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.

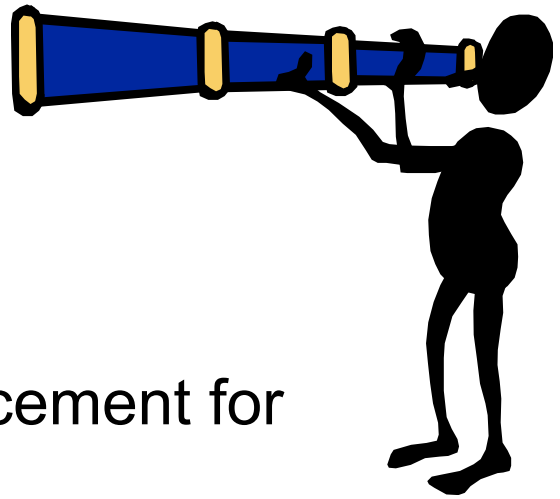
- What have we learned in 19 years?

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

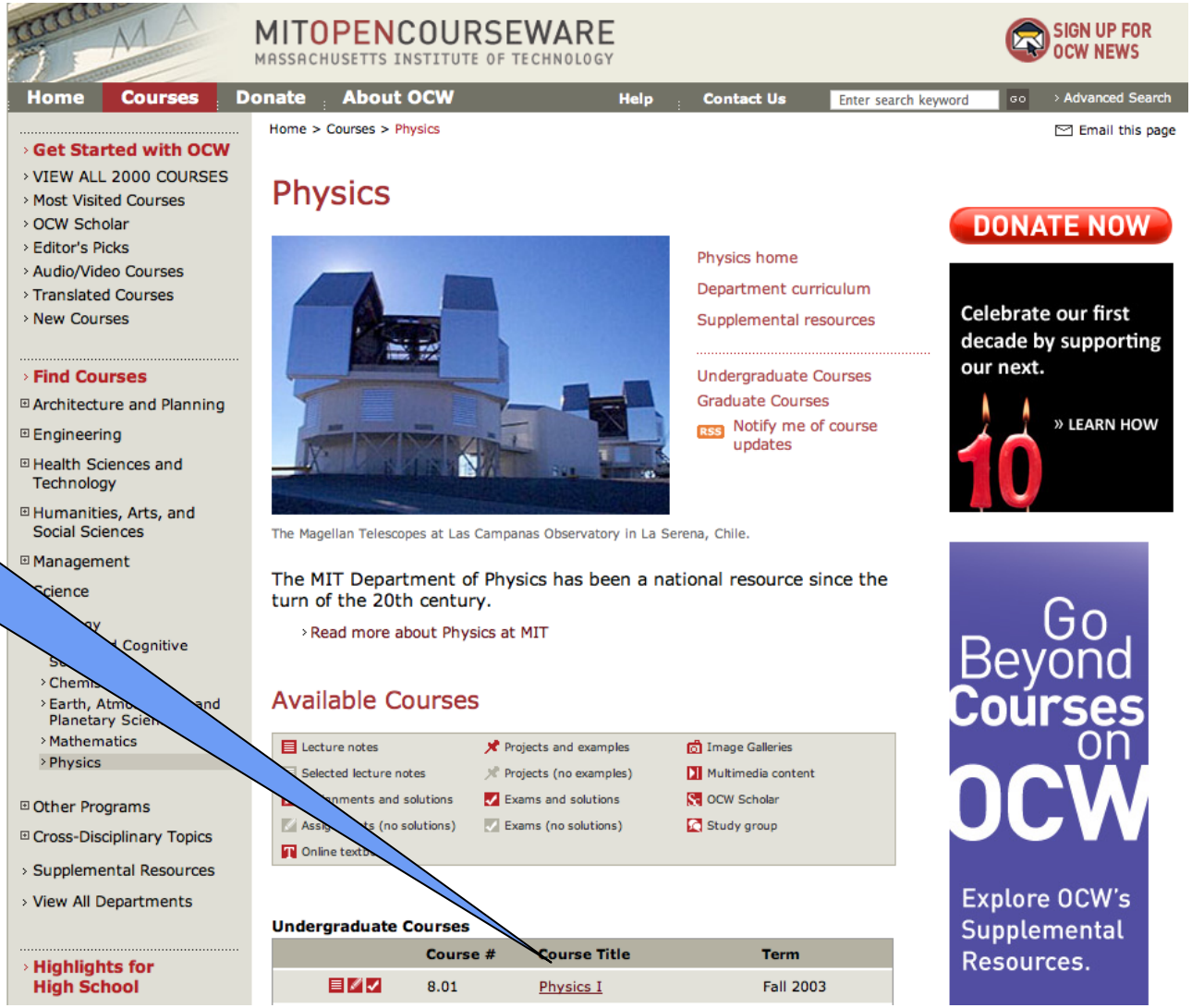
Sharing of Resources

- 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



Sharing of Resources

- But wait!

Physics

	Resource Title
T	Applied Geometric Algebra
T	A WikiTextBook for Introductory Mechanics

^ Back to top

Sloan School of Management

	Resource Title
	MIT Sloan Teaching Innovation Resources (MSTIR)

^ Back to top

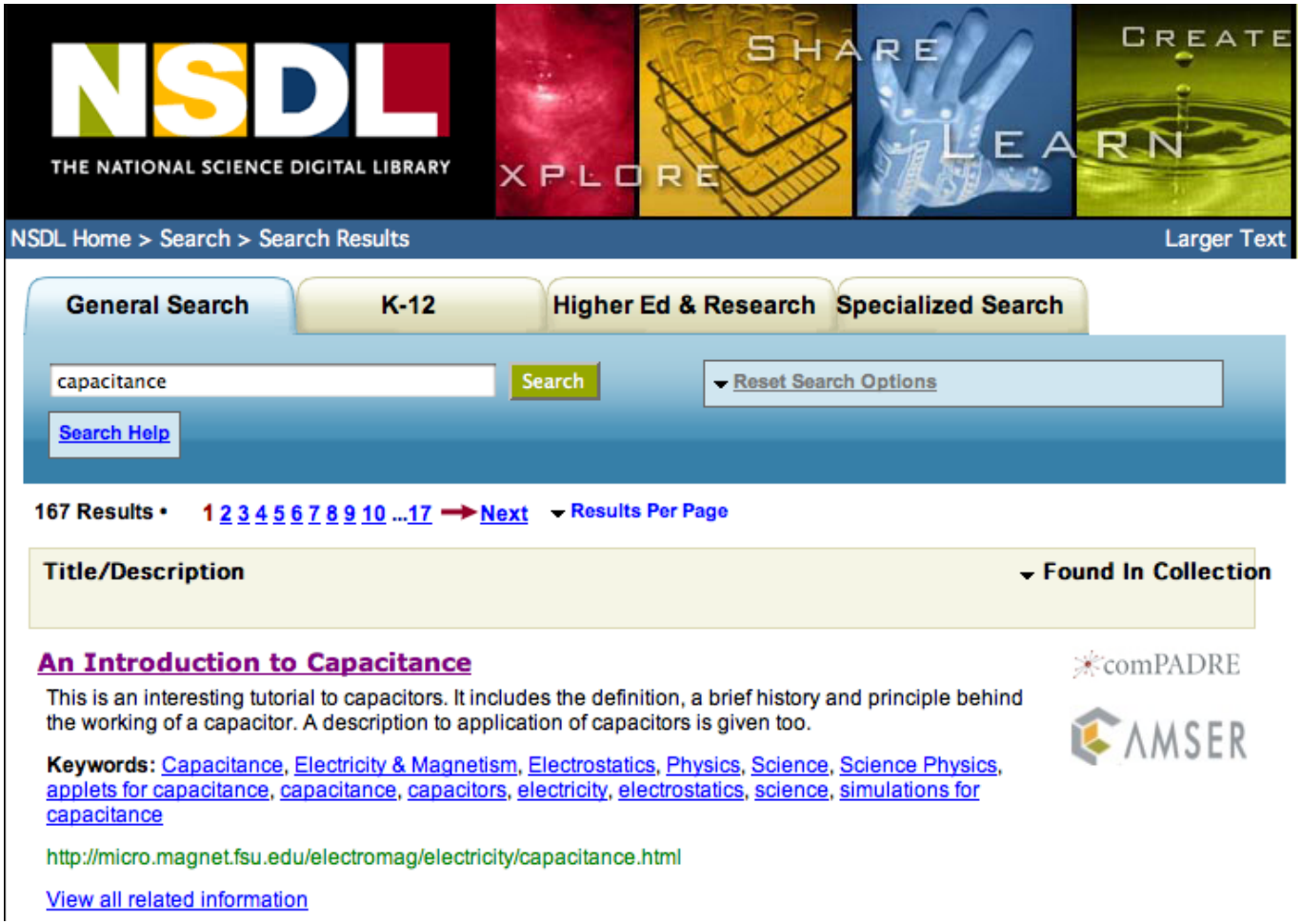
Teaching and Learning Resources

	Resource Title
T	The Torch or The Firehose: A Guide to Section Teaching
	Guidelines on Learning that Inform Teaching

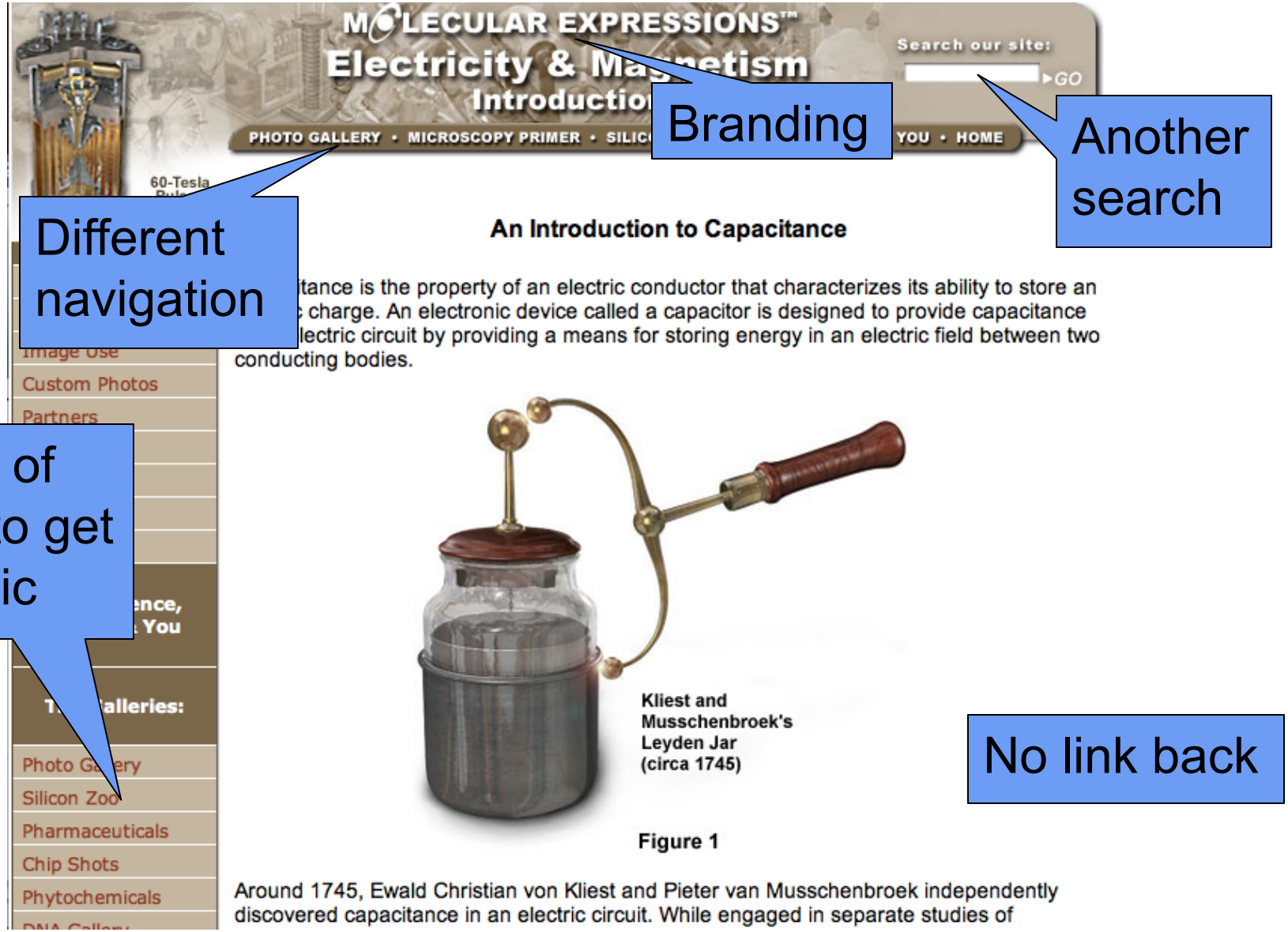
Just a random collection of more pre-assembled stuff

