



# **An Open Access Approach to High-Quality Affordable Textbooks**

*Richard Baraniuk*      *Joel Thierstein*

Rice University

# born of frustration – 1999

**high cost** of textbooks and learning materials

- limits access

difficult to **connect** across concepts, courses,  
grades, curricula

- grade K | 1 | 2 | 3 | ... | 11 | 12 | AP | CC | college
- curricular stove-piping, disintegration

difficult to build **communities, collaborations**  
among faculty, students

- inefficient: no economies of scale
- glacial time scales of development and updating

# *open access* movement

*democratization* – knowledge should be *free* and *open* to use and re-use

draws inspiration from open-source software



Linux, Apache, Mozilla, Firefox



enabled by recent developments in info tech



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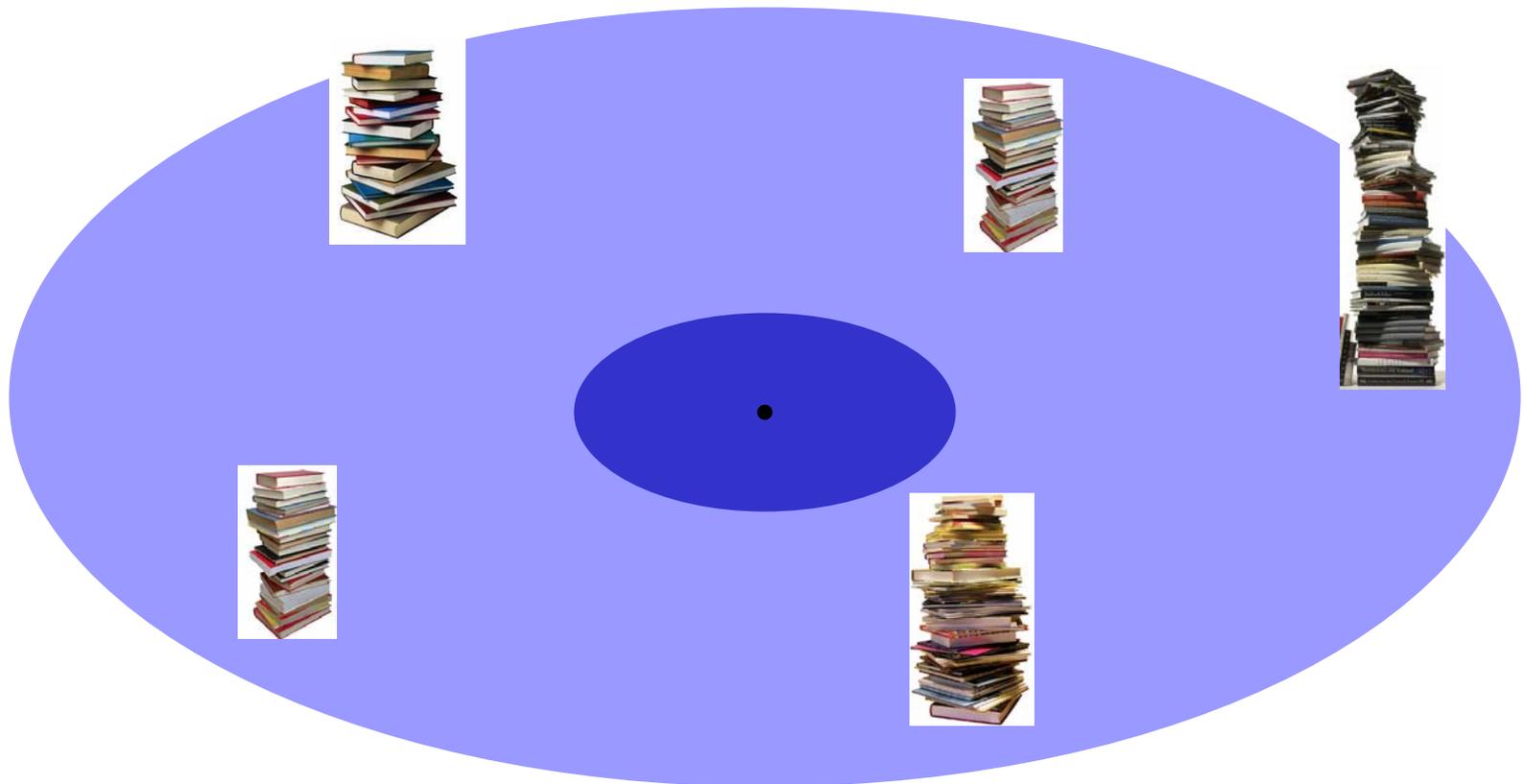
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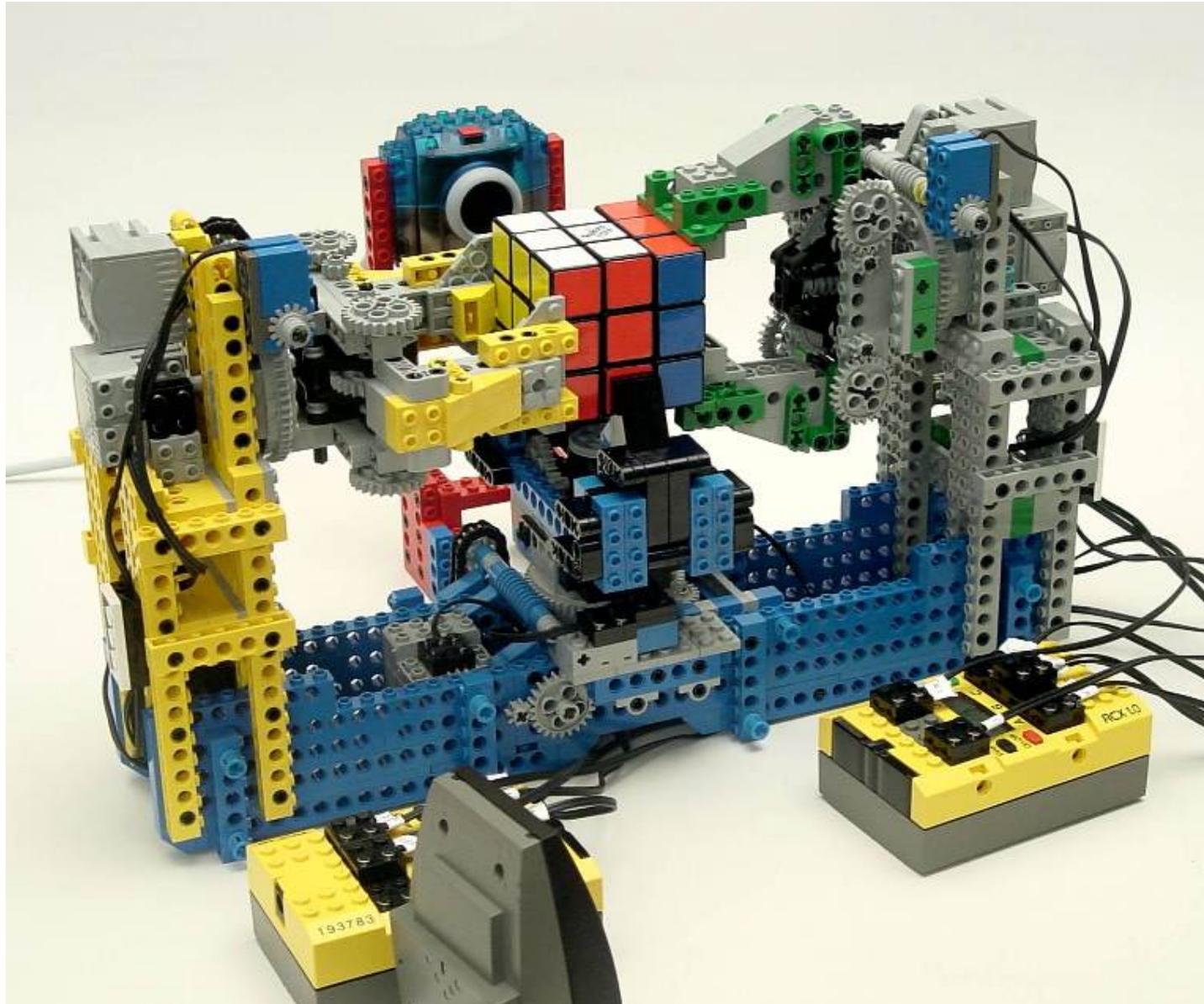
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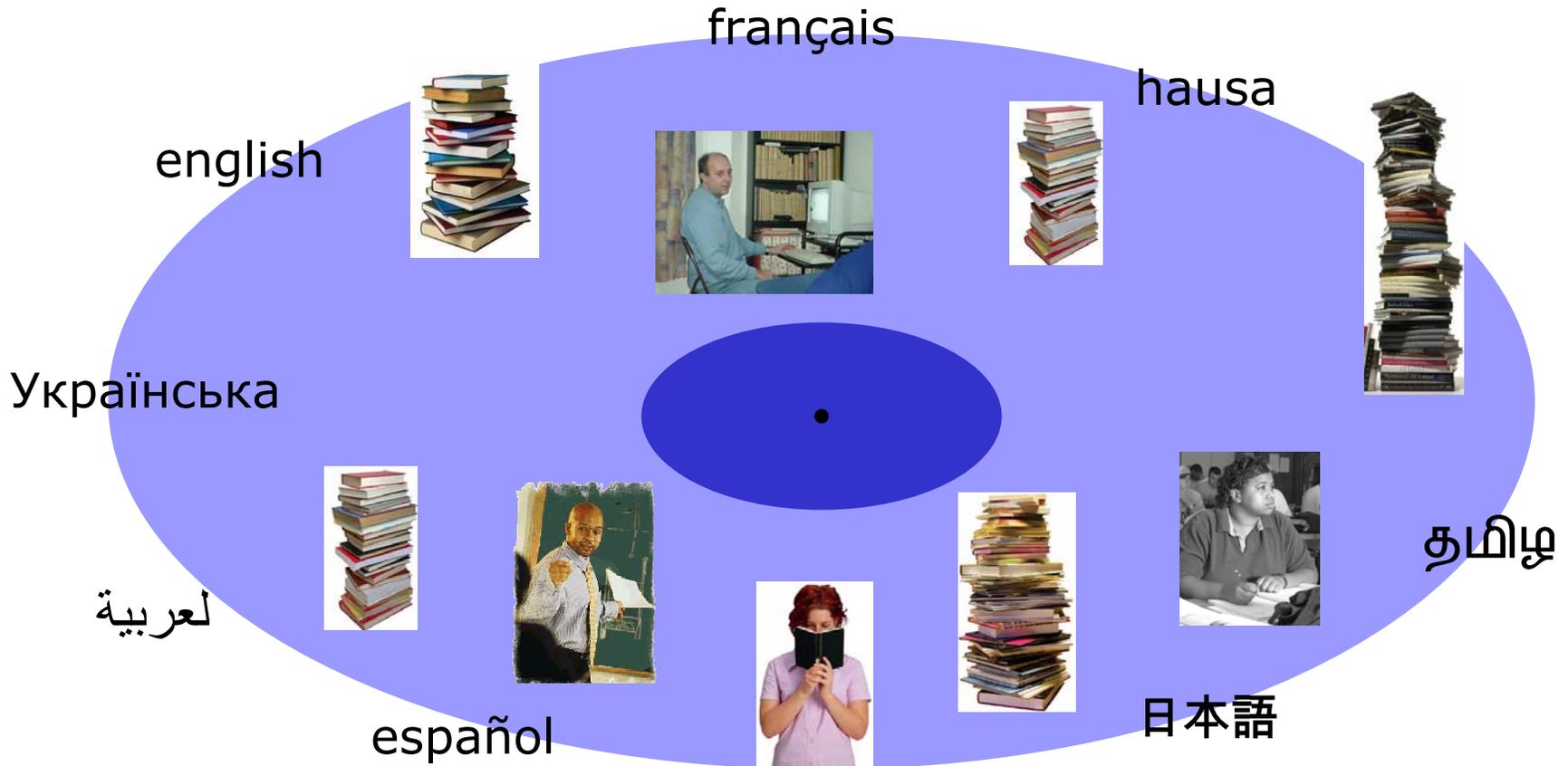
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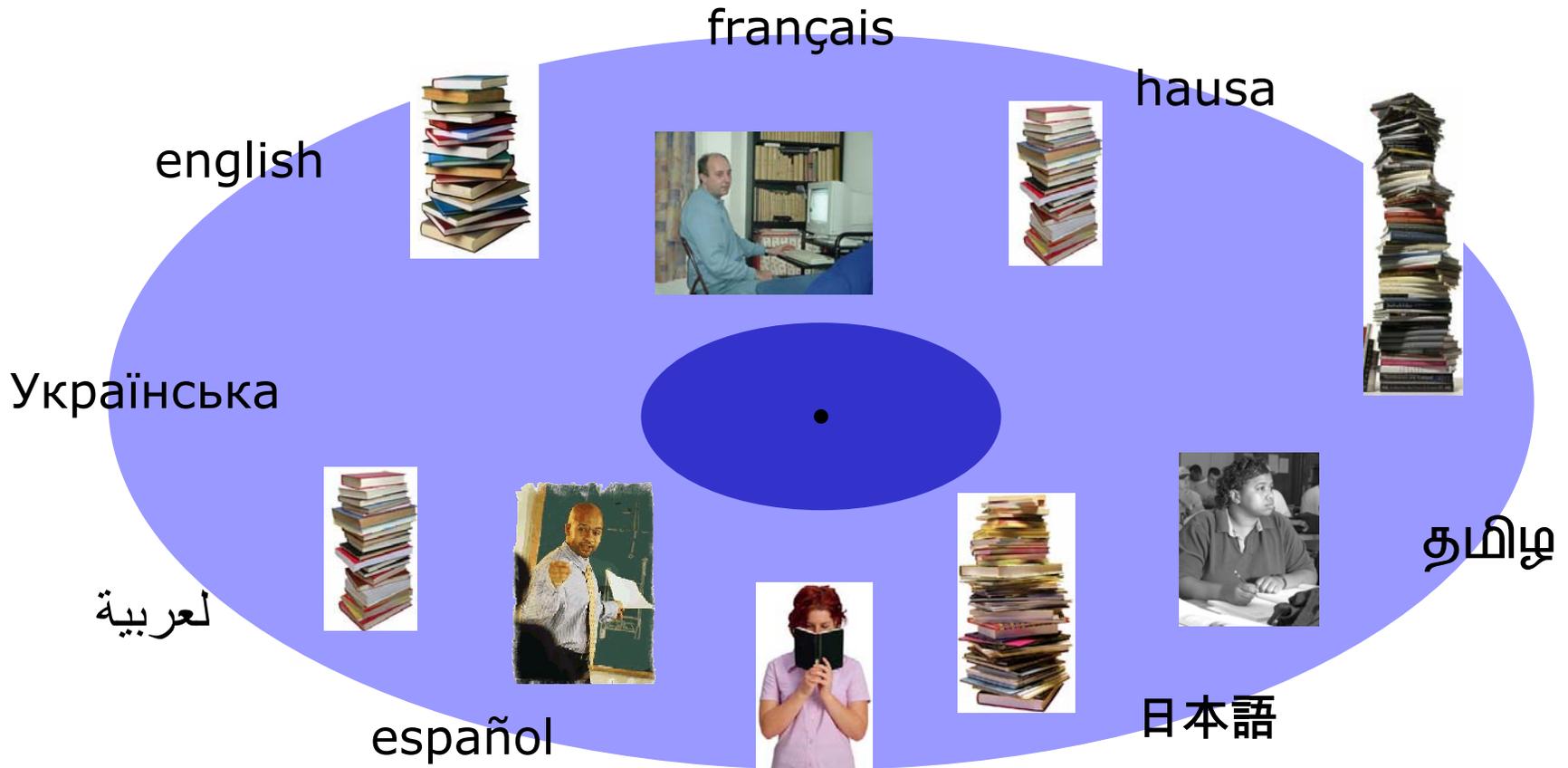
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inclusive *communities*

