The Skunkworks Approach

Using DevOps to Foster Rapid Deployment, Innovation, & Reduce Costs

Innovation@Work!
skunk·works (skəNGkˌwərks)

"A skunkworks project is a project developed by a small and loosely structured group of people who research and develop a project primarily for the sake of radical innovation."

Our Team:

Jeremy Hajek, Illinois Institute of Technology

Joe Liaw, Hinsdale Central HS

Louis McHugh IV, Illinois Institute of Technology
NxtGen Learning Lab Server Project

We currently run three production systems since 2012(!) to support innovative instruction and pedagogy for Chicagoland, CPS, and schools in Colorado and Massachusetts while providing a rich platform for technical research on server optimization, deployment, and implementation (e.g. using alternative lightweight web servers such as lighttpd & Nginx, PHP accelerators such as xcache & opcache, and optimized database servers such as Percona and MariaDB).
Open Source Revolution

- Running Moodle 3.2+ / Snap 3.2+ (THANK you Moodlerooms / Blackboard!)

- Complete refresh of User Experience (UX)

- Ideal toolkit for creative, innovative blended learning, mastery learning, gamification--the sky’s the limit!
Open Source Revolution: *Literally* Saving Lives!

How World Vision is using blended learning to empower its educators to improve our world - Moodle.com

Many of us are familiar with the well known orange beacon logo of World Vision globally and the many good works that this organisation does to engage us to work towards eliminating poverty and its causes. For those who are not as familiar, World Vision is a global Christian humanitarian, development, and advocacy organisation that...

The Green Innovation Centre at AfricaRice is making agricultural learning accessible with the help of the Moodle Mobile App - Moodle.com

The Green Innovation Centre (or CIVA: Centre d’Innovations Vertes pour l’Agro-alimentaire) is part of the ‘One World, No Hunger’ initiative – funded by the German Ministry of Economic Cooperation and Development. CIVA is currently working with AfricaRice in Benin to address the unemployment issues in agriculture in the region. As is the case in most ...
“After trying several different online classroom ideas, I find that ActiveLearning is second to none!”

-Mark Reiss, Tinley Park High School

“The ActiveLearning platform has completely changed the way I teach. When I think about my course 5 years ago, my classes are unrecognizable compared to today. I am able to reach so many more students, putting the onus of learning on the students and delivering high-level rigor despite the challenges of absenteeism and differing levels of motivation and ability.

I teach in an urban public school and access to ActiveLearning enables me to put out a high quality course despite the challenges. This year, I took the plunge to the 'Mastery Learning' model with my Chemistry 1 course. I have wrinkles to work out, but I see all my students working, and working at their own level. I am very excited for the possibilities and the future of LMS!”

-Gregory Banks, Urban Science Academy, Boston
Technical Specs (Nerdy Stuff!)

- **Server:**
  Ubuntu 16.04 LTS / PHP7.0 / MariaDB 10.0 / PHP-FPM / Nginx 1.10.3

- **Tweaks:**
  Opcache / X-Sendfile / HTTP2 (test with Chrome [SPDY extension](#))

- **Security:**
  Running over secure HTTPS connection using automated certificate renewal (Certbot)
Example Partner Schools (over 10,000+ students supported!)

- Glenbard South High School
- Lockport Township High School
- Hinsdale Central High School
- Vista Ridge High School (Colorado)
- Tinley Park High School
- Urban Science Academy (Massachusetts)
- Westmont High School
- DeVry Advantage Academy High School
- Ogden International School of Chicago
- King College Preparatory High School
## Site administration / Server / **Environment**

Check here your server with current and future installation requirements

### Environment

Check here your server with current and future installation requirements

**Moodle version:** 3.2.4+ (Build 20170926) →

#### Server checks

<table>
<thead>
<tr>
<th>Name</th>
<th>Information</th>
<th>Report</th>
<th>Plugin</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>module</td>
<td></td>
<td>version 2.7 is required and you are running 3.2.4+ (Build 20170924)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>database</td>
<td>manadb (5.5.5-10-0.0.31-Mar,26,2014,01,04,2)</td>
<td>version 5.5.31 is required and you are running 10.0.0.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>php</td>
<td></td>
<td>version 5.6.8 is required and you are running 7.0.2,22.0,16,04.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>prononodoa</td>
<td></td>
<td>should be installed and enabled for best results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>php:extension:iconv</td>
<td></td>
<td>must be installed and enabled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>php:extension:json</td>
<td></td>
<td>should be installed and enabled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>php:extension:curl</td>
<td></td>
<td>should be installed and enabled</td>
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<tr>
<td>php:extension:openssl</td>
<td></td>
<td>should be installed and enabled</td>
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<tr>
<td>php:extension:tokenizer</td>
<td></td>
<td>should be installed and enabled</td>
<td></td>
<td></td>
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<tr>
<td>php:extension:xml</td>
<td></td>
<td>should be installed and enabled</td>
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<tr>
<td>php:extension:soap</td>
<td></td>
<td>should be installed and enabled</td>
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<tr>
<td>php:extension:zip</td>
<td></td>
<td>must be installed and enabled</td>
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<td>php:extension:zipb</td>
<td></td>
<td>must be installed and enabled</td>
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<tr>
<td>php:extension:gd</td>
<td></td>
<td>must be installed and enabled</td>
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<tr>
<td>php:extension:simplexml</td>
<td></td>
<td>must be installed and enabled</td>
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<tr>
<td>php:extension:SOAP</td>
<td></td>
<td>must be installed and enabled</td>
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<tr>
<td>php:extension:sp1</td>
<td></td>
<td>must be installed and enabled</td>
<td></td>
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<tr>
<td>php:extension:pcntl</td>
<td></td>
<td>must be installed and enabled</td>
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</tr>
<tr>
<td>php:extension:dom</td>
<td></td>
<td>must be installed and enabled</td>
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</tr>
<tr>
<td>php:extension:xmll</td>
<td></td>
<td>must be installed and enabled</td>
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<tr>
<td>php:extension:xmllreader</td>
<td></td>
<td>must be installed and enabled</td>
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<td></td>
<td>must be installed and enabled</td>
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<td></td>
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<tr>
<td>php:setting:memoryLimit</td>
<td></td>
<td>recommended setting selected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>php:setting:fileUploads</td>
<td></td>
<td>recommended setting selected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>php:setting:opcache:enable</td>
<td></td>
<td>recommended setting selected</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### PHP info

