often) *computational history.*

As in the field of digital and computational humanities in general, there is no commonly agreed upon definition of *digital history*; nevertheless, the term generally seems to subsume two main orientations, which roughly align with either what Roth [31] calls *digitized humanities*, which deal "essentially with the constitution, management, and processing of digitized archives," or with what he calls *numerical humanities*, focused on "mathematical abstraction and the development of numerical and formal models" [31, p. 1].

The Wikipedia entry on *digital history*[1] opens with a surprisingly concise definition: "Digital history is the use of digital media to further historical analysis, presentation, and research. It is a branch of the digital humanities and an extension of quantitative history, cliometrics, and computing." This definition can be understood to comprise both of these two orientations (and the even wider area of "presentation"), but it views it primarily as "an extension of quantitative history, cliometrics, and computing."

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[1]https://en.wikipedia.org/wiki/Digital_history

According to Decker [13, p. 12], "[t]he Digital History approach frequently includes digital processing and storage of oral histories, images, or text." Again, this is a relatively wide definition, but the author then goes on to to stress the "heavy reliance on textual search and analysis, especially of 'Big Data' (which can be roughly characterized for humanists as a body of evidence too massive and/or complex for an individual to read)," and quantitative methods such as topic modeling.

As a third example, Romein et al. [30, p. 293] does not understand digital history as "a distinct discipline or field." They regard digital history as a "signifier" under which "historians experiment with tools, concepts and methods from other disciplines, including computer science, and computational linguistics, to develop new perspectives on our past." While they also allude the ancestry of "quantitative history, often referred to as cliometrics, where historians used mainframe computers for statistical analysis" [30, p. 292], the authors clearly stress the import of "tools, concepts and methods from other disciplines" as a defining characteristic.

In other words, the term *digital history* can be regarded as a common heading for two separate approaches. The first, which is concerned with the uses of digital tools for presentation and publication (to gain interactivity and nonlinearity), as well as for access (digitalization of and access to sources and articles), is fully compatible with established qualitative methodologies. The second approach, on the other hand, can be described as a return of the quantitative tools from statistics re-imported through computer science [30, p. 294–295]. These computational methods (such as topic modeling, computer vision, quantitative text analysis, or network analysis) are primarily quantitative and tend to require "big data," which is more or less broadly construed "as a body of evidence too massive and/or complex for an individual to read" [13, p. 12].

Decker [13, p. 8] also notes that it is notably this "quantitative element" of digital history, which is "repellent to many historians and out of fashion in most fields of history, which rely in the main on case studies and qualitative approaches of interpretation." If, as he argues, digital history embodies the "computational turn," it is precisely the quantitative element that stands in contrast to "the traditional norms of practice within the study of history" and thus characterizes digital history both in outside perception and in significant parts of the field itself.

For example, the first characteristic of computational humanities research mentioned in the call for papers for this workshop is "relying on quantifiable rather than strictly qualitative evidence." Such focus is to be found on departmental Web sites of computational humanities institutes or calls for papers throughout the discipline.[2] The picture of computational humanities that emerges through such presentation is thus that of a field primarily defined by the application of a particular set of *methods* that are otherwise not used in the so-called "traditional humanities," or that of a toolbox providing scholars with shiny new tools.[3]

The way a discipline presents itself matters. The assumption that the humanities traditionally use exclusively qualitative, hermeneutic methods and that quantitative, "objective"

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[2]For example, the call for InfDH 2020 workshop described *computational humanities* as "a new sub-area […], which primarily aims at statistical and algorithmic methods of analysis in the humanities and cultural sciences," and asked for all submissions to stress the "quantitative, computer-based analysis of data from the humanities and cultural sciences" (our translation).

[3]We share with McPherson [23] a certain discomfort with the use of the term "traditional" to describe "non-computational" humanities scholars [see 23, p. 155, note 3] as it does not necessarily imply any of the conventional meanings of the term.

methods need to be brought in from the outside is widespread; it is reinforced, for example, by interdisciplinary funding calls that assign the corresponding roles to researchers, insinuating that the humanities are somehow defective—or at least outdated—in their supposed rejection of the "new" methods of research, and that a transfer of methods from informatics[4] (or perhaps "data science") to the humanities is urgently needed. In a *Nature* editorial from 2011 [3] we read: "It seems just a matter of time before the humanities, like the social sciences before them, wholeheartedly embrace scientific methodology. And that should be reason to rejoice, not remonstrate." We believe that this postulate is inaccurate and counterproductive. It rests on two erroneous assumptions: first, the equation of informatics and quantitative methods; second, the idea that CH consists in introducing these quantitative methods into the humanities.

