

**e-Cornucopia.2011**

The OPEN Digital University

OpenSource•OpenAccess•OpenEducation•OpenSource•OpenAccess•OpenEducation

# The LON-CAPA Shared Content Pool

**Warning:**  
Presentation constantly  
rewritten over the course  
of the day as I listened to  
other speakers.

Gerd Kortemeyer  
Michigan State University



# Experiences

- The whole conference is about sharing content
- No sense preaching to the choir
- Thus: **LON-CAPA**

**The Free Open-Source Distributed Learning  
Content Management and Assessment System**

Sharing and using online learning and assessment materials  
across institutions and disciplines. Since 1992.

- What have we learned in 19 years?

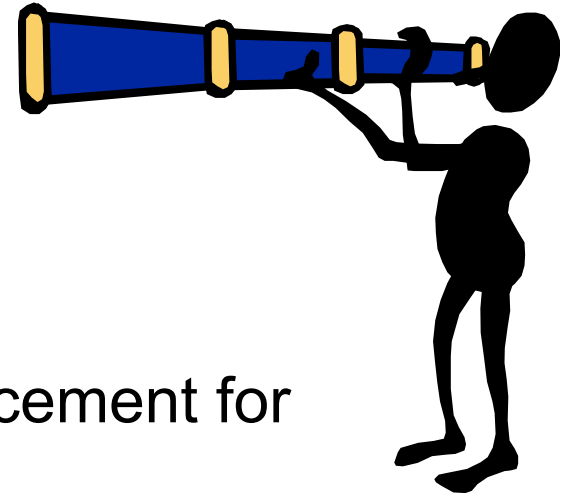
# Experiences

- Focus on online educational resources for learners
  - Not on research publications
  - Not on guides on how to teach better
  - Not digital versions of books
  - Not collections of materials for lecture preparation
  - Not data collections (except for learners to evaluate as part of their learning)



# Experiences

- Focus on large enrollment introductory undergraduate courses and AP courses at schools
  - online
  - hybrid
  - online supplement or textbook replacement for traditional lectures



# Sharing of Resources

- Educators are about educating
  - That's why they chose their job
  - They are motivated by things that help them teach effectively
  - But they don't have infinite time
- Digital repositories/libraries/resource pools/... are about sharing of resources
  - Goal: efficiently share effective teaching resources



# Sharing of Resources

- The key to re-usability is to create course-context free resources
- In other words, same resource can be used in different contexts
- This means:
  - No button “next resource”
  - No button “back to course menu”
  - No wording such as “as we have previously seen”
  - etc



# Sharing of Resources

- Counter-Example:

Pre-fabricated complete courses

MIT OPEN COURSEWARE  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Home Courses Donate About OCW Help Contact Us Enter search keyword Advanced Search

Home > Courses > Physics

## Physics

Physics home  
Department curriculum  
Supplemental resources  
Undergraduate Courses  
Graduate Courses  
Notify me of course updates

The Magellan Telescopes at Las Campanas Observatory in La Serena, Chile.

The MIT Department of Physics has been a national resource since the turn of the 20th century.  
Read more about Physics at MIT

### Available Courses

Lecture notes	Projects and examples	Image Galleries
Selected lecture notes	Projects (no examples)	Multimedia content
Assignments and solutions	Exams and solutions	OCW Scholar
Assignments (no solutions)	Exams (no solutions)	Study group
Online textbooks		

### Undergraduate Courses

Course #	Course Title	Term
8.01	Physics I	Fall 2003

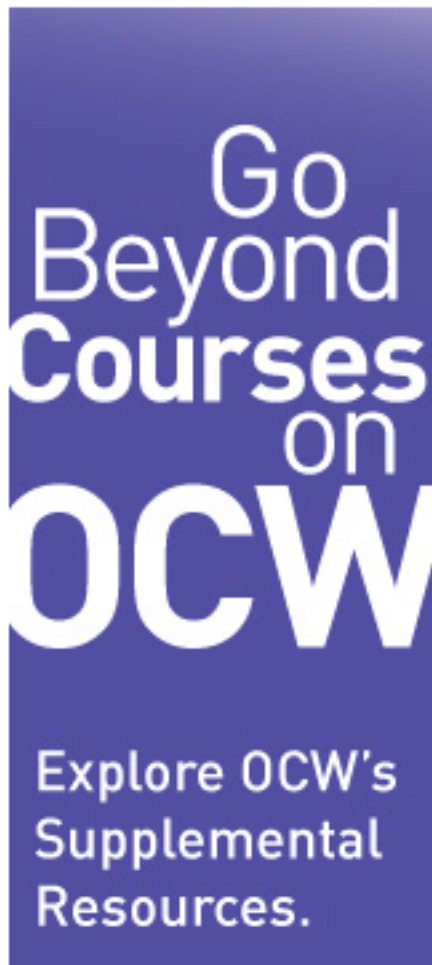
**DONATE NOW**

Celebrate our first decade by supporting our next.  
10  
LEARN HOW

Go Beyond Courses on OCW  
Explore OCW's Supplemental Resources.

# Sharing of Resources

- But wait!



## Physics

	Resource Title
<a href="#">T</a>	<a href="#">Applied Geometric Algebra</a>
<a href="#">T</a>	<a href="#">A WikiTextBook for Introductory Mechanics</a>

[^ Back to top](#)

## Sloan School of Management

	Resource Title
	<a href="#">MIT Sloan Teaching Innovation Resources (MSTIR)</a>

[^ Back to top](#)

## Teaching and Learning Resources

	Resource Title
<a href="#">T</a>	<a href="#">The Torch or The Firehose: A Guide to Section Teaching</a>
	<a href="#">Guidelines on Learning that Inform Teaching</a>

Just a random collection of more pre-assembled stuff



# Sharing of Resources

- Counter-Example:

The screenshot shows the NSDL (National Science Digital Library) search results page. At the top, there is a navigation bar with the NSDL logo and the text 'THE NATIONAL SCIENCE DIGITAL LIBRARY'. Below the logo are four colored boxes with the words 'EXPLORE', 'SHARE', 'LEARN', and 'CREATE'. The search bar contains the text 'capacitance' and a 'Search' button. There are also buttons for 'General Search', 'K-12', 'Higher Ed & Research', and 'Specialized Search'. The search results show 167 results, with a 'Next' button and a 'Results Per Page' dropdown. The first result is titled 'An Introduction to Capacitance' and is found in the 'comPADRE' and 'AMSER' collections. The description of the result is: 'This is an interesting tutorial to capacitors. It includes the definition, a brief history and principle behind the working of a capacitor. A description to application of capacitors is given too.' The keywords are: 'Capacitance, Electricity & Magnetism, Electrostatics, Physics, Science, Science Physics, applets for capacitance, capacitance, capacitors, electricity, electrostatics, science, simulations for capacitance'. The URL is 'http://micro.magnet.fsu.edu/electromag/electricity/capacitance.html'. There is a 'View all related information' link.

NSDL Home > Search > Search Results Larger Text

General Search **K-12** Higher Ed & Research Specialized Search

capacitance

[Search Help](#)

167 Results • [1](#) [2](#) [3](#) [4](#) [5](#) [6](#) [7](#) [8](#) [9](#) [10](#) ...17 [Next](#)

Title/Description	Found In Collection
<b>An Introduction to Capacitance</b> This is an interesting tutorial to capacitors. It includes the definition, a brief history and principle behind the working of a capacitor. A description to application of capacitors is given too. <b>Keywords:</b> <a href="#">Capacitance</a> , <a href="#">Electricity &amp; Magnetism</a> , <a href="#">Electrostatics</a> , <a href="#">Physics</a> , <a href="#">Science</a> , <a href="#">Science Physics</a> , <a href="#">applets for capacitance</a> , <a href="#">capacitance</a> , <a href="#">capacitors</a> , <a href="#">electricity</a> , <a href="#">electrostatics</a> , <a href="#">science</a> , <a href="#">simulations for capacitance</a> <a href="http://micro.magnet.fsu.edu/electromag/electricity/capacitance.html">http://micro.magnet.fsu.edu/electromag/electricity/capacitance.html</a> <a href="#">View all related information</a>	comPADRE AMSER

# Sharing of Resources

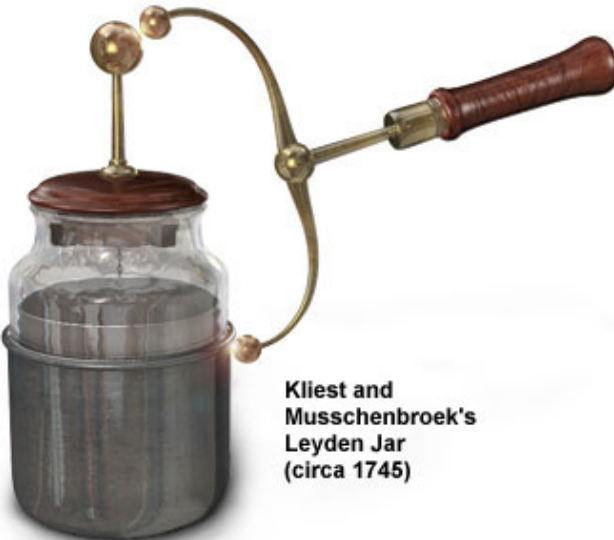
**MOLECULAR EXPRESSIONS™**  
**Electricity & Magnetism**  
Introduction

Search our site:

PHOTO GALLERY • MICROSCOPY PRIMER • SILICON ZOO • YOU • HOME

## An Introduction to Capacitance

Capacitance is the property of an electric conductor that characterizes its ability to store an electric charge. An electronic device called a capacitor is designed to provide capacitance in an electric circuit by providing a means for storing energy in an electric field between two conducting bodies.



**Kliest and Musschenbroek's Leyden Jar (circa 1745)**

**Figure 1**

Around 1745, Ewald Christian von Kliest and Pieter van Musschenbroek independently discovered capacitance in an electric circuit. While engaged in separate studies of

60-Tesla Pulse

Image Use  
Custom Photos  
Partners

ence,  
You

T Galleries:

Photo Gallery  
Silicon Zoo  
Pharmaceuticals  
Chip Shots  
Phytochemicals  
DNA Gallery

Branding

Another search

Different navigation

Plenty of ways to get off-topic

No link back

# Sharing of Resources

- Way-off topic

Amino Acids
Birthstones
Religion Collection
Pesticides
BeerShots
Cocktail Collection

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Digital libraries that are basically catalogued link collections are no better than “surfing the web”

# Sharing of Resources

- You might as well:

Web [Images](#) [Videos](#) [Maps](#) [News](#) [Shopping](#) [Gmail](#) [more](#) ▼ [Web History](#) | [Search settings](#) | [Sign in](#)

Google

capacitance

Search

[Advanced Search](#)

Web [+ Show options...](#)

Results 1 - 10 of about 7,280,000 for **capacitance**. (0.12 seconds)

[Capacitance - Wikipedia, the free encyclopedia](#)

In electromagnetism and electronics, **capacitance** is the ability of a body to hold an electrical charge. **Capacitance** is also a measure of the amount of ...

