Looking through an unknown, remembered gate: Interdisciplinary meditations on humanities computing[1]

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Synopsis
Humanities computing is an interdiscipline concerned with the application of computing to the arts and letters. Although it has been practiced since the late 1940s, it has only recently begun to gain institutional recognition and a measure of self-awareness. In this contribution to the vigorous debate among practitioners, I argue for a common methodological ground shared by the computer-using scholars and students across the disciplines of the humanities. In large part because of the commons, these individuals tend to come together physically in laboratory settings as well as virtually online, pursuing traditional research goals by the means they now share or collaborating on numerous larger projects that computing has enabled. A useful model of their collaboration is Peter Galison's "trading zone", an anthropological-linguistic metaphor he uses to describe interchange among researchers and technicians of the Manhattan Project. Humanities computing functions like a merchant-trader in a Galisonian trading zone: it sees to a similar interchange of tools and techniques among the departmentalised cultures with which it deals, and for itself studies the effects and consequences. It thus exemplifies a true interdisciplinarity. Sufficient work has now been done that we may begin to map out a research agenda for the interdiscipline; this helps to identify the essential habits of mind and skills our colleagues and students must have to refurbish the humanities in the 21st Century. Computing presents the humanities with the need and opportunity to re-conceptualise and rebuild our inherited scholarly forms, which are as historically contingent as any human artefact. Rethinking how we do what we do in turn requires what Clifford Geertz has called "intellectual weed-control". The great project of humanities computing is to help in the construction of a world-wide digital library of resources and tools. Its role within this project is, I argue, primarily to articulate the powers of imagination that computing the humanities demands of us.

Introduction

Many stories are told of Edward Johnston, the father of modern calligraphy. He was, according to his daughter and biographer Priscilla, "one of those characters round whom stories accumulate irresistibly". Many of them attest to his deep love of lettering and – here is my point of entry – passionate commitment to explain his craft and its lore to anyone who would listen. A characteristic though possibly apocryphal instance occurred one day "when he was due to speak at the village hall in Ditchling", a village in Sussex where he lived for years. "[A] search party, setting out three-quarters of an hour after the advertised time of the lecture, found him half way along the road telling a passer-by what he intended to say."[2]

Years ago in Toronto, on numerous occasions I would stop by a local bakery on my way to the university. At the bakery I'd meet the probing curiosity of the baker, an intelligent, hard-working, self-educated man who started work at 4 a.m. I never did manage to explain to him how possibly I could get away with beginning so casually to do whatever it was that I did so late in the day – "Hasn't the school-bell rung already?" he would ask. My repeated failure to explain has stuck in my mind as paradigmatic of a central academic problem. Once upon a

time, formally uneducated taxpayers like him would revere higher education superstitiously, willing to support it without having any clear idea what it was. Now they want an explanation. Intelligent popularising, as in the sciences, would help but is only part of the answer we the humanities desparately need.

The root problem, I think, lies in the partiality of disciplinary specialisation. Jaroslav Pelikan, Sterling Professor Emeritus of History at Yale University, has observed that "the difference between bad scholarship and good scholarship is the result of what a student learns in graduate school, but the difference between good scholarship and great scholarship [lies in] the general preparation of the scholar in fields other than the field of specialisation."[3] Northrop Frye remarked somewhere that each discipline is the centre of all knowledge; but if you don't realise that ours is a world of many centres your view of it is narrow, both empoverished and empoverishing. From such a narrow view it is difficult to communicate to anyone who does not share that view.

Of course we need more dotty lecturers professing their informed enthusiasms to their postmen, and so convincing them to pay taxes in support of higher education, but my point is this: that specialised training may give you a solid place to stand, but interdisciplinary awareness allows you to see that this place borders on a large commons of sharable methods and ideas. From that follows not only a greater generosity of mind and disciplinary self-awareness, which great scholarship needs, but also the impetus to develop conversation with those who do not share your kind of training. It helps to identify what we have in common.

In the following I will examine in some detail a specific intellectual common ground for the humanities – the field known as "humanities computing". This interdiscipline has been practiced within the humanities for the past 50 years[4] but only recently has gained institutional recognition,[5] a measure of self-awareness and with that, a vigorous internal debate as to its nature and purpose.[6] This essay is intended not merely as a contribution to that debate but also as an open invitation to join it. To make the invitation attractive I attempt to demonstrate why it should matter to the disciplines from which it draws its raw material and back to which it returns challenging new problems and useful techniques.

Interdisciplinarity[7]

There are three things that interdisciplinarity in my sense is not. Most obviously it is not what specialists practice when they poach materials and ideas from other fields for their own purposes: for example, the application of psychoanalytic theory to English literary studies, or literary-critical methods to clinical psychology. Neither is it the

creation of a new field, such as anthropology, by exporting methods or concerns from an older one, such as classics, onto new material. Nor is it the systematic formation of a new field by extraction of shared interests from older ones, for example linguistics, which in my own institution is only now moving from a loose association of linguisticians in various departments into a department of its own. Interdisciplinarity almost happens when specialities come together in a taught programme but do not offer a unifying perspective. The students are left to put the pieces together, which is not only unfair – this is a very difficult task – but it also means that the result leaves with them.

Rather, an interdiscipline in my sense is constituted precisely by that unifying perspective on what happens at the intersection of two or more fields. This perspective gives the interdiscipline integrity and basis for its own research agenda, curriculum and publications. Nevertheless, as long as it remains an interdiscipline it depends on continuous activity in the intersecting fields. Preoccupation with what they share puts it in position to foster cross-fertilising exchange among them, as a merchant trader among mutually incomprehending cultures.[8] Thus it serves them, not as a servant his master but collegially – which has radical implications for its institutionalisation.