There certainly are humanities scholars who are sceptical, not to say hostile, towards quantitative methods. However, their presence is typically amplified in order to give substance to the premise that quantitative methods are traditionally foreign to the humanities. They are convincing because they tell the familiar story of stubborn traditionalists rejecting the new ways, on principle, even though they are demonstrably superior. However, this narrative completely ignores the long history of quantitative methods in the humanities and the related methodological discourses. We read in a text written behind the Iron Curtain almost 70 and translated into English almost 50 years ago: "When the historians came to realize that 'they had to count'—which occurred on a visible scale only during the last 50 years—quantitative analyses became a legitimate element of historical narratives" [35, p. 483]. This approach is then nothing new.[5]

Ultimately, the whole qualitative–quantitative dichotomy is fundamentally flawed and unsuited to define computational humanities and its relationship to the humanities disciplines and informatics. We would like to show this on the example of the disciplinary interface between history and computational humanities. In the rest of this paper we first examine the problems caused by ignoring the tradition of quantitative methods in historical research; we then discuss the disciplinary implications and a possible way forward for applied computational humanities; the final section summaries our conclusions.

2. The problem with the toolbox

In contrast to the common narrative, quantitative methods are anything but new in the humanities; in fact, their use even predates computers. Quantitative methods started to be introduced into historical research in the 19th century; this was primarily prompted by the development of economic history (including demography) which, as Topolski [35, p. 484] puts it, "if it was not to become a collection of anecdotes and curiosities, had to study mass phenomena (by making use of sources which had not been studied previously), and that required quantitative methods." Notable examples include Frederick Jackson Turner's

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[4]The terms *computer science* (used in North America) and *informatics* (used in Europe) are often treated as synonyms, and obviously they share a common core; however, the disciplinary and institutional structures differ significantly. As this paper is written from a European perspective, we use the term *informatics* throughout; note that the precise conception of informatics in Europe also varies between national academic systems (for an extensive discussion of the terms and their history see Tedre [33] and, for the German development in particular, Coy [12]).

[5]It also makes many people believe that what we have here is a dispute between young and old, junior and senior scholars. In our experience, however, in the humanities the former often tend to be more "traditional" (i.e., reluctant to use computational approaches) than the latter. This is due to a variety of factors, which we cannot discuss here, but it shows that the fault line is not where the common narrative suggests.

demographical approach (exemplified by his 1893 essay "The Significance of the Frontier in American History"), the work of the French *Annales* school before World War II, and quantitative approaches to economic history with pioneers like Marczewski [22] in Europe or Fogel [15] in the US; for a concise overview, see, for example, Anderson [1]. As soon as computers became available to historians and massively expanded the practicability of large-scale quantitative analyses, a methodological reflection on the new possibilities and the use of quantitative methods in the new context started.

However, the results of this reflection were not, or only to a very limited extent, incorporated into the field what we now call computational humanities. As Decker [13] notes, digital history "retains a modest presence in the broader arena of Digital Humanities" and has not "rooted itself in the academy among the professional guild of historians" either [13, p. 8]. It is likely that this problem is at least in part due to a certain unease about how to integrate quantitative methods into historical research, the association of quantitative approaches with positivism, fears of "a dehumanization of history" [35, p. 488]. Maybe this is also due to the questions raised by the new possibility of automating work that had been traditionally considered the work of the historian and the quite justified fears of missing the effect of hidden biases that come with it. Measured in the life-years of CH it is already a very old problem; it already figures prominently in Bowles [7], one of the earliest publications dedicated to the use of computers in the humanities.

The need for theory to precede any use of computers in historical research is also not new. It was seen early on as a massive challenge to methodology; Bullough et al. [9, p. 402] stressed that "[t]he implementation of effective computer programming relies […] on the articulation of a formal coherent theory about the data processed." Also very early on historians recognized that the "unifying principle" of the various historical sub-fields defined by periods is not just the method: "The common denominator of medievalists is a set of cultural data inherited from a defined period rather than a method" [9, p. 392].