[Capacitors](#) - [Coefficients of potential](#) - [Self-capacitance](#) - [Elastance](#)

[en.wikipedia.org/wiki/Capacitance](http://en.wikipedia.org/wiki/Capacitance) - [Cached](#) - [Similar](#)

[Capacitor - Wikipedia, the free encyclopedia](#)

Jump to [Instability of capacitance](#): The **capacitance** of certain capacitors decreases as the component ages. In ceramic capacitors, this is caused by ...

[en.wikipedia.org/wiki/Capacitor](http://en.wikipedia.org/wiki/Capacitor) - [Cached](#) - [Similar](#)

[Capacitance](#)

**Capacitance** is typified by a parallel plate arrangement and is defined in ... you get by calculating the equivalent **capacitance** of the series combination ...

[hyperphysics.phy-astr.gsu.edu/hbase/electric/capac.html](http://hyperphysics.phy-astr.gsu.edu/hbase/electric/capac.html) - [Cached](#)

[Molecular Expressions: Electricity and Magnetism - Capacitance](#)

This section of the Electricity and Magnetism Primer provides a thorough discussion of electrical **capacitance**. It contains several Interactive Java ...

[micro.magnet.fsu.edu/electromag/electricity/capacitance.html](http://micro.magnet.fsu.edu/electromag/electricity/capacitance.html) - [Cached](#) - [Similar](#)

Sponsored Links

[Capacitors](#)

Allied Has Over 1.2 Million Products In Stock. Order Today!  
[www.AlliedElec.com](http://www.AlliedElec.com)

Related:

[inductance](#)

[capacitor](#)

[impedance](#)

[farad](#)

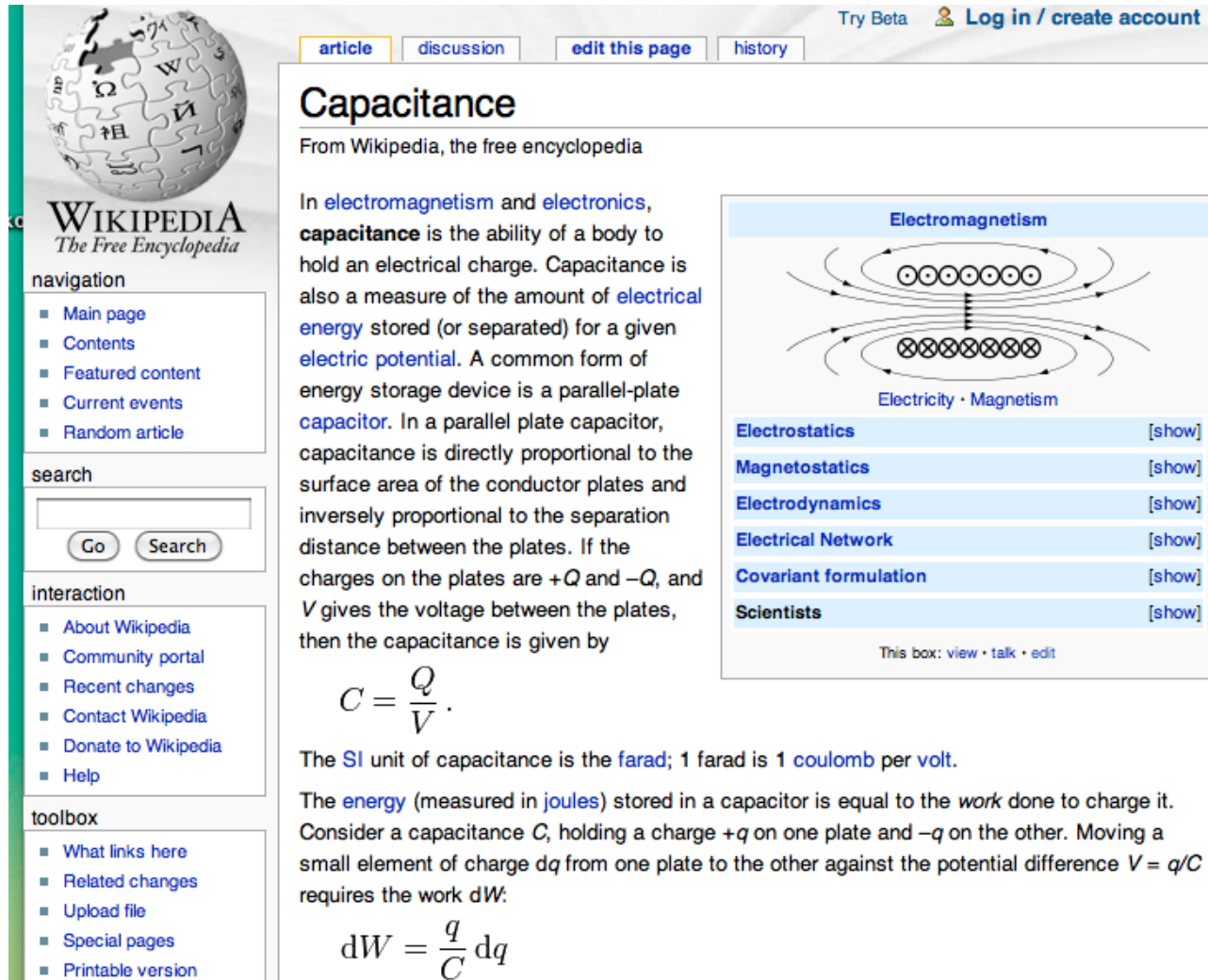
[capacitance formula](#)

[See your ad here »](#)

Actually pretty good!

Same as NSDL

# Sharing of Resources



The screenshot shows the Wikipedia article for "Capacitance". At the top, there are navigation tabs for "article", "discussion", "edit this page", and "history". The article title "Capacitance" is prominently displayed, followed by the text "From Wikipedia, the free encyclopedia". The main text explains that in electromagnetism and electronics, capacitance is the ability of a body to hold an electrical charge. It also defines it as a measure of the amount of electrical energy stored (or separated) for a given electric potential. A common form of energy storage device is a parallel-plate capacitor. The text states that in a parallel plate capacitor, capacitance is directly proportional to the surface area of the conductor plates and inversely proportional to the separation distance between the plates. It further explains that if the charges on the plates are +Q and -Q, and V gives the voltage between the plates, then the capacitance is given by the equation  $C = \frac{Q}{V}$ . Below this, it notes that the SI unit of capacitance is the farad, and 1 farad is 1 coulomb per volt. The article then discusses the energy stored in a capacitor, stating that the energy (measured in joules) stored in a capacitor is equal to the work done to charge it. It considers a capacitance C, holding a charge +q on one plate and -q on the other. Moving a small element of charge dq from one plate to the other against the potential difference  $V = q/C$  requires the work dW, which is given by the equation  $dW = \frac{q}{C} dq$ . To the right of the text is a diagram titled "Electromagnetism" showing electric field lines between two parallel plates (one with positive charges, one with negative charges) and magnetic field lines around a central wire. Below the diagram is a table of related topics with "show" links: Electrostatics, Magnetostatics, Electrodynamics, Electrical Network, Covariant formulation, and Scientists. The left sidebar contains navigation links like "Main page", "Contents", "Featured content", "Current events", "Random article", a search box, and "interaction" links like "About Wikipedia", "Community portal", "Recent changes", "Contact Wikipedia", "Donate to Wikipedia", and "Help". A "toolbox" section at the bottom left includes "What links here", "Related changes", "Upload file", "Special pages", and "Printable version".

So, what is the point of a digital library/ repository/ resource pool for education?



# Sharing of Resources

- Need value-added features beyond
  - catalogues and
  - community functionswhich usually remain unused anyway
- Particularly for educational libraries:  
Provide infrastructure for using resources in educational contexts

# Sharing of Resources

- How do you use context-free re-usable resources in the context of a course?
- The system **dynamically** generates context for context-free resources:
  - Navigation (no getting lost!)
  - Contextual community functions
  - Feedback to instructors and authors
- Instructors and students are different!
  - Instructors select content that students get
  - Instructors customize the content

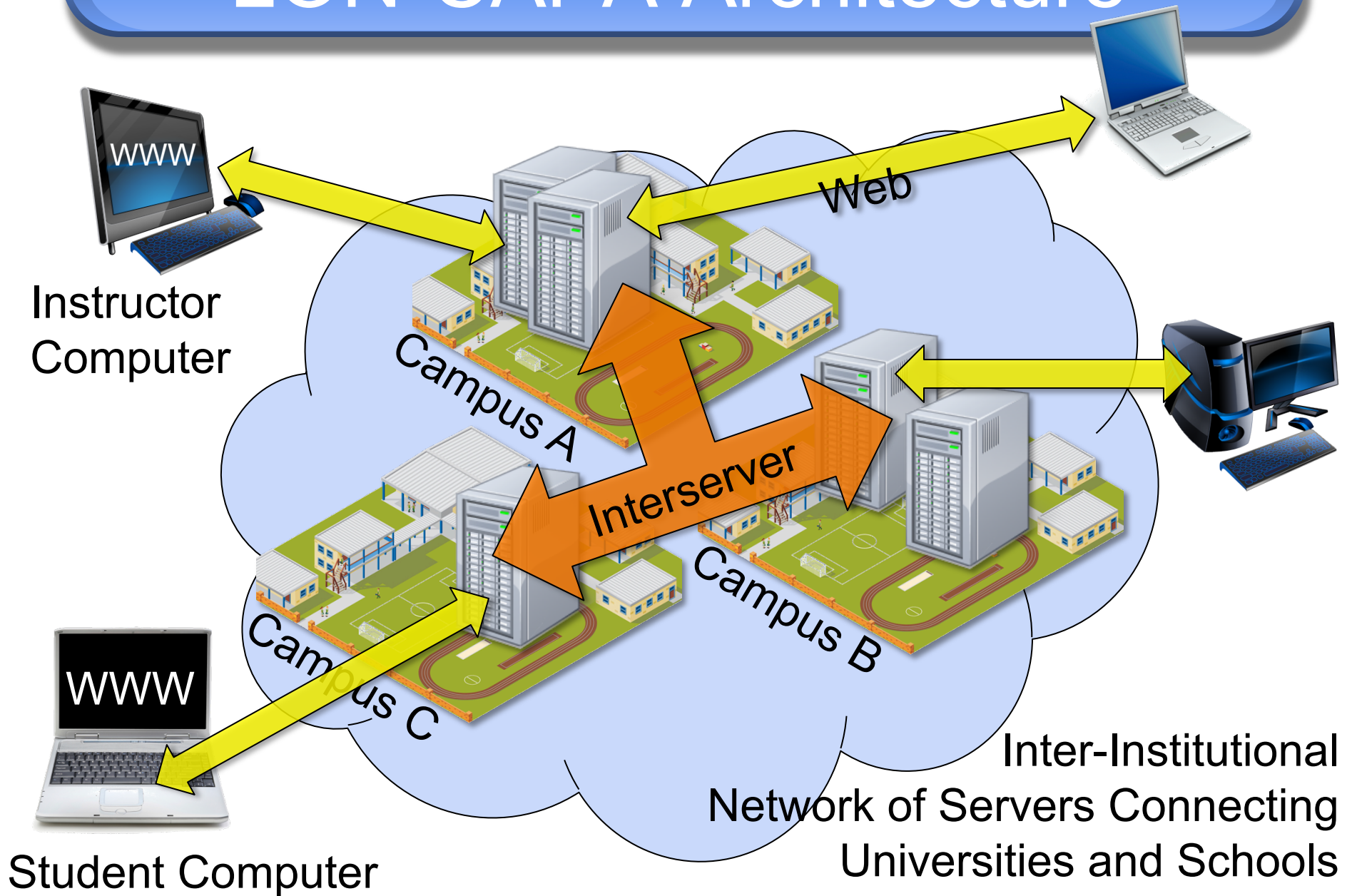
# Sharing of Resources

- In our environment (large enrollment undergraduate courses), you need an infrastructure to
  - Find resources in a library of resources
  - **Sequence them up (put the puzzle together)**
  - **Serve them out to the students**
- Example: LON-CAPA