*grassroots* organization



# knowledge ecosystem



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### Courses using this content

- [Signals and Systems](#)

## Fourier Analysis in Complex Spaces

[Print \(PDF\)](#)

By: [MICHAEL HAAG](#), [JUSTIN ROMBERG](#)

**Summary:** This module derives the Discrete-Time Fourier Series (DTFS), which is a fourier series type expansion for discrete-time, periodic functions. The module also takes some time to review complex sinusoids which will be used as our basis.

### Introduction

By now you should be familiar with the derivation of the **FOUR** functions. This derivation leads us to the following equations t

$$f(t) = \sum_n (c_n e^{j\omega_0 n t})$$

$$c_n = \frac{1}{T} \int f(t) e^{-j\omega_0 n t} dt$$

$$= \frac{1}{T} \langle f, e^{j\omega_0 n t} \rangle$$

frequency  $\omega_0 n$  in  $f(t)$ .



(login required)

In this module, we will derive a similar expansion for discrete-time periodic functions. We will derive the **Discrete Time Fourier Series** (DTFS), or the **DISCRETE FOURIER TRANSFORM** (DFT).

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[NSF P4I support]

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Catherine Schmidt-Jones

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## Introduction to Music Theory

By: [CATHERINE SCHMIDT-JONES](#)

### Start Course

**Instructor:** Catherine Schmidt-Jones  
**Course Author:** Catherine Schmidt-Jones

**Course Description:** This course introduces the basic concepts and terms needed to discuss melody and harmony. It is intended for teens or adults with no background in music theory but some familiarity with reading common notation and playing an instrument (or singing). Concepts covered include interval, major and minor keys and scales, triads and chords.

**Contributing Authors:** Catherine Schmidt-Jones, Russell Jones

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- [Octaves and the Major-Minor Tonal System](#)
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- [Interval](#)
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#### Keys and Scales

- [Major Keys and Scales](#)
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#### Triads and Chords

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**anyone can translate, customize, ...**

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# Análisis de Fourier en Espacios Complejos

[Print \(PDF\)](#)

By: [MICHAEL HAAG](#), [JUSTIN ROMBERG](#), [ERIKA JACKSON](#), [FARA MEZA](#)

Based on: [FOURIER ANALYSIS IN COMPLEX SPACES](#) by [MICHAEL HAAG](#), [JUSTIN ROMBERG](#)

**Summary:** Este modulo deriva la series de Fourier discreto en el tiempo (DTFS), la cual es un tipo de expansión de fourier para funciones periodicas y discretas en el tiempo. El modulo tambien da un repaso a los senosoidales complejos que sirven como bases.



estar familiarizado con la derivación de la [SERIES DE FOURIER](#) par alas Esta derivación nos lleva a las siguientes ecuaciones las cuales usted

$$f(t) = \sum_n (c_n e^{j \omega_0 n t})$$

$$c_n = \frac{1}{T} \int f(t) e^{-j \omega_0 n t} dt$$



$$= \frac{1}{T} \langle f, \mathbf{e}^{j \omega_0 n t} \rangle \quad \text{Univ. Texas-El Paso}$$

donde  $c_n$  nos dice la cantidad de frecuencia en  $\omega_0 n$  in  $f(t)$ .

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**assemble a customized course, ...**

# Fundamentals of Signal Processing



By: [Minh Do](#)

## [Start Course](#)

**Course Author:** [Minh Do](#)

**Course Description:** Presents fundamental concepts and tools in signal processing including: linear and shift-invariant systems, vector spaces and signal expansions, Fourier transforms, sampling, spectral and time-frequency analyses, digital filtering, z-transform, random signals and processes, Wiener and adaptive filters.

**Contributing Authors:** [Anders Gjendemsjø](#), [Benjamin Fite](#), [Clayton Scott](#), [Don Johnson](#), [Douglas L. Jones](#), [Hyeokho Choi](#), [Ivan Selesnick](#), [Justin Romberg](#), [Melissa Selik](#), [Michael Haag](#), [Minh Do](#), [Ricardo Radaelli-Sanchez](#), [Richard Baraniuk](#), [Rob Nowak](#)

## Course Content

» Introduction to Fundamentals of Signal Processing

### FOUNDATIONS

- » Signals Represent Information
- » Introduction to Systems
- » Discrete-Time Signals and Systems
- » Linear Time-Invariant Systems