The more computing in the humanities became detached from specific research questions in the humanities and turned into an independent field (humanities computing, digital humanities, computational humanities), the weaker obviously became the links to discipline-specific methodology. While the link to previous quantitative approaches is still quite strong in the contributions to Bowles [7], as the projects still built to a large extent on pre-computer work, it gets weaker over time as a result of a decreasing reception of the methodological reflection in the humanities. Kenner [20, p. 362] already observes this disconnect in his review of the 1988 Humanities Computing Yearbook when he notes that "[a]t this moment, some humanities computing seems to be in a state of free-fall. It's tool-driven, a bad way to be. Better, be situation-driven," that is: driven by research questions. In other words: by choosing to ignore the history of quantitative methods in the humanities, computational humanities has also come to ignore most of the related methodological work previously done.[6] While Scheinfeldt [32] defends that it is a positive development of digital history that it "traffic[s] much less in new theories than in new methods" [32, p. 125], it might be legitimate to fear that the field's focus on methods has won out over interpretations and argumentation [25, p. 2]. Current approaches to digital history tend to separate methods and interpretation by borrowing the practice of

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[6]Arguably CH largely ignores methodological work in the humanities, plain and simple. Then again, so do large parts of the humanities.

the quantitative sciences—and, as Ben Schmidt points out, thus in a way reproduce the split between narrative and quantitative data of *Time on the Cross*.[7]

The excessive focus on methods as the defining element of computational humanities and the disregard for methodology and theory incorrectly suggests that scholars could freely pick their methods—which, as Mullen [25] points out, is obviously not the case. It also creates the erroneous impression that computational humanities research primarily depends on data size. This is obviously true if one restricts computational humanities to quantitative methods; as William Aydelotte, a pioneer in applying statistics to historical research, pointed out, "formal statistical presentations are appropriate only for a limited range of historical problems [...] They are gratuitous when the number of cases is small, and they are useless when the information is too limited" [4, p. 8]. However, the disciplinary exchange between history and computational humanities shows that there are valid research questions for CH regardless of the size of the data, in particular in the domain of knowledge representation and reasoning; for pioneering work in this sense in archeology and history see Gardin [17] and Borillo [6].

The application of quantitative methods also does not simply solve previously unsolved historical questions; suggesting this overlooks their true complexity and only encourages simplistic approaches along the lines of culturomics [24]. Given that "humanities data" is in many respects fundamentally different from "big data"—the natural domain of data science—it is necessarily problematic when data scientists dabble in the humanities. The results may *seem* convincing at first (especially when they are supported by impressive visualizations), but they rarely hold up to closer scrutiny—if only because the provenance and composition of the underlying data are unclear and the stability of the relationships established is hence unknown. Already the Soviet humanities computing pioneer Ivan Kovalchenko underscored that "[t]he quantitative methods are not a key to absolute truth that is going to render qualitative research meaningless nor are they only applicable in 'mass-data' situations" [21], and Aydelotte noted that "[t]he significance of a project of historical research depends not on whether or not it is quantitative but upon the importance of the problem, the extent of the evidence, and the intelligence with which the research is executed" [4, p. 8].

Historians grappled with the problems posed by large amounts of (not necessarily reliable) data already back in the days of cybernetics and introduced the distinct category of "mass data" [2]. But while it signaled the problem, it did not solve it. They also intuitively understood early on that the use of computers will allow for a vastly expanded source base, but that it will only be profitable if "goals and strategies are carefully planned and designed" and if the research will involve testing "explicitly formulated hypotheses [...] that are guided by theoretical considerations" [11, p. 605], i.e., going well beyond mined correlations followed by post hoc interpretations.

The portrayal of computational humanities as merely a set of (primarily quantitative) methods is doubly problematic from a disciplinary-institutional perspective. The view of computational humanities as a "toolbox" undermines the establishment of theoretical CH[8] as a discipline in its own right, which is necessary for its longer-term survival; *at the same time* it raises the question how applied CH differs from quantitative history, supposedly revealing that applied CH is nothing but "warmed up" quantitative approaches, which have supposedly been overcome a long time ago. Unlike CH, the humanities disciplines very much

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[7]Ben Schmidt: "Two Volumes: the lessons of Time on the Cross".