Sharing of Resources

- Counter-Example:



Sharing of Resources



Branding

Another search

Different navigation

Plenty of ways to get off-topic

No link back

Sharing of Resources

- Way-off topic

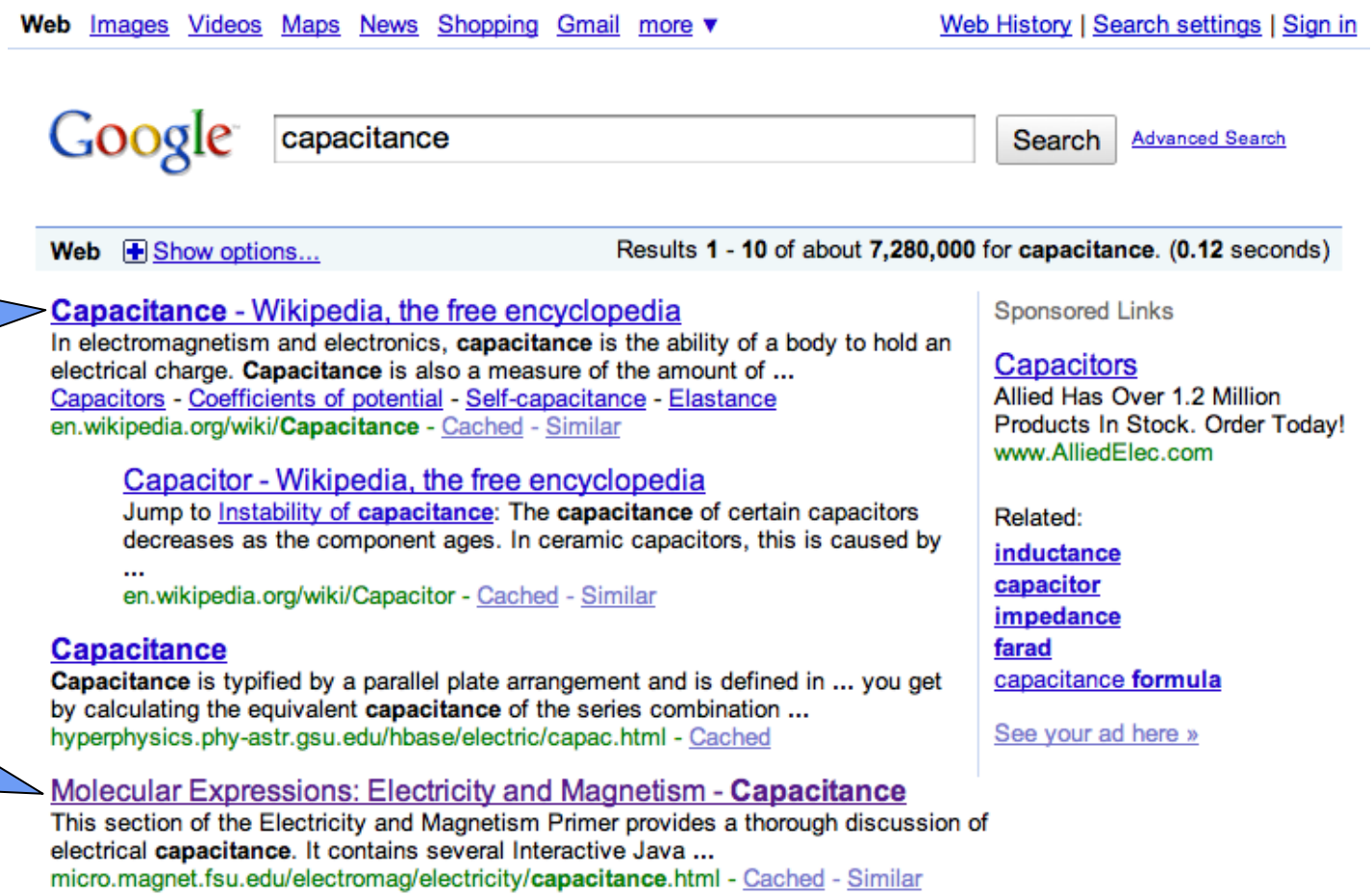
Digital libraries that are basically catalogued link collections are no better than “surfing the web”

Sharing of Resources

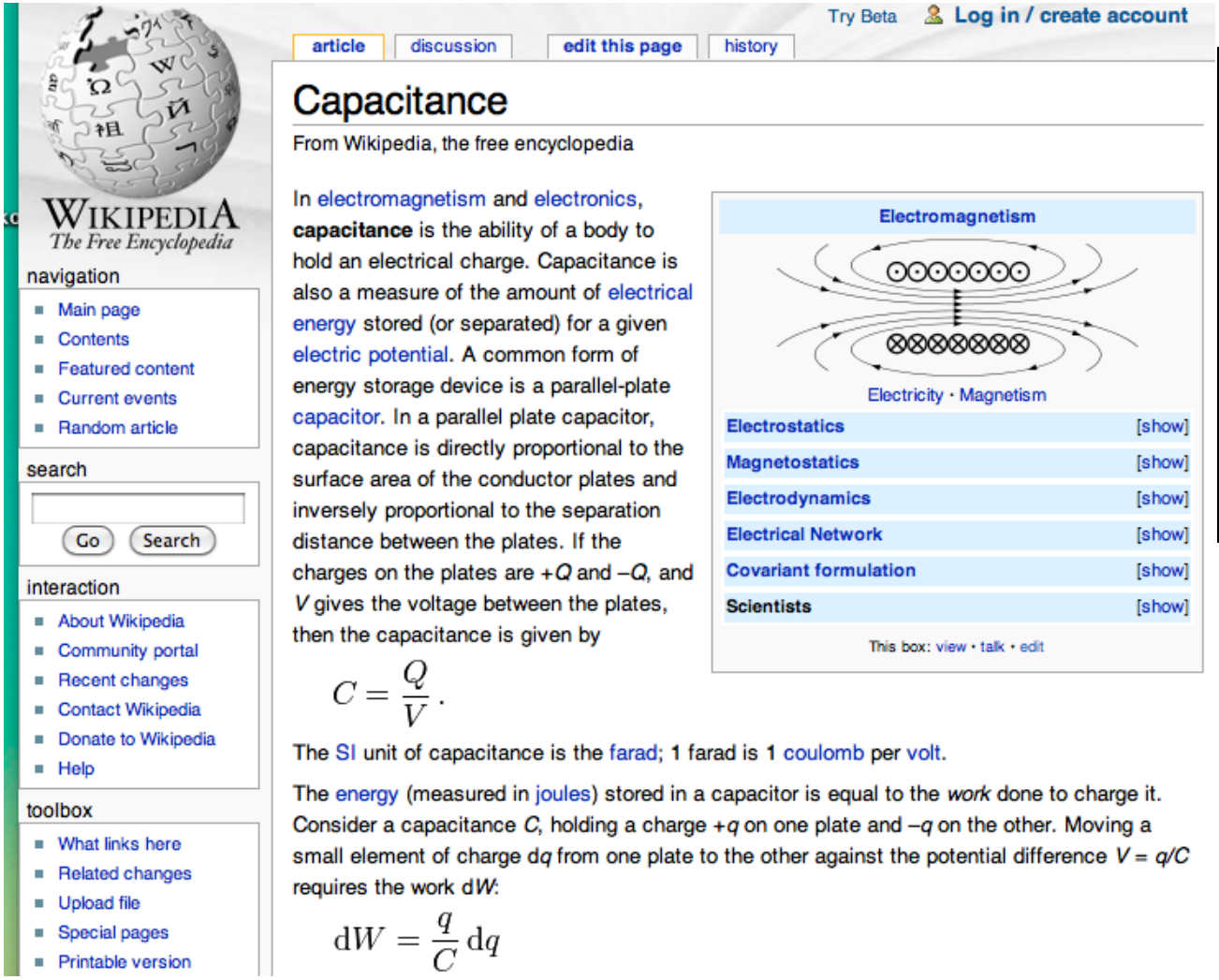
- You might as well:

Actually pretty good!

Same as NSDL



Sharing of Resources



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 functions

  which usually remain unused anyway
- Particularly for educational libraries: Provide infrastructure for using resources in educational contexts