The American academic Stanley Fish has poo-pooed the idea.[9] Without question true interdisciplinarity is not easy to establish nor to maintain in a world defined by specialisations, however great the need, however pious the lip-service. But we have examples that show it can be done: some manifestations of comparative literature and cognitive science come to mind, though how much these fields pay back to the disciplines from which they draw I cannot say. In any case, humanities computing makes no sense to me as a scholarly field otherwise, and it definitely does pay back.

Methodology

The unifying perspective that makes humanities computing possible is methodology, that is, the study of method.

In brief, humanities computing studies the methods that its constitutive disciplines share as these methods survive translation into the mechanical form of computation. It enquires into the gap between what is known in these disciplines and what may be demonstrated by mechanical methods. It seeks to develop new analytical tools to explore this gap.

Because the field is so young, its practitioners are only beginning to sort out its inheritance, to decide which artefacts are digitised and how that is done. For this reason, at this historical juncture, humanities computing starts with what I call an *artefactual analysis*,[10]

that is, a detailed examination of how our inherited forms work, the interactive processes that their use implies. Such analysis makes us acutely aware that, to paraphrase I. A. Richards on the codex book, these artefacts are "machines to think with".[11]

In his essay "Imagining what you don't know" Jerome McGann points out that the mechanical perspective afforded us by computing opens our eyes to the complex and subtle mechanisms that have been developed over the centuries first for handwritten then printed books – marginal and interlinear glosses, footnotes, indexes, commentaries and referential gestures of many kinds.[12] These devices thus illuminated define a great challenge for the new medium and a badly needed corrective for the hyper-enthusiasms of its more ardent proponents. At the same time, our inherited objects – the dictionary, edition, commentary, essay and the like – are hardly timeless, Platonic forms. We have relearned recently the extent to which these venerated objects are historically contingent, based on ideas of language and styles of thinking that, as the Cambridge classicist Simon Goldhill has said about the traditional commentary, we may regard as obsolete or significantly limiting.[13] Thus, for example, a textual edition that presents an idealised *Urtext* constructed by painstaking elimination of "corruptions" implies a very different view of textuality from both the medieval exegete's and the postmodernist's, whose problematising perspective wants a means of exploring the plurality of the text, not reducing it.[14] Similarly commentary-makers, at least in classical studies, are now struggling with the opposed tendencies in the inherited genre to solve problems or, as Fowler recommends, to make them worse.[15]

New methods of analysing data and constructing new forms of expression offer opportunities for addressing the shortcomings we perceive in these inherited thought-machines, or more precisely for experimenting with alternatives. In any case, strict imitation across the technological divide never works for long. New tools inevitably bring with them new tendencies of thought and action.

Allow me here a brief warning. Beware of personifying these tools. Beware even more of personifying the abstract notion of "technology" – as if technology, like a person, could *do* anything. The danger is the determinisms which follow. We are fatally apt, that is, to resign our freedom of will to the products of our own minds. As Northrop Frye used to say, we invent the wheel, then act as if a Wheel of Fortune governed our lives; we invent the book, then live in fear that our names will be omitted from the Book of Life. Not to see that we invented the computer, to treat its advent into the humanities as an alien invasion, first feared now welcomed as a saviour, is to miss the connection with ourselves and what we do that gives its use genuine significance in the humanities.

So far I have used the word "methodology" to denote the object of study in my field. Let me now shift its meaning to how we do this, i.e. to focus not on the products of humanities computing but on the basic processes of research in the field, to its scholarly core. There are several ways of dividing up the activity, about which I see very little consensus among my colleagues, in fact much disagreement. But as Jonathan Culler points out for English studies, the Edenic myth of foundationalism – of a lost original unanimity – is a way of constructing our disciplinary past that obscures the health to which vigorous disagreement attests.[16] There never was any such unanimity in English studies, nor do we need to have any in humanities computing. But we do need to be able to give a coherent account of ourselves from time to time.

In that spirit let me resolve the methodology of humanities computing into three kinds of research, which I call the *algorithmic*, the *metatextual* and the *representational*.[17] I proceed now to discuss these three in turn, then to say what I think they have in common.

Algorithmic research

Algorithmic research in the humanities defines and studies fully automatic ways of investigating texts, images and music. It is called "algorithmic" because its focus is the completely explicit recipe of tightly related actions that computer scientists call an "algorithm". (The word goes back to the 9th century Arab mathematician al-Khowarazmi, "through the translation of whose work on Algebra, the Arabic numerals became generally known in Europe", *OED*.) Algorithms are designed for execution on a computer; they are the basis of computer programs.

When we attempt to translate scholarly practice into series of such recipes, much of course vanishes from sight. (More about that important point later.) Of what remains very little if anything has to do with the disciplinary context; as it turns out, the recipes chiefly depend on the kind of data under consideration – discursive or tabular text, numbers, images, sound. A given concatenation of recipes can be very specific to the occasion, of course; indeed, sometimes a discipline or problem will by its nature require very specific tools. Nevertheless, our experience suggests that as a rule the demands of particular research problems can be met by such a concatenation of common, sharable components, analogous if you will to the letters of an alphabet out of which an indefinitely large number of words may be spelled in many languages. Part of the research agenda for humanities computing is thus to discover what these sharable components are, more precisely to define the *mechanical primitives* of research. Such interoperable primitives, comprising an open "toolbox" for research, are without doubt clearly more economical (in the widest sense of the word) than software custom-built for every distinct application.

The current state of affairs for the practicing humanist (i.e. scholar in the humanities) is, as many know painfully, not as simple or satisfactory as I may seem to have suggested. Mostly like Odysseus on his homeward journey we must sail between two less than pleasant alternatives: on the one hand, roughly assembled bits of commercial and academic software; on the other, smoothly operating but closed systems, which require (as we say not inaccurately) a "religious" commitment. I wish to sketch out here, however, a picture of my field in what Jerome McGann calls the future-perfect tense, as if what we need to happen *will have been done*.[18] At the same time it is absolutely essential that we avoid thinking in the indefinite future tense of the promotional rhetoric that vexes computing. We hear it in glib statements that the next release of hardware or software will solve whatever problem. More seriously it permeates the rhetoric of "strong AI", in the many predictions that by year X we will actually have realised what Douglas Hofstadter calls the "Boolean Dream" of autonomous devices.[19] This is a fascinating dream dating back to the self-actuated tripods that serve the fire-god Hephaistos in the *Iliad* of Homer, but that's another story.[20] A paradox, then? Only if one cannot recognise in current difficulties the difference between practical impediments and opportunities for asking better questions.