[8]We follow Piotrowski [27] in the distinction between *applied* and *theoretical computational humanities*: the former being subfields of their respective mother disciplines, the latter a kind of applied informatics.

have an institutional memory of previous "turns." This memory is often heavily distorted by discourses that label works associated with preceding turns as outdated, if not fallacious. But to learn from that memory is a crucial skill. For example, by unduly assuming that quantitative methods on their own can provide a supposedly objective view, Fogel and Engerman's study of the economics of slavery, *Time on the Cross* [16], created a distorted picture of the past [18]. Moreover, they committed the original "toolbox error" when they defined the methodological framework of their study, they combined a belief in the objectivity of their quantitative tools with implicit assumptions from the field of economics, in line with the cliometric application of "standard economic reasoning in the posing and answering of historical questions" [5]. The controversy following the publication of the book associated the methodology in general with the shortcomings of this study in particular, leading to a widespread dismissal of quantitative and computational historical approaches in North America [34, 37]. Mistaking quantitative methods as a panacea for any limitations of qualitative approaches endangers the whole methodology. Naïvely putting quantitative methods (now in the guise of computational humanities) forward as "the next big thing," only reinforces the supposed qualitative–quantitative dichotomy and leads to a vicious circle of fruitless arguments.

While both the pioneers of computational humanities and historians saw not only those problems but also the need to tackle them on a theoretical level, no wide-reaching theoretical foundation has been built so far. Computational humanities seems to sometimes mistake the intuitive understanding of those problems in humanities in general and history in particular as a lack of methodological reflection. While this reflection was sometimes haphazard, it is very much part of the histories of digital and computational humanities. There is also another issue here: that of terminology. If digital and computational humanities are conceptualized as occupying the grounds between informatics and the humanities, it is important that they realize that different languages are spoken on either side. What is called "theory" in informatics, frequently more closely resembles what is called "methodology" in the humanities, where "theory" is often associated with schools of thought. This leads computational humanities, so to speak, to look in the wrong place for reflections on quantitative methods and corresponding theory in the humanities.[9] After all, the "use of quantitative material by historians is neither a new nor revolutionary development" ([11, p. 602]; [but see also 22]; [36]; [14]).

3. No history without history

The application of quantitative computational methods in history (and in the humanities in general) requires a solid methodological basis—but so does any method. The goal of the preceding section was not to warn of the dangers of an unreflected or inappropriate use of quantitative methods (already the pioneers heeded these dangers); we rather wanted to draw attention to the simplistic understanding of computational humanities as "toolbox" of (quantitative) methods and the correlated disconnect from disciplinary methodology. In other words: the warnings of the pioneers in quantitative history are largely unknown in CH precisely because CH is not conceived as being in the methodological tradition of history (or whatever the relevant humanities discipline may be).

The view of CH as a "toolbox" poses a danger to the sustainability of CH as a research program because it perfectly fits the narrative of the "digital turn"—and as the history of the

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[9]Scheinfeldt's above-quoted delight in digital history's preference of "new methods" over "new theories" [32, p. 125] also seems at least in part due to this confusion.

humanities demonstrates, these "turns" tend to be more akin to short-lived fashions rather than to profound methodological transformations. Lasting change requires institutional change; in academia, change is institutionalized via structures that in some way correspond to disciplines. While digital humanities in its various forms has certainly made inroads, we warn that many structures are less stable than they may appear [27]; Decker [13, p. 12] also notes this as "a certain weakness." He adds that "[d]isciplines by their nature have boundaries, and without such fences, Digital History cannot really develop the sorts of professional norms and functions that define other history fields." The question of whether or not CH is a discipline is therefore not an idle question. How to proceed then?

As we have pointed out before [28], disciplines are not defined by the methods they use, but by the research objects they study and the research questions they aim to answer. Methods are secondary and contingent on the unique combination of research object and research questions that define a discipline. This already restricts to some extent which parts or orientations of CH could possibly be considered a discipline; it also helps to delimit CH from neighboring disciplines.