# LON-CAPA Architecture



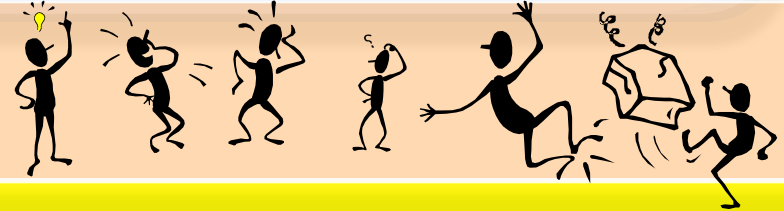
# LON-CAPA Architecture



Course Management

Campus A

Resource Assembly



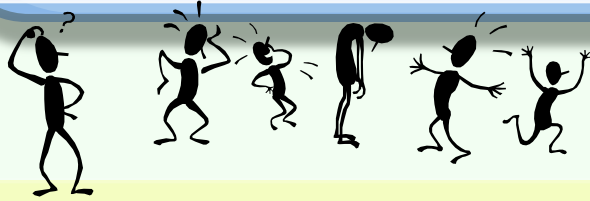
Course Management

Campus B

Resource Assembly

Shared Cross-Institutional  
Digital Resource Library

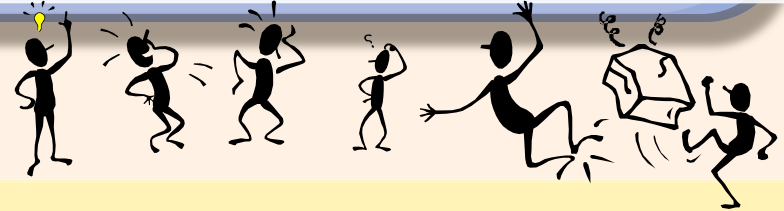
# LON-CAPA Architecture



Course Management

Campus A

Resource Assembly



Course Management

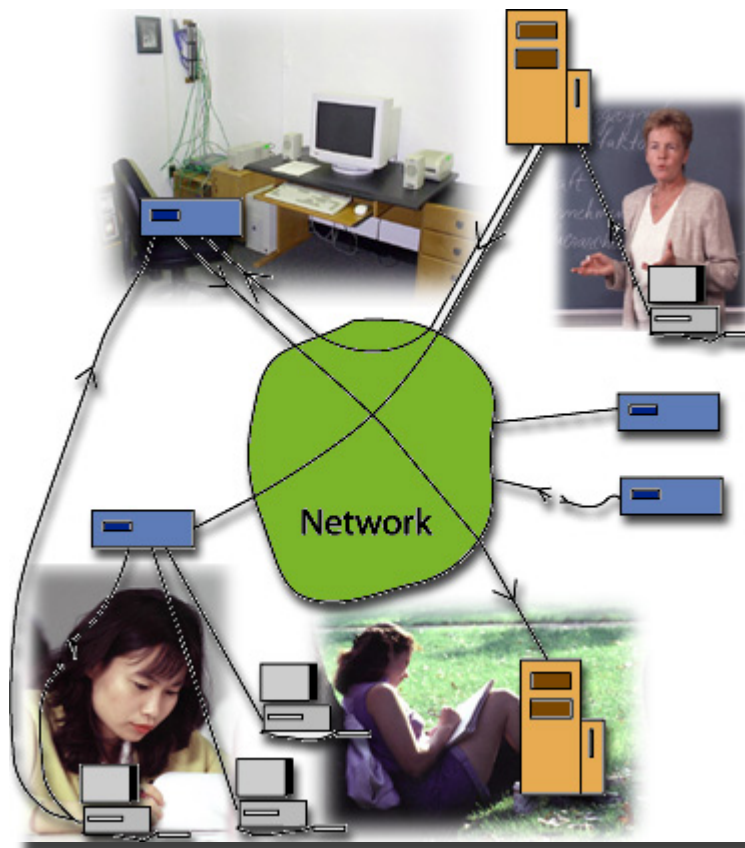
Campus B

Resource Assembly

Shared Cross-Institutional  
Digital Resource Library

# Shared Resource Library

- The distributed network looks like one big file system



Domain - sc (University of South Carolina)
Domain - sfu (Simon Fraser University)
batchelo
chem281
exafs
hanlan
mxchen
slavieri
vjungic
Domain - sunysb (SUNY Stony Brook)
Domain - tmcc (Truckee Meadows Community College)
jensen
mbauer
souza
Greenberg
default.sequence (metadata)
samples
testuser1
Domain - ucf (University of Central Florida)

# Shared Resource Library

- Resources may be web pages ...

EXAMPLE

## Example: Looping

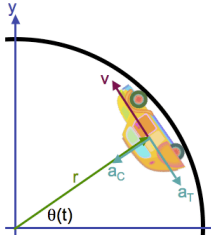
A toy car can go through a looping if it is fast enough. What are the forces that act on it? How fast does it have to be?

The motion is obviously circular, but non-uniform: the car will slow down on the way up, and speed up on the way down. With  $r$  being the radius of the looping, the  $x$ -axis horizontal, the  $y$ -axis pointing up, the origin being in the center of the looping, and  $\theta(t)$  being the angle, the position of the car is given by

$$\vec{r}(\theta) = \begin{pmatrix} r \cos(\theta(t)) \\ r \sin(\theta(t)) \end{pmatrix}$$

as long as it does not fall off the track.

The figure below illustrates the setup:



EXAMPLE

## Focal Length

The following pictures are taken from the same vantage point with three different zoom lenses:

- 17mm-35mm wideangle zoom
- 24mm-70mm normal zoom
- 70mm-300mm tele zoom

using a digital camera with an image sensor of 24mm x 36mm (standard so-called 35mm image format).

17mm extreme wide angle



35mm mild wide angle



24mm wide angle



48mm normal



The addition of the three currents (through the resistor, the inductance, and the capacitance), each of which is  $90^\circ$  out of phase with each other, in quadrature yields:

$$\begin{aligned} V &= \sqrt{V_R^2 + (V_C - V_L)^2} \\ &= \sqrt{(IR)^2 + (IX_C - IX_L)^2} \\ &= I \sqrt{R^2 + (X_C - X_L)^2} \\ &= IZ \end{aligned}$$

where  $I$  is the current,  $X_C$  and  $X_L$  are the [capacitive](#) and [inductive](#) reactances, respectively, and  $Z$  is the [impedance](#). Putting in the values of the reactances, we obtain for  $Z$ :

$$\begin{aligned} Z &= \frac{V}{I} = \sqrt{R^2 + (X_C - X_L)^2} \\ &= \sqrt{R^2 + \left(\frac{1}{\omega C} - \omega L\right)^2} \\ &= \sqrt{R^2 + \left(\frac{1}{2\pi f C} - 2\pi f L\right)^2} \end{aligned}$$

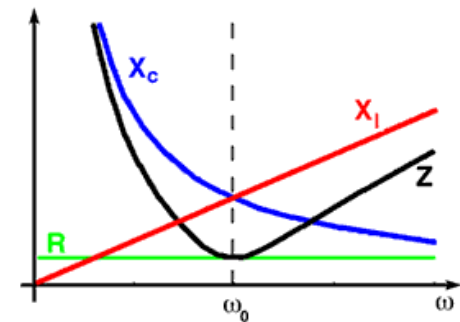
and has its minimum of  $Z = R$  when

$$\omega_0 = (LC)^{-1/2},$$

pure LC circuit. This is the [resonance frequency](#) of the RLC circuit. The impedance and of the reactances is shown in the figure.

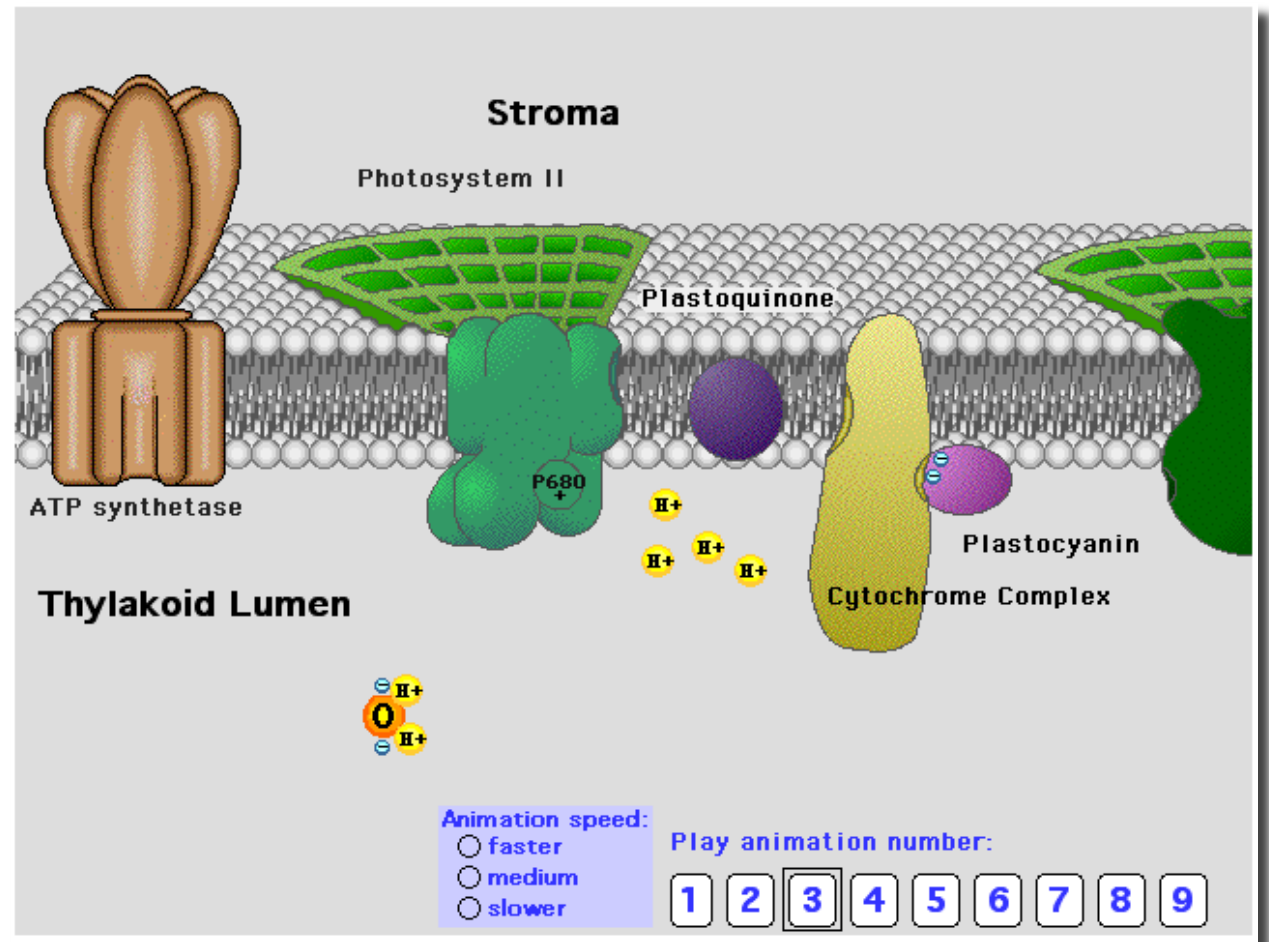
have to be added in a special way. They end up as a single quantity  $Z$ , the [impedance](#).