Asking ever better questions is for the humanities *the* central activity. Later I will return to this activity to say how I think it takes shape and place within computing so that this becomes *humanities* computing. For now, however, I want to complete my sketch of how we do what we do under the two remaining headings, the metatextual and the representational.

Metatextual research

Metatextual research seeks to bridge the gap between computing and our cultural artefacts by devising and attaching computationally friendly categories, then manipulating the categories rather than the original data. It is so called because it centres on "metatext", that is, information about a text or, by extension, about any other kind of primary material. Metatext is, if you will, the body-language of the artefact rendered in explicit form.

If we look, as is our habit, to printed books, we find such examples as words like "book" or "chapter"; textual or graphical signs, such as Roman numerals or decorative markers; typographic features, like italics or boldface; layout, including blank space; and so forth. Each of these implicitly guides or influences reading. Although we seldom have much trouble decoding them – indeed, we seldom pay much conscious attention to them at all – they vary arbitrarily in meaning across professions, nations, languages and cultures, sometimes among books with overlapping readerships, and so require significant

interpretation. Clearly we must be drawing on tacit, unconscious knowledge and an ability to infer the meaning of new signs by analogy with old ones. Because we unwittingly take on the cognitive burden of decoding such metatext, we are apt seriously to underestimate how much of it we do even in reading the simplest, most straightforward text. To return to an earlier point, this becomes quite clear when a text is translated into "computer-readable" form, since what the translator considers to be its relevant metatext must also be translated.

Two examples: chapter divisions and italics.

The beginning of a chapter in a novel may be marked in an indefinite number of ways – explicitly, by the word CHAPTER followed by a number and perhaps a title; implicitly, by the number or title alone; by a graphic of some sort; by space; and so forth. *How* we know an implicit designation marks a chapter is not at all a simple matter; indeed, we may not know if what it marks *is* a chapter. Furthermore a title or other sign may implicitly convey information essential to the understanding of the text it marks. In Barbara Kingsolver's novel *The Poisonwood Bible*, for example, the title of each chapter-like subdivision names the character who tells that part of the story rather than identifies its subject. (This includes the final chapter, which is without a title because it is told by the *muntu*, the nameless "spirit" of a dead child.) There can be no doubt whatever about what Kingsolver is doing but, because the fact is nowhere indicated explicitly, we face what seem to be insuperable difficulties in describing *how* we know it so that a computer could generate the same result automatically. In general useful retrieval and analysis of text by computer depends on being able to express that *how* computationally.

Italics is a simpler case, since it is a singular formatting effect, not a structural idea that may be expressed in several different ways. Words can be italicised for many reasons, however: to give emphasis, mark a foreign language, denote the title of a book, indicate quotation, distinguish another (but unquoted) narrative voice – the list cannot be closed because the meaning of italics, like other metatextual signs, is open to innovation. Again, the fact of italicisation is not at issue for computation; its meaning is, and that in general lies beyond algorithms. Hence as with the previous example, the interpretations that readers perforce must make in order to make sense of a text need to be carried over somehow into the electronic text. This carried-over, *computational* metatext we call "markup".

Two points. First, interpretation cannot be avoided, and on the whole it requires case-specific human input. Second, I am making no claims about what lies permanently outside the ability of algorithms to accomplish. I note, however, that even quite ordinary acts of reading include interpretation we cannot even imagine a general algorithmic solution for. The difficulties get much, much worse for literary

scholars like me, of course: for example, identifying personifications – inanimate things, plants or animals that become persons in the course of a story, sometimes very briefly, then perhaps revert to their former state. Design of an algorithm for personification is stopped cold by the fact that we cannot even satisfactorily define the linguistic conditions involved nor imagine how some of those might themselves be defined exactly. Thus in my work on the Roman poet Ovid's *Metamorphoses*, whose approximately 500 personifications I identify, I must resort to markup.[21] Please note, however, that in respect of the issues in question here, a markup of the *Guardian* newspaper is essentially no different, nor would be a recorded and transcribed conversation in my local pub.

Philosophical arguments massed against the triumph of algorithms make our pragmatic reliance on interpretative markup easier to live with.[22] In any case essential to our practice, and to the broader realism with which I recommend computing be taken, is that the shortcomings of the machine be faced now, not postponed into an indefinite future, as I said earlier. The result is not so much confidence in markup (which is *very* labourious, hence expensive to encode), but a seriousness that leads to rigorous examination of its characteristics and consequences. This is where some of the more important scholarship in humanities computing takes place.

Markup may be thought of as comprising simple declarative statements put into a text, encoded so that no confusion with the primary text is possible. (Think of stage-directions in a play.) These statements we call "tags". A tag can assert anything at all; I can declare magisterially that word X in location Y denotes a personification – full stop. (This is more or less what some people have done in printed texts of the *Metamorphoses* by capitalising the words in question.) The ability of the computer instantly to bring all such declarations together, however, means that inconsistencies are revealed. The user asks, why is X so tagged in location Y but not in location Z? Given no satisfactory answer, he or she loses confidence in the work because it does little more than to reflect someone else's unjustified opinions, or perhaps only carelessness. Scholarship inevitably reveals the scholar, I suppose, but if the scholar is not reasonably successful in reaching beyond the self, then to my mind the result isn't scholarship and certainly isn't very interesting.