Fundamentals of Signal Processing

Minh Do

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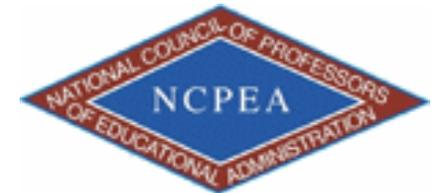
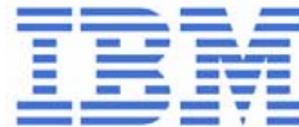
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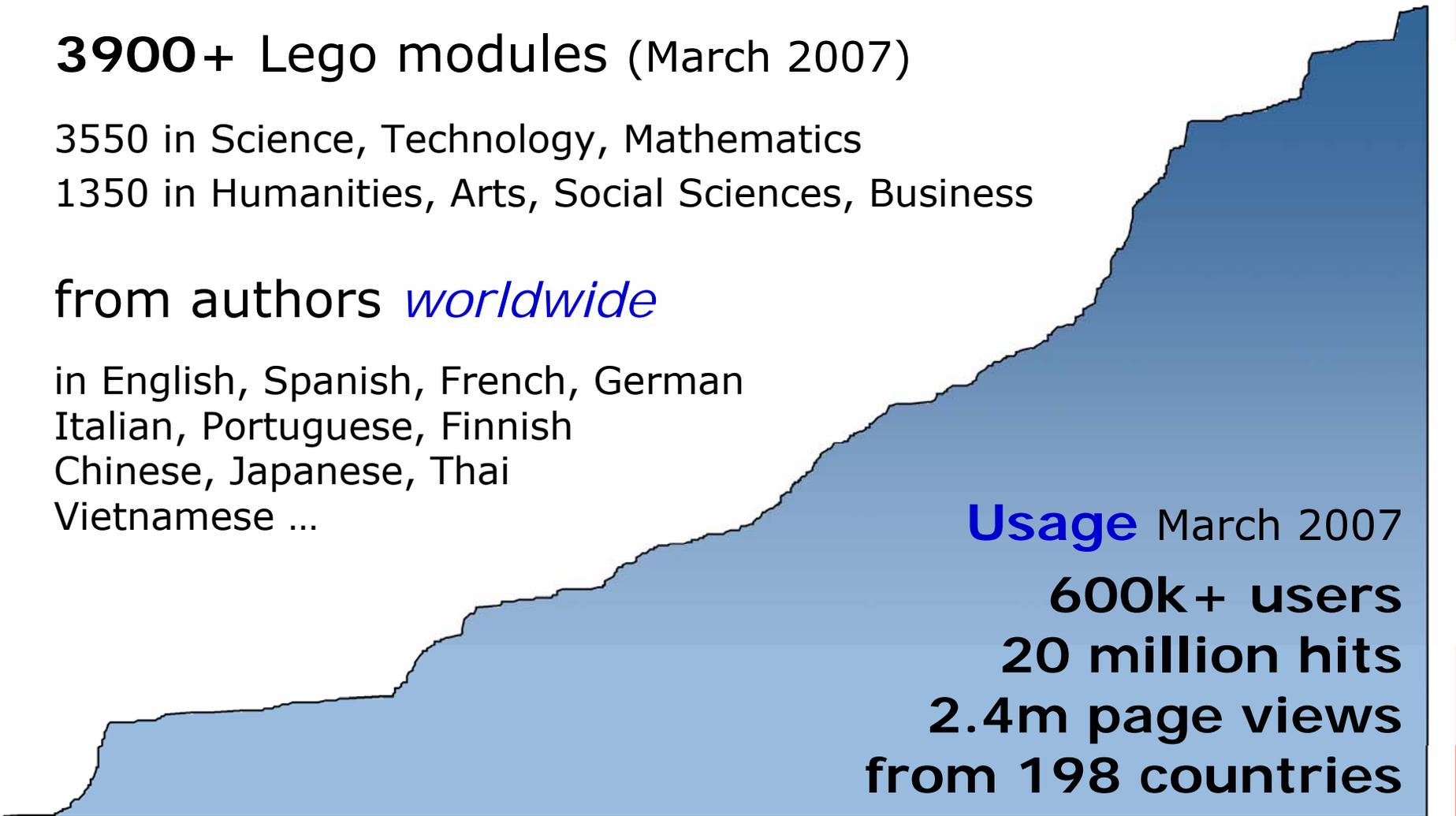
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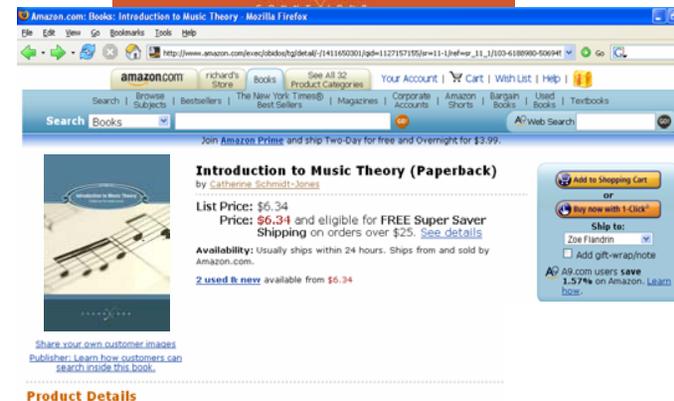
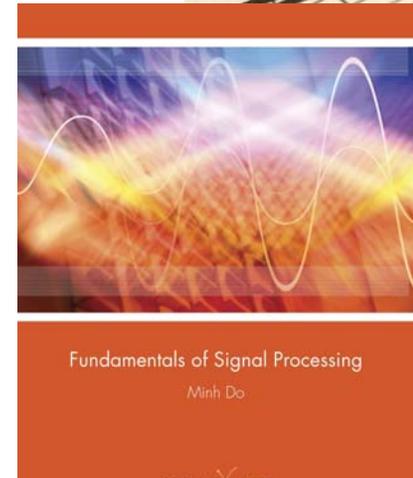
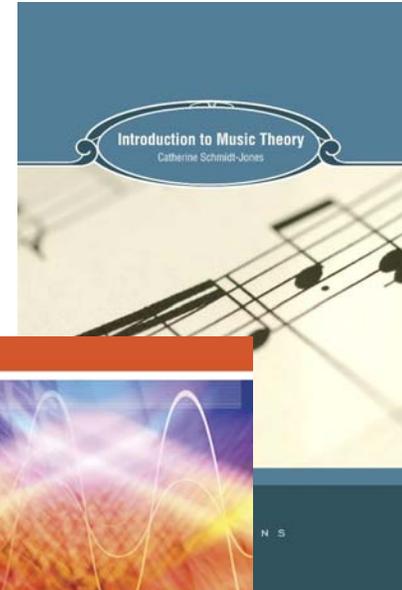
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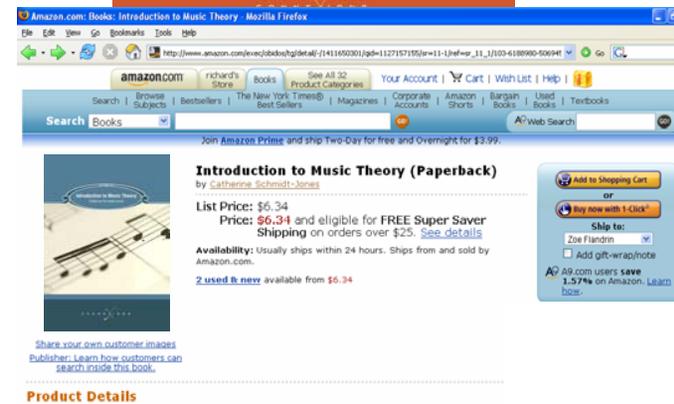
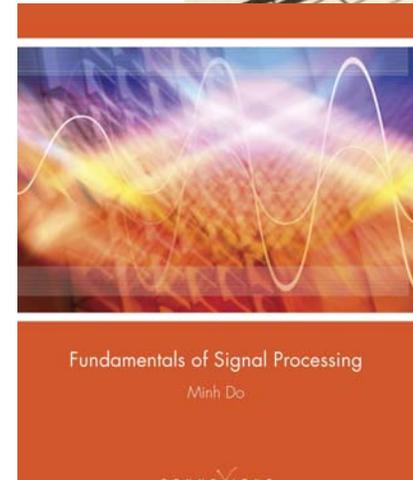
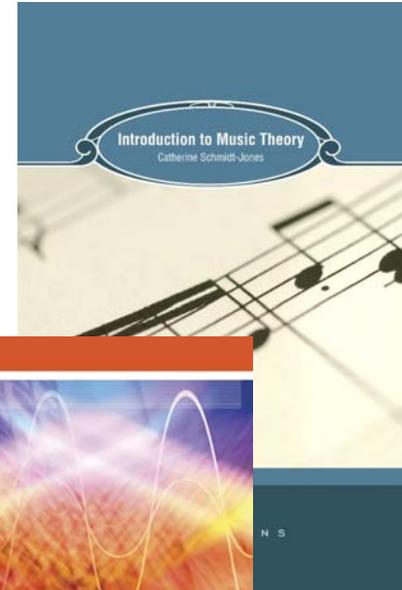
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# rice university press

