

# Breaking out for Bologna 2010

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## Abstract

In 2008, the phrase “book breakout” was coined to capture the notion of going directly from the printed book to an online Internet resource (usually a web page). To describe this phenomenon in an historical context circa 2001 pre-9/11, Manuel Castell’s book “The Internet Galaxy” was used. It was named after Marshal McLuhan’s famous book “The Gutenberg Galaxy”.

The “book breakout” evolved rapidly into the “course breakout” and led uniquely to the first (?) “Internet-accessible open book examination” in the University of Dublin, Trinity College, where candidates were permitted to use “any materials that they see fit. In particular, personal computers, books and notebooks ...”. To resolve official issues at Trinity College level, the exam had to be (re-)classified as “practical”. Three such exams at undergraduate level have taken place. The process has been extended successfully to an MSc examination on “Numerical Methods and Mathematical Modelling” in 2009.

One of the key resources used both in course and exam was Wikipedia. Students were encouraged not only to use it, but also to criticise it and to edit it. This process was particularly challenging for the MSc Mathematics course.

Ideas for Bologna breakout are proposed.

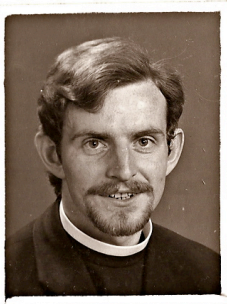
Keywords: backstory, Bologna process, breakout, Internet, Network, Web

## 1 Backstory

“I was already a secondary teacher in St. Fintan’s High School, Sutton, Dublin, when I undertook to obtain a university degree in Mathematics. At that time I was living in the Burrow Road, Sutton, which fronted onto the beach. I had two major problems to overcome: (1) I could not give up the day job (of teaching) and, in the circumstances, I would have to do the degree by ‘private study’ through the University of London [1] (which was in charge of the general process in the (former) British Empire) [2]. The Open University[3] existed at the time (circa 1973) but was not regarded as being ‘suitable’ and there was no Internet as we now know it.

To do the degree by ‘private study’ was a simple affair. One had an outline of the syllabus of each course in question. And one had a list of books to which the lecturer referred. That was it. At the end of the year there was an examination held in each subject in a specially organized centre. For me it was in Carlow.

The degree course took up five years of my life, for one of which I had sabbatical leave. I graduated in January 1978 and received my parchment from the hands of the Queen Mother [4] (now deceased) in the Royal Albert Hall [5], London. My parents accompanied me and were delighted by the spectacle and honor. I have never, in my entire life, set foot in the University of London or in any of its constituent colleges. This five year 'undergraduate experience' informed my subsequent teaching career." [6]



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The above backstory [7] recalls a time twenty years ago when not everyone could go to university (or equivalent third level institution). But, even so, it was possible then to obtain a university qualification at a distance and by private study. The backstory, translated to 2009, is intended to point up the potential for all interested parties, especially

for the teachers of the students, in the unfolding Bologna process [8-10].

Bologna is intrinsically about mobility of students and staff. Such mobility can only make sense in the context of harmonized timetables. The academic year must be broken up into harmonized units across the participating institutions. It is not surprising, therefore, to find that the 12-week semester becomes the unit of learning time, 12 being the number agreed upon for the last two millennia, by which to measure things [11]. The latter is a 'tongue-in-cheek' remark pointing to the obvious measure of 10, given by the fingers on two hands (and the basis of the decimal system) and emphasized in the Latin world by the name of the last month of the year: December. In practice, the 12-week semester may be considered to be composed of a 10-week course, 1 week study period, 1 week examination period,

The reason for 2010 in the title of the paper is due primarily to the fact that the University of Dublin, Trinity College, adopts universal (?) semesterization in the coming academic year 2009-10. In principle, at some not so distant future, students (and staff) will be able and encouraged to "do the course" they need/want and get the appropriate ECTS credit [12] towards their desired-for qualification. For example, a student (living in Dublin or within commuting distance of same) who wishes to take *Latin* in an undergraduate program has, in principle, the choice of Trinity College Dublin [13] in the city centre, University College Dublin in South Dublin [14], or NUI Maynooth [15], around 20 kilometres west of Dublin. Other choices for said student, beyond daily travel range, entail accommodation costs for one semester. Is it not easy to see that such costs are beyond the resources of most students in our times? How would the scenario look, if instead of students moving, it was the teacher? Who pays the teacher?