Thus marking up a text is governed by two computational imperatives: total explicitness and absolute consistency. Markup renders the implicit explicit, leaving nothing (as we say) to the imagination – that is its nature and only purpose. But it must do so with as close to absolute consistency as possible (and there's the rub I'll get back to). From the effort two objects result: the marked up text and, if the work is done properly, the set of rules or descriptive grammar that like an algorithm or program formalises the scholarly analysis in something

like repeatable form. To return to my own case, I have then a grammar of personification derived from the text of Ovid. This serves to explain how I have done my work, but it also enables me or someone else systematically to investigate personification in other authors, and so promises a broader and much improved understanding of the literary phenomenon. Since Ovid was one of the most influential writers in the Western tradition, one has reason to think this a good beginning.

The rub is, as the linguist Edward Sapir said, "All grammars leak".[23] A grammar, like a mathematical proof, may be a beautiful thing, from which one can learn. Research, however, moves on, from what mathematicians call the "trivial" (i.e. proven or established) to the problematic residue. It moves to the leaks in the grammar, the exceptions and anomalies, which hold the possibility of better questions and a more inclusive grammar. So, in a sense failure is the most important result of all. Again, I will return to this point later.

Representational research

The third branch of research in humanities computing, which I call *representational*, concerns the re-presentation of data in differing formats and how this affects our perception of them.

There are two parts to this. First are the computational transformations in appearance or format, such as rearranging a text, changing attributes of an image or altering a musical sequence, which change our perception of the data in question and may illuminate previously undetected patterns. A scholar in the field of application may treat them as "black-box" transformations, learning from them without ever knowing or caring how they work, but for humanities computing the question of how is of great interest. To us they are or must become "glass-box" processes. Studies of the perceptual affects are scattered through several disciplines, from art history and psychology through cognitive science and interface design to typographic theory.[24] The graphical capabilities of modern computers, developed particularly in image-manipulation and scientific visualisation software, bring new emphasis to the importance of what Rudolf Arnheim has called "visual thinking",[25] which applies to the visual representation of all data-types, including sound. The new field of music information retrieval brings cognate analytical and synthetic tools to bear and leads to fundamental questions in musicology.[26]

Allow me one philological/linguistic example, namely the design of the so-called KWIC (or "keyword-in-context") concordance. Prior to the late 1950s concordances were based on extracts of syntactic units – phrases, lines of poetry, etc. – clearly meant to be read. In 1959 H.P. Luhn reported on a new design, intended for the automatic processing of technical documents, in which word-forms were centred and highlighted on the page and given an arbitrary amount of context on

either side – thus keyword-in-context.[27] In the KWIC, *target words* form (as the inventor said) "a column which guides the eye" – and so the mind. Together with the brutal-seeming disregard for syntax with which the arbitrarily fixed amount of context assaults the eye, such reformatting redirects attention away from reading to a study of the words' immediate linguistic environment. This mere shape-change seems thus to have caused, catalysed or otherwise stimulated profound changes in our view of language through subsequently developed techniques in corpus linguistics. With it, and the increasing amounts of available electronic text, linguists began to study how words are actually used in ordinary discourse rather than relying on intuition.

The second part of representational research focuses on the so-called "electronic book", a useful but ill-defined term to denote products of the electronic media that appear to serve roughly the same functions as the mss. and printed codex. I categorise work on the e-book as representational because, as I will argue, its emerging central characteristic is its Protean capability for re-presenting basic resources in new contexts. Much has been and will continue to be said about the electronic book.[28] I have scope here only for a few observations.

Again, the familiar physical object is of course where we as humanists begin, but using the codex as a model, either to imitate or transcend, requires great caution. One of our most serious intellectual difficulties here is with the inseparability of form and content. Two seriously misleading assumptions cloud the issue. The first is that tools are essentially unrelated to what we make with them, as if, for example, the wood-chisel had nothing to do with Donatello's *Mary Magdaline* or the edged pen nothing to do with Italic handwriting. Thus we hear the ignorant, dismissive comment that the computer is "just a tool". The second, closely related assumption is that knowledge is reducible to inert information, which like the Pythagorean soul can pass unaffected from one physical form to the next.[29] At least in humanities computing, William Blake's declaration in *The Marriage of Heaven and Hell* is a better guide:

> Man has no Body distinct from his Soul; for that call'd Body is a portion of Soul discern'd by the five Senses, the chief inlets of Soul in this age.

We also tend conveniently to overlook the lesson from economics and history, that once incorporated into our institutions and ways of life new media of communication are bound to have profound system-wide effects, altering even the terms in which we think and frame our questions.[30] These effects, Geoffrey Nunberg notes,[31] are by nature unpredictable. The forecasts we have in cloying abundance go wrong, as he points out, by naturalising contingent features of the current order of things (for example as futurologists of the 1950s predicted in

detail how the house*wife* of the future would do *her* work). Furthermore, we cannot even see very clearly how the electronic media are essentially different: historical knowledge of the book, of printing as a whole and of other technological inventions blunts the specific revolutionary claims made by new media prophets and, again, highlights the crucial role of unpredictable, contingent events.

It is not, however, a counsel of despair to be told we cannot know what fate will bring *because there is no such fate*. Once the deterministic rubbish has been removed, we are liberated heuristically 'to imagine what we do not know'[32] by building it. Duly cautioned I thus want to leave you with idea of what now is being built and how it might allow us humanist scholars to change the ways we work. This is, if you will, a vision of desire, following Gaston Bachelard's observation in *The Psychoanalysis of Fire* that we are creatures of desire, not of need.[33]

In the sense that the codex is defined by its binding, and so by fixed contents presented (though of course not necessarily accessed) in a fixed sequence, the electronic entity may be defined by its *unbinding*, that is, by the potential for variable contents in reader-determined sequence.[34] For the humanities unboundedness is important because, as with mechanical primitives, it allows new works to be built from independently developed components, such as textual editions, databases, lexicons, commentaries and the like. The continuing growth and development of the Internet, especially now in the form of the World Wide Web, raises the distinct possibility of a worldwide "digital library" of such component resources. We can thus begin to imagine that in the relatively near future a scholar might put together a commentary tailored to his or her own purposes from available components. Allow me briefly to explore the intellectual and practical consequences.[35]

The chief technology involved in the digital library is of course hypertext,[36] which in broad terms we may define as comprising two fundamental ideas: *citation* and *morselisation*. From the perspective of the printed book, that is, hypertext uses the single device of the link to serve two distinct but related purposes: referencing things not immediately present (as in bibliographic citations or literary allusions), and sequencing the parts of a document. In the codex, physical sequence determines a unique, primary structure, however many others may be allowed by tables of contents, indexes and random-access pagination. Hypertext more or less requires division into chunks or morsels, for which a preferred sequence may be suggested by links but in the end is determined by the user. Reader-determined sequencing leads to many interesting problems, such as how to conduct an argument hypertextually. My point here, however, is that hypertextual morselisation changes how writers work as well.