If we examine computational humanities research (in the sense of Piotrowski [27], i.e., excluding research that is not concerned with the construction of computational models or meta-models) we find that some of the work is primarily concerned with humanities research objects (e.g., historical phenomena) and corresponding research questions (e.g., causes and effects of these phenomena), while another part of the research is primarily concerned with informatics research objects (e.g., algorithms) and corresponding research questions (e.g., effectiveness and efficiency of these algorithms). The distinction between *applied* and *theoretical computational humanities* proposed by Piotrowski [27] reflects these two main orientations. This is obviously an idealization, but it helps to clarify the research objects and research questions, as well as the larger disciplinary context (e.g., funding opportunities or evaluation criteria) required for long-term sustainability of the field, which in turn determines the career opportunities of early-stage researchers: applied CH thus describes subfields in the humanities disciplines, whereas theoretical CH can be considered a kind of applied informatics.

Applied CH (or "computational *X*" for some mother discipline *X*) consequently *must* be placed in the methodological tradition of the discipline. Thus, we posit that computational history must be conceptualized as being (partly) in the methodological tradition of quantitative and cybernetic [e.g., 10] approaches to history, but also in the larger methodological scope of history. This concerns both the methodological foundations and the lessons learned, which would be foolish to ignore—this is, however, the obvious and very real risk when considering CH as a toolbox of "objective" methods outside the methodological traditions of the humanities. In other words: you cannot do history without history.

4. Conclusion

We have shown that the use of quantitative methods in the humanities—both in the sense of "un po' di aritmetica" [26, p. 114] as well as in the sense of large-scale statistical analyses—is far from new; it even predates computers. The interest in quantitative approaches in history certainly seems to follow a boom and bust cycle—see, for example, the analysis by Buchner et al. [8] of the use of quantitative methods by German historians from 1951 to 2016. Their applicability obviously also varies by discipline, for example in archaeology, as in linguistics, they have long become a firmly established part of both praxis and training. In any case, the

assumption that the humanities *traditionally* use exclusively qualitative, hermeneutic methods and that quantitative, "objective" methods need to be brought in from the outside is, simply put, wrong.

The fact that the humanities have already worked—and struggled—with quantitative methods for a long time means that they have also made their own mistakes with them and (at least to some extent) learned their lessons, independently from digital and computational humanities. The misrepresentation of research methods in the humanities is already counterproductive on its own, but the main problem, we believe, is the unwarranted focus on *methods* as defining characteristic of applied computational humanities. It suggests that researchers can freely pick their methods, irrespective of the research object and the research question—and insinuates that humanities scholars simply refuse to use supposedly superior quantitative methods. But even more importantly, it places applied computational humanities outside the methodological scope and traditions of their mother disciplines.

It is clear that the methods to be used first and foremost must be adequate for the research object and the research question—in itself hardly a revolutionary, but still mostly intuitively understood principle. Our main point is, however, not to warn against the use of inappropriate methods. In this respect the reflection on methodological coexistence in the humanities is very helpful as it makes it clear that the dichotomy between qualitative and quantitative methods is fundamentally flawed. They do not stand in opposition to each other and a choice of an appropriate method depends on the research problem and *not* on the affiliation with a particular discipline, or as Kovalchenko put it: "any sphere of mathematics is only a means of knowledge, one of the methods of the discovery of the internal nature and qualitative uniqueness of the object of study" [quoted in 29, p. 25]. Topolski was certainly correct when he predicted almost 50 years ago that "the quantitative approach will on an increasing scale serve the improvement of qualitative analyses," but that "the qualitative approach cannot be eliminated from historical studies," because, after all, "why do we collect and classify numerical data if not to obtain answers to specific questions?" [35, p. 484]. Whether in science, engineering, or the humanities: "The purpose of computing is insight, not numbers" [19, p. vii].

We rather want to warn against conceptualizing computational humanities as merely a "toolbox" of quantitative methods. Disciplines are not defined by the methods they use, but by the research objects they study and the research questions they aim to answer—by the research capital they work with. In order to arrive at a coherent conception, we believe it is crucial to distinguish between *applied* and *theoretical* computational humanities, as proposed by Piotrowski [27]. Applied computational humanities must then be firmly placed in the methodological scope and tradition of their mother disciplines—which is why it might be more appropriate to refer to them as "computational history," "computational literary studies," and so on, as they are aiming to answer *why?* questions in the humanities, whereas theoretical computational humanities is concerned with the corresponding *how?* questions in informatics. This distinction does not imply a strict separation—on the contrary: we believe it provides a much better foundation for computational (and not just quantitative) modeling in the humanities that is adequate with respect to both the humanities and informatics.