One could imagine that after a certain period (maybe 20 years?) that the choices of the mobile students would rationalize the provision of the courses on offer. One day there might be only one Latin module on offer in the Dublin region? This

would be a favorable outcome for those who see rationalization and darwinism as desiderata of Higher Education.

But, there is an elephant in the Bologna room! Teaching is usually done in oral fashion; hence the natural language used is the key imperative. In Dublin, it will be assumed that the language is English. The same general language imperative applies to assessment, whether oral or written. Again, in Dublin, the language of assessment will, in general, be English.

The backstory introducing the paper sets the scene for the development of the plot to follow. The title of the play in becoming, "Breaking out for Bologna 2010", suggests a "breaking out" from something that binds and confines. A classical example is the "breaking out" from prison (gaol/jail). In this paper we will focus on the pedagogical aspects of "book breakout" and to a lesser extent "school breakout". To ground the discussion, two courses are presented, one at 3<sup>rd</sup> level (Computers and Society) and one at 4<sup>th</sup> level (Numerical Methods & Advanced Mathematical Modeling).

## 2 Computers and Society

I have been teaching a course with the title of "Computers and Society" (see ACM SIGCAS [16]) for over 20 years (a conservative estimate) in the Department of Computer Science at Trinity College Dublin. At one early period I taught it in the 3<sup>rd</sup> year of the degree, then at the 2<sup>nd</sup> year, and now back again at the 3<sup>rd</sup> year. In this millennium, for a variety of reasons, the majority of students did not and still do not regard the course very highly. They demonstrated their enthusiasm by non-attendance.

This most recent "Computers and Society" course that I taught (2006-2009) is the meat of this paper for breaking out. I was assigned to it for the academic year 2006-07 due to the sabbatical leave of the previous lecturer. And surely anyone who has been placed in such a position (at whatever level) knows exactly what the problem is for the substitute teacher? The course ran for 1 academic year (2006-2007) with just 1 hour per week lecture/event. I had no time and no reason to change the subject matter. From the archives, of which I have my own electronic copy, I note that the "course will be examined through continuous assessment only, with no final exam at the end of the year. Students will be assessed on their Business Review, Business Plan, and critique of another's Business Plan (3 assignments). These assignments are a combination of presentations, group, and individual work." There was "no prescribed text book." A "list of articles, web links and further resources" were "provided in each class." There then followed a list of "some of the more important resources and links."

As far as I recall, every other course at the same level in 2006-07 was a standard 12 weeks module. Student absenteeism was a severe problem (and always was) for the Computers and Society course in the third year and I kept an attendance record to demonstrate to any failed candidate that perhaps non-engagement with the lectures might have been a pertinent factor. In 2006-07 there were approximately 30 students.

## Q. 5 Multimedia and the Internet: The Hypertext beyond Convergence

“**B**OOKS OFFER A DUAL STORY. On the one hand, reference books and encyclopedias in print are being put out of business by the Internet, in a trend that underlines the importance of the educational and information-seeking uses of the Internet over its entertainment function. Textbooks offer extraordinary potential for electronic publishing, among other things because libraries do not have the physical space to cope with the information explosion, and are gearing up to offer books and journals on-line.” (Manuel Castells, *The Internet Galaxy*, p.198, Oxford University Press, 2001).