## Impedance



# Shared Resource Library

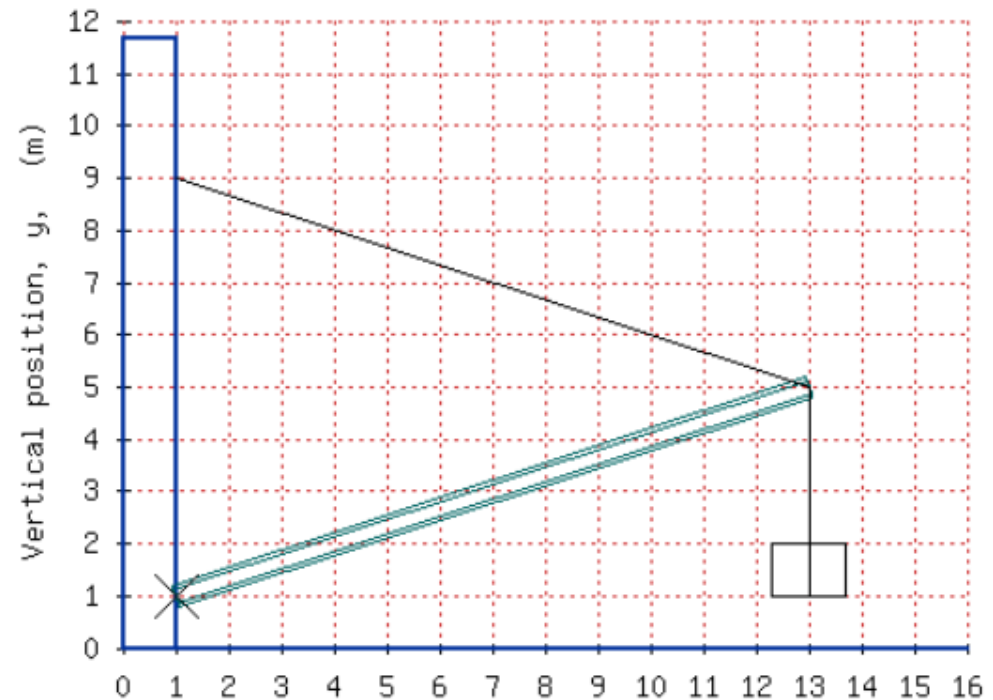
- ... or simulations and animations ...



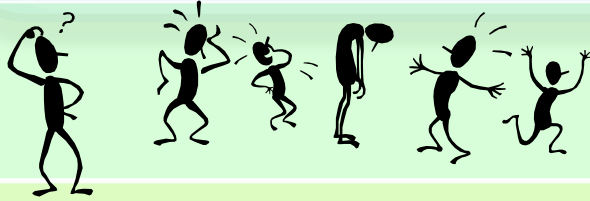
# Shared Resource Library

- ... or this kind of randomizing online problems

A crate with a mass of 155.5 kg is suspended from the end of a uniform boom with mass of 89.5 kg. The upper end of the boom is supported by a cable attached to the wall and the lower end by a pivot (marked X) on the same wall. Calculate the tension in the cable.



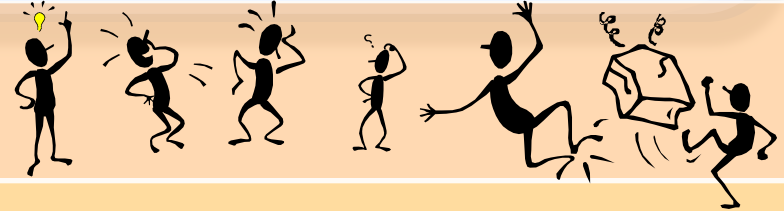
# LON-CAPA Architecture



Course Management

Campus A

Resource Assembly



Course Management

Campus B

Resource Assembly

Shared Cross-Institutional  
Digital Resource Library



# Resource Assembly

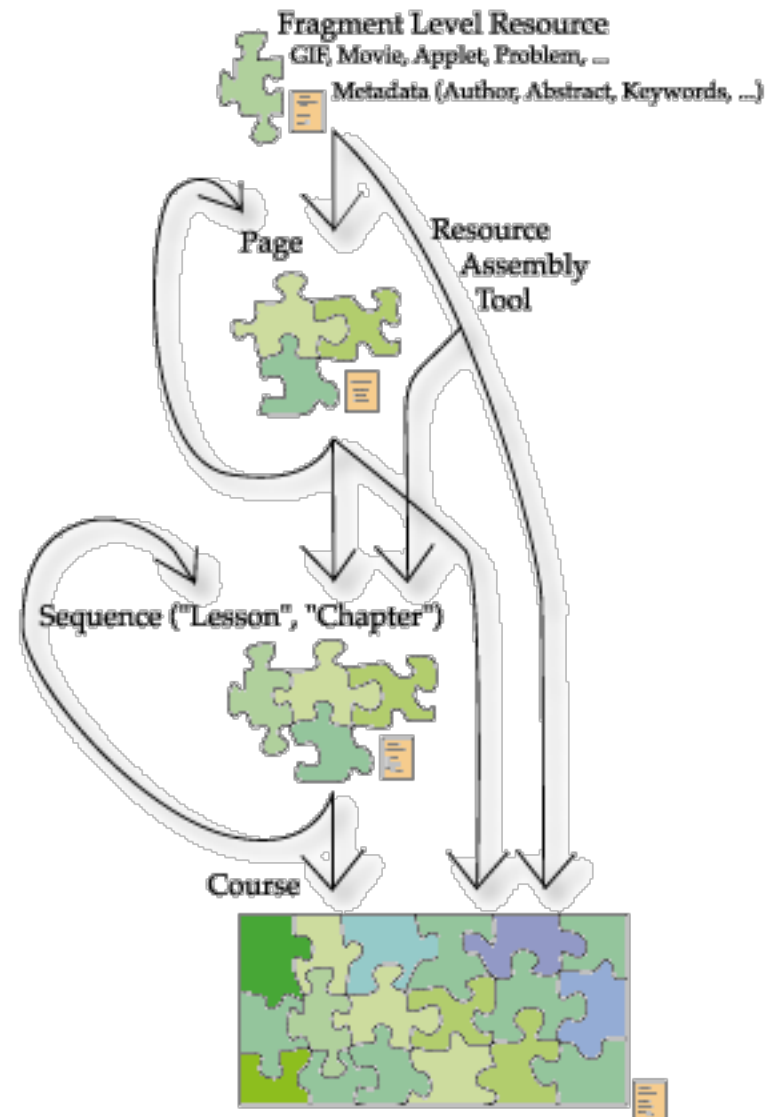
- Take shopping cart to the supermarket



▶	Domain - sc (University of South Carolina)
▶	Domain - sfu (Simon Fraser University)
▶	batchelo
▶	chem281
▶	exafs
▶	hanlan
▶	mxchen
▶	slavieri
▶	vjungic
▶	Domain - sunysb (SUNY Stony Brook)
▶	Domain - tmcc (Truckee Meadows Community College)
▶	jensen
▶	mbauer
▶	souza
▶	Greenberg
▶	default.sequence (metadata)
▶	samples
▶	testuser1
▶	Domain - ucf (University of Central Florida)

# Resource Assembly

- Nested Assemblies
- No pre-defined levels of granularity („module“, „chapter“, etc)
  - People can never agree what those terms mean
- Re-use possible on any level
  - Customize your table of contents