Acknowledgments

References

[1] M. Anderson. "Quantitative History". In: *The SAGE Handbook of Social Science Methodology*. London: SAGE, 2007, pp. 248–264. ISBN: 978-1-4129-0119-2. DOI: 10.4135/9781848607958.n14.

[2] C. G. Andrae and S. Lundkvist. *The Use of Historical Mass-Data. Experiences from a Project on Swedish Popular Movements*. Moscow: Nauka, 1970.

[3] Anonymous. "Poetry in motion". In: *Nature* 474 (June 2011), p. 420. ISSN: 1476-4687. DOI: 10.1038/474420b.

[4] W. O. Aydelotte. "Computers in Historical Research". In: *Proceedings of the Conference on the Use of Computers in Humanistic Research*. New Brunswick, NJ: Rutgers, The State University of New Jersey, 1966, 8f.

[5] F. Boldizzoni. *The Poverty of Clio: Resurrecting Economic History*. Princeton, NJ, USA: Princeton University Press, 2011. ISBN: 978-1-4008-3885-1.

[6] M. Borillo. *Informatique pour les sciences de l'homme: Limites de la formalisation du raisonnement*. French. Bruxelles: Mardaga, 1985. ISBN: 2-87009-202-4.

[7] E. A. Bowles, ed. *Computers in Humanistic Research: Readings and Perspectives*. Englewood Cliffs, NJ, USA: Prentice-Hall, 1967.

[8] M. Buchner et al. "Zur Konjunktur des Zählens – oder wie man Quantifizierung quantifiziert: Eine empirische Analyse der Anwendung quantitativer Methoden in der deutschen Geschichtswissenschaft". German. In: *Historische Zeitschrift* 310.3 (2020), pp. 580–621. ISSN: 0018-2613. DOI: 10.1515/hzhz-2020-0019.

[9] V. L. Bullough, S. Lusignan, and T. H. Ohlgren. "Report: Computers and the Medievalist". In: *Speculum* 49 (1974), pp. 392–402. ISSN: 0038-7134. DOI: 10.2307/2856091.

[10] W. J. Chandler. *The Science of History: A cybernetic approach*. Studies in Cybernetics 7. New York, NY, USA: Gordon and Breach Science, 1984. ISBN: 978-2-88124-012-6.

[11] J. M. Clubb and H. Allen. "Computers and Historical Studies". In: *Journal of American History* 54 (1967), pp. 599–607. ISSN: 0021-8723. DOI: 10.2307/2937409.

[12] W. Coy. "Was ist Informatik? Zur Entstehung des Faches an den deutschen Universitäten". German. In: *Geschichten der Informatik: Visionen, Paradigmen, Leitmotive*. Berlin/Heidelberg: Springer, 2004, pp. 473–498. DOI: 10.10071978-3-642-18631-8.

[13] M. J. Decker. "The finger of God is here! Past, present, and future of digital history". In: *The Historian* 82.1 (Jan. 2020), pp. 7–21. ISSN: 0018-2370. DOI: 10.1080/00182370.2020.1725720. (Visited on 09/06/2020).

[14] R. Floud. *An Introduction to Quantitative Methods for Historians*. Routledge, 2006. ISBN: 978-0-415-60759-9.

[15] R. W. Fogel. *Railroads and American Economic Growth: Essays in Econometric History*. Baltimore: Johns Hopkins University Press, 1964.

[16] R. W. Fogel and S. L. Engerman. *Time on the Cross*. Vol. 1 and 2. Boston: Little Brown, 1974.

[17] J. C. Gardin. *Une archéologie théorique*. French. Paris: Hachette, 1979.

[18] H. G. Gutman. *Slavery and the Numbers Game: A Critique of* Time on the Cross. Champagne, IL: University of Illinois Press, 2003. ISBN: 978-0-252-07151-5.

[19] R. W. Hamming. *Numerical methods for scientists and engineers.* New York, NY: McGraw-Hill, 1962.