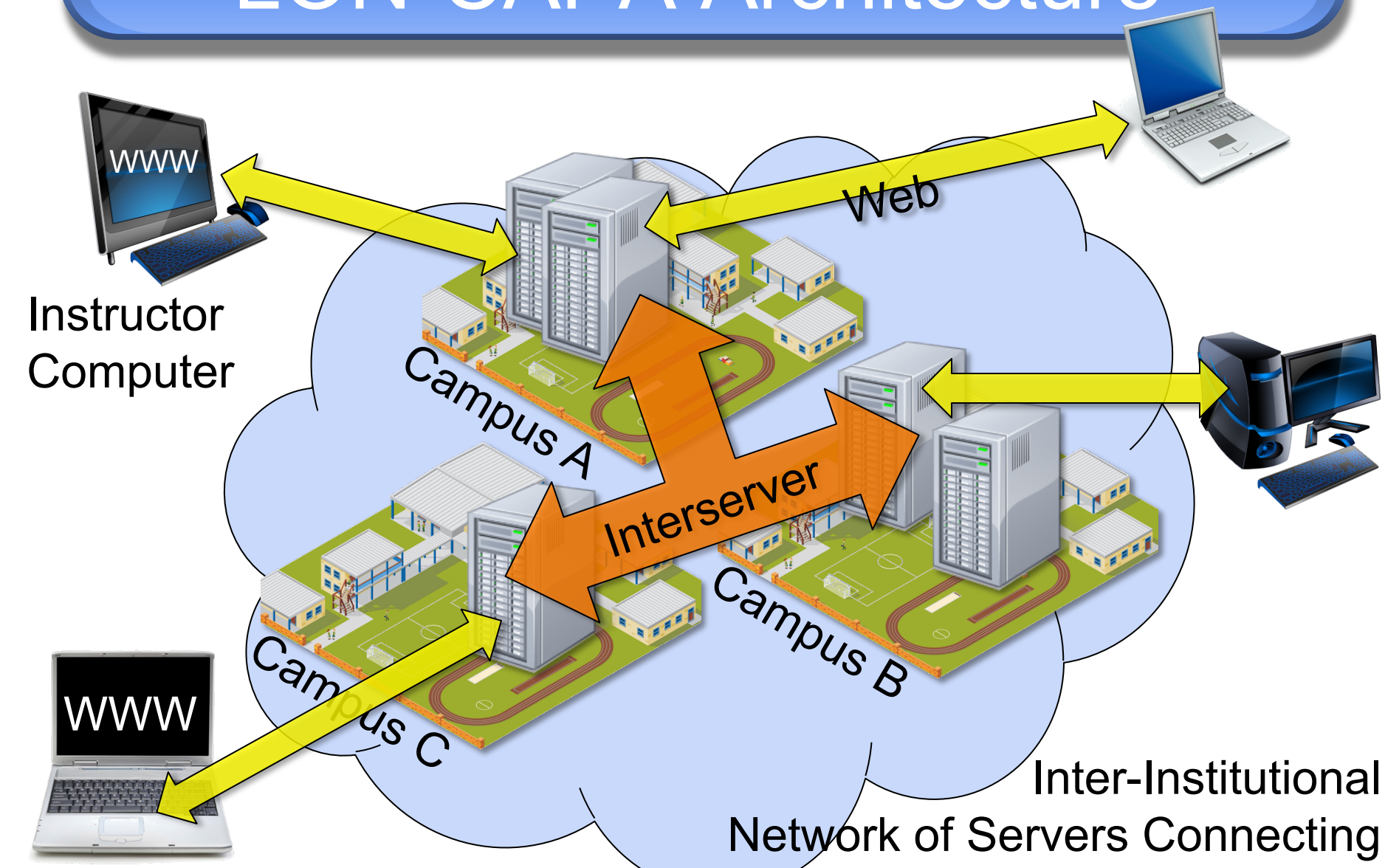
Sharing of Resources

- 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

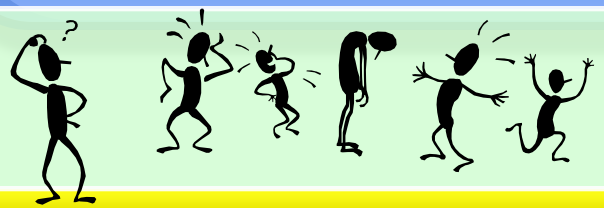
Sharing of Resources

- 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



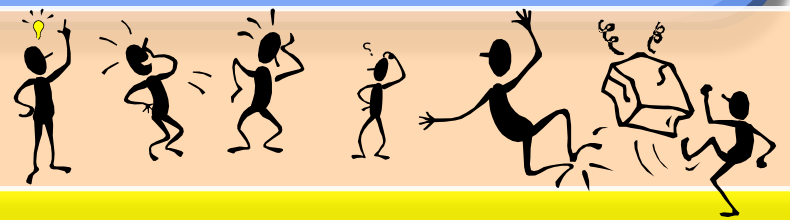
LON-CAPA Architecture



Course Management

Campus A

Resource Assembly



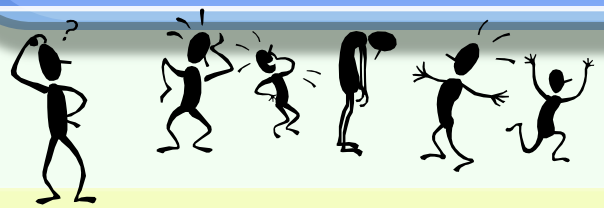
Course Management

Campus B

Resource Assembly

Shared Cross-Institutional
Digital Resource Library

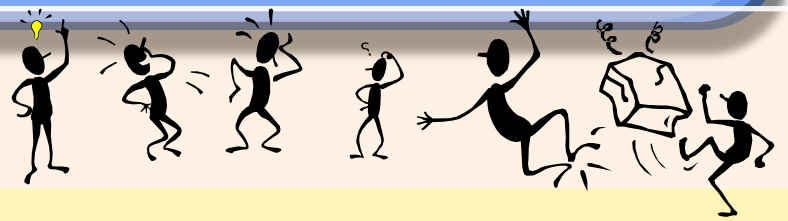
LON-CAPA Architecture



Course Management

Campus A

Resource Assembly



Course Management

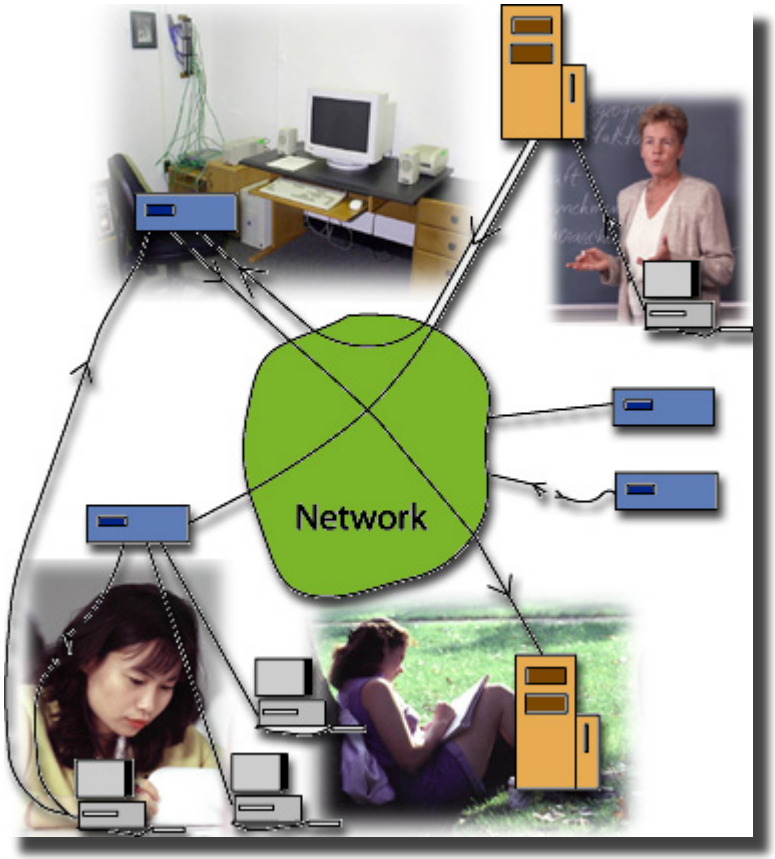
Campus B

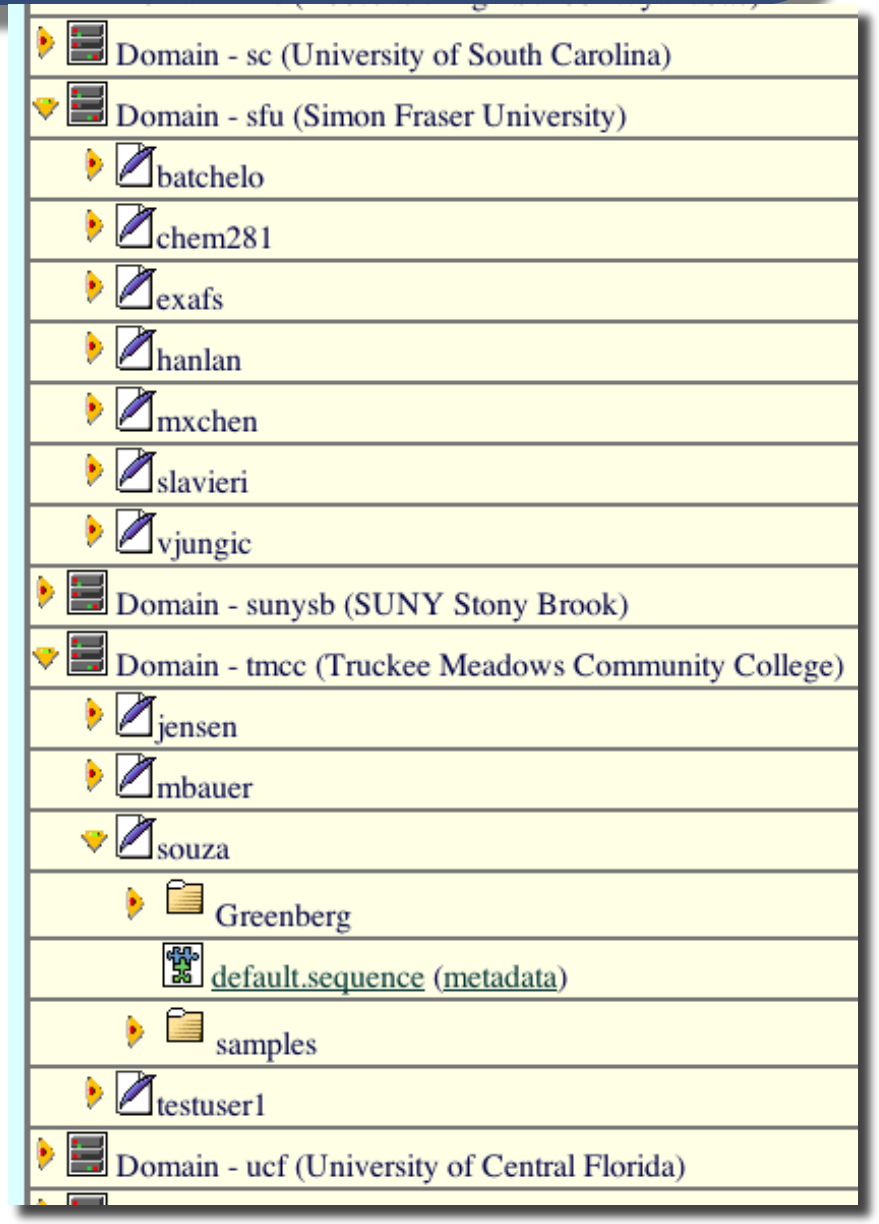
Resource Assembly

Shared Cross-Institutional
Digital Resource Library

Shared Resource Library

- The distributed network looks like one big file system





Shared Resource Library

- Resources may be web pages …

EXAMPLE

Example: Looping

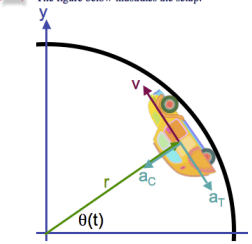
A toy car can go through a looping if it is fast enough. What are the forces that act on it? How fast does it have to be?

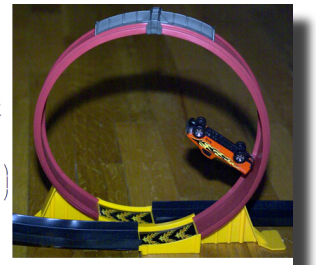
The motion is obviously circular, but non-uniform: the car will slow down on the way up, and speed up on the way down. With r being the radius of the looping, the x-axis horizontal, the y-axis pointing up, the origin being in the center of the looping, and $\theta(t)$ being the angle, the position of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

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

as long as it does not fall off the track.

The figure below illustrates the setup:

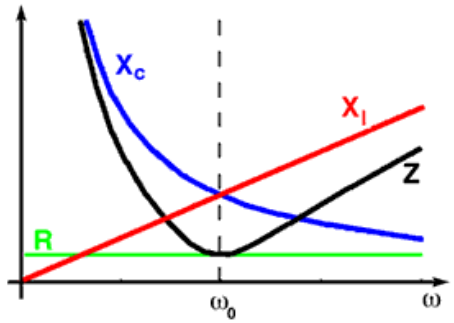




Impedance

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

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



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:

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

nd 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 dance and of the reactances is shown in the figure.

ave to be added in a special way. They end up as a single quantity Z, the alent of the resistance.