<table>
<thead>
<tr>
<th>Server API</th>
<th>Version 7.0.22-0ubuntu0.16.04.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>Ubuntu 16.04.1 LTS</td>
</tr>
<tr>
<td>File</td>
<td><a href="http://www.example.com/phpinfo.php">www.example.com/phpinfo.php</a></td>
</tr>
<tr>
<td>Path</td>
<td>/var/www/html/phpinfo.php</td>
</tr>
<tr>
<td>Additional</td>
<td><a href="http://www.example.com/phpconf.d">www.example.com/phpconf.d</a></td>
</tr>
<tr>
<td>File</td>
<td><a href="http://www.example.com/phpconf.d.conf">www.example.com/phpconf.d.conf</a></td>
</tr>
<tr>
<td>PHP</td>
<td>7.0.22</td>
</tr>
<tr>
<td>Date</td>
<td>2017-03-01 12:00</td>
</tr>
</tbody>
</table>

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Site administration / Server / **PHP info**
Site administration / Reports/ **Benchmark**

Moodle Plugin: Benchmark Report
Site administration / Server / **Opcache management** (PHP accelerator)
Skunkworks Deployment: Open Authentication!

- How do you support 10,000+ students and staff accounts?
  Using Google’s Open Authentication API!

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*OAuth2*

Allow a user to connect to the site with an external authentication provider: Google/Facebook/Windows Live. The first time the user connect with an authentication provider, a new account is created. Prevent account creation (enforces an authentication assertion setting) when authenticating must be done.

Starting from Moodle 3.3, OAuth2 will be supported in Moodle core. We highly encourage you to upgrade to Moodle 3.3 and use the OAuth2 core authentication plug-ins. This plugin is not used by the maintainer so when a critical bug arise you need to rely on the community to find a fix. A similar problem occurring on Moodle core is very likely to be resolved much faster by Moodle HQ. Please understand you are using a third party plugin to manage your users authentication. When problems occur with an authentication plugin they are never minor.

*Settings*

<table>
<thead>
<tr>
<th>Google</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Client ID</td>
<td>Your client ID/Secret can be generated in the Google console API: Project &gt; APIs &amp; AUTH &gt; Credentials &gt; Create new Client ID &gt; Web application</td>
</tr>
<tr>
<td>Authorized Javascript origins: <a href="https://domain.net/app">https://domain.net/app</a></td>
<td></td>
</tr>
<tr>
<td>Authorized Redirect URI: <a href="https://www.example.com/auth/oauth2callback/google_redirect.php">https://www.example.com/auth/oauth2callback/google_redirect.php</a></td>
<td></td>
</tr>
<tr>
<td>You also need to enable the &quot;Google+ API&quot; in Project &gt; APIs &amp; AUTH &gt; APIs</td>
<td></td>
</tr>
</tbody>
</table>

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*MAGIC!*
Skunkworks Deployment: Courses & Enrollment
(how to roll out a bunch of classes with thousands of students on a shoestring!)

● Activate “Course Request” feature to enable instructors to request courses and automate linking them with Teacher role

● Activate Self-Enrollment plugin that allows students to enroll in courses and also be automatically grouped by section / class period.

● Activate teamwork by changing permissions to allow Teacher role to assign other colleagues Teacher role
Sample of Courses Delivered

- AP Physics 1, 2, C
- Honors Physics First
- Biology
- Integrated Physics
- Chemistry
- AP Chemistry
- Biology Honors
- AP Biology
- AP Environmental Science
- Anatomy and Physiology
- Algebra
- Advanced Algebra / Trigonometry
- Calculus BC
- Pre-Calculus
- Statistics
- Geometry
- Spanish 1, 2, 3
- Japanese
Instructor Testimonials / Feedback

“One of the things the Active Learning site has allowed me to do is give my students individualized learning experiences. This has allowed me to gather data on student needs and give targeted assistance to students who would have otherwise been left behind.