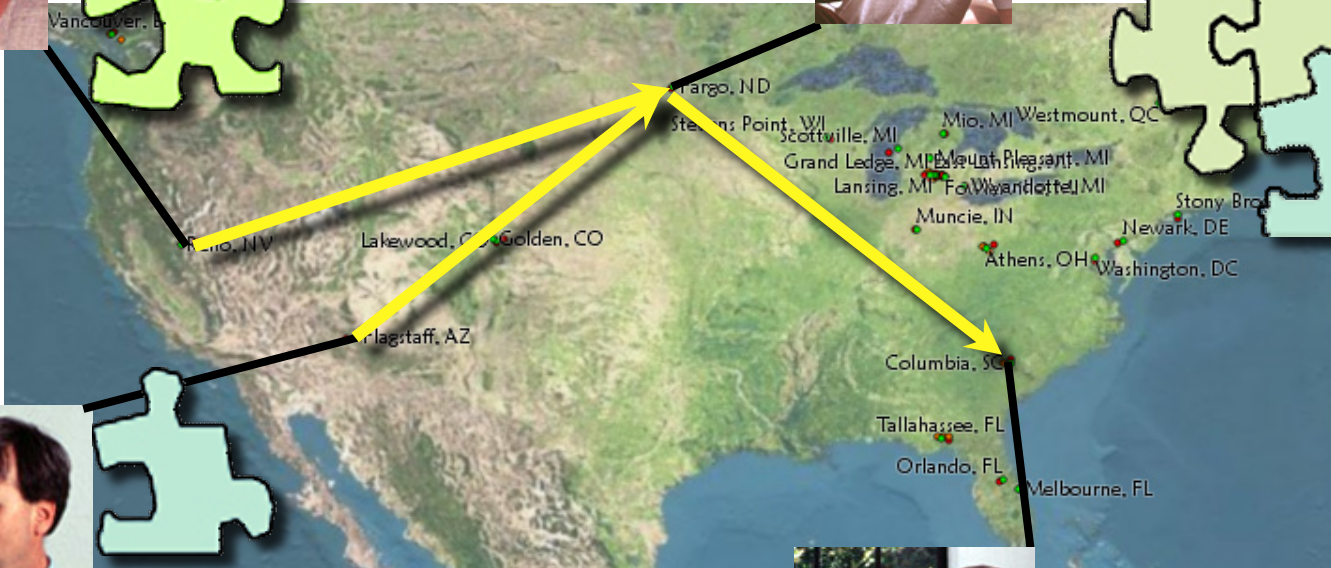
# Resource Assembly



Writes module about energy conservation



Compiles module about conservation laws



Writes module about momentum conservation



Uses whole assembly in his course

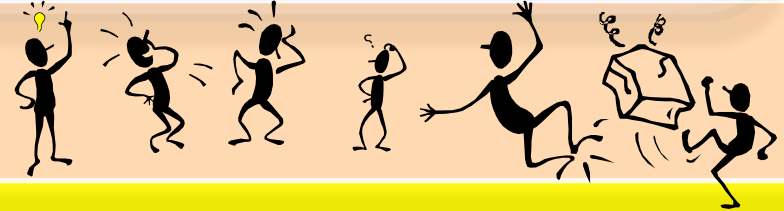
# LON-CAPA Architecture



Course Management

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Resource Assembly



Course Management

Campus B

Resource Assembly

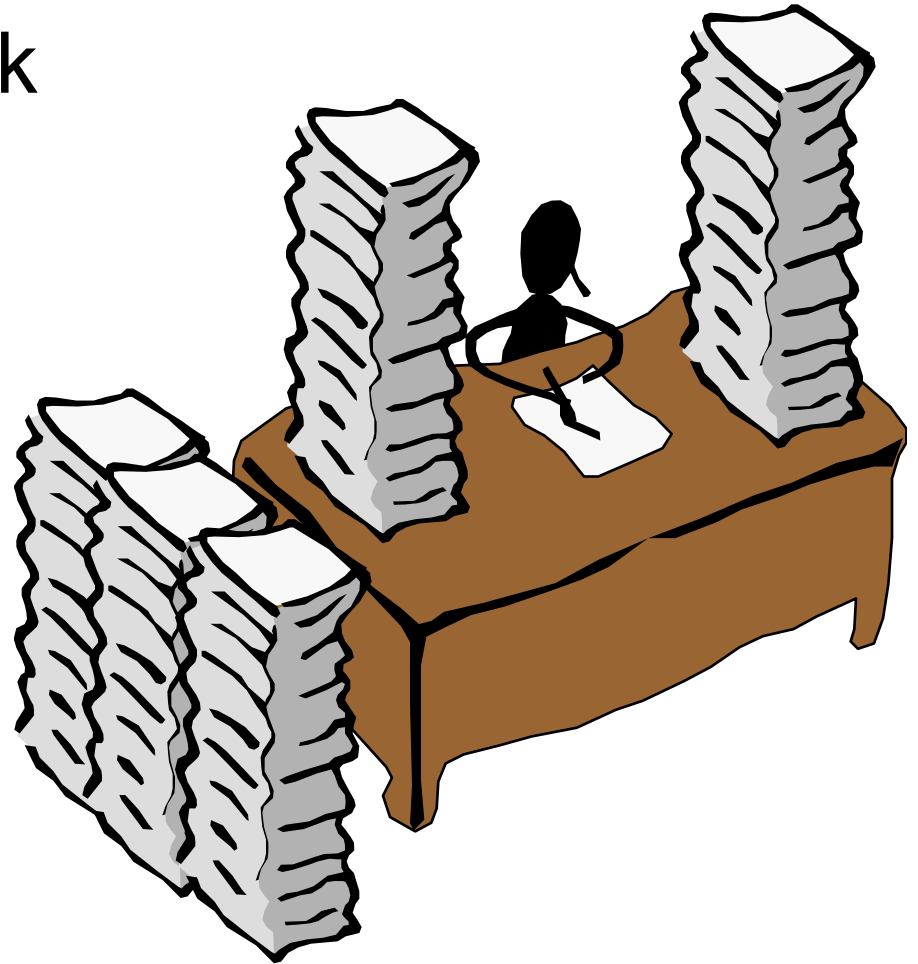
Shared Cross-Institutional  
Digital Resource Library

# Course Management



# Course Management

- Posting of materials
- Posting of homework
- Discussions
- Announcements
- Portfolios
- Scheduling
- Gradebook
- ...



# Course Management

- Instructors can directly use the assembled material in their courses
  - navigational tools for students to access the material
  - access rights management
  - timing
  - contextual discussions and messaging

The screenshot displays a web interface for navigating course contents. At the top, there are navigation links: "Main Menu", "Return to Last Location", "Navigate Contents", and "Course Documents". Below these is a header "Navigate Course Contents" in a purple bar. A search bar contains "Select Action" and a "Go" button, along with a "Sort by: Default" dropdown. The main content area lists course items with expandable icons (square, left arrow, and folder) and a question mark icon. The items are: Syllabus, Calendar Overview, Electrostatics, Electric Field, Capacitors, Capacitors Materials, and Capacitors Homework. Under "Capacitors Homework", there is a list of topics: Force, Spherical Capacitor, Separation, Dielectric Constant, Energy Stored, Dielectric constant 2, Energy Density, Capacitance, and Capacitance 2. Each topic has a question mark icon, a speech bubble icon, and a green "Answer available" status with a yellow 'X' icon. A blue arrow points to the "Capacitance" row.

Item	Question Mark	Speech Bubble	Answer Available
Syllabus			
Calendar Overview			
Electrostatics			
Electric Field			
Capacitors			
Capacitors Materials			
Capacitors Homework			
Force	?	☰	Answer available
Spherical Capacitor	?	☰	Answer available
Separation	?	☰	Answer available
Dielectric Constant	?	☰	Answer available
Energy Stored	?	☰	Answer available
Dielectric constant 2	?	☰	Answer available
Energy Density	?	✉	Answer available
Capacitance	?		Answer available
Capacitance 2	?		Answer available

# Course Management

Gerd Kortemeyer (Course Coordinator) **LB274, Spring 2011 - Intro Calc-Based Physics II** (More ...)

Messages Roles Help Logout

**Main Menu** | **Return to Last Location** | **Course Contents** | **Course Editor** | **Groups** | Switch course role to...

LB274, Spring 2011 - Intro Calc-Based Physics II » **Course Contents**

Tools: [Icons] Sort by: Default

- Syllabus
- Calendar Overview
- ▶  Electrostatics
- ▼  Electric Field
  - Electric Field
  - ▶  Electric Field Materials
  - ▶  Electric Field Homework
- ▼  Capacitors
  - Capacitors
  - ▼  Capacitors Materials
    - Circuits
    - Capacitance
    - Example: Capacitance
    - Factors Affecting Capacitance
    - Parallel Plate Capacitor
    - ? Plate Capacitor ✗ Answer available
    - Example: Farad
    - Example: Cloud
    - Capacitance of a Sphere
    - Example: Sphere
    - Two Spheres
    - Combination of Capacitors

Assembled structure turns into the course navigation

Organized around the content, not the resource type, e.g. embedded assessment



# Course Management

- Course overview/dashboard

## Course Action Items

Gerd Kortemeyer  
Course Coordinator  
LBS 272 - Spring 2006

LBS 272 - Spring 2006 -> Display Action Items

What's New?

[Go to first resource](#)

Page set to be displayed after you have selected a role in this course? Currently: *What's New? page (user preference)* **Change** for just [this course](#) or for all [your courses](#).

[Hide all](#) [Show all](#)

Problems requiring handgrading		<a href="#">Hide</a>
Problem Name	Number ungraded	
<a href="#">Electric Field</a>	4	

Problems with errors		<a href="#">Hide</a>
<i>No problems with errors</i>		

Problems with av. attempts $\geq 3$ or deg. difficulty $\geq 0.8$ and total number of students with submissions $\geq 4$							<a href="#">Hide</a>
							<a href="#">Change thresholds?</a>
Resource	Part	Num. students	Av. Attempts	Deg. Diff	Last Reset	Reset Count?	
<a href="#">Field Lines</a>	single part	24	2.12	0.84		<input type="checkbox"/>	
<a href="#">Net Force</a>	single part	53	2.49	0.80		<input type="checkbox"/>	
<a href="#">Pith Balls</a>	single part	52	4.12	0.90		<input type="checkbox"/>	
<input type="button" value="Reset counters to 0"/>							

Resources in course with version changes since last week				<a href="#">Hide</a>
				<a href="#">Change interval?</a>
Resource	Last revised	New version	Version used	
<a href="#">Applet: Electron Orbit</a>	Fri Jan 13 10:18:52 2006 (EST)	10	10	
<a href="#">Capacitance of a Sphere</a>	Mon Jan 16 12:03:13 2006	8	8	

Unread course discussion posts				<a href="#">Hide</a>
				<a href="#">Change options?</a>
Location	Type	Time of last post	Number of new posts	
<a href="#">Coulomb</a>	Resource	last Monday, Jan 16 at 04:55 pm (EST)	1	
<a href="#">Distance Change</a>	Resource	last Monday, Jan 16 at 07:00 pm (EST)	1	
<a href="#">Field Lines</a>	Resource	last Monday, Jan 16 at 07:49 pm (EST)	1	
<a href="#">Force</a>	Resource	on Wednesday, Jan 11 at 07:01 pm (EST)	3	
<a href="#">Net Force</a>	Resource	23 hours, 19 minutes ago	5	
<a href="#">Pith Balls</a>	Resource	last Monday, Jan 16 at 09:21 pm (EST)	6	
<a href="#">Point P</a>	Resource	last Friday, Jan 13 at 02:34 pm (EST)	5	
<a href="#">Potential</a>	Resource	last Sunday, Jan 15 at 03:15 pm (EST)	1	
<a href="#">Two Charges</a>	Resource	last Sunday, Jan 15 at 03:26 pm (EST)	1	
<a href="#">Vector</a>	Resource	last Saturday, Jan 14 at 01:32 am (EST)	1	
<a href="#">Vectors</a>	Resource	last Saturday, Jan 14 at 12:09 pm (EST)	2	

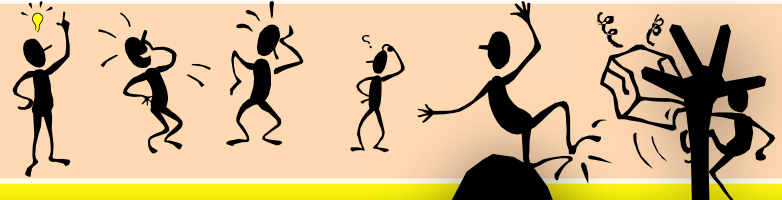
New course messages				<a href="#">Hide</a>
Number	Subject	Sender	Date/Time	
1.	<a href="#">Feedback [msu/mmp/kap18/problems/cd460_problem]</a>	@msu	Sat Jan 14 10:45:02 2006 (EST)	

New critical messages in course		<a href="#">Hide</a>
<i>No unread critical messages in course</i>		

