Building Tools With The Learning Tools Interoperability Specification

MICHAEL D. HILBORN AND ARTIE BARRETT

NERCOMP ANNUAL CONFERENCE

MARCH 26, 2014

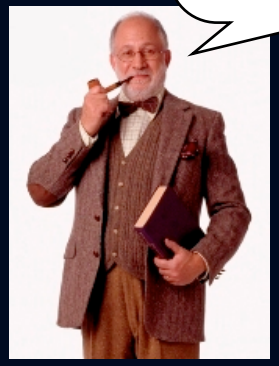
HTTPS://GITHUB.COM/HARVARD-ATG/NERCOMP-LTI-BASIC

Agenda

- What is LTI?
- LTI tools in action
- How LTI works
- Writing an LTI tool
- Challenges to writing LTI
- Resources you can use
- Questions?
- Answers!

Hmm… But what do these circles, arrows, and squares signify?

That, my young lass, we will get to soon!



What Is LTI?

IN WHICH WE LEARN WHAT LTI IS AND PROPOSES TO DO

The Basics

*TLA: "Three Letter Acronym!"

- LTI is a TLA: "Learning Tools Interoperability"
- But first, let's consider another TLA, the LMS
  - (Learning Management System)
- There is quite a landscape of LMS's

canvas

moodle

Sakai

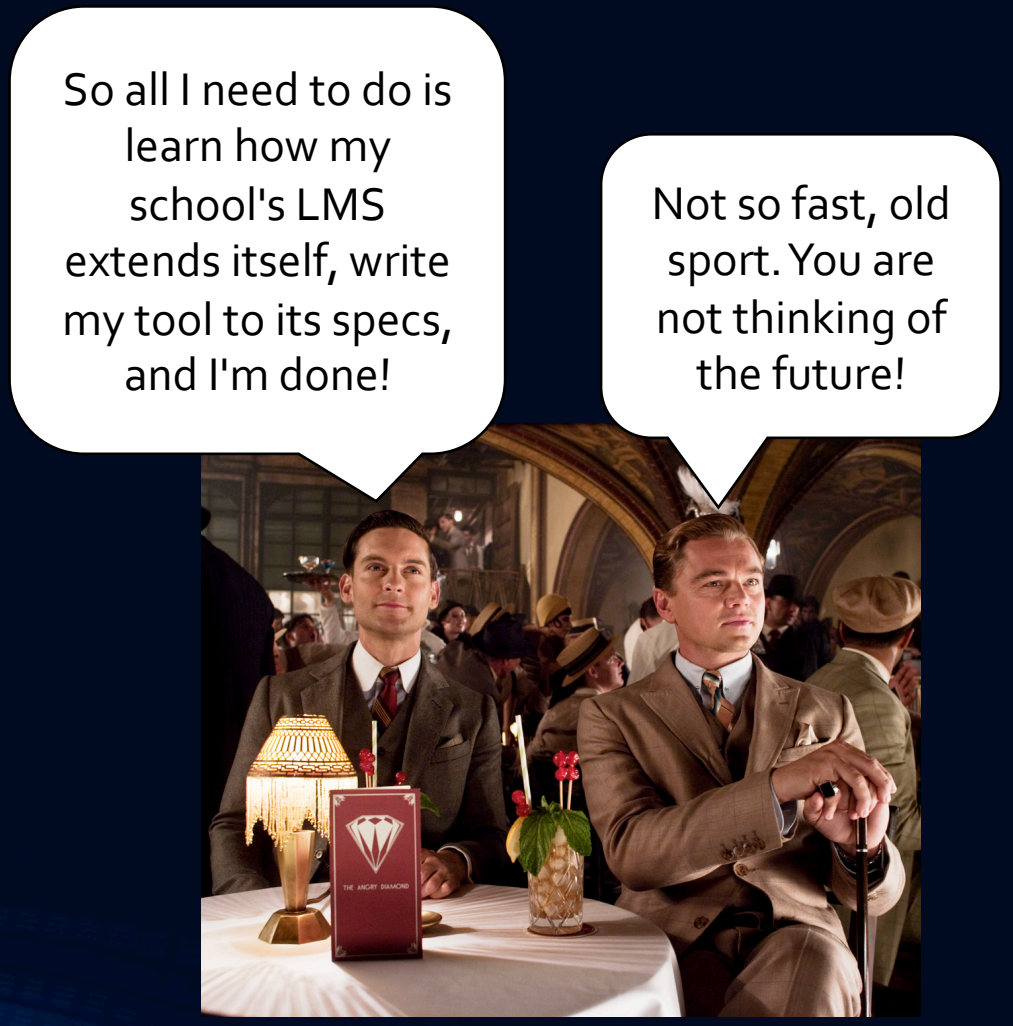
HOME GROWN

Desire2Learn

These LMS's offer a lot of tools, but not quite what I need. What if I want to write my own?

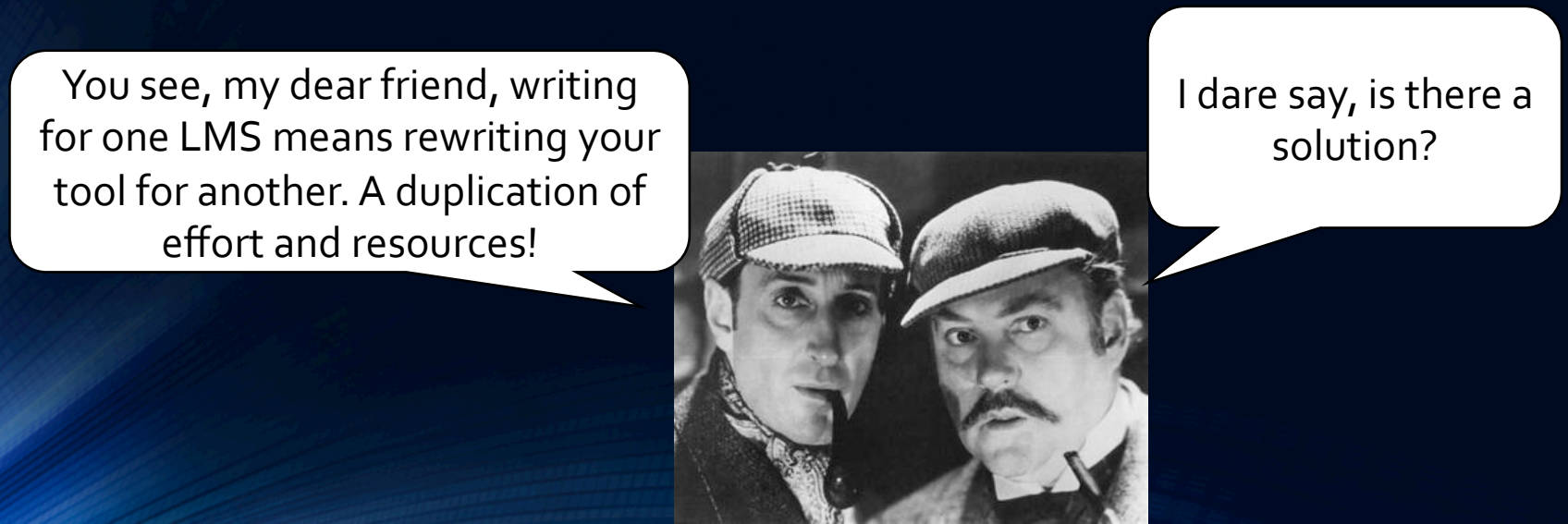
What if you wanted to write your own tool?

- For example, a tool that takes advantage of some of your research data
- You could write an independent tool and iFrame it
  - (But then no data can be passed from the LMS to the tool)
- Most LMS's offer ways of "plugging in" external applications
- This way your tool and the LMS can communicate!



Not so fast, indeed

- What if you wanted to share your tool with some colleagues at another University?
- But their University is running a different LMS?
- And what if your University decided to switch to another LMS?
  - (It's happened before!)