EXAMPLE

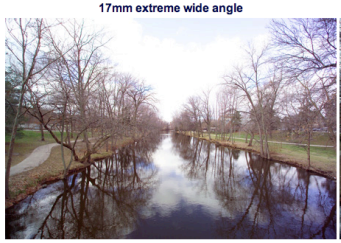
Focal Length

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

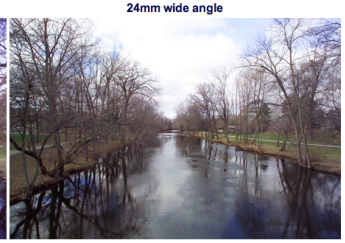
- 17mm-35mm wideangle zoom
- 24mm-70mm normal zoom
- 70mm-300mm tele zoom

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

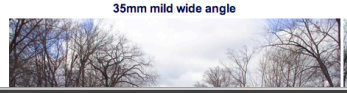
17mm extreme wide angle



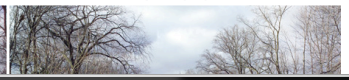
24mm wide angle



35mm mild wide angle

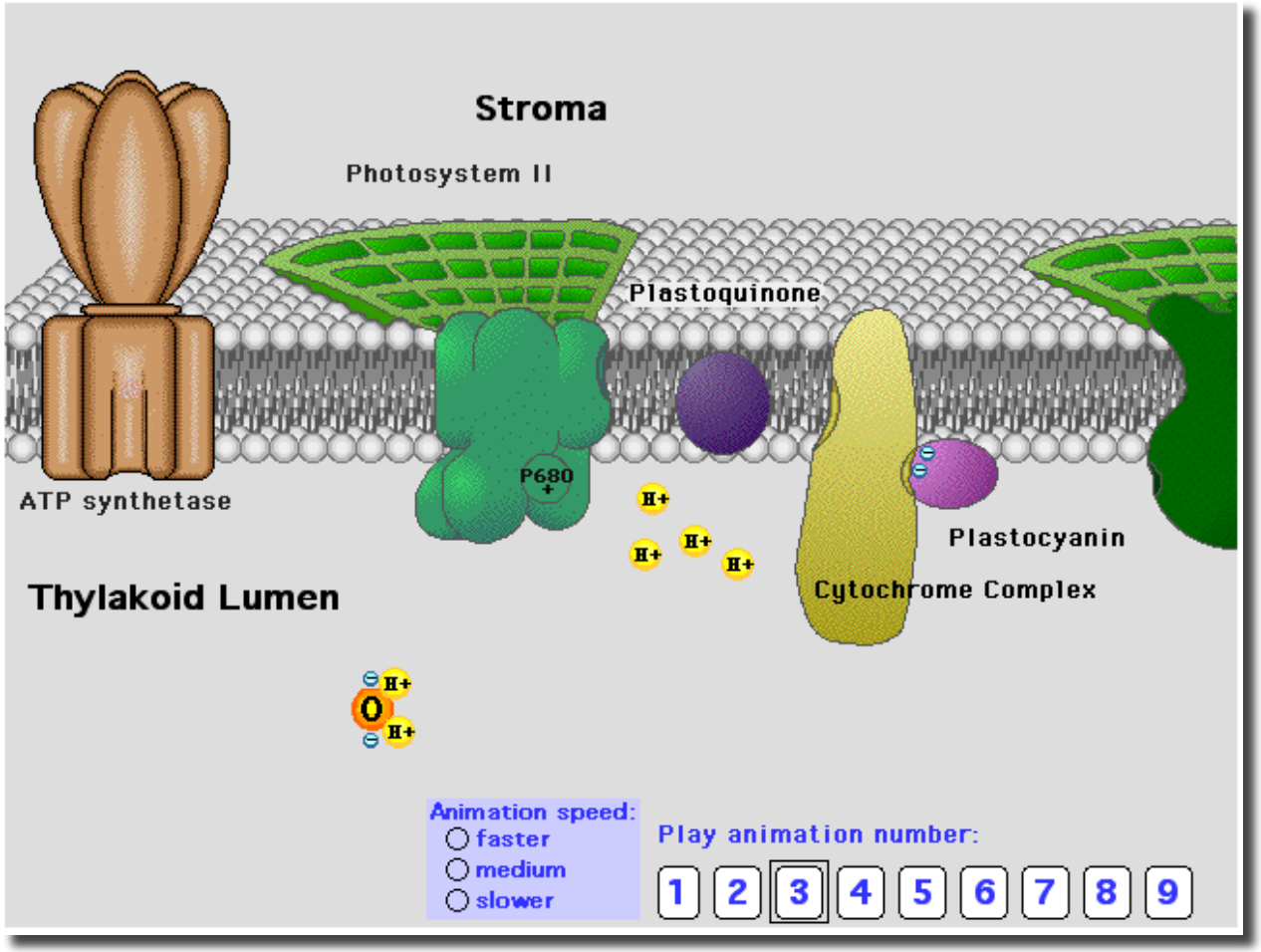


48mm normal



Shared Resource Library

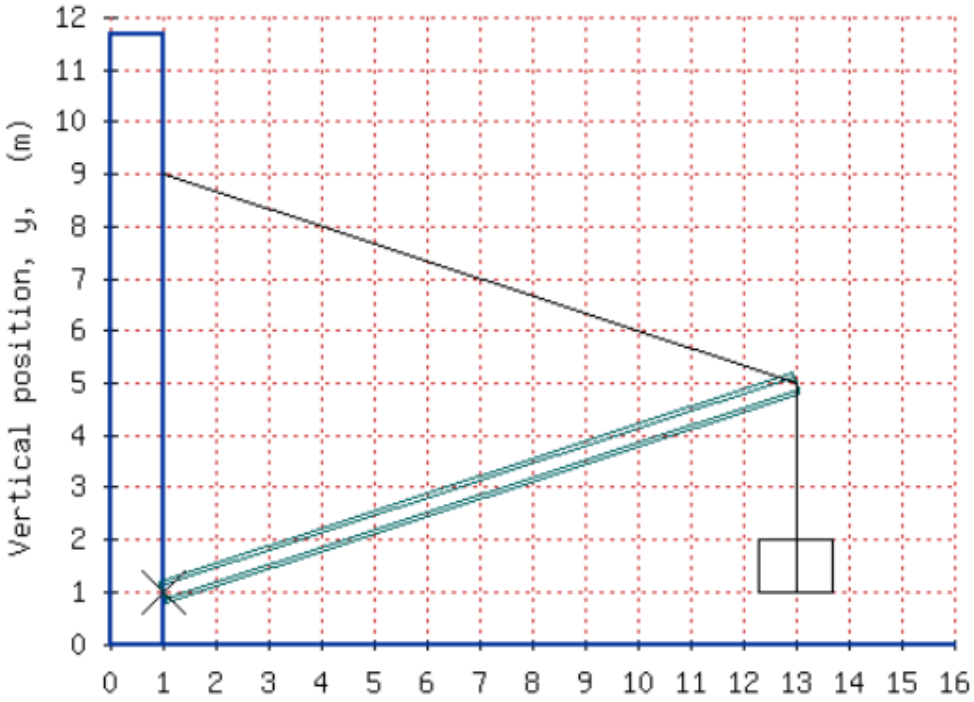
- … or simulations and animations …



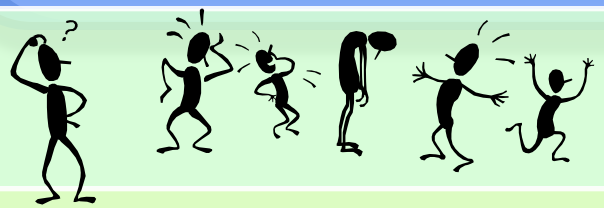
Shared Resource Library

- … 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

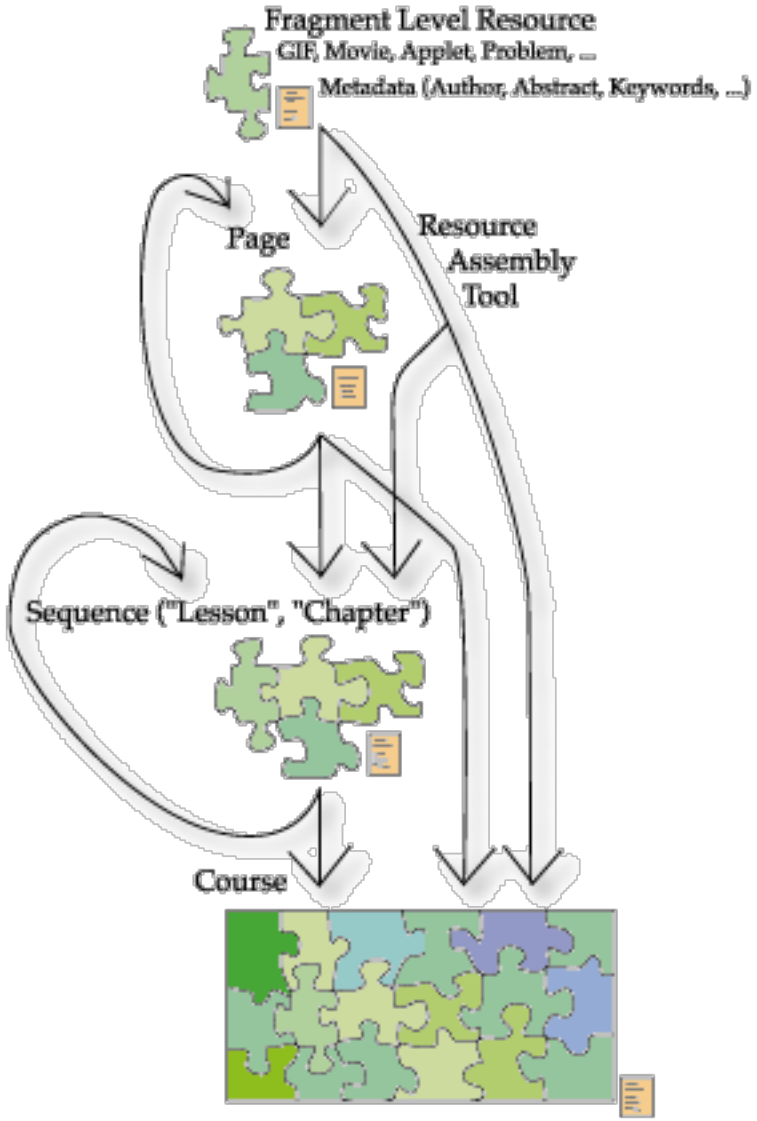
Resource Assembly

- Take shopping cart to the supermarket

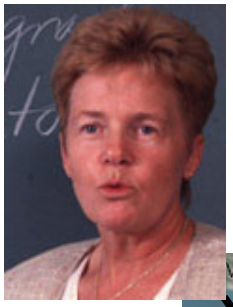
- Domain - sc (University of South Carolina)
- Domain - sfu (Simon Fraser University)
  - batchelo
  - chem281
  - exafs
  - hanlan
  - mxchen
  - slavieri
  - vjungic
- Domain - sunysb (SUNY Stony Brook)
- Domain - tmcc (Truckee Meadows Community College)
  - jensen
  - mbauer
  - souza
    - Greenberg
      - 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