I To which Internet company does Castells specifically refer in connection with the selling of books in 2000-2001? How much profit was it making at the time? What major event(s) caused the company to fire thousands of staff and to close two of its facilities? [8/25]

II A printed book which contains a URI within its text may be said to have the property of Internet-relatedness. Let us denote such passage from the book to the Internet by the phrase “book breakout.” Günter Grass's book “Crabwalk” is a classic example in recent times. In the chapter “Multimedia and the Internet” of the Internet Galaxy, there are just two e-links given and both are related to art. Give an e-link for each of (a) music, (b) video, and (c) book, that appropriately fits and updates the Internet Galaxy for 2008. Give a brief reason for each of your choices. [9/25]

III Marshall McLuhan's “Gutenberg Galaxy” (1962) predates the Internet. Suggest how one might instrumentalise that text today to bestow on it the property of Internet-relatedness? [8/25]

Figure 1 Supplemental Examination Paper 2008

For those unsuccessful candidates, an exam paper had to be prepared. Eight questions were set. Students had to answer four. The time allotted to each was (the standard 30 minutes in a two-hour exam). The exam was held on Monday morning, 17th September 2007. And on the front page in the section “Materials permitted for this examination” was the list:

1. “This is an Open Book examination. Candidates may use any materials that they see fit. In particular, personal computers, books and notebooks may be used without restriction.”
2. “Sheet on Description Logic for Computer Science.”
3. “A print of the digital photograph “Mother and child” under creative commons licence.” [17]

Material item 1 was, in a sense, revolutionary at the time. Not that it was designated “open book”, but rather that “personal computers... may be used without restriction.” In my mind, when phrasing this text, I imagined a resourceful student accessing the Internet (or even another computer) with implicit permission.

Material item 2 indicated another significant breakout. In 2004 the Semantic Web Ontology language (OWL) was formally released. I introduced this, together with the Protégé Editor from Stanford, in order to demonstrate how emerging computing technology would impact upon the society in our times. To illustrate this (in 2006-07) I used the Fine Arts. “Here we are in the classroom. Here is a picture. What do you see?” The question itself was pointedly based on Berger's

“Ways of Seeing” [18]. Today, one can breakout to YouTube to see the original BBC 1972 program [19]. The practical work on the application of OWL DL to Art was done by my PhD student Daniel Isemann in December 2006.

Material item 3 was another **major** innovation. If one wishes to examine students in an official (copyright University of Dublin) examination with respect to the image of an art form, then one needs to be certain that there are no copyright infringements. In the case in question, the use of Creative Commons licensing [20] was a major breakout facilitator.

### 2.1 The Singer, not the Song

The sabbatical leave ended with a formal handover of the course to me. Now, from being a “substitute” teacher, I became “the” teacher. I belong to that group of people for whom the basic philosophy is “The Teacher, not the Course”. And as I thought about articulating and justifying such an overt philosophical view, I recalled the similar phrase that heads this subsection: “The Singer, not the Song” [24]. Recalling an old song, or an old title, is a matter of “memory”. And memory and history go together.

Subsequent examinations would continue the tradition established in 2007:

“This is an Internet-accessible open book examination. Candidates may use any materials that they see fit. In particular, personal computers, books and notebooks may be used subject to the University of Dublin regulations in force to the effect that “candidates are forbidden during an examination... to copy from or exchange information with other persons, or in any way to make use of any information improperly obtained.” University of Dublin Calendar 2007-08, p. H8.” (Supplemental Examination paper, University of Dublin, Trinity College, September 2009).

Figure 1 (above) illustrates the typical examination question template that evolved directly from the concept of breakout. Each question had three parts headed by a short extracted text. The *first* part examined the content of the Internet Galaxy book. The students were advised that the answer might be found by looking up the index to the book. The index [21] was to be regarded as a “book breakin” device. The nature of the book index seemed to have been *taken for granted* by the students. Once placed alongside the more “modern” notion of terminology/ontology the significance of indexing became clear. One might suggest trying to index the book oneself without the use of a searchable electronic edition. For practice, why not choose an electronic book from the Gutenberg Project [22]? As an aid to indexing, why not choose Roget’s Thesaurus [23]?

The second part of the question introduced the idea of “book breakout”. The idea was simple. One was reading a book. Suddenly, a URL appears in the text! If the book is not electronic one must leave the book and join the Internet. That is the breakout, a disturbance of the concentration of the reader and a change of media. Castell’s Internet Galaxy also had the book breakout feature. In his case breakout was confined to the e-Links section at the end of each chapter. It was clear that if the student was internet-connected during an exam, then this aspect

of learning could be examined. Retrieval of internet information had to be recorded for the examiner of the paper. The information might contain images. The normal solution would be the use of a Network directory for each candidate, something which I had already experienced in the late 1990's. The choice I made for this course was the use of a numbered USB stick provided. The students were advised that part 2 was a good opportunity to explore Wikipedia, for example.