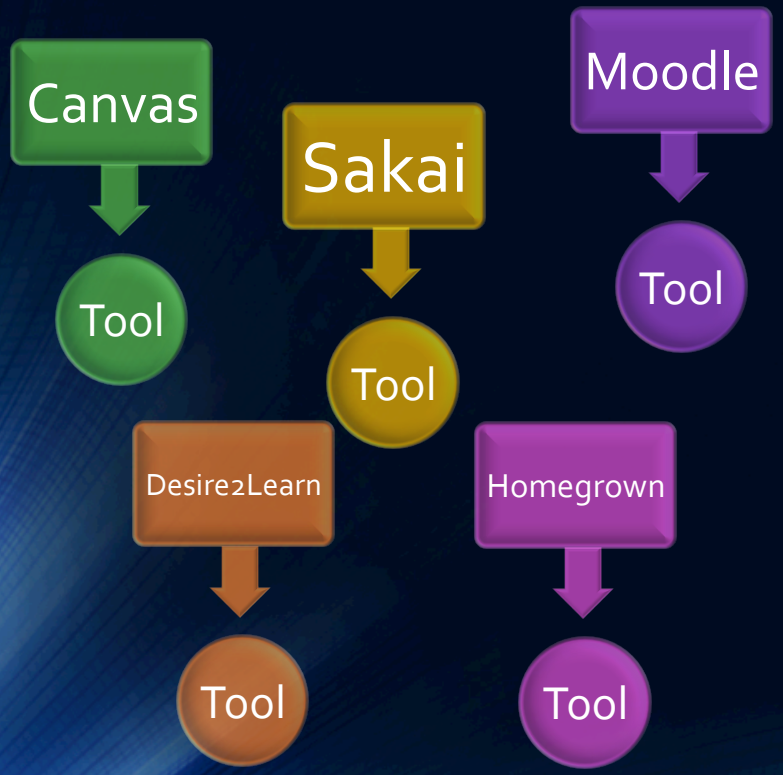


Yes, there is a solution… in the works…

- Welcome, Learning Tools Interoperability!
  - Initiated by the IMS Global Learning Consortium http://www.imsglobal.org
- LTI attempts to:
  - Create standards that all LMS's and tools can implement so that they can speak with each other
  - Make your coding language of choice independent of the LMS
  - Make certain that when an LTI tool is implemented, it can work with **any** LMS
  - Do the above in a systematic, phased approach
    - (v1.0 -> v1.1 ->v1.1.1 -> v2.0)

So, LTI moves us forward...

FROM THIS...



TO THIS...

But the arrows are one-way! Shouldn't there be two-way communication?

Patience! Get to that we will.

LTI Tools In Action

IN WHICH WE DEMONSTRATE A FEW LTI TOOLS INTEGRATED WITH CANVAS

How LTI Works

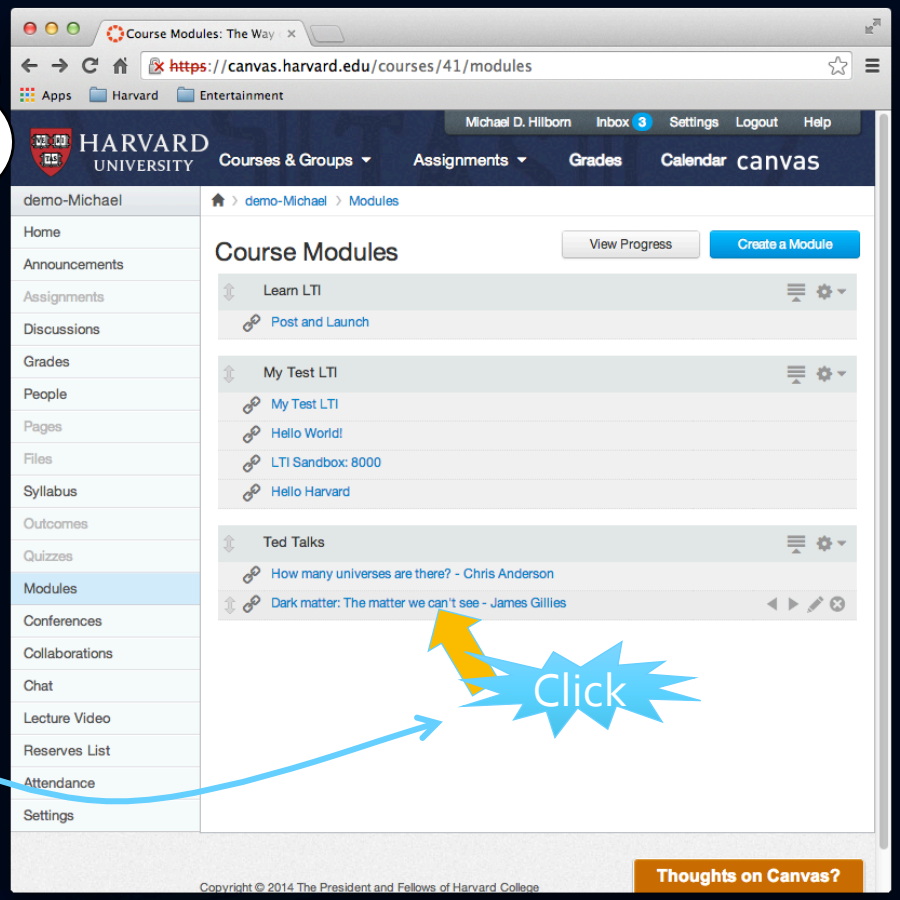
IN WHICH WE GO OVER THE BASIC CONCEPTS OF HOW LTI WORKS

Basic LTI (LTIv1.0)

- To start an external LTI tool, the LMS must first **launch** the tool
- A launch consists of two items sent to the tool:
  - An OAuth signature
  - A set of parameters (a few required, many recommended, others custom)
- In other words, a **signed HTTP POST request**
- Let's look at it in more detail…

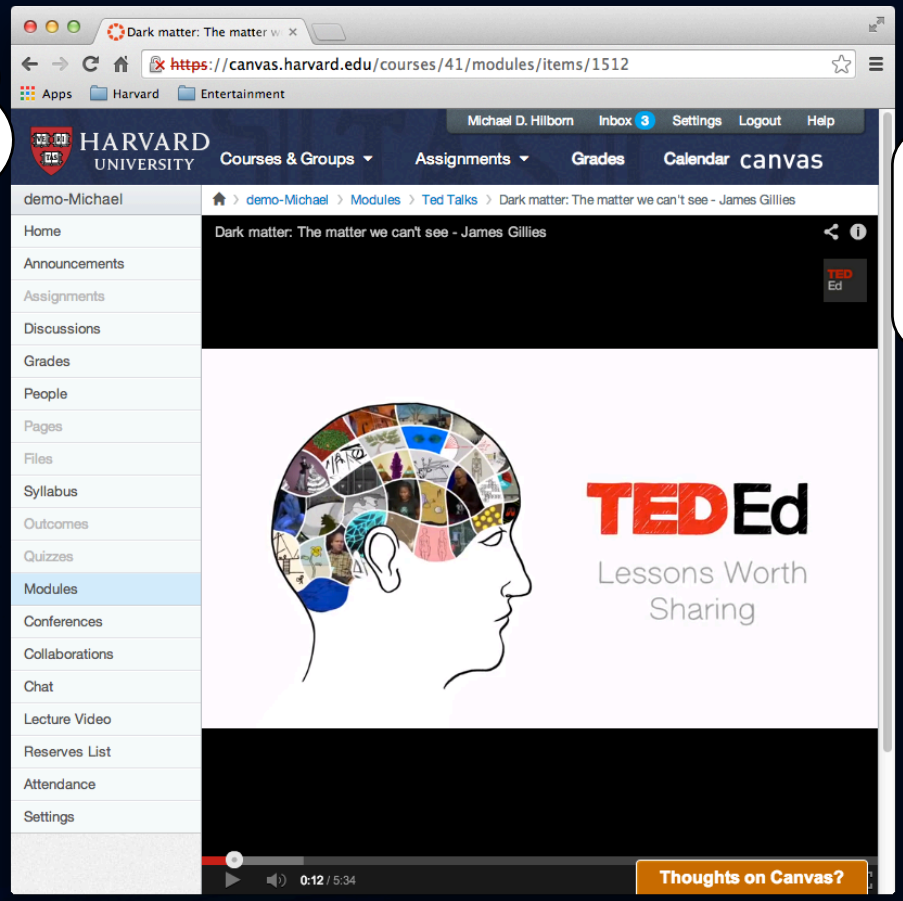
Basic LTI Launch – What The User Experiences

I feel like learning about Dark Matter today. I'll just click here…



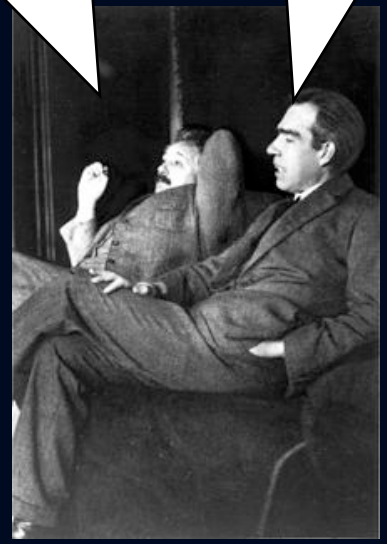
Basic LTI Launch – What The User Experiences

Oh, there's my content. That was relatively seamless...