I sincerely thank you for this opportunity, and if possible, I look forward to working with you all in the future.”

-James Birrell, Tinley Park High School

“Using Moodle via IIT was a game changer for my course. It provided a place for my students to access notes, videos, and practice questions. Originally I had tried a free moodle site which was slow and would not always work but using the IIT platform was smooth every year. I can not thank you enough for providing this for teachers.”

-Jeremy Meisinger, Glenbard South High School
NxtGen Learning Lab Production Systems

1. **ActiveLearning.info:**
   main system for Chicago Public Schools (CPS) and other partner schools

2. **LearningCentral.info:**
   for Hinsdale District 86 to deploy latest plugins and develop training materials

3. **PhysicsCentral.info:**
   for testing latest “bleeding edge” plugins and rapid prototyping
Skunkworks Deployment: Plugin Installation

- Setup Moodle.org account / register sites
- 1 click plugin installation and automatic notification of updates / installation!
Skunkworks Labs: Gamification with Stash Plugin

- Hide “Stash” objects throughout course, in quiz feedback, etc. with variable availability
- Establish “Trades” for objects
- Gamify with robust conditional availability based on Stash objects (e.g. unlock answer key only if you have “Gandalf’s Staff of Light”)
Skunkworks Trick: Flavors Deployment!

Originally developed as a Google Summer of Code project, an experimental plugin that allows you to “package” a Moodle’s admin site settings and plugins as a “flavor” to re-deploy on another site--officially only developed up to version 3.0 but works on 3.1 and 3.2--amazing!!!!
Skunkworks Trick: Cloning Servers!

- **First Leg**: Set up “master” server (Hudson) with all software, databases, configurations, plugins, tweaks, and optimizations.

- **Second Leg**: Pass the baton and use VMWare’s tools to clone servers to new IP addresses / hostnames (Irwin / Johnsburg)

- **Third Leg**: update Moodle config.php file & run the experimental Search and Replace script which patches the Moodle database to point all links and resources to the new server address--MAGIC!!!
The Need for DevOps: Avoiding the Flood of HelpDesk tickets!

From: Liaw, Joe
Sent: Tuesday, April 25, 2017 12:17 PM
To: Daniak, Andrew <adaniak@hinsdale86.org>

Subject: reset server please? (AGAIN!) :)

Hey Andy:

Thanks for all your help with setting up 2 servers for me.....

Update: I got super close to getting everything working, and then something went wonky when I tried to install MariaDB as a drop-in replacement for MySQL and everything **blew up**.....

Can you please reset 66.99.232.135 back to the “fresh” version of Ubuntu 16.04.2 LTS....I think this was the link to the ISO: http://releases.ubuntu.com/xenial/ ? If you need me to put in another ticket, just let me know....

I signed up for a course on Udemy, so hopefully I can learn what I need to do and nail it this time.....

Thanks for all your help and support!!!

--Joe
DevOps Tool Box

- **Chocolately**: Package manager for Windows
- **VirtualBox**: general-purpose virtualizer for x86 hardware
- **Packer**: automates the creation of any type of machine image (build once, deploy anywhere!)
- **Vagrant**: tool for building and managing virtual machine environments in a single workflow, with a focus on automation & scripting
Sample Packer Build / Post Install Scripts

```

```

```
Automation & Scripting @ Work: The “Ghost in the Machine”!
Skunkworks Labs: Advanced Video Engagement Engine for Blended / Flipped Mastery Learning

- Tools for video engagement are based on proprietary platforms
- EdPuzzle / Playposit
- Camtasia SCORM video quizzing
Skunkworks Labs: Advanced Video Engagement Engine
Skunkworks Labs: Advanced Video Engagement Engine

Numbers are dynamically generated for each student! Focus is on mastery and understanding vs. mindless memorization!

Powerful Pattern Match question type—open ended essay question that is scored by keywords and synonyms you key in!
Skunkworks Labs: Advanced Video Engagement Engine

[Image showing a quiz in a physics notebook with options for interactive multiple tries and hints for formative assessment.]
Skunkworks Labs: Advanced Video Engagement Engine

- Filter data by classroom or group
- Create analytics templates for each standard
- Interactive data exploration for improved learning outcomes
- Histograms shift towards mastery over time—every student can succeed!
Active Quiz Plugin

The **Active Quiz plugin** was developed by the University of Wisconsin School of Medicine and Public Health and Teaching & Research Application Development as a way to engage medical students during class in formative assessment, active discussion, and collaboration critical to training our next generation of healthcare practitioners. It was designed based on the principles of **Team Based Learning** pioneered by Professor Larry Michaelsen’s work at the University of Oklahoma’s School of Business.
H5P.org HTML5 Platform

H5P makes it easy to create, share and reuse HTML5 content and applications. H5P empowers everyone to create rich and interactive web experiences more efficiently - all you need is a web browser and a web site with an H5P plugin.
Skunkworks Plugin: Image Optimiser

Build visually rich content courses, but only load images when scrolled into the viewport ("lazy load")!

Saves on bandwidth and uses non-destructive image resampling against original