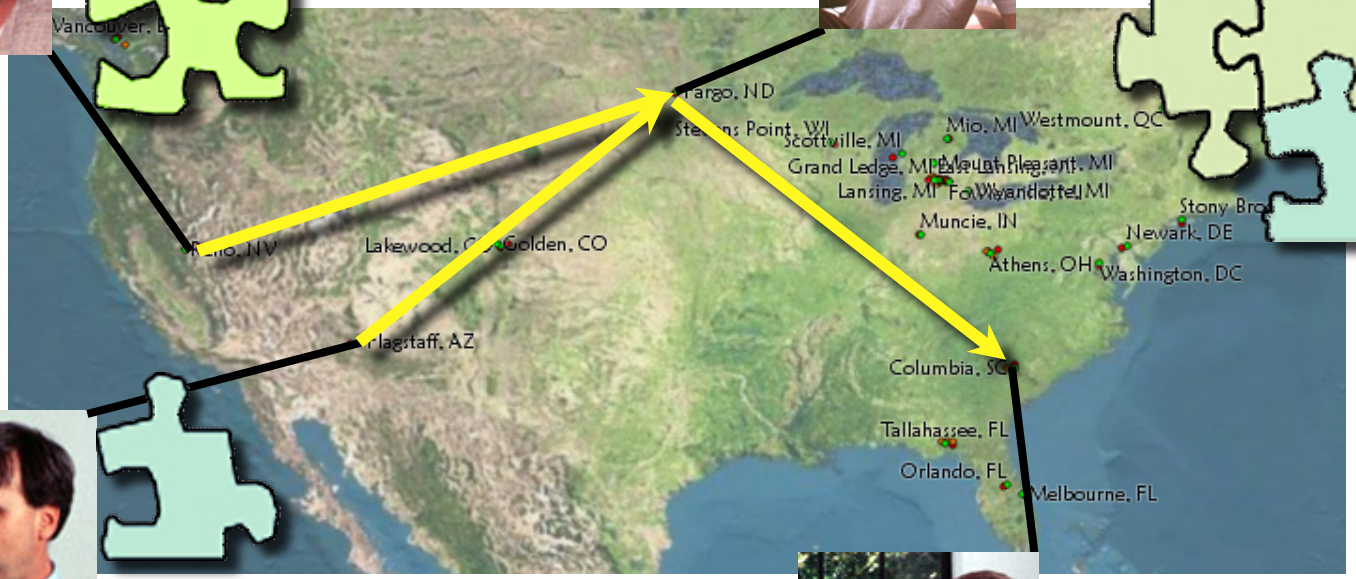


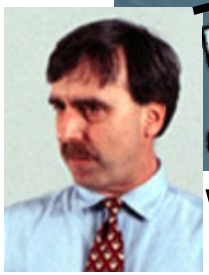
Resource Assembly



Writes module about energy conservation

Compiles module about conservation laws

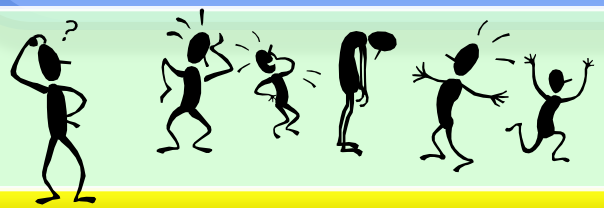




Writes module about momentum conservation

Uses whole assembly in his course

LON-CAPA Architecture



Course Management

Campus A

Resource Assembly

Course Management

Campus B

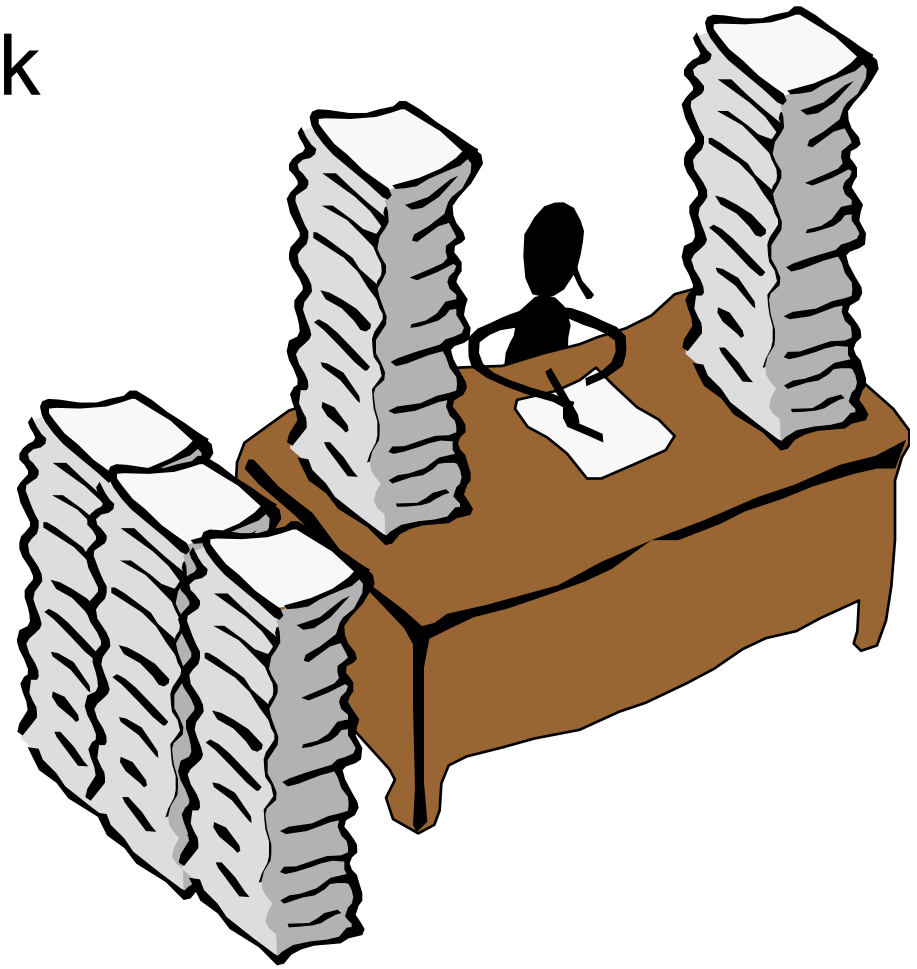
Resource Assembly

Shared Cross-Institutional
Digital Resource Library

Course Management

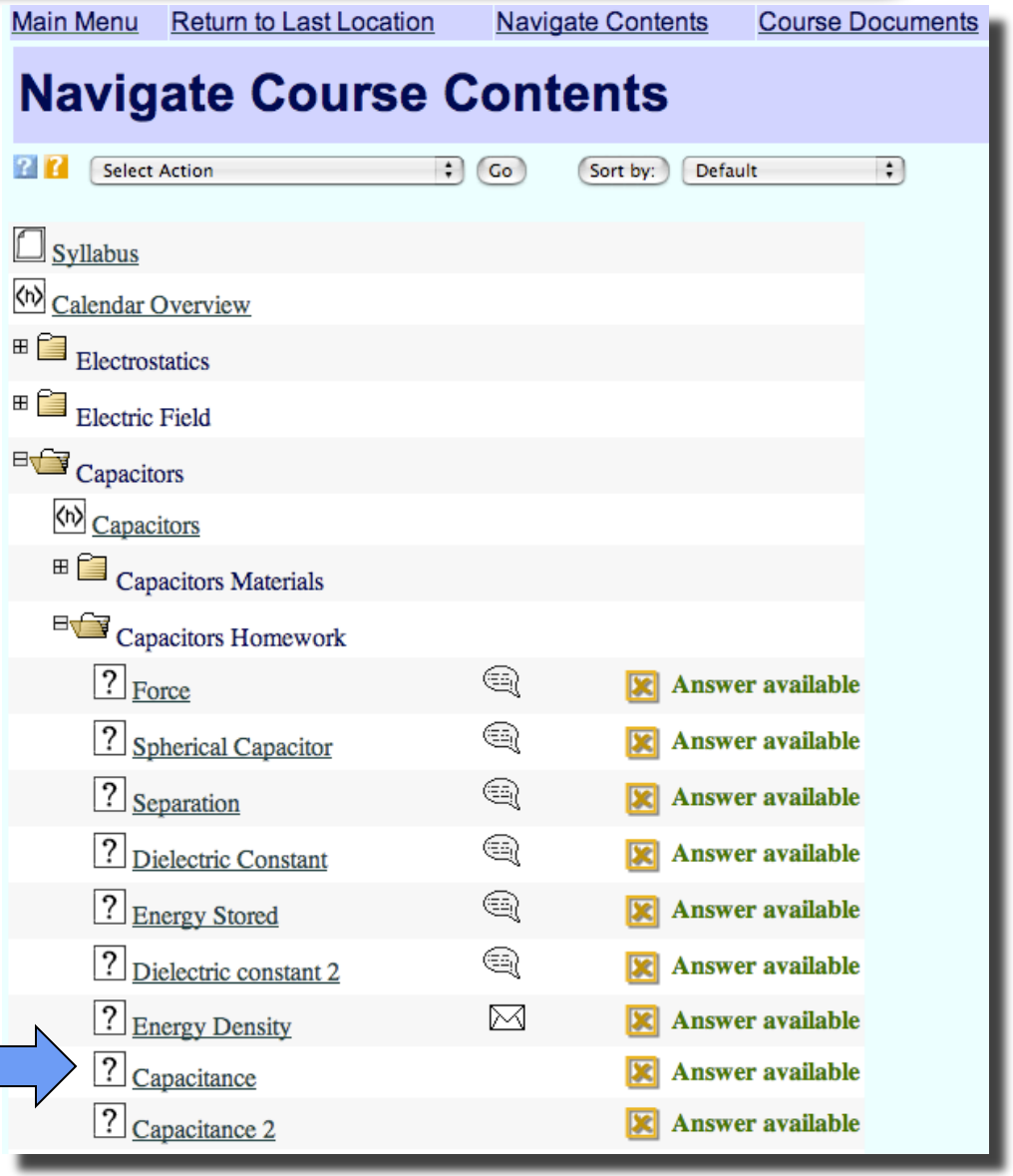
Course Management

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

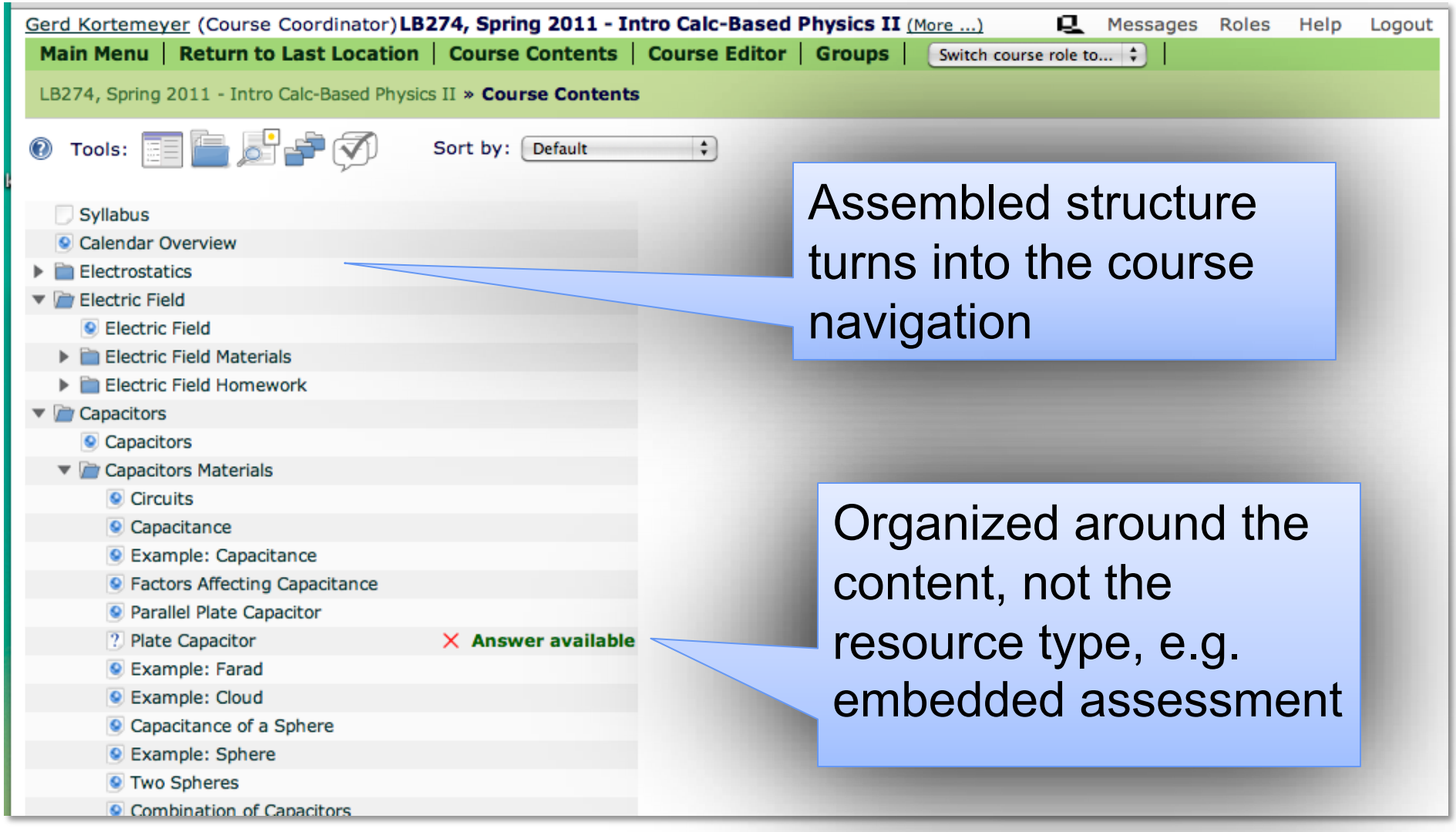


Course Management

- 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

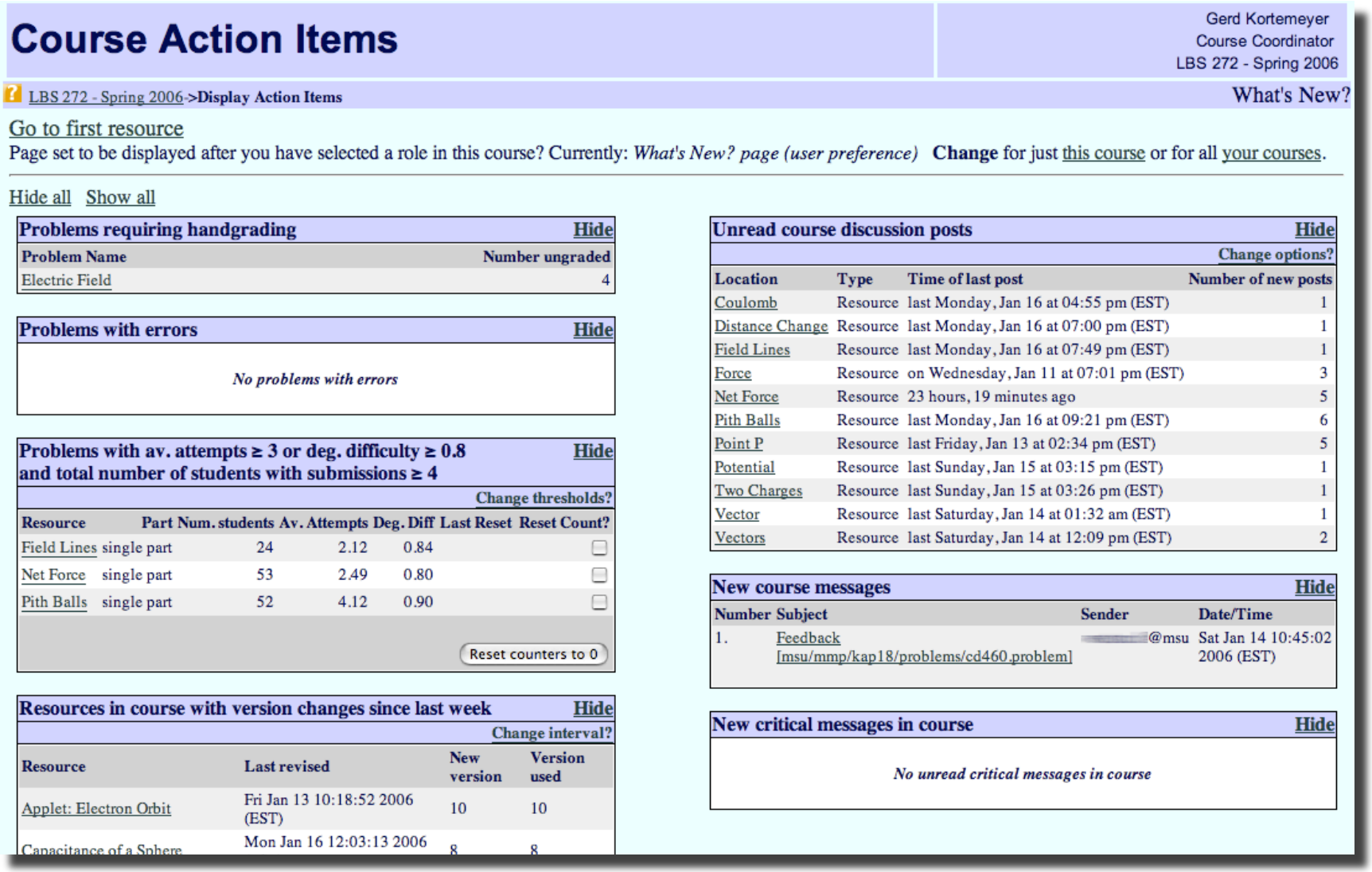


Course Management



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 Hide

Problem Name	Number ungraded
Electric Field	4

Problems with errors Hide

No problems with errors

Problems with av. attempts ≥ 3 or deg. difficulty ≥ 0.8 and total number of students with submissions ≥ 4 Hide

Change thresholds?

Resource	Part	Num. students	Av. Attempts	Deg. Diff	Last Reset	Reset Count?
Field Lines	single part	24	2.12	0.84		
Net Force	single part	53	2.49	0.80		
Pith Balls	single part	52	4.12	0.90		

Reset counters to 0

Resources in course with version changes since last week Hide

Change interval?

Resource	Last revised	New version	Version used
Applet: Electron Orbit	Fri Jan 13 10:18:52 2006 (EST)	10	10
Capacitance of a Sphere	Mon Jan 16 12:03:13 2006	8	8

Unread course discussion posts Hide

Change options?