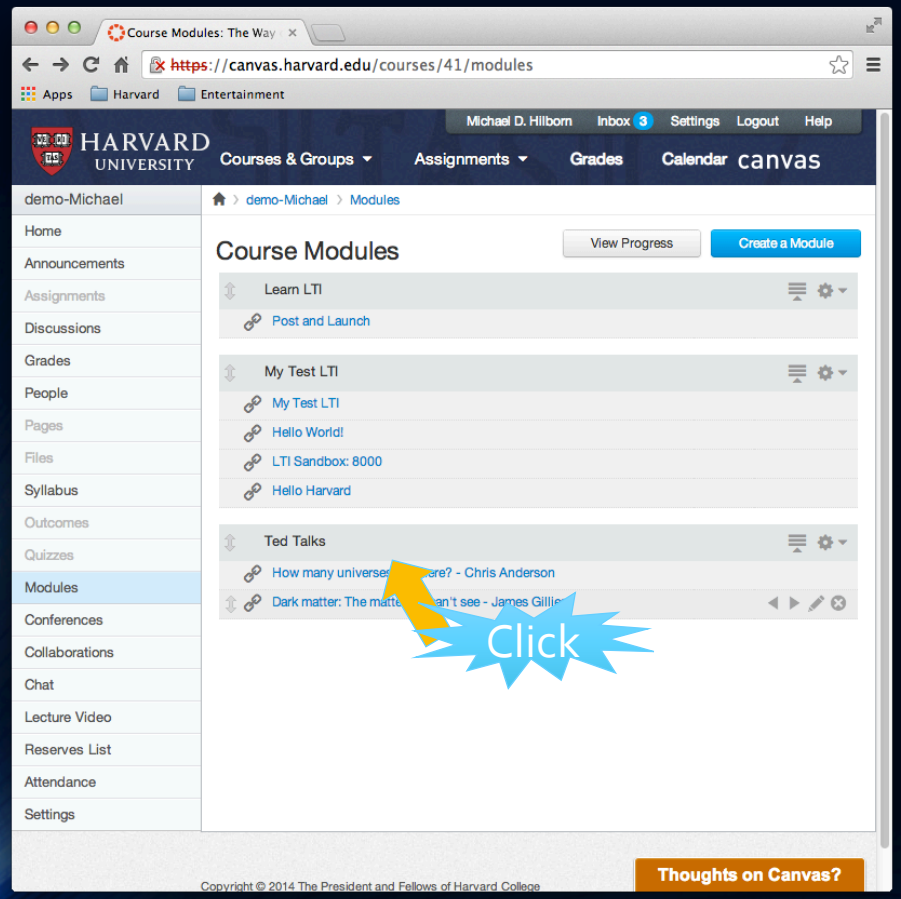


Seems relatively simple enough!

Ah, but let's bore down into the mechanics of it.



Basic LTI Launch – What The Web Experiences



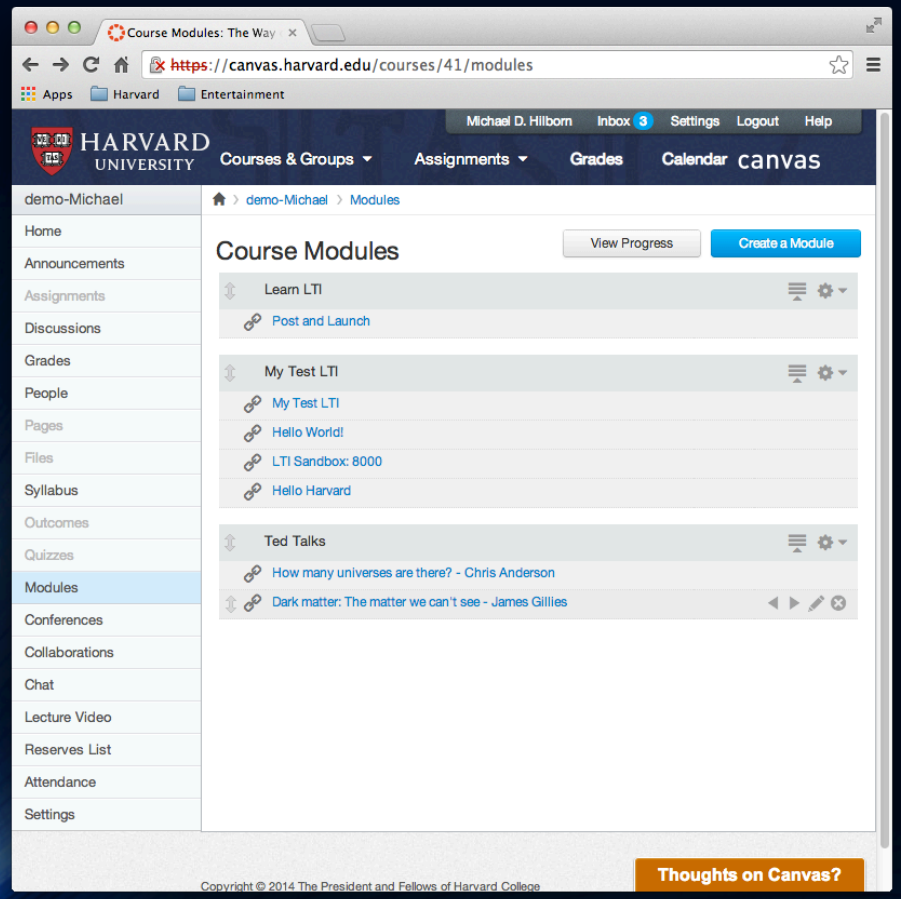
1

The web browser sends the request to the LMS server.

canvas BY INSTRUCTURE

TED Ed LESSONSWORTHSHARING

Basic LTI Launch – What The Web Experiences



1

The web browser sends the request to the LMS server.

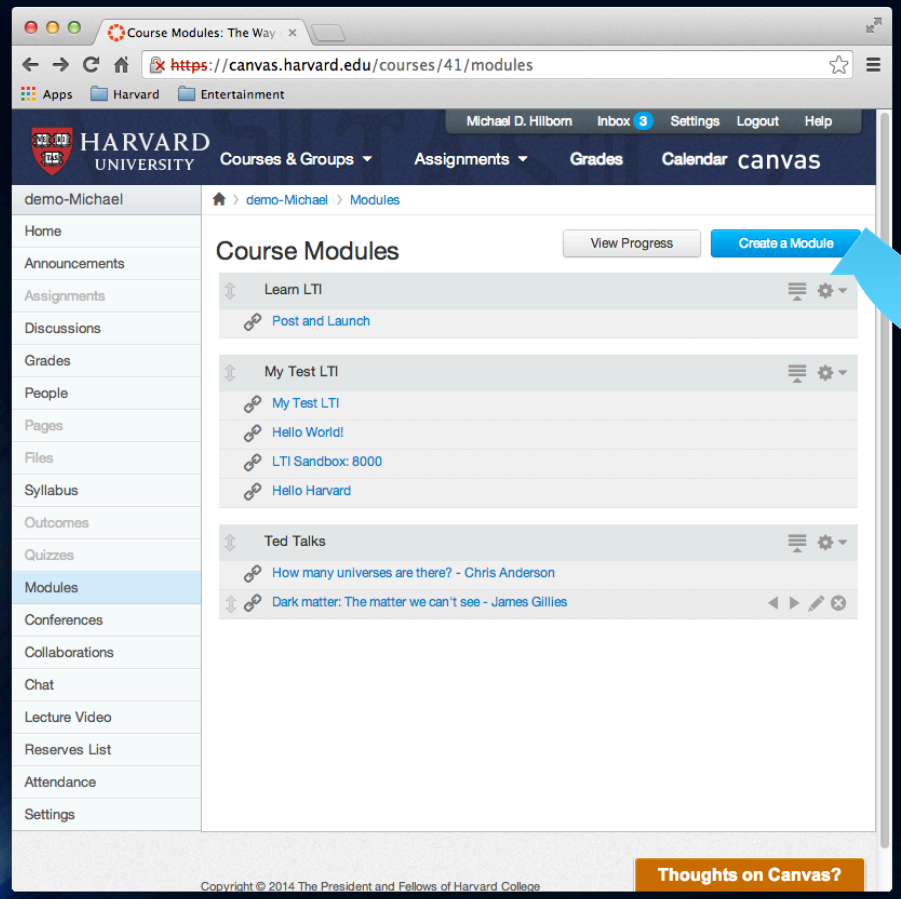
canvas BY INSTRUCTURE

2

The LMS looks up information about user and course, and signs with secret/OAuth signature.