# LON-CAPA Architecture



Course Management



Course Management

Campus B

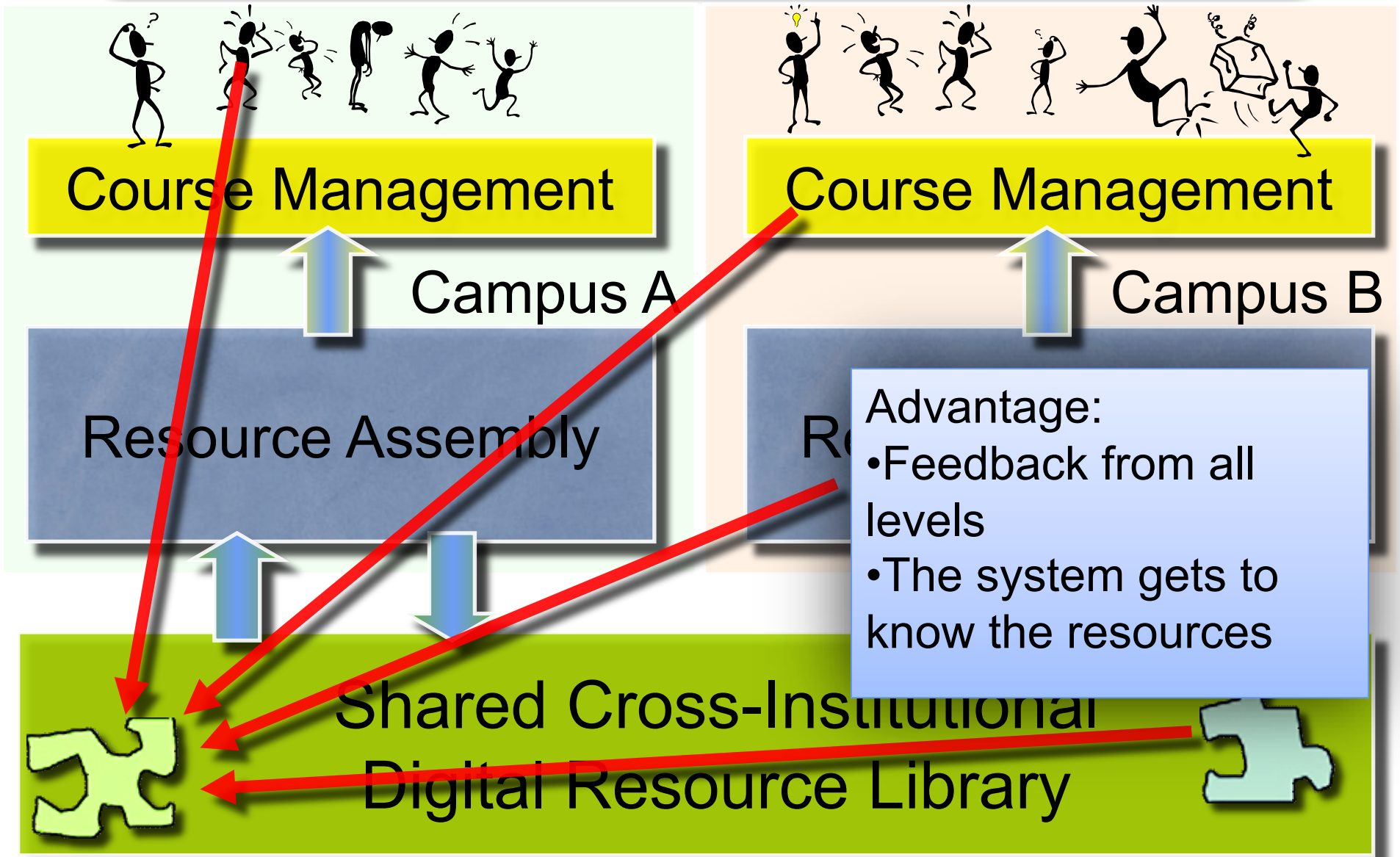
Resource Assembly

R

Isn't that  
rather  
monolithic?

Shared Cross-Institutional  
Digital Resource Library

# Dynamic Metadata



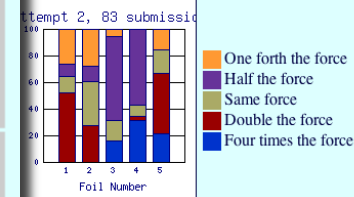
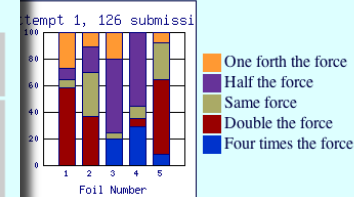
# Dynamic Metadata

- Dynamic metadata from usage
- Assistance in resource selection („amazon.com“)
- Quality control


Foil Number	Foil Name	Foil Text	Correct Value
1	1.6_1_1_2	The distance between the two charges is cut in half.	Four times the force
2	1.6_1_2_2	The magnitude of both charges is doubled.	Four times the force
3	1.6_1_3_2	The magnitude of one of the two charges is doubled.	Double the force
		The distance between the charges is doubled.	One forth the force
		charges are placed in a medium with a factor two higher permittivity.	Half the force

## Access and Usage Statistics

Network-wide number of accesses (hits)	890
Number of resources using or importing resource	1 <ul style="list-style-type: none"> <li>• <a href="#">Eukaryotic Gene Control [msu/bio/Gene_Expr/111f03GeneCtr1_sequence]</a></li> </ul>
Number of resources that lead up to this resource in maps	1 <ul style="list-style-type: none"> <li>• <a href="#">Back to the Original Question [msu/bio/Gene_Expr/problems/originalquestion_problem]</a></li> </ul>
Number of resources that follow this resource in maps	1 <ul style="list-style-type: none"> <li>• <a href="#">Eukaryotic vs Prokaryotic Gene Expression II [msu/bio/Gene_Expr/problems/eukvsprokII_problem]</a></li> </ul>
Network-wide number of courses using resource	3 <ul style="list-style-type: none"> <li>• <a href="#">LBS 145 - Spring 2004</a></li> <li>• <a href="#">ZOL 341 - Fall 2003</a></li> <li>• <a href="#">BS 111 - Fall 2003</a></li> </ul>



## Assessment Statistical Data

Total number of students who have worked on this problem	291
Average number of tries till solved	1.37
Degree of difficulty	 (0.36)

# Dynamic Metadata

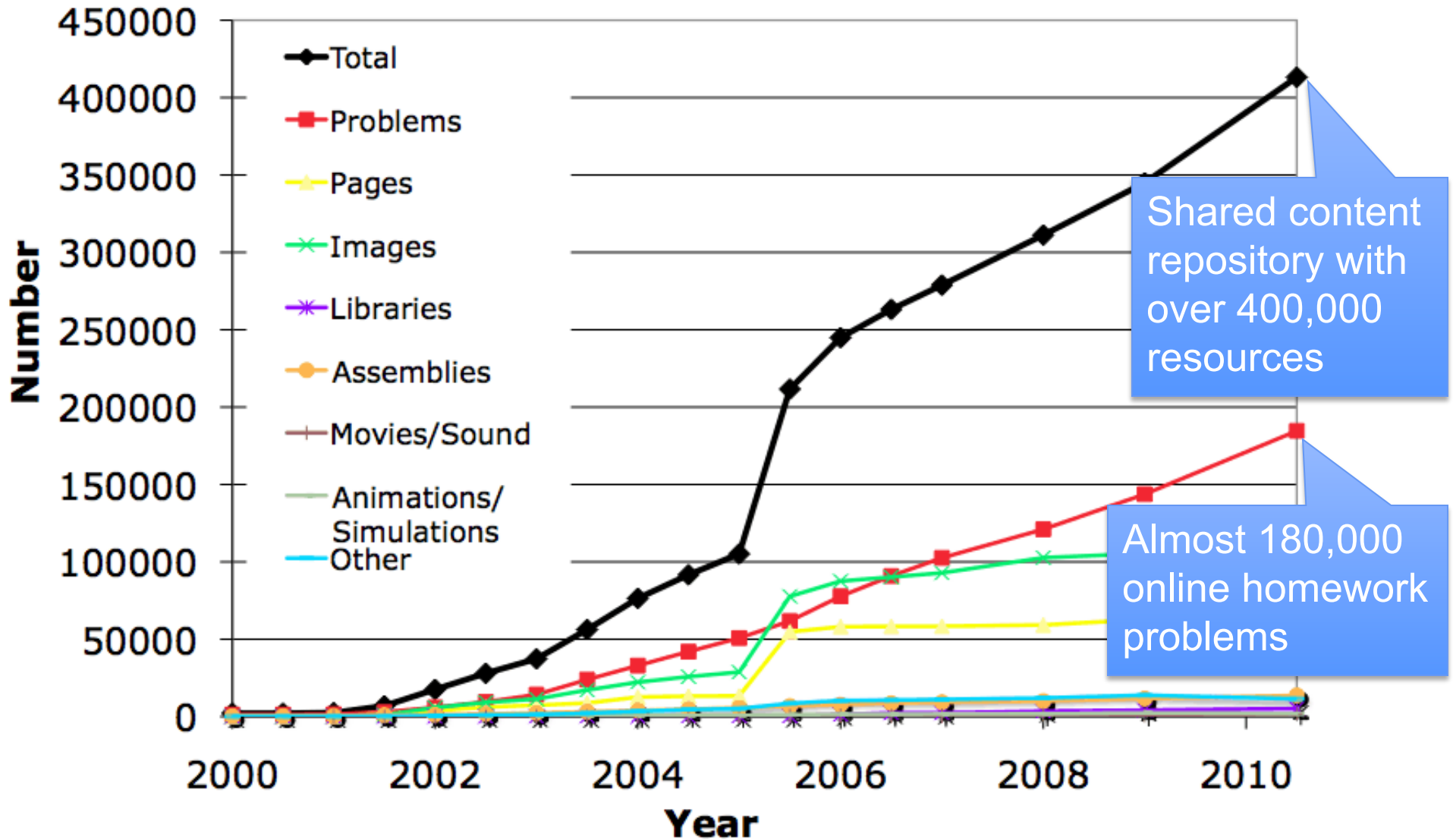
- More useful than static metadata
- Authors
  - spend hours writing beautiful resources
  - do not spend five minutes to fill out even the most basic information
- Dynamic metadata shows the resource “in action”