It is traditional (for me) that the third part of the question ought to be speculative in nature. The book might help. The Internet might help. It was here that the student was expected to show particular originality.

There were six questions. The students had to answer three (within two hours). The allotted time for each question was nominally 40 minutes. It is worth noting that the representatives of the class of 2007-08 put up a formal resistance to the new style of course and examination, much to my annoyance. And it took a great deal of work to find out what their problem was and to solve it.

## 2.2 Computers and Society — Breakout

In the summer of 2007 I argued the case for a semesterized course, on the basis that the students did not take the course seriously enough and that they would be better served if it were to have exactly the same status as every other course on offer in their third year. And so it was! Moreover, the Computers and Society course was rated highly from the point of view of the Institute of Engineers of Ireland (IEI) [25] for the purposes of accreditation of the Computer Science degree.

The current published syllabus had 9 items, all of which (save item 9) were directly based on the chapter headings of the Internet Galaxy book [26]:

1. the History of the Internet and Computing
2. the Culture of the Internet and the World Wide Web
3. e-Business and the new Economy; the Internet of Things
4. Virtual communities; Network Society
5. the Politics of the Internet; Civil Society and the State; Privacy and Liberty
6. Multimedia and the Internet
7. the Geography of the Internet; Networked places
8. the Digital divide
9. Cyberethics

On my first reading of the book, I realized that it provided the perfect watershed for the “Network Society”, clearly published to coincide with the Millennium year, and inadvertently celebrating the first great dotcom crash, and moreover summing up all that we knew of computerized Western Society before the events of 9/11 [27].

### A one book course?

There are many books that one might wish students to read and study in the context of Computers and Society. I made the decision to **ground** the course on one particular book, the Internet Galaxy [26], a book upon which I inadvertently stumbled, in the summer of 2007. My own signed paperback copy has the date 2007-07-30, the date upon which I started to read the text.

There was also a small reading list which I highly recommended: The Gutenberg Galaxy [28], Weaving the Web [29], A Brief History of the Future [30], and The Age of Access [31]. This was my choice. One would imagine that the 3rd year students could make their own comparable choices?

By grounding the course on one book in this manner one was guaranteed (?) that all students had the same basic background for further development. The book proved to be an historical “Computers and Society” baseline in all sorts of surprising ways. Perhaps three examples suffice?

1. There is no mention of Wikipedia; it came into existence early in 2001.
2. The Patriot Act [32] (October 26, 2001) overturned all the presumed internet values of the pre-9/11 event.
3. The “100 billion dollar merger of AOL and Time Warner” is featured prominently in the introduction to the chapter on Multimedia and the Internet.

Each of these historical events can now be checked in considerable detail and studied on the Internet. The first port of call, naturally, is usually Wikipedia.

### Wikipedia

I use Wikipedia on all my courses; I encourage my students not only to use it but also to become editors. I am of the opinion that many indeed use it but very few edit it. To edit a topic is to be confident in the subject matter and to know the supporting literature.

I am an editor of Wikipedia since, approximately, May 2008. I had to become one in order to experience what it is I asked of my own students. The personal learning process was long and difficult. I have made contributions in English, Bulgarian, French (minor), German (minor) and Irish (minor). There is a steep learning curve for new editors and in my early struggles I was fortunate to buy into the notion of using the “Missing Manual” [33].

Preservation of anonymity of editors in Wikipedia is important for all kinds of reasons, one of the most salient of which is avoidance of authorial bias. I want my students to be able to learn to judge the validity of the text irrespective of the identity of the contributors. In other words, each student really ought to have a feel for the veracity of the text and be able to find an independent confirmation. As a simple test of this idea, let us look to see just how significant AISHE is with respect to Wikipedia?