TED Ed LESSONSWORTHSHARING

Basic LTI Launch – What The Web Experiences



1 The web browser sends the request to the LMS server.

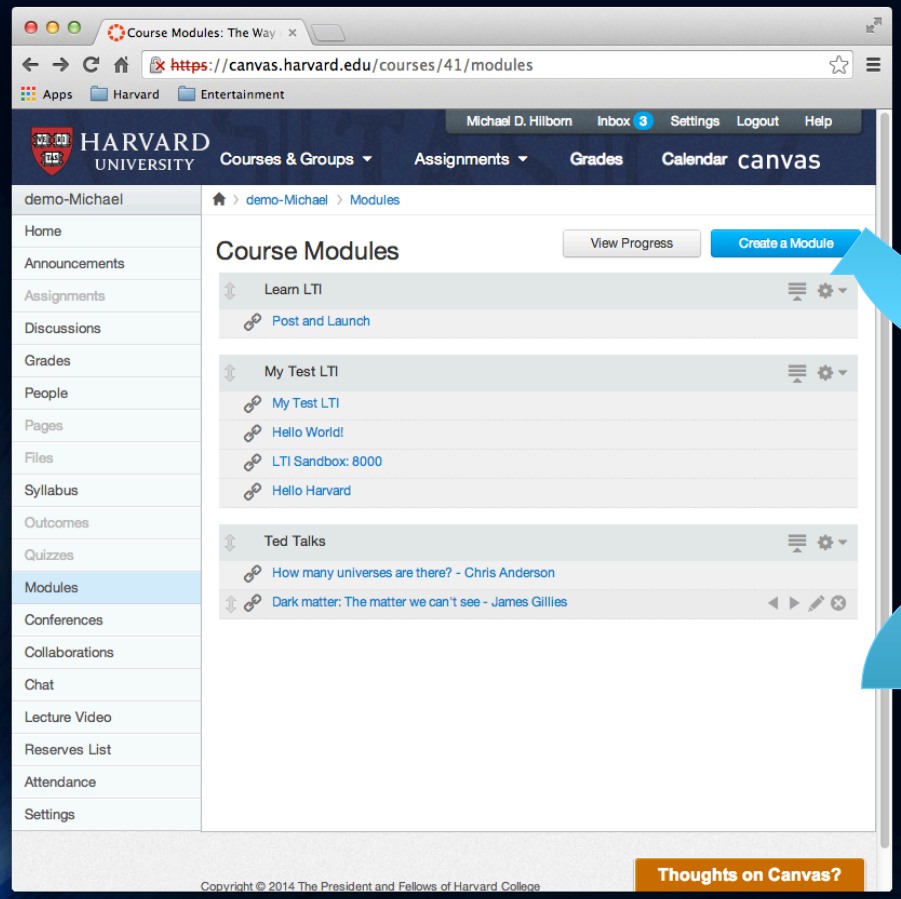
2 The LMS looks up information about user and course, and signs with secret/OAuth signature.

3 LMS server sends data and secret/ OAuth signature back to browser.

canvas BY INSTRUCTURE

TED Ed LESSONSWORTHSHARING

Basic LTI Launch – What The Web Experiences



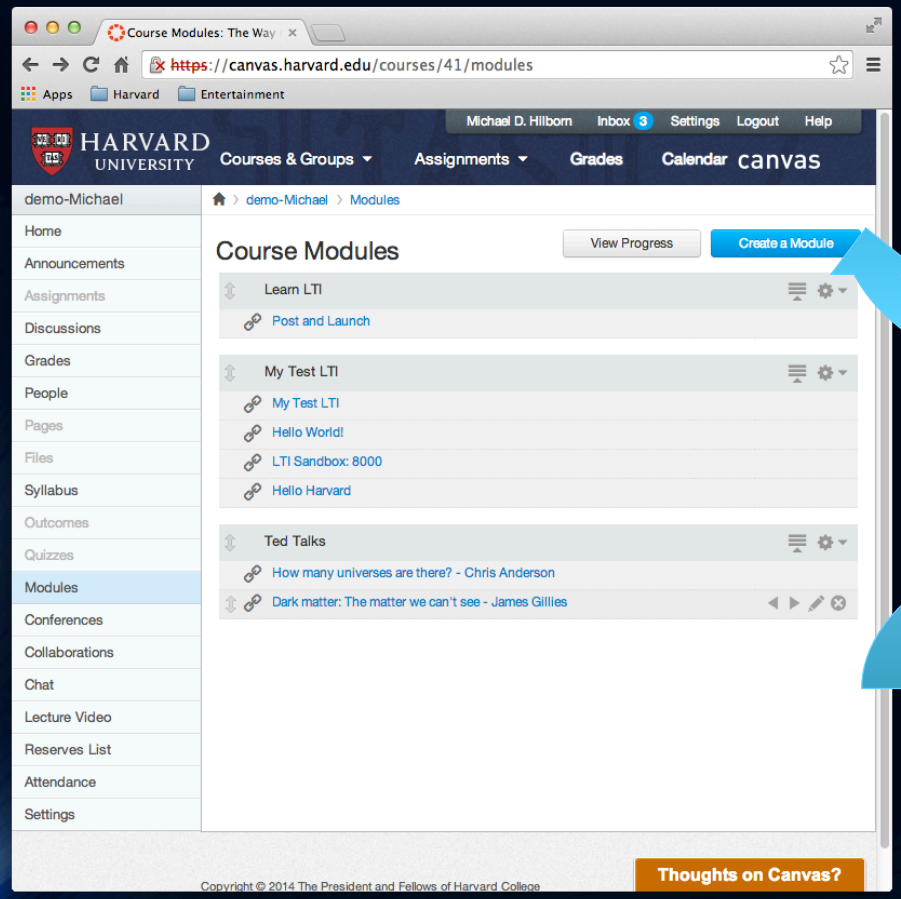
1 The web browser sends the request to the LMS server.

2 The LMS looks up information about user and course, and signs with secret/OAuth signature.

3 LMS server sends data and secret/OAuth signature back to browser.

4 Browser sends **launch,** data, and secret/OAuth signature to tool server.

Basic LTI Launch – What The Web Experiences



1 The web browser sends the request to the LMS server.

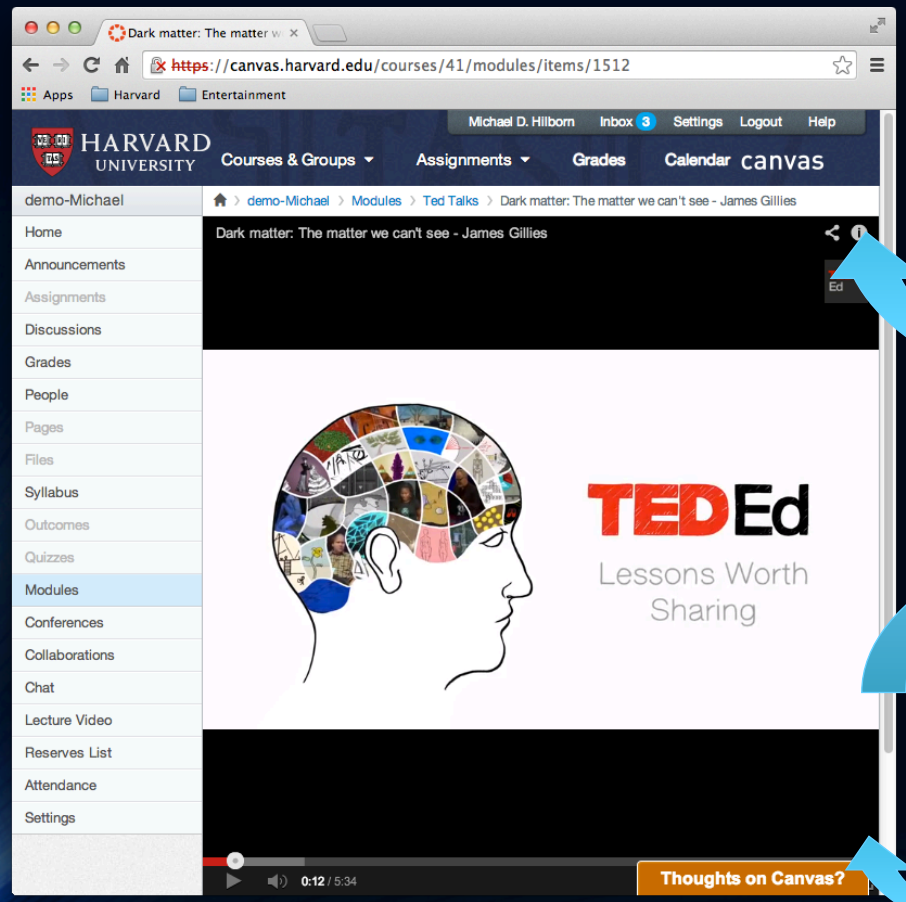
2 The LMS looks up information about user and course, and signs with secret/OAuth signature.