# The LON-CAPA Community

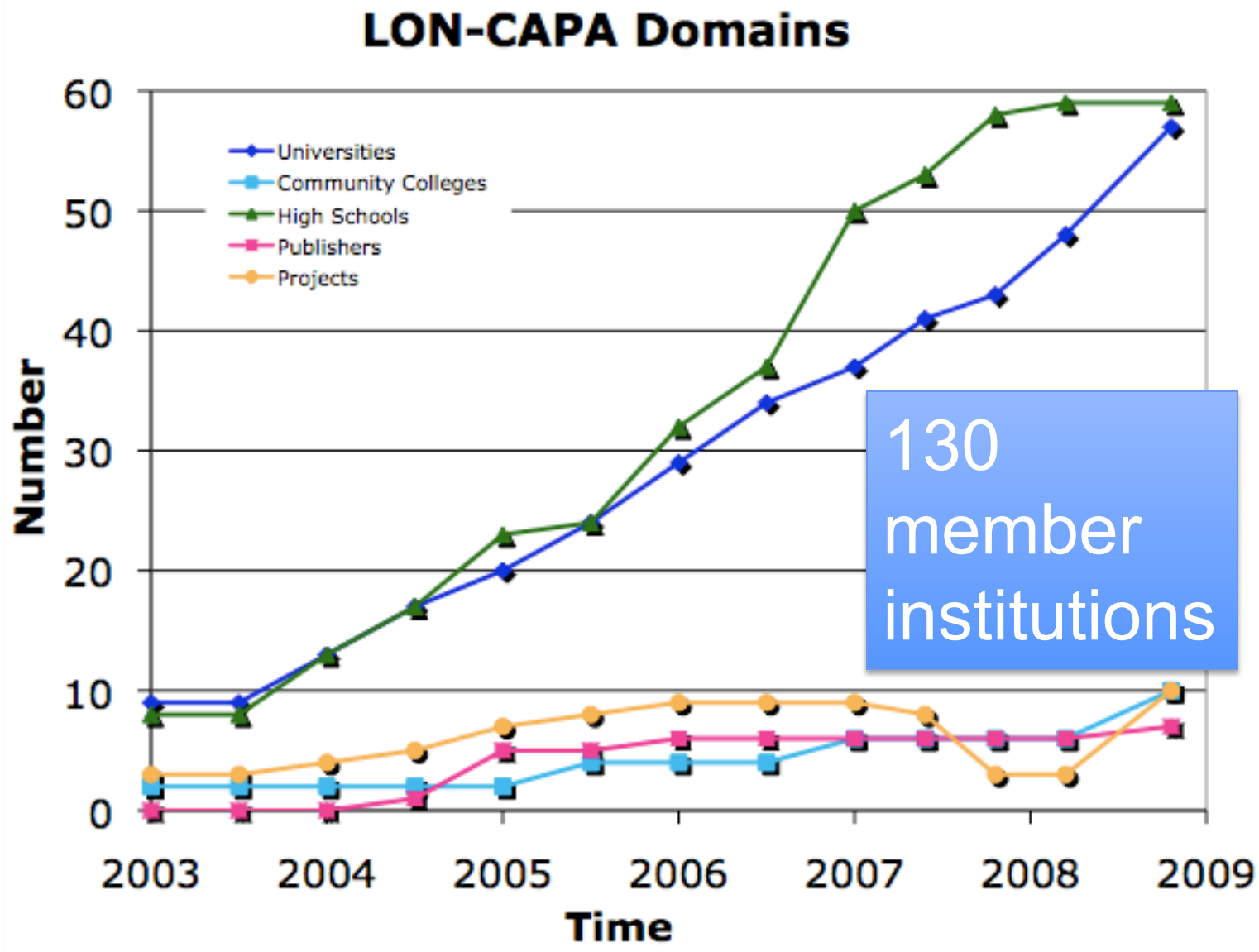
- Does this work?
- Does it scale?

# Shared Resource Library

## LON-CAPA Shared Resource Pool, Summer 2010



# The LON-CAPA Community





# The LON-CAPA Community

High Schools, Colleges, and Universities



... plus grant projects and publishing companies.

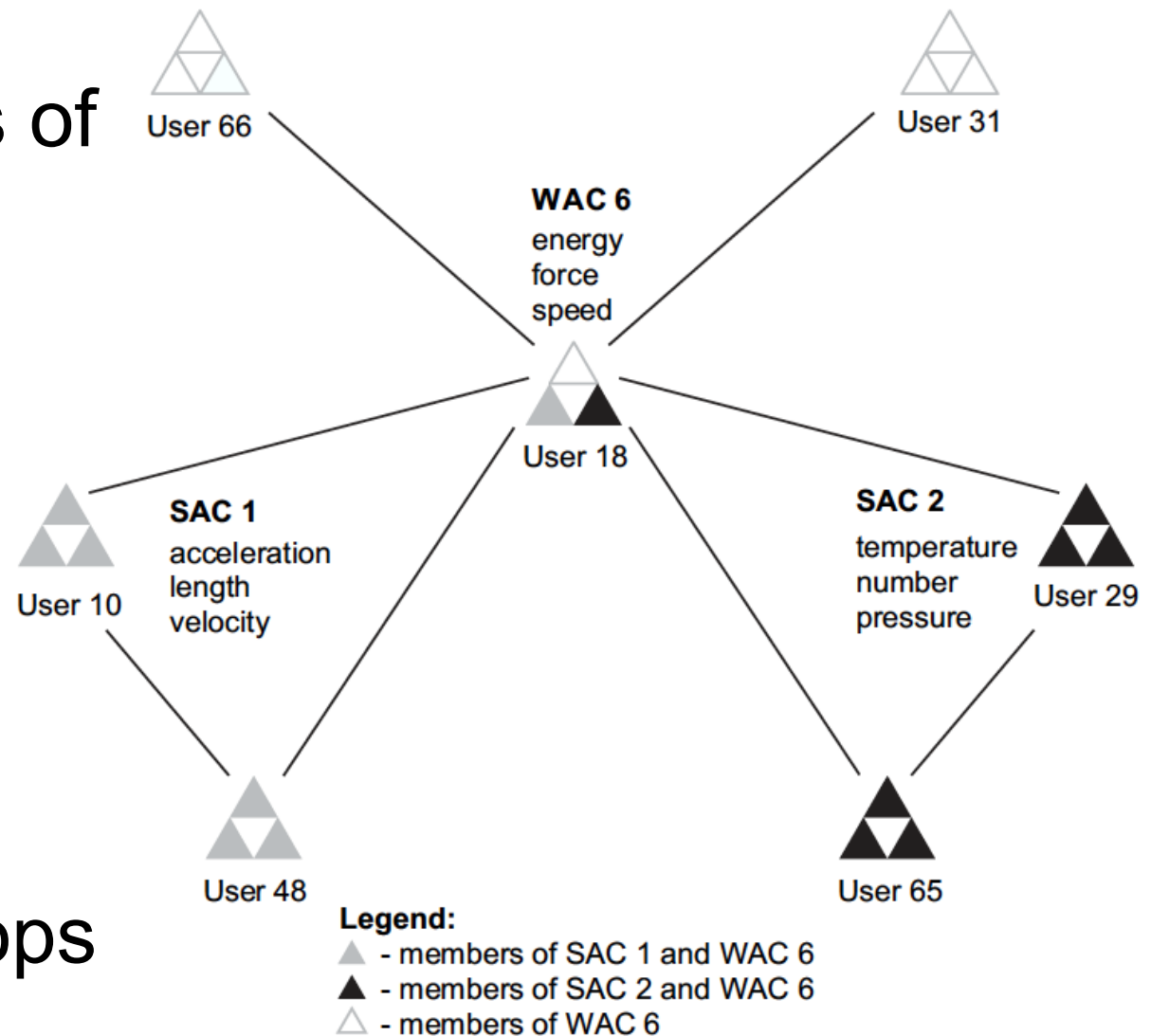
# The LON-CAPA Community

- Cross-institutional use

	U01	U04	PR01	U06	U17	U05	U03	HS20	U12	PR06	U11	U08	U
Available	144418	17545	10809	8799	7635	7037	5120	4439	4066	3750	3283	2989	27
Used	38245	7596	340	4821	2908	4880	3411	3842	2841	1502	1231	2102	3
Used externally	17099	1804	339	974	276	3507	1735	1035	1997	1502	415	62	3
Using													
U01	38855	34790	301	105	17	49	1621	294	74	102	298	137	3
U05	11668	4881	23	14	3	33	4357	866	29	500	328	5	3
U04	10343	2393	6969		10		207	374	8	128	2	18	
U06	10089	2261	64	13	4755		305	1001	8	10	2	72	2
U03	9973	4053	58	27	5	84	1213	3173	7	728	14	166	
U08	8578	2014	1078	6	2	2	720	5					2097
HS20	6465	2138	1	47			40	350	3767	21	70	4	
CC04	6356	1156	25		2	31	1586	789	197	1522		64	7
U17	6270	2689	4	7		2813	188	205	94	140	4		2
HS40	5251	3899	22	5		40	65	293	388	70	27	16	1
U14	5135	1682	213	42	12	1	665	42		3	7	114	
U09	4246	3409	7		1			15		1		1	
U12	3768	184					136	760		2684			
HS39	3467	2101	19	20	5	2	68	26	29	1	808	71	

# The LON-CAPA Community

- Creates communities of practice!
- Connects colleagues doing the same thing
- Annual conferences and workshops



# The LON-CAPA Community

- Driving force: problems

What is the derivative of

$$\begin{pmatrix} 4t^3 \\ 8t^8 \end{pmatrix}$$

with respect to  $t$ ?

You need to multiply with the original exponent.

**Incorrect.** Tries 1

	Available	Used	Used externally	Instances of being used at institutions
Images	105426	29538	15518	87665
Problems	143692	116622	47776	251971
HTML content pages	62787	9429	4405	25913
Libraries	4148	530	470	993
Reusable content assemblies	10859	5761	2205	11668
Animations and simulations	2495	1132	480	3227
Movie and sound files	1284	517	154	1014
Other (PDF, MS Office, etc)	13507	4706	852	7103
<b>Total</b>	<b>344198</b>	<b>168235</b>	<b>71860</b>	<b>389554</b>

<30% reuse

>80% reuse

# Sustainability

- And how is this sustained?

# Sustainability

- CAPA has been around since 1992, initially as pure homework/assessment system
- Since 1999: shared repository (“LON-CAPA”)
- 19 years ... with ups and downs
  - currently “down” – partner institutions have budget cuts
- Components of sustainability:
  - financial:
    - staff
    - hardware
    - travel
  - ongoing software platform development
  - ongoing content contributions
  - increasing user community
  - scholarship



# Sustainability

Lessons learned over 19 years:

- **Have a clearly defined purpose** – even if it precludes some funding “opportunities.”  
Don’t let money drive you!
- **Be selective about whom you allow to contribute** – but then give them freedom
- **Distribute** – a single institution is too fickle an environment
- **Share the wealth** – help your partner institutions get funding, publicity, etc.

# Clearly Defined Purpose

- You cannot be all things to all people
- Do not provide a random hodgepodge of “stuff”
- Otherwise, your users might as well just surf the web
- In LON-CAPA case: the decision makers (instructors) look for tested and trusted resources that they can put in front of their students



# Be Selective

Be selective about whom you allow to contribute

In case of LON-CAPA,

- only bona-fide schools, colleges, universities, and publishers can join the network
- only faculty/instructors at participating institutions can contribute content
- crackpots and folks with some random agendas damage your credibility – the agenda is education



# Be Selective

- Be selective about whom you allow to contribute – **but then give them freedom**
- In case of LON-CAPA:
  - No explicit peer-review
    - hurdle to contributing
    - bottleneck
  - But: implicit peer-review through dynamic metadata (usage tracking)
  - Another instructor choosing a resource for his or her course is peer-review!