Suppose, for example, that I am writing an electronic commentary on Euripides' *Bacchae* in the context of such a digital library, where component parts of historically important commentaries and other reference materials are accessible online, as distinct morsels. I would likely want to incorporate some of them in my own work, but – this is my point – because of the context in which I am working, I would need to think about how to write my components so that when re-used and so recontextualised by someone else they would make best sense. How such a situation (towards which many researchers are working) would affect the making of new commentaries and other documents is a question for which we have hardly begun to seek an answer.

Hypertext research is multidisciplinary, involving scholars in the humanities, computer scientists and others. Unfortunately the humanists, who work on the history and theory of referential gestures, tend not to talk to the builders of systems and *vice versa*; as a result both are impoverished. One task of humanities computing is to see that the needed conversation takes place.

As I said earlier, imagining how our inherited forms of scholarship will be manifested in the new medium begins with an artefactual analysis and reveals the complex subtlety of the print-based mechanisms developed over the last many centuries. Computer scientists such as Steven DeRose, Frank Tompa and Darrell Raymond have repeatedly pointed out that understanding these is a *sine qua non* for an adequate conception of hypertextual linking.[37] Such understanding needs better analytical tools, principally for allusion, intertextuality and literary structure, than we tend to find under the rubric of hypertext research. The computational perspective in turn requires rethinking of these tools, and so promises to enlarge our theoretical grasp. Then, too, scholarship has a communal, sociological dimension from which computing learns and which it affects. Researchers such as Catherine Marshall have shown the complexity of behaviour in how people take notes and annotate texts, for example.[38] Sophisticated research systems result – to which, alas, most of us cannot get access. We have every reason to be utterly unimpressed with the dumbed-down idea of linking that the Web uses.

The artefactual analysis we require need not be from a technical perspective. The Judaic historian Steven Fraade, for example, has written a brilliant account of rabbinic commentary as a socio-historical and literary process.[39] Although his analysis is far from anthing that might be implemented, his dynamic, interactive model of the commentary illustrates the kind of thinking on which a powerful design for an electronic commentary might be based. Once again, the perspective of computing highlights certain things, and so makes us realise that the new has either been there all along, or perhaps that computing is only one among several ways in which it has surfaced in recent times.

Another computer scientist, John B Smith, pointed out a few years ago that no builder of hypertextual systems can afford to ignore the Web, even if its idea of linking is simplistic, because it is the infrastructure for computer-assisted work.[40] Much improvement in the semantics of online linking needs to be made, and we humanists are really the ones to say how this should be done. Again, this means research for us into what we do not know, or now realise that we do not know well enough, not simply pronouncements from superior command of cultural knowledge. Another main impediment to a worldwide digital library is the problem of how to make independently designed components *interoperable*, that is, successfully to communicate with each other.[41] There are doubtless a myriad of difficult technical problems here, but research in humanistic disciplines and in humanities computing needs to deal with related questions specific to the resources we use. Under any conceivable circumstance what, for example, does a lexicon say in response to an ambiguous query?

Thinking future-perfectively about this digital library, we also need to imagine the consequences, then ask for example, do we want to move in the direction of the do-it-yourself commentary?[42] Will this address the problems we have with the dominant commentary form? What new problems will the DIY commentary bring? One we can immediately foresee is what Paul Duguid calls the individuation of scholarly work, or the privitisation of results.[43] If I use my own DIY commentary, how will anyone else be able to trust my results? How do I document my sources?

Again, opportunities to rethink how we do what we do, and so inevitably also to rethink what we do, crowd into the academy. Historically such opportunities are very rare. As in the proverb, we live in interesting times. (And if I were marking up these words, how would I encode my deliberately ironic misquotation of a curse, not a proverb, variously attributed to unnamed Chinese or Jewish sources? What would I learn about referentiality in this and similar attempts?)

Common ground

At the outset I identified three branches for humanities computing research: algorithmic, metatextual, representational. I have described each of these in turn and now wish to reward your patience by fulfilling my promise to draw together the common threads, to identify what is most characteristic of the field I have come to inhabit.

Like all other fields in the humanities, mine draws its vitality and justification from research. Part of our trouble these days stems from pervasive misunderstanding of what this is, or when it is understood, even why we need it. Research, in its so-called “pure” form, is indeed a curious activity: in essence a searching without specific goal, though it

is usually triggered by something in particular. It works not by solving problems but, as the classicist Don Fowler said about the good commentary,[44] by making them worse, by problematising the unproblematic, by unearthing what has been covered over or explained away or simply not seen. In *Changing Places* David Lodge's comic professorial villain Morris Zap aims precisely at what research is not: his commentary of commentaries on Jane Austen will, he asserts, do its job so well that henceforth all discussion of, writing about and reading of Austen will cease. What makes this so funny, of course, is that such *definitive* work is the secret, or not-so-secret, goal of so many.

In the humanities, research in my sense is perforce normal, since there's very little to which our kind of knowledge *can* be applied. (Except, of course, life here below….) Humanities computing feels the misconstruction of research especially keenly because, as an applied field, so much attention is directed to its real or putative successes in the fields of application. Thus my particular stress on the necessity of the open-ended, serendipitous problem-*making* to which all three branches of my field lead.