3 LMS server sends data and secret/OAuth signature back to browser.

4 Browser sends **launch,** data, and secret/OAuth signature to tool server.

5 Tool verifies **launch** and secret/OAuth signature to process data.

Basic LTI Launch – What The Web Experiences



1 The web browser sends the request to the LMS server.

2 The LMS looks up information about user and course, and signs with secret/OAuth signature.

3 LMS server sends data and secret/ OAuth signature back to browser.

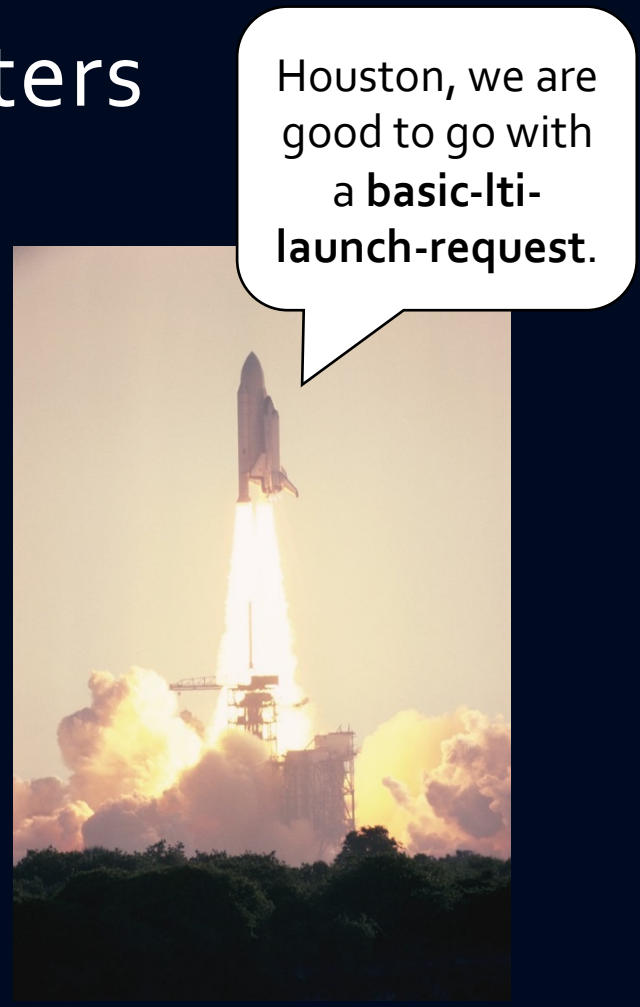
4 Browser sends **launch,** data, and secret/OAuth signature to tool server.

5 Tool verifies **launch** and secret/OAuth signature to process data.

6 Tool server sends content back to the browser for viewing.

Basic LTI Launch – Launch Parameters

- When an LMS launches a tool, it must send the following parameters:
  - **lti_message_type** set to basic-lti-launch-request
  - **lti_version** set to LTI-1p0
  - **resource_link_id** referencing a unique id of a tool instance
- Remember, these are just POST parameters
- If a tool does not receive these parameters, it should gracefully fail



Basic LTI Launch – OAuth

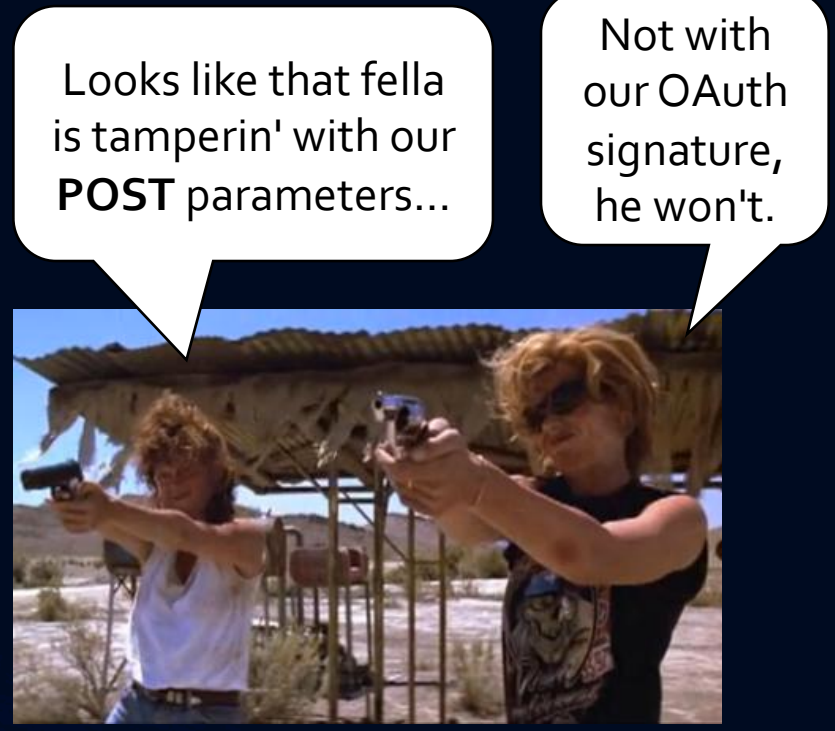
- We have to ensure that the launch parameters and other data are coming from the LMS
- We do so by using OAuth signatures
- But what, exactly, is OAuth?

Basic LTI Launch – A Brief OAuth Primer

- OAuth is a framework that defines a method for clients (i.e. web apps) to access server resources (web service) on behalf of a resource owner (i.e. end-user)
- The end game of OAuth is an access token that the client may use to access protected resources on the server until/unless it is revoked
- What does that mean?
  - Generic methodology for API authentication.
  - Resource owner's credentials are protected (**not shared with client**)
  - Requests are protected by digital signatures.

Basic LTI Launch – A Brief OAuth Primer (cont'd)

- LTI uses a subset of OAuth for protecting HTTP requests
- A digital signature is a scheme designed to give the receiver of a request reason to believe that it is valid
- Signatures help authenticate LMS/Tool requests and prevent unauthorized requests:
  - Ex: protects the requests from tampering with the POST params
  - Ex: protects the LMS/Tool from replay attacks (repeated POSTs)
- For this reason, LTI requests should be signed and verified



Basic LTI Launch – A Brief OAuth Primer (cont'd)

ua = user/context attributes
secret = shared secret
sig = oauth_sig(ua, secret)

confirm that
sig === oauth_sig(ua, secret)

Basic LTI Launch – OAuth Parameters

- So, when an LMS launches a tool, it must send the following parameters:
  - **oauth_callback** often set to about:blank
  - **oauth_consumer_key** set to the consumer key
  - **oauth_nonce** set to the nonce generated by the LMS
  - **oauth_signature** set to the signature sent by the LMS
  - **oauth_signature_method** referencing the encryption (must use at least HMAC-SHA1)
  - **oauth_timestamp** representing the time/date of the request
  - **oauth_version** set to version of OAuth (such as 1.0)
- Coupled with the **secret** that is shared by the LMS and tool, the tool must verify that the signature is valid before proceeding.

Basic LTI Launch – Recommended Parameters

- Although not required, it is recommended that these parameters be sent to an LTI tool:
  - **user_id** referencing unique id of current user
  - **roles** set to the users role, such as Learner or Instructor
  - **lis_person_name_full** set to the user's full name
  - **lis_person_name_given** set to the user's first name
  - **lis_person_name_family** set to the user's last name
  - **resource_link_title** referencing the name of the tool instance

Basic LTI Launch – Recommended Parameters (cont'd)

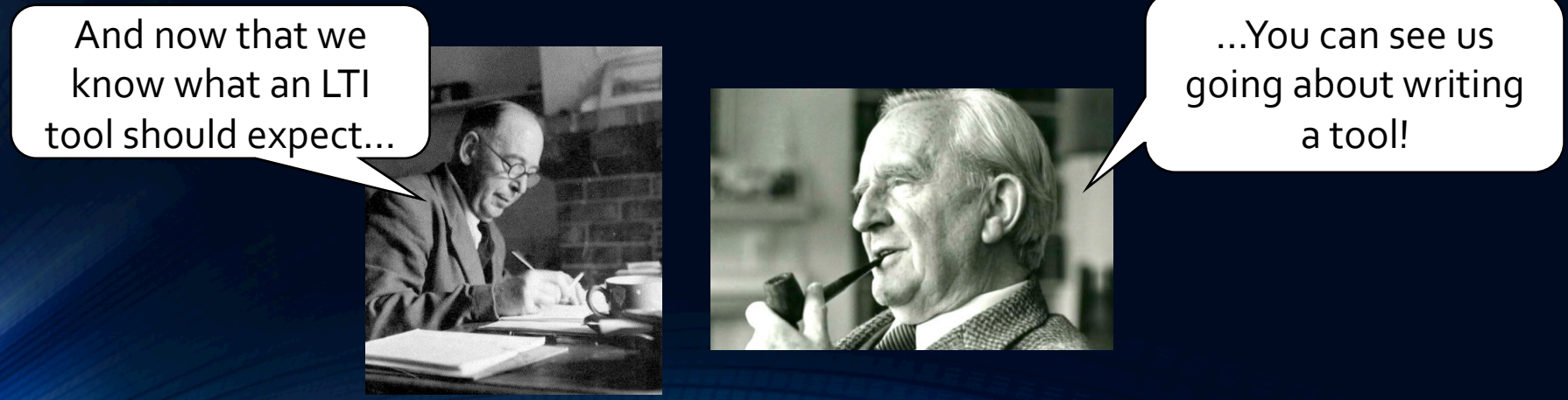
- There's more…
  - **context_id** referencing unique id of the course
  - **context_title** set to the name of the course
  - **context_label** set to the description of the course
  - **tool_consumer_info_product_family_code** set to the name of the LMS
  - **tool_consumer_info_version** set to the version number of the LMS
  - **tool_consumer_instance_guid** set to the instance of the LMS
  - **tool_consumer_instance_name** set to the name of the instance of the LMS
  - **tool_consumer_contact_version** set to the email of the LMS
- And if that weren't enough…