# Content Stewardship

- Copyright stays with author (enforceable!)
- Developed before Creative Commons
- Authors can grant “right of use:”
  - public
  - system-wide by instructors for students
  - only within own institution
  - “custom” – very flexible
  - open-source: make derivative works
- Most authors use:
  - system-wide closed-source

# Content Stewardship

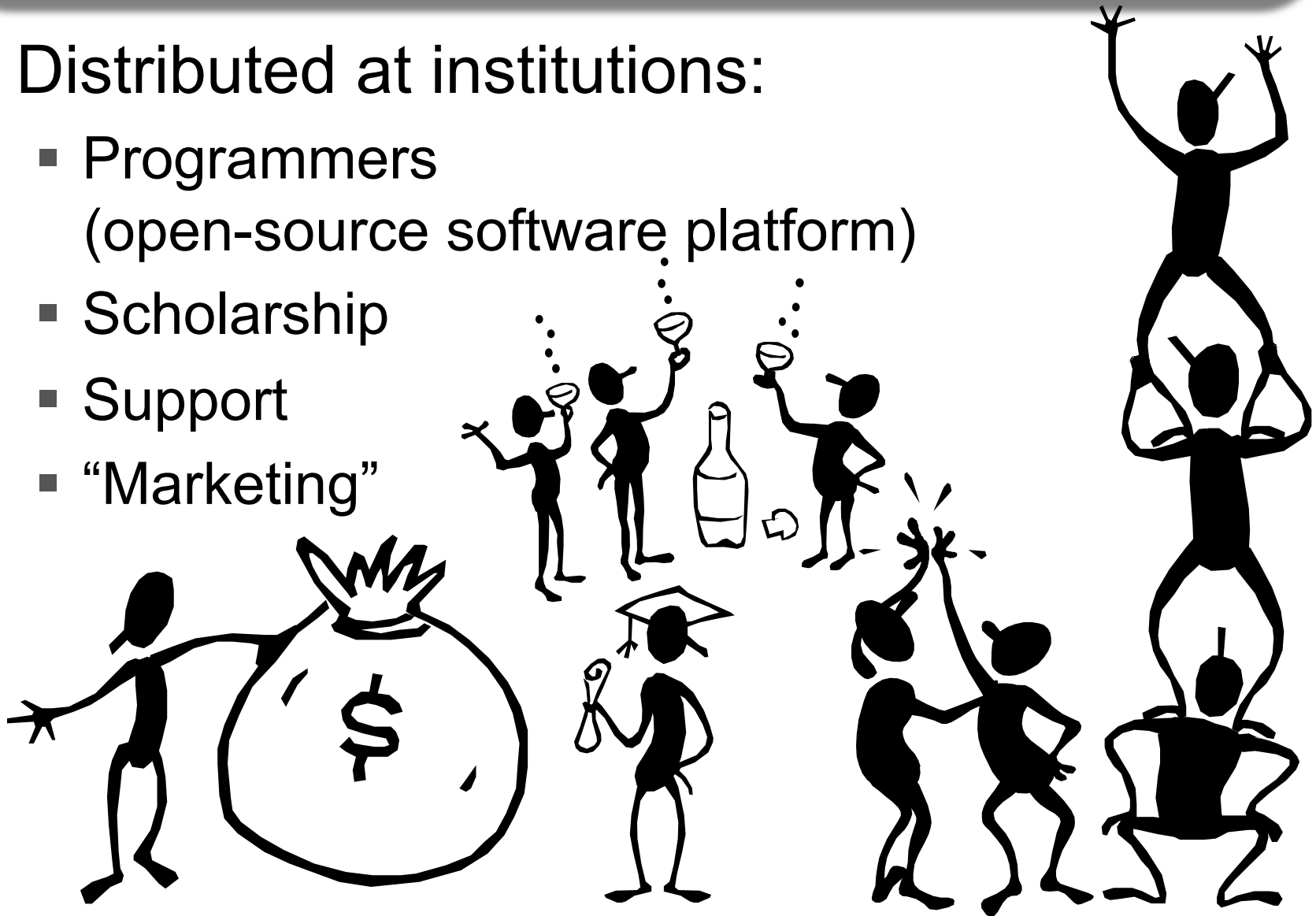
- Have responsibility for author contributions
  - Enforce licensing
  - Protect integrity of for example exam problems
  - Guarantee that the content remains accessible

# Distribute

- LON-CAPA is a “franchise” – local ownership
  - For example, at MSU 11,000 student course enrollments per semester running out of LON-CAPA
  - UIUC: 9,000 student course enrollments
  - SFU, Ostfalia, Ohio U, ...
- Programmers and support staff paid by the partner institutions as part of their instructional support cost
- **LON-CAPA development and support tied into universities’ core business**

# Distribute

- Distributed at institutions:
  - Programmers  
(open-source software platform)
  - Scholarship
  - Support
  - “Marketing”



# Share the wealth

- **Share the wealth** – help your partner institutions get funding, publicity, etc
  - Make platform and content available for free
  - Grants do not need to come to you directly to help
  - Let other institutions do connected scholarship
  - Other people can do marketing for you

# Share the wealth

## Examples:

- Current EUR 200,000 grant to partner university in Germany – MSU does not get one cent of that directly, but project benefits greatly
- Current and past NSF-ASA and NSF-CCLI grants using LON-CAPA as platform – LON-CAPA benefits
- German university paid for booth at CeBIT exhibit two weeks ago
- Scholars at other universities publishing research papers and opinion pieces about LON-CAPA
- Students at various institutions doing thesis work on LON-CAPA
- School offering paid professional development on LON-CAPA to other schools
- Other universities hosting annual conferences





# How to Get Contributions

- Need this for their own teaching, contributions not purely altruistic
- Needs some critical mass of content:
  - If instructors find 80% of what they want for their course, but are missing some concrete things, they might be very willing to just contribute that “missing piece.”
  - Chicken before egg ...

# How to Get Contributions

- Assurance that any content they generate today is going to keep being available
  - Investment has to pay off when teaching the course again a year, two years,  $n$  years from now
  - Provide security and stewardship for content
  - We still support content written in 1993
  - You are entrusted with that content!

# How to Get Contributions

- Faculty need to see impact:
  - Faculty have some urge to “broadcast”
  - They want to see things used
- Show authors how many students in how many courses at how many institutions used their stuff



# Direct Sustainable Income

Direct sustainable income stream?

- Do not want to charge for software
  - Believe in open-source
- Do not want to charge the students
  - Education already expensive enough
- Micropayment schemes
  - Too cumbersome
  - Possible conflicts with institutional intellectual property policies
  - Textbook publishers don't play
  - Educational content has no monetary value: universities sell degrees, not education
- Do not want to charge for service
  - Institutions can run LON-CAPA completely for free

# Direct Sustainable Income

- Spin-Off: eduCog, LLC

## Welcome

---

Welcome to *eduCog*, a company providing cost effective, affordable access to quality educational tools and services.

- Who we are
- What we do
  - LON-CAPA Hosting, K-12
  - LON-CAPA Hosting, Higher Education
  - ...
- How we do it
- How to contact us



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eduCog, LLC  
An Education Service Company  
P.O. Box 26, Haslett, MI 48840  
eduCog@eduCog.com

eduCog ✓

# Direct Sustainable Income

- Hosting of LON-CAPA for institutions that are unable or unwilling to run their own installation
- Attractive since LON-CAPA is also complete course management system (established cost center)
- Constant income stream from low-cost hosting fees

Home > [What we do](#) > LON-CAPA Hosting for K-12

## LON-CAPA Hosting for K-12

### About LON-CAPA

(see <http://lon-capa.org/>):

- Provides an online learning experience for your students
- Makes sharing of resources among teachers simple
- Personalized exercises and problems for students
- Instant feedback to students and instructors
- Reduces grading load
- Allows more time for other course related activities
- Provides for communication and discussion among student and between students and teachers.

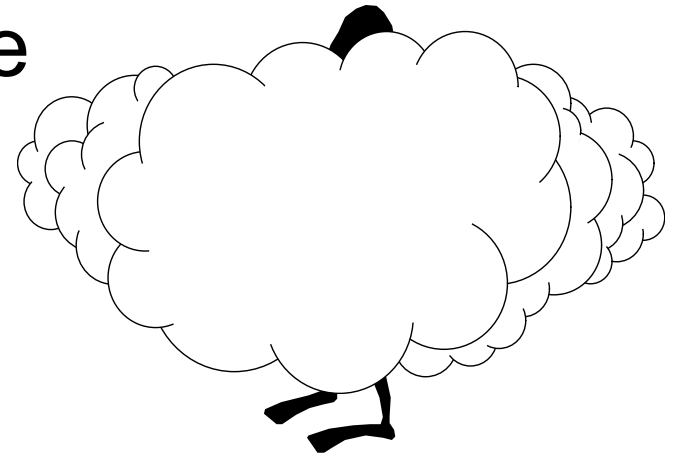
### What eduCog does

- Establishes a LON-CAPA web domain for the school which allows collaboration within the school and with teachers at other schools
- Creates course templates for teachers



# Direct Sustainable Income

- Textbook Publishers
- Warning: complicated mechanism!
- Publishers sell textbooks. Period.
- Instructors are decision makers for several hundred sales at a time
- Incentives for instructors: free ancillary materials, particularly online homework



# Direct Sustainable Income

Textbook publishers pay spin-off company for

- coding ancillary materials
- hosting ancillary materials
- selectively open up these libraries for courses that adopted the textbook (digital rights management)
- constant income stream: publishers intentionally make problem libraries incompatible between editions










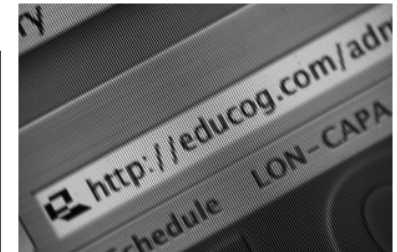
# Direct Sustainable Income

- Five major publishers

## Publisher Content

For the following textbooks, end-of-the-chapter problem libraries are available in LON-CAPA format. Please contact your textbook representative for access.

Academic Area	Author	Publisher	Edition
Physics			
	Tipler	 WH Freeman Clancy Marshall W.H. Freeman & Company 41 Madison Avenue New York, NY 10028 cmarshall@whfreeman.com (212) 561-8204	6th edition
	Cutnell & Johnson	 John Wiley	8th edition
	Halliday, Resnick, and Walker		7th edition
	Serway & Jewett	 Representative: Samuel Subity, 877-999-2350	6th edition
	Serway & Faughn		7th edition



# Sustainability Summary

- Sustainability is not easy to achieve
- Select exactly what you do and what you don't do, and do it well
  - Be flexible if odd funding opportunities come up that support your mission
  - Tie into institutions' core business and established cost centers
  - Don't let random grant opportunities distract you from your mission – grant funding is nice, but not sustainable
- Create community

# Thank you!

- Thank you!
- Gerd Kortemeyer  
Michigan State University  
<http://www.lite.msu.edu/kortemeyer/>  
[korte@lite.msu.edu](mailto:korte@lite.msu.edu)