My argument that humanities computing makes problems rather than solves them is based on the idea, which we share with the sciences, that the computer is in essence a *modelling* machine.[45] With it, that is, we build models of a reality or proposed reality which we wish to study. By "model" here I mean not only a model "of" rather than a model "for",[46] but more specifically a manipulable device, something with which we can experiment to try out an idea, a construct or observation. A model is of course useless for research if it is not well-built or fails to suit the purpose through a flaw of design. If it performs perfectly, however, it ceases to be interesting from a research perspective, however usefully or elegantly it represents what it models. For it to advance research directly, it needs to violate our expectations, either by working when it shouldn't or by coming as close as we know how to get, yet failing in some particular that brings the modelled idea into question.

Failure is not just useful, it is also inevitable, since models are not true: they are, as the philosopher of science Nancy Cartwright says, pragmatic "works of fiction",[47] mechanical renderings of an idea about something, not the thing itself. In the humanities, one seldom if ever fails to notice that the model lies; the tools we have in respect of our data are staggeringly crude. But the knowing use of crude tools, which American physicists have called "tinkertoy modelling",[48] is nevertheless valuable. It is especially so in the humanities, where as my colleague John Unsworth has noted, our very smart data needs only relatively dumb tools to begin yielding its secrets, whereas the relatively dumb data of the natural sciences requires very smart

tools.[49] Certainly our advances are often in consequence of applying conceptually very simple transformations.

In humanities computing, then, we value what the algorithmic procedure fails to do, focus on leaks in our metatextual grammars, wonder what is in those black boxes and look to the approximate nature of our re-presentations. This is not to value the engineering any the less, since without good engineering failures are trivial. Then, too, institutionally humanities computing functions as merchant trader in methodological goods that have to be "worth the candle", as we used to say. But without the drive toward ever better, which is to say, ever more challenging questions, computing would not be *of* the humanities, however much it may be *in* them.

Thus my title, *Looking through an unknown, remembered gate*. This paraphrases a line from near the end of "Little Gidding", the last of T.S. Eliot's *Four Quartets*:

> We shall not cease from exploration
> And the end of all our exploring
> Will be to arrive where we started
> And know the place for the first time.
> Through the unknown, remembered gate
> When the last of earth left to discover
> Is that which was in the beginning…

I will not quote the triumphant remainder, as that would exceed the bounds of this essay. But it is just right to suggest that work in humanities computing follows the larger, ancient pattern of *human* explorations, and that if we use our most marvellous invention well, we will be continually arriving at where we started, continually knowing it for the first time. If *that* is not of the humanities as a whole and individually, then as Peter Winch remarked about a popular philosophy, we will have to consider where we took the wrong turning.[50]

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[1] Originally delivered as the Lansdowne Public Lecture, University of Victoria (Canada), 12 February 2001.
[2] P. Johnston: *Edward Johnston*, 1959, p. 267; London: Faber and Faber Limited
[3] J. Pelikan: *The Idea of the University: A Reexamination,* 1992; New Haven, Yale University Press. Quoted by B. E. Frye: "Introduction", in *The Humanities and the Sciences*, ACLS Occasional Paper 47; New York, The American Council of Learned Societies (http://www.acls.org/op47-1.htm, ,13/8/01). See esp. Pelikan on the idea of the scholarly community, pp. 57-67.
[4] The major bibliographies are G. Adamo: *Bibliografia di informatica umanistica*, Vol. 5 of *Informatica e discipline umanistiche*, 1994; Roma: Bulzoni Editore; I. Lancashire: *Humanities Computing Yearbook 1989-90*, 1991; Oxford: Oxford University Press.
[5] For an accounting and taxonomy of humanities computing centres, see W. McCarty and M. Kirschenbaum: "Humanities computing units and institutional resources", 1999 (http://ilex.cc.kcl.ac.uk/wlm/hc/, 14/8/01).
[6] For the debate itself see the essays listed on my homepage (http://ilex.cc.kcl.ac.uk/wlm/, 15/8/01); J. Unsworth, comp: "Is Humanities

Computing an Academic Discipline?" An Interdisciplinary Seminar", 2000; Charlottesville VA, Institute for Advanced Technology in the Humanities, University of Virginia (http://www.iath.virginia.edu/hcs/, 15/8/01) and the essays referenced there; those by Tito Orlandi (http://rmcisadu.let.uniroma1.it/~orlandi/, 15/8/01); and the many discussions over the last few years on the *Humanist Discussion Group* (http://www.kcl.ac.uk/humanities/cch/humanist/, 14/8/01).

[7] For the literature see W. H. Newell, ed.: *Interdisciplinarity: Essays from the Literature*, 1998; New York: College Entrance Examination Board.

[8] The metaphor is a very fruitful one, which I have developed from Peter Galison's powerful anthropological/linguistic metaphor of the "trading zone", for which see P. Galison: *Image and Logic: A Material Culture of Microphysics*, 1997; Chicago, University of Chicago Press, chapter 9 especially, but also chapter 1 and sections 3.11, 6.7, 6.11, 8.1, 8.5, 8.7). See also W. McCarty: "Humanities computing as interdiscipline", *Is Humanities Computing an Academic Discipline?*, 1999; Charlottesville VA, Institute for Advanced Technology in the Humanities, University of Virginia (http://ilex.cc.kcl.ac.uk/wlm/essays/inter/, 14/8/01); W. McCarty: "Humanities computing: essential problems, experimental practice", *Literary and Linguistic Computing*, forthcoming 2002.

[9] S. Fish: "Being Interdisciplinary Is So Very Hard To Do", *Profession* 89: 15-22; rpt. in W. Newell, pp. 239-49 (see note 7).