Basic LTI Launch – Custom Parameters

- Any number of custom values can be optionally sent to the tool
- The parameters should start with **custom_**
- Such as:
  - **custom_canvas_user_id**
  - **custom_canvas_user_login_id**

Basic LTI Launch – A Review

- To start an external LTI tool, the LMS must first **launch** the tool
- A launch consists of two items sent to the tool:
  - An OAuth signature
  - A set of parameters (a few required, many recommended, others custom)
- In other words, a **signed HTTP POST** request



Writing An LTI Tool

IN WHICH WE DEMONSTRATE HOW TO WRITE A SIMPLE "HELLO WORLD" TOOL

First, Some Tools Of The Trade

- Choose a language
  - (We're choosing **PHP** for our demo)
- Install a Basic LTI library
  - (Here are a few: http://www.edu-apps.org/code.html)
- Set up a development environment
  - (We're using **Vagrant** and **VirtualBox**)
- Find an LMS that supports LTI
  - (We're using **Canvas**)

Examining The Code

- First, we include the Basic LTI library in our code

```
<?php
require_once 'ims-blti/blti.php';

// Any other setup code you might want

$context = new BLTI("secret", false, false);

header('Content-Type: text/html; charset=utf-8');
?>

<!DOCTYPE html>
<html>
  <!-- HTML goes here -->
<?php
    if ($context->valid) {
?>
     <h2>Hello LTI!</h2>
<?php
    } else {
?>
    <h2>This was not a valid LTI launch</h2>
<?php
    }
?>
  <!-- More HTML goes here -->

</html>
```

Examining The Code

- First, we include the Basic LTI library in our code
- Then we initialize the Basic LTI object…

```
<?php
require_once 'ims-blti/blti.php';

// Any other setup code you might want

$context = new BLTI("secret", false, false);

header('Content-Type: text/html; charset=utf-8');
?>

<!DOCTYPE html>
<html>
  <!-- HTML goes here -->
<?php
    if ($context->valid) {
?>
     <h2>Hello LTI!</h2>
<?php
    } else {
?>
    <h2>This was not a valid LTI launch</h2>
<?php
    }
?>
  <!-- More HTML goes here -->

</html>
```

Examining The Code

- First, we include the Basic LTI library in our code
- Then we initialize the Basic LTI object…
- …with our shared OAuth secret

```
<?php
require_once 'ims-blti/blti.php';

// Any other setup code you might want

$context = new BLTI("secret", false, false);

header('Content-Type: text/html; charset=utf-8');
?>

<!DOCTYPE html>
<html>
  <!-- HTML goes here -->
<?php
    if ($context->valid) {
?>
     <h2>Hello LTI!</h2>
<?php
    } else {
?>
    <h2>This was not a valid LTI launch</h2>
<?php
    }
?>
  <!-- More HTML goes here -->

</html>
```

Examining The Code

- First, we include the Basic LTI library in our code
- Then we initialize the Basic LTI object…
- …with our shared OAuth secret
- That's it, really… If the LMS sends this tool the proper LTI and OAuth parameters…

```
<?php
require_once 'ims-blti/blti.php';

// Any other setup code you might want

$context = new BLTI("secret", false, false);

header('Content-Type: text/html; charset=utf-8');
?>

<!DOCTYPE html>
<html>
  <!-- HTML goes here -->
<?php
    if ($context->valid) {
?>
     <h2>Hello LTI!</h2>
<?php
    } else {
?>
    <h2>This was not a valid LTI launch</h2>
<?php
    }
?>
  <!-- More HTML goes here -->

</html>
```

Examining The Code

- First, we include the Basic LTI library in our code
- Then we initialize the Basic LTI object…
- …with our shared OAuth secret
- That's it, really… If the LMS sends this tool the proper LTI and OAuth parameters…
- …you can check to see if the launch was valid; if so, write your code!

```
<?php
require_once 'ims-blti/blti.php';

// Any other setup code you might want

$context = new BLTI("secret", false, false);

header('Content-Type: text/html; charset=utf-8');
?>

<!DOCTYPE html>
<html>
  <!-- HTML goes here -->
<?php
    if ($context->valid) {
?>
     <h2>Hello LTI!</h2>
<?php
    } else {
?>
    <h2>This was not a valid LTI launch</h2>
<?php
    }
?>
  <!-- More HTML goes here -->

</html>
```

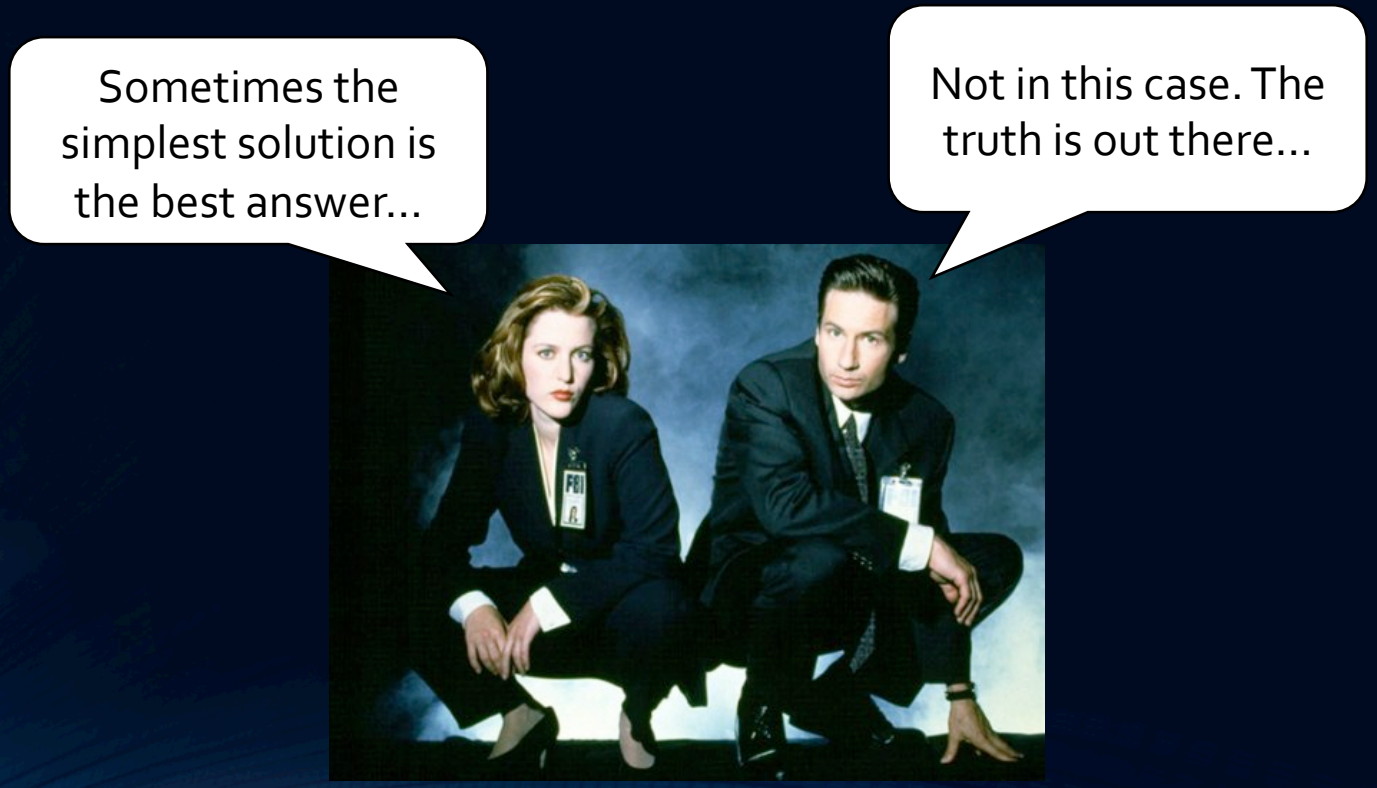
Examining The Code

- First, we include the Basic LTI library in our code
- Then we initialize the Basic LTI object…
- …with our shared OAuth secret
- That's it, really… If the LMS sends this tool the proper LTI and OAuth parameters…
- …you can check to see if the launch was valid; if so, write your code!
- Otherwise, fail gracefully

```
<?php
require_once 'ims-blti/blti.php';

// Any other setup code you might want

$context = new BLTI("secret", false, false);

header('Content-Type: text/html; charset=utf-8');
?>

<!DOCTYPE html>
<html>
  <!-- HTML goes here -->
<?php
    if ($context->valid) {
?>
     <h2>Hello LTI!</h2>
<?php
    } else {
?>
    <h2>This was not a valid LTI launch</h2>
<?php
    }
?>
  <!-- More HTML goes here -->

</html>
```

Is It Really That Simple?