[20] H. Kenner. "Curtains for Lady Buxley". In: *BYTE* (Oct. 1989), pp. 360–361.

[21] I. D. Koval'chenko. "Analysis of Historical Statistics by Mathematical Means". In: *Soviet Studies in History* 3.2 (1964), pp. 13–20. ISSN: 0038-5867. DOI: 10.2753/RSH1061-19830 30213.

[22] J. Marczewski. *Introduction à l'histoire quantitative.* French. Geneva: Droz, 1965.

[23] T. McPherson. "Why Are the Digital Humanities So White? or Thinking the Histories of Race and Computation". In: *Debates in the Digital Humanities.* Ed. by M. K. Gold. Minneapolis, MN: University of Minnesota Press, 2012. Chap. 9, pp. 139–160.

[24] J.-B. Michel et al. "Quantitative Analysis of Culture Using Millions of Digitized Books". In: *Science* 331.6014 (Jan. 2011), pp. 176–182. ISSN: 1095-9203. DOI: 10.1126/science.11 99644.

[25] L. Mullen. "A Braided Narrative for Digital History". In: *Debates in the Digital Humanities 2019.* Ed. by M. K. Gold and L. F. Klein. Minneapolis, MN: University of Minnesota Press, 2018. Chap. 31, pp. 382–388.

[26] T. Orlandi. *Informatica umanistica.* Italian. Rome: La Nuova Italia Scientifica, 1990.

[27] M. Piotrowski. "Ain't No Way Around It: Why We Need to Be Clear About What We Mean by 'Digital Humanities'". In: *Wozu Digitale Geisteswissenschaften? Innovationen, Revisionen, Binnenkonflikte.* Wozu Digitale Geisteswissenschaften? Innovationen, Revisionen, Binnenkonflikte (Lüneburg, Nov. 20–22, 2019). Ed. by M. Huber, S. Krämer, and C. Pias. under review. DOI: 10.31235/osf.io/d2kb6. Submitted.

[28] M. Piotrowski. "Digital Humanities: An Explication". In: *Proceedings of INF-DH 2018.* Ed. by M. Burghardt and C. Müller-Birn. Berlin: Gesellschaft für Informatik, 2018. DOI: 10.18420/infdh2018-07.

[29] G. F. Putnam. "Soviet Historians, Quantitative Methods, and Digital Computers". In: *Computers and the Humanities* 6.1 (1971), pp. 23–29. ISSN: 1572-8412. DOI: 10.1007/BF0 2402320.

[30] C. A. Romein et al. "State of the Field: Digital History". In: *History* 105.365 (2020), pp. 291–312. ISSN: 1468-229X. DOI: 10.1111/1468-229X.12969.

[31] C. Roth. "Digital, digitized, and numerical humanities". In: *Digital Scholarship in the Humanities* 34.3 (2019), pp. 616–632. ISSN: 2055-7671. DOI: 10.1093/llc/fqy057.

[32] T. Scheinfeldt. "Sunset for Ideology, Sunrise for Methodology?" In: *Debates in the Digital Humanities.* Ed. by M. K. Gold. Minneapolis, MN: University of Minnesota Press, 2012. Chap. 8, pp. 124–126.

[33] M. Tedre. *The Science of Computing: Shaping a Discipline.* Boca Raton, FL: CRC Press, 2015.

[34] W. G. Thomas. "Computing and the Historical Imagination". In: *A Companion to Digital Humanities.* Ed. by S. Schreibman, R. Siemens, and J. Unsworth. Oxford: Blackwell, 2004, pp. 56–68.

[35] J. Topolski. *Methodology of History*. Trans. by O. Wojtasiewicz. Synthese Library 88. Dordrecht: Reidel, 1976. DOI: 10.1007/978-94-010-1123-5.

[36] J. Topolski. *Metodologia historii*. Warsaw: Państwowe Wydawnictwo Naukowe, 1984. ISBN: 978-83-01-04987-4.

[37] P. Turnbull. "Margins, Mainstreams and the Mission of Digital Humanities". In: *Advancing Digital Humanities*. Ed. by P. L. Arthur and K. Bode. London: Palgrave Macmillan UK, 2014, pp. 258–273. DOI: 10.1057/9781137337016.