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

New course messages Hide

Number	Subject	Sender	Date/Time
1.	Feedback [msu/mmp/kap18/problems/cd460.problem]	[redacted]@msu	Sat Jan 14 10:45:02 2006 (EST)

New critical messages in course Hide

No unread critical messages in course

LON-CAPA Architecture

Course Management

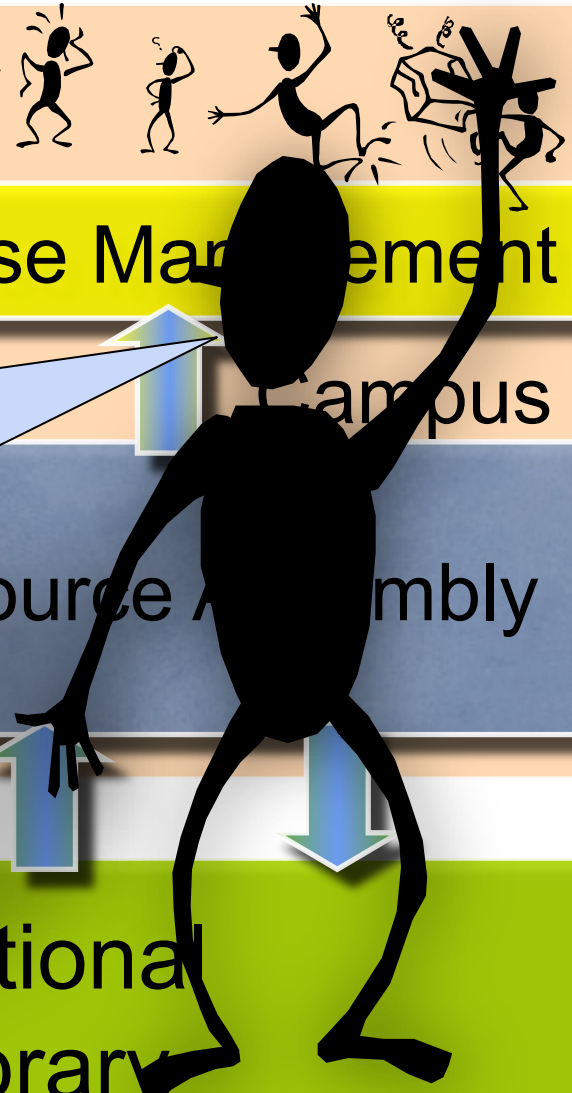
Course Ma emen t

Campus B

R

source A mbly

Isn't that rather monolithic?



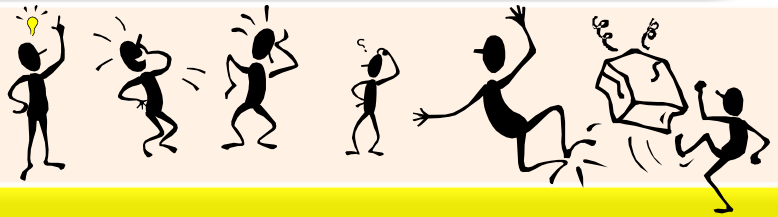
Shared Cross-Institutional Digital Resource Library

Dynamic Metadata

Course Management

Campus A

Resource Assembly



Course Management

Campus B

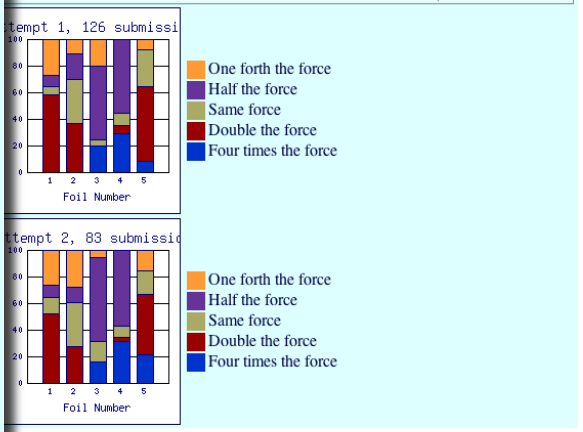
Advantage:
- Feedback from all levels
- The system gets to know the resources

Shared Cross-Institutional Digital Resource Library

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
		stance between the charges is doubled.	One forth the force
		arges 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 • Eukaryotic Gene Control [msu/bio/Gene_Expr/111f03GeneCntrl.sequence]
Number of resources that lead up to this resource in maps	1 • Back to the Original Question [msu/bio/Gene_Expr/problems/originalquestion.problem]
Number of resources that follow this resource in maps	1 • Eukaryotic vs Prokaryotic Gene Expression II [msu/bio/Gene_Expr/problems/eukvsprokII.problem]
Network-wide number of courses using resource	3 • LBS 145 - Spring 2004 • ZOL 341 - Fall 2003 • BS 111 - Fall 2003

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)

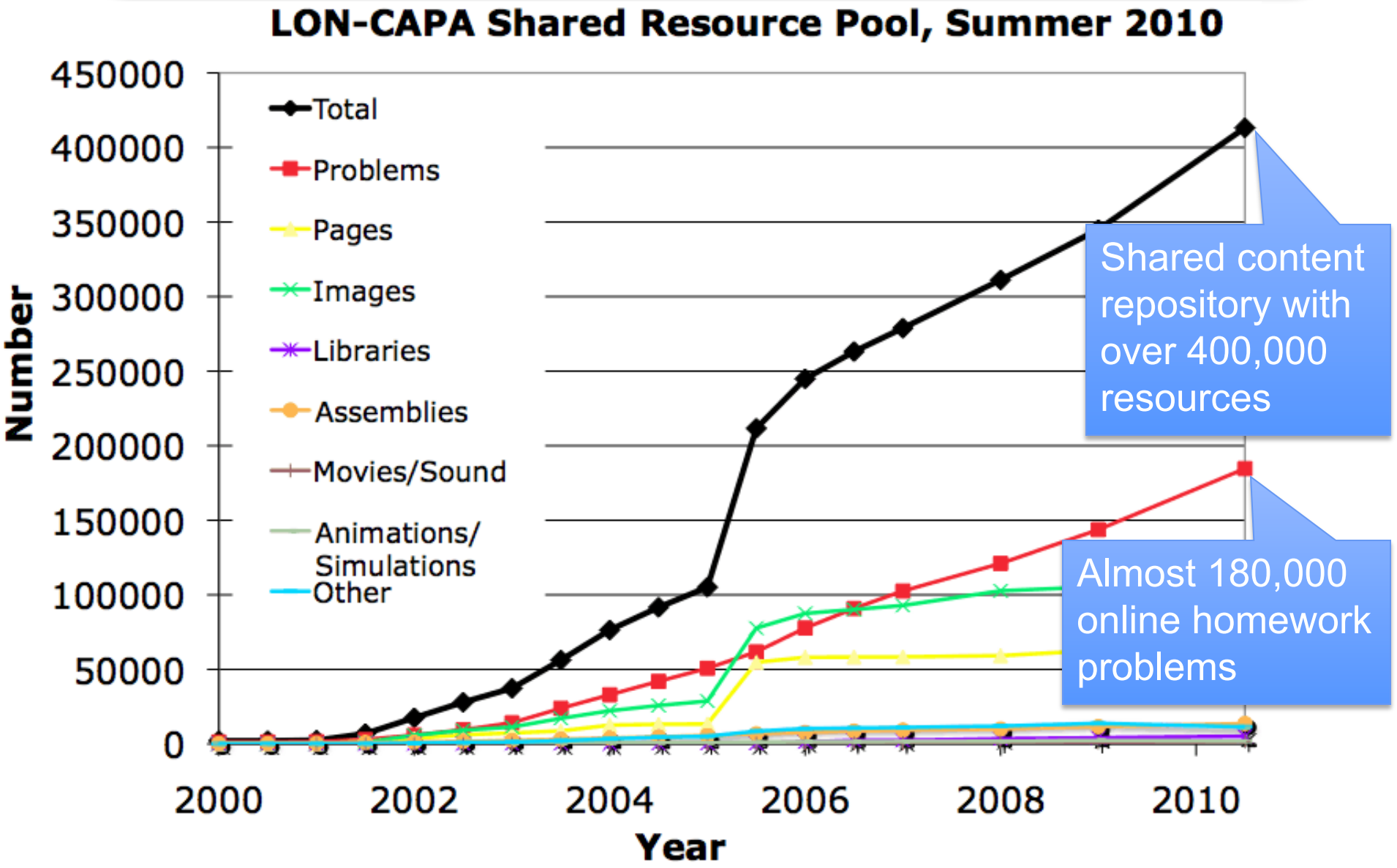
Dynamic Metadata

- 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”