- No, of course not
- Which brings us to our next topic…



Challenges

IN WHICH WE DISCUSS THE CHALLENGES OF IMPLEMENTING LTI TOOLS

Challenges – The Learning Curve

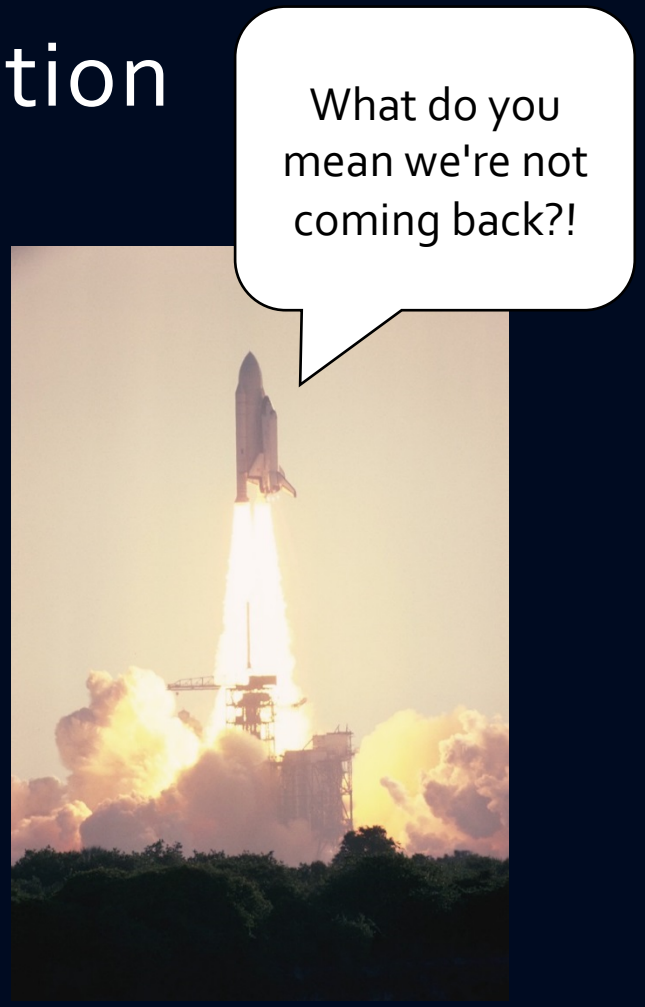
- It takes time to learn things
  - Basic LTI specifications
  - OAuth specifications
  - Your favorite LMS specifications
  - Your favorite Basic LTI library

Challenges – Setting Up (and Privacy)

- It takes time to set things up
  - Your development environment
  - Your production environment
    - (You really want to put this behind SSL)
- And speaking of security…
- …Your tool still needs to comply with privacy
  - FERPA, HIPAA, etc.

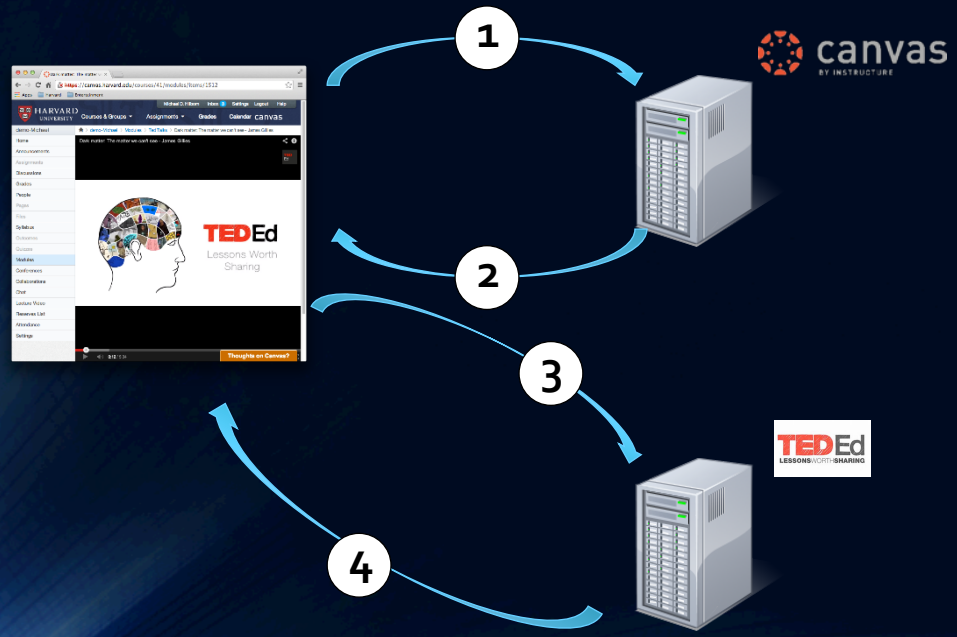
Challenges – Two-Way Communication

- So far, we've been talking about Basic LTI (v1.0)
- Basic LTI describes a launch…
- But it's mostly a one-way trip: The tool generally behaves independently in an iFrame
  - (There is a way to send messages back to the LMS after the tool has finished its job)

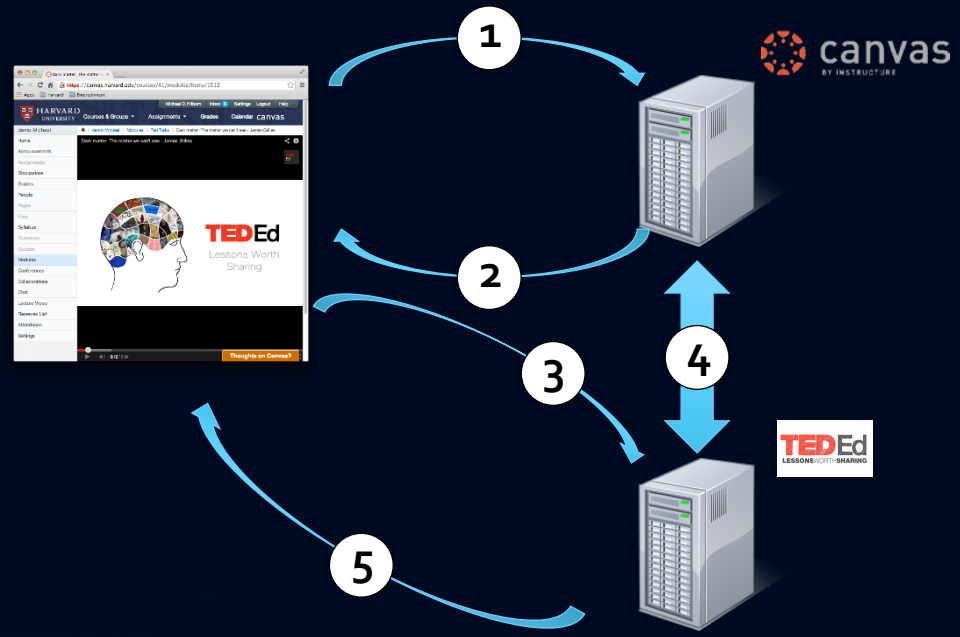


Challenges – Two-Way Communication

SO WE HAVE THIS…



WOULDN'T IT BE GREAT TO HAVE THIS…?