[10] W. McCarty: "A Network with a thousand entrances: Commentary in an electronic age?", in Roy K. Gibson and Chris S. Kraus, eds., *The Classical Commentary*, forthcoming 2002; Leiden: Brill Academic Publishers.

[11] I. A. Richards: *Principles of Literary Criticism*, 2nd edn., 1926; rpt 1960, p. 1; London, Routledge & Kegan Paul; see also P. Duguid: "Material Matters: The Past and Futurology of the Book", in G. Nunberg, ed.: *The Future of the Book*, 1996; Berkeley: University of California Press, pp. 63-101. An earlier version, "Material Matters: Aspects of the Past and Futurology of the Book", is online (http://www.parc.xerox.com/ops/members/brown/papers/mm.html, 14/8/01).

[12] J. McGann: "Imagining what you don't know: the theoretical goals of the Rosetti Archive", 1997 (http://jefferson.village.virginia.edu/~jjm2f/chum.html, 15/8/01).

[13] S. Goldhill: "Wipe Your Glosses!", pp. 380-425, in G. W. Most, ed.: *Commentaries – Kommentare*, Aporemata: Kritische Studien zur Philologiegeschichte, Band 4, 1999; Göttingen, Vandenhoeck & Ruprecht. Compare Peter Galison's argument that the idea of objectivity is historically contingent, in P. Galison: "Objectivity is Romantic", pp. 15-43, in *The Humanities and the Sciences* (see note 3); "Judgment against Objectivity", pp. 327-59, in C. A. Jones and P. Galison, eds., with A. Slaton: *Picturing Science, Producing Art*, 1998; London: Routledge; L. Daston and P. Galison: "The Image of Objectivity", *Representations* 40, Fall 1992, 81-128.

[14] P. Robinson: "The One Text and the Many Texts", Special Issue on Making Texts for the Next Century, ed. Peter M. W. Robinson and Hans W. Gabler, *Literary and Linguistic Computing* 2000, 15.1, pp. 5-14.

[15] D. Fowler: "Criticism as commentary and commentary as criticism in the age of electronic media", in G. W. Most, ed., p. 442 (see note 13).

[16] J. Culler: *Framing the Sign: Criticism and its Institutions*, 1988; Oxford, Basil Blackwell, pp. 41-56.

[17] The following summarises the argument in W. McCarty: "Humanities computing" (see note 8).

[18] See note 12.

[19] D. R. Hofstadter: "on seeing A's and seeing As", in G. Güzeldere and S. Franchi, eds.: "Constructions of the Mind: Artificial Intelligence and the Humanities", *Stanford Humanities Review* 1995, 4.2, pp. 109-21 (http://www.stanford.edu/group/SHR/4-2/text/hofstadter.html, 14/8/01).

[20] *Iliad* 18.376f; see my humorous treatment of this story in W. McCarty: "Language, Learning and the Computer: desultory postprandial investigations", in Peter Liddell, ed.: *CALL: Theory and Applications*, Proceedings of CCALL2/CCELAO2, The Second Canadian CALL Conference, 1993; Victoria BC, University of Victoria (http://ilex.cc.kcl.ac.uk/wlm/essays/ccall/language.pdf, 14/8/01).

[21] W. McCarty: "*An Analytical Onomasticon to the Metamorphoses of Ovid*: Online Sampler", 1999 (http://ilex.cc.kcl.ac.uk/wlm/onomasticon-sampler/, 14/8/01).
[22] As a place to begin, see G. Güzeldere and S. Franchi (see note 19), also W. McCarty, "Humanities computing" (see note 8).
[23] E. Sapir: *Language: An Introduction to the Study of Speech*, 1921; New York, Harcourt Brace.
[24] For art history (with aspects of psychology), see for example R. Arnheim: *Visual Thinking*, 1969; London, Faber and Faber. For psychology see P. Wright: "The psychology of layout: consequences of the visual structure of documents", in *Using Layout for the Generation Understanding or Retrieval of Documents*, ed. Richard Power and Donia Scott, American Association for Artificial Intelligence Technical Report FS-99-04, 2000, pp. 1-9. For graphical semiology see J. Bertin: *Sémiologie Graphique*, 1967; Paris, Mouton / Gauthier-Villars, trans. *Semiology of Graphics: Diagrams, Networks, Maps* by William J. Berg, 1983; Madison,: University of Wisconsin Press. For design theory see E. R. Tufte: *The Visual Display of Quantitative Information*, 1983; *Envisioning Information,* 1990; *Visual Explanations: Images and Quantities, Evidence and Narrative,* 1997; Cheshire MA, Graphics Press; *Genre and Multimodality*, 2000; Sterling: University of Sterling (http://www.gem.stir.ac.uk/, 15/8/01). For typographic theory see F. Baudin: *L'Effet Gutenberg*, 1994; Paris, Ed. du Cercle de la librairie. For software design see M. Petre, A. Blackwell and T. Green: "Cognitive Questions in Software Visualisation", pp. 453-80, in J. . Stasko, J. . Domingue, M. H. Brown, and B. A. Price, eds.: *Software Visualisation*, 1998; Cambridge MA, MIT Press. For the field of new media studies, which potentially embraces all of the above, see L. Manovich: *The Language of New Media*, 2001; Cambridge MA, MIT Press.
[25] R. Arnheim (see note 24).
[26] P.-Y. Roland, E. Cambouropoulos and G. A. Wiggins, eds.: "Pattern Processing in Music Analysis and Creation", Special issue of *Computers and the Humanities* 35, 2001.
[27] H. P. Luhn: "Keyword-in-Context Index for Technical Literature (KWIC Index)", in *Readings in Automatic Language Processing*, ed. David G. Hays, 1966; New York, American Elsevier.
[28] Possibly the best book on the subject remains G. Nunberg, ed. (see note 11), esp. the essays by Nunberg, Duguid, Debray, Hesse, O'Donnell, and the afterword by Eco.
[29] Nunberg's deconstruction of what he trenchantly calls "the impression of information" is essential reading; see G. Nunberg: "Farewell to the Information Age", pp. 103-38, in G. Nunberg, ed. (see note 11). I summarise his argument in W. McCarty, "Network with a thousand entrances" (see note 10).
[30] W. McCarty, "Network with a thousand entrances" (see note 10).
[31] G. Nunberg, "Farewell to the Information Age" (see note 29).
[32] This is a paraphrase from L. Samuels: "Introduction", Special issue, "Poetry and the Problem of Beauty", *Modern Language Studies* 27.2, 1997 (http://wings.buffalo.edu/epc/authors/samuels/beauty.html, 14/8/02); see also J. McGann, "Imagining what you don't know" (see note 12).
[33] "Aussi haut qu'on puisse remonter, la valeur gastronomique prime la valeuralimentaire et c'est dans la joie et non pas dans la peine que l'homme a trouvé son espirit la conquête du superflu donne une excitation spirituelle plus grande que la conquête du nécessaire. L'homme est une création du désir, non pas une création du besoin", G. Bachelard: *La Psychanalyse du feu*, 1938, p. 39; Cinq[me] edn. Collection Psychologie 7; Paris, Gallimard; trans. *The Psychoanalysis of Fire,* by Alan M. Ross, preface by Northrop Frye, 1964; Boston MA, Beacon.
[34] The reader may access the segments of a codex book in whatever order he or she pleases – indeed, the relative random-access allowed by the codex marks perhaps the major innovation of the form. But the authorial (or editorial) presentation of sequence, fixed by the binding, comprises the difference with hypertextual authoring we need more closely to examine. Arguments for or assertions of a revolutionary non-linearity in hypertext have, however, muddied the waters; see esp. J.-F. Rouet, and J. J. Levonen: "Studying and Learning with Hypertext: Empirical Studies and their