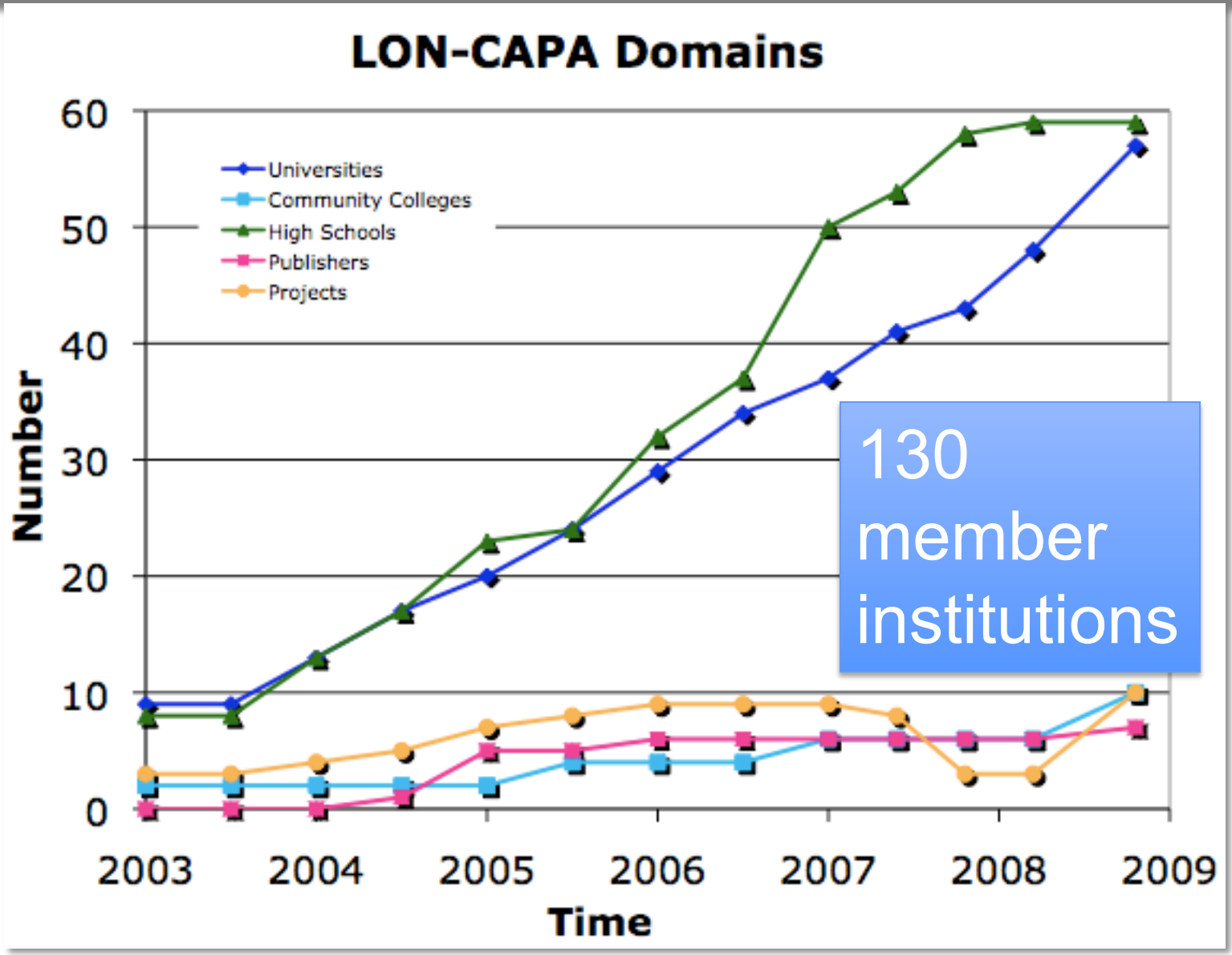
The LON-CAPA Community

- Does this work?
- Does it scale?

Shared Resource Library

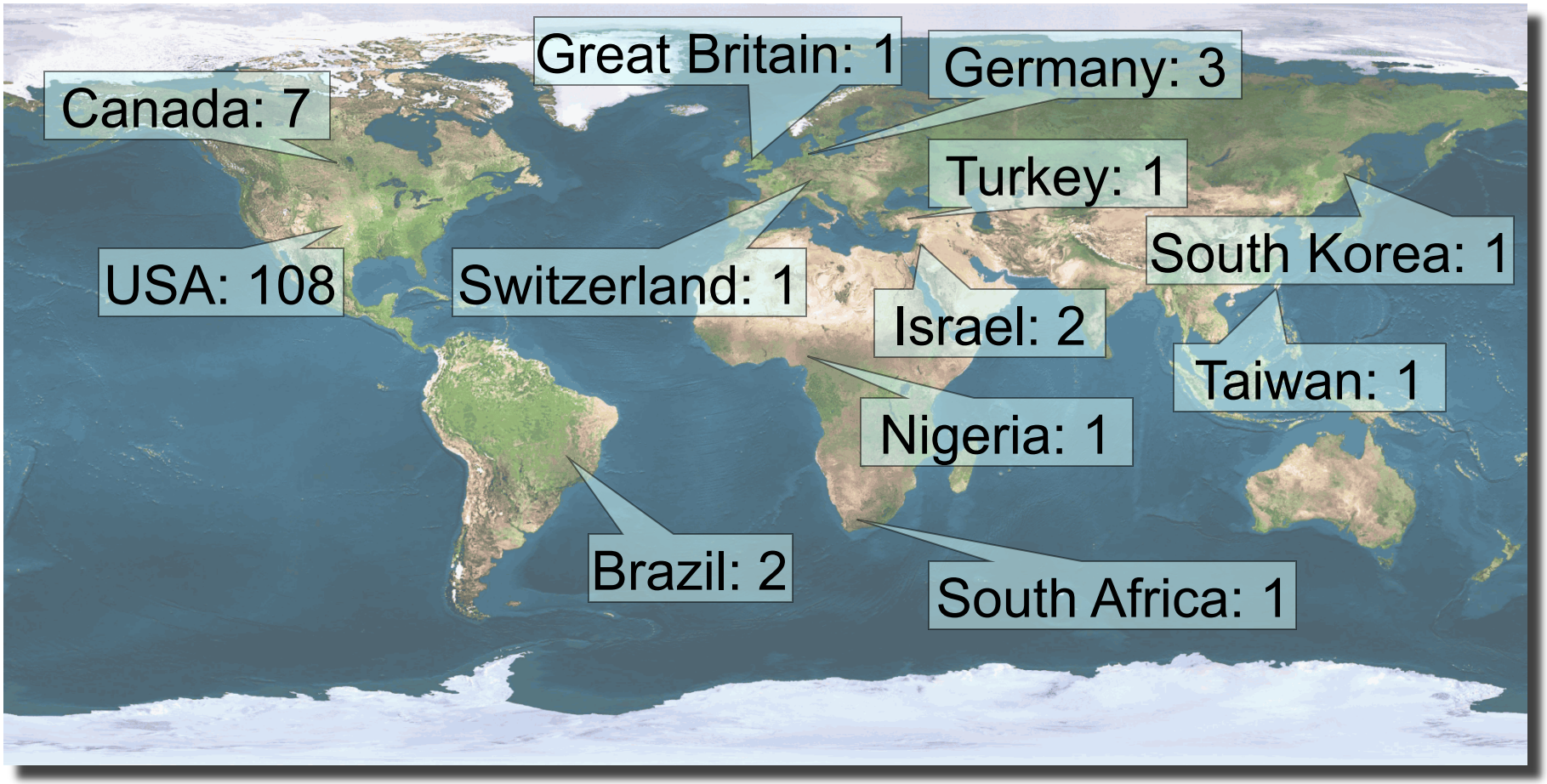


The LON-CAPA Community



The LON-CAPA Community

High Schools, Colleges, and Universities



… plus grant projects and publishing companies.

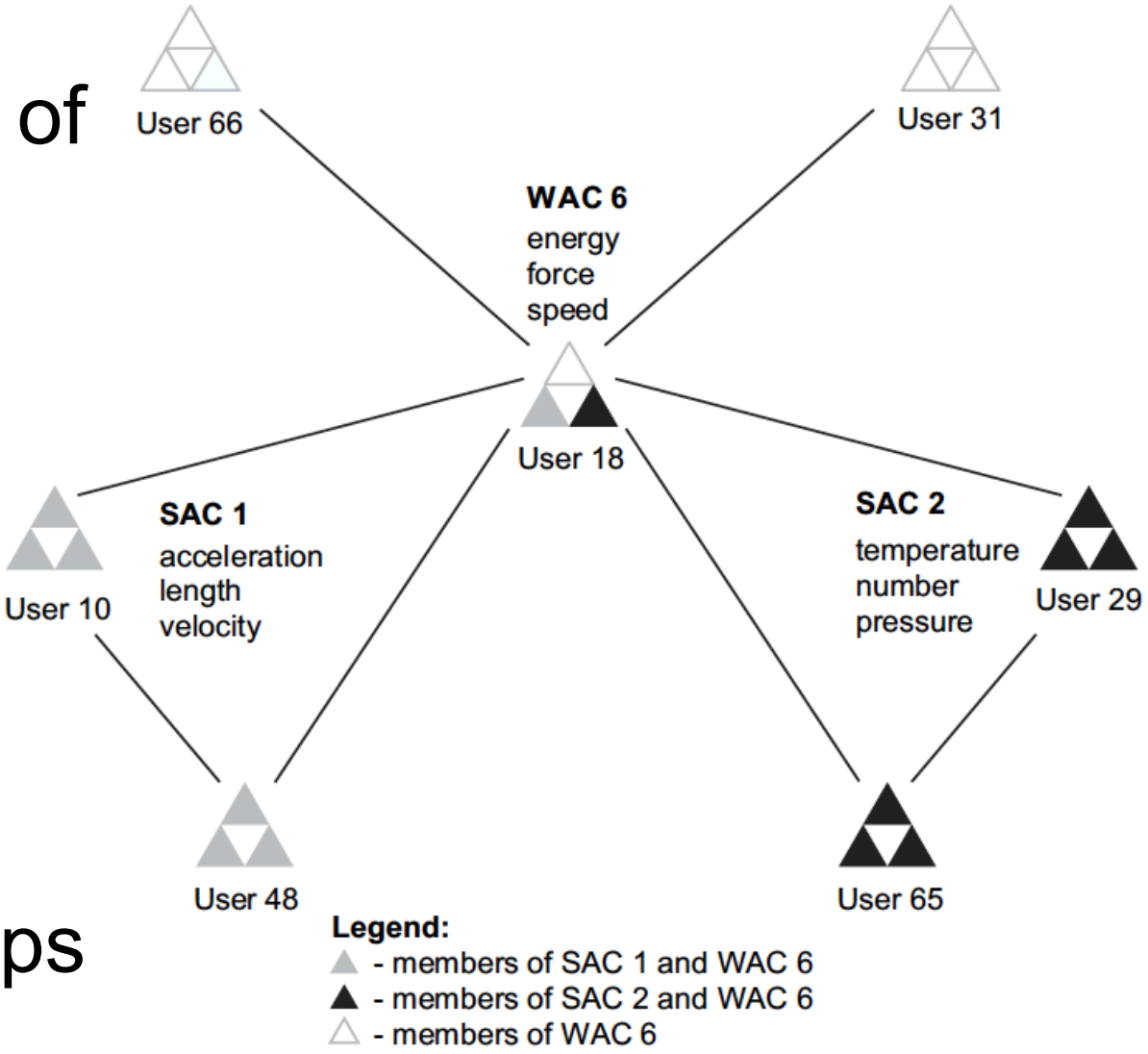
The LON-CAPA Community

- 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	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		