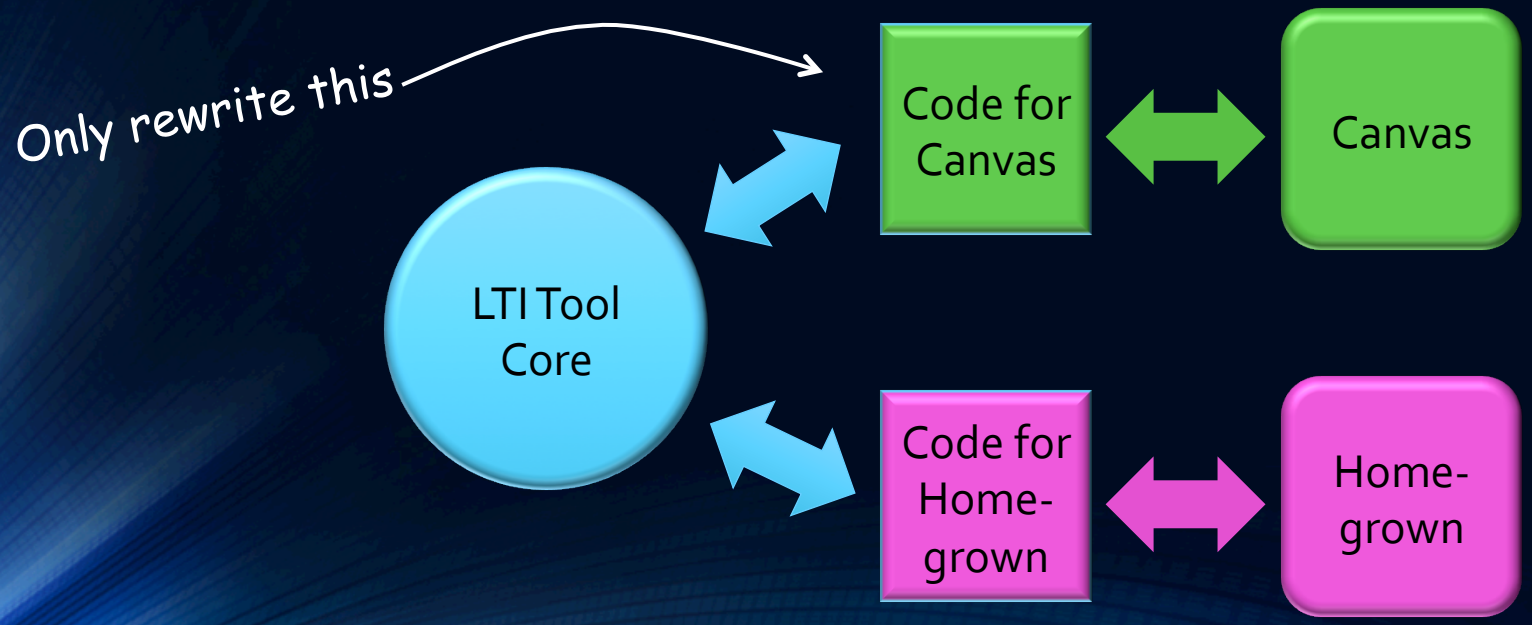


Challenges – Two-Way Communication

- LTI v1.1 does support sending outcomes (grades) back to the LMS
- But that's about all
- You can, of course, have the tool use the LMS extensions and APIs…
- …But that brings us back to rewriting code for each LMS!

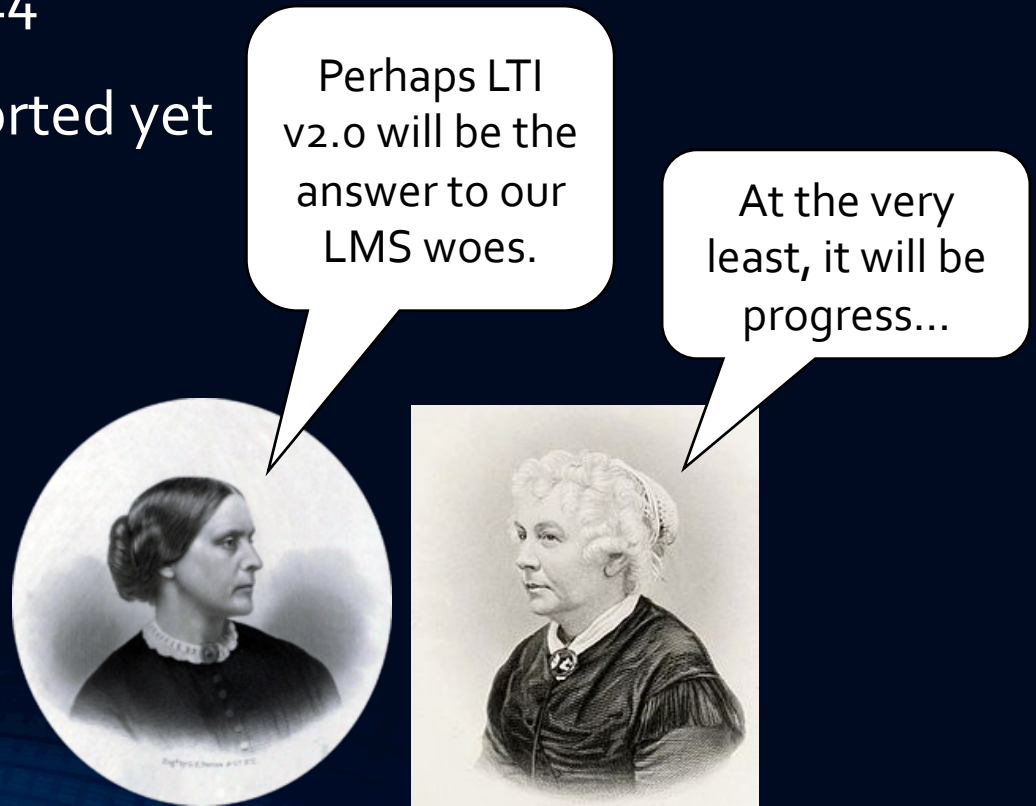
Abstract Your Code

- Fortunately, there are ways to minimize re-writing
- Abstract any portion of code that interacts with an LMS
- That way you need only have to rewrite one portion of your code if you switch to another LMS



LTIv2.0

- Utilizes REST-level 3 web services model for two-messaging between the LMS and your tool
- But it was just released in January 2014
- Doesn't seem to be extensively supported yet
  - (So we won't discuss it, but it's out there)



Resources

IN WHICH WE LIST A VARIETY OF URLS THAT CAN HELP YOU OUT

Introductions To LTI

- The Official IMS LTI Page
  http://www.imsglobal.org/lti/
- LTI Tutorial
  http://developers.imsglobal.org/tutorials.html
- Briefing Paper on LTI
  http://publications.cetis.ac.uk/wp-content/uploads/2012/05/LTI-Briefing-Paper.pdf
- Edu Apps – An open collection of learning tools built on LTI
  http://www.edu-apps.org/index.html

Developing For LTI

- IMS Developers Web Site
  http://developers.imsglobal.org/
- Writing LTI Stuff (with links to libraries)
  http://www.edu-apps.org/code.html
- Canvas Dev and Friends – A Course for Canvas Development
  https://canvas.instructure.com/courses/785215

OAuth Resources

- OAuth Web Site
  http://oauth.net/
- The OAuth 1.0 Guide
  http://hueniverse.com/oauth/guide/
- OAuth for Beginniners
  http://blog.bittercoder.com/2008/06/10/oauth-for-beginners/
- Introduction to OAuth
  http://blog.varonis.com/introduction-to-oauth/

Vagrant and VirtualBox

- Oracle VirtualBox
  https://www.virtualbox.org/
- Vagrant
  http://www.vagrantup.com/
- A beginner's guide to Vagrant
  http://www.erikaheidi.com/2013/07/02/a-begginers-guide-to-vagrant-getting-your-portable-development-environment/
- Automating Development Environments with Vagrant and Puppet
  http://blog.kloudless.com/2013/07/01/automating-development-environments-with-vagrant-and-puppet/

Kudos

IN WHICH THANK THE MANY PEOPLE WHO MADE THIS PRESENTATION POSSIBLE

Kudos

- Our colleagues in the Academic Technology Group
- Our colleagues in the iCommons Group
- IMS Global Learning Consortium
- And all of you!

Questions?

IN WHICH WE END OUR PRESENTATION AND ATTEMPT TO ANSWER YOUR QUESTIONS

Answers!

IN WHICH WE REVEAL THE IDENTITY OF THE CHARACTERS IN OUR PRESENTATION

Nick Carraway & Jay Gatsby

Sherlock Holmes & Dr. Watson

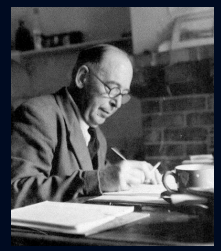
Luke Skywalker & Yoda

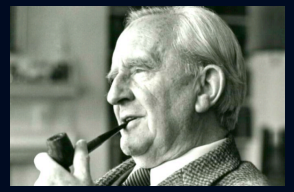
Albert Einstein & Niels Bohr

Daedalus & Icarus

Thelma & Louise

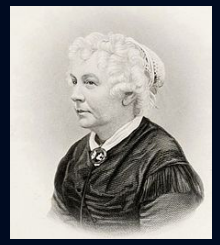
Lucy & Ethel





C.S. Lewis &
J. R. R. Tolkien

Laurel & Hardy



Susan B. Anthony
&
Elizabeth Cady Stanton

Dana Scully & Fox Mulder

Neo & Morpheus

Gilligan & The Skipper