Surprise! The result list for the term “aishe” suggested the “Irish Wikipedia” page [34] and in the second paragraph of the latter “In his paper on Putting the learning back into learning technology, Barry McMullin of Dublin City University suggested that while the Irish Wikipedia is never likely to contain as many articles as the Wikipedias in the world's most widespread languages, it is still a useful resource” [35]. From there one can access Barry McMullin’s paper (electronically) and browse it or search it! A quick search using the Firefox browser shows that “breakout” does not occur. Of interest here is his advocacy for the role of Wikipedia: “the strange case of the wikipedia ...”.

## Wikibook

I am a great believer in the importance of note-taking. The students are advised to take notes. I do not “give out” lecture notes. The taking of notes is a hand, eye, ear coordination process, an active process by which the student (and the teacher) learns. Once written down the notes become dead things, just like text books. I now have volumes of hand-written and type-set notes after 30 years of teaching.

As an aside, I recall the first use of digital cameras (by the Japanese) at conferences in the 1990’s to take (pictorial) notes of projected slides or handwritten text on white boards. I found their behaviour very strange at the time. Today, I do it myself, all the time. Don’t you?

Such notes take on special significance in the context of distance-learning and Bologna. The Internet is, of course, the ideal place in which to locate such material. Originally, I used to use the facilities of the University as a matter of course. Now, in addition, I use one of the facilities available under the Wikipedia umbrella — Wikibooks. There is a Wikibook on Computers and Society [36] to which I am contributing. Some of the material I added came from solicited contributions from the students in 2007-08. Such a Wikibook is, of course, open to the entire world and one can imagine how a Computers and Society course might be fitted into the Bologna framework. In particular, the Wikibook might readily be (collaboratively) translated into other languages.

## Assessment

On the 6th of March 2009 we were asked by the course director of the Computer Science BA degree to examine *ourselves* with respect to the “ACM Curriculum Dec 2008: Appendix A Overview of the Body of Knowledge” [37]. For Computers and Society, the relevant section was “Social and Professional Issues (SP) 92”, where 92, 93, etc., are ACM 2 digit codes. For the record, I (MMaA) returned the following, where the ACM recommendation comes first and my response (MmaM) follows:

1. HistoryOfComputing [core] 93 (Min time: 1 hour); MmaA min 3 hours; **comment:** my general emphasis is on the origins and development of the Internet and then the Web
2. SocialContext [core] 93 (Min time: 3 hours); MmaA min 6 hours; **comment:** I cover geography of the Internet; social networking using examples such as Flickr, YouTube, Facebook,...
3. AnalyticalTools [core] 94 (Min time: 2 hours) ; MmaA min 3 hours; **comment:** Google trends, ...
4. ProfessionalEthics [core] 94 (Min time: 3 hours) ; MmaA min 3 hours; **comment:** none
5. Risks [core] 94 (Min time: 2 hours) ; MmaA 0 hours; **comment:** none
6. SecurityOperations [elective] 95 (Min time: not given in the ACM doc) ; MmaA 0 hours; **comment:** none
7. IntellectualProperty [core] 95 (Min time: 3 hours) ; MmaA min 3 hours; **comment:** none
8. PrivacyAndCivilLiberties [core] 95 (Min time: 2 hours) ; MmaA min 3 hours; **comment:** none



9. ComputerCrime [elective] 96 (Min time: not given in the ACM doc); MMaA min 1 hour; **comment:** none
10. EconomicsOfComputing [elective] 96 (Min time: not given in the ACM doc); ; MMaA min 3 hours; **comment:** none
11. PhilosophicalFrameworks [elective] 96 (Min time: not given in the ACM doc); MMaA min 3 hours; **comment:** none

My MIN compliance is estimated at 28 hours (out of possible 33); MAX:  $12 \times 3 = 36$  hours in the semester, of which 3 hours are given over to the students to prepare for the exam.

### 3 Numerical Methods & Advanced Mathematical Modeling

“This course focuses on the mathematics behind the technologies driving the entertainment and media industries. Students taking the course will learn to model and to solve problems using three complementary approaches: 1) analytical (e.g. examining the math behind features of a computer game of their choice), 2) numerical (e.g. experiencing the primacy of the digital world of our times) and 3) observational (e.g. from world outside to world inside). The course will be taught using Mathematica\* and will be hands-on with examples taken from relevant problems in entertainment technology. In particular, the students will learn how to utilize the resources of the Internet and to contribute to them for the benefit of colleagues and others using media with which each is comfortable: e.g. Wikipedia, YouTube, etc..