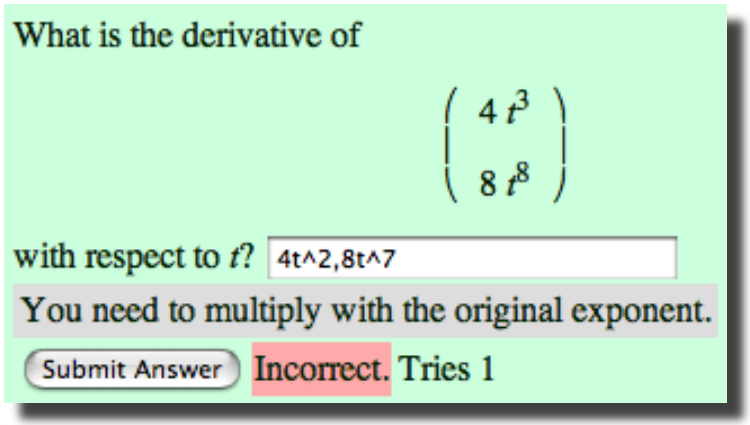
The LON-CAPA Community

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



The LON-CAPA Community

- Driving force: problems



	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*
Total	**344198**	168235	71860	*389554*

<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

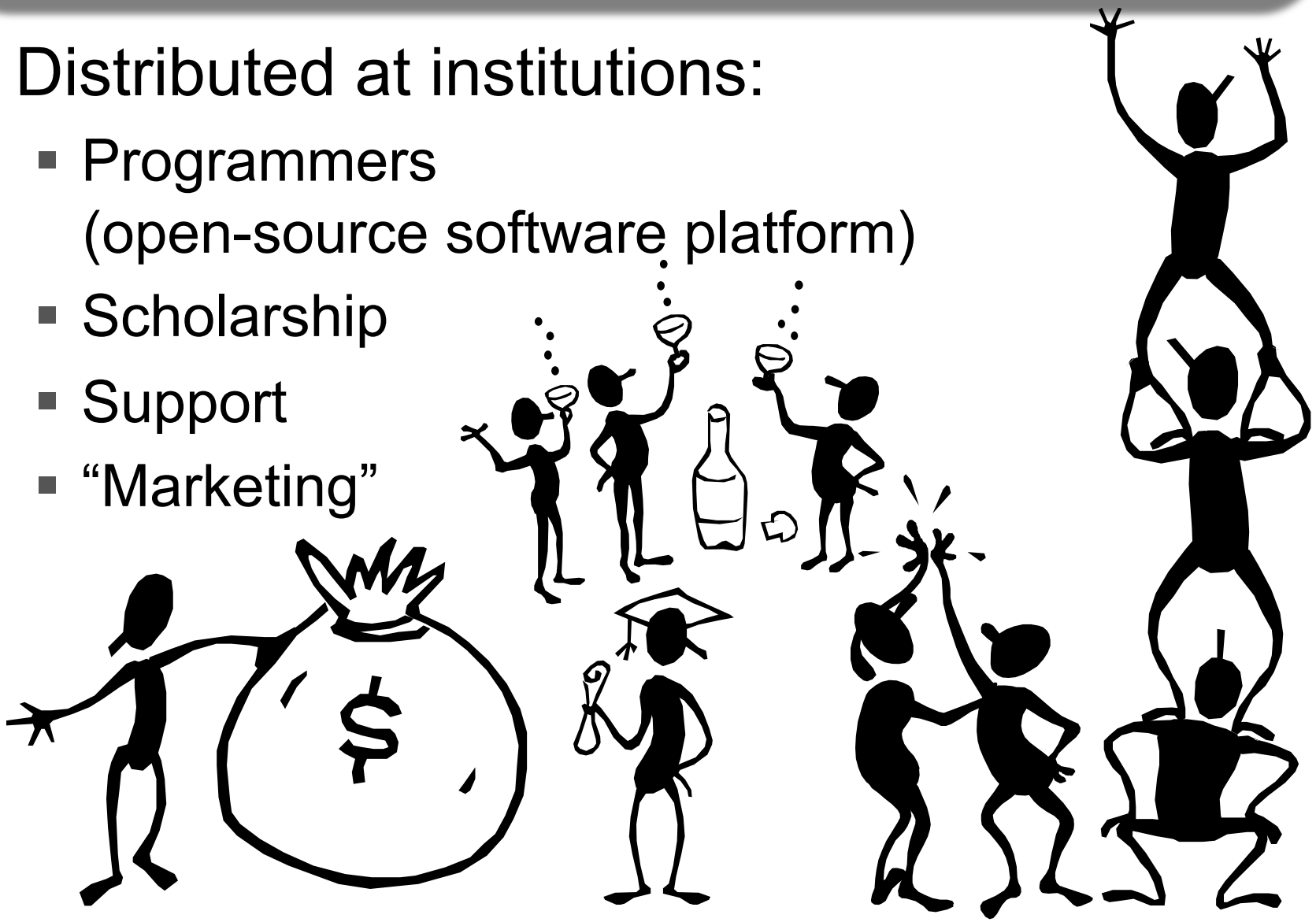
- Have responsibility for author contributions
  - Enforce licensing
  - Protect integrity of for example exam problems
  - Guarantee that the content remains accessible

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”



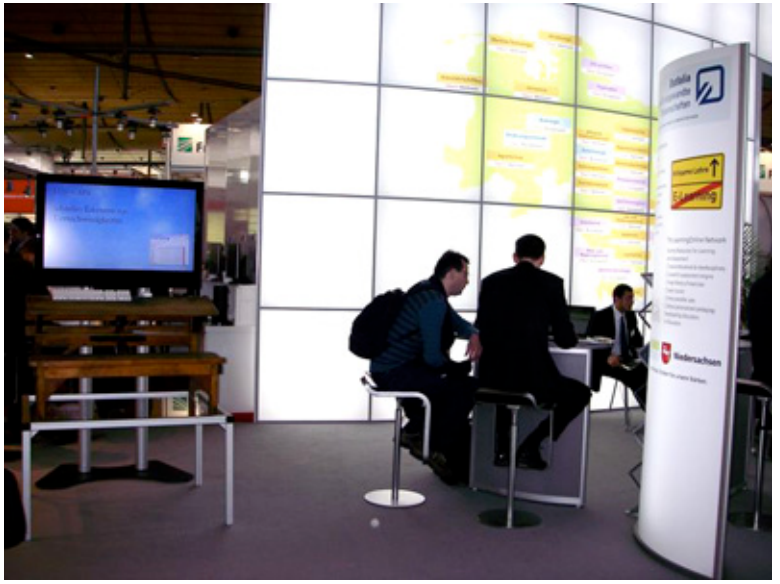
Share the wealth

- **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.

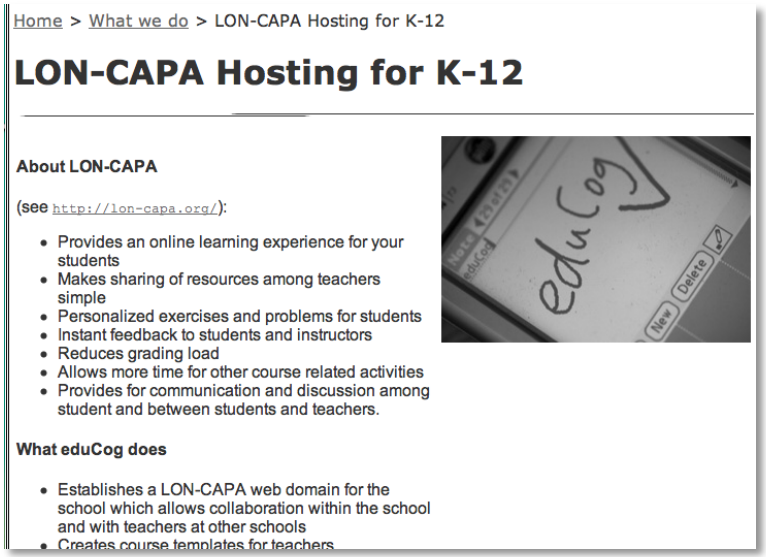
- Who we are
- What we do
  - LON-CAPA Hosting, K-12
  - LON-CAPA Hosting, Higher Education
  - ...
- How we do it
- How to contact us

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/):

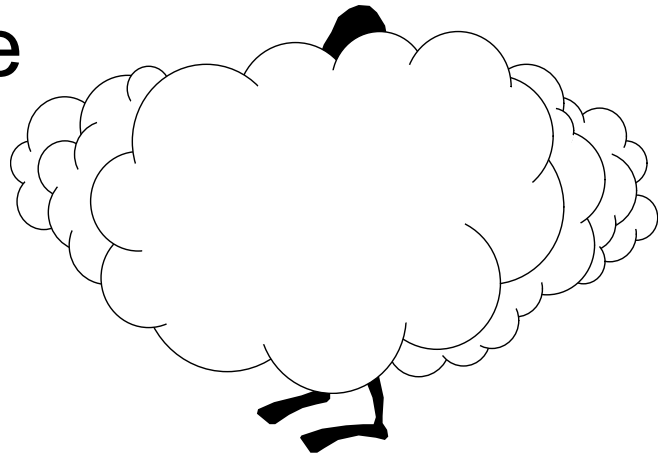
- Provides an online learning experience for your students
- Makes sharing of resources among teachers simple
- Personalized exercises and problems for students
- Instant feedback to students and instructors
- Reduces grading load
- Allows more time for other course related activities
- Provides for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

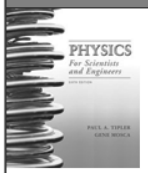
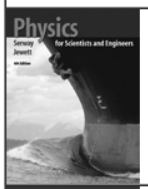
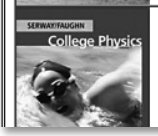
- coding ancillary materials
- hosting ancillary materials
- selectively open up these libraries for courses that adopted the textbook (digital rights management)
- constant income stream: publishers intentionally make problem libraries incompatible between editions

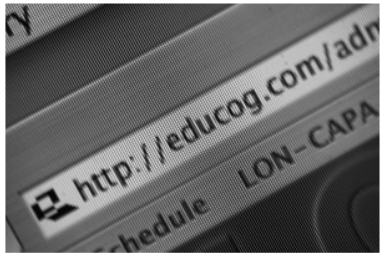
Direct Sustainable Income

- 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	FREEMAN 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	WILEY KNOWLEDGE FOR GENERATIONS John Wiley	8th edition
	Halliday, Resnick, and Walker		7th edition
	Serway & Jewett	THOMSON BROOKS/COLE Representative: Samuel Subity, 877-999-2350	6th edition
	Serway & Faughn		7th edition



SustainabilitySummary

- 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