Rice University Press re-starts as **all digital press** within Connexions (2007)

RUP now exploring joint publications

- University of Michigan Press
- Stanford University Press
- Chicago University Press
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- National Academies
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July 13, 2006

## Rice University Revives Its Press In Digital Model

By REBECCA BUCKMAN  
*July 13, 2006; Page B3*



Chuck Henry

One of the nation's most prestigious universities is resurrecting its defunct academic press online -- a move that adds a new wrinkle to the debate over who will profit from Web publishing.



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# Art History and Its Publications in the Electronic Age

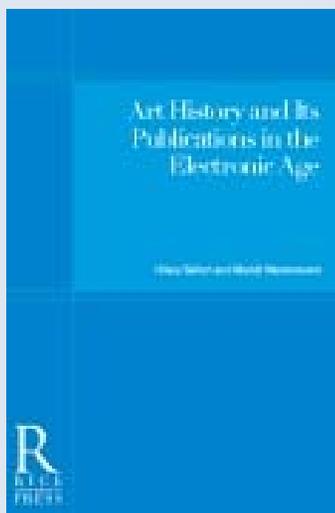
By: [Hilary Ballon](#), [Mariet Westermann](#)

## [Start Report](#)

**Report Authors:** [Hilary Ballon](#), [Mariet Westermann](#)

**Report Description:** Report on a Study Funded by the Andrew W. Mellon Foundation. This report is published by Rice University Press and CLIR.

**Contributing Authors:** [Hilary Ballon](#), [Mariet Westermann](#)



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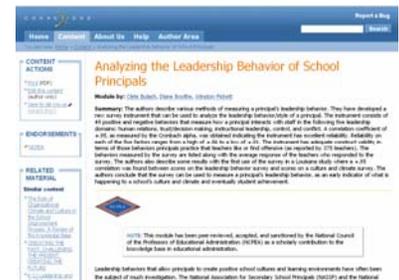
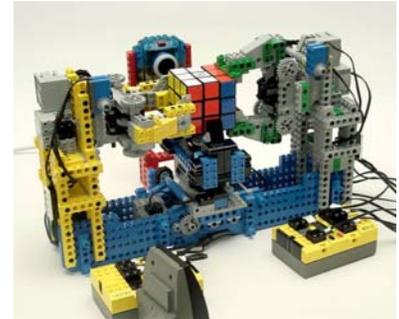
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# how you can help?

**citizens should get more for the \$Billions spent on textbooks each year**

## **encourage open access textbook publishing**

educate publishing industry on benefits of open access

incentives:

- *tax breaks* for opening up languishing textbooks similar to when they are destroyed today
- make (partial) open access a requirement for textbook *adoption* (possible sunset clause)

## **seed quality, useful open-licensed textbooks**

- as the US government did until the 1950s
- example: NIH and PubMed Central
- would be available for use/re-use by publishers

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Connexions has the overarching goal of making high-quality, open-source educational content available and free to anyone, anywhere, anytime. Established in 1999, Connexions is based on a set of intuitions shared by a remarkably wide range of academics: that knowledge should be free and open to use and re-use; that collaboration should be easier, not harder; that people should get credit and kudos for contributing to research and education; and that ideas are linked in unusual and surprising ways.

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Today, Connexions is one of the most-used open-education resources on the web, employed in traditional college and K-12 settings, in distance learning, and by lifelong learners around the globe. Demand is surging; currently the Connexions servers handle over 21 million hits per month representing over 600,000 visitors from over 200 countries. Volunteers are translating modules and courses into a range variety of different languages, including Spanish, Portuguese, Japanese, Chinese, Vietnamese, and Thai; many of these are our most popular.

Connexions content development is grass-roots organized and inter-institutional. Our most active content development areas at present include music, engineering, physics, chemistry, bioinformatics, nanotechnology, and history. For example, a vibrant community of electrical engineering faculty from Stanford, UC Berkeley, University of Illinois, Michigan, Wisconsin, Ohio State, Georgia Tech, Rice, Cambridge, and TU Norway is developing a customizable digital signal processing (DSP) curriculum in Connexions. National Instruments is contributing DSP training materials as well as developing a free “player” version of their popular LabVIEW signal processing tool that will make the materials come alive with sights and sounds, adding much needed interactivity to engineering curricula.