(\*: Students may use Mathematica, Matlab, or any other suitable software package in their coursework and examinations)”

The experience of **breakout** in the “Computers and Society” course was transferred *directly* to a core course [38] of the MSc in Interactive Entertainment Technology, colloquially referred to as the Master’s degree in Computer Games. But, of course, the title (and subject matter is much broader than games).

The same teaching strategy was employed: pick one book to ground the course. The choice, “The Nature of Mathematical Modeling” [39], was not mine. The date of acquisition (on my signed copy) is 2009-10-08. That looks close to the first lecture. There was no time to look around for another text. I recall vividly the shock of matching this book to the mathematical strengths of the class of 2008-09. Perhaps the most important initial innovation was the precise linking of topics from the text to Wikipedia in the syllabus [38].

Courses such as this, at Fourth Level, are indeed typical Bologna-style courses. The method of teaching is mixed mode: whiteboard/blackboard for classical manual math calculation, slide presentation for elegance, and direct online access to Wikipedia when needed. Since Mathematica is an integral part of the course, demonstrations can be carried out in class using the Mathematica Notebooks and again advanced material from the Wolfram site on the Internet can be accessed immediately.

### Q. 8 Architectures

"Polynomials are often the first, and sometimes the last, functional form encountered for fitting. Familiarity can breed contempt; ... we'll see some of the problems with using polynomials for nontrivial problems, and consider some of the appealing alternatives."

(Neil Gershenfeld, *The Nature of Mathematical Modeling*, p.139, Cambridge University Press, 1999).

- I Consider a simple neural network where the input is a vector of elements  $\{x_k\}$ . These are combined by a series of linear filters with weights  $w_{jk}$  to give the inputs to the *hidden units*

$$h_j = \sum_k w_{jk} x_k$$

These inputs  $\{h_j\}$  are then passed through a layer of activation functions  $g(h_j)$  to give the output

$$X_j = g(h_j) = g\left(\sum_k w_{jk} x_k\right)$$

The activation or "squashing" functions are usually chosen to clip for large magnitudes to keep the response bounded. One common choice is

$$g(h) = \frac{1}{1 + \exp(-2\beta h)}$$

where  $\beta$  controls the steepness; typical values are 1/2 or 1. Sketch a graph of such an activation function. [8/25]

- II Find a [3/3] diagonal Padé approximant for the squashing function  $g(h)$  with  $\beta = 1/2$  and sketch the graph. [9/25]

- III What is your assessment of the Wikipedia article on the Padé approximant? Be specific in your critique. How can you justify your assessment? [8/25]

Figure 2 Question 8 of the MSc IET Math Exam 2009

The examination paper was divided into three parts, corresponding to the threefold division of the book. Students were required to answer 4 questions, at least one from each part. This ensured coverage and provided choice of the nature/type of mathematics used in modelling. Figure 2 illustrates Q. 8 taken from the paper. Each question had a lead-in text to inform the student of the context of the question. Part I was a straightforward application of the "nature" of mathematical modelling. Part II was an invitation to solve a well-known problem. It was anticipated that the students would make use of Mathematica. Part III calls upon the student to make a judgement on the relevant Wikipedia article. The breakout from the exam paper into the Internet is necessary to solve this particular problem.

## Breaking out for Bologna 2010

This paper began (unusually) with a backstory (rather than an introduction, prelude, prologue,...) taking us back 30 years or so. I like to think of that story today as typifying the opportunity afforded those who sought to breakout of a system, or culture, or situation through higher education and who did not have the opportunity or resources to travel to the centres of learning. The University

of London facilitated that breakout for people from all over the “former British Empire”. It was soon followed by the Open University (and the collaboration with the British Broadcasting Corporation). Today, especially in the Island of Ireland context, I wonder about facilitating further breakout for those who wish to benefit from our higher education system and I am wondering how Bologna can facilitate that, perhaps beginning in 2010?

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