Implications", pp. 9-23 in J.-F. Rouet, J. J. Levonen, A. Dillon and R.J. Spiro, eds.: *Hypertext and Cognition*, 1996; Mahwah NJ, Lawrence Erlbaum; see also A. Dillon: "Myths, Misconceptions, and an Alternative Perspective on Information Usage and the Electronic Medium", in the same collection, pp. 25-42.

[35] The following summarises an argument in W. McCarty, "Network with a thousand entrances" (see note 10).

[36] W. McCarty: "A serious beginner's guide to hypertext research", 2000— (http://ilex.cc.kcl.ac.uk/wlm/essays/achallc2000/hyperbib.html, 14/8/01).

[37] S. J. DeRose: "Expanding the Notion of Links", *Proceedings of Hypertext '89*, Association for Computing Machinery; S. J. DeRose and Andries Van Dam: "Document structure and markup in the FRESS hypertext system", *Markup Languages* 1, 1999, pp. 7-32; D. R. Raymond, and F. W. Tompa: "Hypertext and the *Oxford English Dictionary*", *Communications of the ACM* 37.7, 1988, pp. 871-9.

[38] See the references in W. McCarty, "Serious beginner's guide", III.B.1 (see note 36).

[39] S. Fraade: *From Tradition to Commentary: Torah and its Interpretation in the Midrash Sifre to Deuteronomy,* SUNY Series in Judaica: Hermeneutics, Mysticism and Religion, 1991; Buffalo NY, State University of New York Press.

[40] J. B. Smith: "The King is Dead; Long Live the King", keynote speech for Hypertext '97, Southampton UK, 6-11 April, *Proceedings of the eighth ACM conference on Hypertext*, 1997, p. 240.

[41] Interoperability appears to be not only the major technical problem of digital library research, it is also a problem no one knows how to solve. See A. Paepcke, C.-C. K. Chang, H. Garcia.-Molina and T. Winograd: "Interoperability for Digital Libraries Worldwide", *Communications of the ACM* 41.4, 1998, pp. 33-43.

[42] W. McCarty, "Network with a thousand entrances" (see note 10).

[43] P. Duguid, "Material Matters" (see note 11).

[44] D. Fowler, "Commentary as criticism" (see note 15).

[45] See my extensive discussion of modelling in W. McCarty, "Humanities computing" (see note 8).

[46] The distinction is made by Clifford Geertz: in a model "for" something, he notes, "what is stressed is the manipulation of symbol structures so as to bring them, more or less closely, into parallel with [a] pre-established nonsymbolic system, as when we grasp how dams work by developing a theory of hydrolics or constructing a flow chart…" In a model "of", however, "what is stressed is the manipulation of the nonsymbolic systems in terms of the relationships expressed in the symbolic, as when we construct a dam according to the specifications implied in an hydrolic theory or the conclusions drawn from a flow chart"; C. Geertz: *The Interpretation of Cultures*, p. 93, 1973; rpt. 1993; London, Fontana Press.

[47] N. Cartwright: *How the Laws of Physics Lie*, 1983; Oxford, Clarendon Press.

[48] The term refers to an originally wooden, now plastic construction set for children invented in the early 20th century; see N. Cartwright, p. 158 (see note 47).

[49] "If your data comes in relatively small amounts and is highly idiosyncratic and complex, then the amount of effort that would be required to produce software smart enough to infer meaning in dealing with that data is probably significantly greater than the effort that would be required to simply make explicit what is known or perceived by a human being looking at that data, and then let stupider software do the simpler but still useful tasks that humans can't do as quickly, or can't do as well. If your data comes in impossibly huge amounts and has data points or patterns that can only be perceived across very large data sets, then you better have smart software. If I want to use remote sensing to count the individual chestnut trees surviving in the Appalachian forest canopy, then I need smart software; if I want to compare patterns of arboreal imagery in metaphor in 19th-century vs. 20th-century American poetry, I need smart (marked-up) data." J. Unsworth, jmu2m@virginia.edu, e-mail 15/8/01.

[50] P. Winch: *The Idea of a Social Science and its Relation to Philosophy,* 1958, p. 2*;* London, Routledge and Keegan Paul.