The University of California at Merced is developing their Introduction to Biology and College Algebra courses in Connexions and is committed to using the Connexions platform across its curriculum; recently, they hired a full-time Connexions facilitator. Their mission is clear: “UC Merced will increase educational access and opportunities for Valley students.” Connexions provides an open-access platform to support their close collaboration with community colleges and secondary schools. Indeed, local schools and colleges can use UC Merced-generated content in their classrooms. This ability to “re-contextualize” content is one of Connexions’ greatest strengths.

The National Council of Professors of Educational Administration (NCPEA) is developing a Connexions knowledge base in school leadership and administration that will supersede their current print materials. NCPEA is also developing a community-based peer review process that involves practicing principals and superintendents to identify and direct readers to high-quality materials that they endorse as an organization. This effort will serve as an example to other professional societies and journals.

With the College of Oceanographic and Atmospheric Sciences (COAS) at Oregon State University, Connexions is exploring dynamically generated content driven by over 17 terabytes of telemetry data per day from real-time ocean/atmosphere observations and predictions. Dynamic science requires a dynamic medium. Connexions authoring process will be automated so that the materials always have the most current data, analyses, graphics, and imagery.

Connexions is the engine driving the Rice University Press, which will reopen after a decade-long hiatus in early 2007 as an all-digital press. RUP will operate just as a traditional press, up to a point. Manuscripts will be solicited, reviewed, edited, and resubmitted for final approval by an editorial board of prominent scholars. But rather than waiting for months for a printer to make an expensive bound book, RUP's digital files will instead be run through Connexions for automatic formatting, indexing, and population with high-resolution multimedia and web links. Users will be able to view the content online for free or purchase a paper copy of the book. RUP's catalog will never go out of print and will be continuously updated.

In the Connexions Community College Initiative, we are developing the top 10 community college courses, including English composition, college algebra, introduction to psychology, general chemistry, and so on. These courses, with appropriate remedial materials, will be available for free in Connexions and in a low-cost printed form. We are working closely with a number of community college partners to ensure that major state-based curricular requirements are addressed, so that the materials can be used immediately. Our goal is to dramatically affect the economics of textbooks in community colleges by providing high-utility courses in Connexions that can be customized and affordably printed.

The developing world is of great interest to Connexions and its supporters. The government of Vietnam has selected Connexions as its platform for higher-education materials development and dissemination for the entire country. Teachers without Borders, which has community teaching and learning centers in 12 countries and teacher training materials in use in 84 countries, has committed to making all of their materials available in Connexions and using the system as their common platform. In the Connexions for the Americas project, we are fostering the creation of a critical mass of high-quality educational materials in Spanish, Portuguese, English, and French for use and re-use by the entire population of the Americas. Since a significant challenge in delivering content to the developing world is the availability of computer and network resources, Connexions is developing a relationship with the AMD 50x15 project. 50x15 aims provide 50% of the world's population access to computers and the internet by 2015.

Connexions' open-source system software is *Rhaptos* ([rhaptos.org](http://rhaptos.org)), a Plone-based educational content management system, developed in house. All content is encoded in CNXML, a variant of XML, to maximize the use of meta-data and semantic content, thereby facilitating searching and construction of semantic webs. Connexions encourages the use of domain specific markup languages, such as MathML, which embed semantic content.

Connexions has received support since 2000 from the William and Flora Hewlett Foundation, the US National Science Foundation, and Rice University and its trustees. The Tech Museum of Innovation, one of the country's leading science and technology museums, recently named Connexions a Tech Museum Awards Laureate in its education division.

Everyone has knowledge to share. Get involved in Connexions and together we can bring textbooks and education into the Internet Age. See [cnx.org](http://cnx.org) for more information or contact us directly.

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## Frequently Asked Questions on Connexions and Open-Access Education

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This FAQ has been compiled from seven years of conversations with authors, instructors, learners, reporters, and other interested folk worldwide.

### **What is “open education” and what are open educational resources (OERs)?**

The open-education movement takes the inspiration of the open-source software movement (Linux) and the power of the internet and applies it to teaching and learning materials like course notes and textbooks. OERs are teaching and learning materials that are free to use and also re-use in new ways around the world.

### **What is Connexions?**

*Connexions* (cnx.org) is a non-profit start-up launched at Rice University in 1999 that aims to reinvent how we write, edit, publish, and use textbooks and other learning materials. It's a global repository of educational content that can be described in four words that borrow from an Apple advertising slogan and a great book by Larry Lessig:

- Create* – in Connexions, everyone is free to create educational materials and contribute them to the repository
- Rip* – in Connexions, everyone is free to copy the material and customize it
- Mix* – in Connexions, everyone is free to mix the material together into new books and courses
- Burn* – in Connexions, everyone is free to create finished products like e-learning web courses, CDroms, and even printed books

### **How is Connexions different from other open education projects?**

First, in *scale*: Connexions has content from all over the world in a growing variety of languages, not just materials from one specific school or university. It also collects materials to support education in K-12, community college, university, continuing education, and industrial training settings.

Second, by the way we support *communities*: Connexions is globally accessible to anyone to not only read and use our materials, but also take them, make them your own, and *contribute them back* to the repository. In reality, most other open education projects are of the “look but don’t touch” variety.

Third, in the way we’re *organized*: Connexions is grassroots organized from the bottom up rather than from the top down like many other open education projects. Everyone is free to join and take on a leadership role.

### **Who is using Connexions?**

Right now, per month, Connexions is averaging over 600,000 visitors from every country connected to the internet. The vast majority of them are students who visit to learn, most from Google and other search engines.

Authors contributing content include professors from several major universities in North America, Europe, and Asia. Other contributors include former “shut outs” like Kitty Jones, a private music teacher from Champaign, IL, USA, who is writing on music theory. Already her material is in high demand; she averages over 600,000 “uses” (page views) of her materials *per month*. This gives you a sense of the size of the audience out there for OERs.

Volunteer translation projects are progressing rapidly in Spanish, Chinese, Japanese, and a number of other languages. Already, this is some of Connexions’ most popular material.

*Teachers Without Borders* is using Connexions as their content engine for training and certifying teachers in 84 countries around the world; they’re in Iraq right now training 20,000 teachers today supported by USAID. The *University of California at Merced*, the latest addition to the UC system, is developing a range of courses in their engineering and science curricula in Connexions. The *National Council of Professors of Educational Administration* (NCPEA) is developing their knowledge base and a peer review quality control process in Connexions. They aim to include not just faculty members in the review process, but also practicing school administrators and superintendents.

### **Why is open education important?**

First, open education strives to bring *people* back into the educational equation, in particular those people who have been “shut out” of the publishing world, like talented K-12 teachers, scientists and engineers out in industry, and people who don’t read and write English.

Second, open education appears to be the most viable way to bring down the *extremely high cost of teaching materials* – for example from a \$125 textbook to a \$25 textbook with no compromise in the quality of the presentation or print quality. The average community college student in the US spends more money on textbooks than tuition; something is out of balance there.

Third, open education strives to reduce the *time lag* between producing a textbook and getting it into the hands of students. By the time most books are printed, they’re out-of-date. This is particularly problematic in fast-moving areas of science, technology, and medicine.

## **Connexions sounds like Wikipedia. What's the difference?**

Wikipedia is a great example of an open educational resource. It is freely available, and everyone is welcome to contribute.

On a simplistic level, the difference lies in that Wikipedia is an encyclopedia, and people generally don't teach from encyclopedias. So, in a sense, Connexions is like the textbook equivalent of Wikipedia.

On a deeper level, there are important differences in how Wikipedia and Connexions handle the credit that goes to authors: in Wikipedia authors are more or less anonymous while in Connexions they are clearly identified. This sort of academic "credit" is important to many authors and is often a prerequisite for them to participate. Moreover, having a named author authenticates the work, which helps out later with quality control.

## **What are the legal ramifications of this? Isn't this a violation of copyright law?**

The materials in Connexions all feature a *license* – created by an organization called the Creative Commons – that makes sharing, using, and even changing the content free and legal, as long as you attribute the original author. And importantly, authors retain their copyright in Connexions, and so they retain control of their materials.

So while Connexions is a totally different way to approach the publication process, it's all carefully designed to be totally legal. This is in stark contrast to what's going on in the music industry today with remixing, file-sharing, and so on.

## **Don't professors make money by writing textbooks? Why would they want to give their work away for free?**

First, the vast majority of faculty do not make significant amounts of money from writing textbooks. If you take into account that most fairly successful textbooks sell a couple thousand copies a year, then amortized over the 3+ years it usually takes to write a book, the royalties work out to something like 25 cents an hour.

Connexions is working out in the "long tail" of the publishing industry. We're trying to make a difference for textbooks that typically sell a few hundreds or thousands of copies; we're not trying to supplant Harry Potter from the best seller list.

Actually, when you get down to it, faculty write textbooks not to make money but to make an *impact*, and systems like Connexions make their work accessible to more people, thus increasing their potential impact. So it's a win-win for both writers and readers.

## **Electronic books have been slow to catch on. Is there any benefit for students or professors that prefer a printed textbook?**

Print is going to be important for a long time. One thing Connexions has been working really hard towards is the ability for anyone anywhere to mix together their own book in Connexions and then have it *printed-on-demand* to arrive the next day by courier. We can do this now, and the savings can be incredible, for example bringing the cost of a 300-page hardback engineering textbook from \$125 to \$25.

And then there's the publication time-lag issue from above. Connexions' web courses and printed books are always up-to-date with the latest material from the global repository.

### **What about quality control?**

Connexions invites everyone to contribute their materials. Because of this inclusive policy, the global repository will have content at different stages of development. In order to help users find the materials they need, we are developing a system that enables anyone (individuals, institutions, professional societies, and so on) to set up their own *review process* that sifts through the entire repository and directs users to the content judged to be "high quality". It's basically analogous to the "peer review" systems used in academic journals, but more scalable.

We rolled out lenses based on the social software del.icio.us in March 2007. Our first reviewing community is the *National Council of Professors of Educational Administration* (NCPEA); they are engaging not just faculty members in the review process, but also practicing school administrators and superintendents.

### **What are the most significant trends you see in the academic publishing world?**

*Disintermediation* (cutting out the middle man) is starting to move from websites like Ebay and sweep through all aspects of "content" development and distribution, from books and the press to music and movies. For example, we are going to see the re-emergence of many of those university presses that were shut down in the 1980s.

Another trend is the increasing use of XML, meta data, and other semantic web (Web 2.0) features to enable new and flexible ways of developing and connecting ideas. Connexions has been XML-based from day one, and we could never have done what we have without it.

### **How did you get interested in open education?**

In 1999, one of us (RGB) was frustrated with teaching an electrical engineering course and thought about writing a new textbook. Instead he decided to "do something modern" and think about how the then emerging open source software world could impact education. Connexions was born out of that "itch that needed to be scratched."

For more information on Connexions, see [cnx.org](http://cnx.org) or contact us directly.

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